

Uncertainty of Measurements in Neurophysiology

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Introduction

It is essential when neurophysiology services are performing and interpreting diagnostic tests of the brain, spinal cord and peripheral nerves, that services are aware of the uncertainties involved in the measurements recorded. These uncertainties affect whether a recording is determined as normal or abnormal for the patient population being investigated. This may impact on the overall interpretation of the test results, and hence affect the patient's management. As part of Improving Quality in Physiological Services (IQIPS) accreditation under the revised standard, services need to be aware of the Uncertainties of Measurements (UoM) in their clinical services and this should be incorporated into service policies.

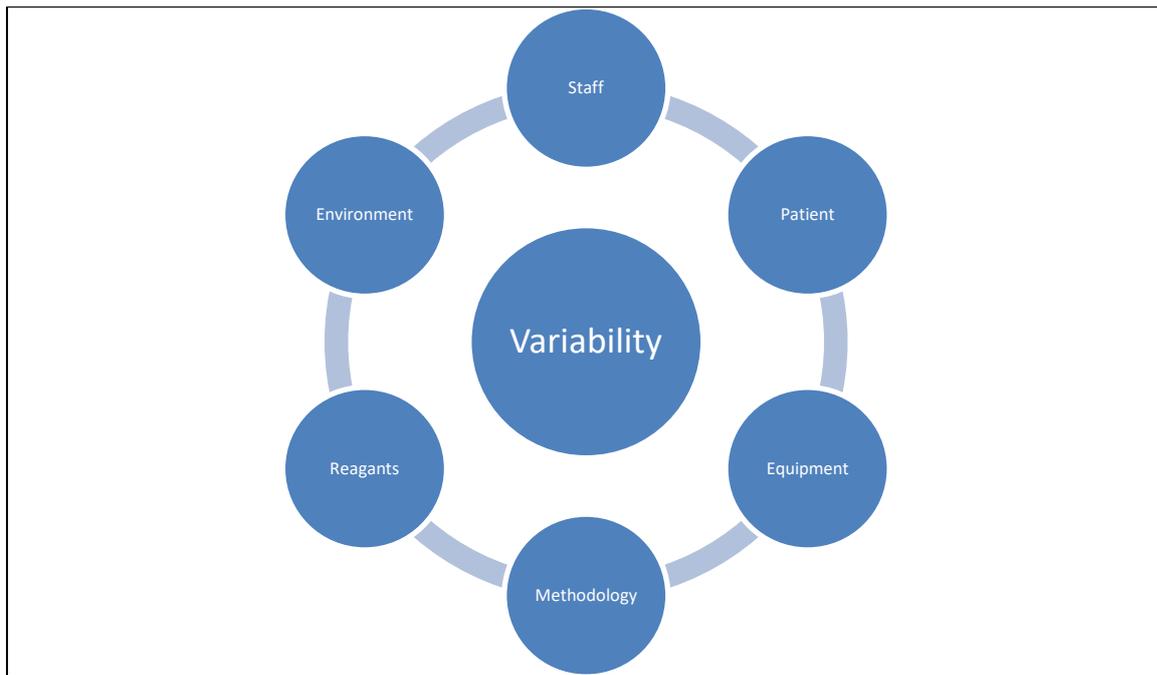
Furthermore, in many Neurophysiological tests, the clinical picture has to be taken into account when interpreting results. Hence many of the tests performed are qualitative rather than purely quantitative.

All diagnostic test results should be interpreted by appropriately trained health care professionals, in conjunction with the patient history, symptoms, clinical examination and often in line with other tests or procedures. Decision making may also take place in conjunction with the multidisciplinary team.

Areas of measurement uncertainty

There are many factors that can lead to measurement variability. Examples are shown below (Fig 1):

Figure 1 – Factors leading to test measurement variability



Scope

This paper will initially focus on diagnostic procedures that are commonly performed in neurophysiology services.:

Nerve conduction studies

Evoked Potentials

Electroencephalography

Uncertainties of Measurement for Neurophysiological Tests

Below is a list of the main factors that can introduce variability into the results of neurophysiological tests.

- Section A – Nerve conduction studies
Patient factors (eg limb temperature, age, height, BMI, co-morbidities). Methodology (eg antidromic v orthodromic, electrode positioning, stimulation, measurement of distance, marking of waveforms, machine settings). Accuracy of recording equipment.
- Section B – Evoked Potentials
Patient factors (eg age, height, state, medications, co-morbidities). Methodology (eg electrode positioning and application, application of stimulus, marking of waveforms, machine settings.) Environment. Accuracy of recording equipment.

- Section C – Electroencephalography
Patient factors (eg age, state, medications, co-morbidities). Methodology (e.g. electrode positioning and application, application of stimulus, machine settings, measurement of frequencies.) Environment. Accuracy of recording equipment.

The paper will be expanded at a later stage to incorporate further diagnostic tests.

Good practice

In order to ensure diagnostic measurements are of the highest quality, many processes (Table 1) need to be implemented within the service. These should be detailed in service policies and based on up to date, evidence based, professional body, national or international best practice and guidelines.

Table One – Processes leading to high quality results

| | |
|--------------------|--|
| <i>Equipment</i> | <i>Equipment and consumables must be appropriate for diagnostic procedures (and patient population) including regular maintenance and servicing. Faulty equipment should not be used.</i> <i>Reagents, including collodion glue, acetone, 10/20 paste, nuprep gel, recording electrodes and alcohol wipes should be stored appropriately and used within their expiry date.</i> |
| <i>Calibration</i> | <i>There should be appropriate quality assurance and quality control processes in place to ensure equipment is reading reliably.</i> |
| <i>Staffing</i> | <i>Staff should be adequately trained in using and calibrating the equipment and performing the procedures, be of the appropriate banding/grade, and receive regular Continuing Professional Development, including peer review. Staff welfare (e.g. health, stress etc) is also important.</i> |
| <i>Environment</i> | <i>The environment should be conducive to making high quality measurements. This includes noise reduction etc.</i> |
| <i>Policies</i> | <i>All services should have accessible up to date, evidence based standard operating policies / protocols that all staff follow where appropriate. This includes the set up of equipment, test performance, analysis and reporting of results. Where appropriate, results should be interpreted using published or internally generated normal values.</i> |