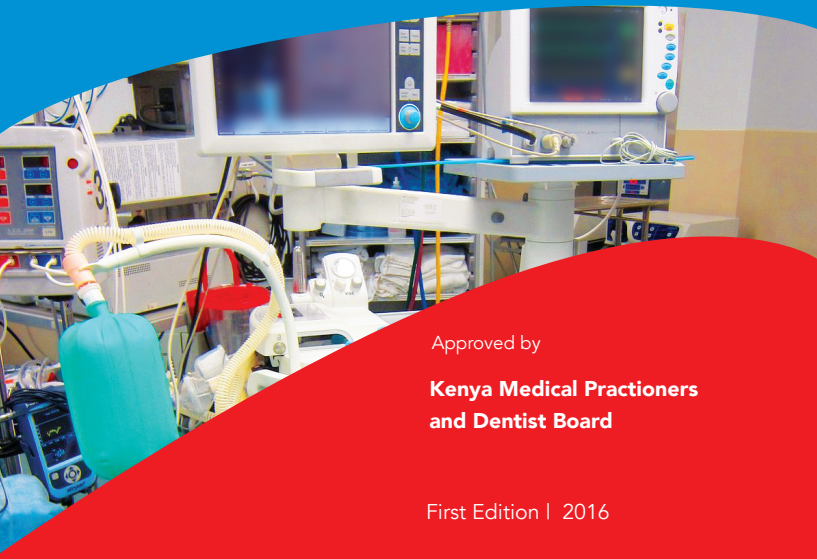
Republic of Kenya
Ministry of Health

National Anaesthesia Guidelines



Approved by

Kenya Medical Practioners and Dentist Board

First Edition | 2016

National Anaesthesia Guidelines

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Ensuring Quality Healthcare

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Foreword

These guidelines are aimed to assist and guide all anaesthetists who have received at least basic training in anaesthesia. It is not our aim to teach you how to give an anaesthetic, but to help you decide as to what best to do in different situations. The Kenya Society of Anaesthesiologists have, in conjunction with the Medical Practitioners & Dentists Board and the Ministry of Health, Government of Kenya, decided to circulate all the guidelines as one booklet. This makes it easier for the reader and the user to refer to any guideline without any difficulty. For easy reading, these booklet has been split into various sections, thus making it more accessible for urgent reference.

It is the aim and desire of the Kenya Society of Anaesthesiologists to organize and provide continuous training to all cadres of anaesthetists, both, by practical training and through these guidelines. This will help us ensure that the same standards of quality and service are available across the board and thus no patient shall get a substandard anaesthetic.

A lot of effort, dedication and hard work has gone into preparing these guidelines and it has been a daunting task for the various teams that were involved in preparing these guidelines. However, they have done a superb job and have come out with very well researched and documented material.

The Kenya Society of Anaesthesiologists strongly recommends further reading and consultation should the reader have any queries. This will help optimize the outcome of our patients and also encourage us to strive to do better every day.

We are also keen to receive comments about these guidelines. After all, it's deficiencies are as important as any positive feedback. Should there be any comments or queries, kindly contact the Kenya Society of Anaesthesiologists for further discussion.

Dr. Madhú Patel

Chairman - Kenya Society of Anaesthesiologist

Acknowledgment

The Kenya Medical Practitioners and Dentists Board wishes to thank the following for their role in coming up with these guidelines:

Kenya Society of Anaesthesiologists for taking the lead in developing these guidelines (Prof. Zipporah Ngumi, Dr. Caroline Njoki, Dr. Charles Kabetu, Dr. David Nekyon, Dr. Ednah Gisore, Dr. George Njogu, Dr. Jacquline Andhoga, Dr. Jane Gwaro, Dr. Karen Mbaya, Dr. Kibet Bhoyyo, Dr. Lee Ngugi, Dr. Patrick Olang', Dr. Samina Mir, Dr. Speciosa Mbula, Dr. Stephen Okelo, Dr. Thomas Chokwe and Dr. Wangari Siika).

The Ministry of Health for their policy support in developing and facilitating inclusion of this as part of the national guidelines towards offering quality health to Kenyans.

Anaesthesia practitioners (Anaesthesiologists, Registered Clinical Officer Anaesthetists and Nurse Anaesthetists) across the country who contributed directly or indirectly in making this possible.

It is our hope that this and subsequent guidelines serve as a gauge upon which anaesthetic care can be based in Kenya. This should apply to all and any site where anaesthesia is provided.

Prof. George A. O. Magoha, EBS.MBS
Chairman - Medical Practitioners and Dentists Board

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Recommendations on Minimum Facilities For Safe Administration of Anaesthesia in Operating Suites and Other Anaesthetizing Locations

This document is intended to apply wherever anaesthesia is administered. This document has been prepared having regard to general circumstances, and it is the responsibility of the practitioner to have express regard to the particular circumstances of each case, and the application of this document in each case.

1. Principles Of Anaesthesia Care

1.1 The provision of safe anaesthesia in hospitals requires appropriate staff, facilities and equipment. These are specified in this Document.

1.2 Anaesthesia should be administered only by medical practitioners with appropriate training in anaesthesia or by trainees under appropriate supervision as per their level of training.

1.3 Every patient presenting for anaesthesia should have a pre-anaesthetic consultation by a Medical Practitioner who has appropriate training in anaesthesia.

1.4 Appropriate monitoring of physiological and other variables must occur during anaesthesia. These include Non Invasive Blood Pressure monitoring every 5 minutes or more frequently according to the physiological status of the patient; continuous monitoring of oxygen saturation, Heart rate and ECG. A means of measuring temperature; End tidal carbon dioxide if under general anaesthesia is Desirable.

2. Staffing

2.1 Each facility must designate:

2.1.1 One or more anaesthesiologists to advice on the choice and maintenance of anaesthesia equipment.

2.1.2 One or more of its staff to be responsible for the organization of cleaning, maintenance and servicing of anaesthesia equipment.

2.2 In addition to the nursing or other professional staff required by those carrying out the operative procedure, there must be:

2.2.1 An assistant for the anaesthetist. The anesthesia professional should ensure that assistance is available as needed and that the assistant is competent at, or has been instructed in the necessary tasks namely;

- assist the anaesthetist in the preparation of the operating room and patients for anaesthesia, and operative or diagnostic procedures.
- assist the anaesthetist with intraoperative monitoring and care of patients.
- assist with the transfer to PACU.
- To function as part of the multidisciplinary team in the operating department

2.2.2 Adequate assistance for positioning the patient.

2.2.3 Adequate technical assistance to ensure proper functioning and servicing of all equipment used.

2.3 All staff in clinical contact with patients must be appropriately trained in resuscitation skills.

3. Anaesthesia Equipment

Essential requirements are listed below. Where a range of equipment is recommended, the facility is expected to provide the type most suitable for its needs.

3.1 In each location where general anaesthesia is to be performed, there must be;

3.1.1 An Anaesthesia Delivery System:

- Each anaesthesia machine must comply with minimum safety requirements as specified in KSA recommendation on anaesthetic machine a user manuals should be readily available .
- The machine must be in good working condition.
- Breathing systems and accessories suitable for paediatric use when necessary.
- A range of suitable breathing systems with appropriate measures to ensure the sterility of breathing gases supplied to each patient.

3.1.2 A manual bag valve/self inflating resuscitation bag must be provided. The size of the bag and its attachments must be appropriate for patients being anaesthetized at that location. Its oxygen supply must be independent of the anaesthesia delivery system.

3.1.3 Suction apparatus must be available for the use of the anaesthetist at all times together with appropriate suction catheters. Provision must be made for an

alternative suction system in the event of primary suction failure.

3.1.4 Appropriate protection for the anaesthesia team against biological contaminants. This must include gowns, disposable gloves, masks and eye shields.

3.1.5 A stethoscope.

3.1.6 A sphygmomanometer.

3.1.7 Monitoring equipment complying with Recommendations on Monitoring During Anaesthesia. These must include; pulse oximeter, non-invasive blood pressure monitor (with appropriately sized cuffs), electrocardiograph and temperature.

3.1.8 Appropriate airway management instruments and accessories, these include

- An appropriate range of face masks.
- An appropriate range of oropharyngeal airways. where necessary, nasopharyngeal, laryngeal mask and other artificial airways should be available.
- One laryngoscopes set per theater with a range of suitable blades.
- An appropriate range of endotracheal tubes and connectors.
- Endotracheal cuff inflating syringe.
- Magill's forceps and throat packs.
- A suitable range of adhesive and other tapes for securing the tubes.

- Scissors.
- Sterile lubricant suitable for use with airway devices.
- Accessories to warm and/or humidify respiratory gases during anaesthesia (HME).

3.1.9 Appropriate accessories for circulation management, these include;

- Tourniquets for use during IV insertion.
- Intravenous infusion supplies with an appropriate range of cannulae and solutions.
- A suitable range of adhesive and other tapes for securing the IV line.

3.1.10 Means for the safe disposal of items contaminated with biological fluids, "sharps" and waste glass.

3.1.11 Appropriate lighting for the clinical observation of patients

3.1.12 Emergency lighting and alternative electric power supply.

3.1.13 Mechanisms for Routines for Checking, Cleaning and Servicing Equipment. This should include;

- Regular sterilizing, cleaning and housekeeping routines for the care of equipment should be established.
- Documented servicing of the anaesthesia delivery system and medical gas equipment by an appropriate organization must be carried out at intervals recommended by the manufacturer. In the absence of a manufacturer's recommendation

on servicing intervals, servicing must be carried out atleast once a year. After any maintenance or modification to the gas distribution system, tests of gas flow, pressure and identification must be carried out and documented according to current national standards prior to use.

3.1.14 An operating table with Trendelenburg position control at the head of the table.

3.1.15 Intravenous fluid infusion pole.

3.1.16 A copy of Protocol for Checking the Anaesthesia Machine or a similar document should be available on each anaesthesia delivery system.

Level 5 and 6 should also have

- Infusion devices designed for controlled delivery of intravenous drugs when required
- Capnography
- Volatile agents / gas analyzer

3.2 In every anaesthetizing location there must be readily available:

3.2.1 Equipment for managing difficult intubations in all locations where endotracheal intubation is electively performed. - A range of endotracheal tube introducers and bougies.

3.2.2 Equipment for the rapid infusion of fluids.

3.2.3 A cardiac defibrillator with capacity for synchronized cardioversion.

3.2.4 Interpleural drainage sets including appropriate underwater seal drainage equipment or one way valves.

3.2.5 Equipment to cool patients in the event of inappropriate increases in body temperature.

3.2.6 When appropriate, having regard to the procedures being undertaken, equipment to minimise patient heat loss including insulating sheets, forced air warming devices, mattress warmers and intravenous fluid warmers.

3.2.7 Instruments required for sub-arachnoid, epidural or regional nerve blocks, when appropriate.

3.2.8 Equipment to ensure safe positioning for patients during procedures.

3.2.9 Telephone/Intercom to communicate with persons outside the anaesthetizing location including an "anaesthesia emergency" call system.

3.2.10 Refrigeration facilities for the storage of fluids, drugs and biological products.

3.2.11 The means to maintain room temperature at range of 18 - 28^{o}C in the anaesthetizing room.

3.2.12 Patient transfer trolleys/beds.

3.2.13 Devices such as rollers or patient slides to assist with transfer of patients in a manner safe for patients and staff.

3.2.14 A minimum of three people to assist with transfer of the patient when required, with the anaesthetist having prime responsibility for the patient's airway, head and neck.

3.2.15 Guidelines for the management of rare emergencies associated with anaesthesia e.g Malignant Hyperthermia, Anaphylaxis, Peri-arrest arrhythmias must be displayed prominently in the anaesthetizing locations.

4. Drugs/Oxygen

4.1 In addition to the drugs and agents commonly used in anaesthesia, drugs necessary for the management of the following conditions (which may complicate or co-exist with anaesthesia) must also be available. Such conditions include:

- Anaphylaxis
- Adrenal dysfunction
- Bronchospasm
- Cardiac arrest
- Cardiac arrhythmias
- Coagulopathies
- Hypoglycaemia
- Hypotension
- Hyperglycaemia
- Hypertension
- Malignant hyperthermia
- Pulmonary oedema
- Raised intracranial pressure
- Respiratory depression
- Uterine atony (where relevant)
- Local anaesthesia toxicity

4.2 Appropriate mechanisms must exist for the regular replacement of all drugs and drug administration equipment after use or when their expiry date has been reached.

4.3 A few packs of normal saline stored in the fridge and ice packs should be available to cool a patient in case of hyperthermic states. Where possible, it is desirable to have an initial supply of dantrolene sufficient for commencing the treatment of a suspected case of malignant hyperpyrexia. The minimum supply is twenty-four 20mg ampoules of dantrolene. Additional doses must be readily available on request.

4.4 Oxygen Sources

4.4.1 If a hospital produces oxygen on a large scale for piping/ storing in cylinders for its use, high concentration oxygen supply must be guaranteed at all times by regular inspection and maintenance programs as per the manufacturer.

4.4.2 Oxygen plants, as well as commercial oxygen sources should produce oxygen concentration of above 99%. If using an oxygen generator or concentrator, then the generated oxygen concentration should be no less than 90% at any one time.An index of the efficiency of operation should be stated in number of litres of oxygen of >90% concentration. The frequency of specified maintenance activities must be also be stated. The oxygen concentrators should be in keeping with ISO standards (ISO 10083:2006)

4.4.3 Oxygen supplies to critical care areas (theatres and intensive care units) should never supply oxygen concentrations below 90% at any one time. Backup oxygen cylinders must always be available at points of care even where piped oxygen is in use.

5. Recovery Room /Post Anaesthesia Care Unit (PACU)

5.1 Structure

5.1.1 It should be located close to the operating suite to permit anaesthesiologists and surgeons to be nearby and allow rapid return of the patient to the operating room if necessary. It is also useful to have the recovery room located near to the ICU.

5.1.2 The size of the recovery room is determined by the surgical caseload of the institution. The number of bed/trolley spaces must be sufficient for expected peak loads and there should be not less than 1.5 bed spaces per operating room. The space allocated per bed/trolley should be 9 to 12 square metres with easy access to the head of the patient.

5.1.3 It should have large doors, adequate lighting, and sufficient electrical socket points and water point /sink.

5.1.4 There should be a central nursing station as well as space for storage of equipment and drugs room. An open ward is optimal for patient observation; however, at least one isolation room is a helpful addition to every PACU for the management of patients with either contaminated wounds or severe immunosuppression.

5.2 Facilities

5.2.1 Each bed space must be provided with a monitor (NIBP, ECG, SPO2, temperature), an oxygen source, two general power outlets, adequate lighting.

5.2.2 There should be a wall clock with a sweep second hand or digital equivalent clearly visible from each bed space.

5.2.3 Communication facilities- An emergency call system and a telephone.

5.2.4 Within the recovery room there must be stethoscope, suction machine a range of devices for the administration of oxygen to spontaneously breathing patients.

5.2.5 A self-inflating manual resuscitator e.g. Ambu bag in order to deliver an oxygen enriched mixture for inflating the lungs.

5.2.6 Equipment and drugs for airway management and endotracheal intubation as well as various sized oral and nasopharyngeal airways must be present.

5.2.7 A well-stocked emergency difficult airway trolley in recovery is useful.

5.2.8 Emergency drugs, a range of intravenous equipment and fluids and drugs for acute pain management should be on hand. Syringes and needles of varying sizes must also be stocked.

5.2.9 Patient warming devices.

5.2.10 There should be immediate access to a monitoring defibrillator preferably with pacing facility, a refrigerator for drugs and blood and a procedure light.

5.2.11 A surgical tray for procedures including tracheostomy and chest drains as well as point of care access to diagnostic services e.g. blood glucose, blood gas and portable XRAY.

5.2.12 The recovery trolley/bed must have a firm base and mattress and must tilt from either end - both head up and head down - to at least 15 degrees and is easy to manoeuvre with functional and accessible brakes. It must also provide for sitting the patient up and have straps or side-rails which must be able to be dropped below the base or be easily removed. The trolley/bed must also have a pole from which intravenous solutions may be suspended.

5.3 Staffing

5.3.1 It is the responsibility of the institution to ensure that the staff appointed to the recovery room is trained and competent. The recovery staff must be available at all times.

5.3.2 A nurse trained and competent in recovery room care must be present at all times. An appropriately trained registered nurse experienced and competent recovery room work should be in charge.

5.4 Monitoring

5.4.1 The patient shall be observed and monitored by methods appropriate to the patient's medical condition. Particular attention should be given to monitoring oxygenation, ventilation, circulation and temperature.

5.4.2 Observations should be recorded at appropriate intervals and should include at least, state of consciousness, colour, respiratory rate, oxygen saturation, pulse and blood pressure and level of pain.

5.4.3 The record should form part of the patient's clinical notes. All patients should remain until the anaesthesiologist considers it safe to discharge them from the recovery room, according to validated criteria, which includes the return of protective airway reflexes, stable cardiovascular and respiratory function, full reversal of neuromuscular blockade, absence of nausea and vomiting and absence of pain. Use of anappropriate PACU scoring system is encouraged for each patient on admission, at appropriate intervals prior to discharge and at the time of discharge

5.4.4 The anaesthesia care provider is responsible for accompanying the patient to the recovery room and adequately handing him/her over to the nursing staff who will document the patient's condition on arrival and subsequent course in recovery.

5.4.5 The anaesthesia care provider/member of the Anaesthesia Care Team shall remain in the PACU until the PACU nurse accepts responsibility for the nursing care of the patient, or delegates this responsibility to another anaesthesiologist or intensivist/medical officer who will supervise the recovery period and authorize the patient's discharge.

5.4.6 When discharge criteria are used, they must be approved by the Department of Anaesthesiology and the medical staff. They may vary depending on whether the patient is discharged to a hospital room, to the ICU, to a short stay ward or home. In the absence of a physician responsible

for the discharge, the PACU nurse shall determine that the patient meets the discharge criteria. The name of the physician accepting responsibility for discharge shall be noted on the record.

6. Referral

6.1 It is desirable that there should be an Intensive care unit within the facility in case of any anaesthesia related emergencies intra-operatively or during emergence. If no intensive care unit is within the facility, there should be a clear referral system in place.

Kenya Society of Anaesthesiologists Pre-Op Review Guidelines

1. Introduction

Review by an anaesthetist is important for the following reasons:

1.1 To create rapport with the patient or their parent/guardian

1.2 To understand the patient's medical history and ensure that the patient's condition has been optimised before surgery.

1.3 To prepare an anaesthetic plan suitable for the patient and the planned surgery

1.4 To obtain informed consent for the planned anaesthetic techniques

2. Guidelines

2.1 An anaesthetist, prior to surgery, shall review all patients scheduled for surgery. *In the event of a time-critical, life-threatening emergency, the anaesthetist may waive this requirement.*

2.2 In the event of life-threatening emergencies, where to insist on a review in the ward would lead to unacceptable delay and potential compromise to the patient, the anaesthetist will perform a quick assessment of the patient in theatre.

2.3 The pre-operative assessment will include review of the patient's notes, examination of the patient, and review of lab tests and relevant imaging.

2.4 Any medication the patient is on will need to be confirmed by a review of the treatment sheet. The anaesthetist will be required to decide which medication should be stopped, what will need to be substituted for something else and what medication may safely be given even while the patient is fasting.

2.5 If there are any concerns regarding a patient's fitness for anaesthesia, the anaesthetist shall document these concerns in the patient's notes and discuss the patient with the surgical team promptly.

2.6 Adult patients with co-existing medical problems will need to be reviewed and cleared by a physician or intensivists (and children by a paediatrician or paediatric intensivist), before surgery can proceed. However, the final decision as to whether or not to proceed with the anaesthetic will remain the anaesthetist's.

2.7 A thorough airway assessment shall be performed pre-operatively and findings clearly documented. Risks of dental trauma will be discussed with the patient, and clearly documented, where difficult airway, loose teeth, caps or crowns are identified.

2.8 Consent will be required for procedures such as nerve blocks or regional techniques. This will detail the risks discussed, whether common or uncommon, serious or minor.

2.9 Parental consent will also be sought where the anaesthetic plan includes the use of suppositories.

2.10 Fasting status will need to be confirmed before surgery can proceed.

2.11 Except for life-, limb-, testes- or eye-threatening emergencies, no patients with a full stomach shall receive sedation or anaesthesia.

2.12 An appropriate post-operative plan will be formulated at the pre-op visit and explained to the patient. This may include the use of PCAs, admission to ICU/HDU, invasive blood pressure monitoring, etc.

3. Pre-Op Testing

The following tests shall be performed pre-operatively on the category of patients described:

3.1 Full haemogram

All patients, at the discretion of the anaesthetist however, ASA I patients for minor surgery may safely be anaesthetised without any blood tests.

3.2 Urea and electrolytes

- All patients for intermediate or major surgery.
- Patients on medication that is likely to cause electrolyte derangements e.g diuretics, laxatives, potassium supplements, salbutamol, etc.
- Patients with cardiac, renal or liver failure.
- Very sick patients.
- Trauma patients.

3.3 Coagulation profile

- Patients on anticoagulation
- Patients with liver failure
- Patients with sepsis
- Patients with major haemorrhage
- Patients with known or suspected coagulopathy

3.4 12-lead ECG

- Diabetic patients
- Hypertensive patients
- Patients with cardiac dysfunction or previous MI

- Patients with renal failure
- Patients over the age of 40 years
- Patients with chest pain

3.5 2-D Echo

- Patients with cardiac history
- Patients with unexplained breathlessness or poor exercise tolerance
- The patient with a murmur
- Patients with abnormal ECGs
- Patients with unexplained chest pain

3.6 Chest X-ray

- Patients with acute or chronic pulmonary disease
- Patients with cardiac disease
- Patients with unexplained chest pain or breathlessness

Further testing may be requested based on the patient's condition or on the advice of the physician, paediatrician, intensivist or anaesthetist.

Recommendations on Monitoring During Anaesthesia

1. Introduction

- Monitoring of fundamental physiological variables during anaesthesia is essential.
- Clinical judgement will determine how long this monitoring should be continued following completion of anaesthesia.
- **The Health Care Facility in which the procedure is being performed is responsible for provision of equipment for anaesthesia and monitoring in good working condition on the advice of one or more designated specialist anaesthetists, and for effective maintenance of this equipment.**
- **Some or all of the recommendations in this document may need to be exceeded depending on the results of the patient assessment at the pre-anaesthesia consultation.**
- Monitoring must always be used in conjunction with careful clinical observation by the anaesthetist as there are circumstances in which equipment may not detect unfavourable clinical developments.
- **Visual and audible alarms must be appropriate and enabled at the commencement of anaesthesia by the anaesthetist.** There may be exceptional circumstances where this may not be achievable (eg. cardiopulmonary bypass surgery where the patient is rendered apnoeic and pulseless) but those alarms should be made operational as soon as practicable.
- The level of monitoring must be influenced by the nature of the surgery undertaken, and to some extent by the quality of the service offered by the institution, and the availability of maintenance and service facilities. Referral hospitals are usually in large centres and must meet higher standards.

- The recommendations are intended to encourage quality patient care, but observing them cannot guarantee any specific patient outcome.
- Presence of the anaesthetist.

2. Application

- The recommendations apply to all general anesthetics, regional anesthetics and monitored anesthesia care in emergency circumstances, appropriate life support measures take precedence.
- These recommendations may be exceeded at any time based on the judgment of the responsible anesthesiologist. In certain circumstances, some of these methods of monitoring may be clinically impractical, or brief interruptions of continual monitoring may be unavoidable,
- Some procedures necessitate special monitoring (e.g. MRI scanning) or remote monitoring to reduce the hazard to staff (e.g. radiological procedures).

3. Role Of The Anaesthetist

1. Clinical monitoring by a vigilant anaesthetist is essential for safe patient care during anaesthesia. This clinical monitoring should be supplemented when necessary by appropriate devices to assist the practitioner responsible for the anaesthesia.
2. **A medical practitioner whose sole responsibility is the provision of anaesthetic care for that patient must be constantly present from induction of anaesthesia until safe transfer to Recovery Room staff or Intensive Care Unit has been accomplished. He should discharge patients from PACU.**

3. In exceptional circumstances brief absences of the anaesthetist primarily responsible for the anaesthetic may be unavoidable. In such circumstances that anaesthetist may temporarily delegate monitoring of the patient to an appropriately qualified person who is judged to be competent for the task.
4. Permanent handover of responsibility must be to an anaesthetist who is able to accept continued responsibility for the care of the patient.
5. The individual anaesthetist responsible for monitoring the patient should ensure that appropriate monitoring equipment is available.
6. A medical practitioner whose sole responsibility is the provision of anaesthetic care for that patient must keep adequate records of the drugs used, record of observations and the status of the patient while under their care. A completed real time anaesthetic record is the evidence.

4. Clinical Monitoring Of The Patient

The clinical monitoring of a patient undergoing any type of anaesthesia must include regular assessment and recording of the following:

Circulation. To ensure the adequacy of the patient's circulatory function during all anesthetics.

- The circulation must be monitored at frequent and clinically appropriate intervals by detection of the arterial pulse, ECG and measurement of arterial blood pressure. Clinical evaluation by palpation of a pulse, and auscultation of heart sounds is of added value.

Ventilation. To ensure adequate ventilation of the patient during the anaesthetic period.

- Ventilation must be monitored continuously by Qualitative clinical signs such as chest excursion, observation of the reservoir breathing bag and auscultation of breath sounds are useful. Quantitative monitoring of the volume of expired gas is strongly encouraged.
- When an endotracheal tube or laryngeal mask is inserted, its correct positioning must be verified by clinical assessment and by identification of carbon dioxide in the expired gas.
- During regional anesthesia (with no sedation) or local anesthesia (with no sedation), the adequacy of ventilation may be evaluated by continual observation of qualitative clinical signs.
- During moderate or deep sedation the adequacy of ventilation shall be evaluated by continual observation of qualitative clinical signs and monitoring for the presence of exhaled carbon dioxide unless precluded or invalidated by the nature of the patient, procedure, or equipment.

Oxygenation. To ensure adequate oxygen concentration in the inspired gas and the blood during the anesthetics period.

- Oximetry values must be interpreted in conjunction with clinical observation of the patient. Adequate lighting and exposure of the patient is important to aid with assessment of patients' colour.

5. Mandatory Monitoring Equipment

The following equipment should be available for use on every patient undergoing anaesthesia. When the monitors are in use on a patient, the

alarms (visual and audible) must be enabled and appropriate. The audible component of the alarm system must be able to be heard by the practitioner responsible for the anaesthesia. When any of the monitors of physiological function are in use during anaesthesia, regular recordings should be documented in the anaesthesia record.

Oxygen Analyser

During every administration of general anesthesia using an anesthesia machine and a breathing system there must be continuous monitoring of oxygen level delivered by the machine. This is done by device correctly fitted in the breathing system, and incorporating an audible alarm and visual signal to warn of low oxygen concentrations.

Breathing System Disconnection or Ventilator Failure Alarm

When a mechanical ventilator is in use, a monitor capable of warning promptly of a breathing system disconnection or ventilator failure must be in continuous operation. It must be automatically activated to give an audible signal when its alarm threshold is exceeded.

Pulse Oximeter

Pulse oximetry provides evidence of the level of oxygen saturation of the haemoglobin of arterial blood at the site of application and may identify arterial pulsation. A pulse oximeter must be in use for every patient undergoing general anaesthesia or sedation. When this particular monitor is in use, the variable pitch pulse tone as well as the low threshold alarm shall be appropriately set and audible to the practitioner responsible for the anaesthesia.

Electrocardiograph

Equipment to monitor and continually display the electrocardiograph must be available for every anaesthetized patient. A 3 lead option is adequate, however, there should be a 5-lead option available in level 5 and 6 hospitals. Every patient receiving anesthesia shall have the electrocardiogram continuously displayed from the beginning of anesthesia until preparing to leave the anesthetizing location.

Intermittent Non-Invasive Blood Pressure Monitor

Equipment to provide intermittent non-invasive blood pressure monitoring must be available for every patient undergoing anaesthesia. A variety of cuff sizes must be available. Every patient receiving anesthesia shall have arterial blood pressure and heart rate determined and evaluated at least every five minutes.

Temperature Monitor

To aid in the maintenance of appropriate body temperature during all anesthetics. Every patient receiving anesthesia shall have temperature monitored when clinically significant changes in body temperature are intended, anticipated or suspected. Equipment to monitor "core" temperature continuously must be available for every patient undergoing general anaesthesia.

6. Other Equipment

Carbon Dioxide Monitor

A monitor of the carbon dioxide level in inhaled and exhaled gases must be in use for every patient undergoing general anaesthesia in level 5 and 6

hospitals. Continual monitoring for the presence of expired carbon dioxide shall be performed unless invalidated by the nature of the patient, procedure or equipment. When capnography or capnometry is utilized, the end tidal CO_2 alarm shall be audible to the anesthesiologist or the anesthesia care team personnel.

Volatile Anaesthetic Agent Concentration Monitor

Equipment to monitor the concentration of inhalational anaesthetics should be in use for every patient undergoing general anaesthesia from an anaesthesia delivery system where volatile anaesthetic agents are available. Automatic agent identification should be available.

Neuromuscular Function Monitor

Equipment to monitor neuromuscular function should be available for every patient in whom neuromuscular blockade has been induced.

It is encouraged for the referral hospitals to have equipment to monitor other physiological variables when clinically indicated, (e.g. the electroencephalogram, central venous pressure, transoesophageal echocardiogram, cardiac output monitor or respiratory mechanics).

Guidelines on The Provision of Obstetric Anaesthesia Services

Purpose

To enhance the quality of anesthetic care for obstetric patients by improving patient safety to ensure favorable outcome for both mother and baby.

Application

These guidelines apply to all obstetric patients who are taken to theater for surgery where anaesthetic services are required.

The primary role of the anaesthetist while offering obstetric anaesthetic services is the care of the mother. Neonatal resuscitation services should be offered primarily by another staff. The primary responsibility of the anesthesiologist is to provide care to the mother. If the anesthesiologist is also requested to provide brief assistance in the care of the newborn, the benefit to the child must be compared to the risk to the mother.

Under unusual circumstances, e.g., extreme emergencies, these standards may be modified. When this is the case, the circumstances shall be documented in the patient's record.

Minimum Facilities For The Provision Of Obstetric Anaesthesia Services

- For anaesthetic services, the Operating theatres and recovery rooms should comply with the minimum essential standards as set out by KSA minimum theatre standards
- Resources for the treatment of potential complications (e.g., failed neuraxial block, failed intubation, inadequate analgesia, hypotension, respiratory depression, pruritus, vomiting) should be immediately available
- Appropriate equipment and personnel should be available to care

for obstetric patients recovering from major neuraxial or general anesthesia

- The hospital /health facility has to ensure that the equipment provided is in good working condition.
- The anaesthetist has to check the equipment's condition and resources available before beginning the case.

Pre-anesthetic Consultation and Evaluation

This must be done before the beginning of every case. And is the same for both obstetric analgesia and anaesthesia.

Appropriate informed consent for anaesthesia should be obtained.

Information on aspects that may influence perioperative decisions may be obtained by .reviewing the medical record, as well as taking a focused history and physical examination of the patient. This should focus on (but is not limited to):

1. General health, anesthetic and medical history,
2. Relevant obstetric history,
3. Airway, heart and lung assessment and examination,
4. Baseline vital signs measurement,
5. Back examination when neuraxial anesthesia is planned,
6. Further systemic examination should be conducted, as is considered relevant.

Under unusual circumstances, e.g., extreme emergencies, at a minimum, a focused preoperative evaluation of airway, lungs and heart must be carried out and vital signs documented.

Recommended Investigations

- Haemoglobin estimation should be carried out routinely.
- It is preferable to know the patient's blood group prior to surgery and a cross match can be done when blood is required.
- Routine blood type and screen or cross-match can be done based on maternal history and physical examination, anticipated hemorrhagic complications (e.g. previous cesarean delivery, placenta accreta in a patient with placenta Previa and previous uterine surgery, APH), presence of Clinical anaemic bleeding.
- Urea, electrolytes and creatinine and full hemogram should be done routinely for all patients with hypertension in pregnancy, or endocrine diseases.

Other investigations, medical tests or consultations should be ordered selectively based on;

- The institution protocol taking into consideration the location of the institution, and the resources available in the institution.
- Patient's condition.

A platelet count based on a patient's history, physical examination, and clinical signs in presence of eclampsia, hypertension or other comorbidity that may increase the risk of bleeding.

Anesthetic Choices For Cesarean Delivery

For cesarean delivery, the choice of anesthesia depends on the urgency of the procedure, in addition to the condition of the mother and fetus and on the skills of the anaesthetist

Central neuraxial blocks are preferred to general anaesthesia for most cesarean deliveries as it is more cost effective and safer if done in an appropriate environment by a person who can handle the complications which may be associated with such blocks.

General anesthesia may be the most appropriate choice in some circumstances (e.g., profound fetal bradycardia, ruptured uterus, severe hemorrhage, and severe placental abruption).

Intraoperative Management

- Timely intervention of emergency to avoid further decompensation of mother and child is encouraged.
- Vigilance on monitoring the level of blood loss and maintenance of circulatory volume status is of utmost importance with appropriate intervention in case of increased blood loss.
- Ensure the mother is comfortable.
- Give appropriate IV prophylactic antibiotics as recommended.
- Uterine displacement (usually left displacement) should be maintained until delivery regardless of the anesthetic technique employed.
- Physiologic monitoring must always be used in conjunction with careful clinical observation by the anaesthetist as there are circumstances in which equipment may not detect or delay in detecting unfavourable clinical developments.
- The clinical monitoring of an obstetric patient undergoing any type of anaesthesia should be as outlined in the recommended standards of monitoring document by KSA.

Recommendations For The Post-Anaesthesia Care

- Recovery from anaesthesia should take place under the supervision of staff trained in the care of patients recovering from anaesthesia in an area designated for that purpose. Observations should be recorded at appropriate intervals.
- All patients should remain in the Post-Anaesthesia Care Unit (PACU) until they have stable vital signs, and are considered safe to be discharged from the recovery area according to established criteria.

Guidelines On The Provision Of Obstetric Analgesia Services

Purpose

To enhance the quality of labour analgesia care for obstetric patients, improve patient safety and increase patient satisfaction.

Application

These guidelines apply to all obstetric patients who are given labour analgesia.

Regional analgesia in labour may be done by neuraxial blocks (spinal or epidural). Intravenous patient-controlled analgesia (PCA) may be offered as an alternative to regional analgesia.

Pre-anesthetic Consultation and Evaluation

- This is the same for both obstetric analgesia and anaesthesia. Labour analgesia involving neuraxial blocks, and the mother might proceed to theatre in case of any complication in the delivery period.
- Under unusual circumstances, e.g., extreme emergencies, these standards may be modified. When this is the case, the circumstances shall be documented in the patient's record.

Minimum Facilities For The Provision Of Obstetric Analgesia Services

- All healthcare facilities in which obstetric analgesia services are provided should have a provision for continuity of care by appropriately trained medical practitioners. Resources for the treatment of potential complications should be immediately available
- Appropriate equipment and personnel should be available to care for obstetric patients recovering from major neuraxial.

General Principles For The Management Of Central Neuraxial Blocks (Analgesia And Anaesthesia) In Obstetric Patients

- The purpose of these guidelines is to facilitate the management of central neuraxial blocks and to reduce the likelihood of adverse outcomes and complications which may be associated with such blocks.
- Central neuraxial blocks should never be initiated and/or maintained in a facility that does not have facilities to manage and/or prevent the potential complications (e.g., failed neuraxial block, failed intubation, inadequate analgesia, hypotension, respiratory depression, pruritus, vomiting) and to provide general anaesthesia in case of failure of block or total spinal where emergency surgeries become necessary.
- Resuscitation equipment should include, but is not limited to: sources of oxygen and suction, equipment to protect and maintain the airway and perform endotracheal intubation, a means to provide positive pressure ventilation, and drugs and equipment for cardiopulmonary resuscitation. These must be immediately available.
- Ensure pre anaesthesia consultation is done as outlined above and establish that the woman has consented to the procedure.

- Clinical assessment of the patient's coagulation status and anticoagulant medications is required in all circumstances as many regional analgesic techniques may have serious complications in the presence of a coagulopathy; for example, epidural hematoma, and retroperitoneal hematoma from lumbar plexus blocks. Laboratory investigations should be undertaken where appropriate. However it should be noted that potent antiplatelet medications, direct thrombin inhibitors and anti-factor Xa drugs are of particular concern because their effects are not readily reversible nor always evident on standard coagulation tests.
- Central neuraxial blocks or obstetric analgesia should be done by a medical practitioner, with training and experience in the technique, or trainees under the supervision of such a practitioner. The person has to be able to adequately manage any hemodynamic changes which may occur as a result of administration of the anaesthetic agents used for the blockade.
- Initiation of central neuraxial blocks needs to be undertaken in an environment where all equipment and drugs that are necessary for the management of complications relating to the procedure are available.
- Intravenous access should be obtained prior to commencement of central neuraxial blocks and maintained for the duration of administration of medication for analgesia.
- Initiation of central neuraxial blocks requires appropriate assistance. This assistance may be a nurse, or a suitably trained Anesthetist's Assistant.
- Suitable Infection control measures must be followed,
- Oxygen should be administered in the presence of sedation.

- A record of the technique, including method, drugs and dose used, complications or problems encountered should be documented in the patient's medical record by the practitioner.
- Consideration should be given to the availability of a lipid emulsion, which may be effective in resuscitation during circulatory collapse due to local anaesthetic toxicity for use in conjunction with advanced cardiac life support.

Considerations Management Of Central Neuraxial Blocks In Anaesthesia

- The anaesthetist must be immediately available for the duration of that surgical procedure or until handover to another practitioner. In the event that an anaesthetist has to away from the patient temporarily, monitoring should be temporarily left to a suitably trained anaesthetic assistant or staff.
- Neuraxial anesthesia for cesarean delivery requires that the standards for basic anesthetic monitoring be applied.
- Monitoring during establishment of central neuraxial blocks for analgesia should include electrocardiography, pulse oximetry, frequent and regular blood pressure measurement, respiratory rate, and conscious state evaluation. This level of monitoring should be continued for at least 30 minutes or until the patient's vital signs are stable. Subsequent monitoring should be as per basic recommendations of monitoring in theater.

Considerations For The Management Of Neuraxial Blocks For Analgesia In Obstetric Patients

- Central neuraxial blocks for analgesiamay be initiated for providing analgesia in labour or in the perioperative setting for the provision of perioperative analgesia.

- Monitoring during the establishment of central neuraxial blocks for analgesia should include electrocardiography, pulse oximetry, frequent and regular blood pressure measurement, respiratory rate, and conscious state evaluation. This level of monitoring should be continued for at least 30 minutes or until the patient's vital signs are stable. Subsequent monitoring depends on the block and drugs used and the clinical circumstances. In general this should include regular assessment of respiratory rate, heart rate, blood pressure, and others as indicated by the clinical circumstances.
- After initiating the central neuraxial blocks it is the responsibility of the practitioner to remain immediately available until a satisfactory block has been achieved, and the patient is stable. When the blockade has been fully established and all hemodynamic changes have been normalized, a practitioner may delegate such responsibility to another suitably trained medical practitioner or competent nursing personnel, who will then assume subsequent responsibility.
- Provided that these personnel have received the required training, ongoing education and reaccreditation this is acceptable.
- Instructions for the subsequent management of the patient should be provided. These include drug orders (dose or infusion rate) and monitoring requirements. Prescription of all analgesic drugs is the responsibility of the practitioner.
- Written protocols and procedures should be in place for the continued management of each technique, its side effects and common complications. Formal institutional protocols and guidelines for each technique are recommended.

Minimum Safety Requirements For Anaesthetic Machines For Clinical Practice

Purpose and Scope

The anaesthetic machine is designed to deliver anaesthetic gases, anaesthetic vapours, oxygen and/or air via a breathing circuit to patients. Safe anaesthetic machines are essential to the provision of safe patient care.

This document specifies minimum safety requirements for anaesthetic machines in clinical use in Kenya.

These standards are basic and higher Standards must be influenced by the nature/complexity of the surgery undertaken and condition of the patient.

All anaesthetic machines in clinical use in Kenya should comply with KEBSKS ISO 5362:2006, KS ISO 21969:2002, KS ISO/TR 16142:2006 KS IEC 60601-1:2012.

Monitoring equipment, whether integral to or separate from the machine, should conform tothe *KSA guidelines document Recommendations on Monitoring During Anaesthesia*.

Mandatory Safety Requirements

General Requirements

1. Connections for medical gas cylinders, yokes or regulators must be pin indexed.
2. A reserve supply of oxygen must be attached to the anaesthetic machine in a manner that ensures easy activation should the oxygen supply fail.
3. Non-interchangeable gas hose connectors must be present on all gas inlet and outlet sockets to prevent incorrect gas supply connections.

4. Colour coding for gas cylinders and pipes should be according to international standards: oxygen (black body with white shoulder), nitrous oxide (French blue) and medical air (black body with black and white shoulder).
5. A display of gas supply line and cylinder pressures must be provided. The pressure displays must be visible from the front of the machine.
6. Oxygen supply failure warning device/system that indicates impending failure of the external/primary oxygen supply must be present. This must:
    a. Activate automatically when the oxygen supply pressure falls below a critical oxygen concentration level of 25%.
    b. Generate an audible continuous alarm to warn the operator.
    c. The only means to reset the alarm will be the restoration of the oxygen supply pressure to a level above that at which the device is activated
    d. Prevent the delivery of a **hypoxic gas mixture.**
7. The anaesthetic machine must not be capable of delivering a hypoxic mixture of gases under any circumstances. When oxygen and nitrous oxide are used, a hypoxic guard must be fitted to ensure a minimum oxygen concentration of 25% by either;
    a. Cutting off the supply of any other gases other than air or oxygen to the common fresh gas outlet or
    b. Proportionally reduce the flow of other gases such as nitrous oxide to maintain the initial FiO2.
8. The machine should have an emergency oxygen flush that bypasses the vaporizers and delivers at least 35L/min of oxygen. The control for this function must be protected from accidental activation.

9. Whenever an automatic ventilator is used, a breathing circuit pressure monitor with high - and low-limit alarms must be incorporated.
    a. Alarms: Adjustable alarm limits for all parameters.(lung tidal volumes and pressures)
    b. Oxygen monitor (inspired and expired), with a low-limit alarm at least. The minimum standard should be for monitoring the FiO2 of the fresh gas being delivered to the breathing circuit.
10. If the anaesthetic machine requires electrical power for normal operation, a backup power supply must be a part of the machine and permit normal operation for at least 60 minutes after a mains power supply failure. An alarm must be activated at the time of the mains failure and the state of the reserve power supply must be indicated while it is in use.
11. A fresh gas outlet, must be 22 mm outer diameter and 15 mm inner diameter, visible to the operator and should be capable of being connected to the closed breathing system in such a way as to prevent accidental disconnection.
12. For semi-closed breathing system, a fresh gas outlet, must be 22 mm outer diameter and 15 mm inner diameter, visible to the operator and should be capable of being connected to the breathing system in such a way as to prevent accidental disconnection.
13. Anaesthetic gas scavenging system connections must be of a diameter that is different from the other connections used for the breathing system.
14. Adequate maintenance of the anaesthetic machine must be ongoing for the life of the unit.

15. Switching "off" an electronic anaesthetic machine during normal operation should require a confirmatory step and the machine should display a warning of imminent shut-down.
16. Switching "off" an electronic anaesthetic machine during normal operation should require a confirmatory step and the machine should display a warning of imminent shut-down.

Gas Delivery Systems and Colour Coding

Gas delivery systems capable of delivering accurately proportioned fresh gas mixtures and the colour codes on the knobs, and gas hoses must be maintained as follows;

- Oxygen (O_2) - white
- Air - black and white or black
- Nitrous (N_2O) - blue

Gas Sources Exclusively From Cylinders Must Have:

1. Non-interchangeable wall points and connectors for nitrous oxide and oxygen and any other gases, conforming to international standards.
2. Colour-coded pipeline hoses capable of withstanding pressures of up to 1 000 kPa affixed to anaesthetic machines by non-interchangeable fittings.
3. Pressure indicators for each line.
4. One back-up cylinder with pin-index yoke for oxygen, with a suitable spanner or key must be available for opening and closing gas cylinders. This should be attached to each individual anaesthesia machine.

Gas Sources From Pipelines With Back-Up Cylinders Must Have:

1. Non-interchangeable wall points and connectors for nitrous oxide and oxygen and any other gases, conforming to international standards.
2. Colour-coded pipeline hoses capable of withstanding pressures of up to 1 000 kPa affixed to anaesthetic machines by non-interchangeable fittings.
3. Pressure indicators for each line.
4. One back-up cylinder with pin-index yoke for oxygen, with a suitable spanner or key must be available for opening and closing gas cylinders. This should be attached to each individual anaesthesia machine.

Appropriate flow controllers for all available gases:

1. The flow meter for oxygen must be accurate. Must be calibrated regularly according to manufactures recommendation.
2. Where there is a sequence of gas control knobs, oxygen must be positioned on the right, as seen from a position facing the machine. The order in which the flow knobs on the rotameter are placed should be oxygen, nitrous oxide, and then air.
3. If the anaesthetic machine incorporates a gas flowmeter bank, oxygen must be the last gas to enter the common gas manifold at the top of the flowmeter tubes.
4. Machines with electronic flow controllers must have a manual device for oxygen delivery, independent of electrical supply.
5. If mechanical means are provided to mix the anaesthetic gases on the anaesthetic machine, there must be only one gas flow control knob for each gas.

Vapourizers

1. If two or more vaporisers can be simultaneously mounted on the anaesthetic machine, a vaporiser interlock system must allow only one vaporiser to be used at a time.
2. Vaporisers with mechanical adjustment dials, when used in high pressure circuits, must increase the delivered anaesthetic vapour concentration when the dial is rotated in an anti-clockwise direction.
3. The vaporiser should be capable of delivering accurate, controllable partial pressures of volatile anaesthetic agents at varying fresh gas flows, and under the full range of normal clinical conditions.
4. The graduations of the control should not exceed 0.5 minimum alveolar concentration (MAC) and should provide at least three times the MAC of the selected agent.
5. These components are to be mounted on a rigid frame that maintains the flow meters in a vertical position and must be sufficiently stable to prevent it from being accidentally tipped over.

Breathing Systems/Circuits

1. A suitable breathing system for adult patients fitted at all junctions with ISO-standard tapered fittings.
2. Paediatric breathing systems must be available in institutions where children might be anaesthetised.
3. An alarm that responds to sustained high and low pressure in the patient's airway must be present.
4. A high pressure relief valve or other means of automatically preventing dangerously high and/or prolonged pressures in the breathing system must be present in the anaesthesia circuit.

5. One set of face masks per machine.the sizes should be appropriate for the patient population.
6. Fresh gas Outflow point connector of 22 mm International Organization for Standardization (ISO) standard male taper.

Other Recommended Safety Requirements

Level 5 and 6 referral hospital requirements must include all or some of those set out below. All these should be part of the monitoring bouquet.

1. Capnograph, displaying end-tidal CO_2 in mmHg or Kpa, or a percentage.
2. Anaesthetic multi gas analyser.

Checking Anaesthetic Equipment Guidelines

Introduction

Improving patient safety requires that the anaesthesiologist or the anaesthetist conducts a pre-use check of anaesthetic equipment as a primary responsibility. Correct functioning of these equipment must be ensured and the anaesthesiologist/anaesthetist must not use equipment which they are not trained and competent to use.

In any location where anaesthesia may be given, a self-inflating bag must be readily available and breathing and ventilating equipment individually checked. A record should be kept with the anaesthetic machine that these checks have been done. Especially important is the 'first-user' check and record after servicing.

Procedures For Checking Anaesthetic Equipment

The following checks should be carried out at the beginning of each operating theatre session. In addition, specific checks should be carried out before each new patient during a session or when there is any alteration or addition to the breathing system, monitoring or ancillary equipment.

It is the responsibility of the anaesthetist to make sure that these checks have been performed, and the anaesthetist must be satisfied that they have been carried out correctly. In the event of a change of anaesthetist during an operating session, the status of the anaesthetic equipment must be confirmed, including that a formal check has been perform before taking over.

Before using any anaesthetic equipment, ventilator, breathing system or monitor, it is essential to be fully familiar with it. Modern anaesthetic workstations are complex devices. It is essential that anaesthetists have full training and formal induction for any machines they may use the first time

by qualified personnel. A quick'run-through' before the start of an operating session is not acceptable.

Careful note should be taken of any information or labelling on the anaesthetic machine that might refer to its current status. e.g. date of last service.

Alternative Means Of Ventilation

The early use of an alternative means of ventilation (a self-inflating bag that does not rely on a source of oxygen to function) may be life-saving. A self-inflating bag must be immediately available in any location where anaesthesia may be given [7, 8]. An alternative source of oxygen should be readily available.

Perform Manufacturer's Machine Check

Modern anaesthesia workstations may perform many of the following checks automatically during start-up. Users must know which are included and ensure that the automated check has been performed.

Power Supply

- Check that the anaesthetic workstation and relevant ancillary equipment are connected to the mains electrical supply (where appropriate) and switched on. The anaesthetic workstation should be connected directly to the mains electrical supply, and only correctly rated equipment connected to its electrical outlets. **Multisocket extension leads must not be plugged into the anaesthetic machine outlets or used to connect the anaesthetic machine to the mains supply.**
- Hospitals should have back-up generators, and many operating theatres will have their own back-up system. Anaesthetists should

know what is available where they are working. Back-up batteries for anaesthetic machines and other equipment should be charged.

- Switch on the gas supply master switch (if one is fitted).
- Check that the system clock (if fitted) is set correctly

Gas Supplies and Suction

To check the correct function of the oxygen failure alarm involves disconnecting the oxygen pipeline on some machines, whilst on machines with a gas supply master switch, the alarm may be operated by turning the master switch off. As repeated disconnection of gas hoses may lead to premature failure of the Schrader socket and probe, these guidelines recommend that the regular pre-session check of equipment includes a 'tug test' to confirm correct insertion of each pipeline into the appropriate socket. It is therefore recommended that, in addition to these checks, the oxygen failure alarm must be checked on a weekly basis by disconnecting the oxygen hose whilst the oxygen flowmeter is turned on, and a writtenrecord kept. In addition to sounding an alarm, which must sound for atleast 7s, oxygen failure warning devices are also linked to a gas shut-off device. Anaesthetists must be aware of both the tone of the alarm and also which gases will continue to flow on the particular model of anaesthetic machine in use.

Medical Gas Supplies

Identify and take note of the gases that are being supplied by pipeline, **confirming with a 'tug test' that each pipeline is correctly inserted into the appropriate gas supply terminal.** Note that excessive force during a 'tug test' may damage the pipeline and/or gas supply terminal.

1. Check that the anaesthetic apparatus is connected to a supply of oxygen and that an adequate reserve supply of oxygen is available from a spare cylinder.

2. Check that adequate supplies of any other gases intended for use are available and connected as appropriate. All cylinders should be securely seated and turned off after checking their contents.

3. Carbon dioxide cylinders should not be present on the anaesthetic machine. Where a blanking plug is supplied this should be fitted to any empty cylinder yoke.

4. Check that all pressure gauges for pipelines connected to the anaesthetic machine indicate 400–500 kPa.

5. Check the operation of flowmeters, where these are present, ensuring that each control valve operates smoothly and that the bobbin moves freely throughout its range without sticking. If nitrous oxide is to be used, the anti-hypoxia device should be tested by first turning on the nitrous oxide flow and ensuring that at least 25% oxygen also flows. Then turn the oxygen flow off and check that the nitrous oxide flow also stops. Turn on the oxygen flow and check that the oxygen analyser display approaches 100%. Turn off all flow control valves. (Machines fitted with a gas supply master switch will continue to deliver a basal flow of oxygen).

6. Operate the emergency oxygen bypass control and ensure that flow occurs from the gas outlet without significant decrease in the pipeline supply pressure. Ensure that the emergency oxygen bypass control ceases to operate when released.

Suction

Check that the suction apparatus is functioning and all connections are secure; test for the rapid development of an adequate negative pressure.

Breathing System and Vaporisers

Whole Breathing System

Check all breathing systems that are to be used and perform a 'two-bag test' before use, as described below. Breathing systems should be inspected visually and inspected for correct configuration and assembly. Check that all connections within the system and to the anaesthetic machine are secured by 'push and twist'. Ensure that there are no leaks or obstructions in the reservoir bags or breathing system and that they are not obstructed by foreign material. Perform a pressure leak test (between 20 and 60 cmH2O on the breathing system by occluding the patient-end and compressing the reservoir bag.

Vaporisers

Manual leak testing of vaporisers was previously recommended routinely. It should only be performed on basic 'Boyle's' machines and it may be harmful to many modern anaesthetic workstations. Refer to themanufacturer's recommendation before performing a manual test. **Check that the vaporiser(s) for the required volatile agent(s) are fitted correctly to the anaesthetic machine, that any locking mechanism is fully engaged and that the control knobs rotate fully through the full range(s). Ensure that the vaporiser is not tilted. Turn off the vaporisers. Check that the vaporiser(s) are adequately filled but not overfilled, and that the filling port is tightly closed.**

Manual Leak Test of Vaporiser

1. Set a flow of oxygen of 5 L / min and with the vaporiser turned off, temporarily occlude the common gas outlet. There should be no leak from any part of the vaporiser and the flowmeter bobbin (if present) should dip.

2. Where more than one vaporiser is present, turn each vaporiser on in turn and repeat this test. After this test, ensure that the vaporisers and flowmeters are turned off.

Changing and filling vaporisers during use. It may be necessary to change a vaporiser during use. Where possible, repeat the leak test; failure to do so is a common cause of critical incidents. Some anaesthetic workstations will automatically test vaporiser integrity. It is only necessary to remove a vaporiser from a machine to refill it if the manufacturer recommends this. Vaporisers must always be kept upright. Tilting a vaporiser can result in delivery of dangerously high concentrations of vapour.

Carbon Dioxide Absorber

Inspect the contents and connections and ensure there is adequate supply of carbon dioxide absorbent.

Check the colour of the absorbent - Indicate what colour shows that it is exhausted.

Alternative Breathing Systems

For Bain-type and circle co-axial systems, perform an occlusion test on the inner tube and check that the adjustable pressure limiting (APL) valve, where fitted, can be fully opened and closed.

Correct Gas Outlet

Particular care must be exercised in machines with an auxiliary common gas outlet (ACGO). Incidents of patient harm have resulted frommisconnection of a breathing system to an ACGO or mis-selection of the ACGO.

Whenever a breathing system is changed, either during a case or a list, its integrity and correct configuration must be confirmed. This is particularly important for paediatric lists when breathing systems maybe changed frequently during a list.

Ventilator

Check that the ventilator is configured correctly for its intended use. Ensure that the ventilator tubing is securely attached. Set the controls for use and ensure that adequate pressure is generated during the inspiratory phase.

Check that alarms are working and correctly configured.

Check that the pressure relief valve functions correctly at the set pressure

Two-bag Test

A two-bag test should be performed after the breathing system, vaporisers and ventilator have been checked individually.

1. Attach the patient-end of the breathing system (including angle piece and filter) to a test lung or bag.
2. Set the fresh gas flow to 5 l/min and ventilate manually. Check the whole breathing system is patent and the unidirectional valves are moving (if present).
3. Check the function of the APL valve by squeezing both bags.
4. Turn on the ventilator to ventilate the test lung. Turn off the fresh gas flow or reduce to a minimum. Open and close each vaporiser in turn. There should be no loss of volume in the system.

Breathing systems should be protected with a test lung or bag when not in use to prevent intrusion of foreign bodies.

Scavenging

Check that the anaesthetic gas scavenging system is switched on and functioning. Ensure that the tubing is attached to the appropriate exhaust port of the breathing system, ventilator or anaesthetic workstation.

Monitoring Equipment

Check that all monitoring devices are functioning and that appropriate parameters and alarms have been set before using the anaesthetic machine. This includes the cycling times, or frequency of recordings, of automatic non-invasive blood pressure monitors. Check that gas sampling lines are properly attached and free from obstruction or kinks. **In particular, check that the oxygen analyser, pulse oximeter and capnograph are functioning correctly and that appropriate alarm limits for all monitors are set.** Be aware of the 'default' alarm settings if using these.

Gas monitoring lines are often the cause of a significant leak; check that they are properly attached and any sampling ports not in use have been blanked off. To eliminate the need to change the sampling line repeatedly, the gas monitoring line should be assembled as an integral part of the breathing circuit by attaching it proximal to the patient breathing filter.

Airway Equipment

These include bacterial filters, catheter mounts, connectors and endotracheal, laryngeal mask airways, etc; check that these are all available in the appropriate sizes, at the point of use, and that they have been checked for patency.

A new, single-use bacterial filter and angle piece / catheter mount must be used for each patient. It is important that these are checked for patency and flow, both visually and by ensuring gas flow through the whole assembly when connected to the breathing system, as described below.

Check that the appropriate laryngoscopes are available and function reliably. Equipment for the management of the anticipated or unexpected difficult airway must be available and checked regularly in accordance with departmental policies. **A named consultant anaesthetist must be responsible for difficult airway equipment and the location of this equipment should be known by all.**

Total Intravenous Anaesthesia (TIVA)

When TIVA is used there must be a continuous intravenous infusion of anaesthetic agent or agents; interruption from whatever cause may result in awareness. A thorough equipment check is therefore the most important step in reducing the incidence of awareness. Anaesthetists using TIVA must be familiar with the drugs, the technique and all equipment and disposables being used.

The Safe Anaesthesia Liaison Group (SALG) has produced safety guidance on guaranteeing drug delivery during TIVA; SALG made the following recommendations:

1. An anti-reflux/non-return valve should always be used on the intravenous fluid infusion line when administering TIVA.
2. Sites of intravenous infusions should be visible so that they may bemonitored for disconnection, leaks or infusions into subcutaneous tissues.
3. Clinical staff should know how to use, and to check, the equipment before use.

Organisations should give preference to purchasing intravenous connectors and valves that are clearly labeled.

Ancillary and Resuscitation Equipment

Check that the patient's trolley, bed or operating table can be tilted head-down rapidly. A resuscitation trolley and defibrillator must be available in all locations where anaesthesia is given and checked regularly in accordance with local policies.

Equipment and drugs for rarely encountered emergencies, such as malignant hyperthermia and local anaesthetic toxicity must be available and checked regularly in accordance with local policies. The location of these must be clearly signed.

Single-use Devices

Any part of the breathing system, ancillary equipment or other apparatus that is designated '**single-use' must be used for one patient only, and not reused.** Packaging should not be removed until the point of use, for infection control, identification and safety.

Machine Failure

In the event of failure, some modern anaesthetic workstations may default too little or no flow, may entrain room air or oxygen only with no vapour. **Users must know the default setting for the machine in use. Alternative means of oxygenation, ventilation and anaesthesia must be available.**

'Shared Responsibility' Equipment

As a member of the theatre team, the anaesthetist will share responsibility for the use of other equipment, e.g. diathermy, intermittent compression stockings, warming devices, cell salvage and tourniquets, but should have received appropriate training. **Involvement with this equipment, especially 'trouble shooting' problems that arise intra-operatively, must not be allowed to distract anaesthetists from their primary role.**

Recording and Audit

A clear note must be made in the patient's anaesthetic record that the anaesthetic machine check has been performed, that appropriate monitoring is in place and functional, and that the integrity, patency and safety of the whole breathing system has been assured. A logbook should also be kept with each anaesthetic machine to record the daily pre-session check and weekly check of the oxygen failure alarm. Modern anaesthesia workstations may record electronic self tests internally. Such records should be retained for an appropriate time. Documentation of the routine checking and regular servicing of anaesthetic machines and patient breathing systems should be sufficient to permit audit on a regular basis.

Recovery

There must be clear departmental procedures for the daily and other checks of equipment that is used in post anaesthesia care unit recovery room. This may also include pre-use checks of patient-controlled analgesia and epidural pumps, etc.

Pre-Anaesthetic Machine Checklist Guideline Summary

Checks at the start of every operating session/ If Machine is moved to new location.
Do not use this equipment unless you have been trained

☐ Check self inflating bag (AMBU bag) is available behind machine		
☐ Perform manufactures (automatic) Machine check		
Gas Supplies & Suction	☐ Gas & Vacuum Tug Test ☐ Cylinders filled and turned off ☐ Flow-meters working (if applicable)	☐ Hypoxic guard working ☐ Oxygen Flush working ☐ Suction clean & working
Breathing System	☐ Whole system patent & leak free using "two-bag" test ☐ Vaporizers – fitted correctly, filled, leak free, plugged in (if necessary) ☐ Soda Lime – Colour checked,	confirm that it's indicated what colour shows it is exhausted, date changed. Alternative systems (Bain, T-piece), Checked ☐ Correct gas outlet selected ☐ Capnography working well
Ventilator	☐ Working and configured correctly	
Scavenging	☐ Working and configured correctly	
Monitors	☐ Working and configured correctly ☐ Alarms limits & volumes set	
Airway Equipment	☐ Full range required available in room & working with spares ☐ Emergency difficult airway aids available	
TIVA	☐ An anti-reflux/non-return valve present	
Check final status of the machine	☐ Vaporisers off ☐ APL valve open ☐ Selector switch to Bag Mode	☐ All flow-meters to zero (or minimum) ☐ Patient suction level adequate ☐ Breathing system ready to use
☐ Note weekly check of oxygen failure alarm is working well.		
☐ **Record this checks in patient record**		

The Two-bag test should be performed after the breathing system, vaporizers, ventilators have been checked individually.

Checks at every hand over of patient between 2 anaesthesia providers	
Breathing System	☐ Patent with no accidental disconnections
Ventilator	☐ Working and configured correctly
Airway Equipment	☐ Full range required available in room & working with spares ☐ If had a difficult intubation - the equipment will be available at extubation
Suction	☐ Present and working
Checks in between cases	
Breathing System	☐ Whole system patent and leak free using "two-bag test" ☐ Vaporisers fitted correctly, filled, leak free, plugged in (if necessary) ☐ Alternative systems (Bain, T-piece) - checked ☐ Correct gas outlet selected
Ventilator	☐ Working and configured correctly
Airway Equipment	☐ Full range required available in room & working with spares ☐ Difficult airway equipment accessible if required.
Suction	☐ Clean and Working

Responsibilities of the Anaesthesiologist

- Regardless of the level of training and support by technicians, the anaesthesia care provider is ultimately responsible for proper function of all equipment used to provide anaesthesia care.
- Adequate familiarity with the equipment, following relevant local policies for performing and documenting the PAC and being knowledgeable about those procedures.
- Do not rely on the automated checkout procedure, as it can be incomplete and/or misleading.

- **A prominent label that is visible to the anaesthesiologist must be attached to all anaesthesia delivery systems to advise of past service(s) and to indicate when the next service is due.**

Requirements for Safe Delivery of Anesthesia Care

- Reliable delivery of oxygen at any appropriate concentration up to 100%.
- Reliable means of positive pressure ventilation.
- Backup ventilation equipment available and functioning.
- Controlled release of positive pressure from the breathing circuit.
- Anesthesia vapor delivery (if intended as part of the anesthetic plan).
- Adequate suction.
- Means to conform to standards for patient monitoring.

Disclaimer

The KSA cannot be held responsible for failure of any anaesthetic equipment as a result of a defect not revealed by these procedures.

References

Recommendations on Minimum Facilities For Safe Administration of Anaesthesia in Operating Suites and Other Anaesthetizing Locations

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3. Guidelines For The Provision Of Anaesthetic Services; Royal College of Anaesthetists/ Association of Anaesthetists of Great Britain and Ireland.
4. SAJAA-SASA Recovery Room Guidelines.
5. Booysen S et al The Recovery Room 'Pitstop or Pitfall'.

Recommendations on Monitoring During Anaesthesia

1. Standards for Basic Anaesthetic Monitoring (Approved American Society of Anesthesiologists House of Delegates 1986 & last amended 2005).
2. AAGBI Recommendations for Standards of Monitoring during Anaesthesia and Recovery (March 2007).
3. Guidelines to the Practice of Anaesthesia: Patient Monitoring by the Canadian Anesthesiologists.
4. Society www.cas.ca/members/sign_in/guidelines/practice_of_anesthesia.
5. Critical Incident Reporting In An Anaesthetic Department Quality Assurance Programme Short TG. O'Regan A, Lew J, Oh TE Anaesthesia 1992 (47) 3-7.

Guidelines On The Provision Of Obstetric Anaesthesia Services

- Anzca Position Statement On The Provision Of Obstetric Anaesthesia And Analgesia Services 2009
- Anzca Guidelines For The Management Of Major Regional Analgesia 2011
- The South African Society Of Anaesthesiologists Practice Guidelines 2006

Definitions

1. The terms **"Anaesthetist"** refers to the physician anaesthetist, and non-physician anaesthetist.
2. **ANAESTHESIA** means "absence of all sensation".
3. **Obstetric Anaesthesia**, when necessary, may be provided by spinal or epidural, or by general anaesthesia.
4. **General Anaesthesia** is a state of drug-induced non-responsiveness characterized by absence of response to any stimulus, loss of protective airway reflexes, depression of respiration and disturbance of circulatory reflexes.
5. **Regional Anaesthesia** is a state of drug-induced non-responsiveness to any stimulus in a region of the body which has minimal, or no effect on consciousness, respiration or circulation (minor nerve blocks), or may affect consciousness, respiration or circulation (major nerve blocks such as spinal or epidural or caudal).

6. **ANALGESIA** means "absence of pain perception". Absence of pain sensation, or reduction in pain perception, is commonly induced by drugs which may act locally (by interfering with nerve conduction) or generally (by depressing pain perception).
7. **Obstetric Analgesia in this document means analgesia** achieved by regional techniques such as epidural, plus or minus other methods of analgesia.
8. **Neuraxial blocks:** These procedures refer to the injection of pharmaceutical preparations into the vicinity of the spinal cord or nerve tissue.
9. **POLICY** – defined as 'a course of action adopted and pursued by the College'. These are matters coming within the authority and control of the College.
10. **Recommendations** – defined as 'advisable courses of action'.
11. **Guidelines** – defined as 'a document offering advice'. These may be clinical (in which case they will eventually be evidence-based), or non-clinical.

Pre-Anaesthetic Machine Checklist Guideline

1. Recommendations for Pre-Anaesthesia Checkout Procedures (2008) Sub-Committee of ASA Committee on Equipment and Facilities.
2. Checking Anaesthetic Equipment 2012. Association of Anaesthetists of Great Britain and Ireland.
3. Anaesthesia Apparatus Checkout Recommendations, 1993. United States' Food and Drug Administration (FDA).

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