Introducing the Guideline on the Management of a Child with a Decreased Conscious Level: A Nationally Developed Evidence-based Guideline for Hospital Practitioners (The Paediatric Accident and Emergency Research Group, The University of Nottingham)

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Abstract
A child with decreased conscious level is a challenging medical problem to health care professionals. The present guideline was developed on an evidence based approach. It facilitate doctors in dealing the problem systemically. Easy to follow and detailed algorithms (Appendix A1-A7) were included to streamline the investigations and treatments. Latest literatures after the publication of the guideline were reviewed and no new evidence was found in subsequent reviews to justify any amendment of the original recommendations. Discussions on local adoption are highlighted in the conclusion of the present paper.

Key words
Adolescent; Child; Infant; Practice guideline; Unconsciousness

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Background

Children presenting with decreased conscious level can be due to a variety of reasons. It was found that about 30 children out of every 100,000 children per year would present in coma not caused by trauma. The overall mortality in this group of children could be up to 46%. While some causes are obvious, others could be much more obscure. The present evidence-based guideline was developed in 2005 to help front line doctors approach the problem systematically, recognise clinically important problems, investigate and treat them.

The scope of the guideline confines to any child <18 years old, with a Glasgow coma score less than 15 or not being Alert (i.e. responding only to Voice, Pain or being Unresponsive) on the AVPU score.

This guideline should not be applied to preterm infants, children with known cause of their decreased conscious level and children with a chronic abnormal conscious level state.

The guideline mainly targets on the problems that can be identified and treated within the first hours of presenting to a hospital. Specific conditions or diseases which require specific treatment protocols are not covered in detail.

The purposes of our working group in reviewing the original guideline are:

I) To review the methodology of the guideline and the appraisal summary prepared by the Royal College of Paediatrics and Child Health, UK.

II) To review latest literature after the guideline was published in 2005 and to see if any major changes are required.

III) To assess the applicability of the guideline to the local Hospital Authority hospitals.

I) Introduction to Methodology of the Original Guideline

The guideline was produced by the University of Nottingham, Paediatric Accident and Emergency Research Group which included medical and nursing professionals from paediatric emergency medicine, paediatric intensive care, metabolic medicine, neurology, general paediatrics, clinical chemistry, patient and lay representatives plus input from other stakeholder subspecialty societies or associations.

Literature was electronically and hand searched between March 2004 and July 2005 for a list of clinically relevant questions drawn up according to the scope and targeted clinical conditions the guideline aimed to answer. Papers selected were then appraised on methodological quality using critical appraisal checklist developed by the Scottish Intercollegiate Guideline Network and were given level of evidence according to the criteria developed by the Oxford Centre for Evidence-based Medicine.

Papers which contributed to grade A and B recommendations were appraised by second member of the Guideline Development Group to ensure validity of the appraisal methodology.

When there was no published evidence found, a consensus approach was adopted. The guideline group utilised a large multi-professional Delphi panel for the Delphi Consensus process which enabled members of the panel to have their opinions registered anonymously, analysed, and then fed back to the same panel for further consideration. The whole panel results were reviewed. The group would help members to reconsider their initial position and panel members were at liberty to change their original opinion or their initial position. Consensus was aimed to achieve after one, two or three rounds of the Delphi panel discussion. The guideline recommendation and good practice points were thus based on agreement using evidence tables or the Delphi consensus results. Disagreement on wordings was settled by discussion or consultation with stakeholder groups.

The draft guideline was then reviewed by all stakeholder groups, followed by an open forum discussion before it was finalised.

Formal appraisal process for the guideline were then performed by the Royal College of Pediatrics and Child Health and the British Association for Accident and Emergency Medicine in November 2005 using the AGREE instrument to assess the methodology quality followed by independent reviewers to examine the original research papers deriving the grade A and B recommendations in the guideline. Only minor regrading of the recommendation levels was made. An algorithm for the patient management was prepared (Appendix A1-A7).
II) Review of the Latest Literature After the Guideline was Published in 2005

The guideline was originally planned to be reviewed 2 years after being published. Our working group thus initiated a simplified but systematic literature search for the latest evidence in the year 2005 and after.

Papers were searched electronically via the Hospital Authority eKG platform using database: Embase, Medline, and all All EBM Reviews – Cochrane DSR, ACP Journal Club, DARE, CCTR, CMR, HTA, and NHSEED and employing keywords: altered consciousness or consciousness disorder and the disease or clinical condition categories of the original guideline. Search was done around May 2009 for review articles and with patient age less than 18 year old and later search was repeated in early November 2009 to include additional keywords: meta analysis, systematic review, unconsciousness, transient loss of consciousness, coma, stupor, drowsiness, obtundation and delirium. Additional searches were done in 2010 on selected topics, especially on those with no Delphi consensus reached in the original guideline (investigation of borderline hypoglycaemia and management of raised intracranial pressure – fluid regime, use of mannitol or hypertonic saline and indication of invasive monitoring device).

After the searches, systematic reviews or evidence based guidelines were identified on the topics of herpes simplex encephalitis, bacterial meningitis and meta analysis from Cochrane Database and Systemic Review on use of steroid in tuberculosis meningitis and use of mannitol for acute traumatic brain injury.

a) Herpes simplex encephalitis – A review article by De Tiege et al was published in 2008. The content of the review was in line with the recommendations made by the Guideline on Herpes simplex encephalitis.

b) Bacterial meningitis – The source articles of the review published in 2009 by Prasad et al concerning the use of corticosteroid were already included in the reference list of the original guideline. Another meta-analysis of individual patient data extracted from recent randomised, double-blind, placebo-controlled trials was published in March 2010. Though adjunctive dexamethasone treatment does not seem to significantly reduce death, dexamethasone seemed to reduce hearing loss among survivors. This is line with the finding of another meta-analysis and the latest review from the Cochrane collaboration review finding that corticosteroid dexamethasone leads to a reduction in hearing loss. The recent NICE guideline also confirmed the beneficial effect of early (before or with the first dose antibiotics) steroid treatment on long term neurological sequelae. The beneficial effect on reducing severe hearing loss can also be observed when steroid is given shortly after the first dose of antibiotics (5 RCTs involving 501 children, RR 0.29, 95% CI 0.14 to 0.63, p = 0.002). A steroid regime was thus proposed in the NICE guideline for patients older than 3 months old with high likelihood of bacterial meningitis.

c) Use of steroid in tuberculous meningitis – The original guideline does not cover the treatment of the tuberculous meningitis. In a systematic review by Prasad et al involving seven trials, 1140 participants (including 411 deaths) with all having used dexamethasone or prednisolone, corticosteroids reduced the risk of death (RR 0.78, 95% CI 0.67 to 0.91). Data on disabling residual neurological deficit from three trials showed that corticosteroids reduce the risk of death or disabling residual neurological deficit (RR 0.82, 95% CI 0.70 to 0.97). Hence, corticosteroids are recommended in HIV-negative people with tuberculous meningitis to reduce death and disabling residual neurological deficit. The use of steroid with concomitant anti-tuberculous treatment is included in the NICE guideline.

d) Use of mannitol for acute traumatic brain injury – In the review by Wakai and Robert, four trials published in 1984 to 2003 were reviewed but there was no articles included after the present guideline was published. Thus there is no new reliable evidence to make recommendations on the use of mannitol in the management of patients with traumatic brain injury. During the literature search, latest articles possibly related to guideline grade A or B recommendations were then appraised on their methodological quality similar to the approach as stipulated in the original guideline and discussed in the Working group meetings. After rounds of discussions, it was finally concluded that there are no new evidence to justify any amendment of the original grade A and B recommendations of the guideline.
III) The Applicability of the Guideline to the Local Hospital Authority Hospitals

Our working group acknowledges that certain recommendations of the original guideline may need local modifications or considerations.

a) Core laboratory investigations for metabolic causes of reduced conscious level and hypoglycaemia in children with no other clear explanation.
   - Local surveys were done covering all Hospital Authority paediatric departments with emergency admissions. All the core investigations are available within their own cluster hospitals. However, some of the investigations for hypoglycaemia are not available locally, like plasma insulin, growth hormone, free fatty acid, plasma beta-hydroxybutyrate, acyl-carnitine profile and urine organic acid. After some follow up arrangements, they can now be accessed through the two university hospitals (Prince of Wales and Queen Mary Hospitals) or through Princess Margaret and Queen Elizabeth Hospitals.

b) Service arrangements like timing of consultation of experienced paediatrician, paediatric subspecialist or specialist of other discipline.
   - While recruiting subspecialist or experts in other fields early in the patient care process is the trend, our working group found these service arrangement recommendation being beyond the scope of our working group review. Differences in medical systems and variations in the settings and organisations of individual hospitals may imply some local adaptation being required before adoption of these recommendations.

c) Conditions identified in the guideline requiring management protocol agreed at a local level.
   - Specific conditions like the management of raised intracranial pressure are recommended to have local guidelines. On the other hand, though the guideline recommends the NICE guideline for the management of diabetes ketoacidosis, it is envisaged that there could also be minor variation among local departments in fine tuning the management of the diabetes ketoacidosis patients.

d) Peri-arrest arrangement or investigations taken at post mortem.
   - The original guideline has grade D recommendations on certain tests to be performed based on grade 5 evidence (expert opinions). While these are useful references, it is worth noting that Hospital Authority has also issued a Guidance note on Perimortem / Postmortem Specimen Collection for Paediatric Patients suspected of unknown infectious diseases in July 2009. In the local guidance notes, tests for toxicology and inborn errors of metabolism are also included. Individual hospitals are advised to review the local guidance note and to liaise with the local pathology department accordingly.

Overall Guideline Review Summary

The present guideline together with the appraisal summary from Royal College of Paediatrics and Child Health and British Association for Emergency Medicine provide concise information and an easy to follow algorithm based on available evidence and consensus of a large representative group of different disciplines. Though the guideline was due for revision in 2007, we could not find new evidence (focused systematic search up to 2009) to justify any amendment of the grade A and B recommendation of the guideline. Additional evidences were noted on the use of steroid in tuberculous meningitis and meningitis likely of bacterial origin. Laboratory investigations for unclear causes of altered conscious are now streamlined in all Hospital Authority paediatric departments after local surveys and follow up actions. Recently, some has advocated including the investigation of poisoning, especially on carbon monoxide poisoning in the use of the guideline Individual departments are encouraged to explore and consolidate the consultation mechanism of subspecialists and the peri-arrest arrangement of investigations in their local setting if required.
References


21. Guidance note on Perimortem / Postmortem Specimen Collection for Paediatric Patients suspected of unknown infectious diseases issued on 3 July 2009, Hospital Authority (Ref: HA 752/10/38/5/2).


Appendix

(A1-A7) Algorithm. The management of a child (aged 0-18 years) with a decreased conscious level (http://www.nottingham.ac.uk/paediatric-guideline/Guideline%20algorithm.pdf) (With kind permission from Dr Richard Bowker, lead author of the Paediatric Accident and Emergency Research Group which developed the guideline and algorithm).
Appendix A1  Guideline for the management of a child aged 0-18 years with a decreased conscious level.

Explanatory notes
Recommendations marked with the symbol (A) or (B) are based on the highest quality of evidence

Entry criteria
The following algorithm should be used for children aged 0 – 18 years who present to hospital with a reduced level of consciousness. This is defined as scoring <15 on the Glasgow Coma Scale (GCS) modified for children or responding only to voice, pain or being unresponsive on the AVPU scale. Ensure the child is maximally roused from sleep before recording conscious level.

Exclusion criteria
Infants on a neonatal intensive care unit.
Children with a known condition for episodes of reduced conscious level (e.g. epilepsy, diabetes) where a management plan is already agreed upon.
Children with learning disabilities, whose score on the GCS is < 15 when they are healthy.

In certain children with reduced conscious level, it may be appropriate to watch and wait. However, if a decision is made to stick a needle into a child to investigate the cause, take all the samples listed as “core investigations” at the first opportunity.

Glasgow coma scale with modification for children

<table>
<thead>
<tr>
<th>Best eye response</th>
<th>Best verbal response (use one of the following)</th>
<th>Grimace response for preverbal or intubated patients</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. No eye opening</td>
<td>1. No verbal response</td>
<td>No response to pain</td>
</tr>
<tr>
<td>2. Eye opening to pain</td>
<td>2. Incomprehensible sounds</td>
<td>Mild grimace to pain</td>
</tr>
<tr>
<td>3. Eye opening to verbal command</td>
<td>3. Inappropriate words</td>
<td>Vigorous grimace to pain</td>
</tr>
<tr>
<td>4. Eyes open spontaneously</td>
<td>4. Confused</td>
<td>Less than usual spontaneous ability or only response to touch stimuli</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Best motor response</th>
<th>Best verbal response (use one of the following)</th>
<th>Grimace response for preverbal or intubated patients</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. No motor response to pain</td>
<td>1. No verbal response</td>
<td>No response to pain</td>
</tr>
<tr>
<td>2. Abnormal extension to pain</td>
<td>2. Incomprehensible sounds</td>
<td>Mild grimace to pain</td>
</tr>
<tr>
<td>3. Abnormal flexion to pain</td>
<td>3. Inappropriate words</td>
<td>Vigorous grimace to pain</td>
</tr>
<tr>
<td>4. Withdrawal to painful stimuli</td>
<td>4. Confused</td>
<td>Less than usual spontaneous ability or only response to touch stimuli</td>
</tr>
<tr>
<td>5. Localises to painful stimuli or withdraws to touch</td>
<td>Alert</td>
<td>Spontaneous normal facial / oromotor activity</td>
</tr>
<tr>
<td>6. Obey commands or performs normal spontaneous movements</td>
<td>Unresponsive</td>
<td></td>
</tr>
</tbody>
</table>

AVPU Scale

<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Alert</td>
<td>Responds to Voice</td>
<td>Responds to Pain</td>
</tr>
<tr>
<td>Unresponsive</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Appendix A2  Algorithm for the management of a child aged 0-18 years with a decreased conscious level.

**Patient entry criteria** (see A1)

- GCS < 15
- V, P or U on AVPU scale

**Assessment**

- AIRWAY
- BREATHING
- CIRCULATION
- DISABILITY

**Give oxygen**

**Consider intubation if:**
- Airway obstructed if not supported
- Airway compromised by vomiting
- Resp rate inadequate for ventilation
- O2 sats < 92% despite high flow O2 / airway opening manoeuvres
- Signs of shock despite 40ml/kg fluid
- Exhaustion
- GCS ≤ 8 or deteriorating
- Signs of raised ICP

**Monitoring**

- Heart rate *
- Resp rate *
- O2 sats *
- BP *
- Temperature
- ECG * recorded every hour
  *monitored continuously

**GCS assessment**
- If GCS < 12 every 15 mins
- If GCS 12-14 every hour

**Start urine collection**

**Core investigations**

- All children
- Capillary Glucose
  - Blood gas (capillary, venous, arterial)
  - Urinalysis (dipstick at bedside)
  - Laboratory glucose (even if Capillary glucose normal)
  - Urea and electrolytes (Na, K, Cr)
  - Liver function tests
  - Plasma ammonia
  - Full blood count
  - Blood culture
  - 1-2ml plasma
  - 1-2ml plain serum
  - 10ml urine

**History features to ask about**

- Vomiting
- Headache
- Fever
- Convulsions
- Alternating periods of consciousness
- Trauma
- Ingestion of drugs
- Presence of any drugs at home
- Any previous infant deaths in family
- Length of symptoms

**Examine the child**

**Problem list**

- Shock
- Sepsis
- Intracranial infections
- Trauma
- Metabolic illness
- Post-convulsive state

**Cause unknown**

- e.g. drug ingestion

**Management**

- Manage concurrently all the problems identified from the Problem list (see A5, A6 & A7)
Appendix A3 Identify all problems.

Several suspected problems may co-exist and need concurrent management. Identify if each problem is suspected and tick the box □. When all problems have been considered go to tables for tests and treatments (see A5, A6 & A7).

**SHOCK □ Go to table 1**

*Recognised* clinically if reduced consciousness and **one or more** of the following:
- Capillary refill > 2 seconds
- Mottled, cool extremities
- Diminished peripheral pulses
- Systolic BP < 95th percentile for age
- Decreased urine output <1ml/kg/hour

**METABOLIC ILLNESS HYPOGLYCAEMIA □ Go to table 5**

*Recognised* if reduced consciousness and capillary glucose < 2.6mmol/l (if capillary glucose 2.6 – 3.5 check glucose result from core investigations urgently)

**SEPSIS □ Go to table 2**

*Recognised* clinically if reduced consciousness and **two or more** of the following 4:
- Temp > 38°C or <36°C
- Tachycardia
- Tachypnoea
- White cell count <4000cumm or >12000cumm
- A non-blanching rash

**METABOLIC ILLNESS HYPERAMMONAEMIA □ Go to table 6**

*Recognised* if plasma ammonia > 200micromol/l

**METABOLIC ILLNESS NON-HYPERGLYCAEMIC KETOACIDOSIS □ Go to table 7**

*Recognised* if reduced consciousness and pH < 7.3 and ketones in urine without hyperglycaemia

**TRAUMA □ Go to table 3**

*Recognised* from history and examination findings

**METABOLIC ILLNESS DIABETIC KETOACIDOSIS □ Go to table 4**

*Recognised* clinically if reduced consciousness and all of the following:
- Capillary glucose > 11 mmol/l
- pH < 7.3
- Ketones in urine

**INTRACRANIAL INFECTION BACTERIAL MENINGITIS □ Go to table 7**

*Recognised* clinically if neck stiffness / pain and total summed score is 8.5 or more using the following rule:

<table>
<thead>
<tr>
<th>Symptom/sign</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>GCS ≤ 8</td>
<td>= 8</td>
</tr>
<tr>
<td>Neck stiffness</td>
<td>= 7.5</td>
</tr>
<tr>
<td>Time of symptoms</td>
<td>= 1 per each 24hrs</td>
</tr>
<tr>
<td>Vomiting</td>
<td>= 2</td>
</tr>
<tr>
<td>Cyanosis</td>
<td>= 6.5</td>
</tr>
<tr>
<td>Petechiae</td>
<td>= 4</td>
</tr>
<tr>
<td>Serum CRP = (CRP in mg/l) / 100</td>
<td>or</td>
</tr>
</tbody>
</table>

If no neck stiffness suspect bacterial meningitis if **fever and two or more** of the following 3:
- Rash
- Bulging fontanelle
- Irritability
Appendix A4  Identify all problems (continued from A3).

Several suspected problems may co-exist and need concurrent management. Identify if each problem is suspected and tick the box □. When all problems have been considered go to tables for tests and treatments (see A5, A6 & A7).

<table>
<thead>
<tr>
<th>INTRACRANIAL INFECTION</th>
<th>HYPERTENSION</th>
</tr>
</thead>
<tbody>
<tr>
<td>HERPES SIMPLEX ENCEPHALITIS (HSE) □</td>
<td>Go to table 13</td>
</tr>
<tr>
<td><strong>Recognised</strong> clinically if reduced consciousness and one or more of the following:</td>
<td></td>
</tr>
<tr>
<td>• Focal neurological signs</td>
<td></td>
</tr>
<tr>
<td>• Fluctuating GCS &gt; 6 hours</td>
<td></td>
</tr>
<tr>
<td>• The child has or has been in contact with herpetic lesions</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>INTRACRANIAL INFECTION</th>
<th>PROLONGED CONVULSION</th>
</tr>
</thead>
<tbody>
<tr>
<td>ABSCESS □</td>
<td>Go to table 14</td>
</tr>
<tr>
<td><strong>Recognised</strong> clinically if convulsion lasts &gt; 10 minutes</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>INTRACRANIAL INFECTION</th>
<th>POST-CONVULSIVE STATE</th>
</tr>
</thead>
<tbody>
<tr>
<td>TB MENINGITIS □</td>
<td>Go to table 15</td>
</tr>
<tr>
<td><strong>Recognised</strong> clinically if reduced consciousness level and focal neurological signs +/- signs of infection and / or signs of raised ICP</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>INTRACRANIAL INFECTION</th>
<th>CAUSE UNKNOWN</th>
</tr>
</thead>
<tbody>
<tr>
<td>RAISED ICP □</td>
<td>Go to table 16</td>
</tr>
<tr>
<td><strong>Recognised</strong> clinically if papilloedema or two or more of the following 5:</td>
<td></td>
</tr>
<tr>
<td>• Reduced consciousness (U on AVPU or GCS ≤ 8)</td>
<td></td>
</tr>
<tr>
<td>• Abnormal pattern of respiration</td>
<td></td>
</tr>
<tr>
<td>• Abnormal pupils</td>
<td></td>
</tr>
<tr>
<td>• Abnormal posture</td>
<td></td>
</tr>
<tr>
<td>• Abnormal doll’s eye / caloric response</td>
<td></td>
</tr>
</tbody>
</table>

Have you identified all the suspected problems?

Only move on to the tables for further tests and treatments (A5, A6 & A7) when ALL PROBLEMS have been considered.
Appendix A5  Management of all 16 identified problems.

### Table 1 SHOCK

**Investigations**
- Core Investigations
  - and look for sepsis, trauma, anaphylaxis, heart failure

**Treatment:**
- Fluid bolus: 20 ml/kg (colloid / crystalloid) and assess response
  - (Good response = ↓ tachycardia, improved capillary refill time, ↑ urine output, ↑ GCS)
  - Further fluid therapy guided by clinical response and ×60 mg may be required
  - If > 40 ml/kg has been given consider intubation / ventilation and drugs for circulatory support.

### Table 2 SEPSIS

**Investigations**
- Core Investigations and consider:
  - Coagulation studies, chest X-ray, throat swab, lumbar puncture (if safe*), urine culture (if urinalysis +ve), PCR meningitis / pneumococcus, skin swab, joint aspiration, thick/thin film, intracranial imaging (if no source detected)

**Treatment:**
- Broad spectrum IV antibiotics after appropriate cultures have been taken
- Review by experienced paediatrician within 1 hour of admission

### Table 3 TRAUMA

**Investigations**
- Imaging appropriate to examination
- Consider Core Investigations if medical collapse led to cause of trauma

**Treatment:**
- Follow ATLS guidelines

### Table 4 DIABETIC KETOACIDOSIS

**Investigations**
- Core Investigations

**Treatment:**
- Follow NICE guideline for DKA in children and young people

### Table 5 HYPOGLYCAEMIA

**Investigations**
- If lab glucose result from Core Investigations is < 2.6 mmol/l then request following tests from saved samples:
  - plasma lactate, insulin, cortisol, growth hormone, free fatty acids, betahydroxybutyrate, acyl-carnitine profile (on "Guthrie card" or saved frozen plasma) and urine amino / organic acids

**Treatment:**
- If capillary or lab glucose < 2.6 mmol/l
  - After Core Investigations taken:
    - Child < 4 weeks old give 5 ml/kg I.V. 10% glucose bolus
    - Child ≤ 4 weeks old give 2 ml/kg I.V. 10% glucose bolus
    - Start I.V. infusion 10% glucose to keep blood glucose between 4 and 7 mmol/l
    - Seek advice from endocrinologist / metabolic specialist for further management

### Table 6 HYPERAMMONAEMIA

**Investigations**
- If ammonia result from Core Investigations is > 200 micromol/l then request following from saved samples:
  - Plasma aminon acids, urine amino acids, urine organic acids, urine orotic acid and check coagulation studies

**Treatment:**
- Seek urgent advice from a metabolic specialist
- Start I.V. sodium benzoate (loading dose 250 mg/kg over 30 mins; followed by infusion 250 mg/kg over 24 hrs = both diluted in 15 ml/kg 10% glucose)
- If ammonia > 500 micromol/l or is not improving and remains between 200-500 micromol/l after 6 hours of sodium benzoate therapy, consider emergency haemodialysis

*For acute contraindications and other details regarding lumbar punctures see Table 17*
### Table 7 NON-HYPERGLYCAEMIC KETOACIDOSIS

**Investigations**
- If pH < 7.3, ketones in urine and a normal or low capillary glucose noted from core
- Investigations then request following from saved samples:
  - Plasma lactate, plasma amino acids, urine amino acids, urine organic acids

**Treatment:**
- Seek urgent advice from a metabolic specialist if child has non-hyperglycaemic ketoacidosis or plasma lactate > 15 mmol/l
- Carefully monitor fluid balance due to risk of raised ICP
- Nutrition should be re-started early to prevent catabolism

### Table 8 BACTERIAL MENINGITIS

**Investigations**
- Core Investigations and lumbar puncture (if safe*)

**Treatment:**
- Give I.V. dexamethasone 0.15 mg/kg before / with antibiotics
- Broad spectrum antibiotics (A) - Don’t delay if lumbar puncture contraindicated*

### Table 9 HERPES SIMPLEX ENCEPHALITIS (HSE)

**Investigations**
- Core Investigations and consider: MRI scan, EEG, lumbar puncture (if safe**)
  - for HSV PCR (A)

**Treatment:**
- Give I.V. aciclovir 10 mg/kg (or 500 mg/m² if aged 3 months to 12 years)
- TDS (A) - Don’t delay if lumbar puncture contraindicated*
- Treatment should continue for 14 days if HSE highly suspected
- If no ongoing clinical suspicion of HSE aciclovir can be stopped before 14 days

### Table 10 INTRACRANIAL ABSCESS

**Investigations**
- Core Investigations and CT SCAN

**Treatment:**
- Broad spectrum antibiotics after blood cultures taken
- Seek urgent advice from a paediatric neurosurgeon

### Table 11 TB MENINGITIS

**Investigations**
- Core Investigations and lumbar puncture (if safe*)(B)

**Treatment:**
- If CSF microscopy is abnormal seek urgent advice from microbiology department

### Table 12 RAISED ICP

**Investigations**
- Core Investigations and consider CT scan (A)

**Treatment:**
- Position patient’s head in midline
- Tilt patient head-up 20 degrees and avoid neck lines
- Maintenance fluids should not be hypotonic (B)
- Rate of maintenance fluids to be agreed locally
- Consider intubation and maintain PaCO₂ between 4.0 – 4.5 kPa
- Mannitol or 3% saline indications and dose to be agreed locally

### Table 13 HYPERTENSION

**Investigations**
- Core Investigations especially reviewing urinalysis, creatinine and urea, look for raised ICP, papilloedema, and check four limb BP

**Treatment:**
- Seek urgent advice from a paediatric nephrologist or intensivist

*For acute contraindications and other details regarding lumbar punctures see Table 17
Appendix A7  Management of all 16 indentified problems (continued from A5 & A6).

**Table 14  PROLONGED CONVULSION**

<table>
<thead>
<tr>
<th>Investigations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Core Investigations if child not known to have epilepsy</td>
</tr>
<tr>
<td>If child under 12 months old request plasma calcium and magnesium</td>
</tr>
</tbody>
</table>

**Treatment:**
- Follow APLS guidelines for anticonvulsant therapy
- If the convulsion is ongoing despite anticonvulsants, consider specific treatments or electrolyte imbalance, e.g.
- Plasma sodium < 115 mmol/l, give 5 ml/kg of 3% saline I.V. over one hour
- Plasma calcium is < 1.7 mmol/l or ionized calcium < 0.75 mmol/l, give 0.3 ml/kg of 10% calcium gluconate I.V. over 5 mins
- Plasma magnesium < 0.65 mmol/l, give 50 mg/kg of magnesium sulphate I.V. over one hour

**Table 15  POST CONVULSIVE STATE**

<table>
<thead>
<tr>
<th>Investigations</th>
</tr>
</thead>
<tbody>
<tr>
<td>It may be appropriate to closely observe the child if normal capillary glucose, without performing any further tests, in the first hour</td>
</tr>
<tr>
<td>Detailed history and exam</td>
</tr>
<tr>
<td>If still reduced GCS after one hour perform Core Investigations and investigations for “Cause unknown” (Table 16)</td>
</tr>
</tbody>
</table>

**Treatment:**
- Treat according to history and examination findings |
- If after 1 hour child has not recovered to their normal conscious level, treat as “Cause unknown” (Table 16)

**Table 16  CAUSE UNKNOWN**

<table>
<thead>
<tr>
<th>Investigations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Core Investigations and if after reviewing these results the cause of reduced consciousness remains unknown request / perform the following: CT scan, lumbar puncture (if safe*), urine toxicology screen, urine organic and amino acids, plasma lactate</td>
</tr>
<tr>
<td>If the cause is still unknown after reviewing Core Investigations results, CT scan and initial CSF results, consider the following: EEG (Non-convulsive status); acyl-carnitine (on Guthrie card or from saved plasma); ESR and autoimmune screen (Cerebral vasculitis); thyroid function test and thyroid autoantibodies (Hashimoto’s encephalitis)</td>
</tr>
</tbody>
</table>

**Treatment:**
- Support treatments to protect airway, breathing and circulation |
- Start broad spectrum antibiotics and I.V. acidovir |
- Discuss with paediatric neurologist within 6 hours of admission

*For acute contraindications and other details regarding lumbar punctures see Table 17

**Table 17  LUMBAR PUNCTURE**

A lumbar puncture should be deferred or not performed as part of the initial acute management in a child who has:

- GCS ≤ 8
- Deteriorating GCS
- Focal neurological signs
- Had a seizure lasting more than 10 mins and still has a GCS ≤ 12
- Abnormal breathing pattern
- Abnormal doll’s eye response
- Abnormal posture

A normal CT scan does not exclude acutely raised ICP

If a lumbar puncture is performed, CSF should be sent for microscopy, gram staining, culture and sensitivity, glucose, protein, PCR for HSE and other virus.