EMERGENCY DEPARTMENT – DISSOCIATIVE SEDATION WITH KETAMINE

This guidance does not override the individual responsibility of health professionals to make appropriate decision according to the circumstances of the individual patient in consultation with the patient and /or carer. Health care professionals must be prepared to justify any deviation from this guidance.

INTRODUCTION

Procedural sedation may be required to perform painful or distressing interventions in the Emergency Department. This is applicable to both children and adults. It is essential that this is carried out in a safe place, in a safe manner, by suitably qualified people. Ketamine is a unique agent that can be used for this purpose. **However**, all usual techniques and alternatives should still be considered first, particularly in the paediatric population e,g. play / distraction therapy, oral / intranasal analgesia, Entonox®, topical / local anaesthesia, and appropriate immobilisation of an injured limb. For procedures that are likely to be prolonged, admitting the patient for general anaesthesia should be considered.

PATIENTS COVERED BY THE GUIDELINE:

Adults and children attending the Emergency Department who are deemed suitable for, and require, procedural sedation using ketamine.

THIS GUIDELINE IS FOR USE BY THE FOLLOWING STAFF GROUPS :

Senior and (supervised) middle grade emergency medicine doctors experienced in the use of ketamine as a procedural sedative in the Emergency Department. The sedationist must be able to manage potential complications (see page 4).

Lead Clinician(s)

Nicholas Turley	Consultant in Emergency Medicine Worcestershire Royal Hospital
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INTRODUCTION

Procedural sedation refers to a technique of administering sedatives or dissociative agents with or without analgesics to induce a state which allows patients to tolerate unpleasant procedures while maintaining cardiorespiratory function. Specifically the drug, dose and technique should allow patients to maintain airway reflexes independently and continuously. The dissociative agent ketamine is ideally suited for this use. Dissociative sedation is described as "a trancelike cataleptic state ... characterized by profound analgesia and amnesia, with retention of protective airway reflexes, spontaneous respirations, and cardiopulmonary stability".[1]

Ketamine ($C_{13}H_{16}ClNO$) is a unique compound in common use around the world today. It was developed in 1962 as a human and veterinary anaesthetic, derived from the compound phencyclidine, but was rapidly overtaken by more advanced drugs. In the Vietnam War it was widely used as a battlefield analgesic and dissociative anaesthetic; more recently this continues in the third world where monitoring equipment is often lacking or at best rudimentary. The evidence base for the safe use of ketamine by non-anaesthetists (globally) is huge.[2,3]

However, due to ketamine's unique profile, it can pose unique problems for the emergency physician. Probably the most challenging is the relatively common and well recognised agitation (with or without hallucinations) that can occur during the recovery period. In addition, children may experience nightmares following a ketamine sedation, although this is transient and will have no long lasting effects. Clinicians therefore must have experience of using ketamine for sedation in the ED, be aware of these and other potential side effects, and be in a position to confidently treat them where necessary. Parents must be made aware of possible delayed effects (in writing) and be advised to return to the ED if concerned. This is covered further on in the guideline.

In the Emergency Department (ED) setting, ketamine sedation is recognised internationally and is in widespread use.[4-7] It is also the extrication drug of choice for pre-hospital practitioners due to its unique properties and safety profile. The American College of Emergency Physicians, the Australasian College of Emergency Medicine, and the Royal College of Emergency Medicine have all published guidelines for its use as a paediatric procedural sedative in the ED.[8]

Ketamine is fundamentally different from other procedural sedation agents, and does not conform to the continuum tenet. Arguably this increases its attraction for the clinician. Dissociation is either present or absent, with a narrow transition zone; this dissociated state has no observable progression or depth, therefore further dosing does not result in deeper sedation, as is the case with opioids, hypnotics and inhalational agents. With non-dissociative agents this would result in an increased likelihood of airway and respiratory compromise. Patients have recovered uneventfully from up to 100 times the recommended dose of ketamine, thus there is a wide margin of safety.

Its effects are exerted through a physiological disconnecting of the thalamoneocortical and limbic systems, in essence dissociating the central nervous system from the outside world. This so-called 'cataleptic state' is characterised by potent analgesia, amnesia and sedation, but with airway, respiratory and CVS reflexes left intact (brainstem function is preserved). Clinically, the patient doses not respond to noxious stimuli or pain, but often the eyes remain open and glazed, with horizontal nystagmus common. Functional residual capacity and tidal volume are both also preserved.[4]

Pharmacologically, Ketamine is primarily a non-competitive antagonist of the NMDA (N-methyl D-aspartate) receptor in the brain, which opens in response to binding of the neurotransmitters glutamate and glycine. Thus blockage of these receptors prevents the passage of electrical impulses through these neural networks (see above). This NMDA receptor mediates the analgesic effects of ketamine at low doses. Evidence for this is reinforced by the fact that naloxone, an opioid antagonist, does not reverse the analgesia. At high, fully anesthetic level doses, ketamine has also been found to bind to opioid mu and sigma receptors. Thus loss of consciousness that occurs at high doses may be partly due to binding at these receptors. The effects seem to take place mainly in the hippocampal formation and in the prefrontal cortex. This evidence, along with the NMDA receptor's connection with the memory formation process, explains ketamine's profound effects on memory and thought. Sympathomimetic actions result in increases in heart rate and blood pressure (making it useful in the haemodynamically compromised patient) and bronchial smooth muscle relaxation (making it a useful induction agent in the context of life-threatening acute asthma).[4,9,10]

INDICATIONS

Examples of brief painful or emotionally disturbing procedures performed in the ED include:

Suturing
Fracture reduction / manipulation
Reduction of dislocated joints
Burn management
Incision and drainage of abscess
Tube thoracostomy placement
Foreign body removal
Wound exploration / irrigation

CONTRAINDICATIONS – ABSOLUTE

Age under 2 years
Psychotic illness / behavioural problems / mental disability / developmental delay
Pregnancy / breastfeeding

CONTRAINDICATIONS – RELATIVE

Procedure likely to stimulate oropharynx
Abnormal or unstable airway anatomy e.g. tracheal surgery or stenosis
Active respiratory disease / infection
Known cardiac disease / hypertension
Glaucoma / acute globe injury
Uncontrolled epilepsy
Altered conscious level due to acute illness or injury
Porphyria
Thyroid disease
Cerebrovascular accident
Drug / alcohol intoxication
ASA grade 3 or more – these patients should be discussed with a consultant prior to sedation.

NEED FOR FASTING

Traditional anaesthetic practice favours a period of fasting prior to procedures requiring sedation. However there is no evidence to suggest that complications rates are reduced with a period of fasting, as long as the procedural sedation is carried out safely and effectively by an experienced practitioner. The urgency of the procedure should be balanced against the fasting state of the child. Recent food intake should not be viewed as an absolute contraindication.

SIDE EFFECTS

- Mild Agitation (20%)
- Hypersalivation and lacrimation (<10%) – recent evidence suggests anticholingeric (e.g. atropine) co-administration is not necessary. [11,12]
- Involuntary movements / ataxia (5%) [14]
- Vomiting – 5-10% of children will vomit in the recovery period [14]
- Transient Rash (10%) [14]

COMPLICATIONS

Published data puts the overall complication rate at 1.4% in children.[13] Historically the major concerns surrounding the use of ketamine refer to the risk of laryngospasm and emergence phenomena. Large series of data from the paediatric population put this in to perspective: [7, 14]

- Apnoea – this can occur transiently after rapid high dose IV bolusing of ketamine but is rare (0.3%). Airway repositioning or brief bag-valve-mask ventilation has been occasionally required. IV administration over 60 seconds eliminates this problem.
- Airway misalignment / Noisy Breathing (<1%) – basic airway repositioning is usually sufficient to resolve this rare event. So called 'ketamine breathing', deep sighing respirations, can be mis-interpreted as stridor, and again is minimised with correct head positioning.
- Laryngospasm – an extremely rare transient event in pooled data of paediatric studies (0.3%).[4, 14] The incidence of requirement for intubation has been reported as 0.02%[14]. The risk appears higher in children who undergo stimulation of the posterior pharynx, or who have active respiratory disease (e.g. URTI) which are therefore contraindications to ketamine use for procedural sedation in the emergency department. Again, airway and patient positioning and occasionally bag-valve-mask ventilation will usually suffice. A meta-analysis in 2008 showed that low IM doses of ketamine (<3.0 mg/kg) exhibited significantly less overall airway and respiratory adverse events. There were no occurrences of either laryngospasm or apnoea in the 682 children receiving lower IM doses.[14]
- Emergence phenomena – ketamine is known to induce agitation and hallucinations in both adults and children as the dissociative effects wear off. In children under 10 years, it is still rare (1.6%), but can effect up to 1 in 3 adults. This can be reduced by positive psychology prior to drug administration ('have a happy dream'), and can be mitigated with benzodiazepines on occurrence in the recovery period; prophylactic administration however is not necessary[14]. There is no evidence that ketamine causes any long term

change in personality or intellectual function, although is known to activate psychosis in schizophrenics.[3]

THE PROCEDURE

Preparation

The ED consultant and Nurse-in-charge **must** be made aware if procedural sedation of a child is being planned.

A full history and examination of the patient is mandatory, with special emphasis paid to possible contraindications, allergies and last meal. If possible the weight of the patient should be determined.

Written consent from the patient or parent / guardian must be obtained. The usual rules apply, and will include a discussion explaining the procedure, the risks, and the possible side effects of both the treatment and the dissociative sedation. Written patient/parent information leaflets should be provided.

Environment

All sedations will occur in the Resuscitation Room of the ED. Equipment must be checked before the procedure (required equipment is listed below).

- **Exit block and ED overcrowding are currently major challenges**. Patient safety must be a priority. If there is no available capacity in resus, or performing the procedure is likely to impact on the provision of emergency resuscitative care to other patients who require the resus room facilities, careful consideration must be given to either delaying the procedure or referring the patient/child to the relevant specialty service to perform the procedure in theatre or other appropriate clinical area that is not within the ED.
- **Sedation at night or times of limited ED staffing**. The responsible clinician for sedation needs to ensure that whilst procedural sedation with ketamine is being undertaken that the needs of the rest of the emergency department are going to be adequately met. This assumes it will be a senor doctor perform the ketamine procedural sedation.

Personnel

- Sedation and airway management – senior or middle grade doctor with experience and knowledge of ketamine dissociative sedation, and airway competencies. This may occur under supervision.
- Procedure – practitioner performing the procedure should be competent to perform the procedure or there should be an additional member or qualified staff providing supervision.
- ED Nurse – paediatric trained if applicable, and experienced in use of monitoring equipment in Resus.

Equipment

- Tilting trolley
- Oxygen supply and non-rebreather mask
- Suction
- Airway adjuncts
- Bag-valve-mask
- Advanced airway kit including laryngoscopes, bougie and ET tubes
- ECG monitoring
- Pulse oximeter
- End tidal CO_2 monitor
- Non-invasive blood pressure cuff and monitoring
- Procedural Sedation proforma and age-appropriate observation chart
- Advanced life support drugs and box
- Equipment for IV cannulation.
- Ketamine (50mg/ml solution for IM, 10mg/ml solution for IV)
- Any equipment required for performing the procedure (e.g. suture kit, plastering materials, chest drain kit, dressings etc.).

- For children:

    - Where time allows, a topical local anaesthetic such as EMLA or Ametop should be used to minimise the pain of cannulation/intramuscular injection.

    - a weight-based KIDS drug calculation chart should be printed from https://kids.bwc.nhs.uk/ to give doses of other important medicines in case they are required to manage potential emergency airway complications.

Interactive monitoring of the patient's vital signs and clinical state must occur by the sedationist throughout the procedure. Any concerns regarding the airway and / or breathing must be addressed by the sedationist promptly. The bare minimum monitoring for ketamine sedation is pulse oximetry and ECG monitoring (in adults); if possible non-invasive end tidal CO_2 monitoring should be used. Repeated blood pressure measurements should be avoided. Oxygen supplementation, although generally recommended during sedation, may not be essential during ketamine sedation. The evidence for the safe use of ketamine in patients breathing room air is vast;[3,13] however, for the purposes of this guideline, oxygen should be administered in the ED Resuscitation Room.

Sedation

An initial dose should be given that is age/weight appropriate.

Sedation effects are usually seen within 1 minute of an IV dose, or anywhere between 1-8 minutes after an IM dose.

Adequate sedation is usually indicated by loss of response to verbal stimuli, glazing of the eyes and nystagmus. Heart rate, blood pressure, and respiratory rate may all increase slightly. Lacrimation and salivation may occur.

Supplemental doses may be required after 5-10 mins to achieve the required dissociative sedative state.

Ketamine doses

	ADULT	CHILD
Intravenous Initial dose	**1mg/kg** (reduce dose in elderly patients to an initial dose of 10-30 mg)	**1mg/kg** Given over 60 seconds
Intravenous supplemental dose if required	**0.25-0.5mg/kg** every 5-10 mins	**0.5mg/kg** slow injection
Intramuscular Initial dose	**4-5mg/kg**	**2.5mg/kg**
Intramuscular supplemental dose if required	**2 - 2.5mg/kg** every 5-10 mins	**1mg/kg** After 5-10mins

Recovery period

It is generally accepted that patients should be allowed to wake in a dimly lit, calm environment to reduce the risk of emergence reactions, although the evidence is limited. Monitoring should continue, and the sedationist needs to be available during this period to manage adverse reactions or vomiting. Once the patient is alert, verbalising normally and making purposeful movements (usually within 60-120 minutes), he or she can be stepped down.

Discharge can normally occur within 60 minutes of recovery, but patients will need a responsible adult to take them home, as ataxia and vomiting may not have completely passed. Driving should be avoided for 24 hours.

Management of Complications and Severe Emergence Phenomena

These are rare

- If the patient is suffering severe emergence reactions and is significantly distressed then small increments of midazolam may be given in doses of 0.05 – 0.1 mg/kg.

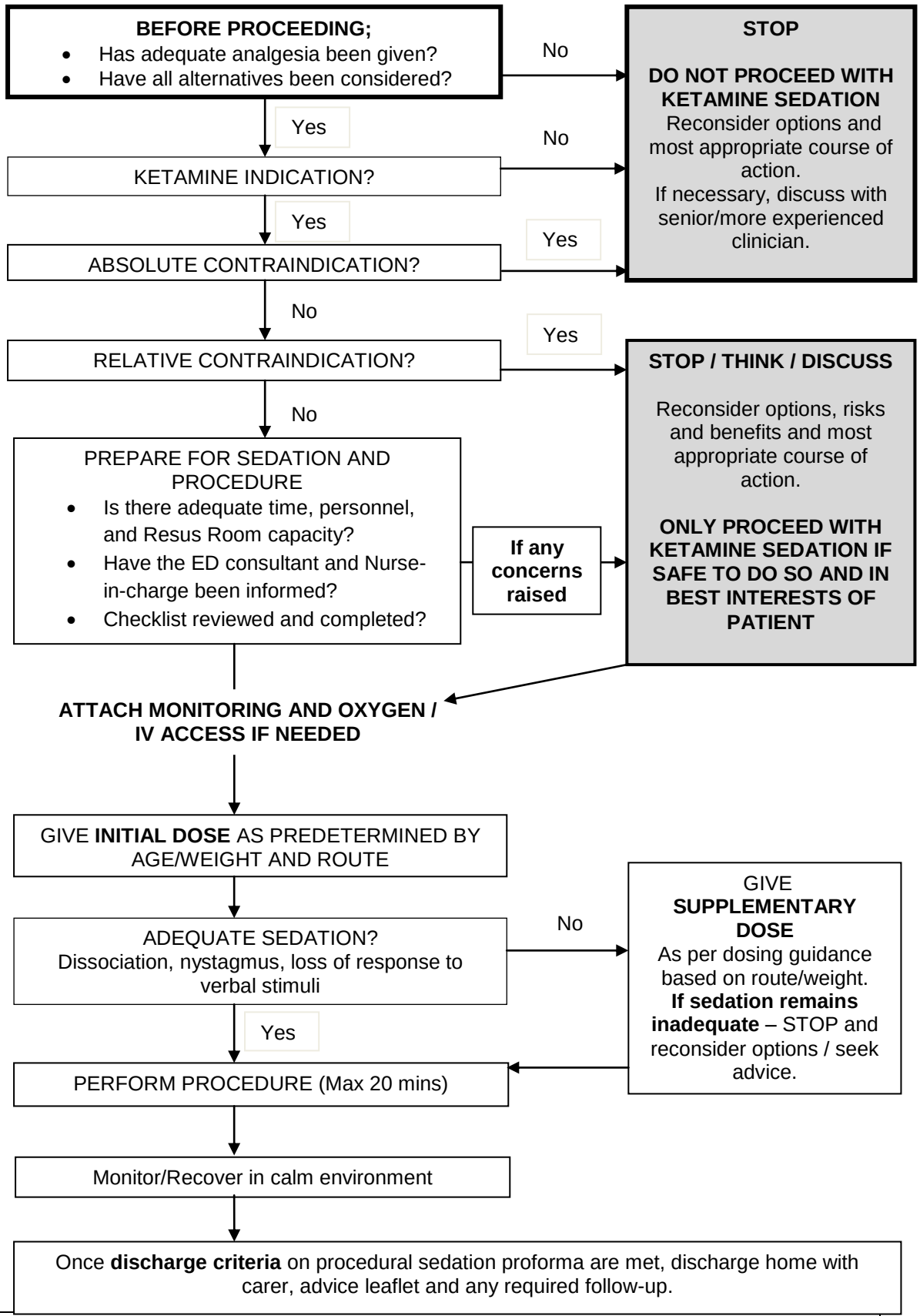
- If intractable vomiting occurs post procedure consider use of IV Ondansetron in a dose of 0.1mg/kg (maximum of 4mg) by slow intravenous injection.

- Laryngospasm
  - If the child develops stridor attempt airway repositioning, gently try suctioning any secretions and apply a high flow oxygen mask with a reservoir bag.
  - If the child is saturating appropriately continue the procedure.
  - If the stridor gets worse or the child starts de-saturating let the child breathe oxygen via a bag-valve- mask. Stop the procedure.
  - If de-saturation reaches below 92% start gentle bag-valve-mask ventilation.
  - If the stridor worsens further, seek anaesthetic assistance and prepare relevant anaesthestic agent (suxamethonium).

Appendices

Appendix 1 – Paediatric Ketamine Sedation Protocol
Appendix 2 – Ketamine Sedation: Infomation for Parent / Care-giver
Appendix 3 – Ketamine Sedation Checklist

Appendix 1 DISSOCIATIVE SEDATION WITH KETAMINE



APPENDIX 2

Ketamine Sedation: Information for Parent / Care-giver

ABOUT KETAMINE:

Ketamine is a medication used for sedating patients who require a brief painful or unpleasant procedure. It lasts for about half an hour.

Ketamine is injected either into a muscle (like a vaccination) or into a vein via a drip.

Under sedation, patients can appear awake but they are unaware of their surroundings. They may drool saliva, have watering of the eyes and may breathe loudly. Occasionally they can make random, purposeless movements or have twitching movements of the eyes, but they are unaware of what's going on.

SAFETY AND SIDE EFFECTS

Ketamine is very safe when used appropriately. Less than 1 in 100 children will experience a serious side-effect. Rarely, some patients will require help with their breathing while sedated. In 0.02% of cases your child may need to be given a general anaesthetic with a breathing tube placed in their windpipe to help their breathing.

Occasionally some patients will experience bad dreams either during the sedation or afterwards. This is transient and has no lasting effects on the patient. For children, it is particularly helpful to encourage them to imagine positive things before the injection. A calm manner and distraction with music, bubbles, toys etc. can also be helpful.

AFTER THE PROCEDURE

Patients can generally go home 90 minutes following the sedation. This is when they are alert, talking and walking unaided. Vomiting may occur, but again this will resolve quickly.

Patients may remain mildly sleepy or clumsy afterwards. They should be closely supervised for the first 8 hours following discharge, and (if applicable) for the next 24 hours **should not**:

- Get involved in strenuous or sporting activities.
- Use play equipment such as monkey bars, climbing frames etc.

Do let the patient sleep, and eat and drink only small amounts to minimise the risk of vomiting.

If you have any concerns that your child may be experiencing problems relating to the sedation that they have received, please contact the local Emergency Department to discuss the issues with a senior doctor or nurse.

APPENDIX 3

Checklist for procedural sedation with ketamine (see also sedation proforma)

Documentation	-	Procedural sedation proforma
	-	For Children : Weight-based KIDS drug calculation chart printed
Patient	-	Past medical history
		Drug history
		Last ate / drank
		Weight
		Informed consent
Environment	-	Resus Room
Equipment	-	Tiltable trolley
		Suction
		Oxygen
		Airway equipment checked
		Monitoring available SpO2
		ECG
		ETCO2
		NIBP
		IV access
		Equipment for procedure
		Emergency drugs available
Ketamine	-	Route (IV or IM)
		Concentration
		Calculation
		Volume
Personnel	-	The responsible clinician for sedation
		The responsible clinician for the Procedure
		Resus room Nurse
Recovery	-	Observations
Discharge	-	Alert
		Talking
		Walking
		Normal vital signs
		Written information / instructions

MONITORING TOOL

Suggested indicators for quality assurance:

Number of ketamine procedures carried out
Indication for sedation
Grade of the responsible clinician for sedation
Completion Procedural Sedation Proforma
Informed consent evidence
Monitoring documentation
Complications – airway / breathing / CVS / saturations / emergence reactions
Information leaflet given (general and specific)
Unplanned reattendance

How will monitoring be carried out? **Audit**

Who will monitor compliance with the guideline? **ED Consultant**

STANDARDS	%	CLINICAL EXCEPTIONS
Appropriate indication	100%	Consultant decision
Sedationist middle grade or above with advanced airway skills	100%	Supervised junior doctor
Checklist completed	100%	
Informed consent	100%	
Observations documentation	100%	
Complications	Serious adverse event <1%	Excludes vomiting / emergence reaction
Information leaflet given	100%	
Unplanned reattendance 48hrs	<5%	

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CONTRIBUTION LIST

Key individuals involved in developing the document

Name	Designation
Nicholas Turley	Consultant Emergency Medicine

Circulated to the following individuals for comments

Name	Designation
Beth Williams	Consultant Emergency Medicine, WRH
James France	Consultant Emergency Medicine, WRH
Ian Levett	Consultant Emergency Medicine, WRH
Jules Walton	Consultant Emergency Medicine, WRH
Ross Hodson	Consultant Emergency Medicine, WRH
James Risley	Consultant Emergency Medicine, WRH
Abdul Jalil	Consultant Emergency Medicine, AH
Faisal Fasih	Consultant Emergency Medicine, AH
Tahir Naqvi	Consultant Emergency Medicine, AH
Mehtab Khan	Consultant Emergency Medicine, AH
Amir Thakur	Consultant Emergency Medicine, AH
Clare Bush	Matron, ED, WRH
Marc Tarrant	Matron, ED, AH
Tina Evans	Pharmacist Team Lead Urgent Care
Sarah Scott	Lead Paediatric Pharmacist

Circulated to the following CD's/Heads of dept for comments from their directorates / departments

Name	Directorate / Department
Julian Berlet	DMD Support Services including Anaesthesia / ICU
Angus Thompson	DMD Women and Childrens
Paul Rajjayabun	DMD Surgery
Jules Walton	DMD Urgent Care
Jasper Trevelyan	DMD Specialty Medicine

Circulated to the chair of the following committee's / groups for comments

Name	Committee / group
Vicky Morris	Medicines Safety Committee