SPs must take note of the consensus statement on fasting before procedural sedation in adults and children by ICAPS.[12]

7. Standards of monitoring

The principles of monitoring are described by the Academy of Medical Royal Colleges in *Safe Sedation Practice for Healthcare Procedures*.[13] All members of the sedation team must have detailed knowledge of the monitoring equipment and interpretation of the information provided by the monitors.

Clinical monitoring alone may suffice in minimal sedation. For all other levels of sedation, both clinical monitoring and electronic monitoring must be used. The sedation technique used (i.e. either basic or standard sedation, or advanced sedation) will also affect the level of monitoring required. For basic or standard techniques where only a single agent is used, the respiratory and cardiovascular systems are usually unaffected. Intermittent assessment of vital signs is appropriate, including clinical monitoring such as level of sedation, anxiety, colour of mucosa/skin and breathing patterns. For prolonged procedures, the use of both a pulse oximeter and a non-invasive blood pressure (NIBP) monitor are mandatory. Should any advanced sedation technique be used, the level of sedation will determine the monitoring required, as set out below.

7.1 Anxiety levels and behaviour, such as confusion, restlessness and agitation

The SP should evaluate the child's cooperation, since this will impact the level of sedation needed for the procedure to be completed safely. An otherwise complacent child who becomes restless and agitated during the procedure, may indicate a possible adverse event (e.g. hypoxaemia, hypoglycaemia, under-sedation or even over-sedation). A full bladder can also cause restlessness, especially during longer cases.

7.2 Level of consciousness and depth of sedation

Children often need deep sedation for procedures to be completed safely. Therefore, monitoring the level of sedation is of utmost importance and should be part of every sedation technique. Since a standard dose or drug in children may have an unpredictable effect, children may end up in a deeper-than-intended level of sedation. Regular communication with the child will assist in monitoring the level of sedation.

Sedation scoring systems were developed to monitor the level of sedation (e.g. the Wilson sedation scale or the University of Michigan Sedation Scale [UMSS]) (Appendix 6). It is suggested that SPs use the UMSS since the scoring system follows the levels of sedation on the sedation continuum.

Even though these scoring systems are a practical way to determine the level of sedation, there are some drawbacks. These scoring systems are all subjective and dependent on interpretation by the individual SP. Since loss of responsiveness to verbal command or light tactile stimulation is considered an indication that the child is under deep sedation (Table I and Appendix 6), the scoring systems rely on stimulating the child, either verbally or physically, in order to determine the level of sedation. This can be counterproductive, especially in children where the purpose of sedation is to induce a sedated and relaxed state to gain the child's cooperation. Stimulating the child at predetermined intervals to determine the level of sedation may also be disruptive to the procedure and the sedation process, and defy the purpose of the sedation. However, there is no other clinical way to determine the level of sedation. As the SP may be reluctant to stimulate the child, the child may enter deep sedation, and even GA, without the SP realising it. Sedation training and skill are indispensable to safely steer the process at this level of sedation. A child under deep sedation requires the same level of care as required during GA.

Interpreting a "purposeful response" is also dependent on the interpretation by the SP. Examples of a purposeful response may include opening the eyes, opening the mouth, taking deep breaths and pushing a painful stimulus out of the way. This, too, may be difficult to ascertain in children, especially young children who may not comprehend what is expected or how to respond. Other groups that may be difficult to monitor include mentally challenged children, children with autism or where language barriers exist.

The only clinical way to distinguish between moderate and deep sedation is by loss of verbal response (or light tactile stimulation), that is between awake and asleep. Once verbal response is lost, it is impossible to determine whether the patient is under deep sedation or GA. It is, therefore, better to aim to keep the patient awake (conscious), rather than asleep (unconscious). Once verbal contact is lost, the patient may drift from deep sedation into GA.

An easy rule is, if anaesthesia is about keeping patients asleep, sedation is about keeping patients awake – this is especially true for procedures performed outside the hospital environment. This, however, is not always possible since there are situations where deep sedation is required (e.g. in very painful procedures, very young patients, mentally challenged patients, or when complete immobility is required). The most important implication is to realise that as the depth of sedation increases so does the risk for cardiorespiratory events. Therefore, an experienced provider and extreme vigilance are required to perform these advanced techniques.

As far as electronic monitoring is concerned, the value of processed electroencephalogram (EEG) monitors (e.g. bispectral index [BIS] monitoring) for sedation outside of a hospital operating theatre is debatable. However, it may be useful where deep sedation and analgesia is used.

7.3 Pain and degree of discomfort

Unlike adults, children may not be able to verbalise when they experience discomfort or pain. Close and continuous observation of the child's face and possible movement of extremities may aid as clues that the child is experiencing discomfort or pain.

In older children, when the demands of the procedure prohibit a verbal response (e.g. dental work or procedures on the head and neck), a signalling system for pain or discomfort should be established prior to the initiation of sedation. In this way, older children will be able to demonstrate whether they are in pain or discomfort (e.g. with a thumbs up or thumbs down).

7.4 Airway patency

Relaxation of the mandible and involuntary opening of the mouth are early signs that the level of sedation is deepening. Noisy inspiration and/or expiration and snoring are indications of an obstructed upper airway and should be corrected by either repositioning the head and neck or lessening the sedation. A patient who stops snoring should be evaluated for complete airway obstruction. SPs should be attentive to possible depression of the chin (e.g. during dental work) and flexion of the neck with deepening of sedation. Since airway patency is directly related to depth of sedation, monitoring of airway patency should be part of every level of sedation.

7.5 Oxygenation and mucosal colour

These should be observed continuously at all levels of sedation.

7.6 Breathing, respiratory rate and ventilation

The breathing pattern and movement of the chest and abdomen should be observed for the duration of the procedure. Breathing should be rhythmic. Signs to watch out for are paradoxical breathing, rib retraction, use of accessory muscles and tracheal tug, which all may indicate airway obstruction. Stridor or coughing and bucking might be the earliest indication of laryngospasm and requires immediate action.

The respiratory rate should be recorded intermittently. When a capnograph is used, the respiratory rate will be displayed continuously. The use of a precordial stethoscope may be useful if capnography is unavailable.

Since the effect of drugs on a patient's breathing and ventilation may be unpredictable at all levels of sedation, these should be monitored irrespective of the level of sedation.

Capnography, the so-called gold standard for monitoring ventilation, monitors the end-tidal concentration of carbon dioxide, which is believed to be a more sensitive monitor to alveolar hypoventilation than pulse oximetry. Askar et al.,[14] in a systematic review and meta-analysis, showed that capnography monitoring reduced the incidence of hypoxemia during PSA. They

also suggest that applying capnography monitoring during PSA would reduce the incidence of hypoxic events.

However, healthy patients (i.e. ASA I and II patients) do not require CO_2 monitoring and since only ASA I and II patients qualify for sedation outside of a hospital operating theatre, the use of capnography in these instances is still controversial. Therefore, capnography is not mandatory for moderate sedation, but it is highly recommended in fragile ASA II children, obese children, children with OSA, and children with respiratory problems like asthma. For prolonged sedation (e.g. some plastic and dental procedures), it is highly recommended that capnography be used for deep sedation and analgesia, as there may be a higher incidence of respiratory depression.

Capnography techniques using nasal cannulae, side-stream analysis and transcutaneous methods are well-tolerated by children undergoing PSA. Even though capnography should never replace clinical monitoring of ventilation or respiration, it is highly recommended that capnography should be part of the standard minimum monitoring techniques in children.

7.7 Heart rate and rhythm

Heart rate and rhythm are considered baseline vital signs and should be recorded on a sedation monitoring flow chart (Appendix 7) before the onset of the sedation. In moderate sedation, in ASA I and II patients, where continuous verbal contact with the patient is maintained, an electrocardiogram (ECG) is not essential and pulse rate, as recorded by pulse oximetry, should be sufficient. However, it may be very difficult to maintain continuous verbal contact with young children and an ECG, which is available on many of the current monitoring devices, should be used. For prolonged sedation or in fragile ASA II patients, ECG monitoring is indicated when standard or advanced techniques are used. Any patient with underlying cardiovascular disease should be monitored with an ECG.

7.8 Non-invasive blood pressure

NIBP must be monitored at all levels of sedation, except maybe for minimal sedation or anxiolysis of short duration. It is important to ensure that the size of the NIBP cuff is appropriate for the age and weight of the child, to ensure accurate measurements.

7.9 Operator-dependent factors

These factors may include airway manipulation, dose of administered local anaesthetic and environmental factors (e.g. room temperature) and must also be monitored.

7.10 Minimum monitoring standards

- ASA I and ASA II patients: pulse oximetry and NIBP
- Fragile ASA II patients, prolonged sedation and patients under deep sedation: pulse oximetry, NIBP, ECG and capnography

Baseline vital signs must be recorded *prior* to the commencement of sedation. Thereafter, the child must be monitored at regular intervals during the procedure and the recovery period, until they are discharged from the facility. The child must never be left alone or unmonitored until fully recovered from all sedative, analgesic and dissociative drugs.

It is recommended that observations be recorded on a sedation monitoring flow chart (Appendix 7). The SP, or staff member designated to monitor the patient, must be in attendance at the patient's side at all times, and must be competent to recognise, and rescue the patient, from any complications.

8. Personnel

Whenever sedation is performed, there should be no less than two people present (i.e. the operator who is performing the procedure and an appropriately trained observer). If the operator also provides the sedation for the procedure (i.e. a single operator-SP), the observer will be responsible for monitoring the child under sedation and to assist the operator in the case of adverse events. If the operator expects of the observer to take part in the sedation (e.g. by topping up the sedation), the observer will only be responsible for monitoring the patient and providing sedation as requested by the operator. The observer will not be able to assist with the procedure and the operator takes full responsibility for the sedation as well as the procedure. Since children often need deep sedation for procedures to be completed safely, this scenario is only acceptable for brief, minor procedures[6] and where minimal sedation with basic or standard techniques are used.

For all other procedures, especially when advanced sedation techniques are used, a three-person model should be followed, with a team consisting of:

- the operator with an assistant responsible to only help him,
- a dedicated SP, and
- an assistant for the SP.

8.1 The sedation practitioner

8.1.1 Qualifications and training requirements

Relevant qualifications and regular updating of knowledge and skills remain the foundation of safe sedation practice. It is recommended that the SP should:

- have a primary, registered medical qualification,
- have full registration with the HPCSA as appropriate,