Ensuring high quality ABR in babies

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NHSP Mission Statement

'Improving outcomes for every child through a high quality hearing screening programme, safe and effective assessments and family centred intervention'

- Programme roll-out 2001 – 2006
- Statistics: in a typical week
  - 13,200 babies are screened
  - 296 (2%) are referred for audiological assessment
 - 22 babies are identified with a permanent childhood hearing impairment (PCHI)

Infrastructure

- Screening and assessment protocols
  - TEOAE initial screen (AABR+TEOAE for high risk)
  - AABR for screening referrals
  - Diagnostic ABR with 30 dBeHL discharge level
  - Protocols for Tone pip, click AC & BC ABR, CM testing
- Staff training & support
  - Specialist training courses for screeners & ABR staff
- Quality Standards
- Quality Assurance monitoring (audits)

QA audit findings

- 2006/8 audit revealed that the quality of ABRs at some sites was poor and risked missing some babies with PCHI

- Why?
  - Unconscious incompetence of ABR tester
    ("I've been doing this for years; I don't need to be told what to do")
  - Too small a population per tester
    (doing tests too infrequently to acquire & maintain competence)
  - Failure by tester to follow national ABR test protocols
    ("I'm reasonably sure I can see a response there")

Threshold ABR Left
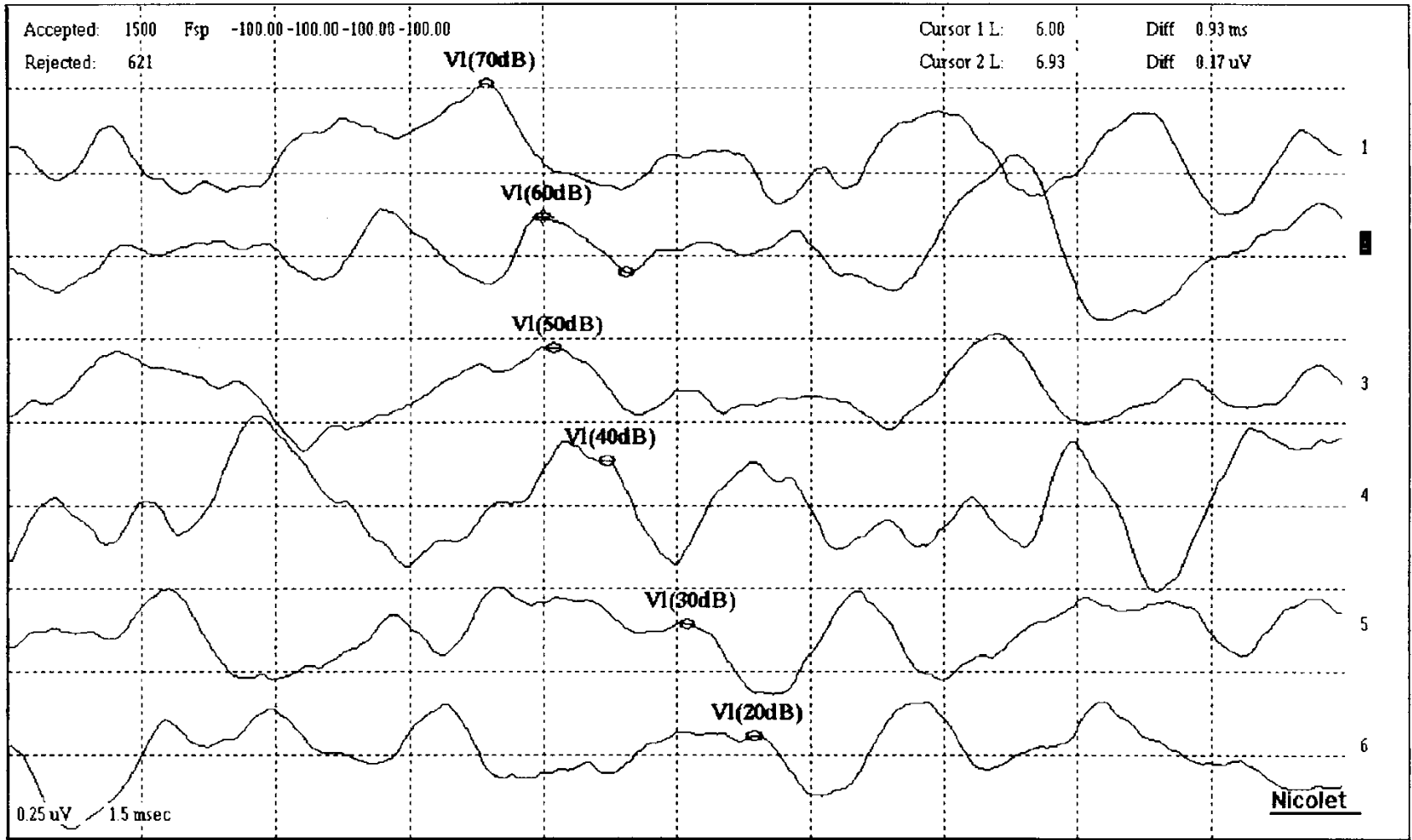
Threshold ABR Left
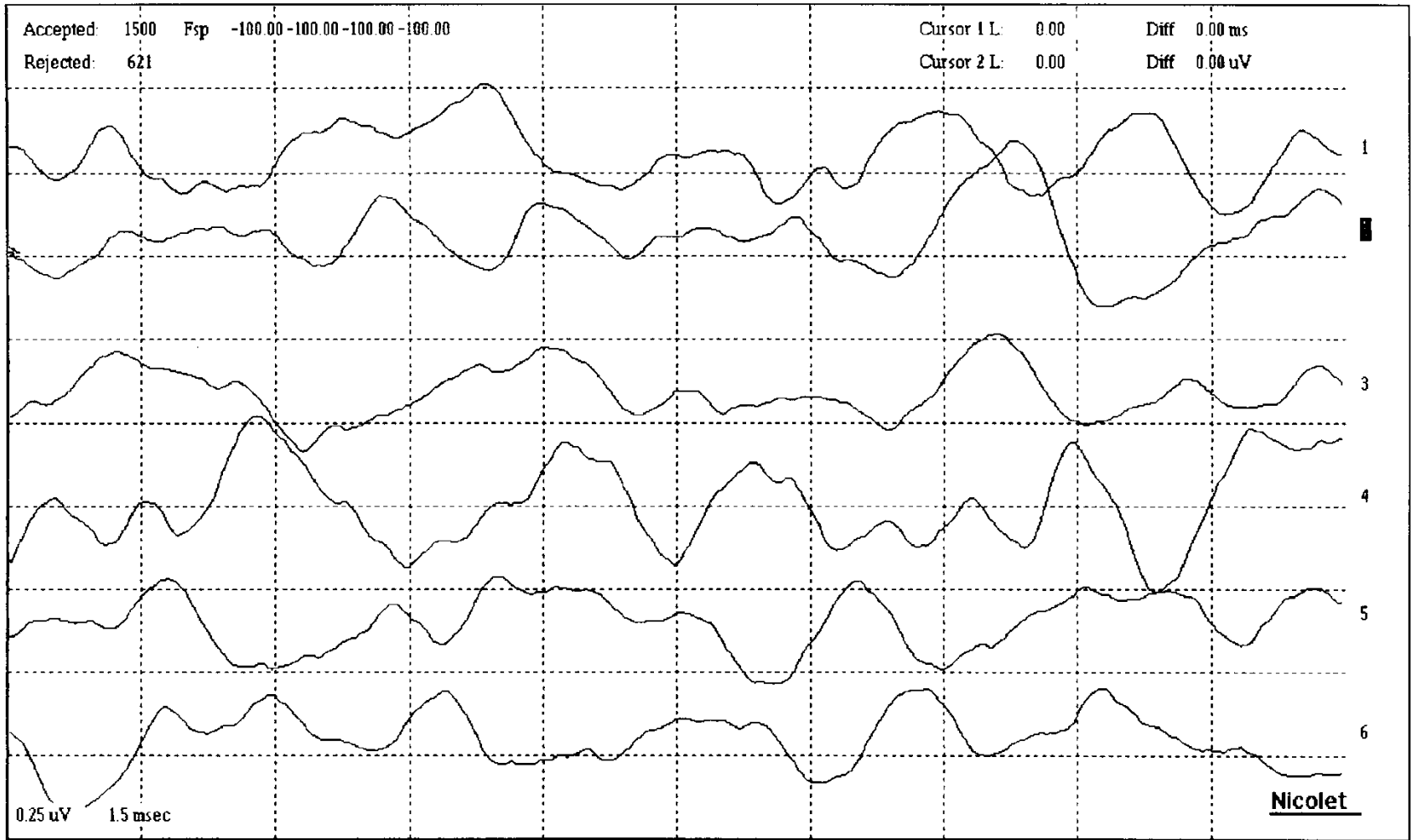
Examples of discharged cases
(35 dBnHL click ABR reported as present)
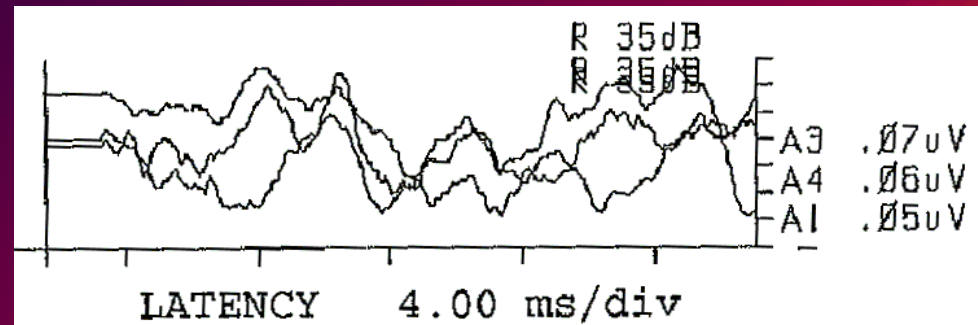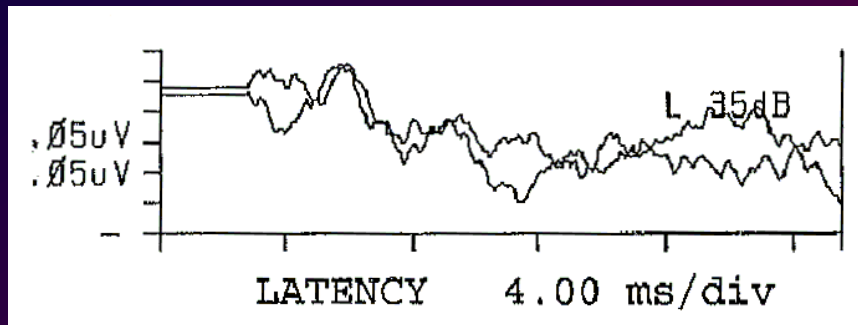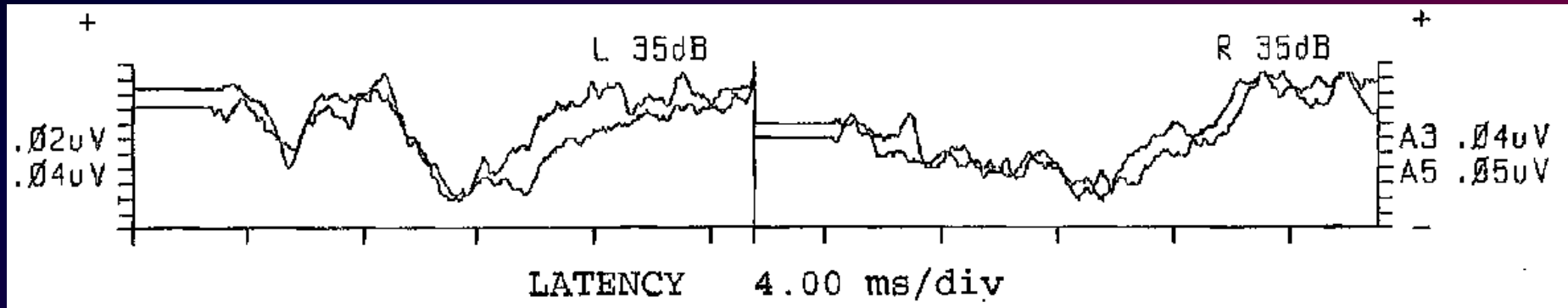
Outline of current ABR protocol

- Test Parameters
    - 20ms timebase (25ms for 1kHz & 500Hz)
    - Rate: as fast as the timebase allows (49.1/s; 39.1/s)
    - Filters: 30Hz – 1500Hz
    - Sweeps: typically 3000 (min 2000)
    - Artifact rejection: ±5 – ±10 µV
    - Display scale: fixed; 0.05 - 0.1µV = 1ms
    - Replication: needed at stimulus levels that define the ABR threshold
    - 4kHz primary stimulus, upon which discharge is based

Definition of ABR threshold

The lowest stimulus level at which there is:

- – a replicated clear response at threshold

- – a replicated clear response at 10dB or 5dB above threshold, and

- – a replicated recording with response absent at 10dB or 5dB below threshold.

- Replicated waveforms should be "optimally superimposed" – shown on the same baseline rather than adjusted to that peaks are aligned
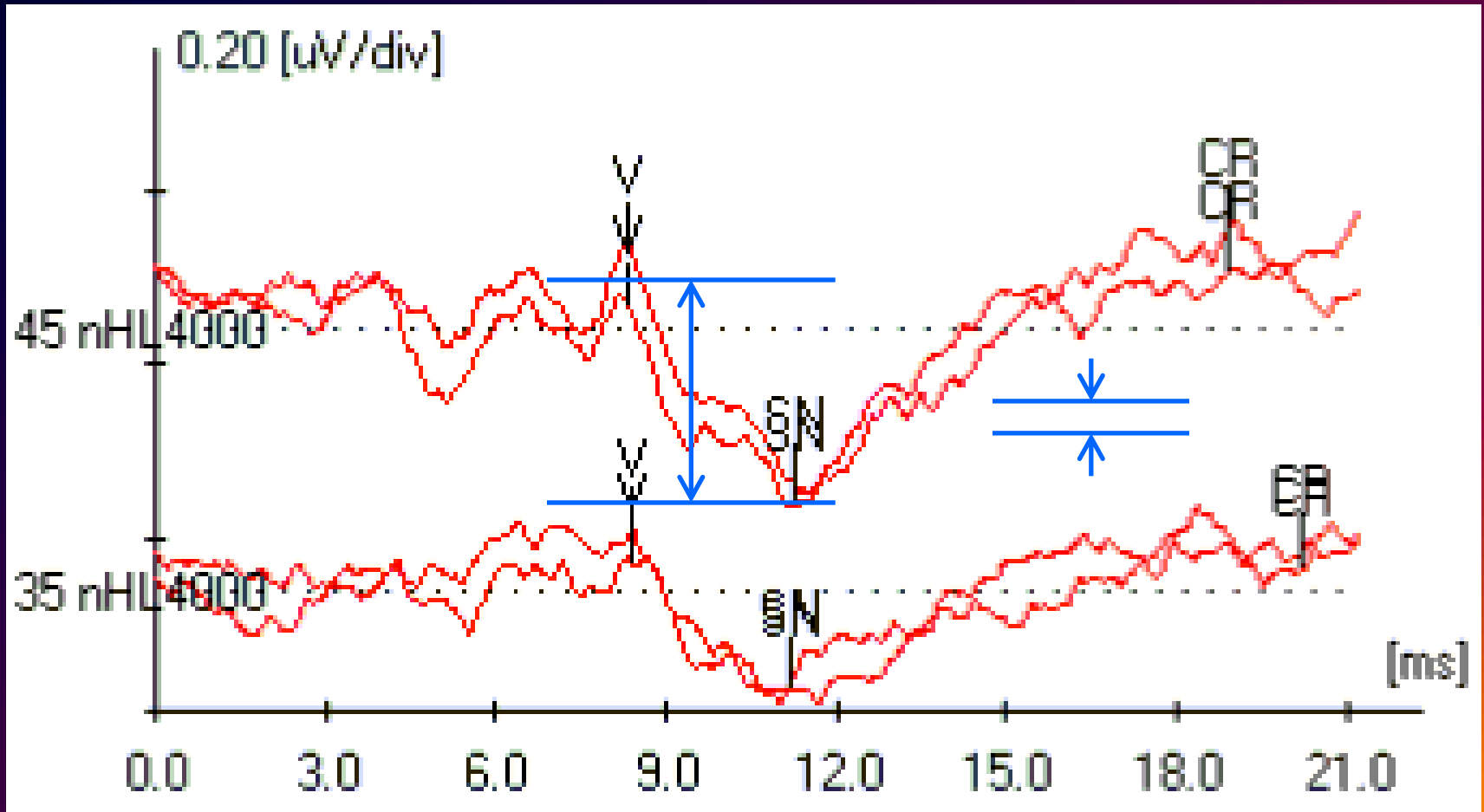
Interpretation of waveforms

"Clear Response" (CR) requirements:

- High degree of correlation between the replications and a characteristic waveform of at least 0.05μV (50nV) in size

- The size of the response should be at least *3 times the amplitude of the background noise level*

- The noise level can be estimated from <u>average</u> gap between the traces across the recording window

This criterion ensures a high degree of confidence (about 98%) in the presence of an ABR response
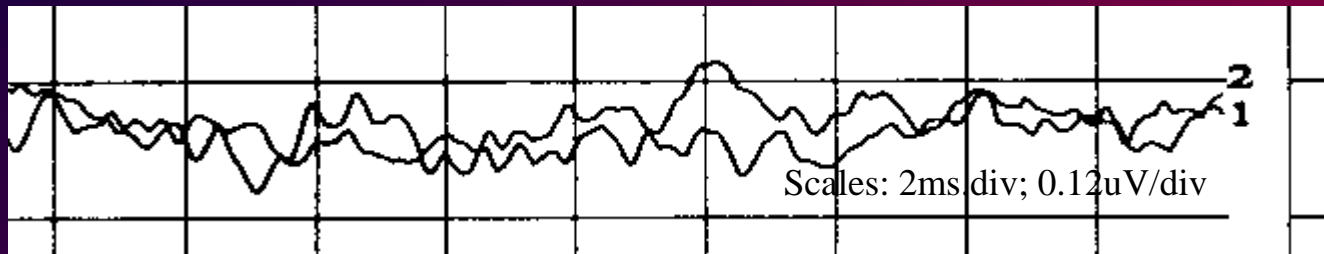
Example – Clear Response present

Interpretation of waveforms
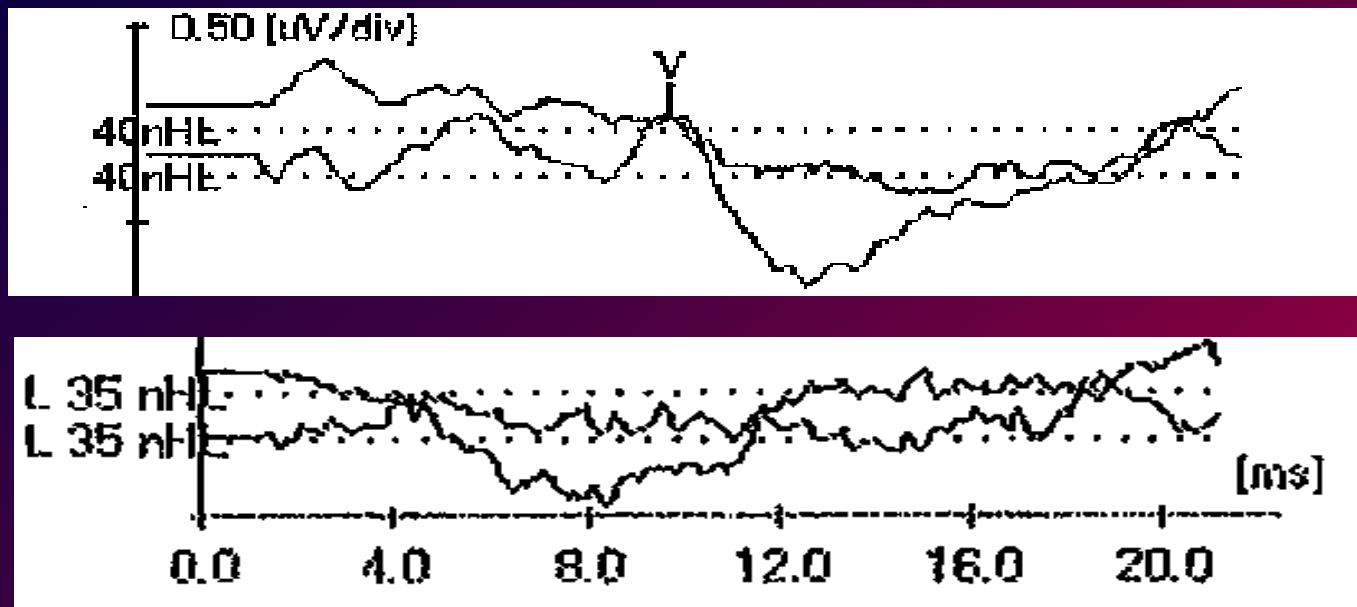
"Response Absent" (RA) Requirements

- Noise is the <u>average</u> gap between replicates (ignore any region of stimulus artefact).

- Average gap must be no more than 25nV (0.025µV).

Scales: 2ms div; 0.12uV/div

Interpretation of waveforms
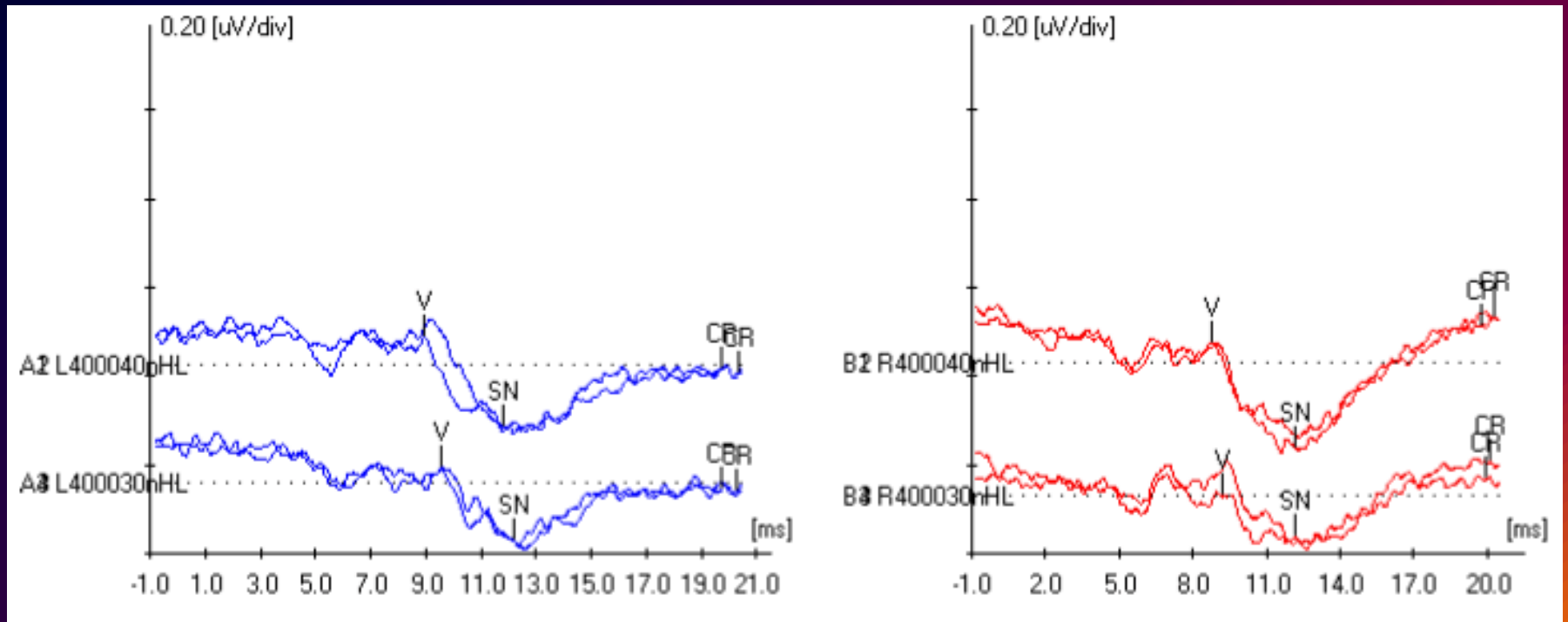
All other waveforms are "inconclusive" (Inc)

   - the replications will have S/N < 3:1 <u>or</u> have no obvious response
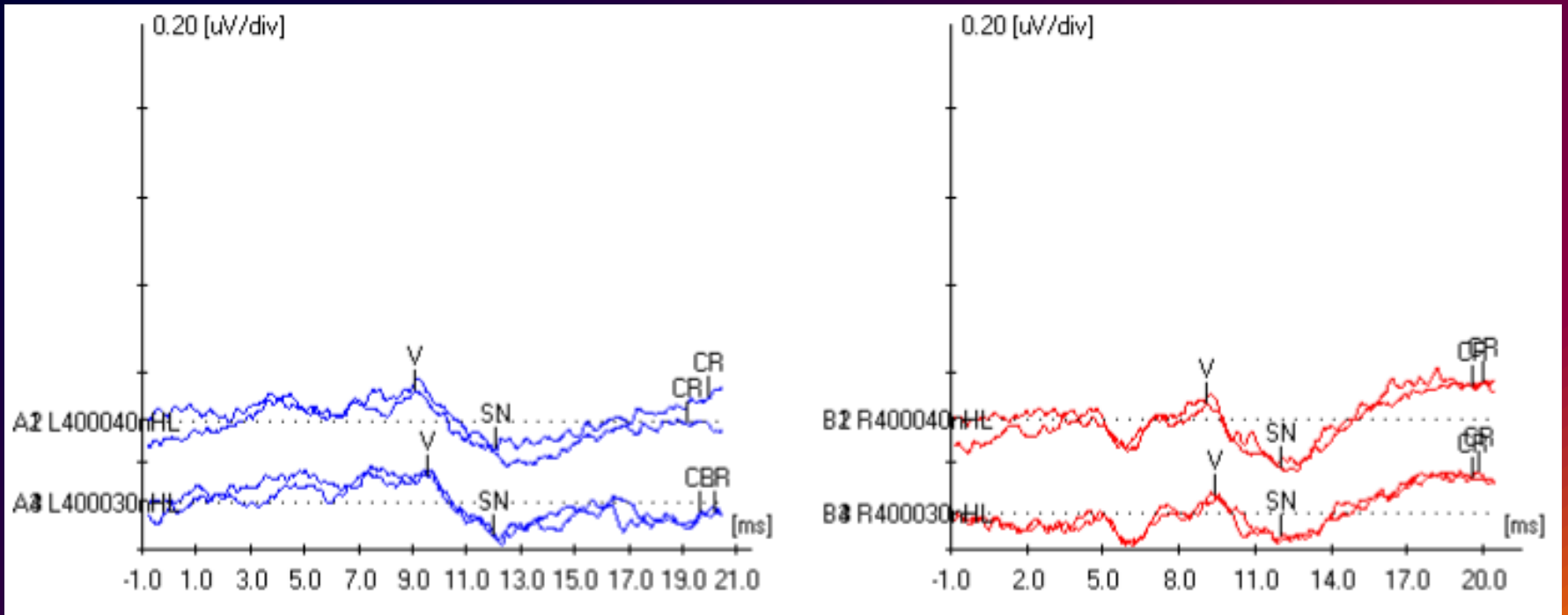
   yet have noise greater than 25nV

Inconclusive waveforms <u>cannot</u> contribute to the definition of the ABR threshold!

The result: high quality, fewer errors

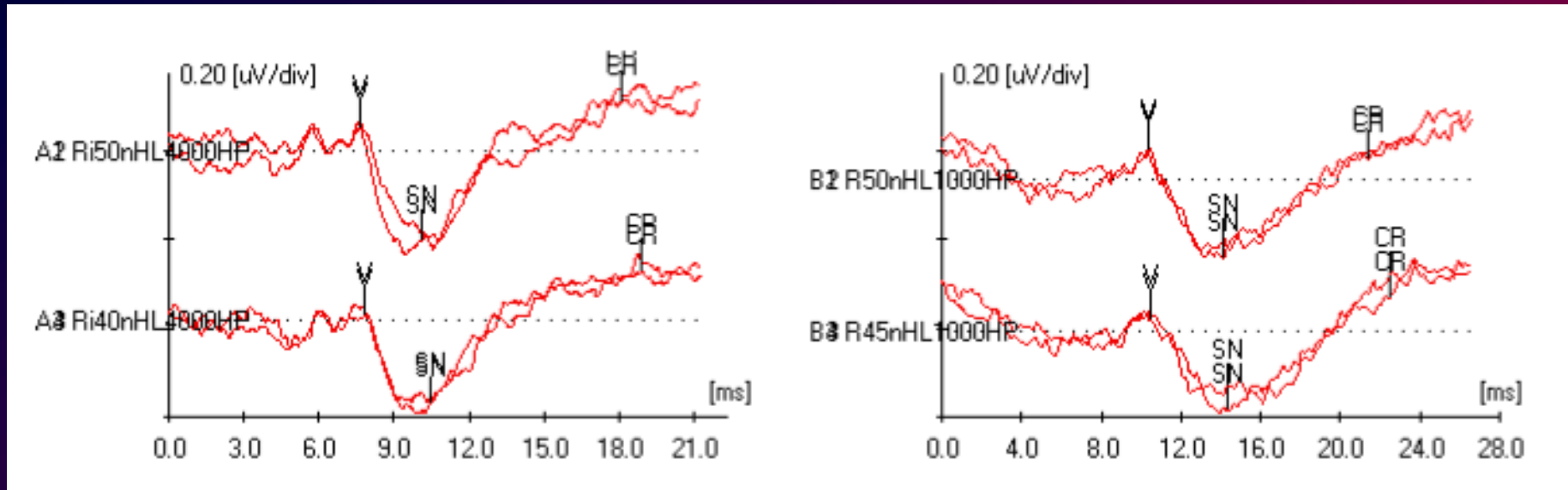Discharge level reached at 4kHz bilaterally
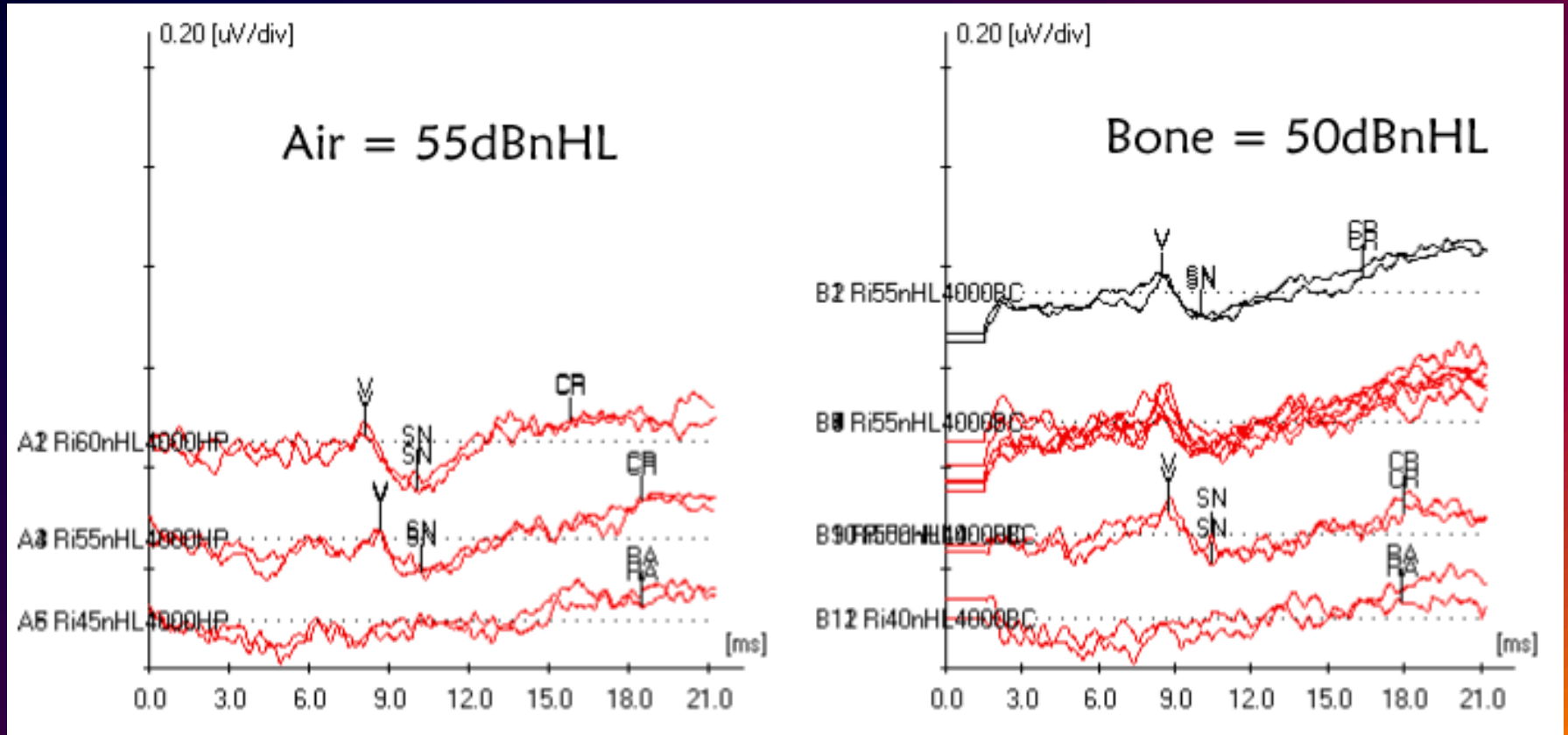
The result: high quality, fewer errors

Discharge level reached at 4kHz bilaterally
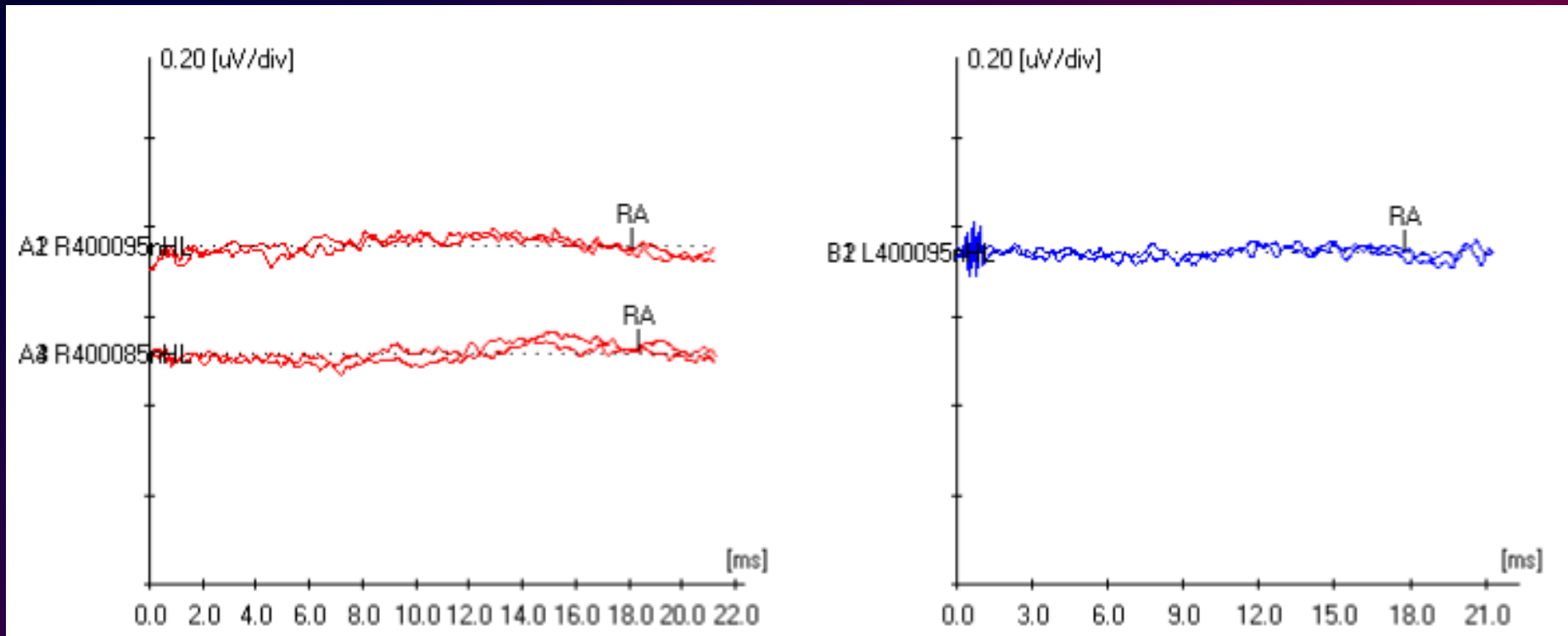
The result: high quality, fewer errors

Discharge level reached at 4kHz & 1kHz

The result: high quality, fewer errors

A mild unilateral cochlear loss (BC was masked)

The result: high quality, fewer errors

A profound bilateral loss (very low residual noise)

The most serious errors in practice

1. Waiting until the baby is too old

   Plan to <u>complete</u> testing by 8 weeks

2. Amp sensitivity too low (artifact rejection too lax)

   NHSP advice: $\pm 5\mu V$ (max $\pm 10\mu V$)

3. Using an incorrect display scale

4. Failure to replicate at levels that define threshold

   Test at threshold, at 5-10dB below <u>AND</u> at 5-10dB above

5. Labelling inconclusive responses as clear/definite and allowing them to influence the result

Improving quality

- Regular 1-day ABR "refresher" courses for all staff
  - Helps to introduce new protocols and allows staff to benchmark their interpretation skills
- Expert phone feedback to sites scoring poorly on QA
- On-site expert training when needed
- Mentoring struggling selected sites
  - all ABR cases reviewed via email until "signed off" as safe
- Introduction of local peer review networks

Local Peer Review Networks

There are a number of models but desirable features include:

- cases selected systematically (e.g. first 2 every month)
- reviewers receive training
- rotation of reviewers with sufficient cover for holiday and sickness
- a quick (typically 48-72 hours) review turnaround time for specific cases to allow feedback to be used in the management of that case
- use of a standard review format plus phone discussions between reviewer and tester when helpful
- regular meetings between testers & reviewers to check and benchmark their own practice
- access to experts for disagreements, queries and periodic moderation
- annual report to include an audit and review of arrangements and results of an external moderation

Local Peer Review Networks

- What doesn't work:
  - reviewing every case (too time consuming)
  - local tester selection of cases (usually only good ones chosen)
  - unwillingness to accept criticism of others
  - meeting over coffee every 3 months (ineffective)
  - reviewers not following national guidance

- The perfect compromise?
  - we don't yet know
  - several schemes are currently being piloted
  - watch is space!

Summary

- Quality standards and audit are essential

  – if our experience is typical you may have an unpleasant surprise!

- Stringent protocols deliver high quality

  – and are easier to achieve than most testers fear

- Staff training & support is vital

  – and should include additional support for struggling sites

- Peer review is likely to be good value

  – but we haven't yet identified the optimum model

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