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A REVIEW OF INDICATIONS FOR ENDOTRACHEAL INTUBATION IN A PRIVATE EMERGENCY CENTRE IN PRETORIA

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MSc Emergency Medicine

A research report submitted to the Faculty of Health Sciences, University of the Witwatersrand, Johannesburg, in partial fulfilment of the requirements for the degree of Master of Science in Medicine in Emergency Medicine

Johannesburg, 2011

DECLARATION

I, Anita Groenewald, student number 0614866G, declare that this research is my own work. It is being submitted for the degree of Master of Science in Medicine in Emergency Medicine at the University of the Witwatersrand, Johannesburg. It has not been submitted for any degree or examination at this or any other University.

_____

Signature

On this _____ day of _____ 2011 in Johannesburg.

ABSTRACT

There is no clear list of indications for endotracheal intubation in the emergency centre. Current indications are derived from studies done in other disciplines, such as anaesthesiology (1, 2). The emergency centre is unique due to the presence of clinically undifferentiated patients as well as the urgency accompanying the management of critically ill or injured patients.

A consensus statement for South African emergency centres was developed using a modified Delphi approach. The statement makes recommendations for a list of indications for endotracheal intubation in the emergency centre. This retrospective record review looks at indications used for endotracheal intubation in a private emergency centre during 2006. These indications were then measured against the consensus document derived from indications suggested by experts.

The study evaluated 183 critically ill or injured patients during the study period of which 56 were intubated. Of all the critically ill or injured patients, only three were not intubated that should have been, according to the consensus document. The study found that the emergency doctors in the specific emergency centre used similar indications to intubate as suggested by the consensus document.

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CHAPTER 1: INTRODUCTION

1.1 INTRODUCTION

This chapter discusses airway management and the management differences in the emergency centre. It also examines the current trends in airway management world wide and reviews the limited literature on airway management in the emergency centre. The aim and objectives will be discussed.

1.1.1 The definition and scope of airway management

Airway management in a patient is the process of ensuring that there is an open pathway between a patientôs lungs and the atmosphere, and that the lungs are safe from aspiration of gastric contents (3, 4). A basic maneuver that can initially be used to provide an open pathway would be to turn the patient laterally. Basic airway maneuvers like head-tilt-chin-lift or jaw-thrust can also provide an open pathway by manipulating the head in order to lift the tongue and prevent it from obstructing the pharynx. This will not necessarily protect the patient from aspiration (inhalation of stomach fluid which will damage the lungs and can even lead to death). More advanced techniques, such as endotracheal intubation are necessary to prevent aspiration. Endotracheal intubation is the introduction of a tube into the trachea to keep it open or restore its patency, if obstructed (5, 6). The endotracheal tube is a cuffed, single-used tube placed through the vocal cords which allows delivery of high concentrations of oxygen and maintain adequate ventilation (7). This maneuver is part of advanced airway management and the healthcare provider requires intensive medical training to master this skill, as inability to pass the tube correctly, leads to complications including death (8, 9, 10, 11, 12). The aim of airway management is to ventilate (provide air or oxygen to the lungs) and oxygenate (oxygen transfer to the blood via the lungs) the patient to sustain vital organ function, such as the brain, heart, lungs and kidneys (13, 14). Ventilation can again be achieved by basic maneuvers including mouth-to-mouth breathing or a resuscitator bag (bag-valve-mask) to blow air or oxygen into the lungs under positive pressure. Successful ventilation will be indicated by evidence of the chest rising with

each breath/blow (14, 15). If these basic maneuvers do not achieve chest rise with every blow/breath more advanced maneuvers may be necessary, such as placing an advanced airway, namely an endotracheal tube. A vast array of different advanced airway devices are available and it is the healthcare providerõs responsibility to decide which device would be best suited in the different circumstances according to his/her scope of practice and experience (12, 14). The emergency doctor must also evaluate the risks involved when attempting an advanced airway as well as the risks when the decision is made not to perform endotracheal intubation on the critically ill or injured patient (10, 12). Additionally, all anticipated difficulties during the procedure must be evaluated, including management thereof (10, 12, 14). Rapid sequence intubation is regarded as the gold standard technique of endotracheal intubation which involves the use of a hypnotic agent as well as a muscle relaxant to assist in passing of the endotracheal tube and thus reduce adverse effects of intubation (9, 11, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25). This study will specifically look at the reasons why the healthcare provider uses endotracheal intubation for advanced airway management purposes.

Airway management is the ñAò in the well-known Airway ï Breathing ï Circulation (ABC) algorithm primarily used by all emergency medical personnel when dealing with critically ill or injured patients (26). This ABC algorithm is taught on all the basic and advanced emergency medical courses involved in the management of the critically ill or injured patient (e. g. Advanced Cardiovascular Life Support Course®, Advanced Peadiatric Life Support Course®, Advanced Trauma Life Support Course®, Fundamental Critical Care Support Course®, the Emergency Management of Severe Burns Course® and many other courses) (11, 15, 27, 28, 29, 30). The critically ill or injured patient is someone experiencing an acute life-threatening event or believed to be in imminent danger of such an event (31). The emergency doctor is a registered medical practitioner, employed in an emergency centre of a healthcare facility to treat critically ill or injured patients. The need for an advanced airway and placement of endotracheal intubation as the best option to manage the airway in a critically ill or injured patient is often the most difficult aspect of decision making for the emergency doctor. A delay in decision making

to intervene and secure an advanced airway early on in medical management may lead to increased difficulty or even failure to secure an advanced airway later.

In the emergency centre with its urgent, dynamic and sometimes uncontrolled conditions and where various procedures must sometimes be undertaken simultaneously due to the clinical presentation of the patient, the decision to intubate can be difficult (9, 10, 11, 32, 33, 34, 35, 36, 37, 38). The young and inexperienced emergency doctor may find it difficult to make the decision to intubate the patient without there being an absolute clear cut indication, for example airway compromise (35). It might also be difficult for young and inexperienced emergency doctors to decide whether intubation is really indicated or whether spontaneous oxygenation and basic manual ventilation will be sufficient. It is the failure to oxygenate the critically ill or injured patient that has fatal consequences, not inability to intubate the trachea (32). The emergency doctor may also not always be in a position to rely on an experienced doctor on duty in the emergency centre for assistance (9).

1.1.2 The emergency doctor

Three different categories of emergency doctors may be found on duty in the emergency centres in South Africa depending on their expertise and training: The emergency physician (registered specialist), the experienced emergency doctor and the inexperienced emergency doctor.

The emergency physician is a trained and qualified specialist in the specialty of Emergency Medicine (4 year post-graduate training as a registrar at a registered medical school) (39). These physicians are registered with the Health Professions Council of South Africa (HPCSA) as specialists and will usually function as consultant specialists in charge of an emergency centre in the public sector emergency centre. During the time of this study there were only 12 emergency physicians registered with the HPCSA. In 2005, the HPCSA began a process of registering emergency specialists under a temporary ñGrandfather Clause which gave recognition to experienced medical

practitioners practicing emergency medicine and who had made relevant contributions to the field of emergency medicine.

The experienced emergency doctor will be defined as a registered medical practitioner with at least five years experience in emergency medical practice and who has completed post-graduate emergency medical courses available locally in South Africa. These doctors may be on duty in either the private or public sector and will be utilised as the senior doctors on duty on each working shift. It is accepted as a norm in South Africa, in the absence of an emergency physician (specialist) in an emergency centre, that the experienced emergency doctor should be able to function at a similar level of acute medical care as their specialist emergency physician counterpart and therefore be able to adequately manage the critically ill or injured patient with the same standard of care.

The last category is the inexperienced emergency doctor (a registered medical practitioner) employed in an emergency centre of a healthcare establishment to treat critically ill or injured or injured patients but with less than 5 years post-graduate experience or who do not have post-graduate training or post-graduate qualifications in emergency medicine.

1.1.3 Standard of practice regarding airway management

In South Africa, the airway management of acutely injured trauma patients by non-anaesthetists is a recognised practice that not only saves time, but also lives (40). Emergency physicians in the United States of America (USA) and Australia undertake most (93%) endotracheal intubations in emergency centres. In the United Kingdom (UK) the emergency physician will perform 31 ï 54% of endotracheal intubations in the emergency centre and the anaesthetist will perform the remainder, even though the British Faculty of Accident and Emergency Medicine recognises that emergency doctors should have the necessary skills to manage the airway of the critically ill or injured or injured patient for the first 30 minutes after presentation to the emergency centre (11, 41). Stevenson et al (42) found that endotracheal intubation was performed by the

emergency doctor as frequently as anaesthetists in the emergency centre of a district hospital in Scotland. Emergency medicine in the UK is evolving rapidly and emergency physicians perceive advanced airway management as a core skill for critically ill or injured patients (11, 17, 18, 41). Tam et al (43) found that the emergency doctor intubated 97% of critically ill or injured patients in a typical emergency centre in Hong Kong. The current literature supports that most endotracheal intubations in the emergency centre are performed by emergency doctors with adequate skills training (10, 11, 25, 44, 45, 46). In South Africa, specialist anaesthetists are generally not consulted by the emergency centre personnel to assist with endotracheal intubation as emergency doctors are ordinarily capable of managing most emergency endotracheal intubations (40, 47).

Emergency medicine is a relatively new principal specialty in the medical world (1, 11, 17). The USA began the first emergency medicine resident training program in 1970 and the first academic emergency centres were established in 1971. The American Board of Emergency Medicine (ABEM) was established in 1976 and emergency medicine as a specialty was only recognised by the American Board of Medical Specialties (ABMS) in 1979, although only conjoint status was given at that time. The ABMS only recognised emergency medicine as a primary specialty in 1989 (48). The UK initiated specialist training in emergency medicine in 1975 (49). Singapore likewise initiated their emergency medicine residency training in 1989 (2). In South Africa emergency medicine was registered as a principal specialty by the HPCSA in the Government Gazette, No R 1457 13th December 2004. This resulted in specialist registrar training being initiated in 2004 by the University of Cape Town, by the University of the Witwatersrand in 2005 and the University of Pretoria in 2008 (Personal communication with the head of the Division of Emergency Medicine at Wits University). As a result of emergency medicine being a very young field of medical specialisation, there is as yet a dearth of appropriate research on acute airway management, specifically relating to emergency centres and it is therefore necessary to extrapolate from other areas of acute care, namely the pre-hospital emergency care or anaesthesiology.

In medicine, it is a recognised practice to evaluate a standard of medical care against accepted practices world wide. In the USA the National Emergency Airway Registry (NEAR) provides a means to evaluate the standard of airway management. It measures specifically problems with acute airway management encountered in USA emergency centres to the exclusion of aneasthesiology or other disciplines. Graham (49) predicts that the UK will have a registry of emergency centre airway interventions within the next ten years, which may then be used to standardise training and hopefully establish airway management competency in emergency centres.

Currently there is no emergency airway registry In South Africa. There is however a national trauma registry known as Trauma Bank® (50) where clinical information, including airway management information and thus endotracheal intubation, are recorded on all trauma patients presenting to the trauma and/or emergency centres. Although Trauma Bank® collects and collates all information on endotracheal intubation in the emergency centre, it does not necessarily provide the specific reason for endotracheal intubation. Secondly it only collects information on trauma patients in those centres that have subscribed to it.

1.1.4 Training available primarily in airway management

The National Emergency Airway Course® started by Ron Walls and the Practical Emergency Airway Management Workshop® by Richard Levitan are two popular courses involved in acute airway management training in the emergency environment in the USA (51, 52). In Canada the Airway Interventions & Management in Emergencies Course® (AIME) is the only recognised airway management course available. The UK has purchased the National Emergency Airway Registry Course® (NEAR) from the USA whilst the Scottish has developed their own Scottish Airway and Ventilation Course® (SAVE) (49).

The Airway Interventions & Management in Emergencies Course® (AIME) from Canada was introduced in South Africa in July 2008 as the SA-AIME course. The American Heart Association Airway Management Course® (only 1/2 day) is also a newly

introduced course in South Africa. Additional training courses available in South Africa which devote time to airway management include the Advanced Cardiovascular Life Support®, Advanced Cardiovascular Life Support for Experienced Providers® and Paediatric Advanced Life Support®, the Advanced Trauma Life Support Course®, Fundamental Critical Care Support Course®, the Emergency Management of Severe Burns Course®, the Battlefield Advanced Trauma Life Support Course® , Fundamentals in Emergency Care Course® (FEC) and Basic Emergency Care Course® (BEST) courses. However, besides SA-AIME, none of the above mentioned topic specific emergency medicine skills training courses has specific protocols regarding indications for endotracheal intubation nor do they comprehensively cover the topic of airway management.

1.1.5 Summary of the study design

This study looked at the management of the airway in critically ill or injured patients by predominantly experienced emergency doctors working in an emergency centre located at a private hospital in the eastern parts of Pretoria. It specifically focused on how the emergency doctor decided when to establish an advanced airway by means of an endotracheal tube. The indications used in the centre will be measured against a consensus document drafted from the opinions of recognised leaders in Emergency Medicine in South Africa such as the academic heads of the Emergency Medicine Divisions at the South African Medical Schools.

1.2 PROBLEM STATEMENT

There is currently no accepted South African list of indications for establishing an advanced airway by means of an endotracheal tube in the undifferentiated critically ill or injured patient presenting to the emergency centre. Currently emergency doctors are using their õownò list of indications derived from studies done in other environments, such as anaesthesiology (1, 2).

There is a need for the emergency doctor to develop accepted indications for endotracheal intubation in the emergency centre in order to maintain an advanced airway.

1.3 AIMS

The aims of this study are

1.3.1 draft a consensus document on indications for endotracheal intubation in the South African emergency centre

1.3.2 perform a record review of the indications for endotracheal intubation in the undifferentiated, critically ill or injured patient by the emergency doctors in a specific private emergency centre

1.3.3 compare the indications for endotracheal intubation in the consensus document with the indications used in the emergency centre

1.4 OBJECTIVES

The objectives of this study are:

1.4.1 To develop a consensus document by experts, on the indications for ensuring an advanced airway management by means of endotracheal intubation undertaken in the emergency centre in South Africa

1.4.2 Analyse all critically ill or injured patient records over a particular time period in order to ascertain the reasons why the patients were intubated or why they were not.

1.4.3 Compare the results obtained in 1.4.1 and 1.4.2 above

1.4.4 Analysing the demographics of all critically ill or injured patients reviewed

1.4.5 Analysing the demographics of the emergency doctors working in the emergency centre during the time of record review

1.5 DEFINITIONS and EXPLANATIONS

Emergency physician: An emergency physician is a registered medical practitioner trained and qualified in the specialty of Emergency Medicine as defined by the Emergency Medicine Society of South Africa (39).

Emergency doctor: A registered medical practitioner employed in an emergency centre of a healthcare establishment to treat critically ill or injured patients.

Experienced emergency doctor: For the purpose of this study it will be defined as a registered medical practitioner with five or more years experience in emergency medicine including post-graduate emergency medicine qualifications and training.

Critically ill or injured patient: A patient who is experiencing an acute life-threatening episode or who is believed to be in imminent danger of such an episode (27). In this study the patients were triaged subjectively into the critically ill or injured category by the attending professional nurse or emergency doctor according to their severity and treatment needed. No protocol existed to assist with the categorising process at that time.

Endotracheal intubation: The introduction of a tube into the trachea to maintain or restore its patency, if previously obstructed (5). In this study the term endotracheal intubation will be used when an endotracheal tube was passed through the vocal cords of a patient as part of the treatment. The endotracheal tube is a cuffed, single-use tube placed through the vocal cords, which is one way of allowing delivery of high flow oxygen and selected tidal volume to maintain adequate ventilation (7).

Emergency Centre: The National Department of Health define an emergency centre as a dedicated area in a health facility that is organised and equipped to provide a high standard of emergency care to those in the community who are in need of acute or urgent care (39).

Glasgow Coma Scale (GCS): A method for determining the level of consciousness that is predictive of patient outcome and used as an objective clinical measure of the severity of brain injury internationally (27).

Rapid Sequence Intubation (RSI): A method of airway management undertaken to facilitate endotracheal intubation (28).

Summary: In this chapter we discussed the differences in airway management in the different emergency centres world wide. It also highlighted the limited availability of literature on airway management in the emergency centre. The aim and objectives of this study were discussed.

CHAPTER 2: LITERATURE REVIEW

A literature review was done of studies on indications for endotracheal intubation found primarily in the last decade. The literature study was done using PubMED, EMBASE, Cochrane Database of Systemic Reviews and MEDLINE from 2006 until 2008 as data sources and only articles in English literature were evaluated. It looked at studies done or the lack thereof in emergency centres, as well as in other departments that manage similar emergency situations.

Available prospective studies on endotracheal intubation in the emergency centre only began in 1979 due to emergency medicine being a relatively new field of specialty in medicine. This included limited studies on the indications for endotracheal intubation (1, 2, 12, 53, 54). Kovacs et al (1) and others discuss the growth of emergency medicine into a recognised specialty where they discuss the utilisation of rapid sequence induction (RSI) in anaesthesiology practice and adapting it into rapid sequence intubation (RSI) in an emergency centre, with endotracheal intubation being the end-point (1, 9, 49). In those studies, they primarily review the risks, complications and success rates of endotracheal intubations done in emergency centres compared to endotracheal intubations undertaken by anaesthesiologists (1, 2, 9, 22, 24, 25, 40, 41, 43, 45, 46, 47, 53, 55, 56).

2.1 Airway management in the emergency centre

The only publication found in the literature which focuses primarily on the indications for emergency endotracheal intubation in the emergency centre, is a review published by Christiaan and Manji (54) where they reported on indications for emergency endotracheal intubation. The authors used the Practice Guidelines of the American Association of Respiratory Care of 1995 as their main source for indications for endotracheal intubation. They adequately discuss the major and minor reasons for endotracheal intubation, elaborating specifically on the major reasons related to the emergency centre. The main indications for endotracheal intubation Include:

- Airway obstruction, including foreign bodies, trauma, upper airway burns, infections, angioedema and upper airway tumors

- Inability to protect the airway, including drugs and toxins, traumatic head injury, cerebrovascular accidents and central nervous system infections
- Respiratory failure (relative or complete), when manifesting itself with elevated respiratory rate, low tidal volumes, hypercapnia and hypoxemia.
- More specifically they mention indications to immediately intubate a head injured patient with the following criteria:
  - A Glasgow Coma Scale Ò8
  - Loss of protective laryngeal reflexes
  - Respiratory failure
  - Spontaneous hyperventilation
  - Respiratory arrhythmias such as respiratory arrest

Additionally, the authors also provide indications where endotracheal intubation is not immediately indicated but which may be required at a later stage if transferring the patient from the emergency centre becomes indicated:

- A deteriorating level of consciousness
- Bilaterally fractured mandible
- Copious bleeding into the oral or pharyngeal cavity
- Grand mal type seizures

Hardcastle (40) conducted the only South African study on endotracheal intubation in the Trauma Unit of Tygerberg Academic Hospital as a prospective observational study. Data collected included patient demographic details, mechanism of injury, initial Glasgow Coma Scale, clinical observations, primary indication for endotracheal intubation, type of advanced airway and clinical outcome of the patient. He made use of the ñEastern Association for Surgery of Trauma practice management guidelines for emergency endotracheal intubation immediately following traumatic injuryò (57). The Trauma Unit at Tygerberg hospital admitted 112 trauma patients during the period 1 August 2006 to 31 August 2006 of which 57 patients (62%) required endotracheal intubation. However, as it was an observational study over a very limited time period, it cannot be applied to South Africa nationally. A further limitation of this study was its application to trauma patients only and the same indications may not always be

applicable to the non-trauma patients. Hardcastle's primary categories for endotracheal intubation (indications) included:

- Failure to maintain and protect the airway (70.3%)
- Inadequate oxygenation or ventilation (26.25%)
- Projected clinical course (3.45%)

He further found that the most common indication for endotracheal intubation in the trauma patient presenting to his trauma unit was a Glasgow Coma Scale of less than 8 (38.59%). This indication is in accordance with the Advanced Trauma Life Support® principles of the College of Surgeons: Committee on Trauma of the USA and as taught in their ATLS® course (27). Finally although all indications for endotracheal indication were recorded, the study is limited in not discussing or analysing the indications mentioned (40).

Similar indications for endotracheal intubation in the trauma patient were found in a retrospective observational study in Singapore from 1 January 1998 to 31 December 2000 by Wong et al (2). This study once again only involved acute trauma patients. A total of 142 cases underwent endotracheal intubation in the emergency centre. The data captured in the Trauma Registry included patient demographics, mechanism of injury, clinical diagnosis, indications for endotracheal intubation, number of attempts at endotracheal intubation by the emergency doctor, whether anaesthetic assistance was sought, medications that were administered for hypnosis and neuromuscular blockade and pre-treatment for head injury, as well as any complications that arose from the endotracheal intubation attempt. The main indications mentioned for endotracheal intubation were:

- Coma (40.1%),
- Traumatic cardiac arrest (24.7%)
- Prophylactic protection of the airway due to future needs in 10.6%
- Minor indications included decreasing Glasgow Coma Scale (9.9%), arterial blood oxygen desaturation (5.6%), post-Computer Tomographic scan (4.2%), airway obstruction (3.5%) and patient combativeness (1.4%)

Although a valuable study, its limitations included its use of trauma patients exclusively and no discussion regarding the different indications for endotracheal intubations mentioned.

In a review article on the initiation of mechanical ventilation in the emergency centre, Orebaugh (58) pays little attention to indications for endotracheal intubation, but rather focuses on respiratory failure to discuss mechanical ventilation and the bewildering array of features of the new mechanical ventilators. He mentions oxygenation failure and marked carbon dioxide (CO2) retention as the major indications for endotracheal intubations and uses the combined term acute respiratory failure for it. However, he does list airway patency/protection, the manipulation of blood pH (altering the acid-base status in the body by making use of hyperventilation or medication) (59), administration of drugs through the endotracheal tube if intravenous access is difficult and prophylactic endotracheal intubation as other indications for endotracheal intubation, but does not elaborate on any of these. I regard the indications by Orebauch of value to the literature review, because he mentions two additional indications, namely a port for medication administration and manipulation of blood pH to the list of indications for endotracheal intubation (58).

A prospective, observational one-month study was done to assess the endotracheal intubations attempted in emergency centres by Staikowsky et al (60). A total of 274 endotracheal intubations were recorded in 51 French units (17 teaching, 29 non-teaching and 5 private hospitals). Their 4 major indications for endotracheal intubation were:

- Decreased mental status or unconsciousness
- Respiratory failure
- Haemodynamic distress
- Cardiac arrest.

This was the first survey done in the French emergency centres and it did not elaborate at all on the specific indications used for endotracheal intubation (60).

2.2 Airway management outside the emergency centre

Reid et al (56) studied rapid sequence intubation outside the operating theatre in the Portsmouth Hospitals National Health System Trust in the UK. He found the following indications for endotracheal intubation: A Glasgow Coma Scale < 8 in 26.3%, falling Glasgow Coma Scale in 11.8%, hypoxia in 26.3%, respiratory failure in 15.7%, to prevent potential airway compromise during transportation in a transferred patient in 7.5%, multiple injuries in 3.5% and other in 9.0%. It was a prospective observational study of 208 patients between August 2000 and January 2001. This study has obvious limitations due to it being undertaken on patients primarily outside of the emergency centre (e.g. 38% of the patients were intubated in the intensive care unit; only 37% were intubated in the emergency centre and 25% were intubated in the wards) and further it did not analyse or discuss the different indications used. However, it has positive results in that it focuses on the level of experience of the doctor performing the endotracheal intubation as well as the complication rates between the different groups. However, the study data collection relied on the honesty of the ñintubatorò and the researchers were not blinded to any aspect of the data. The data in this study compared well with indications found in other studies and may therefore still be considered (56).

Ehrlich et al (61) evaluated endotracheal intubations in paediatric trauma patients undertaken in an urban trauma unit by emergency doctors as well as in the pre-hospital environment by emergency medical service paramedics and flight nurses. Indications for endotracheal intubation were documented as: Fear of losing patent airway control (37%), closed head injury (36.1%), respiratory rate <10/minute or > 40/minute (11.2%), cardiac arrest (6.5%), respiratory arrest (4.6) and airway obstruction (4.6%). This study highlights an indication not yet mentioned, such as a low or high respiratory rate. However, this study once again focuses exclusively on trauma patients, involves the pre-hospital setting and paediatric patients (61).

Other publications or guidelines report similar indications for endotracheal intubation with subtle differences in terminology (6, 18, 62). Indications stated are: coma / Glasgow Coma Scale Ò8 / depressed mental status / altered mental status as the same

entity; airway patency / loss of protective laryngeal reflexes / compromised airway / protection of airway as another entity; ventilatory insufficiency / hypoxia / hypercarbia / respiratory failure as another indication, and apnoea or cardiorespiratory arrest. Walls (63), one of the airway management experts in the USA provides three major reasons for endotracheal intubation in the emergency centre in his publication used in the American National Emergency Airway Management Course (NEAR Airway Course®). He recommends that the decision to intubate should be based on failure/protection of airway maintenance, failure of ventilation and the anticipated clinical course. He indicates that a list of indications to intubate is often incomplete and also difficult to remember in a critical situation whereas most if not all the indications are summarised in the above three situations (63).

2.3 Challenges and training of airway management in the emergency centre

The decision to perform endotracheal intubation can either be straight forward or extremely difficult, depending on several factors. An experienced emergency doctor with adequate experience in the technique of endotracheal intubation should ideally make the decision when to intubate taking into consideration the possibility of difficulties that may be encountered during the endotracheal intubation attempt. Endotracheal intubation in the emergency centre can be challenging due to the various complications that may arise such as patients presenting with full stomachs who have a high potential for vomiting. They may be uncooperative, haemodynamically unstable, have traumatic damage to the upper airway or have ingested drugs or toxins which may complicate endotracheal intubation. Recommended clinical features usually used to predict the possibility of a difficult endotracheal intubation may be impossible to determine in the emergency centre e.g. evaluating maximum mouth opening capability or use of the internationally recognised Mallampati classification in the uncooperative or aggressive patient, because both of these recommended evaluations require a calm, conscious, cooperative patient (9, 10, 11, 33, 34, 37, 54). The decision when to endotracheally intubate and the relevant method of choice are of equal importance, even lifesaving and are unfortunately often ignored (32, 64). King et al (65), argues that airway management

is the most important skill necessary to practice emergency medicine because an apnoeic patient will die within minutes without appropriate intervention whereas a hypotensive patient may survive if left untreated for several hours. A number of authors state that both endotracheal intubation and rapid sequence intubation should be part of the core skills of every emergency doctor working in the emergency centre (9, 11, 16, 18, 19, 20, 21, 22, 23, 24, 25, 40, 41, 47, 49, 54, 55, 56, 58, 60, 63). Butler et al (53), feels that safe and effective airway management in the critically ill or injured patient is the cornerstone of resuscitation and that every emergency doctor should possess the skill of rapid sequence intubation.

Kovacs et al (1) indicates that all doctors with acute care responsibilities including the emergency doctor, are expected to be reasonably competent in airway management and they must actually have the skill to manage the full spectrum of airway problems. He devotes at least one third of his article towards the training available in airway management in the USA and changes in the relevant short emergency airway management training courses to facilitate more up to date management (1). Graham et al (49) indicates that the trend in the UK is for trainees in emergency medicine to voluntarily undertake longer periods in anesthesia than the required three months mandatory training and eventually this may evolve into a compulsory one year training in anesthesiology and critical care in the next ten years due to the lack of training availability in airway management currently. Other studies also support training and development in airway management in the emergency department in the critically ill or injured patient (9, 10, 11, 40, 41, 47, 53, 54, 56).

The Airway Interventions & Management in Emergencies Course® (AIME) from Canada is the only structured internationally recognised airway management course aimed at the emergency environment available in South Africa. According to the course outline as published on the Emergency Medicine Society of South Africa website (www.emssa.org.za), the course spreads over one full day, it is dedicated to aspects of airway management and one entire module is devoted to the indications for intubation. The emergency doctor requires continued practical experience and review and the SA-AIME course advocates the use of the anaesthetic environment if the emergency centre

cannot provide the practical experience. At this stage, this course is offered locally and on the African continent by the Division of Emergency Medicine of the University of the Witwatersrand. A locally derived airway management training course has since been introduced in Cape Town. However, the availability of these courses in mainly two urban areas will limit the training experience in South Africa.

The Advanced Trauma Life Support Course® (as advertised by the Trauma Society of South Africa on www.traumasa.co.za) teaches emergency airway management during their skills stations for approximately one ï two hours. This course is presented in South Africa as one of the short (2½ days) emergency medicine and trauma training courses presented to emergency doctors and has become a basic compulsory requirement for newly appointed surgical registrars as part of their basic emergency medical training during their training. The ATLS® course indications for endotracheal intubation in the acutely injured patient are based mainly on clinical findings and include:

- Presence of apnea (no spontaneous breathing)
- Inability to maintain a patent airway by other means
- Need to protect the lower airway from aspiration of blood and vomitus
- Impending or potential compromise of the airway
- Presence of a closed head injury requiring assisted ventilation (Glasgow Coma Scale < 8)
- Inability to maintain adequate oxygenation by face-mask oxygen supplementation (27)

The American Heart Association Airway Management Course® is designed for healthcare providers requiring proficiency in use of airway devices and techniques such as endotracheal intubation specifically in adults. According to the 36 page manual (7) it aims to teach students the primary and basic principles oxygenation and endotracheal intubation with emphasis only on the technique and equipment used with only a mere 3 pages on endotracheal intubation. Their criteria to intubate include:

- Cardiac arrest when bag-mask ventilation is not possible or ineffective,
- Responsive patient in respiratory compromise when unable to oxygenate adequately despite noninvasive ventilatory measures

- If the patient is unable to protect the airway (7)

The Advanced Cardiovascular Life Support Course® (ACLS®) and the Paediatric Advanced Life Support Course® (PALS®) discuss indications for endotracheal intubation as:

- Administration of medication through the endotracheal tube if no intravenous access are available
- Arterial oxygen saturation <90% despite receiving 100% inspired oxygen
- Questionable airway patency or ventilatory status during transport
- Airway obstruction
- Ventilatory deterioration and fatigue - acute life threatening asthma, severe shock, severe head injury
- Decreased mental status (15, 28, 66)

The Fundamental Critical Care Support Course® (FCCS®) which originates from the USA (Society for Critical Care Medicine at www.sccm.org) and is presented to the resuscitation team members who react to medical emergencies within the hospital or any other healthcare provider who is responsible for the medical care of acutely or critically ill or injured patients. This course has little emphasis on airway management, but has the following indications for endotracheal intubation: airway protection, relief of obstruction, provision of mechanical ventilation and oxygen therapy, respiratory failure, shock, hyperventilation for intracranial hypertension, reducing the work of breathing as well as facilitation of suctioning which is a new indication not yet mentioned (29).

Other medical skills training courses available in South Africa to emergency healthcare providers and which incorporate emergency airway management include the Emergency Management of Severe Burns Course® (EMSB®), the Battlefield Advanced Trauma Life Support Course® (BATLS®), Fundamentals in Emergency Care Course® (FEC®), Basic Emergency Care Course® (BEST®). Most of these topic specific emergency medicine skills training courses will dedicate only 1 ï 2 hours of active training to management of the airway in the critically ill or injured patient. None have a specific dedicated module on the indications for endotracheal intubation. However,

indications for emergency endotracheal intubation that are mentioned in these various course mentioned above include:

- Protection of the airway from aspiration, hypoxia or hypercarbia
- Maintenance of airway patency when other methods fail
- Facial trauma precluding bag mask ventilation
- Predicted clinical course or hyperventilation required (30, 67, 68, 69).

Summary: This chapter has highlighted various studies found regarding indications for endotracheal intubation in the emergency centre as well as in studies done in other environments. It highlighted the challenges the emergency doctor faces in the emergency centre as well as the importance and availability of topic specific emergency medicine skills short course training opportunities to the doctor working in the emergency centre in South Africa.

CHAPTER 3: METHODS

3.1 STUDY DESIGN

Part 1: Development of a consensus document

There are no specific guidelines for the indications for endotracheal intubation of patients in an emergency centre in South Africa. A consensus document was developed using a modified Delphi method. (Appendix A and B).

This study used a structured questionnaire for round one. In round two the participants received a second questionnaire and were asked to review the items as summarised by the investigator after the first round.

The heads of the Divisions of Emergency Medicine at South African Medical Schools were identified as the possible expert respondents, because of their extensive experience in training in the emergency environment. The medical school attached to the University of the Free State does not have a specific emergency division as with all the others school and therefore the head of the emergency centre was asked to act as the expert respondent. The experts were asked to comment on the level of importance that each indication has in terms of a possible guideline for the endotracheal intubation in the emergency centre. The consensus document kept any statement if it was noted by more than 80% of these experts. In the event of fewer people noting a feature, the document was modified and sent out for a second time. Consensus was reached by 80% of these experts with the second round.

The grading that was recommended after the first round by all the participants was summarised. The recommendations from all the participants were taken into account during the drafting of the second consensus document. All indications with a grading of 3 and less by at least half of the participants were either changed or left out as recommended. All indications with a grading of 4 or 5 and by at least two thirds or more of the participants were kept as consensus on that particular indication and included in

the second document. The second document was sent out with all the changes. Consensus of 80% with this round was reached and no further document was sent out.

To summarise the steps:

- Step 1: Creation of the list
- Step 2: List sent to experts
- Step 3: Responses of experts taken into account in creation of second list
- Step 4: Evaluation responses and finalising list

Part 2:

A retrospective review was done on the records of all patients who had been classified by the study site as critically ill or injured from 1 January until 31 December 2006. The data from the records were analysed to evaluate the indications used by the emergency doctors to endotracheally intubate the patients. The indications applied were then compared to the consensus document. The data was also analysed in relation to the consensus document to establish whether the airway management met the requirements set out in the consensus document.

3.2 STUDY SITE

The study was conducted at the Wilgers Trauma Unit, a private emergency centre, attached to the Life Wilgers Hospital in the eastern parts of Pretoria, South Africa.

The spectrum of patients seen at the Wilgers Trauma Unit, ranges from routine family practice type patients, to critically ill or injured patients who may require emergency intervention. The Wilgers Trauma Unit treated 28 355 patients during 2006 with an average of 78 patients per day. In 2006 the criteria to classify a patient as critically ill or injured were not standardised. No specific protocol to identify the critically ill or injured patient existed. The patients were triaged into the critically ill or injured category by the attending professional nurse or on duty emergency doctor according to their severity and treatment needed. The critically ill or injured patients seen in 2006 numbered 212 which is 0.7% of the total patients seen.

Doctors employed in the emergency centre had different levels of qualification and experience including emergency doctors, locum tenens medical practitioners (qualified doctors working on a temporary basis) and family practitioners working extra hours in the emergency centre for experience and financial gain. The eight emergency doctors permanently employed in the emergency centre during that time were all registered as general practitioners and each had an interest and experience (80% of them > 5 years experience) in emergency medicine. The locum tenens doctors working in the emergency centre were registered medical doctors, employed to undertake shift type duties as the second doctor on duty at busier times during the day and night. At any given time during the day or night shift, one of the two doctors on duty was one of the permanent experienced emergency doctors. It was also emergency centre protocol that only the experienced emergency doctor treated the critically ill or injured patient unless he/she was already involved treating another critically ill or injured patient.

The permanent nursing staff working at the Wilgers Trauma Unit at the time of the study comprised 2 trauma qualified professional nurses (3 or 4 year degree or diploma qualification, as well as a two year post graduate qualification in trauma), 10 professional nurses (3 or 4 year degree or diploma qualification) and 5 enrolled nurses (2 year diploma qualification). Routinely 2 to 3 professional nurses were on duty on any given shift. During the day shift a total of 5 nursing staff were on duty and a total of 3 nursing staff during the night shift.

3.3 STUDY PERIOD

The period of the record review was from 1 January 2006 until 31 December 2006.

3.4 STUDY POPULATION

The study population included all the critically ill or injured patients that presented to the Wilgers Trauma Unit. All records of patients who were classified as critically ill or injured in the emergency centre during the period above have been reviewed.

3.5 STUDY SAMPLING

3.5.1 Study Population Size

The sample size is also the study population and it was collected from all the patients who presented to the emergency centre in the predetermined period who were classified as critically ill or injured while in the unit. In 2006, 28 355 patients were seen in the emergency centre of which 212 (0.7%) patients were classified as severely ill or critical. The 183 patients (212 ï 29 excluded patients - see attached exclusions) will be used as the study population.

3.5.2 Selection of subjects

A retrospective record review was performed. On-duty personnel were required to complete a medical register during each shift with information consisting of demographic data of the patients, the clinical diagnosis, diagnostic tests performed, treatment provided, clinical outcome including grade of severity. This register was used to compile a list of all the patients that were classified as critically ill or injured in the emergency centre and their respective clinical files were drawn. As already explained under paragraph 3.2 this was not standardised, but was done by the attending professional nurse or emergency doctor according to the severity and treatment needed by the patients. All the data was kept anonymous.

3.5.3 Inclusion criteria

All the patients, classified as critically ill or injured, admitted in the emergency centre during the designated period were included; a total number of 212. This number includes patients from all ages and both sexes as well as the patients that died during their stay in the centre.

3.5.4 Exclusion criteria

Critically ill or injured patients who arrived at the centre already endotracheally intubated (29) were excluded from the study, because this data could not contribute to the study

since the reason for the endotracheal intubation could not accurately be determined. The study population therefore decreased to 183.

3.6 DATA COLLECTION

The data collection was done by the researcher. The patient registers used between 1 Jan 2006 and 31 Dec 2006 were reviewed and a list was compiled of all the critically ill or injured patients admitted to the emergency centre. The files of all these patients were collected, either from the existing pool of files or from the stored pool. The clinical data in these files were collected and a Microsoft Excel ™ data spreadsheet with numbers and codes were created. This data spreadsheet allowed separation from the files for anonymous data collection. The spreadsheet included information regarding patient demographics, patient medical history, relevant clinical observations on the patient, the clinical examination of the patient, special diagnostic tests undertaken and results, treatment administered and the clinical outcome of the patient (Appendix C). Statistics (Fischer exact test) were used in the study.

3.7 ETHICS

The protocol has been submitted to the ethical committee of Life Wilgers Hospital who gave ethical approval (See Appendix E). All patient data was coded so that information obtained would remain anonymous. Consent from the emergency doctors was requested although the use of this information was also coded so as to reduce the possibility of identification.

The protocol was submitted to the Human Research Ethics Committee (Medical) of the University of the Witwatersrand and clearance was given (See Appendix D).

Summary: This chapter discussed the methods used with regards to the study design, the study site, the study period, the study population and sampling. It also discussed the methods of data collection as well as how ethics was applied in the study.

CHAPTER 4: RESULTS

In this chapter the results of the study will be presented in two parts:

- The outcome of the consensus statement including the relationship of the practice at the study site to this statement
- The results of the retrospective record review

Part 1: Establishment of the consensus document

The Delphi method gathers data from respondents within their domain of expertise to achieve a merge (convergence) of opinion on a specific issue by means of group communication. It allows reassessment as well as anonymity (70). The number of experts used in a Delphi study is generally determined by the number required to form a representative pooling of judgments ranging usually from less than 50 with an average of 15 to 20 experts. This study only used six respondents because of the limited number of heads of the Divisions of Emergency Medicine at South African universities.

With the Delphi process, usually three rounds of distribution will be enough to reach consensus in most cases. With round one an open-ended questionnaire can be used and the information received will then be used to convert it into a well-structured questionnaire or an already structured questionnaire can be used from the start based upon an extensive review of the literature. Further rounds will be used to reach consensus. In the final round the consensus document will be distributed for a final opportunity to revise the personal judgments. Consensus reached in a Delphi study usually necessitate having 80% of respondents/subjects votes fall within two categories on a seven-point scale or 70% of subjects/responders have a rate of three or higher on a four-point scale and the median should be Ó3.25.

The consensus document derived from the indications used on the South African Airway Interventions & Management in Emergencies (SA-AIME) course was sent to the selected expert respondents. Five of the six expert respondents gave their feedback on the consensus document. With the initial feedback 80% consensus was not achieved

and the changed/adopted document was sent out a second time with a consensus result of 83%.

The SA ï AIME course uses a memory aid to help list the indications: **O**pen and Maintain airway, **P**rotection of airway against aspiration, **E**xchange of gases for respiratory failure manifesting as hypoxia and hypercarbia and lastly **N**ear future needs as the predicted clinical course (**OPEN)**. This was adapted into a list of indications which was presented to the expert panel for the modified Delphi review. The literature review on endotracheal intubation indications has followed the same general principles as the indications found in the SA-AIME course (1, 2, 53, 54, 71, 72).

The initial consensus document listed 5 major indications for endotracheal intubation with subdivisions to most of them (see table 4.1).

Table 4.1: Indications used in initial consensus document

No	Main reasons	Divisions	Subdivisions	Examples
1	**Open and maintain airway**	Functional obstruction		*Position of patient*
				Tongue
		Mechanical obstruction	*Intrinsic*	*Oedema*
				Haematoma
				Infection
				Tumour
			Extrinsic	*Foreign body*
				Applied cricoid pressure
2	**Inadequate protective reflexes**			*Low GCS*
3	**Correct inadequate ventilation**	Hypoxemia		*PaO2 < 60mmHg on 40% oxygen*
	Or Exchange of gasses			*Saturation < 90% on 40% oxygen*
		Hypercarbia		*PaCO2 > 60 mmHg*
				↓ Level of consciousness with inadequate respiration
4	**Predicted clinical course or Near future needs**	Presenting condition		*Asked to list possible clinical conditions*
		Potential deterioration		*Continued swelling or bleeding*
				Tiring causing respiratory failure
				Continued ↓ level of consciousness
		Transport outside facility		*Outside facility/ hospital*
		Transport inside facility		*Radiology*
5	**Other conditions**			*Asked to list possible clinical conditions*
6	**Comments**			

The first round consensus document found that the following were definitely or highly applicable indications for endotracheal intubation in the emergency department:

- To obtain and maintain an open airway (mechanical obstruction e.g. oedema)
- Protection of the airway (e.g. low Glasgow Coma Scale)

- Correction of inadequate respiration/ventilation (respiratory failure)
- Predicted clinical course (presenting condition/potential for deterioration/transport)

Functional obstruction (e.g. tongue) as well as extrinsic factors obstructing the airway (e.g. foreign body), was not a highly or definitely applicable reason and was therefore excluded as a major indication after the first round. This initial document was then adjusted according to the suggestions. The following adjustments were done:

- Functional obstruction and extrinsic mechanical obstruction under open and maintaining of airway were eliminated
- Inadequate protective reflexes was retained due to a good response
- Correction of inadequate respiration/ventilation (respiratory failure) was retained
- Predicted clinical course (presenting condition/potential for deterioration/transport) were also retained.

This final consensus document is available as Appendix B and is also set out in table 4.2.

Table 4.2: Final consensus document reasons

No	Main reasons	Divisions	Subdivisions	Examples
1	**Open and maintain airway**	Mechanical obstruction	*Intrinsic*	*Oedema*
				Haematoma
				Infection
				Tumour
2	**Inadequate protective reflexes**			*Low GCS*
3	**Respiratory failure or Exchange of gasses**	Hypoxemia		*PaO2 < 60mmHg on highest FIO2 mask possible*
				Saturation < 90% on highest FIO2 mask possible
		Hypercarbia		*PaCO2 > 60 mmHg*
				↓ Level of consciousness with inadequate respiration
4	**Predicted clinical course or**	Presenting condition		*Facial trauma / fractures*
	Near future needs			*Inhalation burns*
		Potential deterioration		*Continued swelling or bleeding*
				Tiring causing respiratory failure
				Continued ↓ level of consciousness
		Transport outside facility		

Part 2: Retrospective review of indications used in the department

The reasons for endotracheal intubations used by the treating emergency doctors were found in the clinical file of each patient. The emergency doctors did not have any clinical protocol to assist with the decision to endotracheally intubate and the reasons found in

the files were words used by the attending emergency doctor. The main reason (sometimes more than one reason given) found in the files of the 56 patients that were endotracheally intubated in the emergency centre, could be divided into 11 different indications. The indications given were:

- 14 because of a low oxygen saturation (oxygen level as measured by pulse oximetry)
- 13 as a result of cardiac arrest
- 11 as a result of airway compromise or obstruction
- 10 because of a low Glasgow Coma Scale (<8)
- 2 because of combativeness
- 1 each because of patient seizure activity, deterioration in metabolic acidosis, *external transcutaneous* pacing, on request by a specialist physician and for transport to another medical facility
- 1 had no indication in the file

The indications to intubate their patients (their own words) used by the emergency doctors in the emergency centre during the study time, were compared to the consensus document and the following matches with the õown wordsò were made:

Table 4.3: Matches between indications found in file with consensus indications

Indications as given in file	Open and maintain airway	Inadequate protective reflexes	Inadequate ventilation / respiratory failure	Predicted clinical course
Low saturation			Å	
Airway compromise	Å	Å		Å
GCS < 8	Å	Å		Å
Cardiac arrest	Å	Å	Å	Å
Seizures	Å	Å	Å	Å
Combativeness			Å	Å
Deterioration in BP			Å	Å
Deterioration in met acidosis			Å	Å
Pacing			Å	Å
Transport to other facility	Å	Å	Å	Å
Request by specialist			Å	Å
No reason(neck laceration)	Possibly Å			Possibly Å

The indications as found in the consensus document were used to evaluate the critically ill or injured population of 183 patients. Fifty five patients in the emergency centre who were endotracheally intubated matched the recommended indications of the consensus document. One of the patients had no indication listed for endotracheal intubation in the

patient file. The observations on this specific patient, as well as the diagnostic tests undertaken, provided no indication for endotracheal intubation. The patient appeared fully awake and suffered a laceration to the neck after he fell with a glass in his hand. There were no indications in the file as to whether the patient was intubated to open and maintain the airway or for any of the other reasons, such as predicted clinical course (See table 4.3). If the clinical situation of this õover treatedò patient was taken into account it could be argued that the laceration in the neck could lead to obstruction of the airway (open and maintain airway) or predicted clinical course (near future needs) where swelling around the wound could lead to obstruction of the airway. This would be speculation, because no indication could be found in the file that would support this.

Eight of the non-intubated critically ill or injured patients should have been endotracheally intubated according to recommendation of the consensus document. All eight patients should have been endotracheally intubated to correct inadequate respiration/ventilation and three of them should also have been endotracheally intubated to protect the airway (low Glasgow Coma Scale) (See table 4.4).

Table 4.4: Correlation of intubated patients versus the consensus document (n=183)

	Consensus indicated intubation	**Consensus did not indicate intubation**	**Total**
Intubated in centre	55	1	56
Not intubated	8	119	127
Total	63	120	183

With evaluation of the eight patients that had to be intubated according to the consensus document, the following were apparent:

- One patient had severe emphysema and a low Glasgow Coma Scale, the doctor held off endotracheal intubation because the patient improved clinically on medical treatment within 30 minutes, although the arterial blood gas still showed respiratory failure.

- One patient had pneumonia with underlying emphysema and only one set of vital signs and one arterial blood gas was done before admission. No reasons were given for not intubating the patient.
- One patient had severe gastro-enteritis and the initial arterial blood gas showed respiratory failure, but no further saturations were recorded.
- One patient had a possible overdose and was in respiratory failure, the Glasgow Coma Scale was low but the **paediatrician requested** no endotracheal intubation at that stage.
- One patient was in a preterminal clinical state as well as respiratory failure, but was not intubated due **to his preterminal state**.
- Two patients (heart attack and pneumonia) had respiratory failure, but the **specialist requested** no endotracheal intubation at that stage.
- One patient was in respiratory failure for unknown reason and she was not intubated because of a **living will**.

If the reason for not intubating is taken into account, only three patients had no objective reason or restriction namely specialist request or living will, for not endotracheally intubating them and these would fit into the category of critically ill or injured patients that could have been managed differently according to the consensus document (See table 4.5). The patient with the emphysema had good reason initially to be intubated (***P*** ï protection of the airway due to a low GCS and ***E*** for exchange of gasses due to respiratory failure). The patient received a trial of treatment which seemed to work except that the $PaCO_2$ remained high (115mmHg) on the second arterial blood gas. The patient was awake and his saturation was 95% on oxygen before transfer. This could be a case of permissive hypercarbia in emphysema since the level of consciousness did improve (73, 74). Possible fatigue was not mentioned in the file and that could be the reason why this patient should then have been intubated (**N**ear future needs). The patient with pneumonia also had emphysema and his arterial blood gas did not show hypercarbia, but hypoxia (PaO_2 of 44.4 with a pH of 7.51 and a $PaCO_2$ of 29.1), which would then be permissive hypoxia with emphysema and the patient was almost immediately admitted under the Cardiologist (known patient) in the Cardiac intensive

care unit for further management there. The third patient was a baby with severe gastro-enteritis and a low PaO_2 on the arterial blood gas (52 mmHg). The special tests indicated severe dehydration and the patient improved clinically before he was transferred to another private hospital for admission under the known paediatrician.

Table 4.5: Evaluation of patients not managed as per consensus document (n=183)

Reason for not intubating	Had to as in Consensus	No in consensus	Total
No reason found	3	1	4
Reason found	5	0	5
	8	1	9

Evaluation of the study data also gave valuable information on other issues that could be used in the centre to standardise as well as upgrade the level of care. It will be discussed in the following paragraphs.

There was a total of 212 critically ill or injured patients (including the exclusions), and 85 of them (40%) needed endotracheal intubation. Of these patients (including exclusion), 104 (49%) were brought in by an ambulance and 108 (51%) came on their own or were brought in by family or friends. Twenty nine of the patients brought in by ambulances were already intubated (28% of ambulance patients). These patients are excluded from the study population, since the indication for endotracheal intubation is unknown and can therefore not be included in the data. Of these 75 ambulance patients (exclusions taken into account) another 24 (23%) had to be endotracheally intubated by the emergency doctor in the centre. This brought the total percentage of endotracheally intubated patients brought in via ambulances to 51%. Of the 108 (51% of all critically ill or injured) patients that came in on their own, only 32 (30%) were endotracheally intubated in the centre (See figure 4.1).

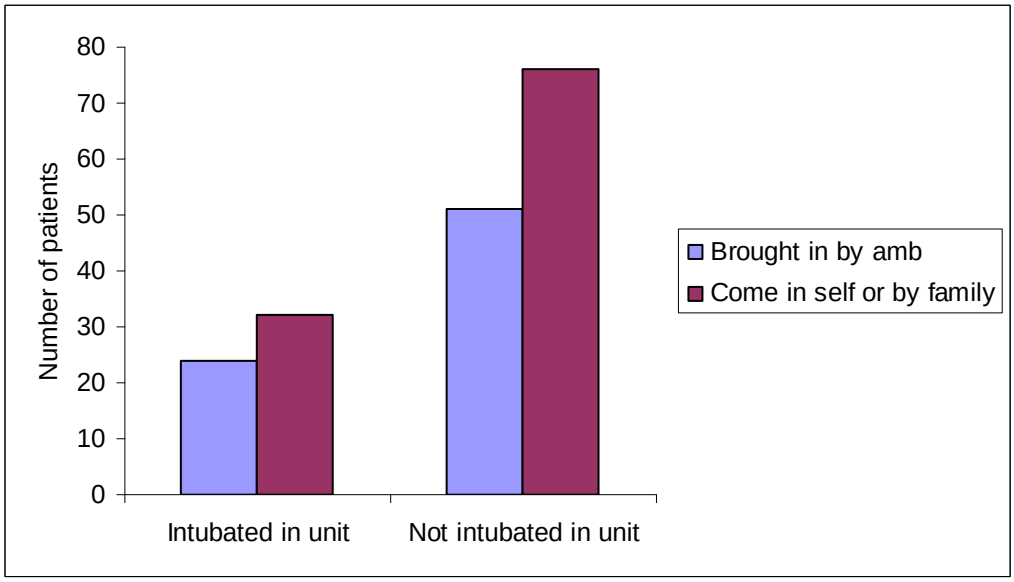

Figure 4.1: Airway management on the patients brought in by ambulance (n=183)

The gender differentiation of the study population (183) was males 108 (59%) and females 75 (40%). The age differentiation was 158 adults (86%) and 25 children (14%). A child was classified as a person aged 12 years or younger (<13 years). The 158 adults had a mean age of 51 years with 17 years as the youngest and 94 years as the oldest. The 25 children had a mean age of 2 years 10 months with 3 months as the youngest and 12 years as the oldest.

Table 4.6: Sex differentiation of the critically ill or injured patients (n=183)

	Child	Adult	Total
Male	15	93	108
Female	10	65	75
Total	25	158	183

The centre endotracheally intubated 33 male (59%) and 23 female (41%) patients. Of the 33 male patients who needed endotracheal intubation in the centre, 17 (52%) were brought in by the ambulance and 16 (48%) came in on their own or with family/friends. The 23 female patients were divided into 11 (48%) ambulance and 12 (52%) non-ambulance patients (See table 4.7).

Fifty four percent (30 patients) of the endotracheally intubated patients had co-morbid factors/illnesses. In 30% (17 patients) of cases no co-morbid illnesses were found and in 16% (9 patients) of cases co-morbid factors/illnesses were unknown due to insufficient history.

Table 4.7: Mode of transport (n=56)

	Non-ambulance	Ambulance	Total
Male	16	17	33
Female	12	11	23
Total	28	28	56

The critically ill or injured population consisted of 120 medical patients (66%) representing non-trauma related diseases and 63 patients (34%) with trauma related injuries. Eighteen of the 63 (29%) trauma patients and 38 of the medical patients (32%) were endotracheally intubated in the centre (See figure 4.2).

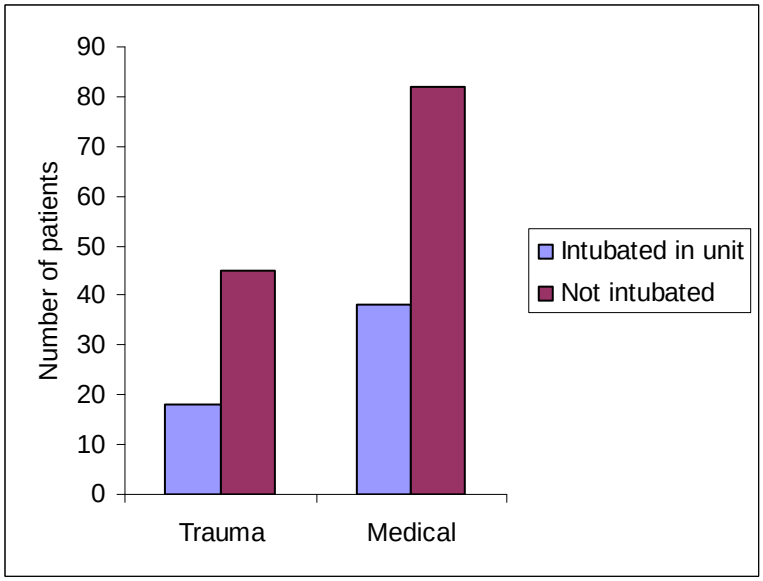

Figure 4.2: Medical versus Trauma patients (n=183)

The day staff (07h00-19h00) treated 98 critically ill or injured patients (54%) and the night staff (19h00-07h00) treated 85 critically ill or injured patients (46%). Twenty four (43%) of the endotracheal intubations were done during night shifts and 32 (57%)

endotracheal intubations took place during day shifts (See figure 4.3). This difference is not significant statistically (Fisher exact test, p = 0.55).

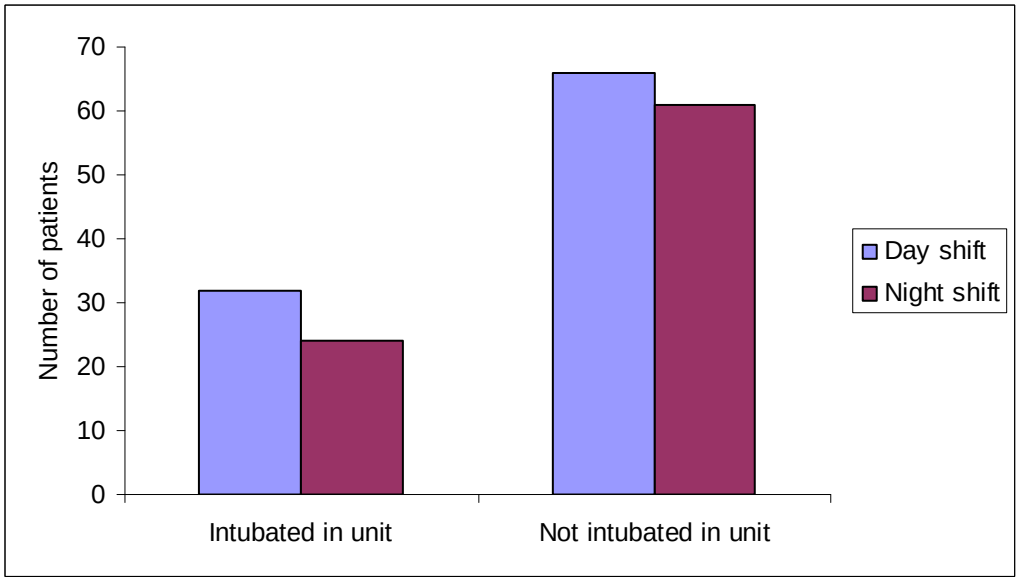

Figure 4.3: Shift differences (n=183 and statistically not significant p = 0.55)

Not all critically ill or injured patients were admitted; 11 died (6%) and were then sent to the mortuary and 4 (2%) were discharged home. The discharged patients were incorrectly classified as critically ill or injured. The remainder of the patients were admitted; 109 (60%) to intensive care, ten patients (5%) to high care, 27 patients (15%) to general wards and 22 patients (12%) were referred and transferred to other hospitals. The referrals were 13 patients (59%) to public hospitals and nine patients (41%) to other private hospitals due to a lack of bed availability. All the endotracheally intubated patients in the study that were admitted to the hospital attached to the emergency centre, were either admitted in an intensive care unit or died and were sent to the mortuary. It is difficult to evaluate if the patients referred to other hospitals would have been admitted to an intensive care centre. The patients who were referred to other private hospitals were most probably admitted in intensive care units, because of a lack of intensive care unit beds in the hospital attached to the emergency centre. In personal experience the private hospitals almost never close due to a lack of general ward beds, but mostly due to a lack of intensive care beds ï the patients can wait a few hours for a non-monitored bed, but not if they need intensive care facilities. The patients referred to

the public hospitals were referred due to a lack of funds (usually given the option to be admitted in the private facility but no funds or no medical aid) but 4 of those patients were endotracheally intubated before transport and they would have needed intensive care. This will bring the percentage of patients who needed intensive care or high care to 73% (60% + 5% + 2% + 5%) (See figure 4.4).

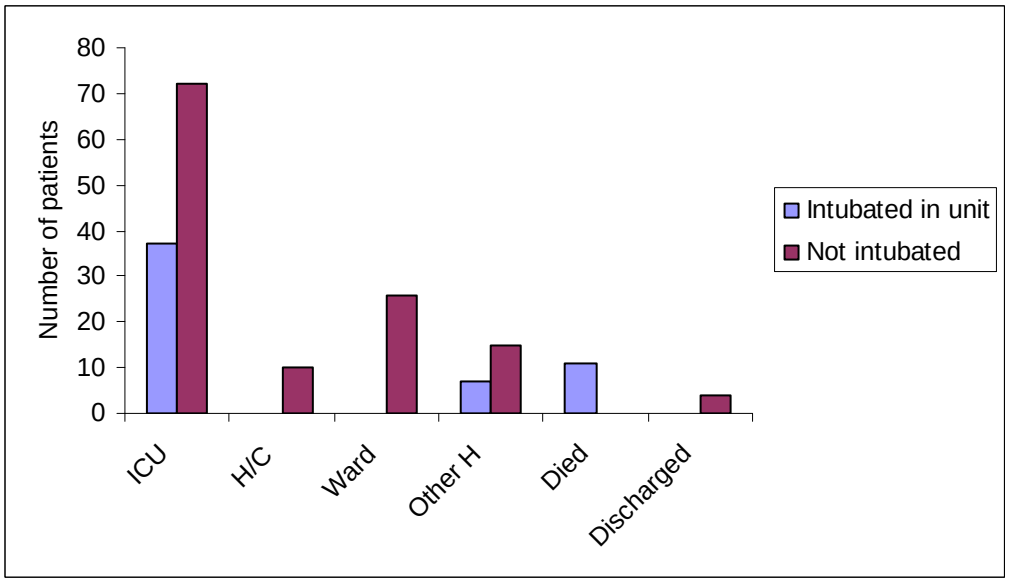

Figure 4.4: Admissions (n=183)

Rapid sequence intubation (RSI) as method of endotracheal intubation was used in 35 (62.5%) of the 56 intubated patients. These patients needed a paralytic as well as a hypnotic agent to facilitate endotracheal intubation. Another 7 patients (12.5%) needed at least an induction agent to facilitate endotracheal intubation. The patients that only received an induction agent before endotracheal intubation were two patients with a Glasgow Coma Scale (GCS) of 3, three patients with a GCS of 4, one patient was intubated nasally by a neurosurgeon which used an awake intubation technique and one had no particular reason why only a hypnotic agent was used and not RSI as the preferred method. Fourteen endotracheal intubations (25%) were done without any paralytic or hypnotic agent. These thirteen patients were either in cardiac arrest (9 patients) or had a Glasgow Coma Scale of 3 (4 patients).

The time spent in the emergency centre before the patient was endotracheally intubated ranged from minutes to more than 2 hours. Four patients (7%) were in the centre for more than two hours before they were endotracheally intubated, eight (14%) were in the emergency centre between one and two hours, ten (18%) were between 30 minutes to one hour in the emergency centre and 34 (61%) patients were in the emergency centre for less than 30 minutes before they were intubated.

The 183 critically ill or injured patients were treated by 14 different doctors. Most of the critically ill or injured patients, 179 patients (98%), were seen by the experienced emergency doctors with > 5 years of experience in an emergency centre. Three of the 14 emergency doctors were locum tenens doctors with little experience in managing critically ill or injured patients.

Difficult or failed endotracheal intubation, where there were three or more attempts before success, occurred in four (7%) cases in total. These are divided as: Success on the 4th attempt, only success after multiple attempts (amount unknown), failed twice and specialist had to intubate, and success at 3rd attempt. The help of a specialist with endotracheal intubation was only needed in one (2%) of these cases.

Summary: In this chapter we discussed the establishment of the consensus document as well as the different indications used by the emergency doctors in the emergency centre and their similarities. Other valuable information gathered but not directly related to the topic, was also discussed.

CHAPTER 5: DISCUSSION

This chapter will concentrate on the discussion of the data gathered, as set out in chapter 4. It will specifically discuss the indications for endotracheal intubation, as used by the emergency doctor, as well as how it correlated with the consensus document. Other factors derived from the study, but not specifically investigated will also be discussed including the medical and trauma patients, shift differences, admission statistics, experience of the emergency doctor and endotracheal intubation failure rate.

5.1 Consensus document

The indications used in the consensus document were derived from the South African Airway Interventions & Management in Emergencies Course (SA-AIME), as this is currently the only structured and comprehensive airway management course available in South Africa specifically aimed at the emergency environment. The course offered by the Division of Emergency Medicine at the University of the Witwatersrand has already trained 320 health care practitioners since its inception in October 2008 until December 2010. It is a good principle to attempt to standardise training in emergency medicine by not attempting to invent a new list of indications if possible, but to use those already in place.

The heads of Divisions of Emergency Medicine at the different medical schools in South Africa were used as the experts except the school attached to the University of the Free State where the head of the emergency centre was asked to act as the expert respondent. These are regarded nationally as the leaders in emergency medicine in their region and at their university and therefore would have the experience to decide on a standard of care in airway management in South Africa. Only five of the six respondents reacted to the request to help with the consensus document, which is still acceptable as it presents 83% of the experts.

According to the final consensus document the indications to intubate a critically ill or injured patient in an emergency centre can be summarised as follows ï (the **OPEN** pneumonic is used in the SA-AIME course):

- ***O**pen* and maintain the airway e.g. intrinsic mechanical obstruction like oedema, haematoma, infection and tumours
- Inadequate protective reflexes such as a low GCS = ***P**rotection of airway against aspiration*
- Respiratory failure such as hypoxemia or hypercarbia using PaO_2, oxygen saturation and $PaCO_2$ or diminished consciousness as measure = ***E**xchange of gasses*
- Predicted clinical course such as presenting condition, potential for deterioration or transport of the patient = ***N**ear future needs*

These major reasons for endotracheal intubations were generally found in the literature review used in this study although the exact wording may have differed but the studies did not highlight all the possibilities. Other indications found in the literature study not mentioned in the consensus document include manipulation of the pH, administration of medication, hemodynamic deterioration, multiple injuries and closed head injury (2, 40, 54, 56, 58, 60, 61). All of these indications can be compared and matched with one of the major indications e.g. predicted clinical course (near future needs) as set out in the previous paragraphs. The short, post-graduate emergency medicine skills training courses in South Africa generally also teach most of the indications as found in the consensus document, although with slight differences in wording as well as extra indications not mentioned in the consensus document (7, 15, 27, 29, 30, 66, 67, 69).

5.2 Indications in consensus document measured against indications used in the critically ill or injured patients

Table 4.4 indicates that 63 patients and not only 56 patients should have been endotracheally intubated in the emergency centre if the consensus document indications were used and that one of the endotracheally intubated patients had no

specified reason (over treated) to be endotracheally intubated compared to the consensus document.

Five of the patients should have been endotracheally intubated due to the consensus document had good reason for not endotracheally intubating such as per request of the treating specialist in three cases, a living will in one case and a pre-terminal patient in whom endotracheal intubation may have been futile. This indicates that reasons not to endotracheally intubate should also be taken into account in the emergency centre.

The three patients that should have been endotracheally intubated according to the consensus document (Table 4.5) will be the true missed opportunities that should have been managed in the emergency centre according to the consensus document. Statistically this is not significant (According to the Fischer exact test ï p = 1.000 and therefore there is no statistical association between the indications found with the consensus document and the critically ill or injured patients that were endotracheally intubated or not).

5.3 More data not specifically investigated

The data collection identified other factors that did not influence the decisions to endotracheally intubate, but have some relevance to the endotracheal intubation of the critically ill or injured patient. These factors will also be discussed in the next paragraphs.

Although only 0.7% (212 of 28 355 patients) of all patients seen in the centre were classified as critically ill or injured, a critically ill or injured patient was seen at least every two days. This average helps the personnel to maintain competency in clinically diagnosing and adequately treating critically ill or injured patients. Hardcastle (1) suggested that one endotracheal intubation per day provides a sufficiently high enough caseload to maintain endotracheal intubation competency in an emergency centre if compared to other studies. However this study indicated that only 4.6 patients per month or one patient every 6.5 days are endotracheally intubated. This may not be a sufficient caseload, but the relatively low failed endotracheal intubation success rate in

this study (7%) correlates well with the international literature where a failure rate of less than 5 to 10% is accepted in the emergency centre (1, 2, 40, 41, 47, 53, 54, 55, 56, 65).

The difference in percentage of critically ill or injured patients needing endotracheal intubation that were transported by ambulance (51%) and the patients that arrived using private vehicles (30%) could be the result of the patients / family / friends realising the value of ambulance transport and/or availability of ambulance services (EMS) in the urban setting. It may also indicate the value of effective pre-hospital emergency services and the role the EMS plays in the team approach to emergency treatment of critically ill or injured patients (Figure 4.1 and Table 4.7).

Only 34% of the critically ill or injured patients had a trauma related illness whereas 66% of all the critically ill or injured patients were primarily due to medical illnesses (Figure 4.2). The higher incidence of medically ill versus trauma related illness may be due to the higher incidence of co-morbid diseases in South Africa. The average age of the adult patient who needed endotracheal intubation was 51 years and that will also support co-morbid factors in the critically ill or injured patients. The study also showed that co-morbid factors could be proven in 54% of the endotracheally intubated patients. Only 25 patients (14% of study population) were children ranging from 3 months to 12 years with the median age 2 years and 10 months. This indicates that the emergency centre manages a small patient load of critically ill or injured children, but when they present as critically ill or injured they mostly fall into the baby and small child group.

More of the endotracheal intubations took place during the day shifts (57%), which compared with the higher incidence of critically ill or injured patients during the day shifts (54%) as seen in Figure 4.3. It indicates that the emergency doctor on duty during the day and night shift should be proficient in emergency airway management because 43% of all the endotracheal intubations happened during the less supported night shifts (1, 7, 40, 41, 47, 53, 54, 55, 63, 65).

The admission of the critically ill or injured patients indicate that most of them would need intensive care management (60%) or at least high care facilities (5%) as seen in

Figure 4.4. The critically ill or injured patient needs constant monitoring and management to prevent complications, worsening of the condition and eventually dying and this can only be done in an environment such as the intensive or high care units where there is enough personnel and sophisticated equipment to facilitate it. If the patients transferred to other institutions are taken into account up to 73% of patients needed admission to an intensive or high care. The patients that died in the emergency centre indicate that critically ill or injured patients still have a probability to dying in spite of advanced medical care in an emergency setting and in this study the mortality rate was 6%. Only 27% of the critically ill or injured patients in this study did not need a monitored facility such as is present in the high care or intensive care units with 15% admitted to the general wards, 2% discharged, 9 non-intubated patients (5%) transferred to public hospitals and 6% died. This supports the feeling that a private emergency centre cannot function on its own, but needs close interaction and good relationships with the attached hospital and its specialist care facilities and personnel to facilitate the best care for their patients. The need for a monitored bed could also be a reason why a patient who ideally needs endotracheal intubation will first be optimally treated medically (if no monitored beds are available) or ventilated non-invasively. Only if that also fails will the patient be endotracheally intubated. The one patient with the emphysema and hypercapnia that was not endotracheally intubated could easily fall into this category, but it is speculative because it was never mentioned in the file. This study did not find any proof of this theory.

The critically ill or injured patients were predominantly treated by the more experienced emergency doctors on duty at the time (98%). Only one of the patients seen by a relatively inexperienced doctor was endotracheally intubated during stay in the emergency centre. These experienced emergency doctors with > 5 years of experience in emergency medicine were permanently employed by the emergency centre and as part of their working agreement were required to maintain their knowledge and skills by remaining current with a number of emergency medicine training skills courses, specifically ACLS®, PALS® and ATLS®. Three of the permanent emergency doctors employed by the emergency centre also had a post-graduate diploma qualification in emergency medicine namely the Diploma in Primary Emergency Care (Dip PEC(SA))

from the College of Emergency Medicine of South Africa. This post-graduate qualification in emergency medicine was the only post-graduate qualification available to emergency doctors who wished to upgrade or maintain their emergency medicine skills and knowledge. As mentioned, academic registrar training (4 years) only started in 2004 in Cape Town and in 2005 in Johannesburg. Three of the 14 emergency doctors were locum tenens doctors. These locum tenens doctors were inexperienced with less than 5 years experience in an emergency centre and they also did not have to update their short post-graduate emergency courses because they would primarily treat the non-critically ill or injured patients. The locum tenens doctors would be asked to update their courses as soon as possible since joining the department. They only treated 2% (1) of the critically ill or injured patients. These statistics support the literature that only experienced emergency doctors should be managing critically ill or injured patients, more specifically the airway of critically ill or injured patients (1, 7, 41, 53, 54, 55, 63, 65).

Most of the endotracheally intubated patients required medication to facilitate endotracheal intubation. Rapid sequence intubation (RSI) was used in 62.5% of patients whereas another 12.5% needed at least a hypnotic agent. Only fourteen endotracheal intubations (25%) were done without the help of any medication. One of the patients that only received a hypnotic agent had no good reason mentioned in the file why RSI was not used as the preferred method of endotracheal intubation in the emergency centre as is the gold standard world wide (9, 11, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25). The rest of the group of patients who received only a hypnotic agent before endotracheal intubation were four patients with a GCS of 4, one patient where an awake intubation method was used because other methods failed and one patient with a GCS of 3 where efforts without medications failed. This supports the literature that the emergency doctor would need to be proficient in emergency airway management and effective rapid sequence intubation (1, 7, 40, 41, 53, 54, 55, 63, 65).

The vast majority of patients that were endotracheally intubated were endotracheally intubated within 30 minutes of arrival in the emergency centre (61%), and supports the

literature that indicate that the airway problems in critically ill or injured patients can cause deterioration and even death if not acted upon timeously (41).

Dibble (47) conducted a systemic review on 407 papers of which only 12 were found relevant for analysis. It appears that the emergency doctor can perform rapid sequence intubation and endotracheal intubation at least as well as the anesthetist, with an overall high success rate and a low complication rate, provided the emergency doctor undergoes training in the field (47). The discussion in a study done by Wong (2) primarily addressed the success rates for endotracheal intubation under emergency doctors, whether the anesthetist must be called to intubate in the emergency centre, and the complications recorded with endotracheal intubation in the emergency centre. This retrospective, observational study over three years, with 142 endotracheal intubations in the emergency centre, proved that the emergency doctor endotracheally intubated 79.6% of patients successfully with the first attempt, with an overall success rate of 90.8%. The anesthetists only had to endotracheally intubate 13 patients (9.2%) (2). The success rate in the South Africa trauma unit at Tygerberg hospital was 96.5% and only 2 patients (3.5%) were unsuccessfully intubated and needed a more senior person or an alternative method (40). Reid (56) found no failure to intubate in his study of 208 patients although a difficult laryngoscopy resulting in a poor view of the vocal cords occurred in 12% of cases. A second operator (and on 11 occasions an assistant from the same emergency department) was called to assist or advice 25 times (9%) with only one failed endotracheal intubation documented in the study in the French emergency departments (60). Other studies have also found that there were little or no difference in the rates of success between emergency doctors and anaesthetists performing Rapid Sequence Intubation (75, 76). A difficult or failed attempt at endotracheal intubation in this study occurred in 7% (4 cases), with only one case (2%) where a specialist had to intervene and assist supporting the findings in the literature review that the emergency doctor should be able to manage the airway of a critically ill or injured patient successfully.

CHAPTER 6: LIMITATIONS

This study was a retrospective record review and because of that it has the following limitations:

- Loss of information is a known limitation in a retrospective record review and one file could not provide the indication for endotracheal intubation in the particular patient.
- The definition for a critically ill or injured patient was not standardised before the data was collected and it led to the inclusion of 4 patients that were discharged from the emergency centre after initial treatment.
- The data captured in the files could not be validated due to the retrospective capturing of the data. The emergency doctorôs clinical examination, as well as the observations done by the nursing personnel could not be standardised beforehand and were captured as it was recorded. This lack in standards and no possibility to validate the data can lead to bias.
- The study did not differentiate between the different age groups and airway management in adults and children are not necessarily similar.

The data can also not necessarily be extrapolated to other emergency centres in South Africa because of the following factors:

- The small numbers of endotracheally intubated patients
- Data only represents one year of study
- Data was collected in a private emergency centre

Other limitations to this study will be the following:

- The consensus statement used very few expert participants. If this study can be done today there would be more respondents to participate because there are more specialists in the field of emergency medicine.

- The ability of the specialist to request that a patient should not be intubated when there is a clear indication to endotracheally intubate the patient, can change the statistics and it will not necessarily be the situation in the public sector.

CHAPTER 7: CONCLUSIONS

Conclusions from this study are as follows:

- The study has found that the indications for endotracheal intubation as suggested in the consensus document and derived from the South African Airway Management & Interventions in Emergencies (SA-AIME), are valid for the emergency centre critically ill or injured patients. It is recommended that these indications should be used in the emergency centres to manage the airways of the critically ill or injured patients.
- The emergency doctors in this private emergency centre did use indications for endotracheal intubation on their critically ill or injured patients during 2006 as were suggested by experts in a consensus document.
- Experienced emergency doctors should be available and on duty with each shift (day or night) to be able to manage critically ill or injured patients.
- It would assist emergency doctors to understand special situations when endotracheal intubation in a critically ill or injured patient is not indicated in the emergency centre for various reasons.
- This study does show that the experienced emergency doctors at the study site are able to manage the majority of airways in critically ill or injured patients without specialist registration and that this may apply to many other experienced emergency doctors in South Africa.

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