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Dear Friends,

It gives me immense pleasure to introduce NCCDF from my perspective. I would like to give a background of how NCCDF was established.

The concept of NCCDF arose when I was pursuing my Clinical Fellowship in Adult Critical Care Medicine at University of Toronto. Every time I was in working in ICU, I use to be very contended and excited and had tremendous job satisfaction. Whereas when I was back in Nepal, there was always some stress or other. Then I realized that the source of my satisfaction in work were the resources that I had. Being in Canada, and Health Service Ontario paying all the patients charges and all utilities and equipments being free to the patient was a big boon. Not a single person, including patients, families, healthcare workers had to worry about drugs, utilities and equipments whereas in a poor country like Nepal, we might have to even wait for hours after ordering an IV cannula for the patient family to buy and bring. At times, I also wished I could collect those disposables that we waste and bring it to Nepal, and wonder that would last another few years (some could be recycled).

With these thoughts, I was wondering if we could have some institution that can help in this regard. My thoughts became more energized after I met Dr. Redouane Bouali at University of Ottawa, Civic Campus and he explained the possibilities of my thoughts. We discussed and concluded that all of this was possible because of Department of Critical Care Medicine being a separate faculty in North America, and has separate budget, economic resources. Once the department and faculty becomes separate, then it will be more easy to concentrate on development of that specialty rather than trying to uplift whole health care of the nation, which is more of a responsibility of the state. What the department earns can utilize in its development. Dr. Bouali suggested that we should establish an NGO that could support the development of Critical Care Medicine, not only in an institution but also across Nepal, which will try to gather support from people around the world who will like to develop Critical Care Medicine and ICU services in Nepal. After this, I put this thought to my Attending Consultant, at University of Toronto, Dr Laura Hawryluck, who was also very much keen to help and develop CCM in Nepal.

And after my return to Nepal, I started my career at my home institution, Institute of Medicine, as the First Intensivist in Nepal (with an University Accredited Fellowship in Critical Care), from July 2012. I then sat with my friends Dr. Archan Adhikary, Dr. Pramesh Shrestha, and Dr Diptesh Aryal and discussed about it. These three friends of mine have always been a great help and support to me in multiple aspects of my life and career. Then, we started looking for someone we could resort to opening and registration of NGO, and found a young dynamic guy, Mr. Nipesh Acharya. With his academic background from Norway, and vision to support the organization, we invited Nipesh in the team. Then we formed an adhoc committee and registered the NGO as Nepal Critical Care Development Foundation (NCCDF). Once NCCDF was registered, the adhoc committee became the Founder Executive Committee and then Dr Redouane Bouali and Dr Laura Hawryluck became our International Members. Mr. Nipesh Acharya, the General Secretary of NCCDF, who pursued all the administrative and managerial hassles, was appointed as Managing Director for NCCDF who is now working for smooth functioning of NCCDF.

And now, NCCDF is working to achieve its goal to develop Critical Care Medicine in Nepal. NCCDF will now start supporting Academic institutions, Professional Societies in conducting CMEs, Workshops, Seminars, Trainings and other aspects of Critical Care Medicine.

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We also found that Critical Care Medicine has developed to this present state in North American countries, not only because of resources and equipments and advancement in technology, but also because of dedicated Critical Care Nurses. There, to become a Critical Care Nurse, after the Nursing School (which is a Bachelor Degree) they become a Registered Nurse (RN), and they have to work for at least two years in the wards and have a separate training program. This training program provides all mandatory knowledge, and skills that a Critical Care Nurse must have provides Critical Care Registered Nurse (CCRN) Certification. But surprisingly in Nepal, most ICU nurses are fresh pass out from Nursing School (Proficiency Certificate Level; +2 Level) and most of them directly are posted in ICU and some might even does not have basic nursing experience. And thus, it's the fault of the system, which wants to get complicated things done from Nurses who are just crawling in their career. Thus, NCCDF also is working towards development of Critical Care Nursing and is in favor of establishment of Critical Care Nursing Association or Society which can conduct training and provide certification system so that Critical Care Nursing Improves in Nepal. We have also been able to make some collaboration with Nurses from Canada who has volunteered to come to Nepal and conduct on site training to our ICU Nurses.

I will also like to thank our International Members and their team who have been visiting Nepal with the sole purpose of development of Critical Care Medicine in Nepal.

Above all, I would like to express my sincere gratitude to all individuals, institutions, societies who are dedicated to serve critically ill patients.

Let’s work together to care for these patients. They need us. Your support in any form will be valuable for us.

Dr. Subhash P Acharya, MBBS, MD, FACC, FCCP
Critical Care Physician (Intensivist)&Clinical Coordinator, Intensive Care Unit,
TU Teaching Hospital, Institute of Medicine (IOM), Tribhuvan University.
Email: drsuvash@gmail.com
Message from the Director

Dear Friends,

Nepal Critical Care Development Foundation was established in 2012, with an aim of developing critical care medicine by conducting CMEs, workshops, trainings, seminars, supporting academic institutions and professional societies in the country. I was approached by Dr. Subhash with his thought of setting the institution and I agreed to his proposal. It was not easy registering such institution as we previously thought with constant visits to the Central District Office, Ministry of Health and Population, Department of Health for the approval of our objectives and aims. Finally we got the approval from the government institutions and were officially registered as a Non-Government Organization.

The first annual year was a year of important beginnings. We conducted our first CME on Acute Care and Emergency Medicine Workshop at Shankharapur Hospital, Jorpati with Mr. Christopher Macejewiski, ATLS Instructor from Toronto. Our international members Dr. Redouane Bouali and Dr. Laura Hawryluck participated on CME’s conducted by Nepalese Society of Critical Care Medicine and Society of Anesthesia Nepal. They spoke about various topics in critical care medicine during their time here.

On May 1st, 2013 we conducted our first charity movie show. The show was highly received by the participants and we had a full house show at Jai-Nepal Cinemas. People were happy with what we have started and were willing to help more in the coming days.

The fund collected from the charity show was used in donating the Air-Mattresses to the Tribhuvan University Teaching Hospital (TUTH) and Bir Hospital ICUs. This was a new start to the things to follow. We hope to do more equipment donations and support the ICUs in the future.

In an attempt to create awareness regarding the Hand Hygiene issues, we printed and distributed the Hand Hygiene posters to all the ICUs in the valley for free. The hand hygiene was another successful attempt to encourage medical professionals make aware about the simplest and effective technique. In the coming days, we will be distributing more posters to the ICUs outside the valley.

We have started setting up “NCCDF ICU Care Box” in the ICU in TUTH. This box contains emergency medicines and equipments essentials in the treatment process in the ICUs. Thus in an emergency situation, the ICU can use these medical drugs/equipments for the patients. The sole aim of the box is to facilitate the treatment process so that the patient continues getting the care even if they cannot afford to pay for the medical drugs/equipments. We will be setting up the care box in Bir Hospital too.

In the coming days we plan to support more ICUs in the country with donations and awareness programs. In an effort to develop specialist critical care nurses, we plan to conduct critical care nursing training program to develop a big pool of specialized critical care nurse. The skilled nurses will help improve the quality of care provided in the ICUs around the country.

We look forward to achieving many more milestones ahead.

With Gratitude,
Nipesh Acharya
Managing Director
nipesh@ncdfnepal.org
Section A
Introduction
Critical Care or Intensive Care Medicine is a fairly new specialty in the field of medicine. It is a multidisciplinary specialty that takes care of critically ill patients suffering from life-threatening illnesses in the intensive care unit (ICU). This branch is manned by the physicians who are trained in this specialty and are called as ‘Intensivists’ or ‘Critical Care Specialists’. Managing critically ill patient in ICU requires a team effort and therefore all physicians, nurses, paramedical staff, educators, councillors, physiotherapist works together and brings the best out of themselves.

The four most common admission criteria to ICUs in context of Nepal are post-surgical treatment, infectious diseases, trauma, and peripartum maternal or neonatal complications. Insufficiencies of supporting disciplines (e.g., laboratories, radiology, surgery), poor general health status of patients, and in many cases delayed presentation of severely sick patients to the intensive care unit, contribute to comparably high mortality rates in Nepal. In Nepal, the lack of infrastructure in delivering the health care to general public is a major hindrance in providing better critical care service to the patients. The ICUs usually remain an ad hoc area within hospitals and the disciple of critical care may be poorly organized. Speciality trained Intensivists and critical care nurses are minimal.

Nepal Critical Care Development Foundation (NCCDF) is non-political, non-profit, and social organizations established with an aim of developing Critical Care Medicine in Nepal and help upgrade the status of ICUs in the country. The foundation performs analysis of the available critical care medicine services and helps improve it further to support more patients. NCCDF frequently conducts training, workshop to the nursing staffs, medical officers, residents, and other professionals involved in ICU. NCCDF also organizes seminar, meeting, discussion, and offer volunteer opportunities to the medical professionals in the ICU.

We have realised that we have very limited skilled nurses working in the ICUs. The Critical Care Nurses in Nepal are scarce, so we are planning to conduct projects in order to develop more nurses with critical care nursing skills.

The foundation is established with an aim of achieving the following objectives:

• To develop Critical Care Medicine as a separate speciality in Nepal and develop specialised human resources to achieve the same.

• To analyse the availability of Critical Care Medicine Services and increase the facility thus providing further care to help more patients.

• Help academic institutions and professional organisations to providing Short Term Trainings, Courses, Diplomas, Fellowships, to the nursing staff, medical officers, residents, graduates and postgraduate degree holders in Critical Care Medicine.

• Organising and coordinating different Continuing Medical Education (CME), seminars, group discussions and information dissemination on various topics to update the recent advances in Critical Care Medicine.

• Bring together the health care personnel involved in Critical Care Medicine in Nepal and seek to provide the Continuous Medical Education and trainings.

• Forming collaboration with hospitals in Nepal and abroad and providing opportunities for observer-ship/electives/Volunteerwork to those individual coming from abroad.

To perform its objectives, NCCDF has been working and performing various activities as described below.
Charity Movie Show

On May 1st, 2013, NCCDF organized its first Charity Movie Show with a Nepali movie named ‘Apabad’. Apabad is a 2012 Nepali film produced by Ideas and Images Pvt. Ltd. The movie show was huge success with a house full at Jai Nepal Cinemas. We were overwhelmed with the support we received from the participants.
Participants at the Charity Show

Participants at the Charity Show
The Hand Hygiene Poster

Hand Hygiene is another name for hand washing or cleaning. Hands can be effectively cleaned with either soap or water, or with waterless hand sanitizers. Both are equally effective. Hand hygiene is simple and is the most important way of preventing infections in hospital. Our hands may look clean but many germs are invisible to our eyes. We can unknowingly transmit bacteria and viruses to others and our environment. People (especially children) sometimes take short-cuts when they are supposed to wash their hands – particularly when there is no dirt visible. And unfortunately, hand hygiene is sometimes not well performed by health care workers.

NCCDF has been distributing free Hand Hygiene Posters throughout hospitals around the Kathmandu Valley. In an attempt to create awareness on Hand Hygiene NCCDF has been delivering the posters to the hospitals so that the medical staffs are aware about the issue. Washing hands properly can help prevent the spread of the organisms that cause the diseases.

The Hand Hygiene Poster reveals:

- **BEFORE initial patient/patient environment contact:**
  - Before touching patient or
  - Before touching any object or furniture in patients environment
  - **WHEN?** Clean your hands when entering:
  - **WHY?** To protect the patient/patient environment from harmful germs carried on your hands

- **BEFORE aseptic procedure**
  - **WHEN?** Clean your hands immediately before any aseptic procedure
  - **WHY?** -To protect the patient against harmful germs, including the patient’s own germs, entering his or her body

- **AFTER body fluid exposure risk**
  - Before an exposure risk to body fluids (and after glove removal)
  - **WHEN?** Clean your hands immediately after an exposure risk to body fluids
  - **WHY?** To protect yourself and the health care environment from harmful patient germs

- **AFTER PATIENT/PATIENT ENVIRONMENT CONTACT**
  - **WHEN?** Clean your hands when leaving:
    1. After touching patient or
    2. After touching any object or furniture in the patient’s environment
  - **WHY?** To protect yourself and the health care environment from harmful patient germs
Air Mattress Donation

Why we choose to donate air mattress?
Air mattress are very comfortable to the patient and reduces problems like Bed sores and blistering of skin which occurs in pressure areas like heel of legs, ear lobe, back, sacral areas. Even though the cost of mattress is not high, it definitely has a high impact on patients’ condition especially on those patients who are bed ridden for days.

TUTH ICU:
NCCDF donated Air Mattresses to Tribhuvan University Teaching Hospital (TUTH) from the funds collected from the Charity Movie Show. Dr.Archan Adhikari, vice president of NCCDF, handed over the mattresses to Bimala Shrestha, Nursing Charge ICU at TUTH.

Dr Archan Adhikari, Vice- President of NCCDF, handing over Air Mattresses to Ms. Bimala Shrestha, ICU Nursing Incharge TUTH

NCCDF Team with TUTH ICU Team
Bir Hospital ICU:

We, also, donated Air Mattresses to Bir Hospital ICU from the funds generated from the Charity Movie show. Dr. Diptesh Aryal, executive member of NCCDF, handed over the Air Mattresses to Prof. B B Singh, HOD, Department of Anesthesia and Intensive Care, Bir Hospital.

Dr. Diptesh Aryal, Executive Member of NCCDF, handing over Air Mattresses to Prof. Dr. B.B. Singh, HOD, Department of Anaesthesia and Intensive Care, Bir Hospital

NCCDF Team with Prof. Dr. B.B. Singh, Dr. Ravi Ram Shrestha and ICU Nurse Incharge at Bir Hospital
‘We Save Lives!’ T-shirts!

NCCDF has printed T-Shirts with “We Save Lives!” caption.
The t-shirts were available in 3 colours- Blue, Grey, and White.

The T- Shirts are also being sold to Doctors and Nurses and others with the aim to increase awareness about ICUs and also money collected will be used for Charity by NCCDF. The funds collected is used in supporting different ICUs with equipment donations or support in some ways.
A number of patients lose their lives in an ICU in Nepal just because they cannot afford to buy essential drugs and medical equipment required for their treatment. Majority of the population are poor here and cannot pay for health care as there is no health insurance system.

Sometimes in an emergency situation, health care workers have to order these medical equipment and drugs from pharmacies and ask the patients family or visitors to buy them and bring them to the ICU which usually wastes a lot of time and money more importantly at these situations, time is life or death of these patients.

So Nepal Critical Care Development Foundation came up with an idea to setup an ICU Care Box, “NCCDF ICU Care BOX”, which contains medical equipments and drugs which could be used for a poor patients’ treatment and in an emergency situation.

The box contains various medical equipments and drugs such as Endotracheal tubes, Chest Tubes, arterial line kits, Central Venous Catheters, ventilator circuits, cannulas, blood transfusion set to name a few. The box generally contains most of the medical equipments and drugs essential in an ICU setting. The stock of the medical equipments and drugs will be checked and refilled at regular intervals by the Nepal Critical Care Development Foundation (NCCDF). This care box will be handed over to the Nurse Incharge of the ICU and will be accessible to doctors and nurses in an ICU to ensure the proper use of the drugs and equipments and all used items will be recorded in a register.
Academic Activities:

1. **Acute Care and Emergency Medicine Workshop (Dec 2012):**

   NCCDF welcomed Mr. Christopher Maceijewiski, ATLS Instructor from Toronto, for a workshop organized by NCCDF in collaboration with Shankarapur Hospital, Jorpati. The one day workshop was conducted on the Acute Care and Emergency Medicine in December at Shankharapur Hospital premises.

   Eighteen participants coming from different hospitals around the Kathmandu Valley were trained. The trainee were Staff Nurses and Paramedics working in Emergency Department of Medicare Hospital, Norvic International Hospital, HAMS Hospital and Shankharapur Hospital.

   The training session was held for eight hours where Christopher taught the trainees with valuable insights into the Acute Care and Emergency Medicine. All the trainees were also presented with Training Certificate afterwards. The President of NCCDF, Dr. Subhash Prasad Acharya and Dr. Ramesh Dhakal of Shankarpur Hospital, presented Mr. Christopher Maceijewiski with a Certificate of Appreciation.
2. **CME Organized by NSCCM at Hotel de l' Annapurna**

International Members of NCCDF, Dr. Laura Hawryluck and Dr. Redouane Bouali talking at a program organized by NSCCM (Nepalese Society of Critical Care Medicine). Dr. Bouali spoke about Leadership Quality Improvement, Patient Safety and Performance improvement in Critical Care. While Dr. Hawryluck spoke about Decision-Making re use of Critical Care: Ethics at the end of life.

![Dr. Hawryluck speaking at the CME organized by NSCCM.](image1)

![Dr. Bouali speaking at the CME organized by NSCCM.](image2)
3. CME Organized by Society of Anesthesiologists of Nepal (SAN) at Dhulikhel Hospital

The International Members of NCCDF, Dr. Redouane Bouali and Dr. Laura Hawryluck were invited to speak at Dhulikhel Hospital, Dhulikhel, where Dr. Bouali spoke about Shock What's New and Dr. Hawryluck spoke about Acute Respiratory Distress Syndrome (ARDS).

Dr. Hawryluck speaking at the CME organized by SAN.

Dr. Bouali speaking at the CME organized by SAN.
It has been said, by many, that societies are judged by how they treat their most vulnerable members. Today we live increasingly in a world where regional and national boundaries are disappearing and where it is ever more recognized that we share in a global responsibility to seek to alleviate needless suffering, to abolish socioeconomic disparities and, frankly, to show through our actions that we truly care across vast distances of space and time. In 1941, in his State of the Union address, United States President Franklin D. Roosevelt spoke of four freedoms: freedom of speech, freedom of worship, freedom from fear and freedom from want. These fundamental principles of what every society should strive to provide its members resonated then and resonates still for people the world over. They were such key concepts that they ultimately were incorporated into the United Nations Human Rights Declaration on December 10th, 1948. Yet sixty-five years later, our world is one in which a vast number of people lack fundamental access to essential healthcare and to justice—and who struggle hence to maintain their hope for a better future. Within medicine we remain a long way from achieving freedom from want and fear especially within low and middle income countries such as Nepal.

Most people, when they think of healthcare needs in such countries, think of maternal/child health, infectious diseases from pathogens that currently have been either eradicated or aren’t as frequently seen in more developed countries and those illnesses arising from water and food borne pathogens. Many international NGOs/charities have excellent programs directed towards meeting these needs.

What doesn’t necessarily come as readily to mind is the need to develop knowledge and skills in critical care medicine. Yet worldwide, specialists in critical care medicine are those physicians, nurses and allied healthcare professionals who devote their lives to trying to save the sickest and most vulnerable patients, those whose illnesses are immediately life-threatening. These are the patients struck down by severe sepsis, involved in terrible motor vehicle accidents or who have sustained devastating workplace injuries. They are the patients who need to undergo complex surgical procedures whether it be abdominal surgery, burn resections, neurosurgery or cardiovascular surgery. Such injuries and infectious illnesses are the greatest cause of mortality in Nepal. These complex surgeries occur daily across the country. These patients are generally young people, those that represent a country’s future or, middle aged people, those who through their wealth of experience, can ensure a country’s stability and growth. Physicians and nurses trained in critical care medicine can return these people to health, to a life with meaning and quality and, to a future within their family and within society. Research has shown that specialized training plays a vital role in improving patients’ outcomes and survival from critical illnesses.

Yet critical care medicine remains in its infancy in Nepal: there is a profound lack of trained physicians and nurses, and a significant lack of resources whether it be specialized equipment or intensive care unit (ICU) beds when compared to most other countries and, to appropriate standards accepted worldwide. However, the needs for such critical care services are just as pressing in Nepal as elsewhere in the world. Arguably, due to socioeconomic factors, when they present with life-threatening illnesses, patients are even more vulnerable than those in many other countries.

This fall, for the first time ever within Nepal, a 3 year
Doctorate of Medicine in Critical Care will be accepting physicians for specialty training at the Institute of Medicine, Tribhuvan University and Tribhuvan Teaching Hospital (IOM/TUTH) with the International support and collaboration of the Royal College of Physicians and Surgeons of Canada (RCPSC). The two co-Directors of the project for the RCPSC, Dr Laura Hawryluck and Dr Redouane Bouali, have worked with faculty at IOM/TUTH and have created an educational curriculum that will ensure future critical care physicians are very well trained. The Canadian and international faculty team is a team of volunteers who will actively participate in teaching DM candidates, help in mentoring their research and will work with IOM/TUTH faculty too as part of faculty development initiatives.

The DM in Critical care curriculum will encompass core critical care medicine knowledge and skills, end of life care, communication skills, teaching skills, and knowledge in ethics and law as these pertain to critically ill patients and their families. In addition, recognizing the need for other essential skills, the curriculum will seek to develop leadership and crisis management skills and focus as well on improving patient safety and quality of healthcare. The DM curriculum as devised contains innovations in both its content and its teaching methods above and beyond those seen in many Canadian and International programs. Educational sessions will occur online and during site visits from international faculty. It is a program that should give the sickest patients confidence in the care they will receive and one which the entire IOM/TUTH and Canadian faculty hopes all Nepali people will be proud of.

Through NCCDF, you can help be a part of this exciting project. Volunteers are needed to help with simulation teaching by acting as healthy models for physical and ultrasound exams and by acting as patients and family members in order to help effectively teach communication skills to physicians and nurses. Some equipment, such as ultrasound/echocardiogram machines, are needed to allow physicians to quickly evaluate at the bedside the extent of a patient’s injuries, whether they have appropriately resuscitated these patients, their heart and lung function and to insert large intravenous for medications and monitoring devices needed to closely and effectively follow a patient’s course with life-threatening illness to give some examples. Other equipment will also be needed and NCCDF will work with the DM program to identify these needs and make, you, our supporters aware of how you may be able to help.

Technology is inherent in critical care medicine. Though the field strives to be as least invasive as possible and to leave as small a footprint as possible on a patient’s life, there is no escaping its need when treating life-threatening illnesses. Yet in the midst of all the technology, it is the profound sharing of humanity, the understanding of vulnerability, the openness and caring, that is the most remarkable and essential feature of critical care medicine. For it is through this global support and sharing of humanity that we all appreciate our continued search for freedom from want and from fear; the search that unites us all.
Reflections on our work in Nepal

Ramya Satyanarayana
Debrah Gaynair
Yang Qi

Like many countries in the world, due to political turmoil, Nepal is struggling to improve its health care system. Though the government is providing cheap health care through government hospitals, the health care system is mostly private and people have to pay. There are also academic institutions (medical colleges) and community hospitals which offer cheaper and sometimes free treatment to the poor and underprivileged population, but to a limited degree.

RAISE Nepal is an ambitious project that has been started to create the first 3 year Doctorate of Medicine in Critical Care in Nepal. The project is collaboration with Tribhuvan University and the Royal College of Physicians and Surgeons of Canada that seeks to train physicians and nurses in critical care medicine. We were informed about this project by the Program Directors for the Royal College, 2 Intensivists Dr. Laura Hawryluck from the University of Toronto and Dr.Redouane Bouali from the University of Ottawa. With their help we were able to plan our work in Nepal.

As nurses working in academic medical surgical neurosciences intensive care units in Toronto Ontario Canada, our experience in Toronto’s diverse setting has exposed us to many different cultures, from our inter-professional teams to our clients. We were able to extend this experience to the global community by sharing our knowledge, skills, and experiences with the Critical Care Team in Nepal.

We were fortunate to have an opportunity to work in Tribhuvan University Teaching Hospital, TUTH. We began our project by listening to the experiences of our Canadian Colleagues including those of Marilyn White Registered Nurse from Ottawa Hospital, who had the opportunity to perform a SWOT analysis with the nurses at TUTH during a previous visit. On our first day in TUTH, Dr. Subhash Acharya, Intensivist and Clinical Coordinator at TUTH introduced us to the ICU team and this allowed us to observe how the nurses work, perform patient care and what constitutes their daily routine. At the end of that first day, we reflected on the differences and similarities in our practices even worlds apart and what we could learn and share in order to improve our collective knowledge and skills in caring for some of the sickest patients in the hospital.

The nurse-patient ratio was very different than what we were used to and we did observe that nurses worked very hard. Nurse- patient ratio is one of relative privilege in Canada where it is common to have 1 nurse/patient as compared to 1 nurse/3 patients. The scope of practice of nurses in Nepal is in many ways broader and we witnessed nurses performing tasks that would be done by pharmacists or assisted by fancy IV pumps in Canada. Detailed assessment and observation of any changes in critically ill patients are an essential part of nursing in any ICU. With these additional demands on their practice, we perceived that one of the most useful things we could do to help would be to help nurses develop more effective bedside assessment and triage skills so that they could more quickly identify new patient problems or those that were not resolving as they should. In addition such skills are crucial, to more effectively communicate care issues among ICU team members and to become better patient advocates.

To achieve these goals, we started interactive discussion groups during the afternoon. We focused on head to toe assessment, and hands on assessment of patients as a group. We taught and used the Situation-Background-Assessment-Recommendation (SBAR) communication tool, in order to provide more structure with respect to communication between nurses and in particular between doctors and nurses to improve collaboration. SBAR has been internationally recognized in the literature to prevent the breakdown of verbal and written communication. In crisis situations SBAR promotes patient handover, safety, and escalation of care.

Infection control issues are increasingly important in ICUs around the world as multi-drug resistant (MDR) bacteria become ever more problematic. We had to quickly understand the challenges that arise in TUTH and Nepal in particular in view of differences in ICU resources between our countries. We worked with the team to share and develop some simple techniques and processes that we all hope will help improve and focus the team on the importance of infection control measures.

Later we focused in on specific life-threatening illnesses and topics, that as nurses within a Medical- Surgical-Neurological ICU in Toronto, we have developed specialized skills. We discussed Neurological assessment including GCS, C-spine precautions, and what to expect presented with a neurological injury.

Patients were not sedated, they were awake. Very rarely did we perceive delirium, less sedation kept the patient alert and awake, which was wonderful to see. This perhaps is good for the patient’s outcome after the prolonged ICU stay. Since we are used to abundance of resources, we were surprised to see with bear minimum resources how patients survived in Nepal. This taught us a lot and we find ourselves reflecting on how to better conserve resources now that we are back home. All credit goes to skilled Doctors and Nurses who used resources efficiently and team work was excellent.

Nurses at TUTH participated enthusiastically throughout
the discussions and they were a pleasure to work with. With them and Dr Acharya we developed some clinical tools that we adapted to critical care nursing at TUTH. Such tools will, we hope, be of use to many other ICUs across the country. At the nurses’ request, we spent a lot of time developing educational materials and handouts about the topics we covered. It was a good review for all of us. We made the handouts easy to use as quick references in order to promote both knowledge translation into practice and continuing education. We also ensured pictures as posters were created that would be able to be used as visual aids and reminders to help them review topics that we had discussed with them.

We were so pleased to see a difference in assessment skills, for example when a nurse asked us to help them understand or hear lung sounds that they could not differentiate. Nurses were enthusiastic and raised important questions in trying to understand deteriorating neurotrauma patient and chronic neurological condition of the patients in the unit. It was nice to see their confidence grow every day at the bedside.

Not only did we have the privilege of being welcomed into a great team in order to help them improve their knowledge and skills and to develop clinical and educational tools, we as a group, had huge learning curve in trying to understand and comprehend cultural differences beneath the technological and medical care provided to patients. For example: a recurring challenging situation was when family members were ready to bag and take their critical family member home away from monitors and medical system.

In addition, we now reflect on how fortunate we are to have easy access to free specialized critical care in Canada. Patients in Nepal have a challenging time getting proper assessment and working diagnosis in the community. It is equally hard for family members to bring in their family members suffering from an illness in to hospital and to financially afford the medical treatment prescribed for the patient. If I was a patient or a family member in Canada, I would not have to think how much money I have to get the treatment that I need, or how many days can I support my family member in hospital with the money that I have. Everything starts with money in Nepal and sadly ends with perhaps family who may lose their house and farm with patient’s death. This experience allowed us to understand what the healthcare system is about, but also to understand what it means to patients who are on the edge of life and death. People travelled hours and days away from Kathmandu to reach this hospital for basic care. Still they have to pass through unimaginable waiting time. This puts the vulnerable, seriously ill patient in inevitable danger in a way that was foreign to us as Canadians.

We found this one of the biggest challenges yet it was crucial that we overcame this difference if we were to be of any use at all to our colleagues in TUTH. We hope we succeeded and that we found some ways of bridging the gap, of using our skills to help in a setting where resources are much more scarce. It was challenging for us to comprehend and compare our health care system in Canada with Nepal. While we worked in TUTH, scarcity of resources in Nepal and abundance of resources here in Toronto, made us think how can we minimize waste in our hospital and make best use of all resources we have before it is wasted. How long can we last if we continue to waste? Will there be any resources left in 5 to 10 years from now?

Finally, the most important lesson we learned was that life is not about things we have, it is about making the best of every situations and resources we have. We did learn how people lived with very little resources, and were content with life. It was nice to see Nurses and Doctors who were humble and incredibly grateful for the time we spent and experience we shared together.

We would like to thank our colleagues and many other people who helped us make our trip a wonderful experience. Personally like to thank Dr. Laura Hawryluck, Dr. Redouane Bouali, Dr. Subhash Archarya and Nipesh Archarya for all their support and encouragement throughout our work/trip in Nepal.
How can you help?

As a best member of our society and as a human being, it is our nature to help others and support others in times of need. So you can also help NCCDF achieve its objectives and improve ICU services in Nepal in following ways:

**NCCDF ICU Care Box / Friends of NCCDF:**

As mentioned previously, this box contains emergency equipments and drugs that will be required if a patient becomes very critical or a life threatening condition occur. At these times, in our ICUs, because of lack of resources, health care workers have to order these equipments/drugs from pharmacies and specifically ask the family members/visitors to buy them and bring them to ICU which usually wastes a lot of time and money more importantly at these situations, time is life or outcome of these patients. So NCCDF ICU Care Box will include these equipment/drugs and will be kept in various kits. Thus in any emergency situation, the ICU can use these drugs/equipment for the patients. This drugs/equipment will be replaced once the patients’ family/visitor brings them but in case they can’t, it will be recorded as un-afforded.

This stock of drugs/equipment will be rechecked and stock filled at regular intervals by NCCDF. Whoever would want to help this box will be designated ad “FRIENDS OF NCCDF”. This can be achieved in following ways:

1. **Lump-sum Donation:** Friends of NCCDF can donate any sum of money to the foundation for this ICU Care Box according to their wish. The funds can be hand delivered or wire transferred to the foundation’s bank account. RamyaSatyanarayana, a critical care nurse from Canada and her team has started this step and has supported NRs. 30,000 for the first ICU Care Box.

2. **A Dollar A Day:** For international friends, who want to help very critical patient in ICU, can contribute one dollar per day to the foundation. This can be done on an annually or biannually basis based on the convenience of the donor.

3. **Equipment Donation:** Friends of NCCDF who wants to donate equipments can do so via the foundation. The foundation will help in the procurement process, installation and maintenance of the equipments.
NCCDF’S POOR PATIENTS FUND

NCCDF poor patients fund is formed with the aim to help the poor and needy patients admitted in the ICU. This fund will be used to donate medications/drugs/equipments to patients who are not able to afford their treatment. However, this fund will be allocated only to those patients who are young (less than 65 years of age) and have critical illness of reversible nature and required treatment for short period of time which will be identified by the treating Intensivist. A form will be developed, which will have to filled and signed by treating Intensivist and given to NCCDF, and NCCDF will help the patient based on availability of Poor Patient Fund.

We welcome everyone who is interested in helping our cause by choosing of the proposed schemes. This NCCDF’s poor patient fund can be supported in two ways:

1. **Lumsum Donation:** donation of specific amount of money to this fund.

2. **Regular Donorship schemes:**
   - i) Platinum Plan – monthly 5000 or more
   - ii) Diamond plan – monthly 2000-5000
   - iii) Gold plan – monthly 1000-2000
   - iv) Silver plan – monthly 500-1000

Any individual or organization involved in helping the cause will be provided with the Donors identity card and a certificate of appreciation from the foundation for their effort.

Few generous people have already started this in the memory of their beloved ones.

**Gold Plan:**

1. Late Gita Devi Acharya: NRs 1001 per month from September 2013
2. By Mrs Sanu Chapagain in the name of Late Mr.Bishal Chapagain: NRs 1001 per month from October 2013
NCCDF INSTANT DONATION SCHEME

NCCDF welcomes any individual or organization help the foundation by directly donating to the foundation. This fund will be used to:

- Donate equipment’s to intensive care units
- Improve ICU services in various hospitals
- Create awareness about various process (e.g. hand washing) diseases/condition in ICU (e.g. Sepsis, ARDS) or procedures in ICU (CPV line, Tracheostomy, Arterial Line etc.)
- Education and training of health care workers in the ICUs. But this fund won’t be used for sending individuals for training or to support travel/accommodation for any health care workers.

The individuals or organization helping the foundation via the instant donation scheme will be provided with a certificate of appreciation and thank you note on the foundation’s website.

The instant donation can be done via:

1. PRIVILEGDED DONORS – more than 10 lakhs
2. PREMIUM DONORS – 5-10 lakhs
3. EXCLUSIVE DONORS – 2-5 lakhs

The privileged donors will be provided with a Certificate of Appreciation for their support and invited to the annual general meetings. These donors’ names will be included in the equipment donations made by the foundation. Their recognition will be done via the foundations’ social media.

The Premium and Exclusive donors will also be appreciated with a certificate from the foundation. The names of the individuals or organizations will be mentioned in the foundation’s website for their support.
Section B
Articles about ICUs in Nepal
published in various Journals
*All the journal articles have been published with consent from the corresponding authors*
Critical care medicine in Nepal: where are we?

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Although critical care medicine has been established as a separate specialty in the rest of the world it is still in its initial stages of development in Nepal and intensive care units (ICUs) here are still in primitive stages. This article describes the history, the types and current status of ICUs, the challenges, and academic training and certification in critical care medicine in Nepal, compared with existing ICUs in other parts of the world. Keywords: Critical care medicine, Nepal

Country profile

Nepal is a small country with an area of 147 181 km² and a population of approximately 29 million; it is one of the poorest countries with per capita income of only US$642.1 With these limited resources and political turmoil, the country is struggling to improve its health care indicators. The infant mortality rate has decreased to 46 and maternal mortality rate to 54 per thousand live births; the life expectancy at birth continues to increase and is now, in 2009, 67 and 68 years for males and females respectively.1,2 Though the government is providing cheap health care through government hospitals, the health care system is mostly private and people have to pay. There are also academic institutions (medical colleges) and community hospitals which offer cheaper and sometimes free treatment to the poor and underprivileged population, but to a limited degree.

History

Intensive care started during World War II when ‘shock wards’ were established to resuscitate and treat the injured soldiers. After the polio epidemic of 1952, the world’s first intensive care unit (ICU) started in 1953 in Copenhagen, when Dr Bjorn Aage Ibsen, a Danish anaesthetist, initiated treatment of respiratory paralysis by intubating polio patients.3 Though Dr W.E. Dandy started a three-bed unit for care of postoperative neurosurgical patients at Johns Hopkins Hospital in 1932, this ICU became the first multidisciplinary ICU only in 1958 and started providing care 24 hours a day.4 This also became the first ICU to be covered by an on-site physician (anaesthesia resident) 24 hours a day and 365 days a year. In the early 1990s, critical care medicine was established as a separate branch of medicine, thus the ICU started functioning as a separate department, and a separate curriculum was introduced for teaching critical care in medical colleges by almost all universities in North America, Europe and, more recently, India.

The first ICU started in Nepal in 1973 at Bir Hospital, as a five bed medical ICU. This ICU was developed after the then King, Mahendra Bir Bikam Shahdev, developed a heart problem in 1970. This was the only ICU in the country for almost 20 years.5 In 1990 a six bed mixed medical surgical ICU became functional after the development of Tribhuvan University Teaching Hospital at the Institute of Medicine (IOM), Maharajgunj. Immediately following this, a five bed coronary ICU and 10 additional beds in high dependency units referred to as Intermediate Cardiac Care Unit (ICCU) and Surgical ICU were added. Furthermore, with increasing demands on ICU beds, critical care is slowly progressing and has reached its present shape.

The term ‘ICU’ in Nepal refers to a separate area in the hospital identified to admit critically ill patients requiring life support including inotropes/vasopressors and/or mechanical ventilators. However, there are no governing bodies to monitor the services, quality and facilities required to run an ICU.

Current status

Shrestha conducted a survey of ICUs within the Kathmandu Valley and included 51 hospitals from a list of 50+ bed capacities obtained from the Ministry of Health.6 Of these, 11 (22%) were government hospitals, 8 (16%) were community hospitals and 32 (63%) were private hospitals. Out of these 51 hospitals, only 33 (65%) have ICU facilities. There were 48 Intensive Care Units, with 331 ICU beds, which comprise 4.7% of total hospital beds (n = 7040). There were only 161 ICU beds with facilities for mechanical ventilation, which comprises only 2.3% of total hospital beds. Considering the population of Kathmandu as 2 179 171 as per Central Bureau of Statistics in 2011 there are only 15.2 ICU beds per 100 000 population and only 7.2 ICU beds with ventilators per 100 000 population.5 Though the development of hospitals and ICUs has progressed over the last decade, there are no data or publications to delineate the number of ICU beds and services outside the Kathmandu Valley. Now almost all hospitals in the country have a few named ‘ICU beds’ amounting to a total of around 450 ICU beds in the country. The services, standards, outcomes and efficiency of these ICUs has never been published, except for a very few hospitals.7,8 Most ICUs in Nepal are still functioning in a similar or inferior way to the ICU established by Dr. Dandy in 1958, without 24 hour cover by an on-site physician. Only 18 (38%) ICUs inside Kathmandu Valley have an in-house covering

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Medical Officer.6 Even though there are many papers to delineate the progress of Critical Care in other countries, in Nepal, there are very few publications based on studies conducted in ICUs in Nepal.9–14.

With the exception of one ICU in Nepal they are all ‘open ICUs’ where patients are admitted and treated in their ownway. This has several disadvantages, including polypharmacy and the lack of responsibility of a specific physician to the patient. Primarily, internal medicine and anaesthesiologists are managing ICUs in Nepal in these open ICUs. These open ICUs all over the world were converted to ‘closed ICUs’ early in the 1990s but this has not happened in Nepal because of lack of intensivists. Though intensivists lead the critical care, the patient care is multidisciplinary as they receive opinion and services from all departments when needed. Numerous literature has supported the advantages of closed ICUs and their benefits over open ICUs, especially in a poor country like Nepal.15,16. The only closed ICU in Nepal is at BP Koirala Institute of Health Sciences (BPKIHS), Dharam, which has been managed by the Department of Anaesthesia since 1994.3,11

The concept of subspecialty ICUs emerged around the world in the early 1990s but this was unsustainable as they did not offer any benefits in outcome, but rather increased the demand of specialized human resources.37 Unfortunately the outcome was worse when a patient was admitted to the ‘wrong’ specialty ICU (e.g. a cardiac patient admitted to a neuro ICU). Henceforth, the concept of a general or mixed ICU is now popular except for subspecialty centers where they have ICUs pertaining to that specialty. According to the same survey by Shrestha, out of 48 ICUs in Kathmandu Valley, there are 30 (62%) mixed ICUs, 8 (17%) coronary, 3 (6%) cardiothoracic, 2 (4%) medical, 2 (4%) surgical, and 1 (2%) maternal ICU.6 There are no other data available about types of ICU outside Kathmandu Valley but almost all of them are mixed ICUs.

Considering pediatric ICU (PICU), there is only one Government pediatric hospital (Kanti Children’s Hospital) in the country, which has 10 PICU beds and 8 Neonatal ICU (NICU) beds. There are also other academic institutions, which have a total of 25 PICU beds and 20 NICU beds in the country. A few private pediatric hospitals have emerged with 10 PICU beds and 25 NICU beds. Thus, in total, there are less than 60 PICU beds and 75 NICU beds in the country. However, as with adult ICUs, there is no governing body to monitor the quality of these ICUs.

Considering monitoring facilities within the ICU, most ICUs in Nepal have non-invasive monitoring facilities with electrocardiogram, noninvasive blood pressure and pulse oximetry. Out of the 48 ICUs in Kathmandu Valley, only 24 (50%) have intra-arterial BP monitoring facilities.6 Central venous catheterization is done in almost all ICUs even outside Kathmandu Valley, whereas the practice of pulmonary artery catheterization is limited only to few cardiac surgical ICUs and also less frequently than developed ICUs probably because of associated morbidity and availability of other non-invasive options (such as echocardiogram and non-invasive cardiac output monitors).

Regarding diagnostic facilities in ICUs within Kathmandu Valley, blood gas analyzers are available in 10 ICUs, portable bedside X-ray in 28 ICUs, bedside ultrasonogram by radiologist in two ICUs, and bedside echocardiogram by cardiologist in two ICUs. Transesophageal echocardiogram has been recently been introduced and is being done in only two cardiac surgical centers in Kathmandu Valley.

Regarding support services, mechanical ventilators are available in almost all ICUs in Kathmandu Valley and in other parts of Nepal but only 48.6% (161) of the ICU beds in Kathmandu Valley have facilities for mechanical ventilation. Renal replacement therapy is available in the form of intermittent hemodialysis in only one ICU in Nepal, at Tribhuvan University Teaching Hospital. Though there are risks involved with transferring patients, intermittent hemodialysis is done outside ICUs in 14 other hospitals within Kathmandu and a few hospitals outside Kathmandu. Continuous renal replacement therapy (CRRT) was started in 2005 at Sahid Gangalal National Heart Center (SGNHC), Bansbari, Kathmandu but could not be sustained because of its high cost. Peritoneal dialysis is still the most common form of renal replacement therapy and is being done in 29 ICUs in Kathmandu. SGNHC is also the lead institution in extra corporeal life support in pediatric patients in the Cardiac Surgical ICU but to date very few patients have received this support.

Though no guidelines have been put forward regarding nurse patient ratio in ICUs in Nepal, most ICUs run a 1:2 to 1:3 nurse to patient ratio.6

The commonest causes of admission are peritonitis, postoperative monitoring, organo-phosphorus poisoning, sepsis/multi organ dysfunction, pneumonia, intestinal obstruction, and COPD.8 Other less common causes are neurosurgery, trauma and head injury, burns, tetanus, etc.7,8 Average mortality in ICUs in Nepal varies, ranging from 15.2 to 39.3%.7,10

The expense of ICUs varies from hospital to hospital and is much more expensive in private hospitals. The ICU charges in a government hospital are around US$15 for ICU services and US$15 for ventilators per day. Moreover, this does not include another US$50 required for lab investigations, lines and tubes, and the price of medications which adds another US$50–100 per day. In total, the cost of an ICU admission per day comes to around US$100–200, which has to be borne by the patient’s family. This does not include other consultation and procedure charges that can occur during the ICU stay. The private hospital ICU is, on average, three to five times more expensive than government ICUs.

**Academic training and certification**

Academic training in critical care medicine varies between different Universities and Countries. To date there are no academic training programs in critical care medicine in Nepal. However, in 2012, a combined three-year postgraduate super-speciality program (DM) in pulmonary medicine, critical care and sleep medicine was started by the National Academy of Medical Sciences (NAMS). But the Nepalese Society of Critical Care Medicine (NSCCM) and the Society of Anaesthesiologists of Nepal
There are no certifying institutions in Nepal and a two-year Indian Fellowship of Critical Care Medicine (IFCCM) offered by the ISCCM. Only one institution in India, PGI Chandigarh, has a combined subspecialty DM in pulmonary medicine, critical care and sleep medicine. Divatia JV et al. have published guidelines on defining function, roles and responsibilities of intensivists in India and mentions that one year training in critical care medicine from a ‘reputed ICU abroad’ is adequate to be called an Intensivist. Fortunately, to improve human resources and develop critical care medicine in developing countries, some universities in India are offering a one-year international fellowship program for specialist physicians who want training in critical care medicine but will return back to their country.

Critical care medicine training in India has drastically risen since 1993 after establishment of Indian Society of Critical Care Medicine (ISCCM) and there is now a one-year Indian Diploma in Critical Care Medicine (IDCCM) and a two-year Indian Fellowship of Critical Care Medicine (IFCCM) offered by the ISCCM. Only one institution in India, PGI Chandigarh, has a combined subspecialty DM in pulmonary medicine, critical care and sleep medicine. Divatia JV et al. have published guidelines on defining function, roles and responsibilities of intensivists in India and mentions that one year training in critical care medicine from a ‘reputed ICU abroad’ is adequate to be called an Intensivist. Fortunately, to improve human resources and develop critical care medicine in developing countries, some universities in India are offering a one-year international fellowship program for specialist physicians who want training in critical care medicine but will return back to their country.

There are no certified training courses for allied health staff in Nepal; there are a few short-term courses run by persons or institutions based on their needs. One such program conducted regularly (bi- or tri-annually) is the three-month ICU training for nurses being conducted by the Nursing In-Service Education Unit at Tribhuvan University Teaching Hospital, Maharajgunj. There are no respiratory therapists in Nepal and thus the Anaesthesiology team usually manages mechanical ventilators. Other health staff such as dieticians, pharmacists, and physiotherapists play a supporting role in the critically ill patient but their involvement is minimal and only on a need basis. There are no ICU specific training programs for these health care workers in Nepal.

**Challenges**

The main challenge in critical care in developing countries like Nepal is the high cost of treatment, which has to be borne by the patient or their family. As most patients cannot afford these ICU expenses, their families often resort to selling their assets in order to treat their loved ones. This becomes an ongoing expense for until they stop or withdraw treatment. A substantial number of patients leave hospital against medical advice: 5% reported by Sharma and 13% reported by Koirala et al.

Unavailability of medications, drugs and equipment are other drawbacks in developing countries. Even though medical science has advanced in developed countries, that advancement takes decades to reach developing countries, mainly because of economy. Even matters that look simplest e.g. supply of medical gases such as oxygen; clean water and electricity become major issues in developing countries. Most of these challenges have been elaborated by Basnet et al. in the setting up of a paediatric ICU at Patan Hospital in Nepal. Numerous papers have also discussed the demands and its challenges, especially in developing countries, and have also proposed solutions.

Because of political fluidity, apart from litigation and legal claims, health care in Nepal also experiences vandalism, physical threats and even blackmailing by patients’ families and unidentified groups who work as mediators or are hired by patient families. This is because of weak security systems and the absence of medical laws. Patient families try to avoid understanding the disease process and complications so that they can get monetary benefit from hospitals and physicians when some complication happens to the patient. Complication of a medical disease or condition is often considered as negligence by families.

Lack of human resources is another problem not only in developing countries but also in the developed world. Physicians, nurses and respiratory therapists are always being recruited to work in the Critical Care Units. However, many skilled health care personnel are drained to developed countries, which are seeking such skilled staff, and thus there is a constant scarcity of manpower. And because of the poor resources, there is no proper academic training or certification offered to any members of this multidisciplinary team.

**Conclusion**

Though ICU services have started and are being developed throughout Nepal, critical care medicine is in its initial stages. In this era of the development of super specialty training programs (DM/MCh) in various faculties across many institutions in Nepal, establishment of critical care medicine as a separate branch of medicine, development of closed ICUs and initiation of academic subspecialty training programs (DM or Fellowship) in critical care medicine is urgently needed at this time to improve the ICU services and outcome of critically ill patients in poor and developing country like Nepal.

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A Survey of Adult Intensive Care Units in Kathmandu Valley

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Abstract

Introduction: Well designed, well equipped and well staffed intensive care contributes significantly to improved health outcomes for patients. In recent years, many private hospitals and teaching hospitals have been established in Nepal. Most of these hospitals claimed of having well equipped and well staffed ICU services, but there are no published data on the overall intensive care services in Nepal.

Methods: This is a cross-sectional observational study done to survey the structure, staffing resources and available technologies of adult Intensive Care Units of Kathmandu valley. A structured questionnaire was distributed and relevant information was obtained from physician in-charge or the sister or nurse in-charge of each unit. Any clarification found necessary was done over a telephone.

Results: Out of 51 hospitals with bed capacities of 50 and more situated in Kathmandu valley, 33 (64.7%) hospitals were identified as having ICU services. Twenty-seven (81.8%) of those hospitals were located in Kathmandu district, 5(15.2%) in Lalitpur and 1(3%) in Bhaktapur. Twenty-one (63.3%) of those hospitals were private, 6(18.7%) were government and remaining 6(18.7%) were community hospitals. All together there were 48 separate adult intensive care units, among which 30(62.4%) ICUs were mixed medical and surgical units. There were 331 ICU beds. Out of them 161 (48.6%) beds were equipped with ventilator. Thus, 7.2 ICU beds equipped with ventilator were available for 100,000 population. More than half (56.3%) of ICUs had bed numbers ranging from 5-8. Nurse patient ratio of 1:2 was observed in 40% ICUs in the morning and evening shift but it was > 1:4 in the night shift. Only 18(37.5%) ICUs had resident medical officer within the ICU 24 hours a day. All ICUs had basic monitoring facilities of electrocardiography, pulse oximetry and noninvasive blood pressure measurement but invasive pressures were available only in 24(50%) ICUs. Peritoneal dialysis was available in 29(60.4%) ICUs, hemodialysis facility in 14(29.2%) ICUs, defibrillator in 43(89.6%) ICUs, blood gas analyzer in 31(64.6%) ICUs, portable X-Ray in 47(97.9%) ICUs, portable ultrasonography in 39(81.3%) ICUs and portable echocardiography was available in 29(60.4%) ICUs.

Conclusion: There is acute shortage of ICUs in Kathmandu valley especially in the government hospitals. Most of the ICUs lack resident medical officers, staff nurses, invasive monitoring facilities, diagnostic facilities and organ support facilities.

Key words: Intensive care unit, structure, staffing resources, facilities

Introduction

An intensive care unit (ICU) is a specially staffed and equipped area of a hospital dedicated to the management of patients with life-threatening illnesses, injuries or complications.1 Studies have shown that well designed, well equipped and well staffed intensive care contributes significantly to improved health outcomes for patients.2,3,4,5 Nepal's first intensive care unit / coronary care unit service was opened in the early 1970s at Bir Hospital in Kathmandu6 following heart problem of Late King Mahendra. Intensive Care has emerged as a distinct specialty in the world over the last 3-4 decades. Successful intensive care medicine depends on a meticulous interaction between human, technological and spatial resources.7 Since 1990, many private hospitals and teaching hospitals have been established in Nepal, mainly in cities. Most of these hospitals claimed of having well equipped and well staffed ICU services, but there are no published data on the overall intensive care services in Nepal. Thus, this study was conducted to collect information about structure, staffing resources and available technologies of adult intensive care units of Kathmandu valley.

Methods

This was a cross-sectional observational study. A list of hospitals with 50 and more bed-capacities running in Kathmandu, Lalitpur and Bhaktapur districts was obtained from the Ministry of health and population. All the adult intensive care units of these hospitals were surveyed in the context of their structure, staffing resources and available technologies. The ICU structure included total ICU beds, types of ICU, size of ICU and the department with which
ICU was affiliated. The staffing resources included nursing staff and resident medical officer around the clock. The technologies included monitoring facilities, organ support facilities and diagnostic facilities. Monitoring facilities included continuous ECG, continuous pulse oximetry (SpO2), noninvasive blood pressure and invasive pressures. Organ support facilities included mechanical ventilator, renal support therapy (peritoneal dialysis, hemodialysis) and defibrillator. Diagnostic facilities included blood gas analyzer, portable X-ray, portable ultrasonography and echocardiography. For the purpose of this study, intensive care unit is defined as a unit where physicians and nurses observe and treat desperately ill patients 24 hours a day. A structured questionnaire was distributed and relevant information as mentioned above was obtained from physician in-charge or the sister or nurse in-charge of each unit. Any clarification found necessary was done over a telephone. Data collection was completed within a 4-week period in April 2011 and was analyzed using Microsoft Office Excel 2007. A nurse: bed ratio was calculated as the ratio of number of nurses in each shift to the number of beds in the ICU. The population statistics were obtained from the central bureau of statistics.

Results

As per record obtained from the ministry of health and population (April 2011), there were 51 hospitals with bed-capacities of 50 and more running in the Kathmandu valley. Out of those hospitals, 37(72.5%) were located in Kathmandu, 7(13.7%) in Lalitpur and 7(13.7%) in Bhaktapur districts, while 32(62.7%) hospitals were private, 11(21.6%) were government and 8(15.7%) were community hospitals. Only 33 (64.7%) hospitals out of 51 have the facility of Intensive Care Unit. Out of those 33 hospitals with ICU facility, 27(81.8%) were located in Kathmandu, 5(15.2%) in Lalitpur and 1(3%) in Bhaktapur. Institution wise, 21 (63.3%) hospitals were private, 6(18.7%) were government and 6(18.7%) were community hospitals.

Few hospitals had more than one unit of ICU for special surgical or medical cases. All together there were 48 separate Intensive Care Units. Out of those 48 ICUs, 30(62.4%) were mixed type where both medical and surgical cases were admitted followed by 8(16.6%) Coronary Care Units. The rest of the types of ICU are shown in Table 1.

Medical ICUs and CCUs were affiliated to department of medicine and run by physicians. Surgical ICUs were affiliated to department of anaesthesia and run jointly by anaesthesiologists and surgeons. Mixed general ICUs in tertiary hospitals and teachings hospitals were affiliated to department of anaesthesia but in private nonteaching hospitals, no specific department was affiliated to ICU. In such ICUs, anaesthesiologists had their role only when mechanical ventilation and invasive procedures were required. None of the ICU was "closed" ICU in which treatment decisions are cohesively managed under the guidance of an intensivist.

There were all together 331 intensive care beds available in those 48 intensive care units making 6.9 ICU beds per each ICU and 4.7% of total hospital beds. Out of 331 ICU beds, only 161 beds (48.6%) were equipped with mechanical ventilator making it 2.3% of total hospital beds (Table 4). Considering the total population of Kathmandu valley in 2011 as 21791719, the available ICU beds was 15.2/100,000 population and the available ICU beds with facility of mechanical ventilator was 7.2/100,000 population (Table 2 ICU Characteristics).
Most (56.3%) ICUs had bed numbers ranging from 5-8.

A recommended nurse patient ratio of 1:1 varied with shift duty. In the morning shift, only 8.3% ICUs had 1:1 nurse patient ratio while 39.6% ICUs had 1:2 nurse patient ratio. Similar findings were observed in the evening shift (Table-Table 5 Staffing (Nurse Patient Ratio)). However, in the night shift 41.7% ICUs had >1:4 nurse patient ratio and only 4.2% ICUs had 1:1 nurse patient ratio. Only 18(37.5%) ICUs had resident medical officer within the ICU 24 hours a day while in remaining 30(62.5%) ICUs medical officer from other departments such as emergency, wards would attend the call when informed by the ICU nurse.

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Most (56.3%) ICUs had bed numbers ranging from 5-8.

Table 2. ICU Characteristic

<table>
<thead>
<tr>
<th></th>
<th>Kathmandu</th>
<th>Lalitpur</th>
<th>Bhaktapur</th>
<th>Total (Valley)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total no of ICUs</td>
<td>41(85.4%)</td>
<td>6(12.5%)</td>
<td>1(2.1%)</td>
<td>48</td>
</tr>
<tr>
<td>Total no. of ICU beds</td>
<td>283(85.5%)</td>
<td>42(12.7%)</td>
<td>6(1.8%)</td>
<td>331</td>
</tr>
<tr>
<td>ICU beds per unit ICU</td>
<td>6.9</td>
<td>7.0</td>
<td>6.0</td>
<td>6.9</td>
</tr>
<tr>
<td>ICU beds per 100 hospital beds</td>
<td>5.3</td>
<td>3.4</td>
<td>1.4</td>
<td>4.7</td>
</tr>
<tr>
<td>ICU beds with ventilator</td>
<td>138(48.8%)</td>
<td>21(50%)</td>
<td>2(33.3%)</td>
<td>161(48.6%)</td>
</tr>
<tr>
<td>ICU beds with ventilator per unit ICU</td>
<td>3.4</td>
<td>3.5</td>
<td>2.0</td>
<td>3.4</td>
</tr>
<tr>
<td>ICU beds with ventilator per 100 hospital beds</td>
<td>2.6</td>
<td>1.7</td>
<td>0.5</td>
<td>2.3</td>
</tr>
</tbody>
</table>

Table 3. Population based ratios of ICU beds

<table>
<thead>
<tr>
<th>Districts</th>
<th>Population (CBS* 2011)</th>
<th>ICU beds/100,000 population</th>
<th>ICU beds with ventilator / 100,000 population</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kathmandu</td>
<td>1472707</td>
<td>19.2</td>
<td>9.4</td>
</tr>
<tr>
<td>Lalitpur</td>
<td>424219</td>
<td>9.9</td>
<td>5.0</td>
</tr>
<tr>
<td>Bhaktapur</td>
<td>282245</td>
<td>2.1</td>
<td>0.7</td>
</tr>
<tr>
<td>Total</td>
<td>2179171</td>
<td>15.2</td>
<td>7.2</td>
</tr>
</tbody>
</table>

*Central Bureau of Statistics

Table 4. Size of ICU - no of ICU beds in each unit

<table>
<thead>
<tr>
<th>Size of ICU</th>
<th>&lt;5</th>
<th>5-8</th>
<th>9-12</th>
<th>&gt;12</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Government</td>
<td>2</td>
<td>11</td>
<td>2</td>
<td>1</td>
<td>16</td>
</tr>
<tr>
<td>Community</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>0</td>
<td>6</td>
</tr>
<tr>
<td>Private</td>
<td>5</td>
<td>14</td>
<td>7</td>
<td>0</td>
<td>26</td>
</tr>
<tr>
<td>Total</td>
<td>10 (20.8%)</td>
<td>27 (56.3%)</td>
<td>10 (20.8%)</td>
<td>1 (2.1%)</td>
<td>48 (100%)</td>
</tr>
</tbody>
</table>

Figure 2. Monitoring facilities
Monitoring facilities such as continuous ECG, pulse oximetry (SpO₂) and noninvasive blood pressure measurement were available in all the 48 ICUs but invasive pressure monitor was available only in 24 (50%) ICUs.
The Discussion

Figure 4. Diagnostic facilities

Mechanical ventilators were running without defibrillator machine. Remaining 51.4% ICU beds were functioning only as high dependency care. This is again because of limited financial resources and trained medical personnel.

On an average 7.2 ICU beds equipped with ventilator was available per 100,000 population in Kathmandu valley, highest of 9.4 in Kathmandu district and lowest of 0.7 in Bhaktapur district. We considered here the population of the valley who are permanently residing. Kathmandu is the capital city. So the catchment area of the hospitals and the ICUs situated here represent almost the whole country. Very limited fully equipped hospitals and ICUs are available outside the capital. Then, the ratio of ICU beds per 100,000 population becomes much less. This ratio is 20 in USA, 24.6 in Germany and 1.6 in Sri Lanka. Having few ICU beds may result in either refusal of intensive care or delayed admission of critically ill patients with recoverable conditions. A systematic review by Sinuff and colleagues confirmed that hospital mortality is increased three-fold for patients refused ICU admission.

Based on the calculation described by Lyon, the minimum number of ICU beds required is 6 per 100,000 population. Population of Nepal in 2012 is 29,128,517. Thus, minimum number of ICU beds required for Nepal in 2012 is 1748. This estimate of ICU beds based just on population may not be valid as it also depends on total admissions, emergency or elective admissions, length of stay, bed occupancy, mortality, deferral and transfer rate.

The ESICM recommends nurse patient ratio of 1:1 for high level care and 1:3 for low level care. Only 8.3% ICUs maintained nurse patient ratio of 1:1 and 40% ICUs maintained nurse patient ratio of 1:2 in the morning and evening shift. However, in the night shift, 41.7% ICUs had nurse patient ratio ≥ 1:4. The evidence indicates that inadequate nurse staffing leads to adverse patient outcomes and increased nurse burnout. Amaravadi et al 19 demonstrated that decreased nurse staffing at night is associated with postoperative complications, increased length of ICU stay and increased health care costs. Bouza C et al in 2007 20 reported in his prospective cohort study that 46% of unplanned extubation in orally intubated medical patients in the ICU occurred during the night shift. Inadequate number of nursing staff was significantly associated with increased risk of complications in patients undergoing abdominal surgery.21 Thus, we may say that patients in our ICUs are not getting optimal care.

The findings in this survey demonstrate for the first time the status of critical care services in Kathmandu valley and more importantly the areas requiring improvement. Only around 65% of hospitals (50+ bedded) in Kathmandu valley had ICU services. The WHO states that every hospital where surgery and anaesthesia are performed should have an ICU. Most (82%) of the ICUs were located in Kathmandu district. Private hospitals delivered more ICU services than government hospitals (21 out of 32 versus 6 out of 11 hospitals). This may be the reflection of the tendency of the government to focus more towards the preventive aspects and invite in the private sector for the curative aspects. But this will make the expensive ICU service inaccessible to the low income people.

Most (62.4%) ICUs were mixed type where both medical and surgical cases were admitted. Critically ill patients are primarily managed by physicians or surgeons in most of the ICUs with input from anaesthesiologists only when patients require mechanical ventilation and invasive procedures. Although current evidence support ‘closed’ versus ‘open’ ICUs in the context of better outcomes for patients 4,11 and resource utilization, ‘open’ policies were carried out in almost all of ICUs. This may be due to the non-availability of sufficient number of medical and nursing specialists in the field of intensive care.

More than half (56.3%) of ICUs had bed numbers ranging from 5-8. On an average each ICU had 7 beds which tally with the size of the functional ICU (6-8 beds) as recommended by the European Society of Intensive Care Medicine (ESICM). This size of ICU is appropriate in terms of efficiency and economy.

Only 48.6% of ICU beds were equipped with mechanical ventilator. Remaining 51.4% ICU beds were functioning only as high dependency care. This is again because of limited financial resources and trained medical personnel.

On an average 7.2 ICU beds equipped with ventilator was available per 100,000 population in Kathmandu valley, highest of 9.4 in Kathmandu district and lowest of 0.7 in Bhaktapur district. We considered here the population of the valley who are permanently residing. Kathmandu is the capital city. So the catchment area of the hospitals and the ICUs situated here represent almost the whole country. Very limited fully equipped hospitals and ICUs are available outside the capital. Then, the ratio of ICU beds per 100,000 population becomes much less. This ratio is 20 in USA, 24.6 in Germany and 1.6 in Sri Lanka. Having few ICU beds may result in either refusal of intensive care or delayed admission of critically ill patients with recoverable conditions. A systematic review by Sinuff and colleagues confirmed that hospital mortality is increased three-fold for patients refused ICU admission.

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Resident medical officers were present within the ICU around the clock only in 37.5% ICUs. In the rest of the ICUs, staff nurses primarily handle the cases and would call the duty medical officers from other departments like
emergency / medical / surgical ward if required. This would often lead to delay in the recognition and management of critical events in the ICU.

Patient monitors allow continuous monitoring of a patient, with nursing staff being continuously informed of the changes in the condition of a patient. This result in improved quality of care as even slight changes in a patient’s vital signs are detected and treated. Monitoring facilities such as continuous ECG, oximetry (SpO2) an noninvasive blood pressure measurement were available in all the 48 ICUs but invasive pressure monitor was available only in half the ICUs. Invasive pressures like central venous lines, arterial lines are required for severely ill patients with hemodynamic instability and multiple organ dysfunction syndrome.

Mechanical ventilators were available only in 93.8% ICUs whereas 3(6.2%) ICUs did not have mechanical ventilator support so these ICUs were essentially high dependency units (HDUs). There was also limitation in availability of organ support facilities like peritoneal dialysis (available in 60.4% ICUs), hemodialysis (available in 29.2% ICUs) and defibrillator (available in 89.6% ICUs). Lack of these organ support facilities will make the management of patients with one or multiple organ dysfunction syndrome very difficult.

Similarly our ICUs were running with compromised diagnostic facilities such as blood gas analyzer (available in 64.6% ICUs), portable Ultrasonography (available in 81.3% ICUs) and portable Echocardiography (available in 60.4% ICUs). One ICU was functioning even without availability of portable X-Ray. Limitations in these diagnostic facilities make the outcome of ICU patients worse. As suggested by Bastos et al the inadequate medical and technical equipment of most ICUs substantially contributes to the high mortality rate of critically ill patients.

**Conclusion**

There is acute shortage of ICUs in Kathmandu valley especially in government hospitals. Most of the ICUs lack resident medical officers, staff nurses, invasive monitoring facilities, diagnostic facilities and organ support facilities. This study has provided a crucial step toward understanding current critical care services in Kathmandu valley and need of upgrade in numbers and the facilities to improve patient outcome.

**Acknowledgement**

The authors would like to thank Ms Iswori Devi Shrestha, Chief Nursing Administrator, Ministry of Health and population for giving the information on lists of hospitals in the Kathmandu Valley and the physician and nurse incharge of ICUs for providing ICU related information and Anaesthesia residents of National Academy of Medical Sciences for helping in data collection.

The result of this survey was presented in 12th National Conference of Society of Anaesthesiologists of Nepal and 4th SAARC Critical Care Congress held in Kathmandu, April, 2011.

**References**

Outcome of intubated post-surgical cases in intensive care unit in Tribhuvan university teaching hospital, Nepal

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A retrospective study was carried out for to evaluate the outcome in intubated post-surgical cases in Intensive Care Unit in TU Teaching hospital, Kathmandu, Nepal. A total of 303 cases were admitted in Intensive Care Unit during the fiscal year 061-062, from 1st Shrawan 2061 to 31st Ashad 2062 (July, 2004 to July, 2005). Among them, 177 (58.5%) were medical and non-surgical cases while 126 (41.5%) were post-surgical cases. Total mortality in the ICU was 26.2% (p value > 0.05). Among the postsurgical cases, which includes all surgical sub specialties, the mortality was 15.9% (p value = 0.92).

Surgical cases were admitted in ICU either on elective basis where ICU bed was pre occupied. Where as other emergency surgical cases requiring ICU care were admitted in ICU in an unplanned way. A total of 37 post-surgical cases required mechanical ventilatory support. Maximum stay in ICU for a medical case was 4 months and 28 days with maximum support of mechanical ventilation was for 4 months and 21 days. In contrast, the maximum stay for the postsurgical cases in ICU as well on mechanical ventilation was 60 days, while minimum stay was only one day. Regarding post-surgical cases on mechanical ventilation two cases (5%) left the hospital against medical advice (LAMA), while out of 35 patients on mechanical ventilation, 17 patients died, accounting for a mortality of 48.6%, and 18 cases were successfully weaned off and extubated (51.4%) and further discharged from ICU to Surgical Ward.

Introduction

Among the post-surgical cases whose haemodynamic status is unstable are placed in intensive care unit for both invasive as well as non-invasive monitoring. With the availability of intensive care unit even the most critically ill patients have achieved the good result. Intensive care unit accepts all those cases whose haemodynamic condition is unstable. As equipped and efficient the intensive care unit is so efficient the outcome of the patients will be.

Methods and Materials

A retrospective study on 126 post-surgical cases was carried out in intensive care unit, TU Teaching Hospital, Kathmandu, Nepal. All the cases from various surgical sub specialties that were admitted in intensive care unit postoperatively and on mechanical ventilation were selected for this study and the data were collected from the medical records from the Hospital Central Medical Record Section. Cases from all the surgical sub specialties were taken into consideration including Cardiac, Neurosurgical, Thoracic, General Surgery, Otorhinology, Gynae-obstretics and Urosurgery. Maximum and minimum days of hospital stay both in mechanical ventilation and ICU was recorded. Statistics of morbidity and mortality was calculated.

Results

A total of 126 (41.5%) post-surgical cases were admitted in intensive care unit, TU Teaching Hospital over a period in one year. Among them, 37 cases needed mechanical ventilatory support, accounting for 29.4%. Total mortality in post-surgical cases in ICU was 16.7% while the mortality was much higher in intubated postsurgical patient population, which was calculated to be 48.6%(17/36). There were two patients who left against medical advice (LAMA, 5.4%), that was excluded from the principle study.

Days of mechanical ventilation

Patient remained in mechanical ventilation for maximum of 60 days during this study period. However successful weaning and extubation was achieved up to 42 days in mechanical ventilation. Longer the mechanical ventilation, worse the prognosis, which is clearly obvious as per table below (Table 1).

<table>
<thead>
<tr>
<th>Days on Mechanical Ventilation</th>
<th>Total</th>
<th>Extubated</th>
<th>Expired</th>
</tr>
</thead>
<tbody>
<tr>
<td>1- 2</td>
<td>12</td>
<td>7</td>
<td>5</td>
</tr>
<tr>
<td>3- 5</td>
<td>9</td>
<td>5</td>
<td>4</td>
</tr>
<tr>
<td>6- 8</td>
<td>4</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>&gt;= 9</td>
<td>10</td>
<td>4</td>
<td>7</td>
</tr>
<tr>
<td>Total:</td>
<td>35</td>
<td>18</td>
<td>17</td>
</tr>
</tbody>
</table>

Median days for mechanical ventilation = 8.5 days.
Average days for mechanical ventilation = 14 days.

Discussion

Intensive Care Unit accepts cases whose post-operative status is life threatening or hemodynamically unstable to the extent that he/she requires special monitoring like electrocardiogram, oxygen saturation, capnograph, and needs special equipments like mechanical ventilator, infusion pump, syringe pump etc. Transfer of cases in ICU may be planned or unplanned, most of the unplanned cases have high mortality. Morbidity and mortality ratio varies with the severity of diseases, multi-organ failure, severity of sepsis, so on and so forth. Deborah, et al, reported...
overall mortality of 17.2 % with standard management in intensive care unit. However, if the patients are in multi organ failure, the mortality has been seen up to 65 %. ICU is the major sources of nosocomial infection, especially with pseudomonas, klebsella, proteous and E. coli species. Some study showed that in ICU patients, mortality with these nosocomial organisms has been seen in 35 % of the cases. If the patient is on mechanical ventilation, the predicted mortality is 47 %as reported by Smith IE, et. al,7 which is analogous to our observation (48.6 %) (p value>0.05).

Being in ICU is a very stressful condition with increase in neuroendocrine response. These cases have increase oxygen extraction ratio: therefore, these patients need more than normal oxygen delivery. Cellular hypoxia increases the ICU mortality. Further study shows that persistent hypoxia increases the mortality up to 33 %.1 Inadequate ventilation, airway obstruction, bronchospasm, aspiration and hemodynamic instability are the other contributing factors for the outcome of post-surgical cases in ICU.5 Longer the stay in ICU worse the prognosis. Pre-existing diseases like renal hepatic, cardiac, respiratory, metabolic and endocrine and major trauma like cervical spine, head injury, abdominal trauma, chest injury all lead to prolonged ICU stay and poor outcome of these patients.6 Moreover, cervical spine injury is troublesome, which causes respiratory failure. Claxton, et al,2 reported shows that 21 %died within first 3 months, 57%remained on ventilator for more than 3months. From the result of many studies, it has been concluded that outcome of post-surgical patient varies with patients preexisting disease pathology, severity of trauma, Type of surgery and quality of ICU management itself. In our study, post-surgical patients requiring mechanical ventilation (48.6 %) had three-fold mortality compared that of total postsurgical cases (16.7%).

**Conclusion**

Post-surgical mortality in ICU including all surgical subspecialties was 16.7 %. Postsurgical patients who required mechanical ventilation had higher mortality rate (48.6%).

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Application of “the Sequential Organ Failure Assessment (SOFA) score” in predicting outcome in ICU patients with SIRS

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Abstract

Background: Various scoring systems have been developed to prioritize patient admission and management in ICU. The objective of this prospective, observational cohort study was to evaluate application of one such system, the Sequential Organ Failure Assessment (SOFA) Score in predicting outcome in ICU patients with SIRS. Patients and Methods: Fifty patients admitted to a six bed multidisciplinary ICU with SIRS were consecutively enrolled in the study and SOFA scores were calculated at zero hour, after 48 hrs, and after 96 hrs and patients followed till discharge from hospital.

Results: When compared to outcome, the non survivors had high initial, mean and highest SOFA scores as compared to survivors. (p value = 0.002, <0.001, <0.001 respectively). Delta SOFA was not significantly associated with outcome. (p value= 0.117). The initial SOFA score > 11 predicted a mortality of 90%. (OR 23.72, 95%CI2.68-209.78, p=0.004). Similarly, mean SOFA score of > 7 predicted a mortality of 73.9% (OR 22.7, 95%CI 5.0 – 103.5, p<0.001) and high SOFA score > 11 predicted a mortality of 87.5% (OR 32.66, 95%CI 5.82-183.179, p< 0.001). Area under receiver operating characteristic (ROC) curve for mean SOFA was 0.825, for high SOFA was 0.817 and for initial SOFA was 0.708. Thus mean, high and initial SOFA scores were helpful in predicting between the survivors and the non survivors.

Conclusion: The SOFA scoring system is useful in predicting outcomes in ICU and thus help in proper utilization of ICU resources.

Key words: Sequential Organ Failure Assessment (SOFA) Score, Systemic Inflammatory Response Syndrome (SIRS), Intensive Care Unit (ICU).

Critical care medicine is a complex, multidisciplinary specialty, designed to care all sort of patients with critical illnesses. Even in developed countries, concerns about the high costs in the ICU are increasing. Thus, illness severity scoring systems have been devised depending on therapeutic, anatomical and physiological basis. If ICU admissions could be prioritized based on scoring systems, the use of limited financial, medical and human resources can be optimized and will allow the best usage in the ICU. Such studies are very few in the developing countries, and in particular no studies have been done with the SOFA score (Table 1) in Nepal. Thus this study was conducted to predict the outcome in ICU patients with SIRS with the SOFA score. The Sequential Organ Failure Assessment (SOFA) Score has been developed by European Society of Critical Care Medicine (ESCCM), in 1994, as a system for measuring the status of the patient in the ICU. It basically evaluated the six different organ systems separately. Different variables and parameters are included in each of the organ system and a definite score is given to that state varying from 0 - 4, all of which is later added to calculate the SOFA score, (out of a maximum of 24). The score increases as the organ system functioning worsens, thus assessment of individual organ dysfunction or failure can be done along with evaluation of patient as a whole. SOFA score can be used to evaluate all patients in the ICU; we limited our cohort to those patients who met the criteria of Systemic Inflammatory Response Syndrome (SIRS) with the aim to study the outcome of these patients with SIRS in the ICU and see whether SOFA score will be able to predict the outcome or not. The SIRS criteria was based on 1992 consensus conference, conducted by the American College of Chest Physicians (ACCP) and the Society of Critical Care Medicine (SCCM), where definitions and terminology associated with sepsis and its sequelae were clarified. In December 2001, a second conference was organized by the ACCP, SCCM, the American Thoracic Society, and the European Society of Critical Care Medicine to update the original definitions. After that, an expanded list of signs and symptoms was outlined to facilitate recognition of sepsis.
**Objectives**

The main objective of the study is to determine the usefulness of the measurement of Sequential Organ Failure Assessment (SOFA) scores for prediction of outcome (mortality) in the intensive care unit (ICU) in patients with SIRS.

**Materials and methods**

With permission from the Institutional ethical committee and department of anaesthesiology, a prospective, observational cohort study was conducted from 15th June 2005 for a period of four months at a six bed Multidisciplinary Intensive Care Unit (ICU) at a University Hospital in Kathmandu, Nepal. Fifty patients consecutively admitted to the ICU, of any specialities, who fulfilled the SIRS criteria, Age between 15 and 70 years and an informed consent given by the patient or immediate relative (first degree). Paediatric and Geriatric age group were excluded to avoid controversy in the study due to influence of age on mortality in critically ill patients in these extreme of ages. Patients taken out from ICU against medical advice, whose investigations could not be done or lost, and loss of patient follow up, after discharge from ICU were also excluded from the study.

All patients meeting the inclusion criteria, any time after admission into the ICU were consecutively included in the study. This time is noted as the 0 hr, when SIRS was diagnosed and patient was included in the study. Relevant clinical examinations and measurements were recorded and blood investigations sent. Arterial Blood Gas Analysis was done in the ICU with heparinised arterial blood sample with the blood gas analyzer nova biomedical UK. (Model: Stat Profile® pHOX). All the reports of investigations and clinical measurements were recorded and the score was assigned according to the score for individual organ system of the SOFA, (Table 1) and a final SOFA score of that time (0 hr) recorded. The same investigations, measurements were done and SOFA score was calculated after 48 hrs and after 96hrs and recorded. Then after, all patients were followed up and outcome recorded till they were discharged from the hospital. The outcomes of the patient were classified as non survivors and survivors. Only SOFA score inside ICU was recorded and outcome recorded. The different SOFA scores were compared to outcome of the patient in ICU with SIRS using independent sample t tests and the paired sample t tests. Odds ratio with 95% confidence interval was computed using univariate logistic regression analysis with ICU outcome as the dependent variable. A Chi square test (with Yates correction when applicable) and Fisher’s exact test (when chi square test was not applicable) was used to evaluate statistical significance of categorical variables. Receiver operating characteristic curves were also studied to analyze between different SOFA variables. Patient outcome was compared also with the Age, Sex, Length of ICU stay, Duration of Mechanical Ventilation, using independent sample t test. p value < 0.05 was considered significantly. Statistical analysis was done with the computer software SPSS for windows.

**Results**

Mean age of the patient admitted to ICU with SIRS was 34 yrs ±14.4 yrs. There were 29 males (58%) and 21 females (42%). In the study group, the longest duration of stay in ICU was 69 days and the minimum duration of ICU stay was 1 days. The averaged duration of ICU stay was 9days. Regarding different specialities, 20 patients were admitted by Internal Medicine (40%), 10 by Neurology (20%), 8 by General Surgery (16%), 7 by Neurosurgery (14%), 3 by Obstetrics & Gynaecology (6%), and 2 by Cardiothoracic and Vascular Surgery (4%). 68% required mechanical ventilator support while 32% did not require. Mean duration of mechanical ventilation was 9.5 days. Regarding procedures, among 50 patients, central venous monitoring line was inserted in 68% patients and invasive arterial blood pressure monitoring line was inserted in 18%. Tracheostomy was done in 10%, Haemodialysis in 4%, and Bronchoscopy was performed in 2% of patients.

Analyzing outcome, 20 patients (40%) expired in the ICU (Non- survivors, while 30 patients (60%) survived and were transferred out of ICU and then discharged home subsequently, with a good recovery. Residual deficit was noticed in 8 patients (16%). The common residual deficit noticed was tracheotomy (and thus temporary loss of speech) in 10%, hemiparesis in 4%, aphasia in 4% and dyskinetic movements in 2%.

Mean age was 35.7 yrs in non-survivors while it was 32.4 yrs in survivors. In the non-survivors, 13 (65%) were males and 7 (35%) were females while in survivors 16 (53.34%) were males and 14 (46.67%) were females. The mean length of ICU stay was 4.85 days in non-survivors while it was 11.3 days in survivors. The mean duration of mechanical ventilation was 4.7 days in non-survivors while it was 16.35 days in survivors.

**Analysis of SOFA score**

Initial SOFA Score ranged from 1 to 17, average Initial SOFA score was 7.9. Non-survivors (M1) were significantly associated with the Initial SOFA score of 10.3. (p value 0.002). Initial SOFA score of more than 11 had a predictable mortality of 90 %, (p value = 0.001) But 27.5% of patients who had initial SOFA score of less than 11 also expired.

Mean SOFA Score ranged from 1 to 19, average of mean SOFA score was 7.8. Non-survivors (M1) were also significantly associated with the Mean SOFA score of 11.5. (p value < 0.001). Mean SOFA score more than 7 had a predictable mortality of 73.9%. (p value < 0.001). But 11.1% of patients who expired also had mean SOFA score of less than 7.

Highest SOFA Score ranged from 1 to 21, average highest SOFA score was 9.5. Non-survivors (M1) were significantly associated with the Highest SOFA score of 13.5. (p value < 0.001). Highest SOFA score more than 11 had a predictable mortality of 87.5% (p value = 0.00002). But 17.6% of patients who expired also had highest SOFA score of less than 11.

**Delta-SOFA Score ranged from 0 to 7, average**

Delta-SOFA Score was 2.8. However there was no significant association of Delta-SOFA Score with the outcome. Delta-SOFA in Non-survivors was 3.5 while it was 2.4 in Survivors. (p value = 0.117). And in predicting mortality also, Delta SOFA score was not able to predict mortality significantly by both Fisher’s exact test (p value = 0.67) and univariate logistic regression analysis. (p value = 0.40).

The area under the ROC curve (Fig 1) shows that Mean SOFA of > 7 has the highest correlation with mortality followed by High SOFA of > 11, and then Initial SOFA of > 11. The equivalence of areas under ROC curve for mean and high SOFA score also suggests that they are similarly effective in predicting outcome (mortality).
Table 2: Univariate logistic analysis for SOFA score variables

<table>
<thead>
<tr>
<th>SOFA SCORE</th>
<th>ODDS RATIO</th>
<th>95% CI FOR OR</th>
<th>p VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>INITIAL &gt; 11</td>
<td>23.72</td>
<td>2.684 – 209.78</td>
<td>0.004</td>
</tr>
<tr>
<td>MEAN &gt; 7</td>
<td>22.7</td>
<td>5.0 – 103.5</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>HIGH &gt; 11</td>
<td>32.667</td>
<td>5.825 – 183.179</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>DELTA &gt; 4</td>
<td>4.84</td>
<td>1.075 – 21.84</td>
<td>0.40</td>
</tr>
</tbody>
</table>

Table 3: Prediction of mortality

<table>
<thead>
<tr>
<th>SOFA Score</th>
<th>TOTAL Number</th>
<th>EXPIRED Number</th>
<th>PREDICTED (% OF EXPIRED)</th>
<th>p VALUE</th>
<th>TEST APPLIED</th>
</tr>
</thead>
<tbody>
<tr>
<td>INITIAL &gt; 11</td>
<td>10</td>
<td>9</td>
<td>90%</td>
<td>0.001</td>
<td>Fisher’s Exact</td>
</tr>
<tr>
<td>MEAN &gt; 7</td>
<td>40</td>
<td>11</td>
<td>27.50%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>HIGH &gt; 11</td>
<td>23</td>
<td>17</td>
<td>73.91%</td>
<td>0.00002</td>
<td>Chi square (Yates correction applied).</td>
</tr>
<tr>
<td>DELTA &gt; 4</td>
<td>10</td>
<td>7</td>
<td>70%</td>
<td>0.67</td>
<td>Fisher’s Exact</td>
</tr>
<tr>
<td>DELTA ≤ 4</td>
<td>40</td>
<td>13</td>
<td>32.5%</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Analysis of the Receiver Operating Characteristic (ROC) Curve

![ROC Curve](image)

Fig 1: Area under ROC Curve

<table>
<thead>
<tr>
<th>Test Result Variable(s)</th>
<th>Area</th>
</tr>
</thead>
<tbody>
<tr>
<td>SOFA at 0 hrs (&gt;11)</td>
<td>.708</td>
</tr>
<tr>
<td>Mean SOFA (&gt;7)</td>
<td>.825</td>
</tr>
<tr>
<td>High SOFA (&gt;11)</td>
<td>.817</td>
</tr>
<tr>
<td>Delta SOFA (&gt;4)</td>
<td>.625</td>
</tr>
</tbody>
</table>
Fig 2: 95% Confidence Intervals for different SOFA scores and duration of stay amongst the survived and the expired...
Fig 3: Histograms comparing between discharged/survivors (Left Panel) and non survivors/expired (Right Panel) among various SOFA, SOFA at 0 hrs, Mean, high, Delta SOFA respectively.
Discussion

Among the various scoring systems for predicting outcomes in ICU, SOFA score is easy as the variables measured are easily available and routinely measured in the ICU and can be measured in various cohorts of patients. Patients with sepsis usually presents with SIRS in the initial phase and later progress to sepsis and then to septic shock, as mentioned in the Sepsis occurrence in acutely ill patients (SOAP) study by Sprung CL et al.3 We thus narrowed our cohort of patients to those patients with SIRS. We also found through our Medline search that there are very few studies with the SOFA score in patients with SIRS, thus we planned to take SIRS patients as our cohort for our observational study.

Ideally SOFA scores should have been measured daily for all the patients but, as progression of SIRS is usually more progressive and delayed, so it was measured every 48 hrs. Thus to see the gradual change in SOFA score along with the change in the patient clinical status, 48 hrs interval was chosen, and this interval of 48 hrs, is equally relevant and was also chosen in other studies of SOFA score.5,7

In this study, mean age of the patient was 34 yrs, whereas the mean age was 59 in the study of Ferreira et al1 while mean age was 61.2 yrs in the study of Rocker G et al.8 In our study 58% were males and 42% were females. These differences may be because those studies have included all patients in ICU while our cohort included only those patients with SIRS. Among these, 68% of patient’s required mechanical ventilatory support and 68% required invasive monitoring.

In this study, 60% patients survived while 40% patients with SIRS died in the ICU. Overall mortality of ICU in our cohort of patients was 40% compared to overall ICU mortality of 35.7% in the study of Rocker G et al.8, 34.3% in the study of Mhamed SM et al, and ICU mortality of only 22% in study of Vincent et al.9 This difference may also be because of the same reason that the calculated mortality in our study included only those patients with SIRS while the given mortality in other studies are the overall ICU mortality in all groups of patients.

In our study, mean length of ICU stay was 9 days, non survivors had a shorter stay of 4.85 days, but survivors stayed in the ICU for a longer duration of 11.3 days. (p value = 0.06). Schuster also reported shorter length of ICU stay in patients who died.10 But this result is also contrary to some disease specific studies done by Shaughnessy in post CABG patients and by Williams in patients with acute pancreatitis where longer duration of ICU stay was associated with increase mortality.11,12

The study population had a mean duration of hospital stay of 12.5 days, with the range of 2 to 83 days. In non-survivors mean duration of hospital stay was only 5.95 days while it was 17.23 days in survivors. (p value = 0.001) This shows that survivors are significantly associated with a longer duration of hospital stay than the non survivors.

Mean age of patient among the non survivors was 35.7 yrs while that among the survivors was 32.6 yrs. (p value = 0.429) Thus age was not significantly associated with outcome in these patients with SIRS. Among the non survivors, 65% were males, while among the survivors only 53.4% were males, and similarly 35% of non survivors were females and 46.6% of non survivors were females. (p value = 0.41) Thus in our study sex was also not associated with outcome. This was similar to most of the studies.5,7,13

All of the non survivors (100%) required mechanical ventilation while only 14 patients (46.67%) of survivors required mechanical ventilation. The requirement of mechanical ventilation was thus also not associated with outcome. (p value = 0.253)

Analyzing the SOFA scores, when Initial SOFA, Mean SOFA, Highest SOFA, and Delta SOFA scores were compared to outcome, the non survivors had high initial, mean and highest SOFA scores as compared to survivors. (p value = 0.002, <0.001, <0.001 respectively). These results were similar to the study of Ferreira et al.1 But correlation of Delta SOFA with outcome was not significant. (p value = 0.117) which was in contrast to study of Ferreira et al.3 where Delta SOFA was also significantly associated with outcome.

This may be because of the different way of calculating the Delta SOFA score. Ferreira et al.3 calculated the difference between SOFA at 48hr and SOFA at 0 hr and mentioned this value as Delta SOFA 48 – 0. Similarly they calculated the difference in SOFA at 96 hr and 0 hr and mentioned as Delta SOFA 96 - 0. They calculated the change in SOFA score with reference to the initial SOFA score (at 0 hr). However, Machado et al.10 assigned Delta SOFA as the variation of SOFA score day 1 and day 3, and did not consider any value then after. In another study, Hiroshi et al11 assigned Delta SOFA as the difference between maximum SOFA and baseline SOFA score. But in our study we calculated the greatest score among the two values; Delta SOFA 48 - 0 and Delta SOFA 96 – 48 (that is the change in every 48hr with comparison to the previous score, either increase or decrease in the score.) and designate that value as the Delta SOFA Score. This is probably the reason why Delta SOFA was not associated to outcome in our study while it was significantly associated with outcome in the study of Ferreira et al,1 Vincent et al,2 Machado et al10 and Hiroshi et al.11 This value assigned as Delta SOFA score in our study has been taken in few other studies as Delta-max SOFA but this variable has also been associated with outcome.16

Regarding prediction of mortality, the initial SOFA, i.e. SOFA scores at diagnosis of SIRS, when > 11, predicted mortality of 90%, which was similar to the study of Ferreira et al.1 but when initial SOFA > 11 predicted a mortality of 95%. In our study, the mean SOFA, i.e. the average SOFA score during the stay in ICU, when > 7, predicted mortality of 73.9%. Highest SOFA, among the SOFA score up to 96 hrs of admission to ICU, if > 11, predicted mortality of 87.5% which was comparable to >80% mortality in the study of Ferreira et al.3

But the Delta SOFA score did not correlate to mortality. (p value = 0.117 ). In our study, initial, mean and highest SOFA score were the reliable predictors of ICU outcome throughout the ICU stay which was similar to the study of Ferreira et al,3 Vincent JL et al,2 Saulius V et al.,17 and Machado R et al.5

Analyzing the area under the Receiver operating characteristic curve (AuROC), it was seen that the mean SOFA of > 7 has the highest correlation with mortality (AuROC: 0.825), followed by high SOFA of > 11 (AuROC: 0.817), and then initial SOFA of > 11 (AuROC<0.708). These were comparable to the study of Ferreira et al.,3 Ceriani et al.16 But in their study area under ROC was largest for high SOFA followed by mean and initial SOFA. But the area under Delta SOFA > 4 was lesser (AuROC: 0.625) as compared with other studies. The equivalence of areas under ROC curve for mean and high SOFA score also suggests that they are similarly effective in predicting
outcome (mortality).

As the scoring systems are not always 100% accurate, ICU physicians must learn to integrate data into clinical decision making. These scoring human systems do not dehumanize the decision making process but rather aid to eliminate physicians reliance on emotional, poorly calibrated, over pessimistic subjective estimates.18

As with all studies, our study also has some limitations. The study population was very small and will need larger multicentric studies with large number of patients (e.g. Ferriera et al3, Vincent JL et al 2) and should be compared to other scoring systems also as done by Saqib ID19 and Silva E et al.20 The SOFA scores was calculated every 48 hrs only, ideally it should have been measured every 24 hrs and thus monitoring the progression of the disease and would have been more informative if compared to other scoring systems in the ICU like APACHE, MODS, etc.

Conclusion
The SOFA score was able to predict outcome in ICU patients with SIRS. Initial SOFA, Mean SOFA and Highest SOFA, all correlated well with the mortality. The SOFA scoring system can help the ICU physicians in admitting patients, monitoring the clinical course, assessment of organ dysfunction, predicting mortality, and for transferring patients out from the ICU and thus in proper utilization of ICU resources also in developing countries like ours, where the resources are limited. However, further studies with greater number of patients, more frequent measurement of variables and comparison between different scoring systems is required to improve the accuracy.

References
INTRODUCTION

Critical care is very expensive. Intensive Care Unit (ICU) beds are limited and constitute only 8-10% of all hospital beds, yet accounts for a major part of hospital expenditure.¹ Scoring systems are designed to objectively quantify physiologic derangements and comorbid conditions for estimating mortality, length of stay and ICU resource use.² Precise disease classification and accurate outcome prediction can optimize ICU bed usage by reducing unnecessary low-risk monitored-only patients and futile care of terminally ill patients.³

APACHE (Acute Physiology, Age, Chronic Health Evaluation) III was introduced in 1991 with a much larger database and better predictive capacity than APACHE II. APACHE III score is the sum of acute physiology score, age score and chronic health problem score. Acute physiology score is based on the worst physiological values during the first 24 hours of admission. Scores range from 0 to 299 (acute physiology 0 to 252, chronic health evaluation 0 to 23 and age 0 to 24) with higher values having the worst prognosis, as described by Knaus et al.⁴ APACHE III accurately predicted ICU mortality in United States,⁵ Australia,⁶ Brazil,⁷ and Germany.⁸ Performance of APACHE III was better than other scoring systems in some studies,⁹⁻¹¹ but this system is complex, difficult to administer and proprietary.²

Sequential Organ Failure Assessment (SOFA) scoring system was introduced by European Society of Critical Care Medicine (ESCCM) in 1994. It evaluates six different organ systems based on simple and routinely available variables (PaO₂/FiO₂ for respiratory system, mean arterial pressure for cardiovascular system, Glasgow coma scale for central nervous system, serum creatinine or urine output for renal system, platelet count for coagulation system and serum bilirubin for hepatic

### Table-1: Distribution of age, duration of stay, APACHE III score and initial SOFA score.

<table>
<thead>
<tr>
<th></th>
<th>Mean</th>
<th>Standard Deviation</th>
<th>Minimum</th>
<th>Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (years)</td>
<td>43.18</td>
<td>18.49</td>
<td>16</td>
<td>84</td>
</tr>
<tr>
<td>Duration of stay (days)</td>
<td>11.33</td>
<td>11.25</td>
<td>1</td>
<td>66</td>
</tr>
<tr>
<td>APACHE III score</td>
<td>66.99</td>
<td>33.49</td>
<td>16</td>
<td>162</td>
</tr>
<tr>
<td>Initial SOFA score</td>
<td>8.38</td>
<td>4.28</td>
<td>0</td>
<td>23</td>
</tr>
</tbody>
</table>
system). All parameters are graded 0-4, which are summed up to calculate SOFA score. It also incorporates therapeutic interventions like mechanical ventilation and use of inotropes. Score can be calculated daily in ICU which takes into consideration the changing severity of organ dysfunction over time as described by Vincent et al.\textsuperscript{12} Initial SOFA score is calculated based on worst values in 24 hours immediately following admission.\textsuperscript{13-15} Some studies have found initial SOFA score to be a good predictor of outcome in ICU.\textsuperscript{9,14,16,17}

Our study aims to see whether initial SOFA score can predict ICU mortality as effectively as APACHE III score.

**MATERIALS AND METHODS**

Data was prospectively collected from six bed multidisciplinary ICU. A total of 117 consecutively admitted ICU patients from September 2009 to March 2010 were enrolled. Patients were excluded if age was less than 16 years or the patients were taken away from ICU against medical advice. Laboratory reports and clinical information necessary for APACHE III and SOFA scoring were obtained and the scores were calculated based on worst values in first 24 hours of ICU admission. APACHE III and initial SOFA score were calculated as defined in original reports.\textsuperscript{4,13} Outcome was recorded as survivors or non survivors in ICU.

**Statistical Analysis:** Data were analyzed using descriptive statistics, frequency distribution, independent t test, chi square test, scatter diagram, linear regression analysis and univariate binary logistic regression analysis. Variables found significant in univariate analysis were analyzed using multivariate analysis. Spearman's rho test was used to calculate correlation between APACHE III and initial SOFA score. Discrimination was tested using the area under receiver-operating characteristic (ROC) curve. ROC analysis was also performed to calculate the cut-off values, sensitivity, specificity and overall correctness of prediction. The best Youden index (sensitivity + specificity – 1) was used to determine the best cut-off point. Survivors and non-survivors were compared above and below the cutoff points. Calibration, which compares the number of observed and predicted deaths, was assessed using the Hosmer-Lemeshow goodness-of-fit test. Data were entered in Microsoft Excel 2003 and analyzed using SPSS program, version 17.0.

**Sample size calculation:** Sample size (117 patients) was calculated to ensure power of 0.80 using the formula $z^2pq/d^2$. Pretest of 60 cases showed proportion of non survivors (p) to be 0.45, proportion of survivors (q) to be 0.55 with maximum tolerable error (d) of 0.09 and reliability coefficient for 95% confidence interval of 1.96.

**RESULTS**

Mean age was 43.18±18.49 years and 73 (62.4%) of the

<table>
<thead>
<tr>
<th>Outcome</th>
<th>Mean</th>
<th>Standard Deviation</th>
<th>Standard Error of Mean</th>
<th>p Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>Survivor</td>
<td>41.11</td>
<td>17.332</td>
<td>2.029</td>
</tr>
<tr>
<td></td>
<td>Non Survivor</td>
<td>46.61</td>
<td>19.998</td>
<td>3.015</td>
</tr>
<tr>
<td>Duration of stay</td>
<td>Survivor</td>
<td>11.10</td>
<td>10.516</td>
<td>1.231</td>
</tr>
<tr>
<td></td>
<td>Non Survivor</td>
<td>11.73</td>
<td>12.483</td>
<td>1.882</td>
</tr>
<tr>
<td>APACHE III score</td>
<td>Survivor</td>
<td>50.14</td>
<td>21.762</td>
<td>2.547</td>
</tr>
<tr>
<td></td>
<td>Non Survivor</td>
<td>94.95</td>
<td>30.836</td>
<td>4.649</td>
</tr>
<tr>
<td>Initial SOFA score</td>
<td>Survivor</td>
<td>6.32</td>
<td>3.157</td>
<td>0.370</td>
</tr>
<tr>
<td></td>
<td>Non Survivor</td>
<td>11.82</td>
<td>3.649</td>
<td>0.550</td>
</tr>
</tbody>
</table>

Fig. 1. Correlation between APACHE III and initial SOFA score. Spearman’s rho correlation coefficient ($r^2$) is 0.721 for all patients, 0.552 for survivors and 0.574 for non survivors.
Table-3: Prediction of ICU mortality on the first day of ICU admission.

<table>
<thead>
<tr>
<th></th>
<th>Cut off point</th>
<th>Sensitivity (%)</th>
<th>Specificity (%)</th>
<th>Youden index</th>
<th>Overall correctness (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>APACHE III score</td>
<td>≥61</td>
<td>90.91</td>
<td>73.97</td>
<td>0.65</td>
<td>80.34</td>
</tr>
<tr>
<td>Initial SOFA score</td>
<td>≥8</td>
<td>90.91</td>
<td>65.75</td>
<td>0.57</td>
<td>75.21</td>
</tr>
</tbody>
</table>

patients were male. ICU mortality was 37.6%. Demographic data, APACHE III score and initial SOFA score are listed in Table-1. APACHE III score and initial SOFA score were compared between survivors and non survivors as shown in Table-2 and both the scores were significantly higher in non survivors (p<0.001). Age and duration of ICU stay did not differ significantly between survivors and non survivors (Table-2). For initial SOFA score, with unit increase in score, there was 1.645 (95% CI=1.367, 1.979) times higher odds for mortality and for APACHE III score, there was 1.066 (95% CI=1.042, 1.091) times higher odds for mortality. Univariate analysis revealed that females were more likely to be non survivors (p=0.01). Patients requiring mechanical ventilation in the first 24 hours of ICU admission were more likely to die (p<0.001). Similarly, patients requiring inotropic support during first 24 hours had the higher chance of being the non survivors (p=0.01). However, multivariate analysis showed only APACHE III score (p=0.031; OR=1.036, 95% CI=1.003, 1.070) and initial SOFA score (p=0.024; OR=1.359, 95% CI=1.041, 1.773) to have statistically significant relationship with outcome. A positive and strong correlation was seen between initial SOFA score and APACHE III score. Spearman’s rho correlation coefficient ($r^2$) was 0.721 for all patients indicating that 72.1% variance in initial SOFA score is

Table-4: Hosmer-Lemeshow goodness-of-fit statistics for APACHE III and initial SOFA score.

<table>
<thead>
<tr>
<th>Predicted deciles of mortality (%)</th>
<th>n</th>
<th>APACHE III score</th>
<th>Initial SOFA score</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Survivor</td>
<td>Non survivor</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Observed</td>
<td>Expected</td>
</tr>
<tr>
<td>0-10</td>
<td>12</td>
<td>12</td>
<td>11.594</td>
</tr>
<tr>
<td>&gt;10-20</td>
<td>12</td>
<td>12</td>
<td>11.290</td>
</tr>
<tr>
<td>&gt;20-30</td>
<td>12</td>
<td>11</td>
<td>10.780</td>
</tr>
<tr>
<td>&gt;30-40</td>
<td>12</td>
<td>11</td>
<td>10.043</td>
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<tr>
<td>&gt;40-50</td>
<td>11</td>
<td>8</td>
<td>8.522</td>
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<tr>
<td>&gt;50-60</td>
<td>12</td>
<td>8</td>
<td>8.355</td>
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<td>&gt;60-70</td>
<td>13</td>
<td>5</td>
<td>7.419</td>
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<td>&gt;70-80</td>
<td>12</td>
<td>1</td>
<td>3.432</td>
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<tr>
<td>&gt;80-90</td>
<td>12</td>
<td>5</td>
<td>1.397</td>
</tr>
<tr>
<td>&gt;90-100</td>
<td>9</td>
<td>0</td>
<td>0.167</td>
</tr>
</tbody>
</table>

$\chi^2$=16.904, df=8, p=0.031

$\chi^2$=7.140, df=8, p=0.522
explained by APACHE III score. The coefficient was 0.552 for survivors and 0.574 for non survivors (Fig. 1).

Area under ROC curve for APACHE III score was 0.895 (p<0.001; 95% CI=0.839, 0.952) and for initial SOFA score it was 0.881 (p<0.001; 95% CI=0.822, 0.940) as shown in Fig. 2. Discrimination was good for both APACHE III and initial SOFA score.

Calculation of Youden index showed the best cut off point for APACHE III to be e" 61 and the best point to be e" 8 for initial SOFA score. At these cut off points, APACHE III had Youden index of 0.65 and 80.3% overall correctness of prediction and initial SOFA score had Youden index of 0.57 with overall correctness of prediction of 75.2% (Table-3). Among the patients with APACHE III score < 61, 6.9% were non survivors whereas 67.8% of patients with APACHE III score e" 61 died (p<0.001). Similarly, as shown in Fig. 3, among the patients with initial SOFA score < 8, 7.7% died whereas 61.5% of patients with initial SOFA score e" 8 were non survivors (p<0.001).

For assessing goodness-of-fit, Hosmer and Lemeshow test for APACHE III score produced $\chi^2$ of 16.904 and p of 0.031 indicating the model does not fit the data. As shown in Table-4, initial SOFA score produced $\chi^2$ of 7.140 and p of 0.522. For initial SOFA score, which produced insignificant $\chi^2$ value and thus had a better calibration and performed better to predict non survivors when compared with APACHE III score (Table 4). Similar results were seen in a study by Chen et al\textsuperscript{9} where initial SOFA score (Chi-square = 5.006, eight degrees of freedom [df], p = 0.757) had better calibration than APACHE III score (Chi-square = 10.392, eight degrees of freedom [df], p = 0.239) in cirrhotic patients.

**DISCUSSION**

APACHE III and SOFA score were shown to perform well in a variety of patient populations\textsuperscript{9,18- 20} Medline search did not show any study in multidisciplinary ICU comparing these two scoring systems. So we compared initial SOFA score (simple, with few variables and economical) with APACHE III score (based on large database with enhanced predictive capacity) in our multidisciplinary ICU enrolling both medical and surgical patients.

In our study, there was no significant relationship between age of patient and outcome (p=0.11) as shown in Table-2. It is consistent with the findings of Acharya et al\textsuperscript{17} Influence of age on outcome was shown to decrease with increasing disease severity.\textsuperscript{21} Similarly, there was no relation between duration of ICU stay and outcome (p=0.77). It was in contrary to studies by Acharya et al\textsuperscript{17} and Schuster et al\textsuperscript{22} where non survivors had shorter duration of ICU stay. This might be because our study also enrolled postoperative patients admitted in ICU for short period of observation.

Both mean APACHE III and initial SOFA score were significantly (p<0.001) higher in non survivors when compared to survivors (Table 2). Similar results were seen in studies by Ferreira et al\textsuperscript{14}, Acharya et al\textsuperscript{17} and Chen et al\textsuperscript{9} as A positive and strong correlation was seen between initial SOFA score and APACHE III score ($r^2$ of 0.721 for all patients) (Fig. 1). Similar correlation was observed in a study by Chen et al\textsuperscript{9} ($r^2$ of 0.628 for all patients). Discrimination was good for both APACHE III (area under ROC curve 0.895) and initial SOFA score (area under ROC curve 0.881) (Fig. 2). Similar results were seen in other studies. Area under ROC curve for APACHE III was 0.90 in a study by Knaus et al\textsuperscript{4} and 0.89 in a study by Zimmerman et al\textsuperscript{5}. Area for initial SOFA score was 0.89 in a study by Chen et al\textsuperscript{9} and 0.79 in a study by Ferreira et al\textsuperscript{14}. There is a significant difference (p<0.001) in non survivors above and below the best cut off point giving the highest Youden index for both APACHE III and initial SOFA score (Fig. 3). Hosmer Lemeshow test showed initial SOFA score to produce insignificant $\chi^2$ value and thus had a better calibration and performed better to predict non survivors when compared with APACHE III score (Table 4). Similar results were seen in a study by Chen et al\textsuperscript{9} where initial SOFA score ($\chi^2 = 5.006$, eight degrees of freedom [df], p = 0.757) had better calibration than APACHE III score ($\chi^2 = 10.392$, eight degrees of freedom [df], p = 0.239) in cirrhotic patients.

Despite the encouraging results, our study has some limitations. First, this study was conducted in a single
center and enrolled both surgical and medical patients. So the results may not be generalized to other centers or to the ICUs dedicated specially for management of medical or surgical patients. Second, only initial SOFA score was calculated. Daily SOFA scoring would further enhance the predictive capacity. Finally, patients were followed only till ICU discharge. Larger multicentered studies and evaluation of special category of patients may be helpful.

In conclusion, this study demonstrates that there is a strong and good correlation between APACHE III and initial SOFA score. Discrimination was good for both the scores. Moreover, initial SOFA score had better calibration and performed better to predict non survivors when compared with APACHE III score. So initial SOFA score can be used as a simple, economical yet reliable tool to predict outcome in ICU and can help clinicians for better utilization of limited and expensive ICU resources.

REFERENCES


Sepsis: a private hospital experience in Nepal

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Introduction: Sepsis, severe sepsis and septic shock are associated with high mortality. Data about patient profile and outcome of sepsis in ICU of Nepal is lacking. This study was conducted to investigate the source of infection leading to sepsis, its complications and eventual outcome.

Material and Methods: It is a prospective study carried out from August 2004 to July 2005 in the ICU of B & B Hospital. The patients admitted in the ICU with the diagnosis of sepsis in accordance to the criteria laid down by American College of chest physician and Society of Critical Care Medicine were analysed and followed up Age, sex, source of infection, duration of stay in the ICU, co-morbidities (Mc Cabe’s score), associated severe sepsis, septic shock, acute respiratory distress syndrome (ARDS), multiple organ dysfunction syndrome (MODS), disseminated intravascular coagulation (DIC) and the eventual outcome of sepsis were taken into account. The cause of death was also studied. Infection was diagnosed on the basis of clinical, radiological and microbiological parameters.

Results: Of the 28 patients included in the study, 53.6% were male and 46.4% were female, the youngest was 15 years old and the oldest was 93 years old. More than half of the patients were more than 60 years old (53.6%) the average stay in the ICU was 6 days and the main source of infection was lung/respiratory tract (57.14%). 10.7% had sepsis, 89.3% had severe sepsis, 82.9% had septic shock, 42.9% had MODS, 32.1% had ARDS and 7.1% had DIC. The overall mortality was 39.3%. In elderly them mortality rate was higher (46.7%). The mortality rate was highest in patients with MODS. The mortality rate of sepsis, severe sepsis and septic shock increased progressively from 0%, 39.3% and 47.8% respectively. The mortality rate in patients with ARDS was 55.6%. The most commonly failing organ was circulatory system(82.1%). The mortality was 100%in patients with 3 or more organ failure.

Conclusion: Sepsis with its complications has high mortality in our hospital that is similar to the recent findings in Brazil, Norway and USA. Awareness of sepsis and its appropriate treatment as per Surviving Sepsis Campaign Guidelines has become mandatory to reduce its mortality.

Introduction

Sepsis is an increasing problem in medical science. Some explanations for this are increasing proportion of elderly people in general population and those admitted to hospitals, more intensive and aggressive treatment of various diseases and injuries, and increased microbial resistance, especially in the hospital environment. Recent reports from USA suggest that sepsis is a serious national health problem, on the same level as ischemic heart disease, and the number of deaths due to severe sepsis is similar to the number of deaths related to ischemic heart disease1. Data about patient profile and outcome of sepsis in ICU of Nepal is lacking. This study was conducted identify the source of infection leading to sepsis, its complications and eventual outcome.

Material and Methods

It is a prospective study carried out from August 2004 to July 2005 in which the patients admitted with the diagnosis of sepsis in the ICU of B & B Hospital were analysed and followed up. A total number of 30 patients were admitted with sepsis in this time period, out of which 2 patients were eventually transferred to other institutions and were excluded from the study. Age, sex, source of infection, duration of stay in the ICU, co-morbidities (Mccabe’s score), associated severe sepsis, septic shock, acute respiratory distress syndrome (ARDS), multiple organ dysfunction syndrome (MODS), disseminated intravascular coagulation (DIC) and the eventual outcome of sepsis were taken into account. The cause of death was also studied. Sepsis and sepsis related conditions were diagnosed in accordance to the criteria proposed by American College of chest physician and Society of Critical Care Medicine2 that is as follows – Systemic inflammatory response syndrome (SIRS) was diagnosed by two or more of the following criteria-

- Temperature > 38°C or < 36°C,
- Heart rate > 90 beats per minute,
- Respiratory rate > 20 breaths per minute or PaCO2 < 32mmHg,
- WBC count > 12,000/cumm or < 4000/cumm or > 10% immature forms.

Sepsis was defined as SIRS due to infection.

Severe sepsis was defined as sepsis associated with organ dysfunction, hypoperfusion or hypotension3. The organ dysfunction variables included –

- Arterial hypoxemia (PaO2/ FiO2 < 300 torr),
- Acute oliguria (urine output < 30-50 ml/hr for at least 2 hrs), Creatinine > 2.0 mg/dl
- Coagulation abnormalities (INR> 1.5 or APTT > 60 seconds)
- Thrombocytopenia (platelet count < 1,00,000/ cumm)
Hyperbilirubinemia (Serum total bilirubin > 2mg/dl)

Haemodynamic variables (systolic blood pressure < 90 mm Hg or systolic blood pressure decrease > 40 mm Hg)

Septic shock was defined as acute circulatory failure despite of crystalloid fluid challenge unexplained by other causes.

Acute circulatory failure was defined as persistent arterial hypotension (systolic blood pressure < 90 mm Hg or a reduction in systolic blood pressure > 40 mm Hg from the baseline despite adequate volume resuscitation).

MODS were defined as the presence of altered function of 2 or more organs in acutely ill patient.

ARDS was defined as –

\[ \text{PaO}_2/\text{FiO}_2 < 200 \text{ torr} \]

Bilateral lung infiltrates in chest radiograph

No evidence of left heart decompensation clinically.

(Note: the third point of PCWP < 10 mm Hg as per American – European Consensus Conference Committee Criteria could not be implemented because of lack of facility of measurement of PCWP in our ICU. The lack of evidence of left heart decompensation clinically was used as a surrogate).

DIC was defined as constellation of the following in the setting of acute illness –

Thrombocytopenia (1,00,000/cumm)

INR > 1.5

APTT > 60 seconds

Positive D-dimer

Hypofibrinogenemia (<150mg/dl)

DIC was deemed to be occult if there was no clinical bleeding and it was deemed to be frank if there was clinical bleeding. McCabe’s score was graded as the following –

1= Non fatal illness
2= Ultimately fatal illness
3= Rapidly fatal illness

The patients were grouped in various groups by the decade and divided into male and female. The average stay in the ICU was also calculated. Infection was diagnosed on the basis of clinical, radiological and microbiological parameters. The infection source was classified as lung/respiratory tract, urinary tract, gastrointestinal and hepatobiliary, and female genital tract. We did not have any case of primary blood stream or wound site infection.

The cause of death was categorised as due to –

Sepsis

MODS

DIC

If the patient died due to refractory shock despite vasoactive/inotropic support he/she was categorised into death due to septic shock. If the patient’s blood pressure was maintained above 90/60 mm Hg with vasoactive/inotropic support but died due to failure of other 2 or more organ system then he/she was categorised into death due to MODS. If the patient died due to exsanguination from bleeding despite of replacement therapy he/she was categorised into death due to DIC.

Results

Of the 28 patients included in the study 15 were males (53.6%) and 13 were females (46.4%). The youngest was 15 years old and the oldest was 93 years old. The patients were grouped into various age groups by the decade (Fig. 1).

Fig. 1. Occurrence of sepsis increases with age

Fifteen out of 28 (53.6%) were above the age of 60 years indicating more than half of the patients with sepsis were elderly. The average stay in ICU due to sepsis was 6 days. Respiratory tract was the commonest source of infection leading to sepsis (57.14%) followed by infection of the urinary tract (Table. 1).

Table. 1. Classification of infection source as a cause of sepsis.

<table>
<thead>
<tr>
<th>Source of infection</th>
<th>No. of patients</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lung/respiratory tract</td>
<td>16</td>
<td>57.14%</td>
</tr>
<tr>
<td>Urinary tract</td>
<td>9</td>
<td>32.14%</td>
</tr>
<tr>
<td>Gastrointestinal &amp; hepatobiliary</td>
<td>2</td>
<td>7.14%</td>
</tr>
<tr>
<td>Female genital tract</td>
<td>1</td>
<td>3.57%</td>
</tr>
</tbody>
</table>

Of 28 patients, 3 had sepsis, 25 had severe sepsis, 23 had septic shock, 12 patients had MODS, 9 patients had ARDS and 2 patients had DIC. Out of 2 patients with DIC, one had occult DIC and the other had frank DIC (Table. 2).

Table. 2. Sepsis and its complications with its distribution

<table>
<thead>
<tr>
<th>Sepsis and its complications</th>
<th>No. of patients</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sepsis</td>
<td>3</td>
<td>10.7</td>
</tr>
<tr>
<td>Severe sepsis</td>
<td>25</td>
<td>89.3</td>
</tr>
<tr>
<td>Septic shock</td>
<td>23</td>
<td>82.1</td>
</tr>
<tr>
<td>MODS</td>
<td>12</td>
<td>42.9</td>
</tr>
<tr>
<td>ARDS</td>
<td>9</td>
<td>32.1</td>
</tr>
<tr>
<td>DIC</td>
<td>2</td>
<td>7.1</td>
</tr>
</tbody>
</table>

The overall mortality was 39.3%, 11 out 28 patients died. In elderly (>60 years) the mortality was 46.7%, 7 out of 15 patients died. The mortality rate was highest in patients with MODS. Ten out of 12 patients with MODS died (83.3%). The mortality rate in patients with septic shock, severe sepsis and ARDS were 47.8%, 39.3% and 55.6% respectively (Table. 3).
Patients with sepsis but without any evidence of organ failure or hypoperfusion did surprisingly well, all the three patients survived. The most commonly failing organ was circulatory (82.1%), 23 out of 28 patients had septic shock. One patient had frank DIC and died of exsanguination despite of replacement therapy. One patient had occult DIC as a part of MODS and died of MODS.

Of the 11 patients that died in our study, 8 were due to septic shock (72.7%), 2 were due to MODS (18.2%), one was due to DIC (9.1%). All the patients who died invariably had septic shock although septic shock was not the cause of death in all the patients.

Higher McCabe's score was not associated with higher mortality rate in our study as anticipated. As a matter of fact, those with McCabe's score more than 2 had mortality of 33.3% (7 out of 21 patients). And those with score of 1 had higher mortality of 57.1% (4 out of 7 patients). There was no patient with McCabe’s score of 3 in our study. But mortality definitely depended upon the number of organ failed, the greater the number of organs failed, the higher the mortality, with mortality of 100% in patients with 3 or more organ failure.

Discussion

In 1914, Schottmueller wrote "septicaemia is a state of microbial invasion from a portal of entry into blood stream which causes signs of illness". In the last few decades, the evidence that sepsis results from an exaggerated inflammatory host response induced by infecting organisms is compelling; inflammatory mediators are the key player in the pathogenesis of septic shock and multiorgan dysfunction syndrome. Sepsis and its sequelae represent a continuum of clinical syndrome encompassing systemic inflammation, coagulopathy and haemodynamic abnormalities. Severe sepsis and septic shock continue to be major cause of morbidity and mortality worldwide.

In our study the occurrence of sepsis was almost equal in both male and female. This is in keeping with an American study where they found that the number of cases of sepsis between men and women were about equal. Occurrence of sepsis was found to increase with age. Reports from Angus D C et al also showed similar findings.

Flaatten et al from Norway also share our experience that mortality in sepsis increases with age. The main source of infection was lung/respiratory tract as was in the study done by Silva E et al from Brazil. Mortality rates were highest in patients with MODS as it has also been shown in the Norwegian study where mortality rate with MODS was 71.8% compared to 83.3% in our study.

Severe sepsis and septic shock carried very high mortality rates of 39.3% and 47.8% respectively. Silva E et al showed mortality of 47% and 52% respectively for severe sepsis and septic shock. Flaatten H et al showed mortality rate of 27% in severe sepsis in his study.

Patients with sepsis but without organ dysfunction or hypoperfusion all survived in our study. The Norwegian study showed mortality of 7.1%. The seemingly good result in our study is most likely due to small sample size. The most common failing organ system in our study was circulatory (82.1%). A very high percentage indeed as compared to 23.4% in study conducted by Flaatten H et al. Contrary to our anticipation, higher McCabe’s score was not associated with higher mortality. This underscored the fact that it was not the severity of co-morbidities but the number of organs failed due to sepsis that determined the mortality, with mortality of 100% in those who had 3 or more organ failure.

Conclusion

Sepsis with its complications has got high mortality in our hospital that is similar to recent findings in Brazil, Norway and USA Awareness of sepsis and its appropriate and early treatment as per Surviving Sepsis Campaign Guidelines has become mandatory. The goal of campaign is to achieve a 25% reduction in sepsis mortality by 2009. It will be of interest to see if we can achieve this goal in Nepal.

References


Table 3. The mortality rate.

<table>
<thead>
<tr>
<th>Sepsis and its complications</th>
<th>Total no of patients</th>
<th>No of patients died</th>
<th>Mortality rate %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sepsis</td>
<td>3</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Severe sepsis</td>
<td>25</td>
<td>11</td>
<td>39.3</td>
</tr>
<tr>
<td>Septic shock</td>
<td>23</td>
<td>11</td>
<td>47.8</td>
</tr>
<tr>
<td>MODS</td>
<td>12</td>
<td>10</td>
<td>83.3</td>
</tr>
<tr>
<td>ARDS</td>
<td>9</td>
<td>5</td>
<td>55.6</td>
</tr>
</tbody>
</table>

Patients with sepsis but without any evidence of organ failure or hypoperfusion did surprisingly well, all the three patients survived. The most commonly failing organ was circulatory (82.1%), 23 out of 28 patients had septic shock. One patient had frank DIC and died of exsanguination despite of replacement therapy. One patient had occult DIC as a part of MODS and died of MODS.
Percutaneous dilational tracheostomy: An initial experience in community based teaching hospital

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Wire, a short rigid introducing dilator, an 8 FG guiding catheter, and several curved dilators of graduated size (12FG, 18FG, 21FG, 24FG, 28FG, 32FG, and 36FG) with an optional 38FG dilator.

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E-mail: gs_malla@yahoo.com

Abstract
Percutaneous dilational tracheostomy (PDT) is frequently performed in the intensive care unit to prevent the long term complications associated with prolonged endotracheal intubation.

Objective: To report the analysis of our experience with percutaneous dilation tracheostomy. Study Design: A prospective documentation of 40 patients who received percutaneous dilational tracheostomy in a multidisciplinary intensive care unit during a 12-month period.

Method: The patients demographic, indications of intubation and PDT, time required to perform the procedure, complications and the outcome of these patients in the intensive care unit were noted.

Result: Among 425 patients, 40 underwent percutaneous dilational tracheostomy that included 22 females and 18 males with the median age of 35 years. Prolonged ventilatory support was the most common indication for tracheostomy. The average duration of intubation before PDT was 5 days. Median procedure time was 20 minutes. Complications included minor bleeding in two (5%), subcutaneous emphysema with pneumothorax in two patients (5%), tracheal stenosis in three (7.5%), tracheo-oesophageal fistula and glottic granuloma in one patient each (2.5%). Among forty patients, 28 (70%) were discharged to the ward, 8 died in intensive care unit and 4 left hospital against medical advice.

Conclusion: Percutaneous dilational tracheostomy is a safe, quick and effective way for long term airway management in critically ill patients.

Tracheostomy is a well established and frequently performed technique in many intensive care units (ICU) (1). In addition to facilitate weaning, the other important reasons to perform tracheostomy are long term airway protection and pulmonary toileting. Percutaneous dilational tracheostomy (PDT) is less invasive and safe beside procedure. Several modifications of percutaneous technique have been described (2). We used Ciaglia percutaneous dilational tracheostomy set to perform tracheostomy. This technique involves the sequential use of serial dilators of increasing diameter to create a tracheostome. To our knowledge, no institute or hospital of Nepal has reported the use of percutaneous dilational tracheostomy to tracheostomise patients either in the intensive care units or in the operating rooms. The purpose of our report is to describe the initial experience with percutaneous dilational tracheostomy in the intensive care unit.

Material and methods
As per requirements and indications, PDT had been performed in patients admitted in the 6-bed general intensive care unit at B.P. Koirala Institute of Health Sciences, Dharan between July 2003 and June 2004. Written informed consent was obtained from the relatives of the patients. All patients were anaesthetized with Midazolam, Pethidine and Vecuronium. Patients with short, thick neck, coagulopathy and enlarged thyroid gland were not eligible for the procedure. Progressive dilatation percutaneous tracheostomy using Ciaglia percutaneous dilational tracheostomy kits (Cook Critical Care Inc.) was performed at the bedside in the ICU. A PDT kit (Fig 1) included a disposable scalpel blade, an introducer needle, a J-tip flexible guide wire, a short rigid introducing dilator, an 8 FG guiding catheter, and several curved dilators of graduated size (12FG, 18FG, 21FG, 24FG, 28FG, 32FG, and 36FG) with an optional 38FG dilator.

PDT was performed by two consultant anaesthesiologists or the anaesthesia trainees under direct supervision. The tracheostomy tube used for PDT were 7-8.5mm in internal diameter.

Patients were already intubated prior to tracheostomy. They were ventilated with 100% oxygen throughout the procedure. Electrocardiogram, non-invasive blood pressure, SpO2, and end-tidal CO2; tidal volume and airway pressure were monitored during the procedure. Patients were positioned with a transverse roll under the shoulder blades to extend the head and neck to facilitate the identification of landmark and ease tracheostomy. Endotracheal tube was withdrawn under vision with direct laryngoscopy to the level of glottic opening to keep the tracheal lumen free for PDT. The neck was cleansed with antiseptic solution.
and properly draped. The cricoid cartilage was identified, and the skin was anesthetized with 2% lidocaine with 1:200,000 adrenaline below the cricoid cartilage. A 1.5- to 2-cm transverse skin incision is made at the level of the second and third tracheal rings. Then blunt dissection in the midline was performed until tracheal rings were identified. Introducer needle, attached to a saline filled 5cc syringe was introduced into the trachea and the position was confirmed by free flow of air on aspiration. Guide wire was passed through the needle and the needle was removed leaving the guide wire in situ.

The serial dilators ranging from 21 and 36 FG were advanced over the guide wire and guiding catheter through the soft tissues and into the trachea up to it’s marking of 36 FG external diameter to make a tracheostome (Fig 2).

Tracheostomy tube was fitted over 24 FG loading dilator and advanced through the stoma once maximum dilation of 36 FG was achieved (Fig 3). The position of tracheostomy tube was confirmed by capnography, adequate tidal volume, SpO2 and easy passage of suction catheter and then the oral endotracheal tube was removed. Tracheostomy tube was secured with the ribbon gauge.

Prospective documentation of data was done to analyze age, sex, diagnosis, indication and duration of intubation, indication of PDT, time required to perform PDT, complications, length of stay in the ICU and the outcome of these patients. Time to perform the procedure was defined as interval from skin incision until connection of tracheostomy tube to the ventilator.

**Fig 1:** Ciaglia Percutaneous dilational Tracheostomy Kit

**Fig 2:** Dilation with 36 FG dilator during PDT

**Fig 3:** Tracheostomy tube fitted over the 24 FG loading dilator

**Results**

During the 12-month period of prospective data collection, forty (9.4%) among 425 patients admitted in ICU required tracheostomy (table 1). The mean patient age was 35 years (range 18-65 years). Most of them were females. Head injury was the most common diagnosis (20%) for tracheal intubation followed by post operative patients, drug overdoses (17.5%) and infections (15%) (Table 2) In all patients, trachea was intubated orally for median duration of 5 days (range 1-15 days) before the procedure. Oral intubated were done at various locations of the hospital but all PDT were performed bedside in the intensive care unit. Anticipated prolonged ventilatory support (22/40, 55%) was the most common indication for PDT. Others were for airway protection (14/40, 35%) and pulmonary toileting (4/40, 10%). The median duration of the procedure was 20 minutes (range 13-32 min). Complications associated with the procedure are shown in table 3. The most common complication was minor bleeding (~10ml) which occurred in three patients; however the bleeding was easily controlled with sustained pressure over the site. A false passage was created in a patient during the procedure which was detected immediately and the procedure was restarted. Subcutaneous emphysema associated with pneumothorax
Table 1: Patient Demographics

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Total no. of patients</td>
<td>425</td>
</tr>
<tr>
<td>Total no. of PDT</td>
<td>40</td>
</tr>
<tr>
<td>Age (years)</td>
<td>35(18-65)</td>
</tr>
<tr>
<td>Sex</td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>18</td>
</tr>
<tr>
<td>Female</td>
<td>22</td>
</tr>
<tr>
<td>Location of intubation</td>
<td></td>
</tr>
<tr>
<td>Emergency</td>
<td>13</td>
</tr>
<tr>
<td>ICU</td>
<td>11</td>
</tr>
<tr>
<td>Ward</td>
<td>9</td>
</tr>
<tr>
<td>Operating room</td>
<td>7</td>
</tr>
<tr>
<td>Intubation prior to PDT (days)</td>
<td>5 (1-15)</td>
</tr>
<tr>
<td>Operating time (minutes)</td>
<td>20 (13-32)</td>
</tr>
<tr>
<td>Total days in ICU</td>
<td>14 (3-58)</td>
</tr>
</tbody>
</table>

Table 2: Diagnosis of patients admitted in ICU requiring PDT

<table>
<thead>
<tr>
<th>Diagnosis</th>
<th>No. of patients</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Road traffic accident: head injury</td>
<td>8</td>
<td>20.0 %</td>
</tr>
<tr>
<td>Drug Overdose</td>
<td>7</td>
<td>17.5 %</td>
</tr>
<tr>
<td>Post operative: Viscus perforation, Eclampsia, intestinal obstruction,</td>
<td>7</td>
<td>17.5 %</td>
</tr>
<tr>
<td>Infections: cerebral malaria, meningitis, Encephalitis,</td>
<td>6</td>
<td>15.0 %</td>
</tr>
<tr>
<td>COAD, Pneumonia</td>
<td>5</td>
<td>12.5 %</td>
</tr>
<tr>
<td>Hypoxic encephalopathy, CVA,</td>
<td>4</td>
<td>12.0 %</td>
</tr>
<tr>
<td>Guillian Barré syndrome</td>
<td>2</td>
<td>5.0 %</td>
</tr>
<tr>
<td>Burn</td>
<td>1</td>
<td>2.5 %</td>
</tr>
</tbody>
</table>

Table 3: Procedural complications

<table>
<thead>
<tr>
<th></th>
<th>Number</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>No complications</td>
<td>29</td>
<td>72.5%</td>
</tr>
<tr>
<td>Minor bleeding</td>
<td>03</td>
<td>7.5%</td>
</tr>
<tr>
<td>False passage</td>
<td>01</td>
<td>2.5%</td>
</tr>
<tr>
<td>Subcutaneous emphysema &amp; pneumothorax</td>
<td>02</td>
<td>5%</td>
</tr>
<tr>
<td>Glottic granuloma</td>
<td>01</td>
<td>2.5%</td>
</tr>
<tr>
<td>Tracheal stenosis</td>
<td>03</td>
<td>7.5%</td>
</tr>
<tr>
<td>Tracheo-esophageal fistula</td>
<td>01</td>
<td>2.5%</td>
</tr>
</tbody>
</table>
Discussion

Tracheostomy is a better alternative to oral or nasal intubation because it is well tolerated and eases pulmonary toileting as well. The requirement for less sedation and analgesia facilitates early weaning from the ventilator. Surgical tracheostomy is routinely performed by the ear, nose and throat (ENT) surgeons. Modification of tracheostomy technique has lead to introduction of percutaneous tracheostomy in 1955 that did not gain much popularity because of associated fatalities(3). Ciaglia and colleagues in 1985 reintroduced the technique as percutaneous dilatational tracheostomy. Since then it has almost replaced the conventional (surgical) tracheostomy in critical care setup. Meta-analysis concluded that percutaneous tracheostomy is simpler, quicker and safer bedside procedure with lower complication rate than the surgical approach (5). Evidence also suggests that the incidence of ventilatory associated pneumonia may be lower following tracheostomy (6).

We report our early experience of percutaneous dilatational tracheostomy in which a total of 40 patients admitted in ICU underwent tracheostomy. We used Ciaglia percutaneous dilatational tracheostomy kit because of its availability in the hospital. The appropriate timing of the tracheostomy in intubated patients is yet to be defined. In our report, the mean duration of intubation prior to tracheostomy was 5 days. The earliest tracheostomy (within 24) performed in our report was in a patient with massive facial burn in anticipation of requiring prolonged ventilatory support and delayed PDT was on the 15th day of intubation in another patient as the relatives of the patient failed to consent for the procedure. A recent study compared early (within 48 h) with late (at day 14–16) tracheostomy using a prospective randomized controlled trial in ICU patients. They found a decreased mortality [19/60 (early) vs. 37/60 (late)] and a significantly decreased use of resources in the ICU, including length of stay and days ventilated in early group.

The median time required to perform PDT was 20 minutes. The minimum time in our report was 13 minutes. The time was comparable with Donaldson et al who reported a mean time of 13.2 minutes but Bewsher et al completed PDT in 2 min 7 sec. Our early experience may have contributed for longer time to perform the procedure. Percutaneous tracheostomy is not without complications but fatal life threatening complications are rare. The periprocedural complication rate with percutaneous dilatational tracheostomy (PDT) technique is 4 to 15%. Twenty nine patients (72.5%) in our report were without complications. The most common intraoperative complication was bleeding described oozing (<10ml) which was noted in three patients. Freeman et al conducted meta-analysis of trials comparing percutaneous and surgical tracheostomy in critically ill patients reveals that PDT was associated with less perioperative bleeding, less postoperative complications, lower postoperative bleeding and stomal infections. Subcutaneous emphysema associated with right-sided pneumothorax was recorded in two patients requiring intercostals chest drain. Chest X-ray was done in all the patients following PDT.

Blind insertion of introducer needle can cause tracheal injury more frequently leading to the development of potentially life threatening complications as tension pneumothorax, pneumomediastinum and even false passage. There are evidences to suggest that use of bronchoscopes to visualise the correct position of introducer needle into the tracheal lumen during PDT decreases the chances of complications related to the procedure (6). We could not perform bronchoscopy because of the unavailability of the equipment in the department. The other complications encountered were glottic granuloma, tracheo-esophageal fistula and tracheal stenosis. Three patients who developed tracheal stenosis remained intubated for 13 or more days prior to PDT. The definite cause of stenosis could not be established but CT neck confirmed stenosis. The other patient who developed tracheo-esophageal fistula was discharged from the hospital following successful repair of the fistula. There were no mortalities related to PDT. Among 40 patients with PDT, 28 (70%) were discharged to the ward, 8 (20%) died in ICU and 4(10%) patients left ICU against medical advice with tracheostomy in situ. Among 28 patients, 20 (71.4%) were decannulated and discharged from the hospital and 8 died in the ward within a month.

Conclusion

Our study shows PDT can be done safely in hospitals and with low morbidity and mortality rates. With growing operator and experience, most of the tracheostomy performed in our ICU is PDT. We expect the use of PDT in other hospitals of Nepal because it is safe, minimally invasive technique and easy to perform.

Reference

Section C
Free Papers
Bedside point-of-care ultrasonography in ICU

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Introduction
Goal directed bed side point-of-care ultrasonography has been used frequently by the physicians involved in managing critically ill patients. It allows direct visualization of pathology or abnormal physiological state at the bedside. Critical care ultrasonography differs from standard sonography by radiologists and cardiologists. During goal directed bed side ultrasonography, intensivist personally performs and interprets the ultrasound examination and immediately integrates the results into the overall clinical assessment and plan. The examination may be repeated as needed to follow the evolution of illness and the response to therapy.

Use
Proper management of undifferentiated shock in acute care setting can be one of the most challenging issues. Physical examination findings can be misleading due to complex physiology of shock. Accurate and prompt initial care of these patients can significantly affect the outcome. Various protocols have been proposed and studied for algorithmic ultrasound assessment of the patients with undifferentiated shock. The protocols like FATE (Focus Assessed Transthoracic Echocardiogram), ACES (Abdominal and Cardiac Evaluation with Sonography in Shock) and RUSH (Rapid Ultrasound in Shock) can facilitate the intensivist or bedside physician to categorize the patient’s underlying physiologic state of shock.

The RUSH exam divides bedside ultrasound examination into three parts: the pump, the tank and the pipes. While assessing the pump, intensivist looks for the presence of pericardial effusion and cardiac tamponade. Global left ventricular function is determined and assessment is made for the presence of acute right ventricular strain. While assessing the tank, inferior venacava is evaluated to assess the intravascular volume status and to predict fluid responsiveness. FAST (Focused Assessment with Sonography in Trauma) exam of abdomen is performed to look for free intraperitoneal fluid (leakiness of tank). Lungs are scanned for the presence of pneumothorax (causing compromise of tank), pulmonary oedema (as an indicator of tank overload) and presence of alveolar consolidation (for the possible cause of septic shock). While assessing the pipes, patient is examined for presence of aortic aneurysm (causing rupture of pipes) and sonographic evidence of lower extremity deep vein thrombosis (causing clogging of pipes).

Bedside ultrasonography can help clinicians make a rapid diagnosis in patients with acute respiratory failure. In the hands of a trained person, it is a sensitive and specific tool for diagnosing pneumothorax, pneumonia, pulmonary oedema, pulmonary embolism, asthma and chronic obstructive pulmonary disease. Bedside ultrasonography performed by physician was found to be more sensitive and specific than chest radiography for diagnosing pneumothorax. Routine use of lung ultrasound was found to be associated with reduction of number of chest radiographs and CT scans performed in ICU. Similarly, ultrasound guidance during thoracentesis and paracentesis was associated with fewer complications.

Incorporation of bedside sonography during Advanced Cardiac Life Support (ACLS) in cardiac arrest patients can be helpful to find the cause of cardiac arrest. Absence of cardiac activity during ACLS, as detected by bedside focused echocardiography predicts a significantly lower likelihood of Return Of Spontaneous Circulation (ROSC).

Bedside sonographic evaluation of the diaphragm is valuable in the assessment and follow up of patients with diaphragmatic weakness or paralysis. In mechanically ventilated patients, it is useful in bedside diagnosis of diaphragmatic dysfunction and thus identify the patients at high risk of difficulty weaning. Airway management of critically ill patients can be facilitated by bedside ultrasonography. It is helpful in preintubation assessment of airway, verification of position of endotracheal tube and for guiding percutaneous tracheostomy.

Ultrasonography of Optic Nerve Sheath Diameter (ONSD) was shown to be a reliable bedside tool for detecting intracranial hypertension. Bedside Transcranial Doppler ultrasonography (TCD) can be useful to recognize the development of cerebral vasospasm in patients with subarachnoid haemorrhage. American Heart Association/ American Stroke Association guidelines for the management of aneurysmal subarachnoid haemorrhage recommends TCD to monitor for the development of arterial spasm in these patients.

Real-time ultrasound guided venipuncture is associated with fewer immediate complications and faster access. It is recommended that properly trained clinicians use real-time ultrasound during internal jugular cannulation whenever possible to improve cannulation success and reduce the incidence of complications. Similarly, real-time two-dimensional ultrasound guidance for radial artery catheterization was shown to improve first-pass success rate.

Real-time ultrasound guidance during central line placement significantly reduces complications.
Competency and training

Ultrasoundography has widespread utility in the diagnosis and treatment of critically ill patients. It is a valuable and accessible tool for intensivists. So, the intensivists who practice ultrasoundography should be trained and attain competence with critical care ultrasoundography (CCUS) in three main areas – general critical care ultrasound, basic critical care echocardiography and advanced critical care echocardiography.

Conclusion

Bedside goal directed point-of-care ultrasoundography by a trained intensivist, when integrated with clinical assessment in acute care setting can be valuable in early detection of physiological derangement and guiding the management. In addition, it can enhance safety for some important bedside procedures.

References

The Critical Care Nurse

Shreejana Singh; Nurse, Dept of ENT

Choosing a career in nursing should be a life’s pathway- a desire to heal, protect and serve others. Caring for patients completely is a calling that is not meant for everyone. It is hard to work with numerous challenges as well as rewards. It takes a very strong, smart individual to work in the nursing field and it is indeed difficult to use mind as well as heart at the same time.

Nurses could be referred to as the “guardians of humanity” and the “sentinels of society,” with good reason.

Critical care nursing requires a nurse to have additional skills. The critical care nurse needs to:

- Be well versed in advanced pathophysiology.
- Tactful while treating patients in environments that require quick decision making skills under life-threatening conditions.
- Coordinate the multiple disciplinary team.
- Provide leadership in the management of care.

Critical care nursing is highly technical and is generally considered beyond the level of a new graduate. In order to provide excellence in care, a nurse should become certified in a specific area of critical care nursing.

According to AACN (American Association of Critical Care Nurse), there are 10 critical care nurses’ role and responsibilities:

1. Support and respect for the patient’s autonomy and informed decision making.
2. Intervening when it is questionable about whose interest is served
3. Helping the patient to obtain the necessary care.
4. Respecting the values, beliefs and rights of the patient.
5. Educating the patient/surrogate in decision making.
6. Representing the patient’s right to choose
7. Supporting decisions of patient/surrogate or transferring care to an equally qualified critical care nurse.
8. Interceding for patients who cannot speak for themselves and who require emergency intervention.
10. Acting as liaison between the patient/significant others and others on the health care team.

The critical care nurses are facing many challenges in many forms but include economic, staffing, educational issues.

Economic challenge:
- Low pay scale, not providing salary timely which may subject nurses to moral distress.

Staffing challenges:
- As the population ages, there is an emergence of chronic and new illnesses. Critical care nurses find themselves frequently overworked and stressed. Added to this, they face biasness among the staffs which may lead to moral distress.
- Moral distress is caused by a situation where the nurses know the right thing to do but is prevented from doing it because of restraint created by peripheral situations.

In order to help combat the incidence of moral distress the AACN has developed 4 A’s model which was developed in order to help critical care nurses handle situations and have a course of action if they become subject to moral distress.

| The 4 A’s model of assessing for and preventing moral distress |
|-----------------|---------------------------------------------------------------|
| Ask             | “Am I experiencing or showing signs of suffering?” |
| Affirm          | “Am I taking care of myself personally and professionally?” |
| Assess          | “Where is my distress coming from?” |
| Act             | “Am I developing an action plan to prevent this suffering? Who can help me? Is there institutional or unit help that can be instituted?” |

Educational issues:
- There are many educational challenges that the critical care nurses are facing. Included in these challenges are the education of new critical care nurses, refresher courses for critical care nurses, providing continual education for nurses.
- To develop and maintain autonomy as professional nurses, we must continue to be actively creative and dedicated in our roles. And as nurses, we must do it right the first time and everytime. The consequences of performance below the standard of care can be disastrous.
- Lastly I would like to state that a life as a nurse will not make one a millionaire, but it will provide steady, worthwhile, satisfactory employment for those with the moral strengths and will power.
- Last but not the least, to work as a critical nurse and to be competent in the field one should develop aptitude, undergo training and have a will to work hard.
The power of education

Malala, a 16 year old girl from Pakistan, has inspired millions of people around the world with her courage to speak up against the deadly rebels Talibans. She is a true exemplary model of bravery and gallantry. I was incited by her constant effort to raise her voice against Talibans from a very young age and even after sustaining brutal and heinous gunshots by them. She surely is a living legend whose story will be passed on from generation to generation. She left no stone unturned to protest against prohibition of girl education at an age when every teenager is conscious of their looks and wants to dress well and look attractive. I was awestruck by her charm and fearlessness to come up in front of camera to encourage girls to not leave school even when the whole city was living under the terror of Talibans.

I wondered where that courage in her came from. She belonged to a well educated family where her father is a school principal who had been supportive of his children throughout. Despite the threats of the terrorists, he continued to walk hand in hand with his daughter and the other girls in order that they may not lose hope and stop going to school.

Education, definitely our only key to the world, is an indispensable treasure for every one of us. Perhaps, the words may not be adequate to describe education but it certainly has affirmative sides and renders fruitful results. In simple terms, it refers to imparting knowledge, building skill and developing attitude in an individual. As a whole, it builds up and strengthens a person physically, mentally, spiritually and socially.

Malala has definitely understood the caliber of education and she also has desires to contribute to the society the best way she can. Education has profound capacity to mould the mind of a person and fill it with morale and ethics. That is the reason why she is unstoppable and invincible, and she will continue to educate herself and encourage all the other girls around the world to respect education wholeheartedly.

Nelson Mandela, the former revolutionary leader of South Africa has stated that “Education is the most powerful weapon which you can use to change the world.” Infact, the power of education is surpassingly amazing and beyond definition. Even a popular phrase ‘A pen is mightier than a sword’ apparently proves that all the world leaders have been great scholars of their times. To name a few, Abraham Lincoln, John F. Kennedy, Mahatma Gandhi, Jawaharlal Nehru, Benazir Bhutto and so on.

The literacy rate in Nepal in the census of 2068 B.S. report is at 76.92%. It has markedly increased from 54.10% as of census 2058 B.S. to 76.92%. That is quite an achievement and it also reflects the awareness and inclination of people towards the importance of education.

However, there are still some areas in Nepal where women are forbidden of education. The society is sadly driven by conservative and superstitious rites and rituals. As a result, such society is inevitably regressive of women’s development. Subsequently, women are deprived of education which is the only source of enlightenment and empowerment. Education is simply investing on human capital which gives productive result in return. It is the only source that can eliminate poverty and conflict, be it domestic or political, in a country.

Malala is a protagonist representing the importance of education around the world. Having brought up in such a conservative place where child marriage is so prevalent, she crossed that bar with such guts putting her life at stake. She is an idol to look upto and to worship.
Regulated suction pressure for endotracheal tube suctioning

Rashmita Bajracharya; Nurse, ICU

Endo-tracheal suctioning, an essential component in the management of airway patency and secretion removal in the critically ill, has become a routine part of care for mechanically ventilated patients in the Intensive Care Unit. The upper airway warms, cleans and moistens the air we breathe. The ET tube (Endotracheal tube) bypasses these mechanisms, so that the air moving through the tube is cooler, dryer and not as clean. In response to these changes, the body produces more mucus. These secretion should be removed by using suction catheter.

Various risks are involved in the procedure and have been reported since the earliest days of invasive respiratory support. Some of the risks involved are: Atelectasis (reported and shown by radiological examination), Pulmonary haemorrhage, Tissue trauma (from the vigorous insertion of the suction catheter as the tissue lining the airway is suctioned into the side ports of the catheter) etc. Since suctioning is associated with various side-effects; regulated suction pressure for endotracheal tube suctioning is necessary for patient’s safety and practitioner’s confidence.

Before applying suction we have to know the size of catheter to be used for suctioning. According to the research done by Rosen and Hillard it has been recommended to use a suction catheter that occluded less than half the internal diameter of the endotracheal tube in order to prevent the build up of large negative intra-pulmonary pressures during the suctioning procedure as there would be sufficient return airflow down the endotracheal tube to compensate for that removed by the suction catheter within the lung.

Choosing a size of suction catheter is complicated by the common misunderstanding of Charriere’s French scale commonly used for labelling suction catheters. However, converting the French scale to mm merely involves dividing the number by 3. For example if we are using a 12Fr catheter then we should divide the number by 3 i.e. the internal diameter of the suction catheter is 4mm. Also it is usually recommended to perform suctioning without disconnecting ventilator because this continuously provides PEEP.

Suctioning is an essential procedure of the critical care areas. While mechanically ventilated patients require assistance in removal of airway secretion, endotracheal suctioning is an inherent procedure associated with inherent risk to the patient from airway trauma, hemodynamic disturbances and difficulties in gas exchange. So suction pressure should be regulated. The best evidence of setting an adequate suction pressure arises out of 50 years of heterogenous studies done by a group of interested professionals.

Flow rates of 15 to 20 liters of air through the suction catheter has been recognized as a recommended level of flow rates in various studies. This amount of pressure is adequate for the removal of secretion from the airway. Also a suction pressure of 80-100 mm of Hg for neonates and less than 150 for adults appears to be recommended. The mentioned above are the flow rates and the suction pressure that has been mentioned in most of the text. Nevertheless, studies also show that even the suction pressure regulated at this level can cause lung volume loss and trauma to the lungs tissue. While no safe maximum has been determined: there is no evidence to support suctioning an artificial airway from an unregulated wall suction outlet.

So what is the optimum level of suction pressure required to apply during the course of endotracheal suctioning?

As much as necessary and as little as possible.

References:
Tracheostomy

Sita Devkota; Nurse, ICU

Tracheostomy is creating an opening into the trachea usually between the 2nd and 3rd rings of cartilage. It is performed as a life saving measure in a person who is unable to maintain his/her airway. Tracheostomy is usually performed surgically by ENT surgeon in operation theatre, but in critical case setup it is also frequently performed percutaneously by an Intensivist or ICU team (percutaneous dilatational tracheostomy).

Emergency tracheostomy is done when the laryngeal obstruction is acute and there is impending respiratory failure due to this and demands urgent intervention to save life. Elective tracheostomy is usually planned in ICU for weaning from mechanical ventilation if the patient has been ventilator-dependent for too long. Permanent tracheostomy is done when larynx is removed, for example total laryngectomy done for carcinoma of larynx.

**Indications for tracheostomy:**
1. Facilitate weaning from mechanical ventilation by decreasing anatomical dead space.
2. Upper airway obstruction: foreign bodies larynx, subglottic edema.
3. Artificial ventilation: Head and chest trauma, neuroparalytic disease.
4. Airway toileting.

**Complications of tracheostomy:**
Hemorrhage, Surgical emphysema, tracheoesophageal fistula, pneumonia, stoma infection are some of the complications of tracheostomy.

**Steps of tracheostomy care:**
The main principle of tracheostomy care is to prevent the blocking of the stoma by the secretions and prevent the spread of secondary infection to the patient.

**Preoperative care:**
- Well explain the procedure to the patient and patient party with written consent.
- Perform basic necessary investigations like hemoglobin, platelets, PT/INR and arrange blood if needed.
- NPO for at least 6 hours prior to the procedure.
- Collect the necessary equipments like tracheostomy tube (usually size 7.5 and 8 for adults)
- Arrange for tracheostomy set and drapes if planned for percutaneous tracheostomy.

**Postoperative care:**
- Receive the patient in bed with 45 degrees head up opposition
- Watch for bleeding cyanosis, respiratory distress.
- Monitor vitals frequently
- Close monitoring of the patient for 12 hours.
- Emergency drugs and suction equipments kept in bedside
- If the patient is in ventilator, give sedation if needed; provide analgesic and antibiotics as needed.

Besides this, to maintain an open airway; assess for secretions and suction the tube. Give 100% oxygen for 2 minutes before starting suction. Use sterile technique while suctioning to prevent infection.

To prevent dislodgement of tube; use tapes or neck ties to secure the tube in place.

The tracheostomy wound and surrounding skin are kept dry and free of secretions as possible. So clean the tracheostomy site with povidone iodine or savlon solution two times a day. The wound is dressed properly and protected with sterile dry gauze to fit around the tube.

If metallic tube is used, soak the inner canula with hydrogen peroxide or sodium bicarbonate then clean with soap in running water then sterilize before use. If outer tube is blocked, it is also removed after 48 hours and cleaned as needed.

Besides these, following factors should also be considered:

**Humidification:** Provide constant airway humidification with steam to avoid thickening and crusting of bronchial secretions which have the propensity to cause airway obstruction.

Nutrition: Adequate nutrition as per need (based on body weight) should be maintained. Fluid and electrolyte balance should be looked for. Start feeding the patient after documenting gag reflex.

**Oral hygiene:** Chlorhexidine solution 6 hourly.

**Communication:** Patients with cuff inflated cannot talk, so frequently communicate with the patients with pad and pen, call bell and use symbolic language whichever is appropriate. Reassure that the patient’s ability to speak will return once the tube is removed.

**Exstubation:** Before the tracheostomy tube is removed the patient must learn again to breathe through the upper respiratory tract. After removal of the tube the stoma is closed and wound is dressed till it heals.

**Care of the person discharged with tracheostomy:**
Patient and patient party are taught to care and clean the tube

Explain about dangers of aspirating water through the tracheostomy tube while bathing and avoid swimming

Cover the stoma with clean cloth.

Avoid close contact with those with respiratory infection.

If tube is blocked, immediately contact ER for tube change or evaluation.

Regular follow-up.
Do Not Resuscitate (DNR) Issues

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Introduction:
The term "do not resuscitate" or "DNR", sometimes called a "No Code", is a legal order written either in the hospital or on a legal form to respect the wishes of a patient not to undergo CPR or advanced cardiac life support (ACLS) if their heart were to stop or they were to stop breathing. Do-not-resuscitate (DNR) orders are commonly implemented in the critical care setting as a prelude to end-of-life care.

DNR does not affect any treatment other than that which would require intubation or CPR Patients who are DNR can continue to get chemotherapy, antibiotics, dialysis, or any other appropriate treatments.

Alternative forms of DNR:
- DNI (Do Not Intubate)
- NFR (Not For Resuscitation)
- DNAR (Do Not Attempt Resuscitation)
- AND (Allow Natural Death)

Purpose of DNR:
- DNR supports a patient's autonomy past the point where they are able to express this autonomy.
- DNR provides written evidence of a patient's wishes that can be used to guide the appropriate course of action taken by a medical team.

When to obtain consent for DNR:
Consider a do-not-resuscitate (DNR) consent when:
- A patient's presumed consent for cardiopulmonary resuscitation (CPR) is in question,
- The patient has an illness that is terminal or severe and irreversible, or
- He or she is permanently unconscious or likely to have cardiac or respiratory arrest.

Who can give DNR consent:
Patients with capacity can refuse CPR in advance (as they can with all other treatments) without necessarily giving justification to their decisions. However the health team must ensure that their decision is not based on any inaccurate information or any misunderstanding.

If a person lacks capacity, the international law permit the next of kin to make medical decisions of incapacitated relatives. Any previously expressed wishes should be considered whilst making a DNR decision.

When can DNR be suspended?
Those who develop cardiac or respiratory arrest via reversible causes (choking, anaphylaxis etc.) unless the patient has specifically refused treatment in such cases.

Those going into procedures known to have a chance of causing cardiac/respiratory arrest (e.g. cardiac catheterisation, surgical operations)

Can children give DNR consent?
A child (anyone under 18) can refuse to consent to medical treatment. However, this refusal can be overruled by the parents of the child or by a court. It is interesting to note that although there is right in law for patients to consent to treatment if they are below 16, there is no right in law for patients to refuse treatment.

Can a DNR order be revoked?
Yes, a patient or their surrogate decision-maker can revoke a DNR order at any time. If the order is written on the patient’s chart, the patient/proxy must notify the physician to cancel the DNR order. If this occurs, make sure that the Medication Administration Record and the Cardex are updated to reflect the cancellation.

Conclusion:

'Do not resuscitate' does not mean 'do not treat'
Birth and deaths are two definite facts of life. Death is what we always fear of. Before joining the nursing profession I had never touched or seen the dying people from a very close distance.

On the very first day of my clinical posting as a student in 2057 BS in Patan Hospital Medical ward, I was assigned to one patient. He was an old guy with some chronic illness and I was providing nursing care to him. He suddenly became still and would not respond to my calls. I was unaware of his death as I had never been face to face with death. I was very scared and shocked. Well that was how it began. Now after working for more than a decade in nursing field and having faced dead or dying people a lot of times, I feel like I’ve become an emotionless person or I’d rather say my emotions have gone into hibernation. It might be because in our profession we have to go through such stressful situations so many times that, perhaps we forget how to react to those situations; or maybe we learn how to cope with stress and that’s why we are able to teach others to cope with stress effectively.

Nursing has a long history of holistic person-and-family centered care. There is perhaps no setting or circumstance in which caring for dying person is less important any other job. Knowledge about end-of-life decisions and principles of care is essential to support the patients during decision making and in achieving of goals of such principles.

Education, clinical practice and research concerning end-of-life care are evolving and the need to prepare nurses and other health care professionals to care for the dying has emerged as a priority.

The palliative care task force of Last Acts Campaign (Last Acts, 1997) identified the following as precepts or principles underlying a more comprehensive human approach to care of the dying:

Respecting patient’s goals, preferences and choices.
- Attending to the medical, emotional, social and spiritual needs of the dying person.
- Using strengths of interdisciplinary resources.
- Acknowledging and addressing care giver concerns.
- Building mechanism and systems of support.

Clinician’s attitude towards death:
Clinician’s attitudes toward the terminally ill and dying remain the greatest barrier to improving care at the end of life. At the earlier time, it was common for patients to be kept uninformed about life-threatening diagnoses, particularly cancer and for physicians and nurses to avoid open discussion of death and dying with their patient. But the research result of Keble-Ross (1969) taught the health care community that healing could not take place in a conspiracy of silence and that as clinicians break the silence and enter the realm of patient’s world, they too can be healed by their struggles and strengths. Her work revealed that, given adequate time and some help in working through the process, patients could reach a stage of acceptance where they were neither angry nor depressed about their fate.

Sociologists Glaser and Strauss (1965) identified four “awareness contexts” described as the patients, physicians’, family’s and other health care professional’s awareness of the patient’s status and their recognition of each others awareness.

Closed awareness:
The patient is unaware of his/her terminal state while others are aware. It may be characterized by families and health care professionals conspiring to guard the secret, fearing that the patient would not be able to cope with full disclosure about his/her status.

Suspected awareness:
The patient suspects what others know and attempts to find out. It may be triggered by inconsistencies in families and clinicians, communications and behavior.

Mutual pretense awareness:
The patient, the family and the health care professionals are aware that the patient is dying but all pretend otherwise.

Open awareness:
All are aware that the patient is dying and are able to openly acknowledge that reality.

Signs of approaching death:
Observables, expected changes in the body take place as the patient approaches death and organ system begin to fail. Nursing care measures aimed at patient comfort should be continued, i.e. pain medication, turning, mouth care, eye care, positioning to facilitate draining of secretions and measures to protect skin from incontinences should be continued.

The following signs are present in patient:
- The person will show less interest in eating and drinking.
- Urinary output may decrease in amount and frequency
- As the body weakens the patient will sleep more and begin to detach from the environment.
- Mental confusion may become apparent as less oxygen is available to supply the brain.
- Vision and hearing may become impaired and speech may be difficult to understand.
Secretions may collect in the back of the throat and gurgle as patient breaths through moth.

Breathing may become irregular with periods of no breathing.

As the oxygen supply in the brain decreases, patient may become restless.

The patient may feel hot one moment and cold the next as he body loses its ability to control temperature.

Loss of bladder and bowel control may occur around the time of death.

As people approach death, many times they report seeing gardens, libraries or family or friends who have died.

**Nursing care of the patient who is close to death:**

Providing care to the patient who is close to death and being present at the time of death can be one of the most rewarding experiences, a nurse can have. Many patients suffer unnecessarily when they do not receive adequate attention for the symptoms accompanying serious illness. Careful evaluation of the patient should include not only the physical problems but also the psychosocial and spiritual dimensions.

The following points highlight nurses’ responsibilities:

- Nurses are responsible for educating patients about the possibilities and probabilities inherent in their illness and their life with the illness.
- They are responsible for supporting the patients in their life review, values clarification, treatment decision making and end of life closure.
- At the same time nurses need to be both culturally aware and sensitive in their approach to communication with patient’s families about death.
- The patient has the right to choose the end of life preferences.

**Methods of stating end-of-life preferences:**

Advanced directives- written document that allow the individual of sound mind to document preferences regarding end of life care that should be followed when the patient is terminally ill and unable to verbally communicate his/her wishes.

Proxy directives: the appointment and authorization of another individual to make medical decisions on behalf of the person who created an advanced directive when he/she is no longer able to speak for him/herself.

Living will: a type of advanced directive in which the individual of sound mind documents treatment preferences, provides instructions for care in the event that the signer is terminally ill.

Nurses are responsible for communication with each patient and family to their level of understanding and values concerning disclosure, general guidelines for the nurse include the following (Addington, 1991):

- Deliver and interpret the technical information necessary for making decision without hiding behind medical terminology.
- Realize that the best time for the patient to talk may be when it is least convenient for you.
- Being fully present during any opportunity for communication is often the most helpful form of communication.
- Allow the patient and family to set the agenda regarding the depth of conversation.

**Caring for families in the ICU:**

Clinician-family communication is an important component of good quality care. Effective clinician-family communication reduces the stress on family members of critically ill patients and improves the family members’ level of understanding. This is of critical importance in ICU because if the patient’s family is under significant distress, their ability to provide surrogate decision making may be impaired and the medical decision they make may not accurately reflect the wishes of the patient.

An important problem with critical care delivery system is dissatisfaction among family members. There is also evidence to suggest that our current approach causes anxiety, depression and post-traumatic stress disorder among family members. Many critical care units only conduct family meetings only after it is clear that an ICU patient is dying but it is important to meet with all ICU families early in the ICU stay because family caregivers are under a high level of emotional and physical stress. In fact, family members of patients who survive the ICU are more dissatisfied with communication in ICU than family members of patients who die.

Last but not the least, we all should follow a VALUE that will help make communication easier:

V: Value family sentiments.
A: Acknowledge family emotions.
L: Listen to the family.
U: Understand the patient as a person.
E: Elicit family questions.
Nurse Teach Reach has developed a comprehensive Skills Assessment manual, which covers basic and specialty topics. This manual is provided to all nurses and comprises of questions and assessments on many basic nursing skills to establish and maintain a standard level of nursing care across the hospital.

Lucy and many of her volunteers have extensive Intensive Care experience and Nurse Teach Reach also wants to support Critical Care Departments in Nepal.

We have developed a strong relationship with the Nepal Critical Care Development Foundation and we hope to develop our association in the future. We have plans to work in Grande International Hospital and Patan Hospital in 2014, working with Critical Care Staff in policy development and implementation.

We are currently developing an Intensive Care Unit Orientation Manual, which will be distributed to new staff. This contains evidence based information and assessments on topics such as Haemodynamic Monitoring, Basic Ventilation, ICU Specific Medications, Advanced Life Support and Advanced Physical Assessment. This will provide new nursing staff with much needed resources to help them transition into their new role in ICU.
Section D
Patient Education Section
Sepsis
The World Sepsis Declaration, Worldwide

Sepsis is one of the most common, least-recognized illnesses in both the developed and developing world. Globally, 20 to 30 million patients are estimated to be affected every year, with over 6 million cases of neonatal and early childhood sepsis and over 100,000 cases of maternal sepsis.

a person dies from sepsis every few seconds.

In the developed world, sepsis is dramatically increasing by an annual rate of between 8-13 % over the last decade, and now claims more lives than bowel and breast cancer combined. Reasons are diverse, but include the aging population, increasing use of high-risk interventions in all age groups, and the development of drug-resistant and more virulent varieties of infections. In the developing world malnutrition, poverty, lack of access to vaccines and timely treatment all contribute to death.

Despite its remarkable incidence, sepsis is practically unknown to the public and is often misunderstood as blood poisoning. Sepsis arises when the body’s response to an infection injures its own tissues and organs. It may lead to shock, multiple organ failure, and death, especially if not recognized early and treated promptly. Sepsis remains the primary cause of death from infection despite advances in modern medicine, including vaccines, antibiotics, and acute care with hospital mortality rates between 30 and 60%.

To stem the rising tide and take appropriate steps to ultimately reverse the global increase in the numbers of deaths from sepsis, we - the global sepsis community - issue this common call to worldwide action.

We ask all relevant stakeholders, by committing to the goals and key targets set out below, to initiate necessary priority actions, and to secure resources and support from governments, development agencies, professional organizations and health care commissioning groups, philanthropists and benefactors, the private sector and all of society.

We call on each country to formalize a nationally achievable, staged development plan intended to deliver these targets by 2020.

Global goals:

1. Place sepsis on the development agenda. The Declaration will increase the political priority given to sepsis by raising awareness of the growing medical and economic burden of sepsis.
2. Ensure that sufficient treatment and rehabilitation facilities and well-trained staff are available for the acute and long term care of sepsis patients.
3. Support the implementation of international sepsis guidelines to improve earlier recognition and more effective treatment of sepsis and enable adequate prevention and therapy for all people throughout the world.
4. Mobilize stakeholders to ensure that strategies to prevent and control the impact of sepsis globally are targeted at those who are most in need.
5. Involve sepsis survivors and those bereaved by sepsis in planning strategies to decrease sepsis incidence and improve sepsis outcomes at local and national levels.

Key targets to be achieved by 2020:

The incidence of sepsis will decrease globally through strategies to prevent sepsis

- By 2020, the incidence of sepsis will have decreased by at least 20% by promoting practices of good general hygiene and hand washing, clean deliveries, improvements in sanitation, nutrition and delivery of clean water and through vaccination programs for at risk patient populations in resource poor areas.

Sepsis survival will increase for children (including neonates) and adults in all countries through the promotion and adoption of early recognition systems and standardized emergency treatment
_ By 2020, at least two-thirds of acute health systems and community and primary care organizations in participating countries will support the Declaration and have incorporated routine sepsis screening into the care of the acutely ill patient.

_ By 2020, sustainable delivery systems will be in place to ensure that effective sepsis control programs are available in all countries. All countries will be monitoring time taken for patients with sepsis to receive the most important basic interventions, antimicrobials and intravenous fluids in accordance with international consensus guidelines.

_ By 2020, we intend that survival rates from sepsis for children (including neonates) and adults will have improved by a further 10% from their levels at 2012. This will be monitored and demonstrated through the establishment of sepsis registries, and is intended to build upon the improvements seen following the launch of the Surviving Sepsis Campaign and the International Pediatric Sepsis Initiative.

Public and professional understanding and awareness of sepsis will improve

_ By 2020, sepsis will have become a household word and synonymous with the need for emergent intervention. Lay people will much better understand what the early warning signs of sepsis are. Families’ expectations of delivery of care will have risen such that delays are routinely questioned.

_ By 2020, all member countries will have established learning needs for sepsis among health professionals and ensured the inclusion of training on sepsis as a medical emergency in all relevant undergraduate and postgraduate curricula. Recognition of sepsis by health professionals as a common complication of high risk medical interventions will have significantly improved, thereby reducing the numbers of patients who become exposed to the risk.

Access to appropriate rehabilitation services will have improved for all patients worldwide

_ By 2020, all member countries will have set standards and established resources for the provision of follow up care following discharge from hospitals of patients who have suffered sepsis.

The measurement of the global burden of sepsis and the impact of sepsis control and management interventions will have improved significantly

_ By 2020, all member countries will have established voluntary or mandated sepsis registries which are consistent with and complementary to the data requirements of the international community, helping to establish sepsis as a common health problem. The international community will be working toward the establishment of an international sepsis registry.
Shock

Shock is a serious condition caused by reduced oxygen delivery to the body. Shock most often arises from reduced blood flow. Blood carries oxygen and nutrients throughout the body. If blood flow decreases, body tissues and organs may not receive enough oxygen to function normally.

Shock can temporarily or permanently damage body organs and tissues. It tends to affect the lungs and kidneys, causing breathing problems, reduced urine production and buildup of waste products. Shock also can affect the brain, immune system, heart, liver, intestines and other organs.

Shock can begin suddenly or be a delayed reaction to trauma. Shock can cause organ failures and can quickly become life threatening. It requires immediate medical treatment.

Types of Shock:

Shock is divided into the following categories, based on what is causing reduced blood flow.

A. Hypovolemic Shock results from excessive loss of blood or other fluids (Hypovolemic means low blood volume). The bleeding may be external, as with a severe cut or heavy vaginal bleeding, or internal, as with a fractured pelvis, rupture of an internal organ or ulcers. Severe loss of body fluids can occur with persistent vomiting or diarrhea, excessive sweating (such as from a fever or strenuous exercise) or overuse of water pills (diuretics).

B. Cardiogenic Shock occurs when the heart cannot pump enough blood to meet the body’s needs. Causes of cardiogenic shock include heart attack, congestive heart failure, extremely low heart rate (bradycardia) and heart valve problem.

C. Distributive Shock results from changes in blood vessels that cause abnormal blood flow. Types of distributive (throughout the body) shock include the following.

i. Septic Shock results from an infection (often in the lungs, abdomen or urinary tract). As the body fights the infection, toxins may be released that damage tissues and interfere with normal blood circulation.

ii. Anaphylactic Shock is caused by a severe allergic reaction. Common substances to which a person may be allergic (allergens) include certain foods (such as shellfish or peanuts), insect bites or stings, dyes, latex, blood transfusions and some medications (such as penicillin).

iii. Neurogenic Shock is caused by nervous system damage that may result from a spinal cord injury, low blood flow or surgical procedure to the spinal cord, anesthesia or certain drugs that cause blood pressure to drop.

D. Obstructive Shock occurs when blood flow from the heart to the body is blocked or slowed, for example by blood clots, excessive fluid around the heart (cardiac tamponade) or high blood pressure in the lungs (pulmonary hypertension).

Symptoms of shock

Shock can produce symptoms that include:

A. Low blood pressure
B. Fast or slow heart rate
C. Increased or decreased body temperature
D. Shallow, rapid breathing
E. Airways swelling and difficulty breathing
F. Unexplained bleeding
G. Decreased urine production
H. Confusion or agitation
I. Dizziness
J. Chest, back or abdominal pain
K. Change in skin color and temperature (cool clammy and pale, or flushed and warm)
L. Hives (red welts), itchiness
M. Extreme thirst

Complications of shock

If shock cannot be reversed within the few days, body organs start to shut down. As one organ begins to fail, others may follow. Failure of more than one organ sometimes is called Multiple Organ Dysfunction Syndrome (MODS). Even with early treatment, shock can lead to complications including:

- Respiratory distress (extreme difficulty in breathing), often caused by pulmonary edema (fluid in lungs); also called acute lung injury (ALI) or acute respiratory distress syndrome (ARDS)
- Heart attack
- Blood clots
- Multiple Organ Dysfunction Syndrome (MODS)
- Unconsciousness
- Coma
- Death

Shock also can lead to disseminated intravascular coagulation (DIC), a serious condition characterized by wide spread blood clots, followed by depletion of blood— clotting substances and bleeding throughout the body. If DIC occurs with MODS, the chance of survival decreases greatly.

Treating shock and organ failure

Shock and organ failure are medical emergencies that require immediate medical treatment in a hospital. Treatment depends on the type of shock. The top priority is to identify and treat the underlying cause, while increasing blood flow and oxygen delivery to body organs and tissues. Medications and other therapies are provided to help keep the person comfortable during treatment.

Management may include:

- Regular monitoring of heart rate, breathing, blood
pressure and other vital signs.

- Blood tests to measure the level of oxygen and other substances in the blood and to check for infection
- Control of bleeding and fluid loss
- Blood transfusion, if hemoglobin is very low, usually less than 1gm/dl
- Intravenous (IV) fluids through a vein
- Nutrition through an IV line or tube in the stomach
- Medication (for e.g. antibiotics fight and underlying infections, steroids to reduce inflammation, or drugs to increase blood pressure and improve heart function)

- Supplemental oxygen or a mechanical ventilator to assist with breathing
- In the case of heart failure, special equipment to help the heart pump
- Placement of a special IV line (central venous catheter) in to the neck, chest or groin if needed for access to the blood stream or delivery of certain medications.
- Placement of special line inside the artery (Arterial Line/Catheter) for accurate monitoring of blood pressure especially where one requires medications to increase or decrease blood pressure.
Acute Respiratory Distress Syndrome (ARDS)

Acute Respiratory Distress Syndrome (also referred to as ARDS) is a specific type of respiratory failure characterized by inflammation and damage to the lung tissue.

ARDS may result from an injury to the lungs that can occur from influenza, pneumonia, aspiration, infection or lung surgery. ARDS also may result from an insult to the body such as a systemic infection, severe trauma or multiple blood transfusions.

The lungs are made up of many small air sacs called alveoli, which normally are filled with oxygen – rich air. Capillaries are tiny blood vessels that surround the alveoli. The capillaries bring blood in contact with the alveoli, which allows oxygen to move from the blood and then to be carried to the rest of the body. In a person who has ARDS, many of the alveoli become inflamed and fill with fluid. This prevents oxygen from entering the alveoli and getting into the blood.

What are the symptoms of ARDS?
Symptoms may begin to appear as early as two to three days after an injury occurs to the lungs or an insult happens to the body. Initially, the person may experience increased difficulty breathing, a possible rise in temperature, an increased amount of secretion from the lungs, and a feeling of not being able to catch his or her breath. Along with these symptoms, the person may required increased oxygen and may appear to be breathing more rapidly. The person also may be anxious and may become easily fatigued during activity.

How is ARDS diagnosed?
There are many factors that determine if a person has ARDS. Most often the previously noted symptoms are present. In addition, a physical examination, which includes a chest X-ray and a measurement of oxygen in the blood, is done to diagnose ARDS. There are other diseases and conditions, such as heart disease and pneumonia that have similar features as ARDS; therefore, testing may de done for these diseases and condition.

Currently, there is no care for ARDS. ARDS is managed by supporting the person with medical treatments while his or her lungs recover. The following are some of the treatments that are used:

Mechanical Ventilation
Mechanical ventilation is the primary treatment for people with ARDS. Patients require a breathing tube, which is placed in the mouth, through the wind pipe and into the lungs to receive mechanical ventilation by a breathing machine (ventilator). The ventilator supports the person by doing most of the work of breathing. Mechanical ventilation provides high levels of oxygen and monitors lung function.

Increased Monitoring
People with ARDS have cardiac (heart), respiratory (lung), and blood pressure monitoring to help determine their response to therapy. They also may need monitoring of the pressures inside the heart and lungs. Often this requires having small tubes (catheters) placed in the patient’s wrist and neck.

Several times a day samples of blood may be taken to be tested. Often patients have a daily chest x-rays during the monitoring period.

Sedation and Pain Medication
It is important that a person with ARDS is kept comfortable. Sedation and pain medications help relieve pain and anxiety and are often required to help patients breathe easier with the ventilator. The patient may appear to be sleeping. The dosing of these medications is closely monitored, yet it is difficult to determine how aware a patient is of his or her surroundings.

Chemical Paralysis Medications
Although patients are heavily sedated and appear to be resting, some patients attempt to breathe on their own, causing the ventilator not to work efficiently as it should. Additional medications may be given to temporarily paralyze a patient to allow the ventilator to work more efficiently thereby allowing the person to breathe easier. This is called chemical paralysis.

Chemical paralysis also is used to conserve energy. Muscles use oxygen as a form of energy. Chemical paralysis decreases respiratory muscles activity, which allows oxygen to be available for other organs and tissues. Chemical paralysis wears off once the medication is stopped.

Blood Pressure Medications
Patients who are seriously ill often are unable to maintain an adequate blood pressure. Medications may be given to support blood pressure ensuring blood flow throughout the body.

Pulmonary Vasodilator Medications
During ARDS, some of the blood vessels in the lungs temporarily become smaller or constrict, making it difficult to get blood to the healthy, oxygen – filled alveoli and improve oxygen levels in the blood. Medications may be used to widen or dilate the blood vessels in the lungs.

Positioning
Changing the body’s position can promote opening of the alveoli. This may result in better transfer of oxygen from the lungs to the blood. The best way to move and position the person may change daily, based on his or her condition. The patient may be on a special bed to assist with frequent repositioning. The patient may be positioned lying on his or her back or stomach.

Nutritional Support
Patients will receive nutrition to support the body’s needs. He or she may receive nutrition through a tube that is
inserted through the nose and then into the stomach, or through an intravenous (IV) catheter.

What are the expected outcomes?
The clinical course and outcome vary for patients who have ARDS. Many factors must be considered, such as the person’s age, previous medical history, function of organs, and presence of infection. A patient may be in a very acute phase of ARDS with intensive monitoring and intervention for several weeks. It is common for patients to have good and bad days during their hospitalization.

Toward the end of the acute phase, patients may continue to need mechanical ventilation. Generally at this time, the person’s health — care provider may suggest that the breathing tube be transferred from the mouth to a small hole in the neck. This is called tracheotomy, and it is requires a small incision in the neck that the breathing tube is inserted through. A surgeon in the operating room performs this procedure. The tracheostomy generally is more comfortable for the patients, and it need not be permanent.

After the acute phase of ARDS, patients may require several months of rehabilitation, and once they return home, they may require additional in-home assistance for a period of time.

What can I do to support my loved one experiencing ARDS?
Ask questions. Write your questions on paper and have them with you when members of your loved one’s health — care team are present.

Allow your loved one time to rest. Visit with the nurse caring for your loved one to determine a schedule that works best for all of you. During all phases of ARDS, rest will be crucial for your loved one. It will be important that he or she not over exert himself or herself, yet have the appropriate amount of activity built in to promote recovery. Recommendations for rest may change everyday based on the patient’s condition.

Involve yourself if possible. You may want to ask the nurse if there are specific things you can do to participate in your loved one’s care. Examples of cares you can participate in may include foot rubs, range of motion exercises, reading to him or her, and playing his or her favorite music.

Take care of yourself. There can be a very stressful time for you. There are many members of the health —care team available to support you and your loved one. Social services can assist with financial planning and rehabilitation plans. Chaplains can assist by providing spiritual support, prayer or visits. Remember to take time to eat, rest, and take breaks away from the intensive care unit (ICU) environment. Recovery after an episode of ARDS can be a long process, and your loved one is going to need you healthy and strong to support him or her during recovery.
Aspiration Pneumonia

Aspiration pneumonia is conditions that can occur if you breathe in (Aspirate) material include the lungs. As with other pneumonias, aspiration pneumonia causes the air space within the lung to fill with fluid, which can make breathing difficult. Aspiration pneumonia is not contagious.

What cause aspiration pneumonia?

Normally, food, saliva and other material are kept out of the trachea (tube leading to the lungs) by a flap of sub tissue (epiglottis) that closes as food or other material passes in to the esophagus (tube leading to the stomach). If the epiglottis fails to close completely when you swallow, you may cuff. Cuffing drinks material back into the mouth, preventing it from going down the trachea and into the lungs. If material is not cuff up and eat enters the lungs, aspiration pneumonia may develop.

Aspiration pneumonia most often is a complication of medical conditions affecting the nervous or muscles that controls swallowing. Other situations that interfere with normal swallowing can produce condition as well. For e.g., aspiration pneumonia may result from being unconscious from anesthesia or deep sedation, or from the use of a tube to asses with breathing or feeding. However, even a healthy person who inhales food or material, as, may happen during vomiting, can develop aspiration pneumonia.

Contributing factors

Although anyone can develop aspiration pneumonia, certain factors increase the risk.

Medical conditions. Conditions that interfere with normal swallowing include brain injury, stroke and diseases affecting nerves or muscles (for example, amyotrophic lateral sclerosis [ALS, Lou Gehrig’s disease] or muscular dystrophy). Swallowing problems can result from impaired memory or concentration as well.

Gastreoesophageal reflux disease (GERD), a condition that causes stomach contents to flow backup into the esophagus, also increases the risk of aspiration pneumonia.

Medical equipment. You are more likely to develop aspiration pneumonia if you use certain medical equipment.

A cervical collar (neck brace) can affect swallowing.

Feeding tubes that deliver liquid nutrition directly into the stomach increase the risk of gastroesophageal reflux (backward flow of stomach contents into the esophagus).

An endotracheal tube (ETT) that assists with breathing can impair the coughing reflex. Saliva and other secretion tend to collect or pool above the balloon (cuff) of ETT. When you inhale, pooled material may drain down the ETT and enter the lungs.

Aging. People of all ages, from newborns to the elderly, can develop aspiration pneumonia. However, the muscles that control swallowing and move food into the stomach may weaken and lose some coordination with age, increasing the risk for aspiration pneumonia.

Alcohol and drug use. Alcohol or drug use can impair the normal gag reflex, thus allowing food and other material to enter the lungs.

Symptoms

Symptoms of aspiration pneumonia may include:

- Coughing when eating or swallowing.
- Difficulty breathing.
- Temperature of 102 degrees Fahrenheit (38.9 degrees Celsius) or greater.
- Chills
- Chest pain.

Diagnosis

Aspiration pneumonia often resembles a cold or the flu, especially in its early stages. Unless you are aware that you have inhaled material, you may not suspect you have aspiration pneumonia. If your symptoms persist, seek medical care.

To diagnose aspiration pneumonia, your health care provider will discuss your medical history with you and perform a physical examination. The examination may include listening to your lungs with a stethoscope to check for sounds that suggest aspiration pneumonia.

Your health care provider may order a chest X-ray or other tests to confirm the presence of aspiration pneumonia and determine the location and extent of inflammation.

Treatment

Treatment for aspiration pneumonia varies, depending on the severity of your symptoms. Treatment may include:

- Medication and comfort measures. Your health care provider may suggest over-the-counter medicines to loosen mucus, reduce fever, treat discomfort and soothe your cough. Occasionally, antibiotic medication is prescribed if a bacterial infection develops. Be sure to complete the entire course of prescribed medication. Do not stop taking prescribed medication when you start to feel better, as this may cause pneumonia to return.

- Removal of inhaled material. Aspiration material may be cleared from your airways by suction through an ETT or other tube, or by use of a special instrument (bronchoscope). Member of your health care team can provide additional information if you are to have these procedures.

- Breathing exercise. Your health care provider may recommend deep breathing and coughing exercise to help clear your lungs. Members of your health care team can provide instruction if this applies to you.

- Occupational or physical therapy. Your health care
provider may recommend therapy to strengthen the muscles that control swallowing and help you learn correct swallowing techniques. Your therapist also can recommend safe texture and thickness of food and fluids.

- Hospitalization. You may need to receive antibiotics, fluids, supplemental oxygen or other treatment in a hospital.

Self-Care

The following tips may increase your comfort and reduce the risk of complications as you recover from aspiration pneumonia:

- **Get plenty of rest.** Your body needs to rest as it recovers. Even when you start to feel better, be careful not to overdo it.

- **Drink the recommended amount of fluids.** Liquids keep you from becoming dehydrated and help loosen mucus in your lungs. Unless you receive other instructions, increase the amount of fluids you normally drink.

- **Practice good eating habits.** A balanced diet of nutritious foods gives your body energy to fight pneumonia. To help avoid reflux of food or stomach acid, sit upright while eating or drinking and remain upright for at least 30 minutes after you eat if possible.

- **Maintain a healthy home environment.** Do not smoke, and avoid secondhand smoke. Smoking irritates the lungs and can interfere with your recovery. Talk with your health care provider about using a humidifier to add moisture to the air in your home.

- **Take the entire course of prescribed medications.** Take all prescribed and over-the-counter medications as your health care provider recommends. If you are unsure about which medications to take or when to take them, talk with your provider.

- **Follow all parts of your treatment plan.** Do deep breathing and coughing exercises as instructed. Use supplemental oxygen if prescribed.

- **Keep all follow-up appointments.** Even when you feel better, your lungs still may be inflamed. It is important to have your health care provider monitor your progress.

Information about breathing and feeding tubes

- Additional precautions are required if you have a breathing tube (an ETT or a tracheostomy tube) or feeding tube in place. If you are a patient in the hospital, members of the health care team can assist you. At home, ask family members and friends for help if needed.

- Do not eat alone. Be sure someone is nearby to help if you cough or choke. Remember to sit upright when eating or drinking and remain upright for at least 30 minutes after you eat if possible.

- Follow your health care provider’s recommendations regarding texture and thickness of foods and liquids. Ask your provider if you should avoid certain foods or fluids.

- Follow your health care provider’s recommendations regarding swallowing techniques.

- Brush your teeth and your tongue in the morning, after you eat and before you go to sleep. Inspect your mouth after brushing to be sure you have removed all food particles. This can help you avoid aspirating additional material and discourage growth of bacteria.

- Ask a member of your health care team to show you oral moisturizing techniques designed to reduce bacteria in your mouth.

- Elevate the head of your bed if instructed to do so.

- Follow your health care provider’s instructions for care of breathing or feeding tubes.
Renal replacement therapy is of utmost importance when kidneys cannot maintain homeostasis of fluid, potassium, metabolic acids and waste products. This failure to maintain homeostasis frequently leads to life-threatening complications for which we have to have mechanism that works instead of failing kidneys. Several such mechanisms / techniques exist which we collectively refer to as renal replacement therapy (RRT). It includes continuous hemofiltration, intermittent hemodialysis and peritoneal dialysis, each with its technical variations.

A common thing between all these techniques is that they all make use of the principle of removing unwanted solutes and water through a semipermeable membrane. Such membrane is either biological (peritoneum) or artificial (hemodialysis membranes).

**Principle of dialysis:**

Water removal: achieved by ultrafiltration, a same process that glomerulus uses.

Solute removal: by diffusion across a semipermeable membrane

Intermittent dialysis is classically considered as the gold standard. The setup is a double lumen catheter, a pump which forces blood into a filter (semi permeable membrane), a dialysate (usually deionized water) which flows in and out, and a return line to the patient. The blood flow rate is 200-400 ml/min, the dialysate flow is approx 500 ml/min, the filtration rate is between 300 and 2000 ml/hr, with urea clearance of 150-250 ml/min. with this high flow and clearance rate, patients, depending on the extent of their catabolism, only require 3-4 hours of dialysis, two or three times a week.

**Indications for dialysis:**

The problem with intermittent hemodialysis in critical care setting is that the patients are severely catabolic, tolerate fluids poorly and prone to develop pulmonary edema frequently. It is for this reason that patients in critical care units may require more dialysis sessions than the patients who are admitted in other wards or those who attend dialysis sessions from home.

The decision as to which modality of renal replacement therapy to use depends on various factors including patient’s clinical condition, need for dialysis and underlying pathophysiology.

- Fluid overload
- Hyperkalaemia
- Severe acidosis
- Metabolic encephalopathy
- Pericarditis
- Coagulopathy
- Refractory gastrointestinal symptoms
- Drug toxicity.
- Dialysis circuit:
Complications of dialysis:

Patient related complications:

- Hypotension (most common)
- Muscle cramps
- Disequilibrium syndrome
- Nausea and vomiting
- Headache
- Chest pain
- Itching
- Fever and chills

Technical complications:

- Clotting
- Blood leak
- Hemolysis
- Air embolism
- Exsanguination
- Dialyser reactions

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Understanding life support measures

Life support replaces or supports a failing bodily function. In treatable or curable condition, life supports is uses temporarily until the body can resume normal functioning. But, in situations where a cure is not possible, life support may prolong suffering. This article is meant to explain various life support terminology and measures the intensivist led team may need to address while your loved one is in the intensive care unit.

A treatment may be beneficial if it relieves suffering, restores functioning, or enhances the quality of life. The same treatment can be considered detrimental if it causes pain or prolongs the dying process without offering benefit. That treatment may diminish a person’s quality of life.

The decision to forego life support is a personal one. It is important to talk to your physician regarding the risk and benefit of each therapy. All life support measures are optional treatments.

Commonly used life support terminology

CPR (Cardio Pulmonary Resuscitation)

Measure taken to restart the circulation in the event of cardiac arrest which includes medications, chest compression, assisting breathing etc.

Do-not-resuscitate order (DNR)

A DNR order written by your physician instructing healthcare providers not to attempt cardiopulmonary resuscitation (CPR) in case of cardiac (heart stops beating) or respiratory (breathing stops) arrest. A person with a valid DNR order will not be given CPR under these circumstances.

Do-not-resuscitate/Full care

Remember: Do—not-resuscitate does not mean do not treat. Patients have the right to receive any and all treatments. When sure is not possible; your physician may decide that the use of CPR may not be medically appropriate. It is a choice to say no to CPR, but yes to all other medically appropriate treatments.

Palliative care: Comfort care

Palliative care is a comprehensive approach to treating the symptoms of illness when cure is not possible. Comfort care focuses on the physical, psychological, and spiritual needs of the patient. The goal is to achieve the best quality of life available by relieving suffering, controlling pain, and achieving maximum independence. Respect for the patient’s culture, beliefs, and values are an essential component. Pain and discomfort associated with terminal illness can always be treated.

Commonly used life support measures

Cardio pulmonary resuscitation (CPR/ACLS)

CPR/ACLS are a group of treatments used when someone’s thought and/or breathing stops. CPR are used in attempt to restart the heart and breathing. It may consist of artificial breathing, and it include pressing on the chest to mimic the hearts function to restart circulation. Electric shocks (defibrillation) and drugs can also be used to stimulate the heart.

What is Defibrillation?

Defibrillation is the sending of a powerful electric shock through the heart. It is used when the heart stop beating effectively on its own.

Does Defibrillation always restart the heart?

If the heart has lost all of its electrical activity or is so damaged that it no longer has enough muscle to pump blood through the body, defibrillation may not be successful in restarting the heart.

If you do wish to receive CPR, your physician must write a do-not-resuscitate (DNR) order on the charge. This order can revoked at any time for any reason.

Vasopressors

Vasopressors are group of powerful drugs that cause blood vessels to smaller and tighter, thereby raising blood pressure. This therapy is only given in the intensive care unit.

Artificial Nutrition And Hydration (Tube Feeding)

Tube feeding is a administration of chemically balance mix of nutrients and fluid through a feeding tube. Most commonly, a feeding tube is inserted into the stomach via the nasal passage (nasal gastric or “NG” tube) or through the abdomen (gastronomy tube or “PEG”) by means of surgical procedure. Another type of feeding tube is inserted surgically through the abdominal wall into the small intestine (jejunostomy tube).

Intravenous feeding

Intravenous (IV) feeding is given to patients who are unable to tolerate tube feedings. Similar to tube feedings, the IV feeding provides the patient with the needed amount of protein, carbohydrate, fat, vitamins, and minerals.

Nutrition and hydration may be supplied temporarily, until the patient recovers adequate ability to eat and drink, or it can be supplied indefinitely. Although potentially valuable and life saving in many situations, artificial nutrition and hydration do not provide comfort care for dying patients. Available scientific evidence has shown that death without artificial nutrition or hydration may cause less suffering.
Mechanical ventilation (MV)

Mechanical ventilation is used to support or replace the function of the lungs. A machine called a ventilator (or respirator) forces air into the lungs. The ventilator is attached to a tube inserted in the nose or mouth and down into the windpipe (trachea). MV may be used short term (i.e., treating pneumonia), or it may be needed indefinitely for permanent lung disease or trauma to the brain. Some patients on long term MV live a quality of life that is acceptable to them. For some patients, MV may only prolong the dying process.

Dialysis

Dialysis does the work of the kidneys, which remove waste from the blood and manage fluid levels. This procedure requires a special central venous catheter. Blood circulates from the body through the dialysis machine, where it is filtered and then returned. Dialysis can be performed in the ICU or in the dialysis unit, depending upon the condition of the patient. Some patients may live on dialysis for years. But, dialysis for the chronically ill/dying patient may only prolong the dying process.

Pacemakers

A pacemaker is a device that produces a low electrical current that stimulates the heart muscle to beat. The heart can be paced temporarily until healing occurs. A surgical procedure to insert a permanent pacer may be required. Patients with non-curable heart disease may choose not to have a pacemaker.