

Use of formal coma assessment scales and approaches to management in non-traumatic conditions associated with altered consciousness.

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Declaration

I declare that this dissertation is my original work and has not been presented for a degree to any other university.

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Dedication

I would like to dedicate this book to my husband, Dr. Samson Muchina Kinyanjui for his patience, help and support during the M.Med programme.

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Table of contents

	page
Declaration	1
Dedication	2
Acknowledgements	3
Table of contents	4
Tables and figures	5
Study definitions	6
Abbreviations	6
Summary	7
Introduction and literature review	9
Justification and utility	16
Objectives	17
Methodology	17
Results	24
Discussion	33
Conclusion	38
Recommendations	38
Appendix 1 - Consent form	39
Appendix 2 - Coma audit form	41
Appendix 3 - Reassessment form	44
Appendix 4 - Recommended management	45
Appendix 5 - Interview of staff form	46
Appendix 6 - Kenyatta National Hospital Ethics and Research Committee approval letter.	48
References	49

Tables and Figures

	page
1. Aetiology studies	9
2. The Glasgow coma scale	11
3. Confidence intervals (95%) around possible observed proportions (50% and 30%) for different sample sizes	20
4. Demographics of the audit population	24
5. Clinical diagnosis in the audit	25
6. Recognition and grading of level of consciousness	26
7. Other assessments of conscious level as a percentage	27
8. Lumbar puncture rates by diagnosis	28
9. CSF findings for lumbar puncture performed for children in the audit	29
10. Inter –rater agreement (kappa)	30
11. Comparison of “other” comments of level of consciousness versus GCS assessment	30
12. Staff knowledge	32
13. Routine tests in the investigation of altered consciousness	45
 Figures	
1. Laboratory investigations performed	27

Definitions

Clinical audit: The systematic and critical analysis of the quality of clinical care.

Consciousness: Consciousness is a state of awareness of self and the environment.

Coma: Coma is an unarousable state lasting at least an hour in which the person makes no purposeful response to environmental stimuli. In deep coma, all brain stem and myotatic reflexes may be absent.

Criteria: Audit criteria are defined as measurable statements about health care that describe its quality and can be used to assess it.

Delirium: A state of impaired arousal and attention

Lethargy: A state of minimal decreased wakefulness where the primary deficit is attention. Drowsiness is prominent.

Obtundation: Mild to moderate blunting of alertness with lessened interest or response to the environment.

Standard: A professionally agreed level of performance appropriate to the population addressed which is observed, achievable, measurable and desirable.

Stupor: unresponsiveness from which a person can be aroused only briefly by vigorous, repeated stimulation.

Abbreviations

AVPU: Alert, responds to Voice, responds to Pain, Unresponsive.

ACDU: Alert, Confused, Drowsy, Unresponsive.

CPP: Cerebral perfusion pressure

CT scan: Computerised tomography scan

CSF: Cerebrospinal fluid

GCS: Glasgow coma scale

EEG: Electroencephalogram

ETAT: Emergency triage and treatment

KNH: Kenyatta National Hospital

LP: Lumbar puncture

NTC: Non traumatic coma

PI: Principal investigator

PFC: Paediatric filter clinic

SHO: Senior House Officer

IMCI: Integrated Management of Childhood Illnesses

Summary

Use of formal coma assessment scales and approaches to management in non-traumatic conditions associated with altered consciousness.

Background:

Altered consciousness states are a recognised sign of severity of childhood illnesses. Timely identification of altered consciousness states and appropriate immediate management is important and impacts on outcome.

Objective:

To describe the use of formal coma scales for the assessment of altered consciousness states, staff knowledge on scales and appropriate investigations and the actual use of simple investigations in children admitted with serious, non-traumatic illness commonly associated with neurological impairment

Study design:

A prospective record review (n=170) was carried out in Kenyatta National Hospital. A nested reassessment of level of consciousness was carried out on forty children. A staff knowledge assessment (n=51) was carried out.

Results:

Overall 170 case records were reviewed. On admission, assessment using the Glasgow coma scale was used in eight percent and 38.9% in the mortality group. When an assessment of consciousness was made, clinicians were more comfortable using AVPU scale (41%) than the Glasgow coma scale (26%) for the assessment. According to locally applicable standards a lumbar puncture was indicated in one hundred and twenty eight children (75.1% of all child records reviewed) but performed on fifty six children (32.5%) while only five (9%) were performed within an appropriate time period. A random blood sugar was performed on fifty six children (32.9%); it was identified as an appropriate immediate investigation by twenty four clinicians (82.8%) while a lumbar puncture was identified by four clinicians (14%) as

an immediate investigation in a febrile child with altered consciousness not due to trauma.

Conclusions:

Assessment of level of consciousness using the Glasgow coma scale is rarely used in practice; rather general and potentially misleading descriptive terms are used. Amongst children with clear indications for simple investigations to establish the cause for altered consciousness and / or assist in its treatment only a blood slide is commonly performed with a lumbar puncture rarely performed appropriately. The quality of care of children admitted to Kenyatta National hospital with altered consciousness would benefit from defining and implementing standard management guidelines.

Introduction and Literature review

The alert state requires intact cognitive function of the cerebral hemispheres and reticular activating system. Disturbances in these functions result in impaired states of consciousness which may vary in severity and duration. Critically ill children often present with some degree of altered consciousness as a result of neurological depression. Coma is a neurological emergency associated with high morbidity and mortality. Some causes are amenable to treatment the outcome of which is influenced by the care provided. Delayed recognition and treatment can have far reaching effects including permanent, long-term neurological damage.

Disturbances leading to altered level of consciousness may result from varying causes which can be broadly divided into traumatic and non-traumatic causes. Traumatic causes of altered states of consciousness in children include accidents, non accidental injuries (shaken baby syndrome) and birth injuries. Non traumatic causes are more varied and include infections of the central nervous system, hypoxic ischemic encephalopathy, metabolic disorders, cerebrovascular disorders, endocrine abnormalities, exogenous poisons and structural and degenerative central nervous system disorders.

Aetiology of coma in childhood

Table 1: Aetiology studies

Author /Year	Country	Age	N (Males)	Infections
Jitta / 1984	Kenya	8 mo -13 yrs	41 (22)	53%
Bondi / 1991	Nigeria		118	78%
Sofiah / 1997	Malaysia	1 mo -12yrs	116 (72)	69%
Prabha / 2003	India	3 mo -12 yrs	270 (142)	80%
Lohr / 2003	Brasil	2 mo -13 yrs	104 (57)	23%
Wong / 2001	U.K.	1 mo – 15yrs	278 (155)	37.9%

Studies looking at coma in children have shown infectious causes as the commonest aetiology as shown in Table 1. Wong in the UK showed 37.9% of the cases of coma

were due to infections¹. Similar findings have been described by Lohr in Brasil at 23%². In developing nations, infection as a cause of coma affects a larger group. Sofiah in Malaysia showed coma due to infection to be 69%³. Nayana Prabha in India also showed 80% of coma was due to infections⁴ with similar findings seen in Ibadan, Nigeria⁵. On the other hand Jitta in Kenyatta National Hospital (KNH) showed that up to 53% of coma was due to infectious causes⁶. Even in studies among adults, infection was an important cause of coma in Africa^{7,8}.

Assessment of altered states of consciousness

The clinician's first response to a child presenting with altered consciousness should be the ABC's of resuscitation⁹ as hypoxemia, hypercarbia, acidosis and ischaemia may all cause or contribute to neurological impairment. Therefore:

1. The **Airway** must be kept clear, patency ensured by positioning or intubation especially if the Glasgow coma scale is less than eight.
2. **Breathing** and adequate air exchange should be ascertained by observation of the chest wall movements and auscultation. Assistance may be necessary using an ambu-bag with oxygen.
3. **Circulation** can be rapidly assessed by examining the pulse, blood pressure and capillary refill time. Intravenous volume replacement and inotrope support may be necessary in cases of hypotension or circulatory impairment.
4. After assessing and managing these ABC's, neurological **Deficit** should be determined.

Many terms have been used to describe the continuum of consciousness such as delirium, lethargy, stupor and obtundation. However due to variation in the meaning of these terms to different persons, standard scales used to grade depth of unconsciousness have been developed. These scales include the Glasgow coma scale, the modified Glasgow coma scale (GCS), the Blantyre coma scale, and the simpler rapid triage scales AVPU (**A**lert, responds to **V**oice, responds to **P**ain and **U**nresponsive) and ACDU (**A**lert, **C**onfused, **D**rowsy and **U**nresponsive).

The Glasgow coma scale

Table 2: The Glasgow coma scale

	GCS (5 years and above)	Modified GCS (below 5 years)
Eye opening		
4	Spontaneous	Spontaneous
3	To voice	To voice
2	To pain	To pain
1	None	None
Verbal response		
5	Oriented	Babbles, coos, words, sentences
4	Confused	Less than usual cry, irritable cry
3	Inappropriate words	Cries to pain
2	Incomprehensible words	Moans to pain
1	No response to pain	No response to pain
Motor response		
6	Obeys commands	Spontaneous movements
5	Localises supraocular pain	Localises supraocular pain
4	Withdraws from nail bed	Withdraws from nail bed
3	pressure	pressure
2	Flexion to supraocular pain	Flexion to supraocular pain
1	Extension to supraocular pain	Extension to supraocular pain
	No response	No response

The Glasgow coma scale was developed in 1974 by Teasdale and Jennet and is the most commonly used coma scale internationally¹⁰. Initially developed for use in trauma patients, it has since been adopted for use in non trauma patients. It has also been modified for use in children to compensate for their age-specific differences in motor and verbal capabilities¹¹. Using the Glasgow coma scale, the motor score and total score have shown a high sensitivity and specificity for predicting outcome in trauma patients but was less good at predicting functional outcomes¹². However a complete Glasgow coma scale assessment may not be possible due to paralysis, intubation or sedation. Furthermore inter-rater reliability was shown to vary between

experienced and inexperienced users¹³. The Glasgow coma scale can also not fully reflect the severity of focal brain injury and does not provide a comprehensive statement of neurological status¹². Despite these limitations children presenting with altered states of consciousness as classified by the GCS are well known to have poor outcomes compared with children ill enough to be in hospital who are nonetheless alert^{14,15}.

The wide applicability and predictive value of the Glasgow coma scale have resulted in it becoming the standard method taught in medical training for the assessment of the level of consciousness while the abbreviated scales such as AVPU are more applicable in the quick assessment of disability. These abbreviated scales are therefore ideal for rapid assessments made by all cadres of health workers but in no way substitute for the comprehensive coma scales which maintain their place in classifying the severity of the condition once emergencies have been dealt with. Although a score of “P” or “U” using the AVPU scale suggest a Glasgow coma scale of less than eight and require urgent attention and further assessment¹⁶, the relationship between the GCS and the abbreviated scales shows the AVPU scale to be inadequate for detecting early changes in conscious level¹⁶. An alternative scale, the Blantyre coma scale was also developed as a quick easy assessment for level of consciousness in children with severe malaria but has not gained widespread use in routine practice in Kenya.

Reliable assessment of the level of consciousness is the key to the management of these patients. The level of consciousness can be used as an indication of prognosis or to monitor progress of illness^{17,18} although inter-observer variability in assessment of level of consciousness, a potential threat to the scale’s value, has been evaluated in only a few studies^{19,20}. Thus if clinicians in the Kenyatta National Hospital apply and interpret the GCS quite differently it may not be a useful tool in practice to identify either improvement or deterioration in a child’s condition. Previous assessments of the agreement between different clinicians in eliciting clinical signs have relied on calculations of the kappa (κ) statistic. The kappa statistic is a chance corrected proportional agreement for two observations made by different individuals on two observations repeated by the same person. Correction for chance agreement is required because if two people assess, in the simple case, whether a sign is present or

absent in a group of ten children then you would expect their assessments to agree in 50% of cases even if both the assessors answered at random (guessed). Therefore only agreement much greater than 50% would indicate agreement beyond chance in a sample of 10 children. A simple scale for interpreting the kappa statistic has been suggested by Koch and others²¹. In studies on inter-observer agreement on coma scores, Teasdale showed 80% agreement rates in the use of the GCS²². A later study supported the use of the GCS by appropriately trained personnel but found it to be less reliable in the hands of untrained or inexperienced staff¹³.

Investigation of the child presenting with altered consciousness

The laboratory and radiological examinations performed are important to help determine the different aetiologies of coma. They also help to guide management both supportive and definitive where applicable. Routine haematology, biochemistry and microbiology (see appendix 4) are often most helpful. Specific tests should be performed when guided by findings in the history, examination and routine tests.

Hypoglycaemia is a common cause of altered consciousness^{23,24}. The brain may suffer severe functional and structural impairment following hypoglycaemia if it is not diagnosed and treated early²⁵. This classifies hypoglycaemia as a medical emergency. Hypoglycaemia is associated with higher mortality despite treatment of the primary illness in some conditions²⁶. The World Health Organisation (WHO) recommends that blood glucose estimation should therefore be available in small hospitals in resource poor countries in the “Integrated management of childhood illnesses” (IMCI) guidelines. Rapid bedside blood glucose testing has been shown to have high correlation with serum blood testing²⁷. However where possible a low rapid glucose result should be confirmed by formal laboratory blood testing. Although there is a poor association with severity of hypoglycaemia and level of consciousness and outcome, patients with symptoms of altered consciousness (drowsiness, agitation, and jitteriness), hypothermia, feeding difficulties and seizures should have blood drawn for glucose estimation as a routine then receive a glucose bolus if the test results are not going to be immediately available to guide management. This strategy would

allow appropriate investigation without delay in treatment as delay in diagnosis and treatment of hypoglycaemia has been associated with neurological sequelae.

Examination of cerebrospinal fluid (CSF) is the definitive test for diagnosing nearly all infections of the central nervous system²⁸. Although CSF sterilisation following antibiotic use is often rapid leading to negative culture growths²⁸ the identification of the organism in cerebrospinal fluid is a high priority as it impacts on treatment and prophylaxis. Rapid latex agglutination tests have aided in identification of organisms following prior antibiotic use. CSF PCR will still be useful after antibiotic use. However a lumbar puncture must be performed when it is safe²⁹.

In a study looking at Kenyan children with meningitis, impaired consciousness was found to be a clear indication of a risk of acute bacterial meningitis and therefore for lumbar puncture¹⁸. While imaging for patients in coma is not the norm, it should be considered more important in children with deep coma, absence of fever, history of trauma and with focal signs³⁰. In these instances computerised tomography (CT) scan of the brain has been shown to identify focal brain lesions well. However, it is not a useful tool to identify or exclude common infectious encephalopathies or meningitis²⁹. It is also limited in the detection of metabolic and extrinsic brain dysfunction³¹. Cranial Magnetic resonance imaging (MRI) has even better resolution for brain lesions especially posterior fossa pathology. Brain imaging is often limited by the finances of the patient's family and may not be used in acutely ill patients before stabilization.

Although rarely available, serial rather than one off electroencephalogram (EEG) monitoring can be more useful in the assessment of coma. EEG is an important indicator of neurological outcome in patients with good or borderline cerebral perfusion pressure. Low amplitude EEG activity and electro cerebral silence in one study was associated with poor outcome³². However EEG does not always correlate with the clinical assessment.

The outcome of altered consciousness in children

The outcome of coma is variable; it is determined by the cause and care provided. Some causes of coma have been associated with increased incidence of complications such as epilepsy, disabilities in cognitive and adaptive outcomes^{33,34}. Severe neurological sequelae from meningitis have been observed in 25%³⁵ and in cerebral malaria in 10%³⁴ children in Kenyan studies. Permanent neurological deficits have also been noted as a result of childhood coma^{2,3,5} with mortality due to coma ranging from 21-36% in the studies described^{2,3,5}

The use of audit

Concerns about the quality of health care and performance of health care professionals have led to the development of programmes for measurement of quality and improvement of care. Clinical audit is a quality improvement process that aims to improve patient care and outcomes by carrying out a systematic review of care offered and implementing necessary changes. Aspects of patient care – including structure, processes and outcomes – are selected and evaluated against explicit criteria or a standard of practice and, where necessary, changes are implemented at an individual, team or service level. Further monitoring can then be used to confirm the improvements in healthcare delivery³⁶. Clinical audit can be described as a cycle or a spiral. Within the cycle there are stages that follow the systematic process of: establishing best practice; measuring care against criteria; taking action to improve care; and monitoring to sustain improvement. As the process continues, each stage aspires to a higher level of quality.

Doctors and other working groups have been involved in the development of national standards of care in hospitals in Kenya, which have been synthesised as the “Clinical Guidelines” and internationally standards have been developed as part of the World Health Organisation’s “Integrated Management of Childhood Illness” guidelines³⁷. These guidelines are often aimed at district hospital situations which are often resource restricted. In the care of the child with altered consciousness, the guidelines recommend the following:

For the purpose of this audit, we aim to compare this basic standard to current practice in our clinical areas as defined below.

- The level of consciousness should be evaluated using AVPU³⁷ or the Glasgow coma scale³⁸ which should then be monitored regularly;
- If meningitis is suspected, perform a lumbar puncture (LP);
- In a malaria endemic area, prepare a blood smear;
- The blood sugar should also be checked³⁷.

Individual institutions may adapt these national standards to their unique situations. However in Kenyatta National Hospital, written standards of care appropriate for the institution's resources – personnel, equipment and services - have not been formally developed. The reliance is often on standard text books, published literature and national guidelines. Use of standard protocols has been shown to improve quality of care by all cadres. While audit data is not formally collected in KNH, the general statistics collected in all departments may be considered as such data. Properly generated audit data would help to positively impact services offered to the community served by the KNH.

Justification and utility

In KNH the paediatric service, is served by three paediatric neurologists. With this limited human resource standard guidelines for assessment and care of children presenting with altered consciousness would help optimise their care and survival. A clinical audit to look at the assessment and management of coma in children has not been documented in the literature in Africa or in Kenya. This clinical audit provides baseline information, which will help in developing strategies for improving the quality of services offered. The resources at KNH while limited can be optimised for the care of children presenting with altered consciousness. This audit will highlight the areas needing strengthening and may form the basis of development of standardised protocols for the management of the child presenting with altered consciousness.

Objectives

Broad objective

To compare current practice with appropriate standard practice of care for children admitted with altered consciousness. (See appendix 4)

Specific objectives

Main objectives

1. To describe the assessment and documentation of the level of consciousness of paediatric patients admitted at Kenyatta National Hospital where concern has been expressed over neurological status.
2. To determine the proportion of children in who relevant specified immediate investigations (random blood sugar, lumbar puncture and blood slide) were performed. These tests are readily available within the paediatric service.

Secondary objective

3. To determine staff knowledge of the scales used for assessment of altered level of consciousness in children and their knowledge on relevant immediate investigations.
4. To assess inter-observer reliability in assessment of the GCS in KNH.

Methodology

Study area and population

The study was carried out in the paediatric filter clinic (PFC) and paediatric wards of Kenyatta National hospital between 15th July 2005 and 28th October 2005. Every month an average of 80-100 children are admitted to our paediatric service with conditions often associated with altered level of consciousness (Data derived from PFC admissions records searched for cases of meningitis, convulsions with malaria, cerebral malaria and shock/severe dehydration).

Study design

The principal study design was a prospective audit (cross-sectional study) with an additional nested cross-sectional study for the assessment / re-assessment of the level of consciousness using the GCS or the modified GCS. A survey of the health worker's knowledge on assessment of conscious level and use of coma scales was also carried out. The study populations are described in the three groups below.

1. The record review (Audit)

The population of interest for the audit consisted of the case records of children with altered consciousness aged one month to twelve years, and admitted to the paediatric wards of KNH within the study period.

Inclusion criteria

Records of children aged one month to twelve years admitted with a primary diagnosis of altered consciousness or the conditions below presenting with altered consciousness:

- a) Meningitis / Encephalitis / Encephalopathy
- b) Cerebral malaria
- c) Complex seizures (multiple convulsions, status epilepticus)
- d) Shock (severe dehydration or sepsis)
- e) Severe Metabolic disorders

Institutional approval had been obtained from the KNH ethics review board for record review prior to commencement of the study.

Exclusion criteria

- Children aged less than one month or more than twelve years
- Informed consent for re-examination declined or revoked in the reassessment group.
- Children with a diagnosis of traumatic coma or head injury.

2. Re-evaluation of conscious level:

- Children whose case records were included in the audit above were eligible for recruitment for the purposes of assessing / reassessing their coma score at the time of admission and during the course of their hospitalisation. These

children were identified in PFC but all examinations were performed on the admitting ward.

- Only children in whom the reassessment could be done within one hour of the routine clinical assessment were enrolled because of concerns that any greater time difference in re-assessments might result in differences in coma score being attributable to true changes in the disease process and neurological status and not inter-observer disagreement.
- Written consent from the caretakers of children enrolled in this aspect of the study was sought.

3. Survey of health workers' knowledge

- Clinical staff deployed to the Paediatric filter clinic and Paediatric wards present were eligible for inclusion.
- Verbal consent was obtained from the participating staff.

Sample size

The main audit was primarily descriptive with simple proportions of children assessed or investigated as the major quantitative results. The precision of these results as represented by the breadth of the 95% confidence intervals provide the main indication of the plausibility of the observed estimates in describing other, similar groups of subjects studied in a similar way. As there was no existing data describing the proportions of children assessed with a coma scale we therefore calculated the confidence intervals around two proportions, 50%, the most conservative assumption, and 30% assuming different possible sample sizes. Exact binomial confidence limits were calculated around the pre-specified proportions for a given sample size using the sample size calculation function of the statistical programme STATA, version 8.0 (STATA Corporation, Texas, USA).

- i) For the main descriptive audit where approximately 80 children per month are admitted through the PFC with the diagnoses of interest we estimated that a minimum of 150 case records would be studied over two and a half months using the stated sampling strategy. (see table below or using the formulae shown below).

$$n = \frac{c^2 N p (1-p)}{(A^2 N)} + (c^2 p [1-p])$$

c = 1.96(95%CI) N = 240 (80 cases/month) p = 0.5 (proportion meeting criteria) A= 0.05 (margin of error) n= 147

Table 3: Confidence intervals (95%) around possible observed proportions (50% and 30%) for different sample sizes

Sample size	40	60	100	150
50%	34% – 66%	37% - 63%	40%-60%	42% -58%
30%	17% - 47%	19%-43%	21%-39%	23%-38%

The first row shows the different sample sizes for which we have calculated confidence intervals. The 2nd and 3rd rows of the second to fifth columns are the 95% confidence intervals for each sample size around the respective proportions.

- ii) For assessment / re-assessment of coma scales, we aimed to evaluate forty children within 1 hour of admission permitting a reasonable description of the number truly in coma (GCS<12). A sample of 40 duplicate observations

would represent a study of comparable size to other studies on inter-observer agreement^{20,39,40}.

- iii) As can be seen from the table above if at least 40 health workers were questioned about their knowledge, results in terms of proportions providing a satisfactory answer, could be presented with modest levels of precision assuming that the staff included were randomly selected. For the purposes of this study random selection of staff for interview was not possible and so convenience sampling was used.

Sampling method and study process

The record review (audit) process

The records of children who satisfied the inclusion criteria admitted between 8pm Sunday to 8pm Friday were eligible for review of case notes as part of the audit. The audit began after ethical approval was granted by the KNH research and ethics committee. The investigator visited the paediatric filter clinic and paediatric wards from Monday to Friday between 8am and 8pm. Records from suitable patients who fulfilled the audit inclusion criteria were identified consecutively. These records were examined and the relevant data abstracted and entered into a pre-coded audit pro forma - appendix 3. The records were examined for three consecutive days for documented comments on levels of consciousness. Other details abstracted were targeted investigations and their results. The outcome was also recorded.

For the purposes of the audit the following standards were predefined.

- Children presenting with altered consciousness or clinical conditions commonly associated with an altered level of consciousness should have a Glasgow coma scale performed on admission and daily thereafter.
- The blood glucose should be performed at initial contact in a child presenting with altered consciousness.
- A lumbar puncture should be performed in a child presenting with altered consciousness before the administration of antibiotics in the absence of a documented contra-indication to lumbar puncture. A lumbar puncture is indicated, at a minimum, in a child with altered consciousness, fever and one of the following: convulsions, bulging fontanelle or stiff neck.

- A blood slide for malaria should be performed in all children presenting with fever to rule out malaria. A history of travel to malaria endemic area may be present or absent.

Reassessment process

Patients who satisfied the inclusion criteria for record review and were admitted between 8am and 8pm from Monday to Friday inclusive were eligible for re-assessment if this was possible within one hour of ward admission and where written consent was obtained from the parent or guardian. The patient was then examined by the investigator using the Glasgow coma scale or modified Glasgow coma scale as was appropriate. The examination aimed to be within one hour of the ward clinician's routine examination to allow meaningful comparison. The principal investigator (PI) examined the patients and recorded the appropriate GCS for three consecutive days. In parallel, the ward clinician assessment or comment on level of consciousness was recorded. Where a coma scale was used, the scale used and score given was noted.

Staff interviews

Interviews of PFC staff and paediatric ward staff on duty for two weeks prior to the study period commencing were undertaken where verbal consent was obtained. Those interviewed remained anonymous. A convenience sample of clinical staff was interviewed to determine their knowledge of different scales used for the assessment of altered consciousness and relevant immediate investigations.

Data analysis

The study questionnaires were pre-coded. All data was entered into an Excel spreadsheet and analysed using STATA, version 8.0 (STATA Corporation, Texas, USA).

The proportions of children assessed for level of consciousness and the proportions with appropriate investigations were computed and compared to the standards suggested. Appropriate confidence intervals around these proportions were calculated. A further comparison was made between descriptive comments on conscious level

and the GCS. Inter-rater agreement was calculated between the GCS assessments performed by the ward clinicians and study PI. For these latter analyses the kappa statistic was calculated which is a measure of chance corrected proportional agreement for two observations between two persons. Staff knowledge of the appropriate management of the child presenting with altered consciousness was described.

Ethical considerations

Written approval to carry out the study was obtained from the KNH Ethics Review Committee before beginning the study.

1. Institutional approval was provided for purposes of the record review. Personal details such as name, residence of the patients were not recorded.
2. Individual informed written consent for assessment of level of consciousness was obtained from the guardian after an explanation of the study and the voluntary nature of participation.
3. For the survey of knowledge among staff, consent was obtained verbally before participation.
4. No patient suffered delay of treatment as a result of the study as the study required no investigations or procedures other than a limited clinical examination in a minority of participants for which informed consent was obtained.
5. Results of investigations or examinations useful to the management of the child were communicated to the attending doctor.

Results

The record review (audit)

One hundred and seventy children's records were included in the audit. Most of the children whose records were reviewed were aged less than 60 months with a mean age of 33 months. Males had a slight predominance at 57.6%. Symptoms suggestive of meningitis were present in over fifty percent of case notes reviewed. The average period of illness was six days prior to admission.

Table 4: Demographics of the audit population

Demographic	Audit (n=170)
Mean Age (months), (95% CI)	33 (27.6 – 38.7)
Sex	
Males	98(57.6%)
Females	72(42.4%)
Symptoms present	
Age over 60 days and fever	130
Convulsions/ seizures	84
Neck stiff / bulging fontanelle	7
Days ill before admission, mean(95%CI)	6 (1-21)

The initial diagnoses described are those assigned by the clinicians at different levels of admission. The PFC diagnoses are assigned by the clinical officers admitting while the admission ward diagnosis is assigned by the admitting clinician who may be the medical officer intern, senior house officer or admitting consultant. This is often a clinical impression as most of the investigative work up is performed in the course of the admission. This may then lead to change or confirmation of diagnosis hence the final diagnosis.

Table 5: Clinical diagnosis in the audit

Diagnosis	Admission		Discharge	
	PFC	Admission ward	Alive	Dead
Meningitis	15(8.8%)	37(21.8%)	40	4
Severe malaria	31(18.2%)	24(14.1%)	24	2
Complex seizures	41(24.1%)	25(14.7%)	17	0
Severe dehydration / sepsis	47(27.6%)	51(30%)	43	7
Severe metabolic disorders	0	0	0	1
Others	36(21.2%)	33(19.4%)	28	4
Total	170	170	152	18

The final diagnosis of meningitis made by the ward clinician was based mainly on clinical signs. Cerebrospinal fluid results where done were often negative as defined by no white blood cells, normal protein and glucose and no organism on gram stain or culture of CSF. “Other” final diagnoses included: renal failure (n=3), pneumonia (n=13), rickets with pneumonia (n=4), hemi paresis (n=2), hydrocephalus (n=3), leukaemia (n= 1), intracranial space occupying lesion (n=2), HIV/AIDS (n=2), acute psychosis (n=1), hepatoma (n=1), adverse drug reaction (n=1) and peptic ulcer disease (n=1).

Mortality in the audit was eighteen children (10.6%). The age range of the children who died was 2 – 97 months. Ten (55.6%) children died by day 2 and fourteen (77.8%) children had died by day 3. Among the children who died, the use of the GCS was 40% (7/18) on admission, 13% (1/8) on day 1 and none (0/4) on day 2. However on day 1, one child each was described as unconscious and semiconscious respectively but the GCS was not assessed. On day 2, one child was again described as unconscious.

The clinical assessments

At the paediatric filter clinic (n=170), sixteen (9.4 %) children had a level of consciousness assessed using formal scales – in this setting AVPU was used. These

assessments were performed by clinical officers stationed there. Seventeen children (10%) did not have any comment on their conscious level. One hundred and thirty seven children (80%) had other comments on their conscious level. These included: lethargic 25%, irritable 15%, drowsy 17%, dull 17%, semi coma 9%, convulsing 2% and delirious 2%. No use of the GCS was documented in the PFC assessments.

On the admitting ward out of 170 children who had an altered level of consciousness reported at admission, 37 children (22%) had a formal coma scale assessed and of these, 14/37 children (37.8%) were assessed using the GCS. Six children (6/170, 3.5%) did not have a comment on their conscious level. One hundred and twenty seven children (127/170, 74.7%) had other descriptive comments on their conscious level, most commonly: irritable 34%, lethargic 32%, drowsy 12%, and dull 7%.

On the first post admission day 160 children were alive, of whom, forty seven (47/160, 29.4%) children had a formal assessment with a coma scale. Twelve children (12/47, 25.5%) were assessed using the GCS. Forty three children (43/160, 26.9%) did not have a comment on their conscious level at all. Sixty nine children (69/160, 43.1%) had other descriptive comments on their conscious level: drowsy 22%, dull 23%, irritable 23%, and lethargic 17%.

Table 6: Recognition and grading of level of consciousness

	No comment on LOC	AVPU	GCS	Descriptive comment
PFC (n=170)	17	16	-	137
Admission (n=170)	6	23	14	127
Day 1 (n=160)	44	35	12	69
Day 2 (n=156)	64	49	6	37

On the second day fifty five children (55/156, 35.3%) had a formal coma scale documented. Six (6/156, 3.8%) children were assessed using the GCS. Sixty four children (64/156, 41%) did not have a comment on their conscious level. Thirty seven children (37/156, 21.77%) had other descriptive comments on their conscious level: drowsy 14%, dull 28%, irritable 25%, and lethargic 16.7%.

Table 7: Other assessments of conscious level

Assessment	PFC n= 137 (%)	Admit n=127 (%)	Day 1 n =69 (%)	Day 2 n= 37 (%)
Irritable	15 (11)	43 (34)	16 (23)	9 (25)
Lethargic	35 (25)	41(32)	12 (17)	6 (17)
Drowsy	24 (17)	15 (12)	15 (22)	5 (14)
Dull	24 (17)	9 (7)	16 (23)	10 (28)

The laboratory investigations

Lab investigations reviewed were the blood slide for malaria, random blood sugar and cerebrospinal fluid for biochemistry and microbiology assessment. These were deemed as the most crucial investigations to the immediate management of these patients.

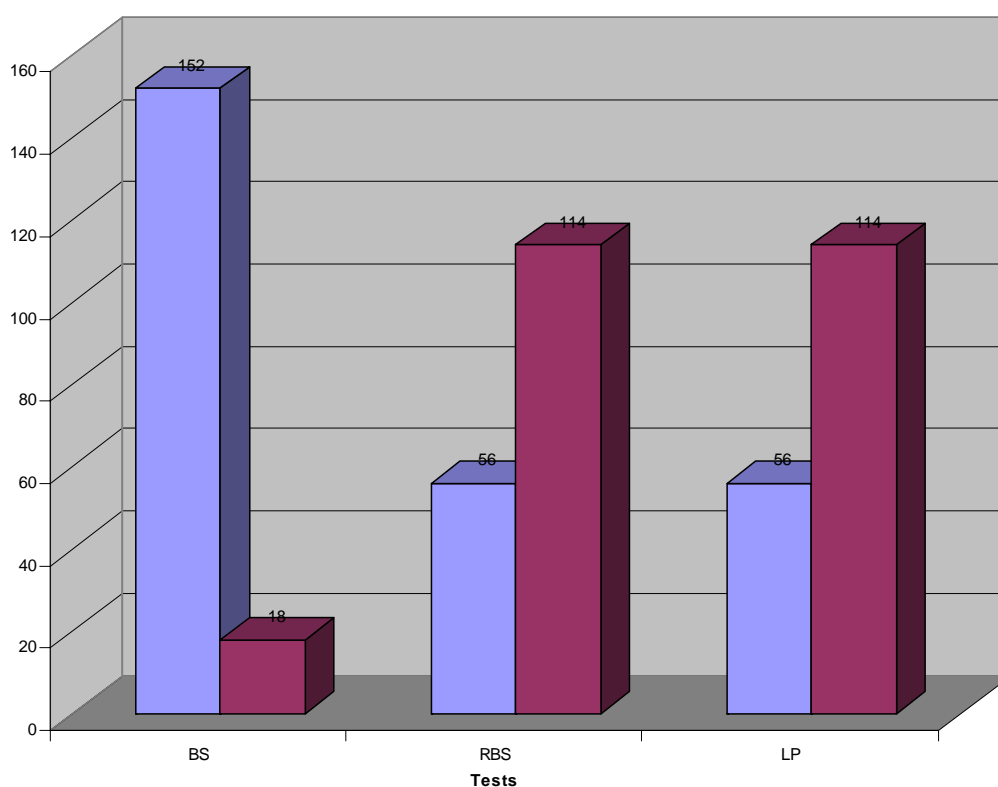


Figure 1: Laboratory investigations performed. (Grey = performed. Black = not performed.)

The blood slides for malaria parasites were performed in the PFC. One hundred and fifty two (89.4%) patients had a blood slide on admission – twenty children (13%) had positive slides for malaria parasites. Among the children who died (n=18), fourteen children (77.8%) had blood slides performed – one (7%) child was positive for malaria parasites. Six children (6/26) with a diagnosis of severe malaria had a negative slide and lumbar puncture performed while two children (2/26) had a negative slide and no lumbar puncture performed. The remainder, sixteen children (16/26) had a positive slide and no lumbar puncture and four children (4/26) had a positive slide and lumbar puncture performed.

A random blood sugar was documented in fifty six (32.9%) children. One (1.8%) child was found to be hypoglycaemic – this was a blood glucose level less than 2.2mmol/L. The random blood sugar range was 1-13.1 mmol/L; mean 6.43 mmol/L (SD 2.3 mmol/L, 95% CI 5.8 -7.05mmol/L) and median 6.1mmol/L. One hundred and fourteen (67.1%) did not have a documented random blood sugar.

Table 8: Lumbar puncture rates by final diagnosis

Final diagnosis	Normal CSF	Positive CSF	LP not performed
Meningitis	18	5	21
Severe malaria	8	0	18
Complex seizures	9	0	8
Severe dehydration/sepsis	5	0	45
Severe metabolic disorders	0	0	1
Others	11	0	21
Total	51	5	114

A lumbar puncture was performed on fifty six (32.9%) children. In five children (9%) the lumbar punctures were performed on the day of admission in PFC or the admitting ward. One hundred and fourteen children (67%) did not have a lumbar puncture performed. Four organisms were found on CSF examination: *Haemophilus influenzae* n=1, *Streptococcus pneumoniae* n=2 and gram positive cocci n=1.

Table 9: CSF findings for lumbar puncture performed for children in the audit

	Range	Mean (SD)	95% CI	Abnormal *
Protein g/dL	0.4 - 4.5	0.86 (1.25)	0.41 – 1.3	12
Glucose mmol/l	0.15 - 9.5	2.74 (2)	2 – 3.5	8
WCC	0 - 120	2.98 (17)	-1.9 – 7.8	4

**Abnormal were protein above 0.4g/dL, glucose less than 1.1mmol/L and WCC greater than 5.*

Cerebrospinal fluid findings for the 56 lumbar punctures performed are as recorded in table 9. Four (7.3%) CSF white cell counts were above 5 leucocytes⁴¹. CSF glucose levels were difficult to interpret as there was not a simultaneous blood sugar performed in any case. CSF glucose was below 1.1 mmol/L⁴¹ in 18 (32.7%) samples. CSF protein was raised above 40 mg/dL⁴¹ in 12 (21%) samples. CSF initial pressure was not assessed.

The reassessment

Forty three children were recruited for reassessment by the study clinician. This group of children had an assessment of conscious level by the principal investigator using the GCS and modified GCS as was appropriate for 3 days consecutively. The first assessment was performed on the admitting ward during admission. The subsequent assessments were performed between 9am and 10 am every morning on the respective ward. The aim was to have both ward clinician's and study clinician's assessments within an hour of each other. The patient's file was reviewed for the ward clinician comment on the 3 days for a comparison of assessment of conscious level.

One hundred and three paired observations were reviewed. Documented comments of level of consciousness by the ward clinicians were as follows: AVPU n=12, other n=46, no comment n=36 and GCS n=15. Thus although the aim was to examine inter-rater reliability for the GCS between ward and study clinician's only fifteen paired observations were available for this analysis because of the very low rate of routine use of the GCS to document the inpatient progress of children with altered

consciousness. However, using the 15 available paired GCS scores; an inter-rater agreement (kappa) was calculated as shown in Table 10. The kappa looked at the agreement of the GCS score between the ward clinician and the principal investigator. The agreement assessed using the kappa score was 0.1 which was poor, based on a criteria originally described by Landis and Koch²¹. In addition, probably because of the small available sample size, the level of agreement did not differ significantly from that one might expect due to chance alone (p=0.07).

Table 10: Inter – rater agreement (kappa)

Agreement	Expected agreement	Kappa	Std. Err.	Z	Prob>Z
20%	9.3%	0.1	0.08	1.5	0.07

Table 11: Comparison of “other” comments of level of consciousness versus GCS assessment

Description of consciousness	GCS range
Coma n=1	4
Semi coma n=1	6
Drowsy n=7	8-14
Irritable n=10	6-13
Lethargic n=10	7-13
Dull n=1	11
Conscious n= 6	8-14
Normal n= 1	8

While it was not possible to make very meaningful comparisons of inter-rater agreement for assessing the GCS it was possible to examine the relationship between the descriptive terms used by clinicians instead of the GCS and compare these with the formally assessed GCS performed by the PI. The table above summarises this comparison for 37 paired assessments. Descriptions of drowsy, irritable, confused understated the clinical condition when compared with the GCS. Of concern was some children described as conscious had a GCS from as low as 8 which is the cut off for deep coma. Descriptions of drowsy, irritable and lethargic also had wide variations

of GCS with some identified as in deep coma by the GCS but described as only lethargic or drowsy by ward clinicians. This would be important as Tables 6 and 7 shows that a large number of our children were assessed using these descriptive comments that convey little consistent meaning about the level of consciousness. This lack of consistency or reproducibility when compared to a standard may result in failures to provide adequate care for children admitted with severely altered consciousness and contribute to poor outcomes in this group.

Staff interviews

The staff interviews were intended to ascertain their knowledge on coma assessment and appropriate investigations. We interviewed 51 persons: 22 nurses, 10 medical officers (MO), 9 clinical officers (CO) and 10 senior house officers (SHO) to assess their knowledge in the management of children presenting with altered consciousness. A convenience sample of available staff was taken and consecutive interviews performed.

The most frequently cited coma scales by different personnel were AVPU 41% and GCS 26%. AVPU was known by seventeen nurses and 3 COs. The GCS was known mostly by the medical officers and registrars. For analysis about assessment and care, nurses were excluded as they do not make direct decisions on care. The following analysis will include 29 clinicians.

The Glasgow coma scale: Twenty eight clinicians were aware of the GCS. One CO had not heard of the GCS. Eighteen clinicians (62.1 % - ten MO and eight SHO) knew the correct range (3-15), six (20.7%) were wrong and four (13.8%) did not know. Twelve clinicians (41.2% - six MO, five SHO and one CO) knew the correct cut off for deep coma on the GCS.

Coma scales used in children: Majority of clinicians chose the GCS 27.6% and AVPU 17.2% in the assessment of children. The modified GCS was known by six staff – two MO and four SHO. When asked, clinicians claimed to document the level of consciousness in their notes using a formal assessment scale, a median of six times

out of ten (range 1-10). This conflicted with the actual observation of use of a GCS score in less than 1/10 patients.

Relevant investigations: When asked to identify relevant investigations for a child presenting with non-traumatic altered consciousness, twenty four clinicians (82.7%) identified a random blood sugar and four clinicians (13.8%) identified the lumbar puncture as appropriate immediate investigations. On specific questioning the contraindications to LP were correctly identified by twenty seven clinicians.

Table 12: Staff knowledge

	Nurses (n=22)	CO (n=9)	MO (n=10)	SHO (n=10)
How to assess LOC	AVPU 16 GCS 5	GCS 4 GCS, other scales 4	AVPU 1 GCS 7 MGCS 2	GCS 1 GCS, other scales 9
Coma scales used	AVPU 17 GCS 5	AVPU 3 GCS5	GCS 7 AVPU 1 MGCS 1	GCS 9 BCS 1
Heard of GCS	10	8	10	10
Aware of correct range of GCS	2	1	10	8
Know range of deep coma	1	1	6	5
Appropriateness of RBS in coma	14	9	7	8
Appropriateness of LP in coma	8	1	1	2

Discussion

The clinical assessment

The child presenting with altered consciousness is a common presentation to our wards with various diagnoses as shown in this audit. The criterion for significant neurological dysfunction in paediatric cases with severe illness is a GCS less than or equal to eleven⁴² or an acute change in mental status with a decrease in GCS greater than or equal to three points from an abnormal baseline.

At the paediatric filter clinic, no use of the Glasgow coma scale was documented during the study period. The formal scale used, when used, was the AVPU. However only nine percent of children's records reviewed had the AVPU documented suggesting that in practice formal assessment is rare even though knowledge about AVPU and even the GCS were reasonable amongst PFC clinical staff. One hundred and thirty seven children had other descriptive comments supposed to provide a clinical indication of their level of consciousness. When exploring the reasons for not using formal scales those cited included lack of regular updates and overwhelming patient volume and turnover. However, in the paediatric filter clinic, wall charts were present displaying the identification and investigation of cases of meningitis showing the AVPU scale. Though it is true that patient load may be overwhelming, the need for proper assessment of the very sick patients can not be overemphasised. This is the essence of triage management. Most staff in the PFC was trained in Emergency Triage Assessment and Treatment (ETAT).

On the admitting ward, Glasgow coma scale use was eight percent in new admissions described in PFC as having altered consciousness. Overall formal coma scale use including AVPU was twenty two percent. The majority of patients had other descriptive comments on their level of consciousness. This trend was seen to continue on the second and third day on the ward while the number of formal assessments declined. However the declining use of formal coma scales may be attributed to the patient improvement as there was also a decreasing rate of any comment on consciousness perhaps suggesting either improvement of level of consciousness

unless it simply reflected poor note keeping. In the paediatric wards, the twenty clinicians interviewed included the medical officer interns and senior house officers. They were all aware of the GCS. Eighteen clinicians knew the correct range for the GCS – two senior house officers did not identify the correct range for the GCS. Despite this reasonable knowledge use of the scale was very poor in practice. Reasons for this anomaly were not clear.

A majority of patients seen on the ward had other descriptive assessments of consciousness level. However the correlation between these descriptions and the standard GCS was very poor as shown by table 10. The clinical teaching at Kenyatta National Hospital which is both a teaching and referral hospital emphasises the use of formal scales such as the GCS and modified GCS. The “Clinical guidelines” published by the Ministry of Health also refer to the use of the GCS³⁸. It is therefore interesting to note such poor uptake of recommended practice. This may be as a result of lack of supervision which might be expected to translate knowledge into practice. Where reassessments were performed, there was a low use of GCS by ward clinicians. Hence paired assessments of GCS performed by different clinicians within one hour of each other were limited to 15 pairs during the three days. With this limited data when the GCS was compared between the ward clinician and Principal investigator, agreement was rated as poor – see table 9. Only one ward had the GCS displayed on the wall in the ward (ward 3A) next to the admission desk. The other ward clinicians seemed to rely on memory or pocket books carried to the ward. The comparison of subjective comments of level of consciousness versus the formal GCS was varied. One child described as in coma had a GCS of 4 but another described as ‘semiconscious’ had a GCS of 6, indicative of deep coma. The other comments when compared to GCS varied widely: “conscious” (n=6) corresponded to a GCS of 8-14 (with 8 being the threshold for deep coma and anything <11 regarded as significantly reduced consciousness). “Lethargic, irritable and drowsy” showed similar results. While clinicians may feel a generic description of level of consciousness may be accurate, we are able to show that the agreement when compared to a standard tool was poor.

Simple diagnostic investigations

Blood slides for malaria were performed in 152 children (89.4%). The high rate of blood slide performance may reflect the Integrated Management of Childhood Illnesses training that is common among PFC staff. Though Nairobi is not a malaria endemic area, the malaria transmission rate is significant along the railway line and in Kibera which mainly has been described as imported malaria. Kimutai et al in 1999 showed a malaria rate of 11.2% in children presenting in Nairobi clinics with fever⁴³. Most of the malaria was attributed to travel to a malaria endemic zone. Malaria prevalence was highest in Kibera and Dagoretti. Ogutu et al in 1998 showed 98.1% of malaria seen in children in Nairobi to be imported malaria⁴⁴. Some malaria transmission was attributed to living in suburbs of Nairobi such as Kajiado, Athi River and Kagundo where malaria transmission is supported by the environment. We did not document if treatment was guided by the BS result but of note only twelve children (13%) with altered consciousness had a positive slide despite the common diagnosis of severe malaria (18% at PFC, 14% at admission and 15.3% at discharge). Blood slide for malaria was not repeated in the situation of negative blood slide. The WHO recommends up to six negative blood slides where malaria is suspect. Although malaria therefore remains an important differential diagnosis for severe febrile illness in the KNH paediatric population it seems very dangerous not to exclude other possible causes of severe febrile illnesses associated with altered consciousness such as meningitis or encephalitis.

A definitive diagnosis of meningitis could only be made on five children. On review of presenting symptoms noted at admission, a lumbar puncture was indicated according to widely accepted clinical criteria in one hundred and twenty eight (75.1%) children studied. A lumbar puncture was performed in forty four (26.6%) children in this group with nine per cent performed in PFC or on the ward at admission. Most lumbar punctures were performed on the second day of admission which would be expected to dramatically affect the quality and value of cerebrospinal fluid results. This prior intravenous antibiotic use may account for the low organism isolation rate⁴⁵ as antibiotic treatment is initiated at the PFC before patients are transferred to the ward for admission. Early lumbar puncture would aid identification of the organism in

CSF and impact on treatment and prophylaxis. CSF sterilisation following intravenous antibiotic use is rapid – 2 hours for meningococcus and 4 hours for pneumococci⁴⁵. This means most culture growths will be negative following antibiotic use. Rapid latex agglutination tests have improved identification of organisms and CSF PCR could still be useful after antibiotic use but these tests are not routinely available in KNH. However a lumbar puncture must be performed when safe. The risk of brain herniation following lumbar puncture has been found to be low at 4.3% where studied²⁹. In the case notes reviewed, no contra-indications to performing the lumbar puncture were recorded. This means that it is currently impossible to accurately assess the prevalence or aetiology of meningitis in children in KNH with current practice.

This low rate of lumbar puncture is of concern as bacterial meningitis can be difficult to diagnose in young children as symptoms may be non specific including lethargy and irritability seen in many other conditions. A lumbar puncture therefore remains the definitive method for confirming or excluding the diagnosis of meningitis with careful CSF analysis and culture. It is recommended in national and international guidelines (with posters of the former pinned to walls in most wards in KNH) where central nervous system infection is suspected.

The low lumbar puncture rate is also reflected in the low initial rate of diagnosis of meningitis – 9.4 % in PFC, 21.2 % on the ward at admission and 25.9% at final diagnosis. It is possible that in PFC the diagnosis of meningitis is not made to avoid doing a lumbar puncture. Such a conclusion is suggested by the high rate of diagnosis of febrile children with ‘complex convulsions’ in PFC and the large increase in the number of children later diagnosed as having meningitis. Notably only twenty three out of forty four children with a final diagnosis of meningitis ever had a lumbar punctures performed indicating that nearly half of children diagnosed with meningitis in KNH have a diagnosis based solely on clinical suspicion. Even if materials were lacking, the intent not to carry out the lumbar puncture was not documented meaning that empirical treatment was considered the best way out.

Reasons for non-performance of lumbar puncture mentioned by staff included unavailability of CSF specimen bottles or sterile packs in the ward or PFC. Some

clinical officers expressed reluctance to perform invasive procedures (lumbar puncture) as they felt performing this procedure was not allowed by the law for their cadre of work (personal communication). Although not mentioned as a reason not to perform a lumbar puncture; the lumbar puncture rate in children who died was low – 11.1%. This agrees with the staff concept that “very sick” children can not withstand an LP. It is worrying that only four clinicians (14%) identified the CSF studies as an important early investigation for children presenting with altered consciousness. However contraindications for LP were correctly identified by twenty seven (93%) clinicians.

A random blood sugar was performed in 56 children (32.9%) described as having altered consciousness. Out of these, one child (1.8%) was found to be hypoglycaemic (random blood sugar less than 2.2mmol/L). This was unlike the prevalence documented in other studies done in Africa where hypoglycaemia was 8.2% in Kilifi²⁴ and 7.1% in Malawi²³. However this audit was not designed to determine the prevalence of hypoglycaemia. Of the children who had a GCS performed on admission, 8/14 (57%) had a RBS performed. However even with the lack of a documented random blood sugar, often in the PFC children may receive a dextrose bolus – personal observation in PFC.

In summary, we have shown that despite clinical teaching on neurology including assessment of level of consciousness using the GCS this approach is rarely used in practice. Instead general descriptive terms are used that do not accurately convey the degree of seriousness of the condition. Amongst children with clear indications for simple investigations to establish the cause for altered consciousness and / or assist in its treatment only a blood slide is commonly performed. A random blood sugar is performed in only half and an appropriately timed LP in less than 10%. Only two children had a GCS assessment, LP and a RBS performed. These findings raise serious concerns about the quality of care of children admitted to KNH with altered consciousness. Defining and implementing standard management guidelines may help improve the quality of care.

Conclusions

1. The clinicians' use of documented formal coma scales was 8.2% for the children admitted with altered consciousness. When other descriptive descriptions of level of consciousness are used, their interpretation is not uniform.
2. The lumbar puncture performance rate was low at 32% amongst patients suspected to have meningitis.
3. A random blood sugar performance rate was low at 32% in children presenting with altered consciousness.

Recommendations

1. There is a need for a standard guideline in Kenyatta National Hospital for the management (assessment and investigation) of children presenting with altered consciousness. There is also a need for regular reinforcement to the staff to follow laid down protocols if developed by the hospital clinical department to improve quality of care.

Limitations

1. The study being an audit (notes review) can only reflect what is documented. This would therefore be a measure of good clinical practice in note keeping.
2. When patients were recruited for reassessment by the PI, we did not enforce GCS assessments by the ward clinician. This then resulted in the low number of paired reassessments. However this allowed us to document the natural history of note keeping.

Appendix 1

Consent form

Name

Inpatient number

Study number

Ward

Date

Study title: Use of formal assessment scales and approaches to management in non traumatic conditions associated with altered consciousness – An audit.

Investigator: Dr Patricia W. Njuguna, Postgraduate student, Department of Paediatrics, University of Nairobi.

Supervisors: Dr. D. Oyatsi, Lecturer, Department of Paediatrics, University of Nairobi.

Dr. Mike English, KEMRI/ Wellcome Collaboration, Nairobi.

We are conducting an audit looking at the way children presenting with altered consciousness are looked after at this hospital. As part of this audit we are interested in assessing the level of consciousness (wakefulness) of some children and comparing our findings with those of the admitting medical staff. This consent form provides you with information to enable you to decide whether you may allow your child to be re-assessed. (Please read or listen to the information from this form carefully.)

Children with altered consciousness are admitted to our wards everyday. Your child has been identified as having a condition sometimes associated with reduced consciousness. We wish to look at the care given to children like yours admitted to our service. It will enable us to assess our performance and where possible make improvements. We will look at the records of your child including care received and any results of investigations that may or may have been performed. However, we would also like to perform a clinical assessment on your child now and for two consecutive days while on the ward. It is for this re-examination of your child that we are seeking permission.

Whereas no direct risks will accrue to your child by participating in this study the information gained we hope will improve clinical care. All information obtained will

be confidential. We will not publish or discuss any information obtained in any way that could be linked to your child. Participation is entirely voluntary and you may refuse or withdraw your consent at any stage without it influencing the care you are given in any way.

If you agree to take part in the audit, please sign below

Signed _____ Date _____

Name of guardian _____

Witness name _____ Signed _____

Date _____

Appendix 2

Coma audit

1. Study number _____

a) Demographic data

2. Ward admitted _____

3. Date admitted __/__/2005

4. Inpatient number _____

5. Date of birth __/__/_____

6. Age (mo) ____

7. Sex M/F

b) Emergency care

8. Was any resuscitation documented? Y/N/NA

Paediatric filter clinic

9. Time at entry to PFC: _____ am/pm

10. Level of consciousness assessment Y/N

11. Date: __/__/2005

12. GCS/ AVPU/ ACUDU/ Other

13. Indicate the level of consciousness accorded. _____

14. If used the GCS, summated score: _____

15. Eye opening _____

16. Motor _____

17. Verbal _____

Any investigations performed:

18. BS for MPS Y/N results _____ Date __/__/2005

19. Blood sugar Y/N results _____ Date: __/__/2005

20. Lumbar puncture Y/N results _____ Date: __/__/2005

21. Diagnosis at PFC _____

c) History

22. Period of this illness _____

23. Symptoms (circle those included): headache, fever, vomiting, diarrhoea, purpuric skin rash, nuchal rigidity, photophobia, irritability, convulsions, bulging/tense fontanel.

24. Other symptoms not stated above _____

25. Previous neurological problems: epilepsy, cerebral palsy, developmental delay, hydrocephalus, other _____.

26. Previous metabolic problems: diabetes mellitus, thyroid disease, other _____

d) Examination on the admitting ward

On admission

27. Date: / /2005

28. Assessment of consciousness Y/N

29. GCS/ AVPU/ ACDU/ Other

30. Indicate the level of consciousness accorded. _____

31. Time assessed: _____ am/pm

32. If used the GCS, summated score: _____

33. Eye opening _____

34. Motor _____

35. Verbal _____

36. Admission diagnosis: _____

37. Designation of admitting clinician: CO, CO intern, MO intern, Registrar, Consultant

Post admission or Day 2

38. Date: / /2005

39. Assessment of consciousness Y/N

40. GCS/ AVPU/ ACDU/ Other

41. Indicate the level of consciousness accorded.

42. If used the GCS, summated score: _____

43. Eye opening _____

44. Motor _____

45. Verbal _____

Day 3

46. Date: / /2005

- 47. Assessment of consciousness Y/N
- 48. GCS/ AVPU/ ACDU/ Other
- 49. Indicate the level of consciousness accorded. _____
- 50. If used the GCS, summated score: _____
- 51. Eye opening _____
- 52. Motor _____
- 53. Verbal _____

e) Ward Investigations

Date when the investigations have been done should be noted.

- 54. BS for MPS Y/N results _____
- 55. Blood sugar Y/N results _____
- 56. Lumbar puncture Y/N results _____

f) Outcome

- 57. Alive or Dead
- 58. If alive, any disability noted: _____

g) Final diagnosis

- 49. What was the final diagnosis? _____

Appendix 3

Coma audit – Reassessment form

Consent given (See consent form and sign)

a) Demographic data

1. Ward admitted _____
2. Date admitted __ / __ /2005
3. Inpatient number _____
5. Age (mo) _____
6. Sex M/F

b) Examination on the admitting ward

On admission

7. Date: __ / __ /2005

8 Time: _____

GCS: show individual domain:

9. Eye opening _____
10. Motor _____
11. Verbal _____

Post admission or Day 2

12. Date: __ / __ /2005

13. Time: _____

GCS: show individual domain:

14. Eye opening _____
15. Motor _____
16. Verbal _____

Day 3

17. Date: __ / __ /2005

18. Time: _____

GCS: show individual domain:

19. Eye opening _____
20. Motor _____
21. Verbal _____

Appendix 4

Management of non-traumatic coma in KNH as recommended by the paediatric neurology team

Emergency management

This is the resuscitation phase and aims to maintain homeostasis.

Airway management -maintain the airway patent by positioning of the neck.

Breathing - ensure air entry.

Circulation - correct shock if present.

Correct any metabolic derangements - glucose, electrolytes.

Assess level of consciousness using the Glasgow coma scale as is age appropriate.

(Use Table 2)

Take vital signs: temperature, pulse, respiratory rate.

Treat seizures if present using a short acting anticonvulsant.

Standard management

Take a history to determine the aetiology and possible complications. The duration over which the loss of consciousness develops must be well established. Routine tests should be performed as shown below.

Table 13 – Routine tests in the investigation of altered consciousness

Microbiology	Biochemistry	Haematology
Blood culture	Blood glucose	Full blood count and film
CSF- microscopy, gram, culture	Blood sodium and urea	Blood slide for malaria

A computerised tomograph of the brain may be performed when indicated. It is important when focal neurological pathology is suspected. However the imaging services at KNH may be limited by availability and funds by the parents. CT scan should be limited to cases where information gained will alter treatment.

Appendix 5

Interview of the clinical staff – coma audit

The information collected will be anonymous. No record of name or age will be indicated. Only the designated level of training will be noted.

Verbal consent given: _____

If no consent, why? _____

Date of interview: _____

1. The interviewee's professional level

nurse, medical student, intern, clinical officer, registrar, consultant.

2. What instruments do you know are used in the assessment of consciousness?

a) _____ b) _____ c) _____ d) _____
e) _____ f) _____

3. What coma scale(s) do you use most often?

4. What coma scales are used in children? If yes list

4.2 Are the coma scales for children different from those in adults? Y/N

4.3 If Yes, how?

5. Out of ten children with altered consciousness assessed, how often would a formal coma scale be documented in your notes? _____

6. Do you know of the Glasgow Coma Scale? Y/N

7. What is the range of Glasgow Coma Scale? _____ to _____

7.1 If yes, what is the summated or total GCS do you consider to be deep coma? _____

8. What difficulties do you experience when using the coma scales in PFC and/or the wards?

Do not remember, no reference chart available, other _____

9. What baseline investigations would be necessary in children presenting with altered consciousness? _____

10. What contraindications might there be to LP?

Appendix 6

References

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