ALL WALES CLINICAL BIOCHEMISTRY AUDIT GROUP

STANDARDS FOR THE MEASUREMENT OF AMMONIA IN BLOOD

INTRODUCTION
The measurement of ammonia in blood is a critical assay for investigating acute illness in some patients, especially children, but as it is unstable in whole blood, careful sample handing and rapid analysis are important. Following incidents suggesting sub-optimal performance of ammonia assays, a questionnaire survey was undertaken on how laboratories in Wales measure ammonia for both paediatric and adult medicine; the findings were presented at an audit meeting in October 2001.

The following guidelines are recommended, in the light of the questionnaire findings, discussion at the meeting and subsequent consultation with clinical biochemists and paediatricians within Wales, to aid the provision of an improved clinical laboratory service for the measurement of ammonia in blood.

STANDARDS

1. **General**: Measurement of ammonia in acutely ill neonates and children is a clinical emergency. Therefore, all hospitals that accept paediatric emergency cases should have ammonia analyses provided on site by their clinical biochemistry department using a robust and reliable method with continuous availability 24 hours a day, 7 days a week.

2. **Sample Collection**: The most common cause of a raised ammonia result is artefactual, due either to poor sample collection or to a delay in analysis.
   a) All laboratories should have details of precautions to be observed for sample handling and collection and the maximum permissible time for the sample in transit to the laboratory documented in their standard operating procedure (SOP).
   b) All staff who may be required to perform ammonia measurements should be aware of the factors contributing to artefactual increases in ammonia, i.e. haemolysis and delays in analysis.
   c) Blood samples for ammonia analysis should be collected by venepuncture into tubes (preferably pre-chilled) containing either lithium heparin or EDTA as anticoagulant, which have been shown to be free of ammonia contamination. Clotted samples, samples collected via indwelling catheters and capillary samples should not be used.
   d) All samples for ammonia analysis should be transported to the laboratory within 15 minutes of collection. The sample should be analysed immediately if the measurement is to be performed on whole blood or the plasma immediately separated for subsequent assay. If a delay is envisaged, plasma can be stored for up to 4 hours at 4°C before analysis. It is probably advisable to avoid pneumatic tube transport.

3. **Sample Analysis**
   a) All staff performing ammonia analyses should be familiar with their laboratory’s SOP and know the operating characteristics of the analysis, e.g. linearity limits and any instrument error codes.
   b) They should try to minimise all potential sources of ammonia contamination from other reagents (e.g. urease-containing solutions) and impure water supplies.
   c) It is recommended that staff working in laboratories with small analytical workloads, who undertake the analysis infrequently, receive regular training and revalidation.
   d) Reflectance meters using dry chemistry strips for whole blood ammonia analysis are convenient for laboratories with small workloads, but are only suitable for initial **SCREENING** of patients for hyperammonaemia. They are **NOT** suitable for monitoring patients with hyperammonaemia, in whom treatment decisions require knowledge of the absolute ammonia concentration, as the upper limit of their working range is 285 µmol/L.
4. **Quality Control and Assurance**
a) All laboratories providing ammonia assays should ensure that appropriate internal quality control (IQC) procedures are in place. For IQC, either commercially available material or solutions of ammonium salts made up in-house can be used.

b) All laboratories providing ammonia assays should participate in an accredited external quality assessment scheme (EQAS).

5. **Reference Ranges**
All laboratories should have separate reference ranges for neonates (up to the age of 1 month), older infants, children and adults. These reference ranges should be properly sourced for the analytical method employed (e.g. enzymatic, whole blood reflectance measurement).

6. **Repeat Analysis**
The decision to repeat an ammonia measurement if the initial result is increased is the responsibility of the clinician, but laboratory staff should comment appropriately if they suspect that an elevated result may be partly artefactual (e.g. due to haemolysis, analytical delay).

**ACKNOWLEDGEMENTS**
Miss H. C. Losty.

**REFERENCES**


**VERSION**: 1.

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**APPENDIX**
**Calendar of Audit Process for Standards for Measurement of Ammonia in Blood**

October 2001 Survey of all 14 Welsh clinical biochemistry laboratories who measure ammonia undertaken by Miss H. Losty (lately Principal Biochemist, University Hospital of Wales, Cardiff) and findings presented at a meeting of All Wales Clinical Biochemistry Audit Group held at Ysbyty Bronglais, Aberystwyth.

April 2002 Initial draft standards prepared by Miss H. Losty, considered at an All Wales Clinical Biochemistry Audit Group committee meeting and presented at an audit meeting held at Prince Charles Hospital, Merthyr Tydfil.

April 2005 Further draft of standards prepared and sent for consultation to clinical biochemists and paediatricians in Wales, to seek their views.

Nov. 2005 Finalised and standard issued.