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Editorial

What can nurses do in the face of regional disasters?

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It has recently been six months since the onset of the extraordinary devastation of the Southeast Asian Tsunami. During the period that immediately followed this tragedy, there was an unprecedented outpouring of support of all kinds for the surviving victims of this horrible event. The public media devoted exceptional attention toward reporting about this incident and the global reactions that followed. For many it was heart-warming to see the large-scale funding that was mobilized by individual citizens of the world as well as their respective governments. Indeed, significant concern was also expressed on the pediatric critical care nursing egroup PICU-Nurse-International.

Six months have passed. In most regions of the world, the tsunami is infrequently discussed in the daily news, despite the fact that it will take many, many years to attempt to 'rebuild' these regions to some level that resembled their prior ways of life. It appears that the ability to remain focused on such devastation is very limited for many. Indeed, many commentators have criticized the fact that this event has (a) diverted attention and support from many other severely troubled regions of the world and (b) demonstrated a form of prejudice toward the kinds of tragedies that most societies will respond to. For example, although hugely greater numbers of people have been dying for years from poverty, malnutrition, and HIV/AIDS in some African regions, this has at best received a marginal to moderate level of support.

What does all of this imply for us as nurses? This issue of *Pediatric Intensive Care Nursing* presents a special focus on the recent tsunami disaster and the involvement of some of our nursing colleagues in attempting to alleviate the human sickness and suffering that followed. These provide some extraordinary exemplars of ways in which nurses can make a difference. Also, in prior issues, some nurses have reported on their regular outreach work in assisting less fortunate societies on an ongoing basis.

As nurses, we possess privileged knowledge and access to resources that can bring about significant good for a great many people. As pediatric critical care nurses, we hold highly specialized expertise that can help comfort and care for children with a variety of life-threatening problems. A journal such as this, and its associated Internet egroup, provides a forum for facilitating the exchange of information and increasing sensitization toward what nurses can do, as well as what nurses **are** doing. As professional nurses with such privileged capabilities as well as voting citizens in societies that may be relatively wealthy, let us concentrate our keen interests in the well-being of children toward ensuring that our communities do not forget about the tsunami victims nor the many victims of other forms of tragedy throughout the world. These needs call for another type of **intensive care**.

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Insight into KKH Tsunami Relief Efforts

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Abstract
It was a tragic end to the year of 2004 as countries across South and Southeast Asia mourned for the massive loss of lives in the tsunami disaster that hit on December 26th. The 9.0 Richter Scale earthquake not only brought catastrophe beyond imagination and killing 300,000 people in countries that were afflicted, it also touched the hearts of many to bring out the best in humanity to provide immediate help to victims ravaged by the cataclysm.

Fundraising efforts kicked off almost immediately in the aftermath of the disaster, with KKH staff pledging up to five percent of their salary for three months. The money was used to purchase equipment and drugs for the Acehnese. Besides rendering support for the various fundraising initiatives, many of our staff rose to the occasion by responding to calls for volunteers for medical relief mission trips.

Medical team riding on board an SAF aircraft

Medical teams from KK Women's and Children's Hospital (KKH) comprised of neonatologists, paediatricians, paediatric surgeons, and nurses from various disciplines, were deployed to Trincomalee, Sri Lanka and Banda Aceh, Indonesia from the 1st of January. The medical relief teams worked alongside organizations such as the Singapore Armed Forces (SAF), Red Cross and Mercy Relief. Whilst the KKH team was in Banda, Aceh, they found the surrounding hospitals in the area had been significantly affected by the tsunami and much of the infrastructure was also severely damaged. At IDP camps and RS Kasdem, mothers turned up only when they had problems or were in labor. No antenatal program was available for women and ultrasound facilities were totally destroyed when the tsunami hit the hospital. Indeed, women following delivery were discharged after 3 hours of stay in hospital since there was not much support left in meeting their care needs.

In response to such needs, two obstetricians were included in the subsequent team to support the sole local obstetrics and gynecology physician and 5 midwives in RS Kasdem and IDP camps. Through local contacts that were established, the KKH team swiftly worked out an 8-week program with Mercy Relief Singapore to provide paediatric and obstetrics and gynecology relief, along with initial reconstruction support and help to health centers in Banda, Aceh. In particular, the RS Kasdem hospital was identified as the main focus of KKH's efforts as it is a small local hospital with both paediatric and obstetrics and gynecology facilities.

The medical missions to Banda Aceh, Indonesia and Trincomalee, Sri Lanka have given KKH the opportunity to play a role in providing humanitarian aid in response to the critical needs of the victims in our neighboring countries. These are two areas where KKH has the healthcare expertise and logistics capability, which were most required in such a magnitude of destruction. In addition to medical and nursing care for children, the team also looked at the other needs that had not been met by other relief groups. This timely offer of help enabled the hospitals to cope with the large number of patients in the aftermath of the tsunami disaster, and gave it time to find replacements as many of the staff lost their lives. Most of the surviving hospital staff had not turned up for work, as many were trying to find their loved ones and recovering from the destruction of their homes.

KKH was not the only hospital that responded to the call for help. Many hospitals in Singapore teamed up and combined their effort to boost the effectiveness of the medical work at the disaster sites. Other public healthcare institutional involvements included a 19-member medical team deployed to Secata Camp in Banda Aceh and a 15-member hospital team for the Zainoel Abidin Hospital Accident and Emergency Department. Other than medical teams, a forensic team comprised of 4 volunteer forensic dentists, a pathologist, a death investigator and mortuary technician were dispatched to Phuket, Thailand to help identify the deceased.

Mobilizing medical relief teams at such a huge scale would not be possible without an efficient ground team to coordinate the work. Ministry of Health and Singhealth have been instrumental in ensuring that our mission trips have been possible by providing updated information, communication channels and equipment, and briefing work. The SAF played a remarkable role in providing not only medical and emergency supplies but also supplied the air and sea transport vehicles required for transporting supplies and relief teams to the disaster sites that could not be reached by land routes during the initial period.

KKH medical team giving immunization to children

In response to the urgent need, KKH immediately set up The International Disaster Response Committee with the appointment of three senior personnel as coordinators to direct the medical relief effort. The work of the committee included mobilizing and accounting of resources, assigning of volunteers to their respective teams, vaccinations for staff volunteers, deployment of equipment from various nursing units and scheduling emotional behavioral support and debriefing sessions for team members. Other preparations included the arrangement of medical insurance

coverage and visa requirements, done by the Human Resource Unit. Furthermore, KKH also enlisted corporate donors to donate milk products, instruments, equipment, medical supplies and even thousands of spectacles as most of the tsunami victims had lost their eyeglasses when the tidal wave struck.

Time was a critical factor for the effectiveness of the relief effort. Hence these preparations were carried out concurrently and the timeline given was about a day or two. With the enormous supports placed by various hospital operational support units and other sources, KKH was able to dispatch teams quickly and efficiently. The critical success factor to the smooth mobilization of relief teams was the top down approach initiation. Other factors included the autonomy given by the hospital top management, which enabled the coordinators to make swift decisions. This inevitably contributed to the speed and efficiency of the work performed.

Despite the limitations in our size, Singapore being the closest neighbor had the compulsion to respond to the best of our capability in providing humanitarian aid. However, it was heartening to see the world coming forth to lend a hand to the tsunami victims, organizing fundraising efforts, donating money, emergency supplies, volunteering on humanitarian relief missions to affected areas. The Singapore teams were able to meet up with their local counterparts to work out ways to augment the resident group and work alongside other medical relief teams from Australia, Belgium, Germany, France, Russia and various others non-governmental organizations. The SAF non-medical team performed cleaning and setting up of work sites, whereas the medical team worked with medics setting up operating theatre facilities for the hospital to treat injuries sustained from the tsunami disaster and the provision of primary healthcare to the refugee camps. KK Children's Hospital Emergency Transport Services (CHETs) was also activated to airlift a septic child with burns from the Red Cross Camp to be treated in our ICU.

Large quantities of resources in terms of equipment and medical supplies were deployed from various parts of the world. Many of the medical relief teams provided short-term support and unused supplies were left for their local counterparts. Equipment instructions and drug supplies were labeled in various languages such that some could not be comprehend by the locals and the relief workers - hence could not put the items to good use. Machines were left in storage with their wrapping, bundled in a corner for weeks, which was later found to be high-end sophisticated water purifiers that they desperately needed.

Innovation:
Spacer made by nurses

Following weeks of relief efforts, as the immediate needs diminished, the medical teams went further to assess other needs. The teams were able to communicate directly with the KKH coordinators and asked for the deployment of resources with wireless Blackberries and satellite phones. There was a time when the Australian team called for the supply of culture media to be sent from the KKH clinical laboratory through our team to bridge the temporary shortage. KKH

also helped the local hospital to set up an inventory system to track equipment and medical supplies. Also, an administrator and store-keeper were deployed to assist with the organizing of an inventory system to maximize the use of resources. Through KKH's collaborations with SAF and other NGOs, the deployment of resources to relief sites was efficient and smooth.

Singapore has also participated in some of the reconstruction work. Several infrastructure projects including the building of a 150-bed hospital in Banda Aceh, and two medical clinics in Meulaboh were proposed. KKH has in many instances transferred our medical and nursing skills through training workshops to several of our neighboring countries. Lending a hand to the medical and nursing counterparts in the region's developing countries is something that doctors and nurses from KKH have been doing for many years. These training programs not only focus on sharing knowledge and skills, it also encompasses 'train-the-trainers' modules that equip the people with the capability of strengthening their own pool of expertise. For instance, KKH will not hesitate to share and assist with the needs required by the tsunami stricken countries especially in the areas of paediatrics and women's health.

Our work on the tsunami relief efforts provided lessons of great value. Not only did it give us an opportunity to help the afflicted, but it also enabled us to look at how KKH could better support such a civilian medical disaster response by coordinating our efforts with both with local authorities and other in-country agencies. This experience has brought about a sense of need in forming a Coordinating Team at the national level, drawing on people with various forms of expertise and resources to move as one to support in the victims at a disaster site. The pooling of efforts and resources by collaborated medical and humanitarian contingents would provide a far greater impact in term of humanitarian aid and the achieving of a higher level of quality outcomes.

Lessons Learned from a Belgian Response to the Tsunami Disaster

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Abstract
This article provides a detailed account of the tremendous difficulties encountered by a Belgian Medical Team in Banda Aceh within the two to three weeks that followed the December 26th 2005 tsunami disaster. This response team was faced with extraordinary medical and social problems.
Note: See the photographic essay that complements this article submitted by the same author in this issue.

December 26th 2005

December 26th, 2004, 07:58 a.m. local time an earthquake with a magnitude of 8.9-9.0 on the Richter scale occurred in the Indian Ocean at an unusually shallow depth, close to Sumatra's coast. Such earthquakes can cause a 'bump' in the global water volume that is located right above the epicentre. The bump (in this case causing a 1 to 3 meter shift) resulted in the formation of outward racing ocean waves. This caused an unparalleled level of devastation. This was the greatest natural disaster ever recorded in the modern world.

For Indonesia's Sumatra province Aceh, which was only 160 km away from the epicentre, it took the ocean no more than 30 minutes to shock residents with tons of water and debris. Many people were trapped, as they drowned in the muddy flood. They were swept at high speeds against walls and trees, breaking various body parts.

Similar devastation afflicted many additional countries over a time span of 7 hours: Sri Lanka, Thailand, Malaysia, Myanmar, India, Somalia, the Maldives, Madagascar, Kenya and Bangladesh. In Aceh, countless infants and children died. Many people living in the towns also died.

Response from Belgium

The Belgian Pediatric Association decided to contribute to the global efforts to assist this severely troubled area. This was the first time this group faced a catastrophe. Being a small country, everyone knows everyone, such that within 24 hours a medical team of 30 volunteers from 4 hospitals was recruited. A goal was established in collaboration with an Indonesian pediatrician that graduated in Brussels. The goal was to help the Rumah Sakit Umum Dr. Zainoel Abidin General Hospital of Banda Aceh.

The Belgian Medical Team (BMT) set out to focus on the pediatric wards of this hospital. Belgian medical and nursing managers managed the required leaves for staff involved with this mission. Some staff were not able to obtain permission and were therefore replaced by others. In most cases, the leave was considered professional (not as holiday time off) with no loss of wage. Consequently, surgery programs and numerous shifts had to be covered by the staff remaining in Belgium. The BMT contacted medical, pharmaceutical and supply companies to collect medications, baby food and medical equipment. Some equipment was borrowed from the hospitals.

Two days before departure (January 7th), the local Indonesian pediatrician was notified that the university hospital of Banda Aceh was not operational – in fact - not accessible. The ocean water was still present throughout the hospital.

It was estimated that nearly half of the personnel died in the tsunami while the other half had disappeared. It remained unclear if there were any remaining patients.

The BMT was divided into three groups. BMT 1 arrived on January 11th (Day 16 post-tsunami). Some children survived this near drowning disaster, without medical support. Thirty BMT members were selected to form BMT 1. The group included 5 nurses (2 senior nurses from Pediatric Intensive Care Units and 3 from the Emergency Department) and 6 physicians (2 surgeons, 1 anaesthesiologist and 3 pediatric intensivists). The team left Antwerp January 9th at 04:00 a.m.

Thirty-six hours later BMT 1 arrived at Banda Aceh's airport. Upon arrival, BMT 1 headed for Banda Aceh – a 30-minute trip through heavy rain and the stench of death from the mass graveyards.

At Banda Aceh we faced a ghost town. The town that previously had 400,000 inhabitants was completely vacant.

Some of us went to inspect the hospital that was about 10 minutes away by foot. There was no light and debris was piled up everywhere - no access could be found.

As we followed some Indonesians that motioned us we discovered a surreal scene where large fishing boats stood on top of the debris and bodies while cats and dogs tore up body bags to eat from the cadavers.

We heard of refugee camps at Sigli where no one had yet received medical attention. So we left for Sigli. On the way, a young girl came to us as she tried to explain something, saying *'America! Adopt!'* She believed we were Americans. It hurt to look away and ignore her as we continued on our way.

It was extremely hot at the refugee camp of Sigli. Of the apparently 4,000 children in the camp, about 50 of them were presented for consultation. All of them had scurvy. We treated scurvy, otitis, impetigo and some infected wounds. We then went to a second refugee camp at Darussalam.

The next morning it was raining heavily as we returned to the hospital. It was a large hospital, with some 2 and 3 story buildings. A long central covered walkway connected all the buildings. Small palm trees and bush reached out of the mud and water, surrounding all buildings. Large eels swam around and crossed the walkways. Large gas bubbles escaped from the mud, which later appeared to be the decomposing bodies of nurses, patients and their relatives that had tried to escape right after the earthquake.

Finally, we reached the different pediatric wards and the so-called anak ICU and the 'rehidrasi' unit. This ward was for children with severe diarrhea. There was an open gutter all around the unit. Feces flowing on the floor were drained off by nurses or relatives.

Many children were dehydrated. One had leukaemia. Some had tuberculosis and infectious diseases (e.g., measles, diphtheria and tetanus). At the maternity ward we noted that all babies had an extremely low weight. No baby weighed more than 2.5 kg. These babies were considered 'normal weight'.

The first pavilion was a unit for the richer Acehnese with single patient rooms, air conditioning and some art on the walls. The second was for the poor. The pavilion could become flooded by monsoon rainwater for a few days a year, such that patients would be in 10-20 cm of water. This happened once or twice a year. That is why some of the pavilions for the rich had a 50-100 cm higher floor.

Starving cats and dogs were freely roaming the buildings in search of food. No water available from the taps and many of the electrical outlets were not functioning.

There were no beds. Some children were lying on beach chairs, cared for by their relatives and nurses from another Acehnese town. No laboratory facilities were available, although some of these babies were severely dehydrated. We inserted several central catheters.

We were invited to occupy a room where we could hospitalize 6 children. Beds and oxygen cylinders were pulled out of the mud and cleaned with socks and the muddy water. We also recovered alcohol from the mud to disinfect the beds and mattresses. We also found a few rusty but cleaned hospital beds.

All of our patients were near-drowning victims. They all survived the tsunami. Mafouta had only his mother left. Maulida was a tsunami orphan, accompanied by her aunt. Ikram lost his father, sister and many other relatives. Niswa lost her father. The father of Firda lost his wife and 3 daughters and was now caring for his little girl.

Upon arrival, it was hard for us to hear the disaster coordinator explain that we were not going to treat severely ill children. Ordinarily, if they required more than oxygen therapy and antibiotics, they were considered 'lost cases'. At Zainoel Abidin's university hospital, 80% of the hospitalized children used to die. This was considered normal and acceptable.

At night it became clear that the local nursing level of care was different from what we were used to. Nurses left to sleep from midnight until approximately 6:00 a.m. Intravenous infusions were left unmonitored. During some local festivities, physicians and nurses departed for 4 entire days, leaving all patients behind in the care of the BMT. The nurses did not measure patient temperatures, did not keep patient charts, did not measure intake and outputs, had no signalling or alarm function and started their morning shift by brooming and cleaning the hospital floor. Cats and dogs entered the patient rooms to search for food.

BMT 1, 2 & 3 returned to Belgium. French teams replaced them as they offered to take over the mission. Their team 5 returned from Banda Aceh with discouragement: the Acehnese did not wish them to stay there and the French government no longer wanted to support their mission.

I was troubled to find that children in the face of a large disaster did not have the same value as adults. Disaster teams are often emergency or military units equipped mainly to deal with adult patients. The countries where this disaster occurred are countries where many children are born and many die. Many children are not even registered (sometimes they even do not have a name) until they have survived measles.

The BMT achieved a 20% mortality rate following the tsunami in a hospital 80% of patients died before the tsunami. Our pediatric critical care background enabled us to see the potential for a disaster area. There is no such thing as an *International Pediatric Intensive Care Disaster Team*. A team of specialists devoted to major global events to care for severely injured or very ill children. A team able to provide care in very difficult conditions, as we were required to do.

The mortality rates we observed were unacceptably high because we arrived late and we were lacking many tools. An earlier departure and a devoted disaster team might have resulted in decreased mortality rates.

These helpless children never had a real chance.

A Photographic Essay From the Tsunami Disaster

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All photographs provided by Dirk Danschutter, a nurse-member of a Belgian Medical Team that responded to this disaster. See Dirk's article in this issue that provides a textual account of this team's extraordinary experience.

Tending to a sick child

Joining the Aussies

Making a pharmacy

The painters

The pediatric ward

The Belgian tsunami team

Surviving in makeshift shelters

Ward mud

A scene from a ward

Endotracheal Suction in Children and Neonates: Towards an Evidence-Based Technique

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Abstract
Endotracheal suctioning is an important procedure in intubated infants and children, but there is no convincing evidence base for many of its aspects. In performing the procedure, clinicians must find a balance between the effective removal of secretions and the risk of complications. The majority of research has focused on the latter, and effectiveness of suction has received little attention. Recent research findings suggest the need to revisit some accepted techniques. This article reviews these findings and suggests directions for future research. It is argued that research specific to the neonatal and pediatric populations, using appropriate methods, and focusing on clinically important outcomes, is required for the development of an evidence base.

Background

Endotracheal suctioning is the most frequently performed invasive procedure in intensive care units. Although a vital component of the care of mechanically ventilated patients, it has long been recognised as a potentially dangerous procedure. Its successful performance depends, therefore, on the effective removal of secretions whilst minimising complications. Despite three decades of research, there is still no convincing evidence base to support many aspects of the technique.[1] Moreover, very little research has been conducted in pediatric patients. While published guidelines recommend the application of research findings obtained in adult populations,[2] the relevance of such findings must be questioned. Although a larger number of studies have been performed in neonatal patients, the findings have been insufficient to provide firm guidelines for clinical practice.[3-5]

The purpose of this review is to highlight deficiencies in the current knowledge base that prevent the establishment of appropriate suctioning practices. It will focus on the two major aspects of the technique, safety (primarily in terms of preventing hypoxemia) and effectiveness. Future research directions to address these deficiencies will be suggested.

Avoiding/Minimising Hypoxemia

Hypoxemia is the most frequently cited complication of endotracheal suction, and has been described in all patient populations. Initially it was thought to occur because of interruption to the oxygen supply and removal of oxygen from the lung during the suctioning phase; hence, administration of supplementary oxygen prior to the procedure has been widely accepted as standard practice. Most guidelines recommend an oxygen concentration of 100% be used in all patients,[2,6] although the degree and clinical significance of changes in oxygenation have been found to vary widely.[1,6] Increasing evidence of the potential for hyperoxia to cause lung injury[7-9] does not appear to have influenced the practice of administering supplemental oxygen to adults or children. However, adoption of the practice has been limited in neonatal patients, in whom adverse effects of hyperoxygenation, most notably retrolental fibroplasia and chronic lung disease, have long been recognised.[3]

An additional technique that may be used to prevent hypoxia is hyperinflation, or delivery of a larger tidal volume than is being

delivered by the ventilator. There is no conclusive research to guide the use of this technique in adult patients,[1,6] and it does not appear to have been studied in the neonatal population.

Only one study has investigated these techniques in children. Kerem at al[10] studied the effect on partial pressure of oxygen (PO2) of three strategies: hyperoxygenation prior to suction, hyperinflation only before suction, and hyperinflation only after suction. The subjects were 25 children aged between 1 day and 10 years. They found all three strategies elevated PO_2 above the starting value; with hyperinflation administered prior to suction only, PO_2 dropped significantly following suction. The authors recommended preoxygenation with 100% oxygen prior to the procedure, and hyperinflation at twice the patient's tidal volume between catheter passes and at the end of suctioning.[10] However, there is no evidence to support these specific protocols over others, such as lower oxygen concentrations or different tidal volumes.

Studies of hyperinflation drew attention to the possibility that hypoxia may be caused by atelectasis resulting from disruption to ventilation, rather than loss of oxygen alone.[10] More recent studies point to the loss of positive end-expiratory pressure as the chief mechanism of this response.[11] Several devices have been developed that enable ventilation to continue during suction, including various types of endotracheal tube adaptor and in-line suction catheters – a technique now dubbed closed system suctioning. Studies in adult patients indicate that the hypoxic response is diminished but not eliminated with the use of closed systems, and there is no consensus regarding the need for additional preventive measures.[1,12] No similar studies have been conducted in children. A small number of neonatal studies have found closed suctioning to result in better physiological stability, but the clinical significance of such differences remains unclear, and a recent Cochrane review concluded that there was insufficient evidence to support one technique over another.[5] A more recent and larger study produced similar findings.[13]

The outcome measure studied most frequently in assessing the effect of suction is oxygenation, as determined by blood gas analysis and/or pulse oximetry. However, this may not be the most important, or even most appropriate, outcome to investigate. Recent researchers have focussed on loss of lung volume during suction, as technological developments have enabled quantification of this effect. Respiratory inductive plethysmography (RIP) is a non-invasive monitoring technique that measures changes in the cross-sectional area of the chest wall and abdomen, and has been shown to be accurate in quantifying changes in lung volume.[14,15] Several researchers have used this technique during endotracheal suctioning in adults[16,17] and children,[18] and have found open suctioning to result in greater losses of lung volume than closed systems. However, the clinical significance of these findings is unclear, particularly in patients with mild to moderate lung failure.[8] Similar comparative studies have not been undertaken in the neonatal population, but a recent conference presentation reported RIP during open suctioning of newborns receiving high frequency oscillatory ventilation.[19] The authors described an initial loss of lung volume on disconnection, with an additional smaller loss during suction; however, lung volume following suction was not statistically different from the pre-suction volume. This is the only study to date to report the effect of any suctioning technique during high frequency ventilation.

These studies call into question some established practices. It is unclear whether hypoxemia is a direct result of loss of lung volume, or a separate phenomenon. If directly related, administration of oxygen may serve to mask the – potentially – more important effects of suctioning, and may in itself have deleterious effects. Hyperinflation may prove to be a more effective means of preventing these effects, but clearly more research is required to determine how this strategy should be applied.

The chief limitation of RIP is that it can only record global lung volume changes, with no indication of regional variations. Atelectasis and overdistension may be present simultaneously, in different lung regions.

Without some means of assessing these variations, hyperinflation may be a dangerous manoeuvre. Electrical impedance tomography (EIT) may provide a solution to this problem.

EIT uses a small electrical current, delivered through electrodes placed around the patient's chest, to produce a cross-sectional image of the lung, similar to a CT scan. It provides real-time images of changes in impedance, which equate to changes in lung volume; importantly, it enables regional variations in impedance to be visualised.[15] While utilisation of EIT technology is in its infancy, it is a promising development in investigating both ventilation and endotracheal suctioning.

Effectiveness of Suctioning

Although an effective suctioning technique is vital, little research has been conducted into this aspect of the procedure. Indeed, there appears to be no objective means of assessing the adequacy of secretion removal in clinical practice,[20] and the effectiveness of specific techniques seems rarely to be questioned.

One exception is the use of closed suctioning systems. Nurses in adult ICUs frequently report that they believe secretion removal with this method is inadequate and that suctioning is required more frequently than with open suction.[21-25] One study, conducted in an adult ICU, investigated the comparative efficiency of open and closed techniques by weighing the secretions obtained by the two methods.[26] The investigators employed a cross-over design, so that each patient served as his/her own control, with random allocation of initial suctioning technique. No statistically significant difference was found between the two techniques.

However, the reliability of these findings has been questioned. Steuer et al.[27] found that in-line catheters acquire moisture, increasing their weight, within a short time of being connected to the patient and ventilator circuit, and that the amount of extra weight could not be predicted. Further, and more importantly, comparing weights or amounts of secretions in the clinical setting relies on the assumption that the same amount is available for removal on each occasion. This assumption may or may not be accurate. A more reliable method would be to compare the ability of open and closed suctioning techniques to remove a known quantity of material.

This method was employed in a recent *in vitro* experiment,[28] in which researchers instilled a quantity of soap gel into an artificial trachea, which was connected to a test lung, and compared the amount of material recovered by open and closed suctioning techniques. They found open suctioning removed significantly larger amounts than did closed suctioning. These findings raise serious questions about the use of closed suctioning systems, and more research, preferably in an *in vivo* model, is required urgently. As such studies cannot ethically be performed in humans, these questions are best addressed in animal experiments. Furthermore, the above study[28] used an adult-sized endotracheal tube and suction catheters; research using smaller tubes and catheters is required to investigate this topic in the pediatric and neonatal populations.

However, findings from animal studies cannot be applied indiscriminately to the clinical setting. More research will be needed to determine their relevance to infants and children. Before undertaking this research, it is vital to determine what are the clinical indicators of effective suctioning – or, conversely, what are the consequences of inadequate secretion removal. Anecdotally, nurses have tended to focus on blockage of the endotracheal tube as the chief, if not the only, outcome of importance. Lobar collapse, microatelectasis and increased work of breathing have been identified as indicators of retained secretions,[29] but these problems are rarely studied as outcome measures. Indeed, it is possible that the effects are more subtle in some patients, potentially prolonging the duration of ventilation without producing obvious clinical signs. This outcome measure is seriously underexamined. Lastly, the possibilities of using technology to determine the effectiveness of suctioning should be explored.

Producing Research Evidence – Lessons From the Past

This review has argued for more research in the areas of both safety and effectiveness of endotracheal suctioning. However, it is important to reflect on some of the reasons why previous research has failed to provide the required evidence base. What lessons can we learn from the past and what pitfalls should we avoid in the future? The following points are offered for consideration and to stimulate discussion.

1. Undoubtedly the lack of research specific to infants and children is the biggest barrier to establishing an evidence base. While it may be appropriate in some circumstances to extrapolate findings from adult studies, caution is required in doing so. At the very least, such findings should be tested in the pediatric and neonatal populations (for instance using pre- and post-test methods) before being adopted.

2. Suctioning is a vital component of ventilatory management, yet is generally studied as a separate phenomenon. Developments in ventilation strategies or methods have not been paralleled by research into suctioning methods. Of particular note is the lack of research into appropriate suctioning techniques for patients receiving high frequency ventilation.[5] A combined approach to researching ventilation and suctioning would enhance knowledge of both practices.

3. Research into suctioning has been seriously hampered by the lack of a systematic approach, characterised by a plethora of individual studies rather than a planned program. This approach limits the knowledge that can be acquired by research teams, prevents findings from one study being built upon in subsequent work, and results in confusing and often conflicting conclusions and recommendations.

4. Partly as a result of this fragmented approach, and partly because of the precedence given to randomised controlled trials, most suctioning studies have employed this method. Systematic reviews have noted that the majority of studies have been characterised by methodological flaws and/or small sample sizes.[1,3,5] Randomised controlled trials are necessary, but cannot be performed without adequate observational studies to guide their design. The findings of some recent observational studies[27,28] suggest many clinical trials have been undertaken prematurely, limiting their ability to provide meaningful results.

5. Almost all the previous research has focussed on the immediate effects of suctioning. Consequently, we know nothing of the long term effects of any suctioning technique. Research into these effects is long overdue.[5] Indeed, there is an urgent need to identify appropriate outcome measures in general.

6. The search for a standard suctioning technique – a one-size-fits-all approach – that is apparent in the majority of recommendations and guidelines[1,2,6,30] is of questionable value. If ventilatory management is tailored to a patient's individual needs, surely a similar approach is required for suctioning practices. Different suctioning techniques may be required in different disease processes. Indeed, it is possible that individual patients will require different techniques at various times.

7. In interpreting research findings, there is often an unfortunate tendency to confuse statistical significance with clinical significance. This confusion may be merely misleading, but it may also be harmful – for instance, the ability of an intervention to increase PO_2 from 100mm Hg to 300mm Hg may represent a statistically significant result, but is it a desirable one? As has been argued throughout this paper, it is vital to define clinically significant outcomes as a matter of urgency.

8. As has been noted, the small sample sizes employed by many researchers have severely limited the usefulness of their findings. It is particularly difficult to obtain sufficient patient numbers in the pediatric population. Multicentre trials can overcome this problem, but are relatively expensive to conduct. Access to funding for researchers without an established reputation is almost impossible. Collaboration and cooperation are, therefore, vital to the successful conduct of research in this area – between

individual researchers, between research teams, between institutions, and between disciplines. Herein lies one very important key to establishing a suitable evidence base to guide endotracheal suctioning practices.

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Pediatric Intensive Care Nursing welcomes paper submissions for upcoming issues of this publication. Papers may focus on any clinical or professional topic relevant to nursing the critically ill child and pertinent to an international nursing readership. Submissions should be 2-4 double-spaced pages in length.

Send your proposed papers directly to Franco Carnevale (Editor):
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Spotlight on PICU

This regular column will provide readers with an opportunity to learn about fellow PICUs in various parts of the world.

Column Editor: Beverley Copnell, RN, RSCN, BappSc, PhD
Postdoctoral Research Fellow, Department of Neonatology, Royal Children's Hospital & Murdoch Childrens Research Institute, Parkville, Victoria, Australia

Some Realities and Perspectives of Pediatric Critical Care Nursing in Brazil

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While some developed countries are currently facing a severe nursing shortage likely to compromise the quality of nursing care and patient safety, in Brazil, as well as in many developing countries, the nursing deficit has been a longtime chronic crisis.[1]

The Brazilian nursing shortage is caused not only by unsatisfactory work conditions but also by the use of non-qualified workers in the health care system. Nursing assistants and technicians are usually in charge of specific tasks such as IV puncture and drug administration, dressing changes, urinary bladder catheterization, endotracheal suction, peritoneal dialysis implementation and other complex interventions. Due to these facts, society has witnessed the spread of low standard nursing care. As a rule, this uninspiring environment underlies the process of social undervaluation of nursing professionals. That is the reason why few people had been choosing nursing as a career. [2]

During the last decades, in large metropolitan areas, some economic aspects of the profession have improved. Notwithstanding the high rates of unemployment in Brazil (app.15%), there is a great demand for health professionals, especially for nurses. Brazil has more than 180 million inhabitants and according to recent statistics, there are one million professionals in nursing. However, only 25% of these are registered nurses. [3]

Facing this reality, educators are encouraged to develop new specialization courses in order to meet the specific needs of the patients and families. Sad but true, only in recent years have these advances taken place in Brazil, mainly in south and southeast regions.

The health care system in Brazil presents significant variations nationwide. These variations are related to the serious economic and social problems faced by developing countries.[1] While many Brazilians can not get access to the health care system, because of the small number of critical care units in nonprofit hospitals, less than 20% of the national population have access to outstanding hospitals, accredited by the Joint Commission International (JCAHO) from the United States of America, for example. [2-3]

Briefly, in this paper we are going to present the principal aspects of nursing practice, education, and research in the PICU.

Practice

Although the high evidence in literature of the benefits of adopting family-centered care, in some units it is still the expression of an ideal. [4] We have been looking for political arrangements to implement this philosophy of care. The strategies include some interesting interventions such as:

- Development of a protocol to implement the family-centered care in a way that is easy to understand and integrate into clinical practice.
- Opening the doors of the units to the family, maintaining a member of the staff responsible for the care of the family, to give the information they need, and to ensure support is available with expert help.
- Development of tools to help the family and the staff to deal with the situation, like booklets with information for the family and checklists to facilitate and ensure that the needs of the family are consistently met.
- Maintaining a comfortable area for the family to remain near the patient and to be cared for. We intend to guarantee a space for family to rest and stay with other family members while living with the hospitalization of a child in PICU.

Nursing education

Federal University of Sao Paulo develops its educational programs exclusively in health areas. At the teaching hospital, efforts are concentrated to prepare health professionals and provide non-profit assistance for communities in Sao Paulo.[3]

The Nursing Department, in partnership with the 9-bed Pediatric Intensive Care Unit (PICU), has run nursing specialization since 1986 and residence programs since 1998. Motivated by the results and a great demand, these programs are kept in a permanent schedule and are coordinated by nursing professors of the pediatric area of the Nursing Department.

Research

For the last few years, we have been trying to increase the involvement of under-graduate students in research projects. The ideal is to put them in contact with professors, researchers, doctoral and master students in order to improve their research skills, providing them with the chance to be part of a team that is developing a larger study. These students can receive a profit provided by the government, in programs designed as Scientific Initiatives.

In some hospitals, mainly the ones linked to universities, nurses have been stimulated to produce research to be designated as clinical researchers. In courses named as nursing residence or specialization all the nurses must develop a paper, with the aim of learning basic steps of scientific methodology.

Master in Nursing courses are undertaken for a two year period, and doctoral post graduate students must write a thesis during the four years of the program. All post graduate students can get financial support for themselves and their project during all the years of each program (Master or Doctoral), so they can have full dedication to the research process. If the nurses decide to maintain their jobs, they cannot receive personal financial support.

The competence and research skills of nursing professors are continually assessed by an agency of the Ministry of Education, and this assessment is based on some indicators, such as number of oriented students by professors, number of papers published in indexed journals, financial support acquired by agencies of research promotion, and others. Our University obtained in the least year five points, the maximum score obtained by national nursing post graduate courses, in a scale that ranges from one to seven points.

Our practice has demonstrated a positive outcome related to the integration between the academy and the practice setting, contributing to the development of the nursing students' skills, the care provided to the children and families, and pediatric critical care nursing as a discipline.

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The main purpose of CONNECT is to provide a forum for critical care nurses around the world to share good practice. It aims to be the voice of critical care nurses world-wide. One of its founding principles is that of support of the Critical Care Nursing speciality. CONNECT aims to create a nurturing environment that enables all critical care nurses to have a voice. As such, the editors believe that all nurses have something valuable to contribute to CONNECT, that others may learn from. For this reason, no articles are rejected on the basis of language, and the editors undertake to provide help to authors, especially those writing in a second language. The main focus of CONNECT is clinical practice, and we (the editors) are particularly keen to receive articles that describe or evaluate developments in nursing. The journal contains a mixture of articles, including descriptions of practice innovation, literature reviews, letters, conference reports, clinical skills guidelines, news items, research and, of course, all the latest information about developments in WFCCN. Its aim is to be a friendly journal - one that nurses read because they are interested - and we make no apologies for its informal style!

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