FROM THE EDITOR IN CHIEF | MESSAGE DE LA RÉDACTRICE EN CHEF

COLUMNS / CHRONIQUES
Educators’ Column – From a Tiny Seed | D’une petit graine jaillit une forêt
Leadership Column – Leading with Problem Solving | Affirmer son leadership par la résolution des problèmes
Students Column – The Journey Begins | J’entreprends mon mandat

DIRECTED READING ARTICLE
Non-invasive Ventilation in ALI/ARDS

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TECHNOLOGY UPDATE
Enhancing the Safety of Medical Suction Through Innovate Technology

ABSTRACTS FROM POSTER PRESENTATIONS / RÉSUMÉS DES PRÉSENTATIONS D’AFFICHES
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CSRT/CARESTREAM STUDENT EXCELLENCE AWARDS

The CSRT is proud to partner with CAREstream Medical Ltd., to provide recognition to students in the twenty educational programs across Canada. This award recognizes students in each respiratory therapy program (accredited through the Council on Accreditation for Respiratory Therapy Education) who have successfully completed the certification exam and have made a substantial achievement as a student.

Congratulations to this year’s winners!

Sherry Hill - College of the North Atlantic, Newfoundland
Chantale Blanchard - New Brunswick Community College (NBCC) - Saint John, New Brunswick
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MESSAGE FROM EDITOR IN CHIEF

Amy Reid, RRT, CRE

Part of the transitioning of the CJRT to a knowledge-based dissemination tool, is to have all scientific papers peer-reviewed as this is essential to scientific publication. This process ensures writing and research standards are maintained. Peer reviews also help guarantee credibility of the journal and its authors, while improving the quality and quantity of manuscripts received. This practice is also extremely helpful to first-time authors as it provides excellent feedback.

Reviewers are experts recruited from all areas of respiratory practice and their reviews are critical to establishing a reliable body of research and knowledge. To preserve the objectivity of the reviewer, all papers are blind-copied. Following peer review, articles are returned to the author with recommendations/suggestions/comments to be considered prior to the final submission for publication.

The regularly featured columns in this issue include:

- “Non-invasive ventilation in ALI/ARDS,” is a self-directed reading presented by Professor Paolo Pelosi
- “When I Nod, I Mean No - behavioral guidelines and cultural tips for health professionals working with people of other cultures”, is a book reviewed by Ana MacPherson
- Students’ Column, is written by new Board of Directors member, Krystle Hong
- “Leading with Problem Solving” is the title of the Leadership Column presented by Kirby Peterson
- Asthma education is discussed in the Educators’ Column by Amy Reid
- Technology Update – “Enhancing the Safety of Medical Suction Through Innovate Technology” is presented by Patricia Carrol
- Abstracts of current literature are also included

In this issue we also present:

- “Transpulmonary Pressure and Positive End Expiratory Pressure: A Case Report”, by Tom Piraino which discusses the “open lung” approach to ventilation using high positive end-expiratory pressure (PEEP).
- “Ethylene Glycol Poisoning and why Respiratory Therapists should always “mind the gap”, is presented by Dr. Peter Brindley who discusses how misdiagnosis, including inappropriate laparotomy and delays in EG therapy, can occur.
- “BMI Percentile a Potential Tool for Predicting Pediatric Obstructive Sleep Apnea”, by Dr. Shane Keene examines how OSA may be predicted by looking at a child’s BMI percentile.
- “Case presentation of a professional liability case”, by Brian Gomes discusses the need for RTs to adequately protect themselves against possible legal action.
- “Say YES to Evidence Based Respiratory Therapy Practice”, by Mika Nonoyama discusses some of the resources available to RTs in clinical practice.
- Abstracts of all CSRT Conference poster presentations are included in this issue.

In order to maintain the value-added process of peer reviewing, the CJRT invites interested individuals to put their names forward at any time to be considered as a volunteer peer reviewer. The responsibilities of a peer reviewer would require approximately ten hours of dedicated time in a 12-month period.

We encourage any person/group of people/institution doing research to consider publishing their work. Publishing research is a cornerstone to our profession. It not only ensures that your research is read, but it also has the potential to further our profession, and advance our practices/procedures across the country. Furthermore, it may spark additional research! Authors are strongly encouraged to submit their papers to the managing editor (rhansen@csrt.com) for consideration.

For any questions or concerns regarding the writing/publishing process, please direct yourself to the ‘Journal’ section of the CSRT website. This section features information for: first time authors, author’s instructions, guidelines for writing book reviews, guidelines for creating directed readings, as well as guidelines for writing columns. The production schedule can also be found here. Please feel free to contact me with any ideas or suggestions for articles at amy.cjrt@gmail.com
MESSAGE DE LA RÉDACTRICE EN CHEF

Amy Reid, t.r.a., é.r.c.

Une partie de la transition du JCTR à un outil de diffusion du savoir consiste à faire réviser tous les textes scientifiques par les pairs, élément essentiel de toute publication scientifique. La méthode garantit le maintien de hautes normes de recherche et de rédaction. Elle assure aussi la crédibilité du Journal et de ses auteurs, tout en permettant d’améliorer la qualité et la quantité des textes. C’est aussi une pratique extrêmement utile aux auteurs de premiers textes puisqu’elle leur permet de recevoir une solide rétrospective sur leur travail.

Les réviseurs sont des experts de différents domaines de la thérapie respiratoire et leurs révisions sont essentielles à l’établissement d’un corps de recherche et de savoir fiable. Pour préserver l’objectivité d’un réviseur, les documents qu’on leur soumet sont anonymes. À la suite de la révision, les articles sont retournés à l’auteur accompagnés de recommandations, de suggestions et de commentaires à prendre en compte avant la publication.

Articles courants du présent numéro :

• “Non-invasive ventilation in ALI/ARDS,” une lecture dirigée présentée par le professeur Paolo Pelosi
• “When I Nod, I Mean No - behavioral guidelines and cultural tips for health professionals working with people of other cultures”, une critique de livre par Ana MacPherson
• La chronique étudiante est rédigée par Krystle Hong, une nouvelle venue au conseil d’administration
• “Affirmer son leadership par la résolution des problèmes” est le titre de la chronique de la direction présentée par Kirby Peterson
• La chronique des enseignants nous présente un article sur l’asthme par Amy Reid
• Mise à jour sur la technologie – “Enhancing the Safety of Medical Suction Through Innovate Technology” par Patricia Carrol
• Résumés d’articles récents

Ce numéro présente également :

• “Transpulmonary Pressure and Positive End Expiratory Pressure: A Case Report”, par Tom Piraino; un examen de la méthode de ventilation d’ouverture du poumon au moyen de la pression positive en fin d’expiration.
• “Ethylene Glycol Poisoning and why Respiratory Therapists should always “mind the gap”, une présentation du Dr Peter Brindley qui explique comment peut se produire une erreur de diagnostic, donnant lieu notamment à une laparatomie inutile et au délai d’une thérapie appropriée.
• “BMI Percentile a Potential Tool for Predicting Pediatric Obstructive Sleep Apnea”, par le Dr Shane Keene qui explique comme prévoir le syndrome des apnées obstructives du sommeil en examinant le percentile de l’IMC d’un enfant.
• “Case presentation of a professional liability case”, par Brian Gomes; un examen de l’importance d’une protection adéquate contre des poursuites en justice pour les TR.
• “Say YES to Evidence Based Respiratory Therapy Practice”, par Mika Nonoyama. Un examen des ressources disponibles aux TR qui travaillent en cliniques.
• Le numéro contient des résumés des présentations d’affiches au congrès de la SCTR.

Dans le but de conserver la valeur ajoutée par les examens par les pairs, le JCTR invite les personnes intéressées à soumettre leur candidature à titre de bénévoles pour examiner les textes de leurs collègues. Les responsabilités d’un réviseur nécessitent environ dix heures de travail par période de 12 mois.

Nous encourageons toutes les personnes, les groupes et les organismes qui effectuent de la recherche à publier leurs travaux. La publication des recherches est la pierre angulaire de notre profession. La publication nous assure non seulement que notre recherche est lue mais que notre profession progresse et que nos pratiques et nos procédures se répandent à l’ensemble du pays. De plus, c’est un excellent moyen d’encourager le lancement d’autres recherches. Les auteurs sont fortement invités à soumettre leurs textes à la directrice de la rédaction (rhansen@csrt.com).

Pour de plus amples renseignements concernant les modalités de rédaction et de publication, veuillez consulter la section du Journal du site Web de la SCTR. La section affiche de l’information pour les auteurs d’un premier texte, des directives à l’intention des auteurs, sur la rédaction d’une critique de livre, sur la création de lectures dirigées et sur la rédaction d’articles. Vous y trouverez également le calendrier de tombée. N’hésitez pas à communiquer avec moi pour me soumettre vos idées d’articles ou vos suggestions : amy.cjrt@gmail.com.
In 2004, Dr. Christopher Licskai (BSc, MD, FRCPC) took an idea, a small seed, and nurtured it. Dr. Licskai wondered if he could improve the lives of patients with asthma while also decreasing healthcare costs by placing trained asthma educators in the community. Between October 2004 and November 2006 a study was created using 523 asthma patients and 33 physicians in 19 sites.

After an initial visit, patients would receive follow-up visits at 4 weeks, 2 months, 3 months, 6 months, and yearly based on need. During these visits the objectives for educators were: to complete spirometry, to describe the role of medication, to provide inhaler device technique teaching, and to discuss environmental control strategies. At the end of the study the results were quite impressive, showing a reduction of healthcare utilization by 58.6%.

Previous studies of the same nature had also been conducted (by the Ministry of Health and Long Term Care) with similar results. It is due to those studies and also due to the results from the coroner’s inquest, for Joshua Fleuelling, that the Ministry of Health determined that asthma education was a worthwhile endeavour and developed a fully funded program for asthma. Presently, in Essex County (Ontario) we are implementing an asthma education program with 60 physicians, 1350 patients, and 19 asthma educators (8 active).

We see patients at 4 weeks, 2 months, 3 months and 6 months as needed. Initial appointments last approximately 1 ½ hours and follow-up appointments are currently scheduled at 1 hour. Our interviews are all guided by a computer program that follows the Asthma Consensus Guidelines. Questioning includes: family history, personal medical history, symptom assessment, current medications, use of devices, environmental assessment (home, work, social), as well as discussions surrounding smoking and smoking cessation. Spirometry is also completed at each appointment. At the close of each interview a management plan is developed collaboratively between the educator and the primary care physician.

We are seeing among our patients the dramatic lack of understanding of their illness. It is astounding to learn what the definition of ‘asthma control’ is for some of them. There are those who believe that they are under control despite daily coughing and constant use of their ‘rescue’ inhaler! Clearly education is not only necessary, but imperative. We need to teach people the importance of asthma control, and how to achieve that control.

Each visit concludes with the patient receiving an individualized action plan - a tailored strategy which a patient can employ in order to help manage their asthma when it becomes out of control. Action plans have been liberating patients with asthma, creating an ability to manage their condition without the need to see a physician for every cold. As a wonderful side benefit, patients have experienced a decreased number of exacerbations! We are witnessing a dramatic first-hand improvement in the quality of life of our patients as well as a decrease in patient reliance on higher cost medical intervention. Clearly, our investment in asthma education is benefiting not only patients but reducing the pressure on our health care system.

As this program continues to grow, other programs are developing with the same intention. This past summer ARGi (Asthma Research Group INC.), piloted its first day camp for children with asthma. The program used was based on RAP...aka, ‘Roaring Adventures of Puff’.

RAP is a supported program by the Lung Association and was created by The University of Alberta – Alberta Asthma Centre. The ARGi program consists of an 8 hour day filled with fun and games aimed at helping children to understand not only the pathophysiology of asthma, but also the treatments and treatment options available to them. The children also quickly develop a distinct sense of camaraderie as they quickly realize that everyone in the room has one thing in common...asthma. At the close of the day the children provided a wealth of positive feedback, and we are hopeful to continue to offer this program in the future.

Another branch from this program is lung health. ARGi hopes to develop a lung health program focused on COPD management. COPD is a leading cause of death and disability in our country. There are many people who are uninformed with regards to their condition. If we could educate them and rehabilitate them we could change lives and less the demand on valuable health care resources.

This is an exciting time for us in Essex County. We as
Respiratory Therapists and Certified Respiratory Educators are finally being recognized and utilized for the part of our expertise which has the potential to have a dramatic impact on the lives of our patients.

In clinics we have seen children who thought that they would never again play sports, parents who regained their dreams for their children, adults who thought their breathing would never get any better. Our patients are controlling their asthma and improving their quality of life! We are enabling through education!

And so, as you can see...from one small seed, a beautiful forest is starting to take root!

RÉFÉRENCES


CHRONIQUE DES ENSEIGNANTS

D’une petite graine jaillit une forêt
Point de vue des éducateurs en thérapie respiratoire

Amy Reid, t.r.a., é.c.r.
Hotel Dieu Grace Hospital, Asthma Research Group Inc., Cottam (Ont.)

In 2004, the Dr Christopher Licskai (BSc, MD, FRCPC) has planted an idea, a tiny seed, and nourished it! The Dr Licskai has asked whether it could not improve the lives of patients with asthma and reduce healthcare costs by placing asthma trained educators in the community. Between October 2004 and November 2006, an survey was conducted with 523 asthma patients and 33 doctors in 19 sites. After a first visit, patients received follow-up visits after four weeks, two months, three months, six months or a year, depending on their needs. During these visits, the educators performed a spirometry exam, explained the role of medications, taught the use of inhalers, and discussed environmental strategies. At the end of the study, the results were impressive, with a 58.6% reduction in healthcare services.

Studies of a similar nature were also conducted (by the Ministry of Health and Long-Term Care) with similar results. Our first meeting is about 1 1/2 hour and the follow-up visits are one hour. Our conversations are guided by the asthma guidelines (Asthma Consensus Guidelines). Questions are asked about family history, personal medical history, device use, environmental evaluation (home, work, society) and discussions on tobacco use and its abandonment. A spirometry test is also performed at each visit. At the end of each meeting, a plan of management is prepared in collaboration with the educator and the treating physician.

We have noticed our patients a lack of understanding of their disease. It is surprising to hear the definition of asthma control given by some of them. Some believe they control their disease even though they cough every day and must constantly use their rescue inhaler! It is clear that education is not only necessary but imperative. We must teach people the importance of controlling their asthma and how to do it.

Each visit ends with the remission of a programme of education on asthma to which participate 60 doctors, 1 350 patients and 19 educators (of whom 8 are active).

We find in our patients a lack of dramatic understanding of their disease. It is surprising to hear the definition of asthma control given by some of them. Some believe they control their disease even though they cough every day and must constantly use their rescue inhaler! It is clear that education is not only necessary but imperative. We must teach people the importance of controlling their asthma and how to do it.

Chaque visite se termine par la remise au patient d’un programme d’éducation sur l’asthme auquel participent 60 médecins, 1 350 patients et 19 éducateurs (dont huit sont actifs).

Nous voyons les patients à des intervalles de quatre semaines, deux mois, trois mois ou six mois, selon les besoins. La première rencontre est d’une durée d’environ 1 1/2 heure et les visites de suivi sont d’une heure. Nos entrevues sont guidées par un logiciel basé sur les lignes directrices sur l’asthme (Asthma Consensus Guidelines). Les questions portent sur les antécédents familiaux, les antécédents médicaux personnels, l’utilisation des dispositifs, l’évaluation environnementale (maison, travail, social) et des discussions sur l’usage du tabac et son abandon. Un test spirométrique est également effectué à chaque visite. À la fin de chaque rencontre, un plan de gestion est préparé en collaboration avec l’educateur et le médecin traitant.

Nous constatons chez nos patients une absence dramatique de compréhension de leur maladie. Il est étonnant d’entendre la définition de « contrôle de l’asthme » donnée par certains d’entre eux. Certains croient qu’ils contrôlent leur maladie même s’ils toussent tous les jours et doivent faire constamment usage de leur inhalateur de secours! Il est clair que l’éducation st non seulement nécessaire mais impérative. Nous devons enseigner aux gens l’importance de contrôler leur asthme et comment y arriver.

Chaque visite se termine par la remise au patient d’un
plan d’action individualisé – une stratégie adaptée que le patient peut utiliser pour l’aider à gérer son asthme lorsque la maladie n’est plus maîtrisée. Les plans d’action on permis de libérer les patients de l’asthme, les rendant capables de gérer leur état de santé sans devoir consulter un médecin au moindre rhume. Dans un autre effet secondaire bénéfique, les patients notent une diminution des exacerbations! Nous constatons une amélioration remarquable de la qualité de vie de nos patients et une diminution de leur dépendance aux interventions médicales coûteuses. Il est clair que notre investissement dans l’éducation des asthmatiques non seulement bénéficie aux patients mais permet de diminuer la pression exercée sur notre système de santé.

Tandis que notre programme continue de croître, d’autres programmes similaires voient le jour. L’été dernier, ARGI (Asthma Research Group INC.) a tenu sous forme de projet pilote un premier camp de vacances à l’intention des enfants asthmatiques. Le programme était basé sur RAP (Roaring Adventures of Puff), un programme soutenu par l’Association pulmonaire et créé par le Alberta Asthma Centre de l’Université de l’Alberta. Le programme ARGI comprend une journée de huit heures de plaisir et de jeux visant à amener les enfants à comprendre la pathophysiologie de l’asthme ainsi que les traitements et les options de traitement disponibles. Les enfants établissent rapidement des liens de camaraderie lorsqu’ils réalisent que toutes les personnes présentes ont un point commun… l’asthme. À la fin de la journée, les enfants ont fait de nombreux commentaires positifs, et nous espérons pouvoir poursuivre ce programme dans l’avenir.

La santé pulmonaire est un autre élément du programme. ARGI espère pouvoir établir un programme de santé pulmonaire basé sur la gestion de la MPOC. La MPOC est l’une des principales causes de décès et d’invalidité au Canada. De nombreuses personnes sont mal informées sur leur état de santé. Si nous pouvions les éduquer et les réadapter, nous pourrions changer des vies et diminuer la pression sur les ressources de santé importantes.

C’est une période stimulante pour nous dans le compte d’Essex. Les thérapeutes respiratoires et les éducateurs respiratoires certifiés sont enfin reconnus et utilisés en fonction d’une expertise qui a le potentiel d’avoir une incidence dramatique sur la vie de nos patients.

Dans les cliniques, nous avons vu des enfants qui croyaient ne plus jamais pouvoir faire de sport, des parents qui ont retrouvé leurs rêves pour leurs enfants, des adultes qui croyaient que leur respiration ne s’améliorerait jamais. Nos patients contrôlent leur asthme et améliorent leur qualité de vie. Nous donnons le pouvoir par l’éducation!

Vous pouvez le faire aussi... d’une petite graine, une grande forêt commence à s’élever!

RÉFÉRENCES

Leading with Problem Solving

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Problem solving can be an intimidating task for anyone in a leadership position. As no institution is without its challenges, it is in our best interest to learn how to deal with them. Effective problem solving involves creating a culture within our institutions: where problems are seen to be opportunities for growth; where problem solving is focused on processes, and not assigning blame; where people are free to learn; and where our staff and clients are encouraged to make suggestions, point out errors and identify deficiencies. To be effective in doing this, we need to use a methodical approach to problems, a fairly simple method is the Plan Do Check (Study) Act process, also known as the PDCA cycle.

PLAN
Planning is the most important step, and should take up a majority of our energy and time. The first task in planning is to identify our problem. We can do this by conducting surveys, looking at Key Performance Indicators, performing audits, tracking incident reports, etc. By examining all of these you will pick out some trends which suggest that an improvement can be made.

Once you have done this, the problem you are solving needs to be defined. Do this by developing a clear and effective problem statement. This statement is neutral in tone and language. It needs to avoid assumptions, blame and has to be concise. Most importantly the stated problem must be solvable.

Now that you have your problem statement it is time to start analyzing the problem. Keep an open mind and realize that all problems have several contributing factors. Problems are usually systemic and the result of a breakdown of a process somewhere. Collect data and start breaking the problem down. A technique used in Root Cause analysis is to keep asking why. Why did this happen? What caused this? Keep asking until you can no longer ask why. There are also many tools to help you analyze your problem: flow charts, Root Cause Analysis matrix, fishbone diagrams, timelines, affinity charts.

The biggest pitfall here is stopping too soon. We come to a point in our analysis where we think that this is obviously what is contributing the most to the problem. Then we go off with a ready made solution. Solving the wrong problem can be worse than doing nothing at all. This wastes your time and energy, and undermines confidence in your ability to lead. Remember, your only goal at this point is to understand the problem completely. Keep looking at until you can say, what exactly happened and why.

You now have a good grasp of the many elements that contribute to your problem, and now can identify potential fixes. There are many strategies on how to do this, so don’t be afraid to get creative. Meet with your staff, talk with others to see how they dealt with similar situations, speak to other managers for their thoughts, seek other’s expertise.

List all the potential solutions, and identify which one is the best for your organization. Weigh their pros and cons, and evaluate how likely they are to work within your facility. Keep in mind any selection criteria that you may have. It may be necessary to do a cost benefit analysis on some of the stronger possibilities. When deciding what your best option is, keep in mind that the following categories of solutions are more effective: physical changes (human factors engineering, design and layout), simplifying processes, standardizing equipment and teamwork. Warning labels, new procedures, training, memos and policies are less effective.

You have decided on a solution, and now you are ready to develop your action plan. Kevin Taylor’s article on this topic in the last issue of the CJRT was excellent, and I encourage you to read it again. Set your goals, and remember the acronym SMART. Keep them Specific, Measurable, Achievable, Realistic, and Timely. Do a force field analysis to identify resistance to your plan, and possible promoters. Plan how you are going to overcome the resistance to your plan. Identify what measures you are taking, and how you are going to monitor the outcomes. Determine your implementation process; would a pilot project be necessary?

DO
You now have your plan, and it is time to start implementing it. Begin by selling your idea. Prepare presentations and announcements to gain support. Be prepared to adjust your presentation according to your audience, and show them how your plan will satisfy their needs. Implement as you have planned, using your key people to help promote. Track your project as you implement.
CHECK (STUDY)
Keep tracking your project, and encourage comments. Perform surveys, audits, and talk to the staff involved. Is this change having the intended effect? Don’t be afraid to tweak things to help improve the solution, or make it more acceptable to staff.

ACT
Once you are satisfied that this is working as intended, implement the change organization wide. Keep tracking, has your goal been met? Go back to how you identified the problem first. Have your indicators changed any? Have the practice audits improved?

This brings us to the top of the cycle again. The final step in act is to go back to the planning stage, what problems are there now for you to address? This is a continual process, integral to improvement.

When we can approach the challenges we face within our departments proactively and methodically, we promote confidence in our ability to lead. Staff is more likely to come to you when they know that you are willing and able to take action. They are also more likely to cooperate with you when they realize that you are interested in finding a solution. When we can do this we have gone a long way towards changing the culture within our departments and institutions.

CHRONIQUE DE LA DIRECTION
Affirmer son leadership par la résolution des problèmes
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La résolution de problèmes peut s’avérer une tâche ardue pour quiconque se trouve en position d’autorité. Chaque organisme se trouve confronté à des défis et nous avons tout intérêt à apprendre à y faire face. La résolution efficace de problèmes suppose la mise en place, au sein de l’organisation, d’une culture par laquelle les problèmes sont perçus comme une occasion de croissance, où leur résolution passe par des procédés, où l’on ne perd pas dans le blâme, où chacun peut prendre et où le personnel et les clients sont invités à formuler des suggestions, signaler les erreurs et recenser les faiblesses. L’efficacité dans ce secteur repose sur une approche méthodique du problème, comme celle du cycle Planifier, Faire, Vérifier (Examiner) et Agir, que l’on appelle aussi le cycle Deming.

Une fois cette étape franchie, le problème à régler doit être défini. On peut le faire en formulant un énoncé clair et efficace du problème. L’énoncé doit être neutre, autant par le ton que par le langage. Il doit éviter les hypothèses et le blâme et il doit être concis. Mais, ce qui est encore plus important, le problème énoncé doit être soluble.


Le plus grand piège consiste à cesser la recherche trop rapidement. Il arrive un moment dans l’analyse où nous croyons avoir trouvé à coup sûr le principal élément déclencheur. Puis, nous appliquons une solution toute
faite. Résoudre le mauvais problème est souvent plus dommageable que ne rien faire du tout. C’est une perte de temps et d’énergie qui mine la confiance en ses propres capacités de leadership. Il ne faut pas perdre de vue que le seul but à cette étape est de saisir toute la portée du problème. Il faut poursuivre l’examen jusqu’à en venir à pouvoir dire ce qui est passé exactement et pourquoi.

Lorsque vous avez bien saisi tous les éléments qui composent le problème, vous pouvez commencer à déterminer des solutions. Il existe de nombreuses stratégies sur la façon de franchir cette étape et il ne faut pas hésiter à se montrer créatif. Réunissez votre personnel, consultez autour de vous et découvrez de quelle façon on a réglé une situation semblable, parlez à d’autres gestionnaires; n’hésitez surtout pas à vous appuyer sur l’expertise d’autrui.

Faites la liste de toutes les solutions possibles, et retenez celle qui s’applique le mieux à votre organisme. Pesez le pour et le contre et évaluez de quelle façon une solution peut s’appliquer à votre cas. Gardez à l’esprit vos critères de sélection. Vous aurez peut-être à effectuer une analyse coûts-avantages pour certaines possibilités s’avérant plus intéressantes. Avant de retenir une option, n’oubliez pas que les solutions suivantes sont plus efficaces : changements physiques (ergonomie, conception et aménagement), simplification des processus, standardisation de l’équipement et du travail d’équipe. L’affichage de mise en garde, les nouveaux procédés, la formation, les notes de service et les politiques sont moins efficaces.

Vous avez opté pour une solution et vous êtes prêt à mettre votre plan d’action en place. L’article de Kevin Taylor à ce sujet dans le dernier numéro du JCTR était excellent et je vous invite à le relire. Fixez-vous des objectifs et n’oubliez pas l’acronyme SMART. Gardez vos objectifs stratégiques, mesurables, réalisables, réalistes et limités dans le temps. Effectuez une analyse des forces en présence pour repérer toute résistance à votre plan ainsi que les promoteurs possibles. Planifiez la façon dont vous vaincrez les résistances. Déterminez les mesures que vous mettrez en place et comment vous surveillerez les résultats. Établissez votre processus de mise en place. Faut-il un projet-pilote?

**FAIRE**

Votre plan est établi et vous vous apprêtez à le mettre en place. Commencez par faire adopter votre idée. Organisez des exposés et rédigez des communiqués pour obtenir de l’appui. Soyez prêt à modifier vos exposés en fonction de l’auditoire et démontrez de quelle façon votre plan répondra à leurs besoins. Mettez votre plan en place comme prévu en ayant recours à votre personnel clé pour le promouvoir. Suivez bien toutes les étapes de mise en place.

**VÉRIFIER (EXAMINER)**

Suivez votre projet de près et sollicitez les commentaires. Effectuez des sondages, des vérifications et parlez au personnel qui participe au projet. Les changements produisent-ils les effets voulus? N’hésitez pas à apporter des mises au point pour améliorer la situation ou la faire mieux accepter par le personnel.

**AGIR**

Dès que vous savez que le plan fonctionne comme prévu, étendez les changements à l’ensemble de votre organisme. Suivez toujours les progrès; votre but est-il atteint? Réexaminez les étapes de la détermination du problème. Vos indicateurs ont-ils changé? Constatez-vous de l’amélioration?

Vous devez revenir au début du cycle. La dernière étape de l’action consiste à revenir au stade de la planification pour constater les problèmes qu’il faut encore aborder. C’est un processus sans fin, essentiel à l’amélioration.

En abordant les défis qui se présentent de façon proactive et méthodique, nous installons la confiance en notre capacité de gestion. Le personnel ira plus facilement vous consulter, sachant que vous êtes prêt et capable d’agir. Il collaborera plus facilement avec vous parce que vous avez démontré que vous souhaitez trouver une solution. Une telle façon d’agir constitue une étape importante vers le changement de culture au sein de nos services et de nos organismes.
t is with great pleasure that I introduce myself as the new CSRT Director of Student Relations. I reside in Edmonton, Alberta and have just completed my first year in Respiratory Therapy at the Northern Alberta Institute of Technology (NAIT). I am excited to begin my position to allow me to bring a professional and reliable student voice to the CSRT Board of Directors during my two-year term.

In January 2010, I applied for my position by submitting a Letter of Intent, in which I stated four goals. It is only reasonable to disclose my platform to my fellow students. My goals for the Director of Student Relations would include:

I. Improvements on methods of communication between the CSRT and the students

II. Increase in awareness of the CSRT and the CSRT mission

III. Increase awareness of the respiratory therapy profession to prospective students

IV. Increase awareness to prospective routes after graduation

Understanding that Canada has numerous RT students and that my goals are continuous, I hope to diligently improve communications and relations between the CSRT and students, satisfying the CSRT’s vision of advocacy, leadership, service, and unity.

My first experience prior to my appointment as Director was to attend the CSRT Board of Directors Meeting in May 2010 as an observer. I was nervous the board that appointed me, not knowing of their expectations. However, as an observer, I was able to acquaint myself with the meeting surroundings and procedures. The two-day meeting was efficient, covering topics that greatly pertain to practicing RRTs and even current RT students. As each director presented, I was able to understand the complexity of each position’s responsibilities and how our team works together to achieve targets and goals.

While educators and leaders were in seminars at the 2010 CSRT Education Conference and Trade Show (May 13, 2010, St. John’s NL), Chantale Blanchard (Past Director of Student Relations) and I hosted a Student Focus Group with 12 students from the College of North Atlantic, 2 students from the College of North Atlantic Qatar, and 2 from the New Brunswick Community College (NBCC). Representing RT students, the hour-long Focus Group meeting allowed us to understand why students choose to enter the RT profession, why students believed they should be a member of the CSRT and what the CSRT does as a professional association. It became obvious that students do not understand the differences between a professional association versus a regulatory body. This then translates to difficulty in delineating the role of the CSRT versus a provincial regulatory board, further transmitting to confusion about the benefits of a student membership in the CSRT. Our goal, then, is to assure that students understand the differences between their provincial boards and the national professional association, to convey to students that a national association is their vehicle for professional advocacy.

After the productive Student Focus Group ended, the student participants were invited to a Student Social Night. The group was able to discuss not only differences in each program and provincial practicing regulations and norms, but was also able to discuss regional cultural differences. The resulting networking between students from different areas is beneficial and continual promotion of student-to-student communication across Canada will only build better professionals.

The opening reception for the Education Conference and Trade Show kicked off limitless seminars and detailed discussions. Feeling like the least RT-educated person there, I was unsure if I could understand the material presented, let alone have the material benefit me. I was naïve, not in knowledge, but in thinking that seminars were beyond my comprehension. Each seminar was intriguing and each speaker was knowledgeable. I began to wish I could split myself up to attend two at once. It was refreshing to have another person speak to me about material that my instructors had preached about during the year. Presentations “made sense” of the material I was learning in school and places the material/skills into perspective and practicality. My ultimate favorite – vendor exhibits – was walking through Santa’s respiratory goodies workshop.

The excitement continues as I accept my position as the Director of Student Relations at the CSRT 2010 Annual General Meeting. The challenges begin and the Albertan in me says “take the bull by the horns”. My first ever CSRT Education Conference and Trade Show allowed me to meet many new people, learn new things, and see new places. Working with Chantale has also eased me into my position. I know the CSRT Board of Directors will be a great support as I pursue my goals for increasing student advocacy and communications.

Ultimately, my direction needs to come from the student members, so don’t hesitate. Please feel free to bring any questions, concerns, or comments to my attention. Simply send me an email through the CSRT website (www.csrt.com). I look forward to receiving your messages.
Je suis très fière d’avoir été choisie par le CA de la SCTR pour assurer les relations avec les étudiants. J’habite à Edmonton en Alberta et je viens de terminer ma première année d’études en thérapie respiratoire au Northern Alberta Institute of Technology (NAIT). Je suis très heureuse de commencer mon mandat de deux ans au sein du CA et je compte représenter les étudiants de façon rigoureuse et fiable.

En janvier 2010, j’ai posé ma candidature au poste en présentant une lettre d’intention où je définissais quatre objectifs. Je crois qu’il est tout à fait à propos de présenter mon programme à mes confrères étudiants. Je vise donc à :

I. Améliorer les méthodes de communication entre la SCTR et les étudiants
II. Augmenter la sensibilisation à la SCTR, ainsi qu’à sa vision et sa mission
III. Augmenter la sensibilisation à la profession de thérapeute respiratoire auprès des étudiants
IV. Augmenter la sensibilisation aux avenirs possibles après l’obtention du diplôme.

Étant donné que le Canada compte de nombreux étudiants en TR et que mes objectifs sont à long terme, j’espère sincèrement pouvoir améliorer les communications et les relations entre la SCTR et les étudiants, tout en respectant la vision de la SCTR en ce qui a trait à la défense des intérêts, le leadership, les services et l’unité.

Avant d’être nommée au sein du CA, j’ai assisté à la réunion du Conseil de mai 2010 à titre d’observatrice. J’appréhendais légèrement la rencontre de ceux qui m’avaient élue, ne sachant pas quelles étaient leurs attentes. Cependant, à titre d’observatrice, j’ai pu me familiariser avec le cadre et les procédures de la réunion. La réunion de deux jours a été tâtonnante et chaque exposé relevait directement de la pratique des TRA et même des préoccupations des étudiants en TR. Au fur et à mesure des exposés des différents administrateurs du conseil, j’ai pu comprendre la complexité de chaque poste et de ses responsabilités et la façon dont l’équipe fonctionne pour atteindre ses buts et des objectifs.

Pendant que les formateurs et les dirigeants assistaient aux ateliers du Congrès éducatif et salon professionnel de mai à St. John’s (T.-N.-L.), Chantale Blanchard (l’ex administratrice des relations avec les étudiants au CA) et moi-même avons tenu un groupe de discussion d’étudiants en compagnie de 12 étudiants du College of North Atlantic, 2 étudiants du College of North Atlantic Qatar et 2 autres du Collège communautaire du Nouveau-Brunswick. Réunis pendant une heure, le groupe de discussion des étudiants nous a permis de comprendre pourquoi les étudiants choisissent d’adhérer à la profession de TR, pourquoi ils croient devoir faire partie de la SCTR et le rôle de la SCTR en tant qu’association professionnelle. Il est apparu évident que les étudiants ne comprennent pas la différence entre une association professionnelle et un organisme de réglementation. La méprise se traduit par la difficulté de saisir le rôle de la SCTR et celui d’un organisme de réglementation provincial et de la propagation d’une confusion à propos des avantages d’adhérer à la SCTR pour un étudiant. Notre objectif vise donc à nous assurer que les étudiants comprennent les différences entre les conseils provinciaux et l’association nationale et de faire comprendre aux étudiants que l’association nationale s’occupe de la défense de leurs intérêts.

Après la rencontre du groupe de discussion, les participants ont été conviés à une soirée sociale. Le défi s’est alors poursuivi sur les différences entre les programmes, les règlements et les normes des provinces, mais aussi sur les différences culturelles régionales. Le réseautage entre les étudiants de différentes régions à cette occasion est bénéfique et il est certain que le fait de favoriser les échanges continus entre étudiants du Canada ne peut qu’enrichir les professionnels de demain.

La réception d’ouverture du Congrès éducatif et salon professionnel annonçait de nombreux ateliers et débats. Chaque atelier était intéressant et chaque orateur connaissait sa matière. J’ai vécu un moment où j’ai voulu me diviser pour assister à deux ateliers en même temps! J’ai beaucoup bénéficié du fait d’entendre parler de connaissances que j’avais apprises durant l’année, sous un angle différent. Les exposés venaient confirmer ce que j’avais appris durant l’année scolaire et plaçaient la matière et les aptitudes en perspective tout en leur conférant une valeur concrète. Et je me suis rendue dans le hall d’exposition : un véritable atelier du Père Noël, rempli de jouets de respiration!

Je suis pleine d’enthousiasme à l’idée d’entreprendre mes fonctions dans le cadre de l’assemblée générale annuelle de 2010. Le défi commence et l’Albertaine en moi « prend le taureau par les cornes ». Mon premier congrès de la SCTR m’a amenée à faire de nouvelles rencontres, à apprendre de nouvelles choses et à voir de nouvelles places. Ma collaboration avec Chantale m’a également rassurée sur mes nouvelles fonctions. Je sais que le conseil d’administration de la SCTR me donnera son appui dans mes objectifs d’augmenter la défense des intérêts des étudiants et la communication avec eux.

Mais, il est certain que l’orientation que je prendrai sera donnée par les membres étudiants; alors, n’hésitez pas à me soumettre des questions, des préoccupations, ou des commentaires. Vous pouvez me faire parvenir un courrier par le biais du site Web de la SCTR (www.csrt.com). Je lirai vos messages avec grand plaisir.
NONINVASIVE RESPIRATORY SUPPORT (NRS) IN ACUTE RESPIRATORY FAILURE

Chidini G MD, Calderini E MD and Pelosi P MD

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ABSTRACT

Purpose of review: The aims of this review are: 1) to discuss the physiological rationale for non invasive respiratory support (NRS) in adults and children with acute respiratory failure; 2) to review clinical available data with preventive and curative NRS and 3) to give some practical recommendations to safely apply NRS in adults and children.

Recent findings: NRS refers to techniques allowing respiratory support without the need of an invasive airway. Two types of NRS are commonly used: 1) non invasive continuous positive airway pressure (nCPAP) and 2) non invasive positive pressure ventilation (nPPV). NRS may be an important tool to prevent (prophylactic treatment) or to treat (curative treatment) Acute Respiratory Failure (ARF) avoiding intubation in adult patients with cardiogenic pulmonary oedema, COPD, postoperative respiratory insufficiency, and hematology-oncology patients with ALI/ARDS. In general, the evidence to support the use of NRS in children with acute respiratory failure is scarce. However, two randomized studies have been recently published suggesting that nPPV ameliorates clinical signs and gas exchange while reducing the need for endotracheal intubation. Moreover, nCPAP and heliox may improve clinical scores and CO₂ washout in infants with severe bronchiolitis, without major complications. Data from non controlled studies show that NRS unloads the respiratory muscles, and that a helmet can be a valid alternative to facial and/or nasal mask when nCPAP is administered to children in the early stage of ARF. The aims of NRS are: 1) to partially compensate for the affected respiratory function by reducing the work of breathing; 2) to improve alveolar recruitment with better gas exchange (oxygenation and ventilation); 3) to reduce left ventricular afterload increasing cardiac output and improving hemodynamics.

RÉSUMÉ

Objet de l’étude : L’étude avait les buts suivants : 1) discuter de la justification physiologique du soutien respiratoire non invasif (SRNI) chez les adultes et les enfants atteints d’insuffisance respiratoire aiguë; 2) examiner les données cliniques disponibles sur le SRNI préventif et curatif; 3) formuler des recommandations pratiques pour l’application sécuritaire du SRNI chez les adultes et les enfants.

Constats récents : le SRNI renvoie aux techniques permettant le soutien respiratoire sans nécessiter une invasion des voies aériennes. Deux types de SRNI sont communément utilisés : 1) la ventilation spontanée en pression positive continue non invasive (nCPAP) et 2) la ventilation en pression positive non invasive (nPPV). Le SRNI peut être un outil important pour prévenir (traitement prophylactique) ou traiter l’insuffisance respiratoire aiguë en évitant l’intubation (traitement curatif) chez les patients adultes atteints d’œdème pulmonaire cardiogène, de MPOC, ou chez les patients postopératoires et oncohématologiques avec ALI/SRAS. En général, les faits soutenant l’utilisation du SRNI chez les enfants atteints d’insuffisance respiratoire aiguë sont rares. Cependant, deux études aléatoires publiées récemment laissent croire que la NPPV permet d’améliorer les signes cliniques et les échanges gazeux tout en diminuant le besoin d’intubation endotrachéale. De plus, l’utilisation de la nCPAP et de l’hélix peut améliorer le score clinique et diminuer le lavage du CO₂ chez les nouveau-nés présentant une bronchiolite grave sans complications majeures. Les données d’études non contrôlées indiquent que le SRNI décharge les muscles respiratoires et que le casque peut être une solution de rechange valable au masque nasal ou facial lorsque la nCPAP est administrée à des enfants aux premiers stades de l’insuffisance respiratoire aiguë. Le SRNI vise à 1) compenser partiellement la fonction respiratoire affectée en réduisant le travail de respiration; 2) améliorer le recrutement alvéolaire par un meilleur échange gazeux (oxygénation et ventilation); 3) réduire la pression diastolique du ventricule gauche pour augmenter le débit cardiaque et améliorer l’hémodynamique.
**INTRODUCTION**

Noninvasive respiratory support (NRS) has seen increasing use in ICUs and emergency departments in recent years mainly because of several clinical trials showing improved outcomes in selected patients with acute respiratory failure (ARF).

However the successful application of NRS requires training and a good interaction between ICU physicians, respiratory therapists, and nurses with the prompt recognition of treatment failure and not delaying intubation.

Conventional management of ARF consists of endotracheal intubation with its associated risks such as the need for sedation, infections (ventilator-associated pneumonia, tracheobronchitis), and laryngeal-tracheal damage [1,2]. NRS is an alternative form of respiratory treatment which includes various techniques directed to improve alveolar ventilation, oxygenation, and unloading respiratory muscles without the need of an endotracheal tube. NRS includes noninvasive continuous positive airway pressure (nCPAP) and noninvasive positive pressure ventilation (nPPV) delivered via an interface (nasal/facial mask or helmet) and ventilator (ICU or home ventilator) [3]. By virtue of its effectiveness NRS has become more frequently used in different acute and chronic pathologic conditions in adult and pediatric patients. In adults, high-level evidence supports the use of nCPAP in patients with cardiogenic pulmonary edema [4], postoperative patients with respiratory insufficiency, and the use of nPPV for exacerbation of COPD, neuromuscular disorders, or respiratory distress in the immunocompromised patient [5]. In preterm infants with respiratory distress syndrome, evidence suggests that early or post-extubation application of nCPAP is advantageous in reducing the need of mechanical ventilation [6,7,8]. Conversely, the application of NRS in infants and children is less well established, and so far, case series constitute the vast majority of the available knowledge. The aims of this paper are: 1) to examine the physiological rationale for NRS in adults and children; 2) to give practical recommendations for its safe application and 3) to review clinical available data on the use of NRS in acute hypoxemic respiratory failure in both adults and children.

**Rationale to deliver NRS**

NRS can be delivered as non invasive continuous positive airway pressure (nCPAP) and non invasive positive pressure ventilation (nPPV).

nCPAP exerts its effects by increasing intrathoracic pressure. The main physiological effects of CPAP are 1) prevention of atelectasis, thus preventing a loss of functional residual capacity; 2) reduction in work of breathing; 3) increase in oxygenation and carbon dioxide washout, and 4) reduction in left ventricular afterload. In small infants and children nCPAP prevents apnea by a stenting effect on small airways and by stabilizing the highly compliant chest wall [9].
During nPPV the patient’s spontaneous inspiratory effort triggers the ventilator to provide a variable flow of gas that increases until airway pressure reaches a selected level. Thus, during each spontaneous inspiration, the patient receives a pressure supported breath. In contrast to nCPAP, nPPV allows for better respiratory system muscle unloading, alveolar recruitment, oxygenation, and carbon dioxide washout improvement. However, patient-ventilator asynchrony may become a major issue affecting outcome [10, 11].

NRS application

NRS has been proposed as a preventive or “prophylactic” application for patients in order to prevent ARF in patients at risk; and as a “curative” application, once ARF occurs, in order to avoid endotracheal intubation. In adults NRS should be initiated according to the following criteria: moderate to severe dyspnea, respiratory rate > 25 breaths/min, use of accessory muscles, and gas-exchange abnormalities (PaCO$_2$ > 45 mmHg, arterial pH < 7.35; paO$_2$/FiO$_2$<250 mmHg).

In children NRS should be initiated if the following are present: dyspnea and/or tachypnea (defined as respiratory rate > 75 percentile according to age) and gas-exchange derangement: hypoxemia (defined as an oxygen inspired fraction >0.5 to obtain SpO$_2$ >94%) and/or respiratory acidosis (defined as arterial pH <7.35).

Contraindications for both adults and children are: 1) cardiac or respiratory arrest; 2) non respiratory organ failure (severe encephalopathy (i.e. GCS<10), severe upper gastrointestinal bleeding, hemodynamic instability, unstable cardiac arrhythmia, etc.); 3) facial surgery, trauma, or deformity; 4) upper airway obstruction; 5) inability to protect the airway (uncooperative, unable to clear secretions, cough), or swallow, and 6) high risk of aspiration.

Setting of NRS

**Adults:** First patients must be prepared and informed before and during NRS. In nCPAP, continuous distending pressure between 7-10 cm H$_2$O is safe and not associated with adverse hemodynamic effects. In nPPV, we suggest starting with nCPAP and positive end expiratory pressure (PEEP) as suggested above, then slowly and progressively increasing the inspiratory pressure level above PEEP at 2 cm H$_2$O increments to a maximum pressure of 20 cm H$_2$O achieving a 6-10 ml/kg expiratory tidal volume, a decrease in the patient’s respiratory rate, and an improvement in comfort (12). The pressure rise time, i.e. the time needed to reach the maximal inspiratory pressure, should be individually set (13-15) in order to optimize tidal volume, and comfort. These recommendations are based on clinical experience without any formal data to support the superiority of one technique over another. We recommend “sequential” use of NRS and total daily use ranging between 3 to 12 hrs. In our practice, during the first 24 h, NRS should be applied for approximately 30 to 45 min at 2 to 4-h intervals (prophylactic), depending on the patient’s clinical condition. Some patients may be treated during the initial period with NRS for 60 to 90 min at 2 to 3-h intervals (range, 8 to 12 h/day; curative). Between the periods of NRS patients may breath through a Venturi mask, to improve comfort. The length of NRS cycles may be then progressively reduced and withdrawn completely as the patient’s gas-exchange and clinical condition improve.

**Children:** There are practically no data on how to initiate NRS in children. The present knowledge is based on the direct experience of clinicians working in the field, and a variety of routines are applied. In nCPAP, continuous distending pressure 4-8 cmH$_2$O is safe and not associated with adverse hemodynamic effects. Of note, when nCPAP is delivered by helmet a high flow system should be used to prevent carbon dioxide rebreathing (minimum flow rate: 40 L/min). A ventilator should never be connected to an helmet in CPAP mode. nPPV delivered by facial / nasal mask is reported in several papers in children with ARF (see below).

A purposed sequence to starting NRS in adults and children is reported in Table 1.

**Equipment to deliver NRS**

Interfaces Different interfaces may be used for NRS such as nasal (covering the nose but not the mouth), oronasal (covering the mouth, nose, and eyes) masks, and helmets (covering the whole head and all or part of the neck; no contact with the face or head). An interface that fits properly is crucial in minimizing air leaks and maximizing NRS efficiency and success mainly in pediatric patients.

The helmets have been recently purposed as possible alternative to masks with potential advantages: 1) less resistance to flow; 2) can be applied regardless of the facial contour, facial trauma, or edentulism; 3) allow coughing; 4) less need for patient cooperation; 4) better comfort; 5) less interference with speech; and 6) lower risk of pressure sores. The expectation is that the helmet will be better tolerated for a prolonged time of use. The presence of an antisuffocation valve and a pressure release valve in the upper hood of the helmet is mandatory to protect the patient in case of 1) interruption of fresh gas flow with CO$_2$ increase inside the helmet or 2) over pressurization of the circuit if PEEP valve dysfunction occurs.

In children, the interfaces have included facial masks, moulded masks, modified nasal cannulae, and, in some cases, full-face masks. However, nasal masks seem to be the preferred type, particularly in younger children. Nasal
cannulas and nasal masks are easy to use and keep in place but are highly flow resistive and associated with mucosal bleeding, excess of nasal secretion with nares obstruction [16-18]. Nasal masks are associated with large air leaks from the mouth leading to airway depressurization and interruption of respiratory treatment. The facial mask has the advantage of limiting oral leak but can increase the number of failures due to patient discomfort from tight fitting masks, facial skin breakdown and difficult positioning [4]. The transparent pediatric helmets, made of polyvinyl chloride, have been recently proposed as a possible alternative to masks with better tolerance and reduced need of sedation [19-21]. However, monitoring of inspired oxygen fraction, pressure and temperature is mandatory even in PICU setting.

**nCPAP systems:** nCPAP in adults could be administered via a high flow system (see below) with an interface such nasal facial mask, full face mask or helmet. CPAP Boussignac refers to a fluidic logic system where the pressure is generated by an elevated fresh gas flow through a tube with increased resistance. In children and small infants, nCPAP is delivered via a high flow system which incorporates a blender, a flow-meter and an underwater PEEP valve (figure 1) or fluidic logic system where the pressure is generated by a high gas flow through a tube with increased resistance. No compelling evidence supports the use of one system over the other.

**Ventilators:** In adults, ineffective inspiratory efforts and double-triggering are the most common types of asynchrony leading to patient discomfort, whereas in children auto-triggering has been recently shown to be the primary cause of difficult patient-ventilator interaction. In order to minimize asynchrony the following options can be considered: 1) set the inspiratory trigger as sensitive as possible while avoiding auto-triggering; 2) prevent prolonged inspiratory time by setting a pre-set limited inspiratory time or an appropriate flow threshold of the expiratory trigger; or 3) use ventilators with a leak compensation software. Both ICU and portable ventilators can be used for nPPV. Studies have shown that leaks play a major role in generating patient-ventilator asynchrony and discomfort [22]. The sensitivity of the inspiratory and expiratory triggers is of great importance in children, in particular in cases of air leaks through the interface.

**Humidification:** No clear recommendation exists concerning humidification during NRS and few hygrometric data are available. A recent study in nCPAP and nPPV showed that both heat and moisture exchangers and heated humidifiers provided adequate airway conditioning and that absolute humidity levels above 15 mgH$_2$O/l were well tolerated [24]. Another study showed the efficacy of heated humidifiers during NRS by helmet [25].

**NRS IN SPECIFIC SETTINGS**

**ARDS**

Several studies have demonstrated that the beneficial effects of NRS in ARDS patients is reduced compared to other categories of patients [26]. In a recent randomized trial it was shown that application of NRS can be helpful to reduce the rate of desaturation at the moment of the intubation in hypoxemic patients [27]. One single randomized study investigated the efficacy of nCPAP compared to oxygen therapy delivered by Venturi mask in hypoxemic patients with ALI/ARDS criteria [28]. They found that application of nCPAP by mask even if was able to improve the level of oxygenation in the first hours of application, did not reduce the number of intubation or complications. Thus it appears that nCPAP cannot be considered a first line, non-invasive approach in hypoxemic patients with severe pneumonia or ALI/ARDS. On the contrary, nPPV has been found to reduce the intubation rate and complications but not ICU survival compared to standard mechanical ventilation in a group of ARDS patients [29]. There is more debate about the use of NRS in hypoxemic patients with community acquired pneumonia. One randomized study showed beneficial effects of reducing the intubation rate and ICU length stay in COPD patients with CAP, but not in COPD patients [30]. On the other hand, another randomized study showed a reduction in the number of intubation and ICU mortality in hypoxemic patients with CAP but not in ARDS [31].

Another important topic is the use of nPPV in immunocompromised patients with ARDS. One randomized trial included patients undergoing solid organ transplantation who developed ARF. This study, comparing the use of nPPV versus standard treatment, showed a reduction in intubation rate and ICU mortality when nPPV was applied.
The beneficial effects of nPPV were later confirmed in patients with hypoxemic ARF with hematologic malignancy or immunosuppression [33]. In another study, it was also found that application of nCPAP was efficient in reducing the number of intubations [34]. A recent meta-analysis [35] suggested beneficial effects of using nPPV in patients with hypoxemic ARF in reducing intubation rate. The effect on the mortality rate was less clear.

The role of NRS could be relevant in the category of immunocompromised patients where the mortality rate is extremely high when they reach criteria for intubation. Thus, NRS has to be considered as a first line treatment in these patients, whenever possible.

Several factors have to be taken into account to predict NRS failure in this subset of patients: 1) the severity of disease; b) lack of improvement of PaO$_2$/FiO$_2$ higher than 150 1 hour after institution of NRS institution. On other hand, a parameter such as no improvement in arterial pH 1 hour after institution of NRS was not predictive of failure [36].

**COPD**

In patients with acute exacerbation of COPD, nPPV has to be preferred over nCPAP. These patients characteristically demonstrate accessory muscles recruitment, reduced lung and chest wall recoil, dynamic hyperinflation with intrinsic PEEP, and increased lung volume. A recent meta-analysis showed that nPPV compared to standard treatment was able to reduce mortality and morbidity with reduced ICU and hospital stay [37].

Another study showed a reduction in complications and a reduction in ICU and hospital length of stay when nPPV was compared with invasive mechanical ventilation [38]. Furthermore, it has been shown that the use of nPPV improves survival at 1 year compared to conventional mechanical ventilation suggesting not only early but also late beneficial effects [39]. nPPV has been proposed as alternative way of weaning in COPD patients. In summary, it appears that in this category of patients weaning should be performed according to the following steps: a) early extubation then b) nPPV application soon after extubation is performed.

Two randomized studies investigated this topic. The first one showed that patients who had recovered from a COPD exacerbation within 48 hours after initiating mechanical ventilation, had a reduction in mortality, ICU stay, days on mechanical ventilation, and the rate of ventilator acquired pneumonia by using this approach [40]. The second study included acute on chronic COPD patients with hypercapnic respiratory failure and showed a 3 day reduction in the mechanical ventilation by endotracheal tube but no significant differences in ICU stay, complications, and survival when nPPV was applied as an alternative to weaning [41].

These favorable results have been also confirmed in a randomized trial including 43 patients (33 with COPD) that failed a spontaneous breathing trial for three consecutive days. They found a reduction in endotracheal and total mechanical ventilation periods, ICU and hospital length of stay, incidence of nosocomial pneumonia, need of tracheostomy, and survival (in ICU and at 6 months) [42]. In a recent randomized trial, it was shown that application of nPPV reduces the intubation rate and improves survival. This occurred mainly in hypercapnic COPD patients if nPPV was applied as prophylactic assistance after extubation. [43]

**Acute Cardiogenic Pulmonary Edema**

The use of NRS, and in particular the use of nCPAP, has a strong pathophysiological rationale in patients with acute cardiogenic edema. In fact, moderate increases in airway pressure increase the intrathoracic pressure and end expiratory lung volume. The increase in the intrathoracic pressure is associated with a reduction in venous return and a reduction in left ventricular afterload. The increase in the lung volume is associated with better oxygenation, improvement in respiratory compliance, and reduction in work of breathing. Overall, this improves hemodynamics, in particular the cardiac output, and reduces pulmonary congestion. A recent meta-analysis showed that nCPAP was associated with a significant reduction in mortality and intubation rate compared to standard therapy (oxygen by face-mask, diuretics, nitrates, and other supportive care) in patients with acute cardiogenic pulmonary edema. The use of nPPV was associated with a significant reduction in intubation rate but only a trend toward reduced mortality when compared to standard therapy in this group of patients. No significant differences were found between nCPAP and nPPV in relation to intubation rate and mortality. Weak evidence of an increase of new myocardial infarction with nPPV versus nCPAP was noted [44]. Thus nCPAP and not nPPV has to be recommended as a first line treatment of patients with acute cardiogenic pulmonary edema. Several factors should be considered before NRS is applied: a) patients with a mean arterial pressure, without vasoactive drugs, <95 mmHg should be considered for prompt intubation, b) the presence of myocardial infarction, without cardiogenic shock is not a contraindication for NRS, and c) patients with hypercapnia (PaCO$_2$ > 45 mmHg) are at increased risk to be intubated [45]. nPPV should be considered as a first line approach if the application of nCPAP does not reach beneficial effects [46].

**Postoperative NRS**

Major changes in respiratory function occur in all patients following cardiac, thoracic and abdominal surgery because of anesthetic and surgical consequences in the first hours.
following surgery. These changes generally regress after one to two weeks [47]. Anesthetics decrease muscle tone which increases lung retractile forces, thus contributing to atelectasis development. Surgery disrupts abdominal, thoracic and diaphragmatic muscles forces, reduces phrenic nerve output, and induces pain. The expected benefit of NRS in postoperative period would be: 1) to partially compensate for the affected respiratory function by reducing the work of breathing; 2) to improve alveolar recruitment with better gas exchange (oxygenation and ventilation); 3) to reduce left ventricular afterload thus increasing cardiac output and improving hemodynamics.

There are a few prospective randomized trials investigated preventative nCPAP with oxygen and physiotherapy in the postoperative period after abdominal surgery [48,49]. All of them reported that nCPAP reduces atelectasis formation in non-cardiac surgery patients. Another study demonstrated the benefit of nasal CPAP in reducing atelectasis formation, pneumonia, and hospital length of stay in patients with thoracoabdominal aortic aneurysms [50].

Different studies have investigated the role of curative NRS after abdominal surgery. This included patients suffering from ARF after abdominal surgery. Jaber et al. [51] in an observational study demonstrated the feasibility, good tolerance and safety of nPPV for the treatment of ARF after digestive surgery. More severe initial hypoxemia and lower improvement of PaO2 after treatment were predictive of nPPV failure. These results were confirmed by a recent study which included 72 patients who developed ARF after abdominal surgery. Of these 72 patients, 42 (58%) avoided intubation with nPPV [49]. Conti et al. [52] in a match-controlled study reported nPPV success rate of 80% in the helmet and of 52% in the facial mask group. More recently, Michelet et al. showed that nPPV was associated with a lower intubation rate, decreased frequency of acute respiratory distress syndrome, decreased incidence of anastomotic leakage, and a reduction in ICU length of stay in patients with ARF after esophagectomy [53].

**Pediatric patients**

In children, hypoxic respiratory failure mainly occurs in disorders characterized by parenchymal pathologies (such as bacterial and viral pneumonia) as well as airway obstruction (such as bronchiolitis and status asthmaticus). At this time, there is a lack of well-designed, controlled experiments of nCPAP or nPPV in children with acute hypoxic respiratory failure [54].

**Intubation Rate.** The efficacy of nPPV in reducing the intubation rate in children with acute hypoxic respiratory failure was evaluated by only two recent studies. Javouhey et al. [55] conducted a retrospective study comparing infants with severe bronchiolitis admitted to the PICU during two different winter epidemics. In the first epidemic, invasive ventilation by tracheal intubation was the sole ventilatory support strategy available (Invasive Ventilation period); during the following winter the attending physician was encouraged to use nPPV by nasal mask as primary ventilation technique (nPPV period). The Authors demonstrated a significantly lower rate of intubation and ventilator-associated pneumonias in the nPPV period as compared to the invasive ventilation period.

Yanez et al. carried out a prospective, randomized, controlled study on the same topic. Fifty children with ARF, mainly from pneumonia and bronchiolitis, were randomly assigned to either nPPV by facial mask or standard medical therapy. nPPV diminished respiratory rate and heart rate within 1 hour and reduced tracheal intubation by 47% as compared to standard therapy. Moreover, infants with ARF are severely tachy-dyspneic with respiratory rates as high as 100 bpm. It turns out that patient-ventilator asynchronies frequently occur when nPPV is used. nCPAP by helmet could represents a valid alternative in non-hypercapnic patients [56-57].

**Bronchiolitis, Heliox.** nCPAP has been shown to be effective in the early treatment of acute severe bronchiolitis. A preliminary uncontrolled study suggested that the effectiveness of nCPAP could be further increased if a mixture of helium and oxygen (heliox) is added to the gas-mixture [58].

A paper by Martinon-Torres et al. has been recently published on this topic. The Authors carried out a single-center, prospective, randomised, crossover study using nasal CPAP with and without heliox in 12 infants with severe bronchiolitis [59]. Nasal CPAP with either gas mixture (air-oxygen or heliox) was safe and effective in ameliorating gas exchange and respiratory pattern in this population. Furthermore, when heliox was used in place of an air-oxygen mixture the level of improvement of the clinical scores and transcutaneous CO2 was almost doubled.

**Immunosuppressed children.** This subset of patients has been regarded as having a poor outcome, especially when tracheal intubation and conventional mechanical ventilation for respiratory failure is required. Two non randomized papers recently explored the feasibility of nPPV in this subgroup: Pancera et al. [60] retrospectively analysed 239 children admitted to the PICU for ARF and treated by either invasive or noninvasive ventilation. In this study, nPPV reduced the need for endotracheal intubation, and hemodynamic impairment was identified as an independent factor for intubation. Piastra et al. [61] evaluated nPPV by mask or helmet in 23 consecutive immunocompromised children with ARDS. They showed that it was effective and that more than 50 percent of children avoided intubation. Moreover, an early improvement in PaO2/FiO2 ratio was able to predict nPPV success.
Neuromuscular patients.
NRS has been proposed in selected patients with neuromuscular diseases. In a recent study, in patients with neuromuscular and chest wall diseases with hypercapnic ventilator failure, nPPV has been found to be successful in improving spirometric parameters and prolonging the time it takes for further deterioration of respiratory function to occur [62]. It was also effective in normocapnic patients with Duchenne disease. Furthermore, a recent randomized trial showed that nPPV improved survival and quality of life in patients with amyotrophic lateral sclerosis without severe bulbar dysfunction.

Do not intubate patients.
NRS application has been proposed in selected “do not intubate” patients. A recent study showed better comfort in these kind of patients when non invasive ventilation was applied [63].

Predictors of NRS failure
Few studies have evaluated the predictors of NRS failure in ARF patients. Antonelli reported a $\text{paO}_2/\text{FiO}_2$ lower than 146 at 1 hr after NRS institution as an independent risk factor for failure. Also associated were severity of illness score at admission and age [64]. Rana reported a high NRS failure rate in a cohort of patients with ALI without cardiogenic edema (70%). In this study, severity of hypoxemia and metabolic acidosis were significantly correlated to NRS failure. Moreover a good tolerance seems to be a strong predictor of success [65].

On this basis, good selection of patient candidates to receive NRS is a key point in obtaining a good outcome: patients with high severity scores at admission and/or patients who do not correct hypoxemia after 1 hour should be carefully monitored in an ICU by a trained staff of physicians, respiratory therapists, and nurses. In such patients, intubation should not be delayed if hypoxemia cannot be rapidly corrected.

CONCLUSIONS
In conclusion: 1) NRS plays a relevant role in the treatment of hypercapnic and hypoxemic critically ill patients, both adult and pediatric; 2) the right indications and exclusion of poor candidates is essential, as well as the right choice as to when to stop the attempts of non invasive respiratory support; 3) NRS has become standard of care in acute exacerbation of COPD patients; 4) Noninvasive positive pressure ventilation has been shown to be effective as an alternative to weaning and in post extubation failure in COPD; 5) CPAP is successful in acute cardiac pulmonary edema; 6) in immunocompromised hypoxemic patients non invasive positive pressure ventilation is first line indication; 7) the application of non invasive positive pressure ventilation can be considered but should be stopped if beneficial effects have not been achieved within one hour; 8) in patients with chronic neuromuscular diseases NRS can be useful to reduce discomfort and improve survival; 9) new developments in the interfaces, such as the helmet, can contribute to the implementation of NRS outside the ICU in adults and improve the tolerance and outcome of NRS in children. NRS in the pediatric population has become an option in the last few years, and is being applied increasingly. In general, the evidence supporting its use in infants and children with ARF is still limited and the identification of the right patient, the right time of application, and the appropriate setting is still lacking.
Table 1. Protocol for initiation of nPPV in adults and children.

- **PCV**, Pressure Volume Control; **PSV**, Pressure Support ventilation; **BiPAP**, Biphasic Positive Airway Pressure; **PEEP**, Positive End Expiratory Pressure; **FiO₂**, Inspired Oxygen Fraction; **SpO₂**, peripheral oxygen saturation

1. Appropriate monitoring: peripheral pulse oximetry, vital signs as clinically indicated

2. Patient sitting at > 30 degree angle in the bed
   - **Pediatrics:** Child sitting at > 30 degree angle in the bed, reassure the child and try to explain what you are going to do

3. Select and fit appropriate interface (mask or helmet or nasal probes in small infants)

4. Check initial ventilator settings before connecting to the mask of the patient:
   - Type of ventilation: PSV, PCV, BiPAP
   - Inspiratory trigger: -1 to -2 L/min or -1 to -2 cm H₂O (i.e., the lowest level without induced auto-triggering)
   - Expiratory trigger: flow set at 40 to 60% of Peak flow or fixed inspiratory time to 0.5 to 1 second.
   - Pressurization rate: moderate to maximal according to patient's comfort, expiratory tidal volume and respiratory rate (the fastest pressurization rate should be used when helmet is applied)
   - Initial maximal inspiratory pressure level: 10-15 cm H₂O
   - Initial PEEP level: 3 to 5 cm H₂O; at least 6 cm H₂O when the Helmet is used.
   - Initial FiO₂: minimum at 50-60% to reach SpO₂ ≥ 95%
   - **Pediatrics:** Modality: PSV, PCV, BiPAP
     - Inspiratory trigger: lowest level without induce auto-triggering
     - Pressure rise time: moderate to maximal according to patient's comfort (when helmet is used in older children, the fastest pressure rise time must be used)
     - Initial maximal inspiratory pressure level: 6 to 8 cm H₂O
     - Expiratory trigger (expiratory cycling setting if available): flow: 40 to 60% or time cycled: fixed inspiratory time = 60 / actual RR x 3.
     - Initial PEEP level: 3 to 5 cm H₂O
     - Initial FiO₂: 0.4-0.6

5. After briefly explaining the most important features related to non invasive respiratory support to the patient, the following sequence should be checked: a) apply headgear; b) avoid excessive strap tension (one or two fingers under strap); c) encourage patient to hold mask or helmet; d) propose to the patient to breathe through the interface selected for few seconds without connected to ventilator

6. Connect interface to ventilator tubing and turn on ventilator

7. Start with low pressures (as set previously) and gradually increase maximal inspiratory pressure (up 15 to 20 cm H₂O; when helmet is used the maximal inspiratory pressure should be set at least 50% higher than that used during mask) and PEEP (5 to 10 cm H₂O) as tolerated without major leaks to achieve: a) reduction in dyspnea, b) decreased respiratory rate, c) increased expiratory tidal volume, and d) acceptable patient-ventilator synchrony. Never exceed total inspiratory pressure more than 25 cm H₂O

8. Set FiO₂ to keep SpO₂ ≥ 90%
   - **Pediatrics:** To facilitate tolerance, administer one or two boluses 0.1 mg/kg midazolam iv
   - Try to adapt the child to the initial settings and then gradually increase maximal inspiratory pressure (8 to 15 cm H₂O) and PEEP (4 to 8 cm H₂O) as tolerated without major leaks to achieve a good patient-ventilator interaction. If so, check for HR and RR reduction and SpO₂ improvement. When helmet is used, set an inspiratory airway pressure at least 50% higher than that used during ventilation by mask.
   - Set FiO₂ to keep SpO₂ ≥ 95%

9. Add humidifier as indicated (heated humidifier or heated and moisture exchanger with low internal volume to avoid excess dead space)

10. Encourage and reassure the patient during the initial application of non invasive respiratory support

11. Monitor blood gases (within 1 to 2 h, then as needed)
   - **Pediatrics:** Check for HR, RR and SpO₂ after 1 hr of NRS treatment. If no improvement occurs, consider endotracheal intubation without delay.

12. Duration: initial period for 60 to 90 min at 2-to 3-h intervals (range, 8 to 12 h/day).
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QUIZ QUESTIONS

1) Which of these parameters represents a clear indication for NRS?
   A. PaO₂/FiO₂ > 250 mmHg
   B. PaO₂/FiO₂ < 250 mmHg
   C. Arterial pH < 7.10
   D. None of them

2) Which of these parameters is a clear contraindication to NRS?
   A. Cardiac or respiratory arrest
   B. Facial surgery, trauma or deformity
   C. Inability to cooperate or protect the airway
   D. None of them
   E. All of them

3) Which of these parameters is predictor of success or failure of NRS in COPD?
   A. No improvement in arterial pH after 1 hour of NRS institution
   B. Poor patients cooperation
   C. Arterial pH at admission
   D. Lack of improvement in PaO₂/FiO₂ 1 hour after starting NRS

4) Which of these parameters is a good predictor of success or failure of NRS in hypoxemic ARF?
   A. The severity of the disease
   B. Age
   C. Lack of improvement of PaO₂/FiO₂ > 150 1 hour after starting NRS
   D. Lack of cooperation
   E. None of them
   F. All of them

5) Which is the evidence that NRS can play a role as an alternative to weaning or after extubation failure in COPD?
   A. High
   B. Moderate
   C. Poor
   D. None

6) Which is the evidence that NRS can play a role as an alternative to weaning or after extubation in hypoxemic respiratory failure?
   A. High
   B. Moderate
   C. Poor
   D. None

7) Which of the followings is true in acute cardiogenic pulmonary edema?
   A. nCPAP is equivalent to nPPV
   B. NRS cannot be used during acute myocardial infarction
   C. NRS can be used when mean arterial pressure is at least 85 mmHg
   D. None of them

8) In immunocompromised patients with hypoxemic respiratory failure, the use of NRS:
   A. It is clearly contraindicated
   B. It should be used only in hypercapnic patients
   C. It is a first line treatment when indicated and no contraindication are
   D. Present
   C. None of them

9) The level of evidence of use of NRS in acute hypoxemic respiratory failure is:
   A. High in community acquired pneumonia
   B. High in ALI/ARDS
   C. Moderate in ALI/ARDS and in community acquired pneumonia
   D. None of them

10) nCPAP exerts its physiological effects by:
    A. Decreasing mean intrathoracic pressure
    B. Increasing left ventricular afterload
    C. Decreasing respiratory muscle workload
    D. Preventing atelectasis and increasing functional residual capacity
11) nCPAP exerts its physiological effects by:
   A. Increasing mean intrathoracic pressure
   B. Reducing left ventricular afterload
   C. Reducing work of breathing
   D. All of them

12) nCPAP exerts its physiological effects effects in infants and small children by:
   A. Stabilizing the elastic chest wall
   B. Stenting small airways
   C. Increasing functional residual capacity
   D. All of them

13) nPPV allows:
   A. To reach a preset pressure level in airways
   B. To better wash out CO₂ respect to nCPAP
   C. To better recruit lung volume respect to nCPAP
   D. All of them

14) The use of facial mask to deliver nPPV respect to the helmet in adults leads to:
   A. Better comfort
   B. Reduced CO₂ wash out
   D. Better respiratory muscles unloading
   E. Increased patient ventilator asynchrony

15) The potential advantages of the pediatric helmet respect to the mask in children:
   A. Better CO₂ wash out in hypercapnic patients
   B. Reduction in patient ventilator asynchrony respect to facial/nasal mask if employed to deliver nPPV via an ICU ventilator
   C. In children is associated with less need of sedation in children and prolonged NRS application time respect to the mask
   D. None of them

16) High free flow CPAP with helmet incorporates:
   A. An ICU ventilator
   B. An air oxygen blender, flow meter, PEEP valve, alarm system on pressure and FiO₂
   C. A capnometer
   D. None of them

17) A safe application of NRS by helmet required:
   A. Application in ICU/PICU or ED with trained staff and ICU ventilators in case of NRS failure
   B. Helmet equipped with antisuffocation and pressure release valve
   C. The presence of a monitoring system with acoustic pressure and FiO₂ alarm in the circuit
   D. All of them

18) Interfaces in children:
   A. Prolonged use of nasal cannulae leads to nasal bleeding and nares obstruction
   B. nPPV could be delivered via nasal cannulae
   C. Facial mask is better tolerated respect to helmet
   D. Nasal mask is of choice in deliver nPPV in ALI/ARDS

19) Patients ventilator asynchrony:
   A. Is frequently due to leaks around the interface
   B. Autotriggering is the main cause in children
   C. Ineffective effort is the main cause in adults
   D. All of them

20) In order to minimize patients ventilator asynchrony in nPPV:
   A. Is mandatory to set the sensitivity of inspiratory and expiratory trigger
   B. Is mandatory to set a good level of pressure support
   C. Is mandatory to zeroing PEEP level
   D. None of them

21) Humidification during NRS:
   A. Heat and moisture exchangers and heated humidifiers provided adequate airway conditioning
   B. An absolute humidity levels lower 15 mgH₂O/l is well tolerated
   C. No humidification is required if NRS is delivered by nasal/facial mask
   D. Active humidification is contraindicated if NRS is delivered by helmet
22) Major physiological changes in respiratory function after abdominal/thoracic surgery consist in:
   A. Diaphragm function impairment
   B. Reduction in FRC
   C. Development of atelectasis and consolidation
   D. Are reversible in 2 weeks
   E. All of them

23) Predictors of failure in nPPV after abdominal surgery:
   A. Low improvement in paO$_2$ level 1 h after starting nPPV
   B. Low improvement in cardiac function 1 h after starting nPPV
   C. Hypotension
   D. Metabolic acidosis

24) In small children with pneumonia/bronchiolitis:
   A. nPPV could improve oxygenation and reduce intubation rate
   B. nPPV is contraindicated
   C. nPPV delivered only with nasal facial mask
   D. nPPV is indicated if paO$_2$/FiO$_2$ < 100 mmHg

25) In immunosuppressed children with ALI/ARDS:
   A. nPPV could reduce intubation rate
   B. nPPV is indicated if paO$_2$/FiO$_2$ < 100
   C. Moderate hypercapnia is a predictor of nPPV failure
   D. nPPV is indicated if paO$_2$/FiO$_2$ > 300

QUIZ ANSWERS ON PAGE 39

SUBMISSIONS TO CANADIAN JOURNAL OF RESPIRATORY THERAPY
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Ethylene Glycol Poisoning and why Respiratory Therapists Should Always “Mind the Gap”.

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ABSTRACT
A 49 year-old female patient was brought to the Emergency Room (ER) by Ambulance with severe acidosis (pH < 6.9) and evolving multi-system-organ-failure (MSOF). Decreasing level of consciousness and hypoxic respiratory failure necessitated endotracheal intubation. Severe hypotension and atrial fibrillation necessitated vasopressors and cardioversion. She had severe anion-gap metabolic acidosis, and a lactate measured by a point-of-care (POC) arterial-blood-gas (ABG) analyzer of 42 mmol/L.

Limited history was available. The Intensive Care Unit (ICU) team assumed care, and notified Surgery in case this lactate elevation represented severe mesenteric ischemia thus required urgent exploratory laparotomy. Sedation precluded an adequate abdominal examination. Abdominal X-ray showed no abnormal bowel, thumb-printing, or portal venous gas. Although consent was obtained for immediate laparotomy, we delayed to permit aggressive resuscitation, obtain an abdominal CT, and optimize hemodynamics and acid-base. The patient was admitted to the ICU. Admission laboratory work included plasma lactate. This sample was drawn minutes after the ABG sample. Unexpectedly, the plasma lactate was only 1.5mmol/L (compared to 42 mmol/L).

Two hours later, laboratory investigations showed an increased serum osmolarity (353 mOsm/L), and an osmolar gap (33). Urine analysis revealed calcium oxalate and hippurate crystals. Therefore, a stat ethylene glycol (EG) level was ordered and found to be 15 mmol/L. As such, it was now clear that the diagnosis was one of EG poisoning. Resuscitation continued, but now included high-flux dialysis and ethanol-infusion to counter EG. Both POC and laboratory samples were repeated and confirmed the high POC lactate and comparatively low plasma-lactate, showing that the discrepancy was real. The EG level decreased rapidly with a decrease in the POC lactate. Plasma lactate measured from laboratory testing never exceeded 3.6 mmol/L. The abdominal CT was grossly normal and no surgery was performed. The patient was admitted to the ICU. Admission laboratory work included plasma lactate. This sample was drawn minutes after the ABG sample. Unexpectedly, the plasma lactate was only 1.5mmol/L (compared to 42 mmol/L).

RÉSUMÉ
Une femme de 49 ans a été transportée aux urgences par ambulance souffrant d'acidose grave (pH < 6,9) et d'insuffisance organique multiple évolutive. La perte graduelle de conscience et la défaillance respiratoire hypoxique ont nécessité une intubation endotrachéale. Une hypotension et une fibrillation auriculaire prononcées ont nécessité l’administration de vasopresseurs et le recours à la cardioversion. La patiente présentait une acidose métabolique profonde accompagnée d’un trou anionique et une mesure lactique de 42 mmol/l, mesurée au point de service (PDS) par gazométrie du sang artériel (GSA).

Les antécédents disponibles étaient limités. L'unité de soins intensifs (USI) a pris la patiente en charge et prévenu le service de chirurgie au cas où l’élévation des lactates aurait été symptomatique d’une ischémie entérique grave, auquel cas une laparotomie exploratoire d’urgence aurait été nécessaire. La sédation ne permettait par un examen abdominal adéquat. Les radiographies abdominales n’ont révélé aucune anomalie digestive, “ empreinte de pouce ” ou embolie gazeuse d’une veine porte. Bien que la permission ait été obtenue d’effectuer une laparotomie immédiate, l’intervention a été retardée afin de permettre une réanimation agressive, une tomodensitométrie abdominale et l’optimisation hémodynamique et acide-base.

La patiente a été admise à l’USI. Les examens de laboratoire à l’admission comprenaient une mesure du taux de lactate dans le plasma. Cet échantillon a été pris quelques minutes après l’échantillon de GSA. De façon tout à fait inattendue, le taux n’était plus que de 1,5mmol/L (comparativement à 42 mmol/L).

Deux heures plus tard, les examens de laboratoire montraient une augmentation de l’osmolarité sérique (353 mOsm/L), et un écart osmolaire (33). L’analyse d’urine a révélé la présence de cristaux d’oxalate de calcium et d’hippurate. Une mesure du niveau d’éthyléneglycol (ET) a donc été demandée, avec un résultat de 15 mmol/L, ce qui indiquait clairement un empoisonnement à l’EG. Les efforts de réanimation se sont poursuivis, avec l’ajout de
EXPERIMENTAL CONFIRMATION

To confirm the hypothesis, venous blood was phlebotomized into vacutainers® (Becton Dickinson, Singapore) containing EDTA/F- (for the Beckman® and Vitros® Analyzers), and heparin (for the i-STAT®, Bayer ABG® and ABL 700 Radiometer® Analyzers). The two blood collections were pooled separately, and samples quickly pipetted and mixed in equivalent collection tubes. These contained the required amount of glycolic acid, glyoxylic acid, oxalic acid and formic acid (Sigma-Aldrich, St. Louis, MO) in 1% of the blood sample volume to achieve the desired concentrations. All blood samples were then rapidly analyzed with these five machines. The i-STAT analyzer (Abbott Laboratories, East Windsor, NJ) was included due to its common usage and dearth of data.

The Radiometer® whole-blood gas POC analyzer showed markedly elevated lactate levels, even at concentrations as low as only 5mmol/L, whereas the iSTAT® and Bayer POC analyzers and the laboratory plasma-analyzers showed minimal elevations (≤4 mmol/L) even at 40 mmol/L glycolate. Glyoxylate also causes marked artificial lactate elevations and to a similar extent when compared to glycolate. It was also found that 20 mmol/L glyoxylate plus 20mmol/L glycolate raised the “apparent” lactate to 31 mmol/L: similar to 40 mmol/L glycolate. Given that glyoxylate may be the predominant human metabolite of EG, it’s effect upon lactate readings is at least as significant as glycolate. We also showed that oxalate (and formate: the primary metabolite of methanol) do not alter lactate readings.

Weeks later, when another patient presented with discrepant lactate readings: ER POC lactate of 25mmol/L (Radiometer 700) compared to a laboratory plasma-lactate of 2.0mmol/L (Beckman LX 20). The ICU team used knowledge of the “lac-gap” to make an immediate presumptive diagnosis of EG ingestion. This permitted initiation of ethanol-infusion and high-flux dialysis 2h before positive plasma EG was reported. Knowledge of this “lac-gap” reduced the door-to-drug time for a time-dependant therapy. Potential misdiagnosis was changed into quicker treatment by knowledge of this laboratory phenomenon.

CLINICAL INSIGHTS

Despite multiple causes, lactic acidosis is generally classified as either lactate overproduction (Type A) or inadequate breakdown (Type B). Clinicians are typically most concerned about overproduction, due to local tissue hypoxia, and potentially from ischemic-bowel. Historically, elevated lactate have been emphasized in the diagnosis of mesenteric ischemia due to a sensitivity approaching 100% [1] (and despite a low specificity of 42-87%).[1,2] Lactate levels >5 mmol/L are associated with poor prognosis in acute mesenteric ischemia.[3] Therefore, elevated lactate is central in any decision to proceed to laparotomy.
Following EG ingestion, acidosis and toxicity are primarily attributed to metabolites. EG is converted to glycolate, glyoxylate and oxalate.[4,5] These metabolites cause systemic acidosis which can contribute to MOF. This could ultimately cause lactate overproduction and inadequate breakdown, and thus elevate lactate. However, this would not explain the discrepancy between analyzers. Instead, although not widely appreciated, certain whole-blood analyzers have been reported to misinterpret glycolate for lactate.[4,6] The effect of other metabolites had not been previously studied before this experiment demonstrated that significant “artifactual” lactate elevation can occur from both glycolate and glyoxalate. In contrast to rabbits and rats, glyoxylate accumulates as the predominant EG metabolite in humans.[5] As such, our study showed that glyoxalate’s propensity to cause misdiagnosis is at least as significant as glycolate.

Most common L-lactate analyzers use L-lactate oxidase which accelerates the reaction between L-lactate and oxygen to form hydrogen peroxide ($\text{H}_2\text{O}_2$) and pyruvate. $\text{H}_2\text{O}_2$ is then used in a reaction with peroxidase to produce a chromophore that is measured to compute L-lactate concentration. Artifactual L-lactate elevation likely results from structural similarities between EG metabolites and lactate. These metabolites subsequently cross-react as substrates for L-lactate oxidase.[4] Lactate elevation has been reported in the ABL 700 Radiometer (Radiometer, Copenhagen, Denmark) ABG analyzer used in our hospital. ABL 625 (Radiometer, Copenhagen, Denmark) ABG analyzer used in our hospital for ER POC testing.[4] It has also been described with the ABL 625 (Radiometer, Copenhagen) and Chiron 865 (Chiron Diagnostics, Medfield, MA).[4] Plasma L-lactate measurements in our hospital laboratory also use L-lactate oxidase (Beckman LX 20, Beckman Coulter, Fullerton, CA, and Vitros 250 chemistry analyzer, Johnson and Johnson, NJ), but these are believed to only modestly overestimate L-lactate at very high (>13 mmol/L) glycolic acid concentrations. This explains the discrepant lactate results in our case. This is likely because its chemical structure should not cross-react with L-lactate oxidase. Enzymatic L-lactate assays can also be incorrectly elevated by some blood gas analyzers following toxic concentrations of isoniazid, acetaminophen, and thiocyanate.[7]

This case illustrates how a markedly false lactate elevation, measured by a common ER blood gas analyzer, might lead to unnecessary laparotomy in a patient who would have had significant peri-operative mortality. Delays in the diagnosis of EG ingestion could also postpone treatments such as ethanol-infusion or dialysis. Delays, or misdiagnosis, could have serious sequelae including renal failure, convulsions or death. Laparotomy was avoided in part because ICU admission meant routine admission orders that included re-measuring lactate. This fortuitously meant a different analyzer, where we showed lactate was likely overestimated by <3 mmol/L as compared to >30 mmol/L. Lactate obtained from the Bayer, iSTAT and Vitros would not likely alter clinical decisions, whereas the massive lactate elevation with the Radiometer might well. Of note, the Radiometer is a very common ER analyzer and ER POC lactate is increasingly used to triage patients. We have also provided unique data from the i-STAT analyzer, another increasingly common POC analyzer.

This case also illustrates that even with significant lactate elevation, that clinicians should remain alert to other diagnoses. Fixation errors: the tendency to assume a single diagnosis despite mounting cues suggesting otherwise, are common in medicine, and affect even experienced practitioners.[9] These risks are likely magnified with patients who may deny EG ingestion, and where denial may not be doubted given an apparent predominance of lactate.[10,11] Clues as to the possibility of EG ingestion included severe acidosis with an increased anion and osmol gap, and urinary calcium oxalate. Lactate elevations to a degree rarely seen (i.e. >30 mmol/L) should also raise diagnostic suspicions. The patient’s clinical status, while certainly severe, did not seem consistent with this massive lactate elevation. Therefore screened for other diagnoses. This reminds clinicians to beware of reliance upon any single test to make critical decisions. In addition to demonstrating limitations of the Radiometer we have also shown how a “lac-gap” can be turned into a diagnostic advantage. Other authors have suggested this phenomenon might be used as a diagnostic clue.[6,8]. In so doing, we are now able to expedite time-dependent treatment by hours.

Patients with late presentations of EG ingestion are often particularly sick due to accumulation of high metabolite concentrations. However, they are also often the toughest to confirm diagnostically because both plasma EG and an osmolar-gap can be absent due to metabolism. Diagnosis is difficult because almost all clinical laboratories measure EG not its metabolites. The “lac-gap” actually offers a surrogate test that confirms the presence of major metabolites: glyoxalate and glycolate. “Lac-gap” is therefore a useful diagnostic test, particularly in late presentations. In addition, the previous inability to measure metabolites means clinicians frequently base EG dialysis protocols upon plasma EG levels, even though metabolites cause toxicity. Alternatively, as long as a “lac-gap” exists, clinicians can be confident that metabolites still exist. The marked “lac-gap” that we have shown occurs with even low metabolite concentrations means dialysis can be stopped with confidence once it has resolved.

EG is not only found in antifreeze, but in many common products. [12] This case demonstrates that even modest ingestion of ethylene glycol-containing agents (resulting in combined glycolate and glyoxylate of 5-10 mmol/L) could produce large “apparent” lactates i.e. 10-20 mmol/L. In
other words it is very sensitive test. A review of 35 cases of EG ingestion, Porter et al.[8] showed 16 cases had glycolate >13 mmol/L. Booth et al.[5] suggest glyoxalate would be at least as high. Our experiment shows how both products would produce additive artifactual lactate elevations. Our first patient shows how a false-positive lactate might cause misdiagnosis. Our second patient has shown how this same phenomenon has been exploited towards faster diagnosis and treatment.

Finally, most clinicians are aware that laboratory errors occur, and will have a suspicious value repeated. This works well for quantitative errors. However, artifactual errors are less commonly considered and require re-testing with a different machine. Our experience illustrates both the dangers of over-reliance on a single analyzer, as well as the potential benefits from more than one machine. Our cases showed a “lac-gap” by contrasting a Radiometer POC analyzer and a Beckman laboratory analyzer. However, our experiment has shown how this “gap” can equally be diagnosed by contrasting two POC analyzers: the radiometer versus either the i-STAT or Bayer. This would mean almost immediate presumptive diagnosis, even further ahead of plasma EG. It would also maintain other potential benefits of POC: rapid diagnosis, low cost, and no need to transport samples or occupy laboratory staff. Without knowledge we might be prone to misdiagnosis with its associated morbidity and mortality. Alternatively, with knowledge, this can be a diagnostic aid. In short, we should always “Mind the Gap”.

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REFERENCES
ORIGINAL ARTICLE

BMI Percentile a Potential Tool for Predicting Pediatric Obstructive Sleep Apnea

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ABSTRACT

Many physicians are reluctant to order overnight polysomnography studies in children to definitively diagnose sleeping disorders because of a lack of expertise in the field, high cost of the examination, or inducing the anxiety of separating the child from its family. The study questioned what if any relationship existed between body mass index (BMI) percentile and pediatric obstructive sleep apnea, and if so, can BMI percentile be used as an additional screening tool (in conjunction with primary snoring) to warrant polysomnography testing. The relevance of discovering such a relationship would be the addition of a noninvasive diagnostic trigger useful to clinicians, specifically pediatricians, as a differential to the diagnosis of OSA. This trigger would add validity to ordering polysomnography testing to diagnose or rule out OSA in pediatric patients. We performed a retrospective chart review of 158 pediatric patients who were tested for OSA in a pediatric sleep laboratory in Northeast Tennessee. Of those 158 patients undergoing overnight polysomnography, 129 were found to be positive for OSA. Of the 129 positive for OSA, 117 were at the tails of the distribution for BMI and fell in the less than fifth percentile for body mass index (BMI) or greater than the ninety-fifth percentile for BMI. This study was significant using the one way Chi Square method (Alpha=.05, p=.770). The significance of these findings to clinical practice in pediatrics is that in conjunction with primary snoring, BMI percentile can predict a diagnosis of OSA. If the child’s BMI percentile is less than the 5th percentile or greater than the 95th percentile, overnight polysomnography is indicated when considering a diagnosis of OSA.

RÉSUMÉ

De nombreux médecins sont réticents à demander des études de polysomnographie chez les enfants dans le but d’obtenir un diagnostic définitif des troubles du sommeil en raison d’un manque d’expertise dans le domaine, du coût élevé de l’examen ou de la possibilité de susciter de l’anxiété chez l’enfant séparé de sa famille. L’étude se demande quel est le lien, s’il en est un, entre l’indice de masse corporel (IMC) et le syndrome d’apnées obstructives du sommeil (SAOS) pédiatrique; et si c’est le cas, si l’IMC peut être utilisé comme outil de dépistage additionnel (avec le ronflement primaire) afin de justifier le recours à la polysomnographie. La pertinence de la découverte d’un tel lien réside dans l’ajout d’un déclencheur diagnostique additionnel utile pour les clinicians, plus précisément les pédiatres, comme outil différentiel dans le diagnostic du SAOS. Le déclencheur augmenterait la validité de la demande d’un test de polysomnographie pour un diagnostic positif ou négatif de SAOS. Nous avons effectué une étude rétrospective des dossiers de 158 patients pédiatres ayant fait l’objet de tests visant à détecter la présence du SAOS dans un laboratoire du sommeil dans le nord-est du Tennessee. Parmi les 158 patients ayant été soumis à la polysomnographie, 129 ont obtenu un résultat positif de SAOS. Parmi ces 129 patients, 117 se trouvaient dans les franges de distribution pour l’IMC (inférieur au cinquième centile ou supérieur au 95e centile) pour l’indice de masse corporelle (IMC). Les résultats de l’étude sont significatifs selon la méthode du chi carré unidirectionnel (Alpha=0,05, p=0,770). L’importance de ces conclusions pour la pratique clinique en pédiatrie tient au fait qu’en conjonction avec le ronflement primaire, l’IMC de l’enfant pourrait permettre de prédire le SAOS. Si l’IMC de l’enfant se situe sous le cinquième centile ou au-dessus du 95e centile, la polysomnographie est indiquée dans l’évaluation d’un diagnostic de SAOS.
INTRODUCTION

Obstructive sleep apnea is a condition characterized by 5 or more periods of apnea (cessation of breathing) lasting at least 10 seconds each occurring per hour of sleep caused by an occlusion of the oropharyngeal airway with continued efforts to breathe. When most characterize a patient with OSA the stereotypical depiction is an overweight adult patient, generally male. While the general public's stereotypical perception of someone suffering from OSA is that of someone similar to a Pickwickian patient who is morbidly obese with a large neck circumference, the disease is not just limited to the adult population. Patients of all ages are susceptible to obstructive sleep apnea.

Pediatric OSA

Pediatric obstructive sleep apnea was first described by Guillenmault in 1976 after he studied a large group of children that snored and had frequent awakenings throughout the night. The prevalence of OSA in the pediatric population is estimated to be up to 2% (Ali, Pittson, & Stradling, 1993).

Research has clearly demonstrated the increased risks associated with pediatric OSA. Children with OSA have been shown to have an increased risk for developing systemic hypertension as well as right ventricular dysfunction due to elevated pulmonary arterial pressure. Children with OSA also have a higher risk of failure to thrive and impairment of growth development. Research suggests that growth hormone secretion is impaired, thus retarding growth (Nieminen, Lopponen, & Tolonen, 2002).

Students that have multiple arousals throughout the night due to OSA have a hard time reaching Slow Wave Sleep (SWS). It is believed that SWS sleep is essential for the body to repair itself and produce essential hormones (cortisol and human growth hormone). Children that are SWS sleep deprived are at very high risk for diabetes and/or failure to thrive (Nieminen, Lopponen, & Tolonen, 2002).

The most extensive evidence on the impairment of sleep in children exhibited as neurocognitive and behavioral consequences. Although the hallmark of (EDS) excessive daytime sleepiness seen in adults does not seem to be the major symptom in children, behavior problems including hyperactivity, inattention, aggression, sleepwalking, and night terrors, as well as impaired learning function and diminished academic performance, are the common symptoms (Stein, Mendelsohn, Obermyer, Amromin, & Benca, 2001).

Studies have demonstrated that the airway is smaller in children with OSA (Arens, McDonough, & Corbin, 2003). The adenoids and tonsils are larger and the airway is most restricted where the adenoids and tonsils overlap. The soft palate is also larger in children with OSA, thus adding further restriction. In addition, it is important to appreciate that many children with OSA have dentofacial abnormalities such as maxillomandibular constriction, maxillomandibular deficieny, and long face syndrome (Zucconi, Caprioglio, & Calori, 1999). The smaller airway found in children with OSA may possibly result from these skeletal deficiencies. Anytime the lumen size of the airway is decreased in any patient it increases (RAW) airway resistance as air flow turns from laminar under low resistance to turbulent in the face of increasing resistance.

Treat Pediatr OSA

While medical treatment, such as Continuous Positive Airway Pressure (CPAP), can be successful in treating pediatric OSA and nasal steroid sprays can be effective in reducing the severity of OSA in children with allergic rhinitis, most investigators would agree that these approaches are not the ideal long-term treatments for pediatric OSA. Today, surgery remains the first-line treatment, with adenotonsillectomy (T&A) the most commonly performed surgical procedure for the treatment of pediatric OSA. The rationale for the procedure as a treatment of OSA is simple: the removal of tissues in the airway lumen relieves obstruction and improves airflow. In addition, it restores airflow from turbulent to more laminar thus decreasing the patient's work when breathing. Following T&A, the upper airway stability is improved due to reduction of collapsibility as measured by critical nasal pressure (Li, 2006).

There is extensive evidence validating the improvement of OSA after T&A. This surgery results in significant increase in patient's quality of life based on validated questionnaires measuring sleep disturbance, physical symptoms, emotional symptoms, hyperactivity, and daytime functioning (Flanary, 2003). While Flanary’s results showed that for children, who had T&A surgery, pulmonary hypertension was normalized based upon echocardiography assessment, Miman, Kirazli, & Ozyurek, (2000), study concluded that school performance was improved, and health care utilization was reduced.

Resolution of abnormal sleep parameters, including respiratory disturbance index, oxygen saturation and arousal index, has been demonstrated by polysomnogram. Most of the complications arising from OSA are highly reversible. Unfortunately thousands of children go undiagnosed and no course of action is implemented.

Research Question Relevance and Feasibility

Pediatric sleep apnea is a very serious condition that can lead to a multitude of problems for the patient if untreated. Most pediatric OSA patients can be cured with adenotonsillectomy. However, pediatric sleep apnea goes largely undiagnosed for many reasons. Many pediatricians and family practitioners lack the expertise or experience to accurately diagnose sleep abnormalities in this population.
While the gold standard and definitive way to diagnose OSA is the overnight polysomnogram, practitioners have very few indicators or tools that increase suspicions for OSA outside of the subjective statements of the parents and children.

Many pediatricians who track snoring in their patients are hesitant to order a sleep study because of the complexity, inconvenience, and cost of the test strictly based on poor reported sleep and snoring. If health professionals had an objective indicator that would lead them to suspect OSA other than subjective indicators such as snoring or behavioral problems practitioners would be more likely to order overnight polysomnography studies. This change in diagnostic practice would lead to more children being accurately diagnosed and treated for OSA.

This following question guided this study: is there a relationship between (BMI) body mass index and pediatric obstructive sleep apnea and if so can BMI be used as an additional screening tool (in conjunction with snoring) to indicate the need for polysomnography testing. The relevance of discovering such causality would be the addition of a noninvasive diagnostic trigger that practitioners would have available that would lead them to suspect OSA in pediatric patients. This trigger would add validity to ordering polysomnography testing to diagnose or rule out OSA.

**REVIEW OF LITERATURE**

One of the biggest problems associated with pediatric OSA is that it goes undetected in a large number of children. Unfortunately, the problem is hard to address because of the complexity of diagnosing the condition and lack of knowledge regarding pediatric sleep disorders among many pediatricians

While the only definitive diagnostic test for OSA is the overnight polysomnography study, it is often difficult for a child to sleep in a foreign environment with a plethora of probes and leads attached to them. The cost of the procedure also is a potential barrier preventing some patients from receiving the proper diagnostic test. However, the primary reason for lack of focus on OSA in infants and children is the low level of awareness in the medical community. Results of a survey by Owens (2001) of 626 pediatricians in Rhode Island, Massachusetts, and Connecticut suggested a lack of basic knowledge about pediatric sleep disorders and an inability to incorporate such knowledge into clinical practice. The survey also indicated that only a fourth of the respondents routinely screened toddlers and school age children for snoring (a sign of OSA when a patient is sleeping in any position besides flat on their back).

A history of poor weight gain can often be elicited in young children with chronic upper airway obstruction resulting from adenotonsillar hypertrophy. A study of 41 children under the age of 3 years of age who underwent a T&A and were monitored for changes in weight and height resulted in 37 of the patients being followed long-term. Many of these patients had dramatic improvement in growth post T&A. At the time of surgery 19 of the 41 (46%) patients were of the fifth percentile or lower for age corrected weight. After surgery, 28 children (75%) showed a change to a higher percentile to weight. Twenty-four of the children (65%) had an increase of at least 15% or more post T&A. The study concluded that a relationship exists between improved growth rate and having a T&A.

The rapid improvement in growth rate was most prominent in children with primary adenotonsillar hypertrophy. The study further concluded that adenotonsillar hypertrophy should be suspected as a possible cause during the workup for children with suboptimum growth (Williams, Woo, Miller, & Kellman, 1991).

The clinical features of two children studied by Everett (1987) in a Philadelphia pediatric clinic who presented with failure to thrive and obstructive sleep apnea are noteworthy. Both patients had subnormal growth patterns for height and weight for months prior to OSA diagnosis. The patients both presented with low body weights for their height. Corrective surgery in the form of a T&A resulted in the immediate weight gain and catch up growth spurting. Normal body weight for height was soon achieved and maintained by both patients. The study concluded that OSA should be considered in the differential diagnosis for failure to thrive children (Everett, Koch, & Saulsbury, 1987).

A study conducted at Churchill Hospital in Oxford, UK among 61 snoring children selected for T&A due to OSA concluded that the symptoms were totally reversed after the T&A. The studies were repeated with six months postoperatively using overnight pulse-oximetry and sleep efficiency questionnaires. Preoperatively, 61% of the children had degrees of sleep hypoxemia above normal and 65% had abnormally disturbed sleep. Postoperatively the hypoxemia was resolved in all cases and via a questionnaire completed by the parents sleep disturbances were alleviated in all of the children. A growth spurt also occurred in most of the children studied that came in with low BMI. Most of the children however that required the intervention had a high BMI indicative of moderate to severe obesity (Stradling, Thomas, Warlwy, Williams, & Freeland, 1990).

A study conducted at Ataturk University in Erzurum, Turkey found that poor growth in children and adenotonsillar hypertrophy may have an association, but the pathophysiological mechanism is unclear. The study included 29 pre-pubertal children with obstructive adenotonsillar hypertrophy, and aimed to investigate the probable difference in energy intake and serum insulin-like growth hormone levels.
factor 1 (IGF-1) and insulin-like growth factor binding protein 3 (IGFBP-3) levels before and 6 months after T&A”. Weight and height standard deviation scores were found to be significantly higher after surgery. IGF-1 levels and energy intake per kilogram were found to be higher as well. The study suggested that adenotonsillar hypertrophy is associated with poor growth development (Selimoglu, Selimoglu, & Orbak, 2003).

A study conducted ay Boston Children’s Hospital Brietzke, 2004 using an evidence-based technique, systematically reviewed the literature to evaluate the accuracy of routine clinical history and physical examination in the diagnosis of obstructive sleep apnea/hypopnea syndrome (OSAHS) in the pediatric patient. The biomedical literature was systematically reviewed. Articles comparing the results of clinical evaluation to polysomnography (PSG) were selected. The level of evidence was assessed using established evidence-based medicine (EBM) guidelines. Twelve articles were identified using the search criteria. Eleven of 12 articles concluded that clinical evaluation is inaccurate in the diagnosis of OSAHS. Clinical history and physical examination are not reliable for diagnosing OSAHS compared with overnight PSG. Complicating the interpretation of this work is the lack of a validated PSG threshold of clinically significant disease. There is an urgent need for the development of adequate screening tests with validated clinical outcomes (Brietzke, Katz, & Roberson, 2004).

**METHODOLOGY**

The design was a case control study of 200 children between 2 and 13 years of age that had a polysomnography study conducted. Data were collected by the researchers as they performed a retrospective review of the children’s medical records. The children were all Caucasian and resided in Northeast Tennessee. All children were evaluated by a pediatric pulmonologist as outpatients and ordered to receive an overnight polysomnography. The results of the polysomnography, as well as, the patient’s vital signs, history, and chart were readily available for the researchers involved in the study.

**Limitations of the Study**

The study was limited to patients in Northeast Tennessee. Because all of the children positive for OSA using polysomnography during the study were included in the sample there was no need to develop procedures for randomization. While the following categories of OSA are widely recognized:

- normal (having an apnea/hypopnea index of less than five per hour),
- mild apnea/hypopnea (index of five-ten per hour),
- moderate (eleven-fifteen per hour), and
- severe (over fifteen per hour)

a diagnosis of sleep apnea was defined as some level of OSA via a polysomnogram. There is limited ethnic diversity in the general population of Northeast Tennessee therefore no minority children presented for polysomnography and the study’s data was limited to Caucasian children. Additionally the study’s participants were between the ages of 2 -17 years. The gender of the study’s participants consisted of 108 boys and 92 girls. Despite the fact that this was a case control study with potential biases the study’s findings could lead to other investigations with stronger empirical evidence such as a cohort study or randomized clinical trial.

**Demographics of the Study’s Sample**

While the population of pediatric patients under study was 200, only 158 of the children were diagnosed with sleep apnea. These 158 children were the study’s sample, and were between the ages of 2 and 13 years. With no minority patients in the study’s population, the participants in the sample were 100% Caucasian in ethnicity.

**Variables**

The dependent variable in this study is the diagnosis of pediatric sleep apnea. The independent variable was BMI percentile. BMI was operationalized in the following manner: BMI percentile taken from the Centers for Disease Control BMI less than the fifth percentile were considered underweight, BMI in the fifth percentile to less than the eighty-fifth percentile are considered to be of normal weight, children with a BMI percentile in the eighty-fifth percentile, but less than the ninety-fifth percentile are considered at risk for obesity, and those that are greater than the ninety-fifth percentile are considered morbidly obese.

**Findings**

Data were entered into SPSS Version 15.0 and a one way Chi-square was performed. The study found that 117 out of 129 of the patient from the sample were less than the fifth percentile or greater than the ninety-fifth percentile for BMI. This is statistically significant using the one way Chi Square method. The convenience sample demonstrated that BMI percentile could be used as an additional tool to predict pediatric OSA.
One Way Chi Square

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Test Statistics

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DISCUSSION

Validated clinical studies have shown positive correlations between sleep apnea and obesity, as well as, sleep apnea and failure to thrive in pediatric populations. This study established the predictive power of the 5th and 95th BMI percentiles as diagnostic triggers indicating a high probability of an abnormal polysomnography. In essence if a child’s BMI is below the 5th or above the 95th, based on our study there is a 90% probability that the child will have an abnormal polysomnography. The predictive power of 5 and 95, is 90%.

REFERENCES


An allegation of negligence or wrongful act to a respiratory therapist (RT) who is not adequately insured can be a financially devastating experience. Even a frivolous accusation can result in crippling defense costs that no individual should have to bear. The sponsored insurance program of the Canadian Society of Respiratory Therapists was established precisely to protect RT’s in such circumstances by providing coverage tailored to members and that follows them through a variety of practice settings.

The comprehensive group-insurance program is a membership benefit designed to meet the needs of any RT while providing professional services to protect individual day-to-day risk exposures. While ensuring adequate risk transfer protection via professional liability insurance is a prudent course of action, it is also important to consider issues surrounding scope of practice, documentation, and risk management as RT’s deliver health care services.

**SCOPE OF PRACTICE**

Accepting responsibilities beyond the scope of your license or can have serious consequences for you, your patients, and your career.

Respiratory therapists should always refuse assignments outside of the legal scope of practice as defined by the applicable provincial regulatory body. If a RT were to accept responsibilities that are reserved for other professionals, he or she may be charged with practicing without a license. The professional liability insurance may not cover members for penalties resulting from actions beyond ones scope of practice that harmed a patient.

In addition, a patient who has been harmed or injured at the alleged negligence of an RT, may put forth a complaint to a regulatory body or even take formal legal action against a respiratory therapist if the therapist was performing tasks within the scope of practice.

It is a prudent best practice to always advise the assigning respiratory therapist when a member is not current on a specific skill needed and if one feels unsafe to provide certain care. Attempting to perform treatments or use equipment without the knowledge and training required can have negative implications to a potential loss where the professional is deemed to be held negligent for any damage or injury.

**DOCUMENTATION**

A malpractice judgment can seriously harm your personal and professional life. Your file documentation can be the only thing between your word and that of a patient who may be filing a complaint or formal legal action. Often your documentation may be the sole item of evidence in a case. Proper documentation is a key element in adverse legal action. Legally credible documentation involves and accurate record of the care your client received and your competence in providing appropriate respiratory therapy services. The file notes should be accurate, honest and appropriate.

Here are some common ensure steps to take to ensure proper documentation.

- Document accurately, be sure to note the time and date.
- Avoid any exaggeration
- Remember that file documentation may be subject to a subpoena.
- Never alter client records.

**RISK MANAGEMENT**

In addition to traditional transferable risks, such as those covered by professional-liability insurance, it is important for a respiratory therapist to also to explore any methods that minimize other risk exposures.
To start the risk-management process, RT’s should view the daily practice settings from a macro and micro perspective and outline any potential day-to-day operational risks by asking and answering questions such as the following:

- What potential scenarios could have a negative impact on my reputation as a professional?
- What can I do to minimize or control these risks?
- Is all my work conducted within my regulatory guidelines and scope of practice?
- Am I following the best possible documentation standards, such as protecting client or proprietary information, and separating and duplicating valuable records?

Members participating within the CSRT medical malpractice insurance program should take a moment to review the specific coverage’s provided through this dedicated comprehensive insurance policy.

A highlight sheet describing coverage elements along with a claims advisory stating necessary actions to take in the event of a potential loss can be found at [http://www.csrt.com/en/professional/liability_insurance.asp](http://www.csrt.com/en/professional/liability_insurance.asp)

This article is written in conjunction with content from Aon’s HSPO and NSO 2009-2010 Risk Advisor.

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**NON-INVASIVE VENTILATION IN ALI/ARDS – DIRECTED READING ARTICLE ANSWERS**

1) B. PaO$_2$/FiO$_2$ < 250 mmHg
2) E. All of them
3) A. No improvement in arterial pH after 1 hour of NRS institution
   B. Poor patients cooperation
4) F. All of them
5) A. High
6) C. Poor
7) A. nCPAP is equivalent to nPPV
8) D. It is a first line treatment when indicated and no contraindication are present
9) C. Moderate in ALI/ARDS and in community acquired pneumonia
10) D. Preventing atelectasis and increasing functional residual capacity
11) D. All of them
12) D. All of them
13) D. All of them
14) D. Better respiratory muscles unloading
15) C. In children is associated with less need of sedation in children and prolonged NRS application time respect to the mask
16) B. An air oxygen blender, flow meter, PEEP valve, alarm system on pressure and FiO$_2$
17) D. All of them
18) A. Prolonged use of nasal cannulae leads to nasal bleeding and nares obstruction
19) D. All of them
20) A. Is mandatory to set the sensitivity of inspiratory and expiratory trigger
21) A. Heat and moisture exchangers and heated humidifiers provided adequate airway conditioning
22) E. All of them
23) A. Low improvement in paO2 level 1 h after starting nPPV
24) A. nPPV could improve oxygenation and reduce intubation rate
25) A. nPPV could reduce intubation rate
Say “YES” to Evidence Based Respiratory Therapy Practice

Mika L. Nonoyama RRT, PhD
Post Doctoral Fellow, Toronto Rehabilitation Institute

You are approached by a respirology resident who asks you what is the most effective puffer to help his patient with chronic obstructive pulmonary disease (COPD) relieve her shortness of breath. A certain degree of foreboding sets in. Several answers swirl in your head, all of which come from various places – the pharmacology course you took from school, the last journal club you attended, a recent in-service, an abstract posted on the board, your experience at your shift last week etc. What do you say to this resident? Do you say “the blue one” and make a run for it? No doubt that idea pops in your head, but fortunately you are an excellent respiratory therapist (RT) and you go forward to help answer his question. How do you go about doing this?

Evidence based clinical practice (EBCP) has been around for centuries, but its explicit methodologies started taking shape in the 20th century with the help of Dr. Archie Cochrane, Dr. David Sackett and Dr. Gordon Guyatt.(1) There are several definitions of EBCP, the most common by David Sackett and colleagues: “the integration of best research evidence with clinical expertise and patient values and circumstances”.(2) This is a nice definition because it points out that EBCP is more than just what is in literature or within the revered randomized controlled trial (RCT). Our clinical expertise and what patients bring to the table are equally as important. One challenge of EBCP is the literature “mountain” that accompanies every clinical scenario we encounter. EBCP provides a systematic approach to finding the best answers to our clinical questions. I hope this column will give you a better understanding of EBCP, providing a starting point for its use in your own clinical practice.

In an editorial, Haynes and colleagues (3) used Sackett’s definition of EBCP to develop a model for evidence based clinical decision making. Four elements are contained in this model:
1) clinical state and circumstances;
2) patient preferences and actions;
3) research evidence and;
4) clinical expertise.
Clinical expertise must encompass and balance all three elements in order for a successful and satisfying result to occur.(3)

Clinical state and circumstances can include: the clinical setting e.g. remote area vs. tertiary care medical centre; the patients’ clinical state; the clinical circumstances; etc.(3) For example, a patient with COPD who complains of dyspnea after climbing several flights of stairs would likely benefit from using a short acting beta-agonist (SABA) on an as needed basis (prn). A patient who becomes dyspneic after walking 25 metres and suffers from frequent exacerbations would benefit from daily use of a combination long acting anti-cholinergic (LAAC) and inhaled corticosteroid (ICS) along with a SABA prn.(4) In both cases the efficacy of the treatment can be modified by adequate follow-up e.g. ensuring these patients are technically and symptomatically using the puffers properly.

Patients’ preferences and actions can include: personal values and experiences; the degree of aversion to risk; healthcare insurance and resources; family input; willingness to take medicines; accurate or misleading information at hand; etc.(3) For example the preferences of patients for ICS medication will depend on the competing side effects of hoarse voice and/or oral candidiasis (4) and the potential cost (especially if they do not have monetary coverage). In addition, the preferences of us as RTs may be quite different than our patient. We may be hesitant to suggest ICS because of the competing risks but the patient may be willing to tolerate the adverse effects and costs in order to relieve his/her shortness of breath.

Research evidence can include: systematic observations from the laboratory; preliminary pathophysiological studies in humans; advanced applied clinical research, e.g. RCTs with outcomes immediately important to patients; etc.(3) The challenge with research evidence is knowing where to look for the information and then figuring out whether it is the most rigorous and if it is applicable toward the specific clinical scenario.(3) In addition there are often alternate therapies each with their own benefit and risk profiles.(3) For example a patient who has dyspnea after walking 50 to 75 metres on a level surface with a remote history of exacerbations may be prescribed either a long acting beta-agonist (LABA) or a LAAC.(4) A couple of studies (RCTs) in patients with COPD have shown the LAAC Tiotropium significantly improved forced expiratory
volume (FEV1) compared to the LABAs Salmeterol (5) or Formoterol (6), but the magnitude was small (Tiotropium improved FEV1 by an average range of 80 to 127mL). For this patient the decision may depend on the side effects, convenience and/or cost of the medication.

Finally our RT clinical expertise plays an important role in EBCP. This includes general basic skills from our schooling and our experience as an individual practitioner.(3) Clinical expertise must encompass and balance all three elements in order for us to find the best answer for our patient. We must be atop research evidence, acquire and hone the skills needed to both interpret the evidence and apply it appropriately to the circumstances and determine what the patient wants.(3) All of us as RTs have the skills to do this.

At this point you may be thinking that EBCP is too complicated and time consuming to fit into daily clinical practice. It is true that it takes time to become comfortable with the process. However you don’t have to be expert in all aspects of EBCP at the get-go. A departmental journal to jot down interesting clinical questions and a once-a-month journal club to help answer those questions is a good start. We all as RTs must be actively involved in lifelong learning. What better way than incorporating clinical circumstances, patient values, the best research evidence and our clinical expertise?

Fortunately there are resources to help. This ranges from single articles to help us search the literature (7), all the way to detailed textbooks (8). In addition several EBCP groups around the world have developed online resources to make the process less daunting. The Clarity Research Group at McMaster University provided annual workshops on how to teach EBCP (www.clarityresearch.ca). The Centre for Evidence Based Medicine at Oxford University offers presentations, documents and other handy tools (www.cebm.net). The University of Alberta created a “toolkit” (www.ebm.med.ualberta.ca) for EBCP that includes a concise and easy to follow “mini-manual” (9). This mini-manual provides a step-by-step guide – all within 24 pages and open access:

- Analyze the clinical situation.
- Ask a focused clinical question
- Access the clinical research literature
  (i.e., the evidence)
- Appraise the best evidence you have found
- Apply the evidence to care of your patient
- Assess the effectiveness of care based on this evidence

And the list goes on…

Based on this brief description of EBCP you may have a better idea how to answer that respirology resident who approached you about his COPD patients. The details on formulating a specific answer go beyond the scope of this commentary however I hope it plants the EBCP seed and allows for further RT specific growth in the area. Our peer professions such as medicine, nursing, physical therapy, occupational therapy, and speech pathology have already created a niche in the area of EBCP. Let’s do it too!

REFERENCES
CASE STUDY

The Use of Transpulmonary Pressure to set Optimal Positive End-expiratory Pressure: A Case Report

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ABSTRACT
The airway pressure generated by the mechanical ventilator does not distinguish the pressure generated within the lung from that which may be present outside of the lung. True lung pressure is transpulmonary pressure, which represents the actual movement of the lung (airway pressure – pleural pressure = transpulmonary pressure). Theoretically, if the pressure outside of the lung at end-exhalation was higher than the Positive End-expiratory Pressure (PEEP) set on the ventilator, the result would be atelectasis, and with subsequent breaths would place the patient at high risk of atelectrauma. This case is an example of how estimating transpulmonary pressure can assist the clinician to optimally set PEEP in a mechanically ventilated patient.

INTRODUCTION
Strategies to prevent atelectrauma, volutrauma, and barotrauma during mechanical ventilation are important in limiting ventilator induced lung injury (VILI). Positive End-expiratory Pressure (PEEP) is a setting of mechanical ventilation used to keep the lungs open and prevent atelectrauma. A current method for managing patients with poor oxygenation is to use high levels of PEEP. However, two large randomized controlled trials compared a low and high PEEP/FiO₂ protocol to guide changes in PEEP and/or FiO₂ in response to oxygenation. These studies failed to show an improvement in clinical outcomes such as mortality. The limitation of setting PEEP using a chart or protocol is that it ignores the individual lung mechanics of the patient and therefore is not optimal. The generalized approach to setting PEEP in these studies may be the reason why the results were not significant in supporting the use of high PEEP. The level (low or high) of PEEP may not be as important as the appropriateness of PEEP, and a limitation of mechanical ventilators is they fail to represent the effect of pleural pressure on the measured airway pressure (Figure 1). The difference between airway pressure and pleural pressure is called transpulmonary pressure (Ptp), and it is normally positive in healthy patients. This can drastically change when a patient in respiratory failure requires sedation and positive pressure ventilation. PEEP that is set optimally should maintain a neutral Ptp (0-3 cm H₂O). A current method used to estimate pleural pressure, calculate Ptp, and set optimal PEEP, is the esophageal balloon catheter.

TRANSPULMONARY PRESSURE AND ESOPHAGEAL BALLOON CATHETERS IN CURRENT LITERATURE
Although the ARDSNet recommendation is to limit plateau pressures to ≤ 30 cm H₂O, an interesting finding with the Lung Open Ventilation Study (LOVS) was that allowing higher PEEP levels and subsequent higher plateau pressures did not increase mortality, or the incidence of barotrauma. The reason for this may be that lung recruitment, lung stretch and strain, and atelectasis are not easily assessed by airway pressure measurements on a mechanical ventilator. The most important pressure to understand what is happening to a lung is the Ptp (alveolar pressure - pleural pressure = Ptp). The least invasive method of measuring pleural pressure is to estimate it with an esophageal balloon. Chiumello et al. studied lung stress and strain using esophageal pressure (Pes) measurements at different
PEEP levels, tidal volume, and plateau pressures. They concluded that plateau pressures and tidal volume are inadequate surrogates for lung stress and strain. In their study, what seemed to be the most important factor affecting lung stress and strain is the change in pleural pressure from rest to end-inspiration (PPL). What may also be of great importance in determining lung stress and strain, as pointed out by Behazin et al., is the additional strain that may be imposed on the lung if the resting state of the lung is at a negative Ptp. A recent clinical trial compared the ARDSNet ventilation protocol to a protocol using 6mls/kg for Vt and Ptp calculated using an esophageal balloon to set PEEP. The primary endpoint of the study was PaO2/FiO2, which after 72 hours was significantly higher in the esophageal balloon group. The level of PEEP at 72 hours was, on average, higher in the esophageal balloon group, as was respiratory system compliance, something that most would suspect to be lower if PEEP was set high (theory of over-distention). The study was designed to enroll 200 patients but was terminated after 61 patients because the predetermined stopping criteria were met. The stopping criteria was the critical significance level of p <0.02 for the difference in PaO2/FiO2 between the two groups. Although the 28-day mortality was not a primary endpoint it was lower in the esophageal balloon group. However, the difference was not significant.

CASE
A 61 yr old female was admitted to the Intensive Care Unit (ICU) from the Emergency Department with a diagnosis of pulmonary sepsis. The patient was hypotensive on admission and required norepinephrine to maintain a stable blood pressure. Her initial PaO2/FiO2 ratio was 143 and Oxygenation Index (OI) was 11. The PEEP level was set to 10 cm H2O and was not increased beyond this level because of hypotension. Over the next 13 hours the patient's FiO2 requirements increased to 0.75 to maintain SpO2 > 90%. We inserted an esophageal balloon using the technique previously described (Figure 2). The Pes and Ptp were monitored using the Avea ventilator (Carefusion, Yorba Linda CA), which has integrated esophageal monitoring technology (Bicore Monitoring Systems, Inc., Irvine, CA). An end-expiratory hold was done on the ventilator to assess Ptp. The resulting Ptp at end-exhalation was – 18 cmH2O (Figure 1), this would imply that the PEEP necessary to prevent atelectasis in the patient was 28 cm H2O. The mean arterial pressure (MAP) prior to increasing PEEP was 62 mm Hg, the PEEP was increased to 28 cm H2O and contrary to expectations the MAP increased to 74 mm Hg immediately. Arterial blood gases were drawn over the next 24 hours and showed a gradual increase in oxygenation. Within 24 hours the FiO2 had been weaned to 0.40 with a PaO2/FiO2 ratio of 345. The PEEP had subsequently been weaned according to Ptp and was by then set at 25 cm H2O (Figure 3). At 48 hours the FiO2 was 0.30 and PEEP was further weaned to 22 cm H2O. The PaO2/FiO2 ratio was 456 with an OI of 6. The patient was switched to pressure support ventilation the next day (day 3 of ICU) with a PEEP of 16 cm H2O and a PaO2/FiO2 ratio maintained at 453, OI had further decreased to 4. Esophageal measurements become complex to estimate Ptp when a patient is breathing spontaneously, so PEEP was no longer guided by Ptp. When the patient was spontaneously breathing PEEP was weaned slowly and oxygenation monitored for response. Once the patient was weaned from vasopressors the next concern was her fluid overload secondary to aggressive resuscitation. The main focus at that point switched to diuresis to remove excess fluid. For a few days the PEEP could not be weaned less than 14 cm H2O without causing a decrease in oxygenation. The response to a fall in oxygenation was to increase PEEP, not FiO2. The patient was extubated from a PEEP of 6 cm H2O on the 12th day of ICU with no further complications. It was speculated that the positive fluid balance was the cause of prolonged mechanical ventilation. Although pulmonary sepsis was her primary diagnosis, pulmonary involvement was ruled out.

DISCUSSION
The case was an example of how our understanding of PEEP and it’s potential harm is limited by the ventilators inability to distinguish airway pressure from Ptp, the latter being true lung pressure. Limiting the PEEP in this patient was a commonly used strategy to avoid further hemodynamic instability in a patient who is hypotensive. The assumption is that elevating PEEP will cause worsening hypotension. However, this assumption is usually accurate if the Ptp at end-exhalation is excessive. With a PEEP of 10 cmH2O this patient had a Ptp of - 18 cmH2O at end-exhalation. This would ultimately result in atelectasis, and an increased risk of VILI.

The use of optimal PEEP is important in preventing atelectrauma in critically ill and sedated patients who are unable to generate negative intrathoracic pressure to assist with lung opening and stabilization of alveoli. It is also important to use optimal PEEP with a lung recruitment strategy so that the appropriate PEEP is applied after lung opening. A proper recruitment and subsequent setting of optimal PEEP will theoretically keep the patient ventilated in the most important phase of the pressure volume curve; the expiratory phase. There are several considerations before using the esophageal balloon to guide optimal PEEP during mechanical ventilation. Talmor and Fessler discussed these concerns...
Some of these concerns include the lack of clinical data for use in patients with ARDS/ALI, and measurement errors. Measurement can be affected by the position of the patient. A patient will have a higher Pes when supine due to the weight of the mediastinum. The recommended compensation for positional artifact (when a patient is supine) is to add 3 cm H$_2$O to your Ptp (or simply subtract 3 cm H$_2$O from the Pes before calculating Ptp)$^{14}$. Others have compensated by +5 cm H$_2$O$^{7,13}$. The limitation of Pes monitoring, as well as other methods to determine optimal PEEP, is that once the patient is making spontaneous efforts the readings are difficult to obtain because the patient’s ability to alter intrathoracic pressure. Once the patient is making spontaneous efforts a slow weaning of PEEP should take place by decreasing PEEP by 2 cm H$_2$O every 6-8 hours and monitoring changes in oxygenation and lung compliance. If the patient’s oxygenation falls within a few hours of weaning PEEP an increase in PEEP should be used rather than an increase in FiO$_2$.

OTHER METHODS OF SETTING OPTIMAL PEEP

The estimation of Ptp is not the only way to optimize PEEP. There are two other methods worth mentioning, one is the decremental PEEP titration, and the other is the stress index.

The decremental PEEP titration is a simple yet time consuming strategy for setting optimal PEEP. It involves a lung recruitment maneuver immediately followed by setting the PEEP higher than what would be expected as necessary, then slowly decreasing PEEP and monitoring dynamic compliance for changes. It is recommended to keep safe consistent tidal volumes during this decremental titration. A volume control mode is used (6 mls/kg of ideal body weight) and the respiratory rate and flow is set to achieve an iT ime of approximately 1.0 second. Rapid inspired flows should be avoided in order to minimize resistance. PEEP is dropped by 1-2 cm H$_2$O, starting from a PEEP of 20-25 cm H$_2$O. Each PEEP titration is maintained until alveoli are stabilized, which could take 2-5 minutes. Dynamic compliance is monitored at each step and the PEEP is continually dropped to the next step until you notice the dynamic compliance decreasing. The point at which the dynamic compliance reached its highest is considered the optimal compliance PEEP. However, the best oxygenation has been shown to occur at 2 cm H$_2$O above the level of best compliance$^{10,12}$. For this reason, after a decremental trial PEEP should be set 2 cm H$_2$O above the point at which best compliance was reached. As mentioned earlier, this procedure and any other optimal PEEP procedure requires the patient to be apneic.

The stress index is a complicated mathematical equation that results in a number of approximately 1$^{16,17}$. The resulting number seems to correlate with a visual finding on a ventilator pressure curve while a patient is receiving volume control ventilation. A stress index of <1 would produce a concave curve in the rising pressure waveform and would imply insufficient PEEP. A stress index of >1 would produce a concave pressure curve and would imply excessive PEEP. A stress index equal to 1 is the target; this would produce a straight pressure curve$^{17}$. The visual representation is easy enough to assess, but may be rather subjective depending on the clarity and scalability of the pressure waveform.

SUMMARY

Airway pressure readings from a mechanical ventilator fail to take into account the pressure that may or may not be present outside of the lung. This can affect the appropriateness of the PEEP level used to manage critically ill patients. A current method for estimating pleural pressure and calculating Ptp is the esophageal balloon. Utilization of this method to set optimal PEEP should be considered when managing patients with hypoxemic respiratory failure.
REFERENCES


BOOK REVIEW

“When I Nod I Mean “NO!”
by Gaynor D. Govias”

Ana MacPherson, RRT, CRE, MASc
Provincial Coordinator, PCAP, Ontario
Asthma Plan of Action

This book focuses on behavioural guidelines and cultural tips for health professionals working with people from other cultures. The readership is written for healthcare professionals as well as any public service worker. The author hopes to provide these professionals with basic knowledge and understanding of their patients’ or clients’ culture and religion, and to encourage them to think about the way they use the English language. The author openly states that this guide is intended to be used as a general, quick-reference source of information. It is a reminder that each person we meet should be treated as unique because there is no such thing as a typical person!

As a healthcare professional for more than 20 years, I have lived and worked in Toronto and Mississauga have populations of which about 47% and 49% (respectively) are visible minorities. As one of those visible minorities, it was very helpful for me to have the same cultural background as some of the patients that I came in contact with from other countries. I was very fortunate to have grown up in a country that is culturally sensitive to its residents. Equally interesting was that as a young child immigrating to a land of opportunities, I had to learn about the culture, religion and government of the country I was immigrating to. Assimilation would have brought on an easy fix with the cultural diversity, but fortunately, Canada’s Charter of Human Rights recognizes people with diverse backgrounds and respects the culture and religion you practise.

I highly recommend this book as a general guide to be used to complement previous or other resources in learning about other cultures. It is a great little book of “quick-reference” for healthcare professionals who work with a diverse patient population in Canada.

I appreciate the way the guide is organized. The book is logically mapped out, which makes it very user friendly.

Section 1 General guidelines of dealing with people from other cultures
Section 2 Culture, beliefs and practices in different countries
Section 3 Major world religions
Section 4 Major religious, national and cultural holidays
Section 5 Brief descriptions of some complementary medicines and medical therapies
Section 6 Glossary and Index

The general recommendations are just that. We know for a fact that each person patient is unique. The cultural background will be the predisposing factor that will influence health beliefs and understanding. Use the guide as a general quick-reference. For further in-depth answers, further research is necessary as suggested by the author. I find this book helpful, but would make no prejudgement until I have spent time with the patient to comprehend their health beliefs. Time spent with the patient will provide us with the basic knowledge of cultural and religious beliefs that will guide us in motivational intervention using the processes of change and teaching our patients self-management of their disease.

The book is written in easy simple language which gives it a flavour right at the outset of how we should be conversing with our patient: in lay and simple terms that should not be interpreted in any other way. One of the recommendations under Section 1 is the cautious use of the English language. I am sure we all have thought of this, but the guide, specifically, identifies that the English language needs to be used with great thought. As an example the phrase:

To “Knock up” could mean:
- To impregnate or to knock at the door

This book shows the care the author has taken in putting this “quick-reference” guide. As healthcare professionals wanting to make a difference with our patients’ behaviour and assisting them with self-management, we need to understand their health beliefs stemming from their cultural and religious background. This book has provided us with that basic knowledge. Everyone working as a healthcare professional or public service worker should have this reference. Thank you to the author for the time and effort. Two thumbs up!
Enhancing the Safety of Medical Suction Through Innovative Technology

Patricia Carroll, RN,BC, CEN, RRT, MS
Submitted by Ohio Medical Corporation (Amvex)

ABSTRACT
Medical suctioning is essential for patient care. However, few clinicians receive training on the principles of physics that govern the safe use of medical suction. While all eight manufacturers of vacuum regulators sold in North America require occlusion of the tube before setting or changing vacuum levels, anecdotal evidence reveals that clinicians are not aware of this requirement or skip this step when pressed for time. This white paper summarizes the physics relating to medical suction, the consequences of damaged mucosa, the risks to patient safety when suction levels are not properly set and regulated, and technology advances that enhance patient safety.

Medical suction is an essential part of clinical practice. Since the 1920s, it has been used to empty the stomach, and in the 1950s, airway suction levels were first regulated for safety. Today, medical suction is used for newly born babies and seniors, and in patients weighing between 500 grams and 500 pounds. Medical suction clears the airway, empties the stomach, decompresses the chest, and keeps the operative field clear. It is essential that clinicians have reliable equipment that is accurate and easy to use.

WHY A SAFETY MINDSET IS IMPORTANT
The current focus on patient safety extends to suction procedures and routines. When suction pressures are too high, mucosal damage occurs, both in the airway and in the stomach. If too much negative pressure is applied through a chest tube, lung tissue can be drawn into the eyelets of the thoracic catheter. Researchers are examining the connection between airway mucosal damage and ventilator-associated pneumonia. In pediatrics, airway suction catheters are inserted to a pre-measured length that avoids letting the suction catheter come in contact with the tracheal mucosa distal to the endotracheal tube. Mucosal damage can also be mitigated with appropriate suction techniques, and every effort should be made to reduce this insult to the immune system of patients who are already compromised. Damaged airway mucosa releases nutrients that support bacterial growth, and P. aeruginosa and other organisms are drawn to damaged epithelium. Mucosal damage in the stomach can result in bleeding and anemia as well as formation of scar tissue.

PHYSICS OF SUCTION
Flow rate is the term used to describe how fast air, fluid, or secretions are removed from the patient. Ideally, clinicians need the best flow rate out of a vacuum system at the lowest negative pressure. Three main factors affect the flow rate of a suction system:
• The amount of negative pressure (vacuum)
• The resistance of the suction system
• The viscosity of the matter being removed
The negative pressure used establishes the pressure gradient that will move air, fluid, or secretions. Material will move from an area of higher pressure in the patient to an area of lower pressure in the suction apparatus. The resistance of
the system is determined primarily by the most narrow part of the system — typically, a tubing connector — but the length of tubing in the system can increase resistance as well. Watery fluids such as blood will move through the suction system much more quickly than thick substances such as sputum. At one time, it was thought that instilling normal saline into an artificial airway would thin secretions, enhancing the flow of secretions out of the airway. However, research shows no thinning occurs and that patients’ oxygenation drops with saline installation. Thus, the practice should be abandoned.

Increasing the internal diameter of suction tubing or catheters will increase flow better than increasing the negative pressure or shortening the length of the tube. However, in most clinical applications the size of the patient will be the key factor determining the size of the catheter that can be safely used. Researchers at the Madigan Army Medical Center explored factors affecting evacuation of the oropharynx for emergency airway management. They tested three substances — 90 mL of water, activated charcoal, and Progresso vegetable soup — with three different suction systems, progressing from a standard 0.25-inch internal diameter to a 0.625-inch internal diameter at its most restrictive point. All systems evacuated water in three seconds. The larger diameter tubing removed the soup 10 seconds faster and the charcoal mixture 40 seconds faster than the traditional systems. The researchers note that this advantage in removing particulate material can speed airway management and reduce the risk or minimize the complications from aspiration.

OCCLUDE TO SET FOR SAFETY

Vacuum regulators are ever-present in the hospital setting. Clinicians use them daily and may not be as attentive to this equipment with the demands of monitors and devices alarming and competing for the clinician’s attention and time. Few clinicians learn the finer points of setting up suction systems. A nursing fundamentals text published in 2007 does not specify critical elements except to tell the nurse to follow manufacturers’ instructions. The text leaves out the critical, universal “occlude to set” step that is recommended by all eight manufacturers of vacuum regulators used in North America.

While a number of organizations have published guidelines, ultimately the clinician must determine the maximum allowable level of negative pressure that can be applied to the patient. This is determined by a number of factors: where the suction pressure is applied (airway, stomach, oropharynx, pleural space, operative field), the age and size of the patient, the susceptibility for mucosal or other tissue damage, and the risks associated with removing air during the suction procedure.

Once the maximum level has been determined, the vacuum regulator must be adjusted so that the maximum pressure is locked in; that is, the regulator must be set correctly so it will not permit a higher pressure to be transmitted to the patient. With traditional technology, the clinician must actively occlude the system by either pinching the suction tubing closed, or occluding the nipple adaptor (where the tubing is attached) with a finger. Once the system is occluded, the regulator is set to the maximum desired pressure; then the occlusion is released. If the system is not occluded during set-up, the maximum pressure is then unregulated and can spike to harmful levels (See Figure 1 and Box 2). Suctioning is a dynamic process. As catheters are used to remove substances from the body, the degree of open flow continually changes based on the fill of the catheter and the viscosity of the substance being removed. Under these dynamic conditions, the regulator continually compensates by adjusting flow rate within the device and the tubing to maintain the desired negative pressure. Periodically, mucus plugs or particulate matter will occlude the patient tube. If the system was not occluded to establish the maximum safe pressure at set-up, pressure will spike to clear the occlusion, and once the occlusion passes, the patient will be subjected to potentially dangerous, unregulated vacuum pressures (see Figure 1).

Figure 1 illustrates results of a bench test of two suction systems. The systems were set up identically as noted in Box 1. The desired maximum level of suction is 100 mmHg (A). One system was set at 100 mmHg with the system open to flow (red line); the other was set by occluding the system to set 100 mmHg (green line). During open flow, the “occlude to set” system will have a lower pressure than the desired maximum pressure because there are no occlusions in the system (B). Once suctioning begins, a dynamic flow condition occurs with varying levels of obstruction, and pressure rises in both systems. The point of maximum suction is key. In the “occlude to set” system,
the pressure never rises above the desired maximum pressure of 100 mmHg. In the other system, pressure in this bench test spiked to 125 mmHg of unregulated suction. Without “occlude to set,” the pressure can rise to 25% higher than the desired maximum level or more, exposing the patient to a safety hazard when regulated suction is needed.

Higher negative pressure is a particular hazard for patients with friable mucosa in the airway or stomach, making it more susceptible to traumatic tears. It is also a hazard for infants who have small lung volumes. When all other variables are stable, a 25% increase in negative pressure will increase the amount of air pulled through the system by 25%. That increase could result in a significant loss of lung volume in intubated neonates and infants.11

Box 1. Suction System Set-up.

<table>
<thead>
<tr>
<th>Equipment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Suction System Set-Up</td>
</tr>
<tr>
<td>Vacuum regulator</td>
</tr>
<tr>
<td>12-inch connecting tube</td>
</tr>
<tr>
<td>1500cc (empty) collection bottle</td>
</tr>
<tr>
<td>6-foot standard connecting tubing</td>
</tr>
<tr>
<td>14 Fr. Suction catheter</td>
</tr>
</tbody>
</table>

Breakthrough Technologies Enhances Safety

An ideal patient safety device removes clinician variables as much as possible by providing the added safety passively while the clinician carries out the procedure. Traditionally, the optimal safety of regulated vacuum pressure has depended on the clinician’s action to occlude the system to set maximum pressure. Now a breakthrough technology from Ohio Medical Corporation in its new Intermittent Suction Unit (ISU), occludes the system automatically when the clinician adjusts the pressure level. This creates a highly effective, passive safety system that removes the clinician variable and protects the patient from unintended, unregulated pressure spikes during suction procedures. The “push to set” innovation assures the clinician that the patient will not be subjected to pressure higher than that set on the regulator.

Another key safety aspect of any vacuum regulator is the ability to quickly adjust to full vacuum mode when emergency strikes and rapid evacuation is essential. An additional unique concept introduced by Ohio Medical is the dual-spring design of the regulating module contained within the vacuum regulator. This feature provides the clinician with the ability to control vacuum levels more precisely in the clinical range of 0-200 mmHg as well as the ability to achieve full vacuum when needed with only 2 turns of the knob on the regulator. In other regulators, six or more knob turns are needed to achieve “full vacuum,” and “full-vacuum” capability may be limited to the clinical range, not the full system vacuum provided by the Ohio Medical ISU. Since full vacuum is needed in emergency conditions, this enhanced responsiveness saves time when seconds are critical.

While vacuum regulators are often considered basic equipment in the hospital, research and innovation from Ohio Medical Corporation has shown vacuum regulators do have a role in enhancing patient safety in clinical settings. Clinicians should advocate for technology that provides passive safety protection, enhanced control of vacuum pressures, rapid response, and ease of use — all of which contribute to a culture of safety around the patient.

REFERENCES

A Collaborative Inter-professional Approach to Reducing Ventilator Associated Pneumonia (VAP) in the Critically Ill Child

Geoff Flannagan, The Hospital for Sick Children, Toronto, ON
Winner of the Poster Presentations, CSRT Education Conference and Trade Show, St. John’s NL 2010

Coauthors: Leanne Davidson, The Hospital for Sick Children, Toronto, ON; Kim Streitenberger, The Hospital for Sick Children, Toronto, ON

INTRODUCTION
Ventilator associated pneumonia (VAP) is the second most common nosocomial infection in the pediatric intensive care unit (PICU), accounting for 20% of such infections in this patient population. VAP prolongs time spent on the ventilator, ICU length of stay (LOS), and hospital LOS following discharge from ICU.

The PICU and Cardiac Critical Care Unit (CCCU) at The Hospital for Sick Children have been making improvements to reduce our incidence of VAP. This poster will describe the successes, challenges & lessons learned during the implementation of pediatric modifications to the evidence based ‘Safer Healthcare Now’ VAP ‘bundle’.

METHODS
An inter-professional team was assembled to research and implement a pediatric VAP ‘bundle’ of practices including:
• Elevation of the head of bed
• Draining ventilator tubing away from the patient & removing circuit condensation
• Mouth care q2-4h

Education was provided to staff during the implementation period. Results were shared with all staff on an ongoing basis through bulletin boards and Quality & Safety committee forums.

RESULTS
The main quality indicators used to track the effect of the bundle implementation on the VAP rate were:
• VAP Rate
• Compliance to VAP bundle components

We observed an overall increase in staff compliance to the bundle components while the VAP rate initially dropped then remained stable.

CONCLUSION
An overall increase in staff compliance to the VAP bundle resulted in an initial drop of VAP rate but a lack of further decrease in infection rate warrants further evaluation of the bundle.

Mechanical Insufflation Exsufflation: Practice patterns among respiratory therapists in Ontario

Shelley Prevost, St. Joseph’s Care Group & Thunder Bay Regional Health Sciences Center

Co-authors: Dina Brooks, University of Toronto; Michel Bedard, Lakehead University; Philip Bwititi, Charles Sturt University

INTRODUCTION
The mechanical insufflator exsufflator (MIE) is effective in assisting cough and in helping to avoid unplanned hospitalizations, tracheostomy and long-term ventilation in patients with neuromuscular disease or spinal cord injury. In spite of this, the availability and usage of the device in Canada is not known.

OBJECTIVE
To investigate practice patterns and availability of the MIE in Ontario hospitals.

METHODS
A cross-sectional, self-administered mail survey was sent to a random sample of 400 respiratory therapists practicing within 96 Ontario hospitals.

RESULTS
A total of 114 (28%) completed surveys were returned from 62 (65%) hospitals. Twenty hospitals (32%) had a MIE. Predominantly the respiratory therapist was the healthcare provider using the MIE. The device was most commonly used in the intensive care unit and medical/surgical units in patients with neuromuscular diseases or spinal cord injury. Optimal pressure spans of 35 cmH2O to 40 cmH2O were used by 54% of respondents. Fourteen of the 20 hospitals with a MIE had policies or guidelines in place and 4 of those hospitals had established staff competencies. Measurements of peak cough flow, maximal inspiratory/expiratory pressure and vital capacity were reported to be infrequently performed.
CONCLUSIONS
This study demonstrated the MIE device is not widely available in Ontario hospitals and there are variations in how the devices are applied possibly resulting in suboptimal therapy. A comprehensive educational program on MIE devices that incorporates best practices and a practical component is recommended for current providers as well as for inclusion in student curriculum.

Developing dynamic guidelines for Tobacco Control in Canada: Bridging research and practice with CAN-ADAPTT

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Janet Ngo, Centre for Addiction and Mental Health, Toronto ON;
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BACKGROUND
Despite the existence of clinical practice guidelines, only 50% of smokers report being asked about smoking by their healthcare provider. There are a number of reasons why practitioners have not yet embraced the guidelines: the guidelines don’t reflect local circumstances, are quickly out of date, and reflect gaps between the perspectives of experts and the day-to-day experiences of practitioners.

The Canadian Action Network for the Advancement, Dissemination and Adoption of Practice-informed Tobacco Treatment (CAN-ADAPTT) is designed to meet these challenges.

METHODS
CAN-ADAPTT’s goal is to facilitate research and knowledge exchange to inform the development of a dynamic set of guidelines for use in both clinical practice and population-based cessation.

RESULTS
The establishment of a practice-based research network (PBRN) will ensure that end-users define and frame research questions that are informed by their practices and produce research results that are readily applicable. The use of an adapted wiki model (a collaborative website which can be directly edited by anyone with access to it) for updates will ensure that the guidelines are up-to-date.

CONCLUSION
Collaboration through CAN-ADAPTT’s network will inform the development of a dynamic set of evidence-based guidelines with the goal of helping to reduce tobacco initiation, use and dependence.

Perceived level of familiarity following a community NICU experience

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OBJECTIVE
This project assessed the benefits and perceived level of familiarity for practice within the Neonatal Intensive Care Unit (NICU) following a 2 week clinical experience in a community based level 2 advanced NICU.

METHOD
4 Respiratory Therapy students from one clinical site spent 2 weeks with a dedicated NICU Respiratory Therapy preceptor in a community based NICU. The same students then spent 3 weeks at a tertiary care level 3 NICU as part of their required clinical rotations. A questionnaire was administered to each of the 4 students once both NICU experiences were complete. The questionnaire used a 7 point Likert scale to assess the students perceived level of preparedness for the level 3 NICU experience.

RESULTS
Overall the students reported an above average level of familiarity for the NICU environment after completing the 2 week community based NICU. This level of familiarity was seen in both documentation procedures and respiratory care procedures with median scores between 5.5 and 6.5 and averages between 5.5 and 6.25 on a 7 point Likert scale. The clinical site, Credit Valley Hospital, observed that the students had a greater level of comfort in the NICU environment, than in previous years when students did not have this opportunity.

CONCLUSION
The results suggest that in this small group of students the 2 week community based NICU experience provided an above average level of familiarity for a level 3 NICU experience. Community based level 2 advanced NICU settings may also offer students additional opportunities for "hands on" experience. While this is a very small sample of students these preliminary results indicate that there may be benefits to exposing students to a community based NICU prior to level 3 NICU experience.
Mechanical ventilation protocols in intensive care units: a survey of Ontario hospitals

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INTRODUCTION

Mechanical ventilation protocols for treating intensive care unit (ICU) patients may increase adoption of evidence-based ventilation strategies and thereby reduce duration of mechanical ventilation (MV) and rates of ventilator associated pneumonia. We sought to ascertain ICU and hospital characteristics associated with adoption of MV protocols in Ontario, and determine factors associated with incorporation of lung protective ventilation strategies (LPV) and spontaneous breathing trials (SBTs) into these protocols.

METHODS

We conducted a postal survey of Respiratory Therapy (RT) leaders in all 97 Ontario hospitals capable of providing mechanical ventilation.

RESULTS

We received responses from 70 (72.2%) hospitals. Only 28 hospitals (41.8%) reported having an intensivist-led staffing model. Most hospitals (48 [70.6%]) used MV protocols, but LPV was incorporated into only half of these (24; 54.6%), while SBTs were present in most (46; 80.5%). Factors associated with reported use of MV protocols were intensivist-led staffing model (89.3% vs. 56.4%, odds ratio (OR) 6.44, [95% confidence interval (CI) 1.66 - 25.0, p = 0.007]), presence of daily multidisciplinary rounds (84.4% vs. 42.9%, OR 7.24 [95% CI 2.22 - 23.6, p= 0.001]), and continuous RT coverage (87.0% vs. 36.4%, OR 11.7 [95% CI 3.44 - 39.6, p< 0.001]). Attending physician-to-patient ratio was associated with adoption of MV protocols; each increase of one patient to the ratio increased the likelihood of having a MV protocol by 1.17 (95% CI 1.01 - 1.35, p = 0.034).

CONCLUSION

The majority of Ontario hospitals reported using MV protocols, but only half of these incorporated LPV. However, SBTs were commonly integrated into MV protocols. Increasing adoption of MV protocols incorporating best available evidence could be considered a target for future quality improvement initiatives.

Early Extubation of Paediatric Cardiac Patients Post Surgery

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INTRODUCTION

An early extubation approach towards post operative paediatric cardiac surgery patients was developed at the Hospital for Sick Children during 2009. The goal was to increase efficiencies and decrease wait lists for paediatric cardiac surgery by facilitating shorter lengths of hospital stay, decreasing ICU lengths of stay, and increasing overall patient satisfaction. There was a fundamental shift in philosophy from an assumption of patient sickness postoperatively, to an assumption of wellness.

METHODS

Protocols were developed to identify patients that would be candidates for early extubation, either in the operating room, or shortly after admission to the Cardiac Critical Care Unit. Five different routine cardiac surgeries were targeted as a starting point for the change implementation. Protocols were then developed from many different disciplines: Changes were made to the anaesthetic approach, the cardiac bypass management, anticoagulation, sedation, pain control and ventilation strategies, parent education and discharge planning. These changes were implemented over the course of 2009 and data was collected on admission numbers, average census, intubation time, readmission rates to the ICU, deferral rates, OR cancellation rates, infection rates and patient satisfaction. This data was collected from February 2009 to January 2010 and was compared to data from previous years.

RESULTS

Overall, the average patient length of stay was decreased by one day for all patients in the Cardiac Critical Care Unit. Those patients with the identified surgical interventions had an overall reduction in ICU length of stay by an average of three days, without an increase in readmission rate. Deferrals to our Cardiac Critical Care Unit dropped from a high of 18 in October 2009 to an average of 2/month from June - December 2009.

CONCLUSIONS

An assumption of "wellness" for many post-operative conditions and an early extubation protocol can decrease length of ICU stay, decrease ventilator days, decrease cost and increase patient satisfaction.
The Preceptorship Experience in Respiratory Therapy Clinical Education: A Qualitative Analysis

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INTRODUCTION
Understanding the experiences of preceptors and students is necessary to identify attributes, skills, and knowledge that are key to successful preceptorship. Literature describing the preceptorship experience exists for various health disciplines but there is a paucity of information describing preceptorship in Respiratory Therapy (RT).

The Department of Respiratory Therapy, University of Manitoba, identified the need for novel research into preceptorship in order to support establishment of its clinical preceptor training program. The purpose of this study was to identify the unique skills, attributes, and knowledge relevant to preceptorship in this context.

METHODS
This qualitative study employed an interpretive descriptive framework. Data was collected through focus group interviews with 22 Respiratory Therapist preceptors and 16 respiratory therapy students. Interview questions were semi-structured and open ended. Focus groups were digitally recorded and transcribed verbatim. Content analysis of the transcripts was performed to determine themes, concepts, or ideas that demonstrated perceptions or attitudes.

RESULTS
Six themes emerged from the data that speak to the preceptorship experience in Respiratory Therapy: (1) limitations in formal preparation for the preceptor role, (2) uncertainty in assigning value to clinical experience and teaching skill, (3) communication amongst the participants, (4) existing barriers to effective evaluation and feedback, (5) desires relating to the student-preceptor relationship, and (6) a vignette of the preferred preceptor’s characteristics. Within each of these themes the unique perspectives of preceptors and students are comparatively illustrated.

CONCLUSION
This investigation serves as a first step to understanding the preceptorship experience in Respiratory Therapy, as well as the learning needs of Respiratory Therapists who provide clinical preceptorship for RT students. The themes identified in this study underscore the complex nature of the preceptorship experience in RT. They illuminate the need for increased educational supports for preceptors, and offer a better understanding of the preceptorship experience for educational programmers.
RÉSUMÉS DES PRÉSENTATIONS D’AFFICHES


Une approche de collaboration interprofessionnelle de la réduction de la pneumonie sous ventilation assistée (PVA) chez les enfants gravement malades

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Geoff Flannagan a remporté le prix de la présentation des affiches au Congrès éducatif et salon professionnel

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INTRODUCTION
La pneumonie sous ventilation assistée (PVA) est la deuxième infection nosocomiale la plus commune dans l’unité de soins intensifs pédiatrique (USIP), représentant 20 % de ces infections dans cette population. PVA prolonge la durée du passage sous ventilation assistée, la durée du séjour en USI et la durée de l’hospitalisation après le congé de l’USI.

L’USIP et l’Unité de soins intensifs en cardiologie (USIC) de l’Hospital for Sick Children ont apporté des améliorations afin de réduire l’incidence de PVA. Cette présentation décrira les succès, les défis et les leçons apprises durant la mise en ?uvre des modifications pédiatriques à la suite de mesures PVA « Safer Healthcare Now » fondée sur les données probantes.

MÉTHODES
Une équipe interprofessionnelle a été constituée afin d’effectuer des recherches et de mettre en place une « suite » PVA comprenant :
- l’élevation de la tête de lit;
- le drainage de la canalisation de ventilation loin du patient et l’élimination de la condensation dans les canalisations;
- soins de la bouche q2-4h.

Une formation a été donnée au personnel durant la période d’implantation. Les résultats ont été communiqués à l’ensemble du personnel sur une base continue par les tableaux d’affichage et les rencontres trimestrielles sur la qualité et la sécurité.

RÉSULTATS
Les principaux indicateurs de qualité utilisés pour faire le suivi des effets de la mise en ?uvre de la suite de mesures du taux de PVA étaient :
- le taux de PVA;
- le respect des éléments de la suite PVA.

Nous avons observé une augmentation générale de la conformité du personnel aux différents éléments de la suite alors que le taux de PVA a d’abord diminué pour ensuite se stabiliser.

CONCLUSION
Une augmentation générale de la conformité du personnel aux différents éléments de la suite PVA s’est traduite par une baisse initiale du taux de PVA mais le fait que la baisse ne se soit pas poursuivie justifie une évaluation plus approfondie de la suite.

Insufflation et exsufflation mécaniques : modèles de pratique chez les thérapeutes respiratoires en Ontario

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Coauteurs : Dina Brooks, University of Toronto; Michel Bedard, Lakehead University; Philip Bwititi, Charles Sturt University

INTRODUCTION
L’appareil d’insufflation et d’exsufflation mécanique (IEM) est efficace pour aider à la toux et éviter les hospitalisations imprévues, les trachéotomies et la ventilation de longue durée chez les patients atteints de maladies neuromusculaires ou de blessures à la colonne vertébrale. Malgré cela, la disponibilité et l’usage de l’appareil au Canada sont inconnues.

OBJECTIF
Étudier les modèles de pratique et la disponibilité des appareils d’IEM dans les hôpitaux de l’Ontario.

MÉTHODES
Un sondage transversal autoadministré a été envoyé par la poste à un échantillon aléatoire de 400 thérapeutes respiratoires dans 96 hôpitaux de l’Ontario.

RÉSULTATS
Au total, 114 questionnaires (28 %) remplis ont été retournés par 62 hôpitaux (65%). Vingt-huit hôpitaux (32 %) disposent d’un appareil d’IEM. Dans la majorité des cas, le thérapeute respiratoire est le professionnel de la santé qui utilise l’appareil, qui est principalement utilisé dans les unités de soins intensifs et les unités médicales/chirurgicales chez les patients atteints de maladies neuromusculaires ou de blessures à la colonne vertébrale. Des pressions optimales de 35 cmH2O à 40 cmH2O sont utilisées par 54 % des répondants. Quatorze des 20 hôpitaux qui disposent d’un appareil d’IEM ont une politique ou des directives en place pour son utilisation et quatre de ces hôpitaux ont établi les compétences du personnel. Selon les données recueillies, les mesures du débit de pointe de la toux, de la pression maximale à l’inspiration/expiration et de la capacité vitale sont prises de façon infréquente.
CONCLUSIONS
Cette étude démontre que l’appareil d’IEM n’est pas largement disponible dans les hôpitaux de l’Ontario et qu’il y a des écarts dans les modalités d’utilisation de l’appareil, entraînant possiblement une thérapie sous-optimale. La mise en place d’un programme complet d’éducation sur les appareils d’IEM, incluant les pratiques exemplaires et un volet pratique, est recommandée pour les fournisseurs actuels et pour inclusion dans le programme de formation des étudiants.

Établissement de lignes directrices dynamiques pour le contrôle du tabac au Canada : jeter des ponts entre la recherche et la pratique avec CAN-ADAPTT

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Janet Ngo, Centre for Addiction and Mental Health, Toronto (Ont.);
Peter Selby, Centre for Addiction and Mental Health, University of Toronto, Toronto (Ont.)

CONTEXTE
Malgré l’existence de lignes directrices sur la pratique clinique, 50 % des fumeurs seulement indiquent que leur fournisseur de soins de santé leur pose des questions sur le tabac. Plusieurs raisons expliquent que les praticiens n’appliquent pas encore les lignes directrices : elles ne reflètent pas les conditions locales, sont rapidement périmées et reflètent les écarts entre le point de vue des experts et l’expérience quotidienne des praticiens.

CAN_ADAPTT (Réseau d’action canadien pour l’avancement, la diffusion et l’adoption de pratiques éclairées dans le traitement du tabagisme) a été conçu pour relever ces défis.

MÉTHODES
CAN-ADAPTT vise à faciliter la recherche et le partage des connaissances afin de documenter à l’échelle nationale l’élaboration de lignes directrices dynamiques pour la pratique dans le domaine clinique et l’abandon du tabac dans la population.

RÉSULTATS
La création d’un réseau de recherche basé sur la pratique permettra aux utilisateurs de définir et de cadrer des questions de recherche éclairées par l’expérience clinique et produira des résultats de recherche directement applicables. L’utilisation d’un modèle wiki adapté (un site Web collaboratif pouvant être modifié directement par toutes les personnes qui y ont accès) pour les mises à jour permettra de s’assurer que les lignes directrices sont tenues à jour.

CONCLUSION
Les résultats semblent indiquer que dans ce groupe restreint de stagiaires, les deux semaines d’expérience en USIN communautaire ont permis d’acquérir un degré de familiarité supérieur en prévision d’un stage en USIN Niveau 3. Le milieu d’USIN communautaire avancée de niveau 2 peut aussi offrir aux étudiants des occasions additionnelles d’expérience pratique. Bien que l’échantillon soit très restreint, ces résultats préliminaires indiquent qu’il pourrait être avantageux d’exposer les étudiants à un environnement d’USIN communautaire avant le stage en USIN Niveau 3.
Niveau de familiarité perçu après une expérience dans une USIN communautaire

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**OBJECTIF**
Ce projet évalue les avantages et le degré de familiarité perçu pour la pratique dans l’Unité de soins intensifs en néonatalité (USIN) après une expérience clinique de deux semaines dans une USIN communautaire avancée de niveau 2.

**MÉTHODE**
Quatre étudiants en thérapie respiratoire d’un site clinique ont passé deux semaines avec un précepteur spécialisé en thérapie respiratoire néonatale dans une USIN communautaire. Les mêmes étudiants ont ensuite passé trois semaines dans une USIN de soins tertiaires de niveau 3 dans le cadre de leur rotation clinique imposée. Un questionnaire a été remis à chacun des quatre étudiants après qu’ils aient terminé leurs deux stages en USIN. Le questionnaire applique une échelle Likert en sept points pour évaluer le degré de préparation perçu des étudiants en vue de l’expérience en USIN niveau 3.

**RÉSULTATS**
Globalement, les étudiants signalent un degré de familiarité supérieur à la normale envers la pratique dans un environnement USIN après avoir terminé le stage de deux semaines en USIN communautaire. Ce degré de familiarité a été perçu dans les procédures de documentation et dans les procédures de soins respiratoires, avec des notes médianes de 5,5 à 6,5 et des moyennes entre 5,5 et 6,25 sur l’échelle Likert qui en compte sept. Le site clinique, Credit Valley Hospital, note que les étudiants présentaient un plus grand niveau de confort face à l’environnement USIN que les stagiaires des années précédentes, qui n’avaient pas eu cette possibilité.

**CONCLUSION**
Les résultats semblent indiquer que dans ce groupe restreint de stagiaires, les deux semaines d’expérience en USIN communautaire ont permis d’acquérir un degré de familiarité supérieur en prévision d’un stage en USIN Niveau 3. Le milieu d’USIN communautaire avancée de niveau 2 peut aussi offrir aux étudiants des occasions additionnelles d’expérience pratique. Bien que l’échantillon soit très restreint, ces résultats préliminaires indiquent qu’il pourrait être avantageux d’exposer les étudiants à un environnement d’USIN communautaire avant le stage en USIN Niveau 3.

Protocoles de ventilation mécanique dans les unités de soins intensifs : enquête dans les hôpitaux de l’Ontario

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**INTRODUCTION**
Les protocoles de ventilation mécanique pour le traitement des patients en unité de soins intensifs (USI) peuvent augmenter l’adoption de stratégies de ventilation fondées sur des éléments probants et ainsi diminuer la durée de la ventilation mécanique (VM) et donc diminuer l’incidence de pneumonie associée à la ventilation. Nous souhaitons établir les caractéristiques des USI et des hôpitaux associées à l’adoption des protocoles de VM en Ontario et recenser les facteurs associés à l’incorporation des stratégies de ventilation protégeant les poumons (VPM) et des essais de respiration spontanée (ERS) dans ces protocoles.

**MÉTHODES**
Nous avons mené une enquête postale auprès des responsables de la thérapie respiratoire (TR) dans les 97 hôpitaux de l’Ontario offrant des services de ventilation mécanique.

**RÉSULTATS**
Nous avons reçu des réponses de 70 hôpitaux (72,2 %). Seulement 28 hôpitaux (41,8 %) disent appliquer un modèle dirigé par un intensiviste. La plupart des hôpitaux (48 [70,6 %]) appliquent des protocoles de VM, mais la VPM n’est incorporée que dans la moitié de ces protocoles (24; 54,6 %), alors que les ERS étaient présents dans la plupart des protocoles (46; 80,5 %). Les facteurs associés à l’utilisation recensée des protocoles de VM étaient les modèles de dotation dirigés par un intensiviste (89,3 % c. 56,4 %, rapport de cote [RC] 6,44, [95 % intervalle de confiance [IC] 1,66 - 25,0, p = 0,007]), la présence de visites multidisciplinaires quotidiennes (84,4 % c. 42,9 %, RC 7,24 [95 % IC 2,22 - 23,6, p= 0,001]), et la couverture continue en TR (87,0 % c. 36,4 %, RC 11,7 [95 % IC 3,44 - 39,6, p = 0,001]). Le ratio de patients par médecin traitant a été associé à l’adoption des protocoles de VM; chaque augmentation d’un patient du ratio augmentait la probabilité d’avoir un protocole de VM par 1,17 (95 % IC 1,01 - 1,35, p = 0,034).

**CONCLUSION**
La majorité des hôpitaux de l’Ontario indiquent recourir aux protocoles de VM, mais la moitié d’entre eux seulement y incorporent la VPM; les ERS sont cependant régulièrement intégrés aux protocoles de VM. L’adoption accrue de protocoles de VM incorporant les meilleures données probantes pourrait être envisagée comme un objectif pour les initiatives futures d’amélioration de la qualité.
Exubation hâtive des patients en pédiatrie cardiaque après la chirurgie

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INTRODUCTION
Une approche d’extubation postopératoire hâtive chez les patients de chirurgie cardiaque pédiatrique a été mise au point à l’Hospital for Sick Children en 2009. Le but visé était d’augmenter l’efficacité et de diminuer le temps d’attente pour la chirurgie cardiaque pédiatrique en favorisant des séjours plus courts, en diminuant le séjour à l’unité de soins intensifs en cardiologie. Cinq chirurgies cardiaques de routine ont été ciblées comme point de départ du changement. Des protocoles ont ensuite été élaborés à partir de plusieurs disciplines différentes : des changements ont été apportés à l’approche d’anesthésie, à la gestion de la dérivation cardiaque, aux stratégies anticoagulatoire, de sédation, de contrôle de la douleur et de ventilation, à l’éducation des patients et à la planification du congé. Ces changements ont été implantés progressivement tout au long de 2009 et des données ont été recueillies sur le nombre d’admissions, le recensement moyen, la durée d’intubation, le taux de réadmission à l’USI, les taux de report, les taux d’annulation de salle d’opération, les taux d’infection et la satisfaction des patients. Ces données ont été comparées aux données des années antérieures.

MÉTHODES
Des protocoles ont été établis afin de recenser les patients candidats à une extubation hâtive, que ce soit dans la salle d’opération ou peu de temps après l’admission à l’Unité de soins intensifs en cardiologie. Cinq chirurgies cardiaques de routine ont été ciblées comme point de départ du changement. Des protocoles ont ensuite été élaborés à partir de plusieurs disciplines différentes : des changements ont été apportés à l’approche d’anesthésie, à la gestion de la dérivation cardiaque, aux stratégies anticoagulatoire, de sédation, de contrôle de la douleur et de ventilation, à l’éducation des patients et à la planification du congé. Ces changements ont été implantés progressivement tout au long de 2009 et des données ont été recueillies sur le nombre d’admissions, le recensement moyen, la durée d’intubation, le taux de réadmission à l’USI, les taux de report, les taux d’annulation de salle d’opération, les taux d’infection et la satisfaction des patients. Ces données ont été comparées aux données des années antérieures.

RÉSULTATS
Globalement, la durée moyenne du séjour en USI a été réduite d’une journée pour tous les patients de l’Unité de soins intensifs en cardiologie. La réduction du séjour en ISU pour les patients des interventions chirurgicales visées a été de trois jours en moyenne, sans augmentation du taux de réadmission. Les reports de notre Unité de soins intensifs en cardiologie sont passés d’un sommet de 18 en octobre 2009 à une moyenne de deux par mois entre juin et décembre 2009.

CONCLUSIONS
L’adoption d’une hypothèse de « santé » pour plusieurs conditions postopératoires et un protocole d’extubation hâtive peuvent diminuer la durée du séjour en USI, le nombre de jours sous ventilation et les coûts tout en augmentant le degré de satisfaction des patients.

L’expérience du préceptorat dans la formation clinique en thérapie respiratoire : une analyse qualitative

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INTRODUCTION
Il est nécessaire de comprendre l’expérience du précepteur et des étudiants pour recenser les attributs, les compétences et les compétences requises pour assurer le succès du préceptorat. Les textes scientifiques décrivant l’expérience de précepteur existent pour différentes disciplines des sciences de la santé mais il y a peu d’information sur le préceptorat en thérapie respiratoire.

Le Département de thérapie respiratoire de l’Université du Manitoba a déterminé qu’il y avait un besoin pour des recherches innovantes sur le préceptorat afin de soutenir la création de son programme de formation de précepteurs cliniques. L’étude visait à définir les compétences, les attributs et les connaissances uniques pertinentes pour les précepteurs dans ce contexte.

MÉTHODES
Cette étude qualitative fait appel à un cadre descriptif interprétatif. Des données ont été recueillies dans le cadre de groupes de discussion avec 22 précepteurs et 16 étudiants en thérapie respiratoire. Les questions étaient semi-structurées et ouvertes. Les groupes de discussion ont fait l’objet d’un enregistrement numérique et d’une transcription. Le contenu des transcriptions a été analysé afin de recenser les thèmes, les concepts ou les idées montrant des perceptions ou des attitudes.

RÉSULTATS
Les données ont permis de déterminer six thèmes relatifs à l’expérience de préceptorat en thérapie respiratoire : (1) limitations dans la préparation formelle au rôle de précepteur; (2) incertitude dans l’attribution de valeur à l’expérience clinique et aux compétences d’enseignement; (3) communications entre les participants; (4) obstacles à l’évaluation et au feedback efficaces; (5) souhaits relatifs à la relation entre le précepteur et l’étudiant; (6) une vignette des caractéristiques souhaitées du précepteur. Sous chacun de ces thèmes, les perspectives propres aux précepteurs et aux étudiants sont illustrées de façon comparative.

CONCLUSION
Cette enquête est une première étape vers la compréhension de l’expérience de précepteur en thérapie respiratoire et des besoins d’apprentissage des thérapeutes respiratoires qui agissent comme précepteurs cliniques pour les étudiants. Les thèmes recensés dans l’étude soulignent la nature complexe de l’expérience de précepteur en thérapie respiratoire. Ils illustrent le besoin de soutiens éducatifs accrus pour les précepteurs et offrent une meilleure compréhension de l’expérience de précepteur pour les programmeurs en formation.
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