

**A SURVEY OF RAPID SEQUENCE
INTUBATION AT THE ACCIDENT AND
EMERGENCY DEPARTMENT, KENYATTA
NATIONAL HOSPITAL.**

**A DISSERTATION PRESENTED IN PART
FULFILMENT OF THE REQUIREMENTS FOR THE
AWARD OF THE MASTERS DEGREE IN
ANAESTHESIOLOGY AND CRITICAL CARE,
UNIVERSITY OF NAIROBI**

DR. TIMOTHY MURITHI MWITI.

MAY 2008.



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KENYATTA NATIONAL HOSPITAL.**

PRINCIPAL INVESTIGATOR:

DR. TIMOTHY MURITHI MWITI, *MBChB(Moi)*,

POSTGRADUATE STUDENT IN ANAESTHESIOLOGY,

UNIVERSITY OF NAIROBI.

SUPERVISOR:

DR. P.O.R. OLANG', *MBChB, M.MED (Anaesth)*

LECTURER IN ANAESTHESIOLOGY,


UNIVERSITY OF NAIROBI.

DECLARATION.

I declare that this dissertation is my original work and has not been submitted for a degree award in any university.

RESEARCHER:	SIGNATURE	DATE
DR. Timothy Murithi Mwiti		24/10/08

This dissertation has been submitted for the degree of masters of medicine in anaesthesiology with my approval as a university supervisor.

SUPERVISOR	SIGNATURE	DATE
DR. P.O.R. Olang'		24/10/08

DEPARTMENT OF SURGERY
COLLEGE OF HEALTH SCIENCES
P. O. Box 19676 - 00202 KNH
NAIROBI
TEL: 2722890 2726300. Ext. 43773

DEDICATION

This work is dedicated to my wife and daughter – my pride and joy.

ACKNOWLEDGEMENTS

Carrying out this survey required input from various individuals. Their efforts are highly and sincerely recognized and appreciated.

I would like to thank the ethics committee, and indeed the Kenyatta National Hospital for allowing me to carry out this study. I also thank the ethics committee for their help in developing the research proposal for this survey. I also recognize the efforts and dedication of the nurses at the resuscitation room of the accident and emergency department to the well-being of the patients. They include Sr. Githu, Sr. Kahuho, Sr. Mugambi, Sr. Opuba, Mr. Kago and Mr. Mutuma among others.

The guidance from my supervisor and teacher Dr. Olang can not obviously go unrecognized. I'm also greatly indebted to Dr. T.M. Chokwe for reviewing and refining this study.

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ABSTRACT

Background: Rapid sequence intubation is the cornerstone of emergency airway management. This study was carried out at the accident and emergency department of Kenyatta national Hospital. Airway management here is primarily the responsibility of the anaesthesia department. There are no fully fledged emergency physicians practising at this hospital.

Objective: To evaluate the practice of rapid sequence intubation at the accident and emergency department.

Methods: This was a prospective, descriptive analytical study of endotracheal intubations carried out at the accident and emergency department. The study population included patients undergoing rapid sequence intubation. Data was collected in real time using a survey tool. Data collected included demographic data of the patients; indications for rapid sequence intubation; timing aspect; the practitioner characteristics; equipment, preparation, and execution of rapid sequence intubation.

Results: Data from 186 rapid sequence intubations were collected and recorded. 92% were adult patients. 75.8% of the patients were male. Severe head injury was the leading cause of rapid sequence indication (69.3%). In 61.8% of cases, the decision to undertake rapid sequence intubation was made after triage but before detailed medical evaluation. Most of the anaesthetic practitioners arrived after 10 minutes of being contacted. Most of the non-anaesthetic practitioners arrived within 5 minutes of being contacted. Only in 15.1% of

intubations were adjuncts to difficult airway available. Cricoid pressure was correctly applied in 12.4% of intubation. Success of intubation at first attempt was 91.4% and 98.9% after 2 attempts. 20% of the intubations had complications.

Conclusion: Rapid sequence intubation is fairly well executed at accident and emergency department of Kenyatta National Hospital.

LIST OF ABBREVIATIONS.

- ARDS Acute respiratory distress syndrome.
- ASA American Society of Anesthesiology.
- CO₂ Carbon dioxide.
- DKA Diabetic ketoacidosis.
- GCS Glasgow coma scale.
- ICU Intensive care unit.
- KNH Kenyatta National Hospital.
- O₂ Oxygen.
- SpO₂ Functional oxygen saturation, pulse oximetry.
- USA United States of America.

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1.0 INTRODUCTION.

Kenyatta National Hospital is the premier referral health facility in Kenya. It runs a very busy accident and emergency department. The accident and emergency department is usually run by general medical doctors, who usually consult with the senior house officers. As such there are no fully-fledged emergency physicians (as specialists) practicing in this hospital. In conditions posing risk to the airway the primary consult is to the senior house officers in the Anaesthesia and Critical Care department. The main method of emergency airway management is tracheal intubation. The disposal of the intubated patients is mainly to the ICU, occasionally to the burns unit and rarely, death.

Rapid sequence intubation is a technique employed in a patient with a potential of regurgitation and aspiration of gastric contents. The main indications for rapid sequence intubation are coma (as assessed using the Glasgow coma scale. GCS of 8 or less necessitates intubation) and respiratory exhaustion. Other indications include burns with inhalational injury and facial injuries. The causes of coma necessitating rapid sequence intubation are commonly head injury, cerebro-vascular accident, infections and poisoning. By definition, rapid sequence intubation is the rapid intravenous sedation and muscle relaxation to aid in securing of the airway as quickly and as safely as possible.^{1,2}

Cricoid pressure is a key element of rapid sequence intubation. The first practice of cricoid pressure was reported at the end of 18th century ('pressure on the lower part of the

larynx to occlude the oesophagus').³ The modern technique of cricoid pressure is ascribed to Sellick.⁴ If carefully applied, it can provide such effective barrier to the flow of oesophageal contents that the oesophagus can rupture should vomiting occur.

Preoxygenation before sedation is crucial. The patient is allowed to breath in 100% O₂ for 3-5 minutes. A seal should be obtained with the face mask. This allows for 'normoxemia' during the period of paralysis and securing of the airway. Ventilation by bagging with a facemask is not advisable in the setting where rapid sequence intubation is indicated.⁵

The choice of the intravenous sedative to be used depends on the practitioner and the underlying condition. The commonly used drug is midazolam. Other agents include thiopental, propofol, ketamine and etomidate. Succinylcholine has been, and still is, the neuromuscular blocking agent of choice of achieving rapid muscle relaxation.⁶ Rocuronium is gaining widespread use as an agent rapid muscle paralysis.⁷

One of the commonly ignored components of rapid sequence intubation is the difficult intubation drill. It is not uncommon to encounter a difficult intubation, but of concern is the unpreparedness for such an eventuality in any setting.^{8,9}

Rapid sequence intubation demands meticulous attention to detail as the outcome of aspiration is often catastrophic. It requires at least two individuals, the anaesthetist/emergency physician and one skilled assistant. The assistant should be competent in applying the cricoid pressure. All the necessary

equipment should be in good working condition and within easy reach of the anaesthetist/emergency physician before starting this procedure. In the practice of emergency medicine the risk of aspiration, especially in the context of potential difficult airway, is very real. This is because most of the patients have full stomachs or have conditions predisposing to slow gastric emptying.^{5,9,10}

2.0 LITERATURE REVIEW.

Rapid sequence intubation is a procedure that was derived from the anaesthetic procedure of rapid sequence induction, the difference being that in rapid sequence intubation the aim is to secure an airway at risk while rapid sequence induction is a starting point for general anaesthesia. Rapid sequence intubation in the accident and emergency department is challenging as patients usually have full stomachs and will not provide any relevant medical history.⁵ Trauma patients are often reported to have specific airway problems plus hypovolaemia and possibly lung injury.^{10,12}

The practitioner conducting rapid sequence intubation should be competent and should have a trained assistant to apply the cricoid pressure.^{4,13,16}

In Australia and USA, rapid sequence intubation is a domain of the emergency physicians while in most countries, emergency airway management is by the anaesthetists. Where non-anaesthetists perform rapid sequence intubation ample training and practice is mandatory.² In a study carried out on anaesthetic trainees in Thailand, the minimum number of tracheal intubation for competency was determined to be 27.¹⁴ Other studies suggest that the minimum training period for non-anaesthesiologists in effective application of rapid sequence should be more than 3 months.^{2,15}

According to Butler et al, safe and effective airway management in the critically ill/injured patients is the cornerstone of resuscitation.^{5,6} They defined rapid sequence intubation as the simultaneous administration of a potent

sedative agent and a neuromuscular blocking agent to facilitate tracheal intubation. In their observational survey, the time from the decision being made to do rapid sequence intubation to the arrival of the intubator was greater than 10 minutes in 20% of cases and 2.5 minutes in 53% of cases.⁵ The indications for rapid sequence intubation according to most studies were securing the at risk airway in patients with reduced level of consciousness, inhalation injury in burns, and in respiratory failure for mechanical ventilation.^{1,6,10,12,17}

Assessment of the airway is one of most important aspects of airway management. Graham advises that it is important to recognize signs of a potentially difficult intubation early and that the practitioner must be aware that unexpected difficult intubation will occasionally occur.¹⁵ The incidence of difficult intubation in the accident and emergency department has been reported to be 3.0 – 5.3% compared to 1.15 – 3.8% in the controlled setting of the operating theatre.¹¹ ASA Task Force on the management of the difficult airway has recommended to limit conventional intubation attempts to 3 to reduce airway trauma, swelling and patient injury. Thereafter an alternative e.g. tracheal tube introducer, laryngeal mask airway, combitube™, fiberoptic bronchoscopy, cricothyrotomy or tracheostomy should be sought.^{12,16}

There is no internationally accepted definition of complications of rapid sequence intubation.¹⁵ Most studies evaluating the complications evolved their definitions from quality assurance principles of airway management. These include major and immediate adverse events, i.e., hypotension, hypoxemia, dysrhythmia, and death. Other adverse events are minor,

delayed, or both. They include pneumonia, soft tissue trauma, tooth trauma, bronchial intubation and vomiting without aspiration.²¹ It has been reported that the incidence of airway and haemodynamic complications distinctly increase with more than 2 laryngoscopic attempts during emergency airway management.^{10,16}

It has been argued that cricoid pressure may cause difficulties in intubation. However, a study by Jabalameli found out that laryngoscopic view with cricoid pressure properly applied was better than without.¹⁸ According to Turgeon et al in a double-blind randomized controlled study, cricoid pressure had no influence on the rate of failed oro-tracheal intubation, and that it had no effect on glottic exposure during laryngoscopy or on complexity intubation.²²

Even with the benefits of rapid sequence intubation, in some critically ill/injured patients, the technique may result in a deterioration of the patient's physiological condition.¹⁹ In some patients, the particular clinical problem(s) may necessitate adjustments to the technique and agents used.^{10,19}

Rapid Sequence Intubation – The Procedure

The general sequence of rapid sequence intubation consists of the "five P's," as follows: preparation, preoxygenation, paralysis, passage of the endotracheal tube, and postintubation care. Preparation begins when the clinician identifies the need for intubation. A period of 5 to 10 min before intubation allows for the evaluation of the patient for signs of a difficult airway and for the preparation of the equipment. Among the various mnemonics that are used to

assist preparation, the phrase "Y BAG PEOPLE?" allows physicians to recall the essential elements of the preparatory phase and emphasizes the need to avoid positive-pressure face mask ventilation whenever possible.^{12,13}

Table 1: Preparation for Intubation Mnemonic¹³

Y	Yankauer suction
B	Bag-valve-mask
A	Access vein
G	Get your team, get help if you predict a difficult airway
P	Position the patient and place the patient on monitor
E	Endotracheal tubes and check the cuffs with a syringe
O	Oxygen and oropharyngeal airway available
P	Pharmacy: draw up and label all the necessary drugs
L	Laryngoscope and blades: a variety and working.
E	Evaluate for difficult airway

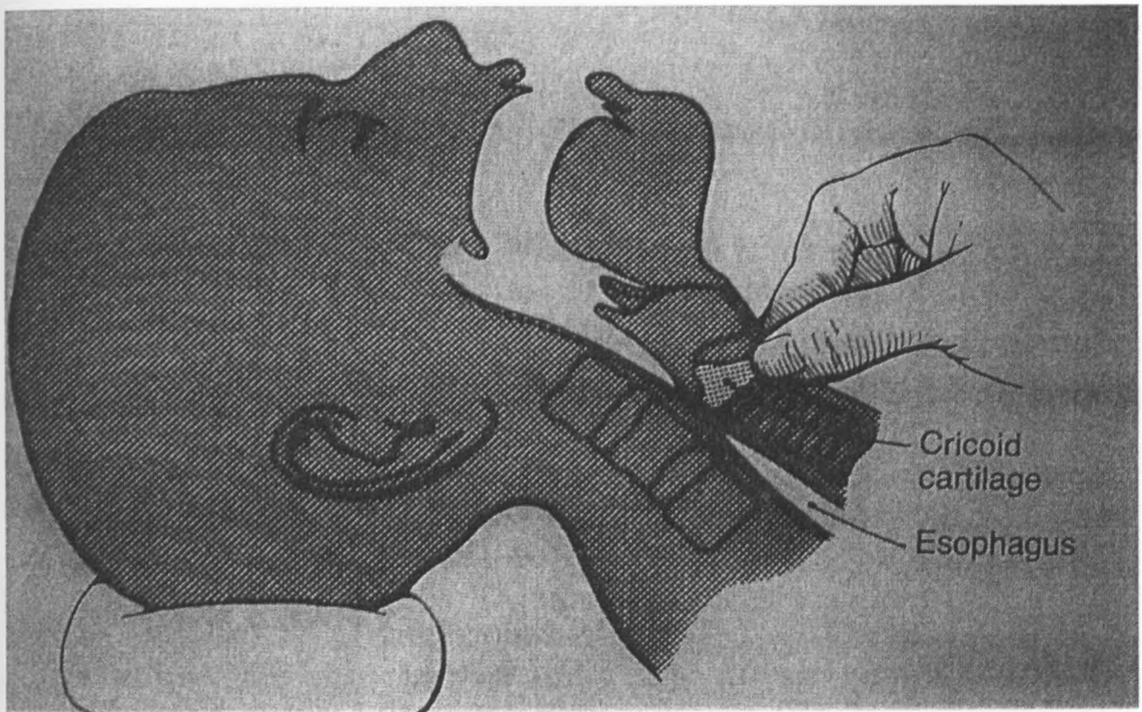
Preoxygenation, also termed alveolar denitrogenation, is performed with the patient breathing 100% oxygen through a non-rebreather mask for 5 min. Mentally alert patients are asked to perform eight deep breaths to total lung capacity. Alveolar denitrogenation creates a reservoir of oxygen in the lung that limits arterial desaturation during subsequent intubation attempts. The use of positive-pressure ventilation administered by facemask is reserved for patients who cannot achieve adequate oxygenation while breathing 100% O₂ by nonrebreather mask.^{6,12}

Successful intubation often depends on correct patient positioning. The patient's head should be level with the rapid sequence intubation practitioner's waist or higher to prevent unnecessary back strain during laryngoscopy.

Rigid laryngoscopy displaces oral and pharyngeal soft tissues to create a direct line of vision from the mouth to the glottic opening. Moderate head elevation (5–10 cm above the bed/trolley) and extension of the atlantooccipital joint place the patient in the desired sniffing position. This position ensures the alignment of the oral, pharyngeal and laryngeal structures for easy and successful laryngoscopy. The lower portion of the cervical spine is flexed by resting the head on a pillow.⁴⁴ However, in cases of suspected or actual cervical injury, this manoeuvre worsens the injury with spinal cord damage being very possible. Instead endotracheal intubation should be achieved with immobilization of the cervical spine. This is done by manual immobilization of the cervical spine by a second assistant.

The sedative and neuromuscular blocking agents are administered immediately after the patient achieves adequate preoxygenation. ⁶ An assistant performs the cricoid pressure (Fig 2) to prevent passive regurgitation and aspiration, and reduce gastric insufflation if the patient is receiving positive-pressure ventilation by facemask. ^{3,4,17} If the patient vomits, the cricoid pressure should be released and the patient should be log-rolled to allow dependent suctioning of the pharynx. ²⁰

Fig 1: Application of cricoid pressure



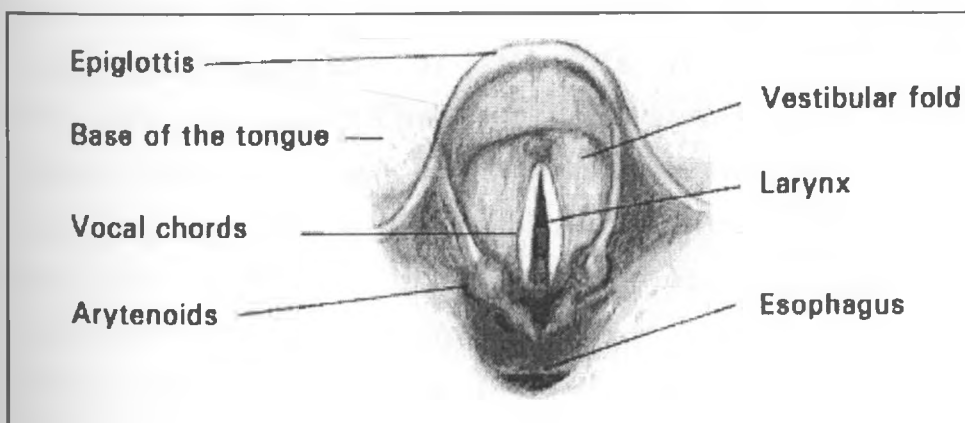
There is a range of induction agents and the appropriate one should be used for specific clinical circumstances. Succinylcholine provides safe and effective neuromuscular blockade for most patients. ^{6,7} Rocuronium may be a more

appropriate choice for patients if there are contraindications or concerns about the use of succinylcholine.⁷

Forty-five seconds to 1 min after induction and paralysis, the adequacy of paralysis is assessed by checking mandibular mobility. Resistance to motion indicates incomplete paralysis, which requires that the patient start to receive oxygen again, with reassessment of relaxation taking place in 15 to 30s.^{12,13}

Once sufficient muscle relaxation has been achieved, laryngoscopy is performed and the vocal cords visualized (fig.2). Visualization of the vocal cords and the glottic opening may be improved by placing pressure on the thyroid cartilage in a backward, upward, and rightward direction (the mnemonic "BURP" or backwards, upwards, right, and pressure). If laryngoscopy is not immediately successful and the patient's SpO₂ falls to <90%, assisted ventilation is initiated with a bag-valve-mask device and cricoid pressure to oxygenate and ventilate the patient before attempting laryngoscopy again. After successful tracheal intubation and cuff inflation, the confirmation of intubation is required.^{6,12,13,19}

Fig 2: View of glottic area via direct laryngoscopy



The goal in the immediate postintubation period is to confirm correct tracheal intubation, and the adequacy of oxygenation and ventilation. Epigastric auscultation followed by auscultation of both hemi thoraces in the axillas assists in assessing for an oesophageal or main stem bronchus intubation. The rise and fall of the chest and the maintenance or improvement of oxygenation should be noted. The measurement of end-tidal CO₂ by either a colorimetric or waveform device has become a necessary step in confirming tracheal intubation. Once satisfied that the endotracheal tube is in the trachea, cricoid pressure may be released. The cuff is then rechecked, and the endotracheal tube is secured to the patient. Many of the induction agents and succinylcholine have a short duration of action. Thus, depending on the level of consciousness of the patient before the intubation, sedation should be considered at this point.^{6,12,13}

Difficult Intubation

The American Society of Anesthesiology defines a difficult airway by the existence of clinical factors that complicate either ventilation administered by face mask or intubation performed by experienced and skilled clinicians. Difficult intubation has been defined by the need for more than three intubation attempts or attempts at intubation that last more than 10 minutes. There many causes of difficult intubation. They include the practitioner's inexperience, inadequate equipment preparation and malfunction, reduced jaw movement (e.g. in fractures, jaw wiring, rheumatoid arthritis), reduced neck movement (e.g. in cervical fracture, rheumatoid arthritis), short neck, protruding incisor teeth, airway oedema, airway

tumours, and obesity amongst others. Difficult intubation can be expected or unexpected.^{13,43}

Assessment of the airway for difficult intubation includes the following:

- a) General appearance of the neck, face, maxilla and mandible.
- b) Jaw movement.
- c) Head extension and neck movement.
- d) The teeth and the oropharynx.
- e) The soft tissues of the neck.
- f) Recent cervical x-rays.
- g) The view at laryngoscopy.

Various screening tests for difficult intubation have been developed. The most popular of these is the Mallampati classification.⁴³ This is difficult to apply in the emergency setting as it requires a conscious and cooperative patient.

Failed Intubation

A failed intubation drill is applied in difficult airway situations where the attempts at securing the airway endotracheally have not succeeded. This may involve waking the patient so that an alternative intervention can be tried but this is usually inappropriate for acutely ill patients. If oxygenation is adequate, further efforts to intubate may be possible. Help from a more experienced operator is advisable especially if optimal external laryngeal manipulation, appropriate laryngoscope blade and an intubating stylet have been used unsuccessfully. If severe hypoxemia develops, attempt at intubation should be abandoned and lung ventilation re-

established. This is done by bag-valve-mask ventilation with an oro-pharyngeal airway in place.^{44,45}

A supraglottic airway may be inserted by an experienced operator. Supraglottic devices include laryngeal mask airway and combitube. Fiberoptic-guided tracheal intubation can also be attempted. An intubating laryngeal mask airway can facilitate blind and fiberoptic-guided tracheal intubation.⁴⁴

If sufficient ventilation cannot still be maintained, a reliable surgical airway must be created rapidly. In the emergency setting this may be by wide-bore cannula or surgical cricothyroidotomy, percutaneous or formal tracheostomy.

3.0 OBJECTIVES .

3.1 OBJECTIVES

3.1.1 GENERAL OBJECTIVE

To evaluate the practice of rapid sequence intubation at the accident and emergency department, KNH.

3.1.2 SPECIFIC OBJECTIVES.

1. To determine the common indications for rapid sequence intubation.
2. To assess the time factor in decision-making and implementation of rapid sequence intubation.
3. To assess the availability of the necessary equipment to carry out rapid sequence intubation.
4. To evaluate the execution of rapid sequence intubation and its complications.

4.0 JUSTIFICATION.

This action research was intended to assess the competency of practice of rapid sequence intubation with the aim of suggesting improvement measures and hence promoting safety of the patients. It was assumed that if the technique and skill was correct then the outcome will be affected positively. Airway adequacy is critical to life. Therefore any threat to the airway needs to be dealt with before any other body system at risk. Any airway insult or ill-executed intervention is usually rapidly fatal. Rapid sequence intubation demands proficiency and special attention to detail.

Studies evaluating the procedure of rapid sequence intubation have been carried out in other countries especially in the USA. None has been carried out in KNH, and therefore, this is the first such study in this hospital. The safety of the procedure of rapid sequence intubation at KNH is unknown and this study set out to assess this. The study addresses the areas of shortcomings and recommendations made. The main aim of this study was to promote patient safety.

5.0 METHODOLOGY.

5.1 Study Design

This was a hospital-based prospective, descriptive and analytical study.

Sample size

In this study the sample size was calculated using the formula:²³

$$n = \frac{z^2 pq}{d^2}$$

where

n is sample size (if the target population is more than 10,000)

z is the standard normal deviation at the required confidence level, in this case its 1.96

p is the proportion in the target population estimated to have characteristics being measured. Since there is no estimate available of the proportion in the target population assumed to have the characteristics of interest, 50% (0.5) should be used as recommended by Fisher et al.²³

q is $1-p=0.5$

d is the level of statistical significance set = 0.05.

Therefore;

$$\begin{aligned} n &= \frac{(1.96)^2 \times (0.5) \times (0.5)}{(0.05)^2} \\ &= 384 \end{aligned}$$

Since the study population in this study was less than 10000, the sample size was calculated as follows:

$$nf = \frac{n}{1+n/N}$$

Where

nf = the desired sample size (when the population is less than 10,000).

n = the desired sample size (when the population is more than 10,000) which is 384 (from above calculation)

N = the estimate of the population size (number of patients undergoing RSI at the accident and emergency department in KNH in a year i.e. about 360²⁴)

Therefore

$$\begin{aligned}nf &= \frac{384}{1+(384/360)} \\ &= 186\end{aligned}$$

Therefore the desired sample size for this study was 186.

5.2 Study Population

The target population for this study was patients undergoing emergency tracheal intubation at the accident and emergency department of KNH.

5.3 Study Area

The study was carried out at the Kenyatta National Hospital. This hospital serves the entire country of Kenya and East and Central Africa at large. It is also the premier teaching hospital in Kenya. The study was conducted at the accident and emergency department.

5.4 Study Procedure

The study focused on all aspects of the rapid sequence intubation technique. It involved the timing of the decision and implementation of rapid sequence intubation, assessment of the patient and preparation prior to the rapid sequence intubation, the skill of the personnel, the actual conduct of rapid sequence intubation and the post-intubation management. Assessment of patients mainly targeted the airway assessment and any physiological compromise. Preparation for rapid sequence intubation entailed the equipment and drugs available. The conduct of rapid sequence intubation was compared with the normative standards of practice (i.e. what the experts think should be done in order to execute the technique correctly and safely).

5.5 Data Collection

Data was collected during the period of 6 months from October 2007 to March 2008. Information was obtained using a survey tool. The data collected included the demographic data, the indication for rapid sequence intubation, the timing of rapid sequence intubation, the personnel performing rapid sequence intubation, and the preparation and execution of rapid sequence intubation. The principle investigator administered the survey tool by observer-participant method. The data collecting tools were checked daily completeness and accuracy.

The data obtained was then be coded and stored in a computer. It was analyzed using *EPI info* computer package. It is presented in tables, graphs and in prose.

5.6 Inclusion/Exclusion Criteria

4.6.1. Inclusion Criteria.

All critically ill/injured patients who underwent rapid sequence intubation at accident and emergency department, KNH.

4.6.2. Exclusion Criteria.

1. All cardiac arrest patients.
2. All critically ill/injured patients who were already intubated on arrival to the accident and emergency department.
3. All patients in whom the investigator intervened to avert potential adverse outcomes.

5.7 OPERATIONAL DEFINITIONS.

- Rapid sequence intubation – use of anaesthetic drugs and cricoid pressure to facilitate tracheal intubation.
- Cricoid pressure – temporary occlusion of the upper oesophagus by form of backward pressure on cricoid rings against the bodies of cervical vertebrae.
- Rapid sequence intubation practitioner – the person who administered the anaesthetic drugs and performed the tracheal intubation.
- Rapid sequence intubation practitioner assistant – the person who applied the cricoid pressure during.

- Possible difficult airway – defined as any occurrence of obvious airway obstruction, thyromental distance less than 3 fingerbreadths, inter-incisor distance less than 2 fingerbreadths, or neck immobilization.
- Difficult intubation – tracheal intubation after more than 2 attempts at intubation.
- Attempt at intubation – insertion of the laryngoscope blade into patients larynx in order to visualize the vocal cords.
- Complications of rapid sequence intubation – these were the adverse events that resulted directly from the procedure of rapid sequence intubation. They were derived from the quality assurance principles of airway management. They included:
 - Hypotension – fall in systolic blood pressure to less than 90mmHg for longer than 10 minutes.
 - Desaturation – a SpO₂ drop from >90% to <90%.
 - Oesophageal intubation – placement of the endotracheal tube into the oesophagus instead of the trachea.
 - Failed intubation – inability to place the tube into the trachea despite numerous attempts.
 - Cardiac arrest – absence of any cardio-respiratory activity

5.8 ETHICAL CONSIDERATIONS.

During the study the following ethical issues were considered:

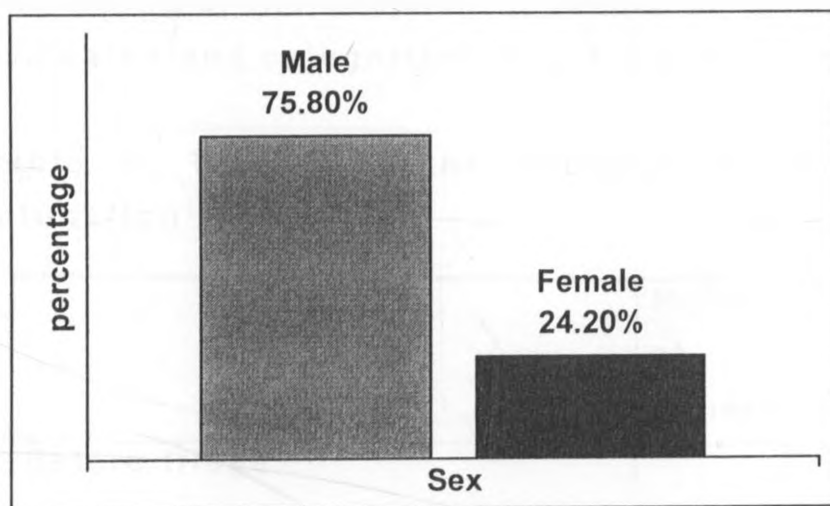
1. The nature of the study was explained to the personnel at the accident and emergency department.

2. Observational consent was obtained from the practitioners. Where possible informed consent was sought from the patient/guardian/ the next of kin, before a patient was included in this study. No names of the participants were written in forms/documents involved in the study. Study subjects were coded with numbers. This was to ensure confidentiality.
3. The study had no harmful effects to the participants. Rapid sequence intubation is actually a life-saving intervention in those patients requiring it. This study did not intend to add any additional components to the standard practice of rapid sequence intubation.
4. Although invasive procedures were involved, these formed part of the routine of rapid sequence intubation and therefore no further costs were incurred by the patient or next of kin.
5. Information obtained from the study was treated with utmost confidentiality.
6. Permission was sought from Kenyatta National Hospital ethics and research committee before commencement of the study.
7. Findings of the study will be availed to the ethics committee of Kenyatta National Hospital as well as the University of Nairobi.

6.0 RESULTS

Details of 186 rapid sequence intubations were recorded. During the period of study the investigator did not intervene during the process of endotracheal intubation for any patient. The only intervention was in the management of the complications. Therefore no data was excluded due to intervention by the investigator. 92% of the patients intubated were adults while paediatric patients accounted for 8% (i.e. 15 patients). The gender distribution of the patients was as shown below. There were a total of 141 male patients and 45 female patients.

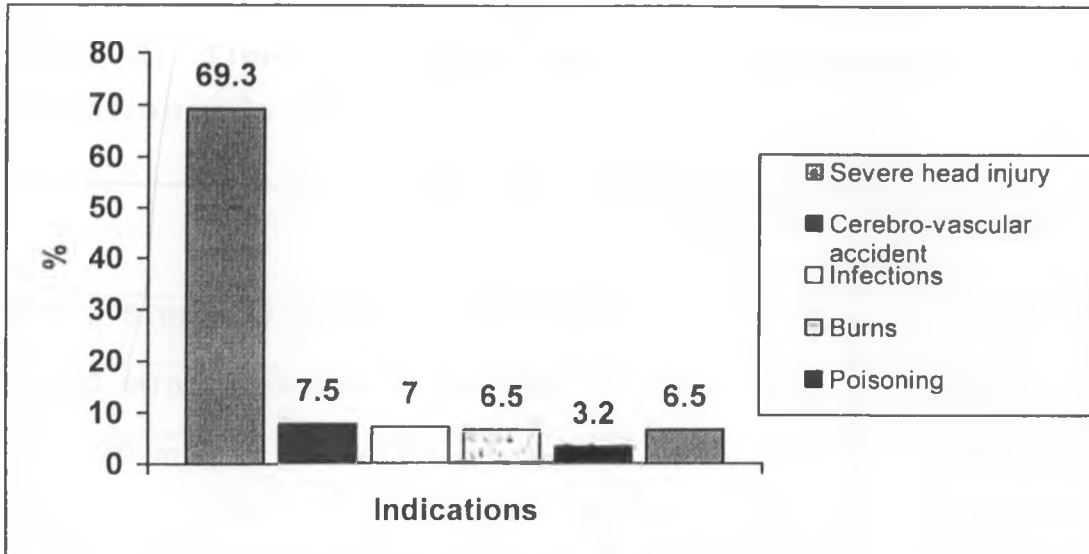
Fig. 3: Gender distribution



The conditions necessitating emergency airway intervention and hence RSI were established. They are presented in the bar graph in figure 3. The leading cause was severe head injury. Infections included meningitis, sepsis, and pneumonia. The category 'other' included diagnoses such as ARDS, DKA, coma

of undetermined cause, pulmonary oedema and tracheal injury. Poisoning was mainly due to ingestion of organophosphates.

Fig. 4: Indications for rapid sequence intubation.



The timing of the decision to secure an airway at risk was also evaluated and categorized into 3 groups as shown in table 2.

Table 2: Timing of the decision to do rapid sequence intubation

	Number of patients	Percentage (%)
Before triage	3	1.6
After triage but before detailed medical evaluation	115	61.8
After detailed medical evaluation	68	36.6
Total	186	100.0

The time at which the rapid sequence intubation practitioner was contacted, after the decision to intubate was made, was recorded as shown below.

Table 3: Time at which the rapid sequence intubation practitioner is contacted.

	Frequency	Percentage (%)
Within 5 min of patient's arrival	7	3.8
5 – 20 min of patient's arrival	90	48.4
After 20 min of patient's arrival	89	47.8
Total	186	100.0

The intubations carried out by different specialties were as shown in table 4. The anaesthetic practitioners were the senior house officers in anaesthesia department. The non-anaesthetic group mainly included the nurses in at the accident and emergency department with background training in rapid sequence intubation. These nurses had training in either critical care nursing or emergency nursing. The arrival times of the practitioners to the patient, after being contacted, are also included in the table. The arrival times were categorized into 3 groups, viz, within 5 minutes of patient's arrival, 5 to 20 minutes of patient's arrival and after 20 minutes of patient's arrival.

Table 4: Specialty and the arrival times for rapid sequence intubation practitioners.

Specialty of the practitioner	Arrival of RSI practitioner			TOTAL
	Within 5min	5 – 10min	After 10min	
Anaesthetic	3	61	94	158
Non-anaesthetic	24	3	1	28
TOTAL	27	64	95	186

In 55.9% of the intubations done in this study no trained RSI assistant was available.

The Equipment

A working suction machine, electrocardiogram monitor, pulse oximeter, and a bag-valve-mask were available for all patients. There were no paediatric blood pressure measuring cuffs, but the adult ones were available. The availability of other necessary equipment, as a percentage of the intubations, is as represented in table 5.

Table 5: Availability of equipment.

	Percentage of the intubations where the equipment was available
Endotracheal tubes in different sizes	94%
Oropharyngeal airways in various sizes	54.8%
Laryngoscope handles and blades in various sizes in good working condition	26.1%
Adjuncts for difficult airway	15.1%

The only adjunct for difficult airway intubation in the 15.1% of intubations was the intubating stylet. For the rest of the intubations no adjuncts were available.

The Preparation

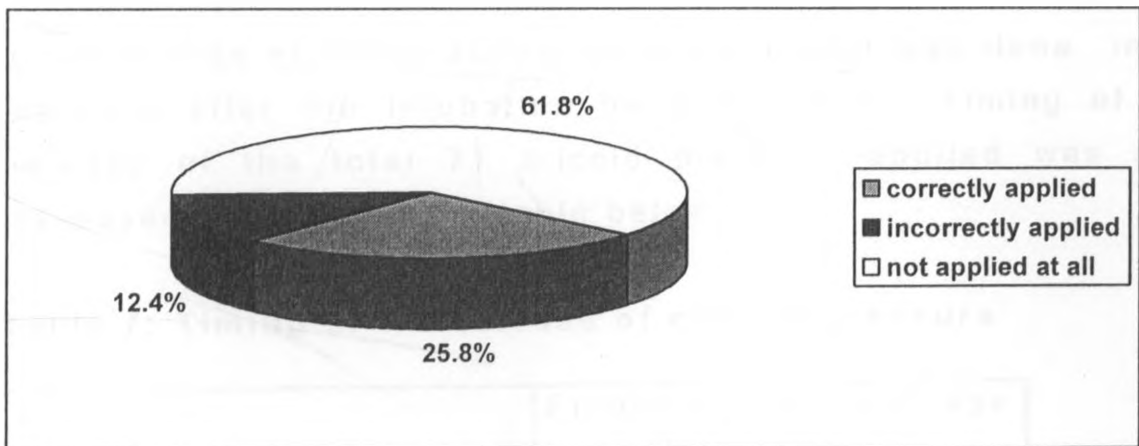
All the patients to be intubated were on monitors. All adult patients had their pulse oximetry, blood pressure, pulse rate and electrocardiography monitored. In all paediatric patients, blood pressure was not monitored. All rapid sequence intubation practitioners did an airway and total patient evaluation before progressing to rapid sequence intubation. All patients had an access vein cannulated and were properly positioned for intubation. In 76.6% of adult intubations, the endotracheal tube cuff was not checked with a syringe before

intubation. All paediatric intubations were with uncuffed endotracheal tubes. Drugs to be used were drawn up and labelled for all patients. Midazolam was used for sedation, while succinylcholine was the muscle relaxants used for patients in this study.

The Process

Preoxygenation was done for all patients. Drugs were administered in the right sequence by all the practitioners. In 25 intubations the suction apparatus was not assembled. The technique of cricoid pressure application was assessed and the results are as represented in the pie chart below.

Fig 5: Pie chart showing the application of cricoid pressure.



Success of intubation after attempts at intubation by different specialties of rapid sequence intubation practitioners was per table 6 below. Success rate at first attempt was 91.4% (95.6%

for anaesthetic group and 67.8% for the non-anaesthetic group)

Table 6: Attempts at intubation.

Intubation attempts Specialty	1 attempt	2 attempts	More than 2 attempts	TOTAL
Anaesthetic	151	6	1	158
Non-anaesthetic	19	8	1	28
TOTAL	170	14	2	186

Endotracheal intubation was successful in all patients in this study. Success rate at first attempt was 91.4%

Confirmation of endotracheal tube placement was done in all patients after the intubation by auscultation. Timing of the release of the total 71 cricoid pressure applied was also assessed and was as the table below.

Table 7: Timing of the release of cricoid pressure

	Frequency	Percent age (%)
Before inflation of the cuff	36	50.7
After inflation of the cuff	35	49.3
Total	71	100

149 of the patients in this study were commenced on mechanical ventilation while 37 were put on spontaneous ventilation via T-piece system.

Only 2 types of complications were encountered in this evaluation, i.e. hypotension and desaturation. The overall complication rate was 20.4%. Table 8 chart below shows the representation of the complications.

Table 8: Complications

	Number of patients	Percentage (%)
Desaturation	14	37.8
Hypotension	23	62.2
Total	38	100.0

Comparison of complications with the specialty of the intubator was recorded and is presented in table 9 below.

Table 9: Complications as per specialties

Complications Specialty of Practitioner	Complications			TOTAL
	None	Desat- uration	Hypote- nsion	
Anaesthetic	132	10	17	159
Non-anaesthetic	17	4	6	27
TOTAL	149	14	23	186

There was no statistical difference between the two groups as per Bartlett's Chi square ($p = 0.35$). Timing of the decision to do the rapid sequence intubation had no influence on the complications. Arrival time of the rapid sequence intubation practitioner and complications was compared (Chi square). There was no statistical difference between the different arrival times ($p = 0.13$).

7.0 DISCUSSION

Rapid sequence intubation is the keystone in emergency airway management. The accident and emergency department of KNH mainly attends to the adult outpatient population and paediatric trauma patients. The bulk of the paediatric outpatient population is attended to at the paediatric filter clinic, which is a different department. This explains the high number of adult intubations in this study. The general intubation rate at the accident and emergency department of KNH is approximately 0.6%. This compares with the rates elsewhere.

As in other comparative studies, male gender had the highest intubation rates in this study. Trauma with severe head injury was leading condition necessitating rapid sequence intubation. Severe head injury, cerebro-vascular accident, intracranial infections, DKA and poisoning cause a reduction in the level of conscious commonly assessed by Glasgow coma scale (GCS). Patients with a score less than 8 are at risk of aspiration as the protective airway reflexes may be absent. Therefore, low GCS score was the leading indication for rapid sequence intubation at accident and emergency department of KNH. This was also evident in similar studies in U.S, Britain and South Africa.^{38,42} Respiratory failure as an indication for rapid sequence intubation occurred in pneumonia, pulmonary tuberculosis ARDS, and pulmonary oedema. The aim was to optimize respiratory function via mechanical ventilation. The reason for airway intervention in burns was where inhalational injury was suspected. Therefore, the indication for rapid sequence intubation was prophylactic airway protection

against airway oedema and subsequent obstruction, which is possible for up to 48 hours post-injury.

The timing of the decision to perform rapid sequence intubation reflects the level of urgency at which the decision-maker attaches to the need of securing an airway at risk.⁵ In some cases, the decision to intubate was made after a detailed medical evaluation. Most of patients who had cerebro-vascular accident fell in this group. Detailed medical evaluation entailed complete clinical evaluation plus the baseline laboratory and imaging work-up, and necessary consultations from different specialties. This introduced delay that could worsen the general condition of the patient and the eventual outcome.^{5,42} The response of the rapid sequence intubation practitioner upon being summoned by the accident and emergency department personnel was quicker with the non-anaesthetic group. This can be attributed to the fact that this group were accident and emergency department staff and were stationed there. The anaesthetic groups' slower response could be attributed to the fact that their involvement was on consultation basis and this of course introduced a delay factor. This was also evident in other centres where the anaesthesia department was involved in emergency department intubations.⁵

Emergency endotracheal intubation is a high risk procedure.^{10,19,26,36} The patients are unprepared and are considered to have full stomachs and may have volume and electrolyte abnormalities.^{10,12} This predisposes the patients to complications including cardiac arrest. In this study the correct procedure was followed except in 13.4% of patients

where suction apparatus were not assembled beforehand. A working suction apparatus is paramount as the oral cavity of the patient may have debris and secretion that would need clearing first before laryngoscopy for better view and/or ventilation. Of much importance, the suction is needed should regurgitation or vomiting occur in a patient with no airway reflexes e.g. unconscious patient or a deeply sedated patient.

In rapid sequence intubation, cricoid pressure is a key component. If done correctly it is supposed to guard against aspiration once consciousness is lost. Aspiration itself is a rare occurrence, even in the pioneering series by Mendelson. The rapid sequence intubation practitioner assistants should be well versed in the correct technique of this manoeuvre. Incorrect application of the cricoid pressure was seen in about half of intubations where it was applied. Training on the correct technique has successfully been done elsewhere using dummies.³⁰ It has been argued that cricoid pressure may make laryngoscopic view difficult. This was not encountered in this study. The release of the cricoid pressure should be done at the end of the intubation once the cuff has been inflated and the tube placement confirmed. This was not the case in 50.7% of the intubations evaluated where cricoid pressure was applied albeit correctly or incorrectly.

In this survey, success of intubation at first attempt was high for the two groups. This reflects the adequacy of training of the rapid sequence intubation practitioners at KNH. Multiple intubation attempts result from inexperience, improper positioning, blade-light malfunction, secretions, damaged cuff and oesophageal intubations.^{2,14,29}

Preparedness for a difficult airway should be the norm in all accident and emergency departments where RSI is practiced.^{34,35,36,41} This entails having the necessary equipment and skill.^{31,41} There should be a variety of oropharyngeal airways, tracheal tubes, laryngoscope blades and handles, and adjuncts to difficult intubation. These equipments were generally lacking during the period of this study. Prediction of a difficult airway can be straight forward but an unexpected difficult airway should always be anticipated in an otherwise seemingly 'easy' airway. It should also be noted that screening tests for difficult airway (Mallampati scoring, neck mobility testing, and thyromental distance) maybe of limited usability in the accident and emergency department.^{15,34,35} Adjuncts to difficult intubation include fiberoptic laryngoscope, laryngeal mask airway, combitube and intubating stylet. These should be readily available, more so at the emergency departments. At the accident and emergency department of KNH, the preparedness for such an eventuality is deficient.

The complications of rapid sequence intubation include hypotension, desaturation, aspiration, failed intubation, oesophageal intubation, and even cardiac arrest.^{26,27,28} In this study only incidences of hypotension and desaturation were witnessed. No cases of aspiration were witnessed even in cases where cricoid pressure was incorrectly applied or not applied at all. This does not rule out the usefulness of cricoid pressure as aspiration is a rare event and a larger sample size is required to evaluate this. The hypotension in this series could be attributed to the sedating drug (midazolam).

Interventions such as the use of diuretics in the management of head injury could have been a contributing factor to hypotension, though this was not measured in this study.³⁹ Desaturation could have been attributed to reduced respiratory reserve as pre-oxygenation was adequately done in all patients. The exact cause of desaturation could not be accurately determined in this survey. The disease process, especially in patients who had conditions leading to respiratory failure, probably was a major contributor to desaturation. In terms of the specialty of the rapid sequence intubation practitioner, there was no statically significant difference in the complication rates between the two groups. This implies that non-anaesthesiology specialties, with adequate training, can safely undertake rapid sequence intubation.^{25,31,32,33,40} A larger sample size is definitely required to satisfactorily evaluate the complications of rapid sequence intubation.

The post-intubation management depended mainly on the indication of the intubation. Patients with low GCS and respiratory failure were commenced on mechanical ventilation. This also formed part and parcel of the management of the underlying condition, e.g. control of arterial carbon dioxide tension in severe head injury with elevated intracranial pressure. These patients were expected to remain intubated for some time. Patients put on spontaneous ventilation were mainly burns patients who were basically fully conscious and required intubation for a short period.

8.0. CONCLUSIONS.

- The technique of RSI fairly well executed at A/E of KNH except for the application and release of cricoid pressure. The success of intubation on first attempt was high.
- Severe head injury was the leading cause of emergency tracheal intubation.
- There was a delay factor in decision-making and implementation of RSI.
- Some important equipment was lacking and there was general unpreparedness for difficult intubation.
- The complication rate was 20.4%. Desaturation and hypotension were the only complications encountered in this study.

9.0 RECOMMENDATIONS

1. There is need to train more non-anaesthesiologist medical staff, especially those resident at the accident and emergency department on emergency airway management.
2. A variety of laryngoscope blades and handles, oropharyngeal airways and endotracheal tubes should be available at all times.
3. Establishment of difficult airway trolleys with selected alternative airway adjuncts/devices. These may include intubating stylets, laryngeal airway mask, combitube, and fiberoptic bronchoscope
4. Development of airway assessment and management protocol for the department.³⁷
5. A larger study is required to fully evaluate the complications of rapid sequence intubation at the accident and emergency department of KNH.

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APPENDIX 1: INFORMED CONSENT EXPLANATION AND FORM.

THIS IS TO BE READ TO THE PATIENT (AND/OR THE CARETAKER) ANY QUESTION ANSWERED.

THE LANGUAGE WELL UNDERSTOOD BY THE PATIENT AND/OR THE CARETAKER SHALL BE USED.

TITLE: A survey of rapid sequence intubation at the accident and emergency department, Kenyatta National Hospital.

Institution: Department of Surgery, University of Nairobi.

Investigator: Dr. Timothy Murithi Mwiti

Supervisor: Dr. P.O.R Olang'

Explanation:

Permission is requested from you for enrolment in a medical research study.

You should understand the following general principles, which apply to all participants in medical research whether normal or patient volunteers.

1. Your decision to enroll in the study is entirely voluntary.
2. You may withdraw from the study at any time.
3. Refusal to participate will invoke no penalties or loss of benefits to which you are otherwise entitled.
4. Feel free to ask any questions regarding the study or your participation.

The purpose of this study is primarily to assess the practice of securing the airway at risk, at the accident and emergency department of Kenyatta National Hospital, by endotracheal intubation. The aim is to suggest any corrective measures.

Absolute confidentiality regarding participation is ensured. No names will be used in any documents. All information obtained will be treated with utmost confidentiality.

INFORMED CONSENT FORM

I _____ (patient/caretaker) do agree to take part in this study as explained to me by _____. My participation is out of my own will and not due to the benefits I may or may not gain from the study.

Participant's signature _____ Date _____

I, the investigator, have fully explained to the participant about the study and its purpose, and I have not withheld any information regarding the study. I have also assured the participant of the confidentiality of the information to be obtained. I have assured the participant of his/her right to withdraw from the research at any time.

Investigator's signature _____ Date _____

APPENDIX 2: SURVEY TOOL.

DATE:
TIME:
TOOL NUMBER:

THE PATIENT:

- AGE
- SEX:
- INDICATION FOR RSI:

TIMING OF THE DECISION TO A RSI:

1. BEFORE TRIAGE
2. AFTER THE TRIAGE BUT BEFORE A DETAILED MEDICAL EVALUATION
3. AFTER A DETAILED MEDICAL EVALUATION

TIME AT WHICH THE RSI PRACTITIONER IS CONTACTED:

1. WITHIN 5 min OF PATIENTS ARRIVAL
2. 5 – 20 min OF PATIENTS ARRIVAL
3. AFTER 20 min OF PATIENTS ARRIVAL

SPECIALITY OF THE RSI PRACTITIONER

1. ANAESTHETIC
2. NON-ANAESTHETIC

ARRIVAL OF THE RSI PRACTITIONER TO THE A/ED DEPARTMENT

1. WITHIN 5 min
2. IN 5 – 10 min
3. AFTER 10 min

AVAILABILITY OF A TRAINED RSI PRACTITIONER ASSISTANT

1. YES
2. NO

THE EQUIPMENT

- I. A WORKING SUCTION MACHINE WITHIN EASY REACH.
 1. YES
 2. NO
- II. BAG – VALVE MASK
 1. YES
 2. NO

- III. PULSE OXIMETER PROBE
 - 1. YES
 - 2. NO
- IV. NON-INVASIVE BLOOD PRESSURE MONITOR
 - 1. YES
 - 2. NO
- V. ENDOTRACHEAL TUBES IN VARIOUS SIZES.
 - 1. YES
 - 2. NO
- VI. OROPHARYNGEAL AIRWAY IN VARIOUS SIZES
 - 1. YES
 - 2. NO
- VII. LARYNGOSCOPE HANDLE AND BLADES OF VARIOUS SIZES IN GOOD WORKING CONDITION
 - 1. YES
 - 2. NO
- VIII. ADJUNCTS FOR DIFFICULT AIRWAY INTUBATION AVAILABLE
 - 1. YES
 - 2. NO

THE PREPARATION

- I. PATIENT ON MONITORS
 - 1. YES
 - 2. NO
- II. ENDOTRACHEAL TUBE CUFF CHECKED WITH A SYRINGE
 - 1. YES
 - 2. NO
- III. DRUGS DRAWN UP AND LABELLED
 - 1. YES
 - 2. NO
- IV. EVALUATION OF THE PATIENT DONE
 - 1. YES
 - 2. NO
- V. EVALUATION OF THE AIRWAY DONE
 - 1. YES
 - 2. NO
- VI. ACCESS VEIN CANNULATED
 - 1. YES
 - 2. NO
- VII. PATIENT PROPERLY POSITIONED

1. YES
2. NO

THE PROCESS

- I. SUCTION APPARATUS CONNECTED TO THE MACHINE
 1. YES
 2. NO
- II. PRE-OXYGENATION DONE
 1. YES
 2. NO
- III. PRE-INTUBATION VITAL PARAMETERS (GIVE THE ACTUAL FIGURES)
 1. SPO₂
 2. BP
 3. PULSE RATE
- IV. DRUGS ADMINISTERED IN THE RIGHT SEQUENCE
 1. YES
 2. NO
- V. CRICOID PRESSURE CORRECTLY APPLIED
 1. YES
 2. NO
- VI. ATTEMPTS AT INTUBATION
 1. ONE
 2. TWO
 3. MORE THAN TWO
- VII. POSITION OF THE ENDOTRACHEAL TUBE PLACEMENT CONFIRMED
 1. YES
 2. NO
- VIII. TIMING OF THE RELEASE OF CRICOID PRESSURE
 1. BEFORE INFLATION OF THE ENDOTRACHEAL TUBE CUFF
 2. AFTER INFLATION OF THE ENDOTRACHEAL TUBE CUFF
- IX. POST-INTUBATION VITAL PARAMETERS (GIVE THE ACTUAL FIGURES)
 1. SPO₂
 2. BP
 3. PULSE RATE
- X. POST-INTUBATION MANAGEMENT
 1. MECHANICAL VENTILATION
 2. SPONTANEOUS VENTILATION VIA T-PIECE
- XI. COMPLICATIONS
 1. FAILED INTUBATION
 2. EOSOPHAGEAL INTUBATION

3. DESATURATION
4. HYPOTENSION
5. ASPIRATION
6. CARDIAC ARREST

APPENDIX 3: APPROVAL LETTER.



Ref: KNH-ERC/01/68

Dr. Timothy Munthi Mwiti
Dept. of Surgery
School of Medicine
University of Nairobi

KENYATTA NATIONAL HOSPITAL
Hospital Rd. along Ngong Rd.
P.O. Box 20729, Nairobi
Tel: 726303-9
Fax: 725272
Telegrams: MEDSUP, Nairobi
Email: KNHplan@Ken.Healtnet.org
22nd January 2008

Dear Dr. Munthi

RESEARCH PROPOSAL: "A SURVEY OF RAPID SEQUENCE INTUBATION AT THE ACCIDENT AND EMERGENCY DEPARTMENT, K.N.H" (P264/9/2007)

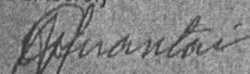
This is to inform you that the Kenyatta National Hospital Ethics and Research Committee has reviewed and **approved** your revised research proposal for the period 22nd January 2008 – 21st January 2009.

You will be required to request for a renewal of the approval if you intend to continue with the study beyond the deadline given. Clearance for export of biological specimen must also be obtained from KNH-ERC for each batch.

On behalf of the Committee, I wish you fruitful research and look forward to receiving a summary of the research findings upon completion of the study.

This information will form part of database that will be consulted in future when processing related research study so as to minimize chances of study duplication.

Yours sincerely


PROF. A. N. GUANTAI
SECRETARY, KNH-ERC

c.c. Prof. K.M. Bhatt, Chairperson, KNH-ERC
The Deputy Director CS, KNH
The Dean, School of Medicine, UON
The Chairman, Dept. of Surgery, UON
Supervisor: Dr. P.O. R. Olang, Dept. of Surgery, UON