An evaluation of current UK practice for Evoked Potentials - VEP

Bryony Carr, Peter Walsh and Jeffery Holman

AIMS

- Evaluation of current practice in Evoked Potential recording throughout the UK
  - To determine guidelines currently being used
  - **TO SET NATIONALLY AGREED MINIMAL STANDARDS FOR VEP**

AUDIT ON VEP PRACTICE: OVERVIEW

- Prospective study of current UK practice
- Questionnaire sent to 83 UK departments
- 36/83 UK departments responded
- Results from a total of 673 VEPs performed over a 3m period.
- Crude data analysis
- Proposed standards and guidelines created

FORM B

BSCN Joint National Audit Project ANS

Post code of centre (please complete		Local case ID (please complete)		Project code (Do not complete – for office use only)	

FORM B (VEP): Please complete for every patient attending for VEP (Note: A separate form should be completed for each modality of EP if patient has more than one)

1. What is the age of the patient?	
2. What is the gender of the patient?	Male / Female
3. Before starting testing the patient is identified and the clinical information from the referral verified.	Yes / No
4. Were the results abnormal?	Yes / No
5. If abnormal, does the report make a statement on any abnormality detected?	Yes/ No
6. What number of averages were taken?	
7. Are traces replicated?	
8. Are traces superimposed?	
9. Does the report of the investigation contain the waveforms?	Yes/ No
10. Does the report of the investigation contain the numerical data?	Yes/ No
11. Is the professional status of the practitioner performing the investigation identified?	Yes/ No
12. Is the professional status of the practitioner reporting the investigation identified?	Yes/ No
13. Is the report is signed by the practitioner taking medico-legal responsibility for it?	Yes/ No
14. What was the referral diagnosis	Confirmation of MS Diagnosis of MS Optic neuritis Optic ischaemia Visual acuity testing Visual field loss Other, please specify
15. Was any other modality of EP performed on this appointment? (circle all that apply)	SEP lower SEP Upper BAEP Other (Please state)
16. Was visual acuity assessed?	Yes / No

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17. Does the report state whether the patient wore glasses for the VEP?	Yes / No

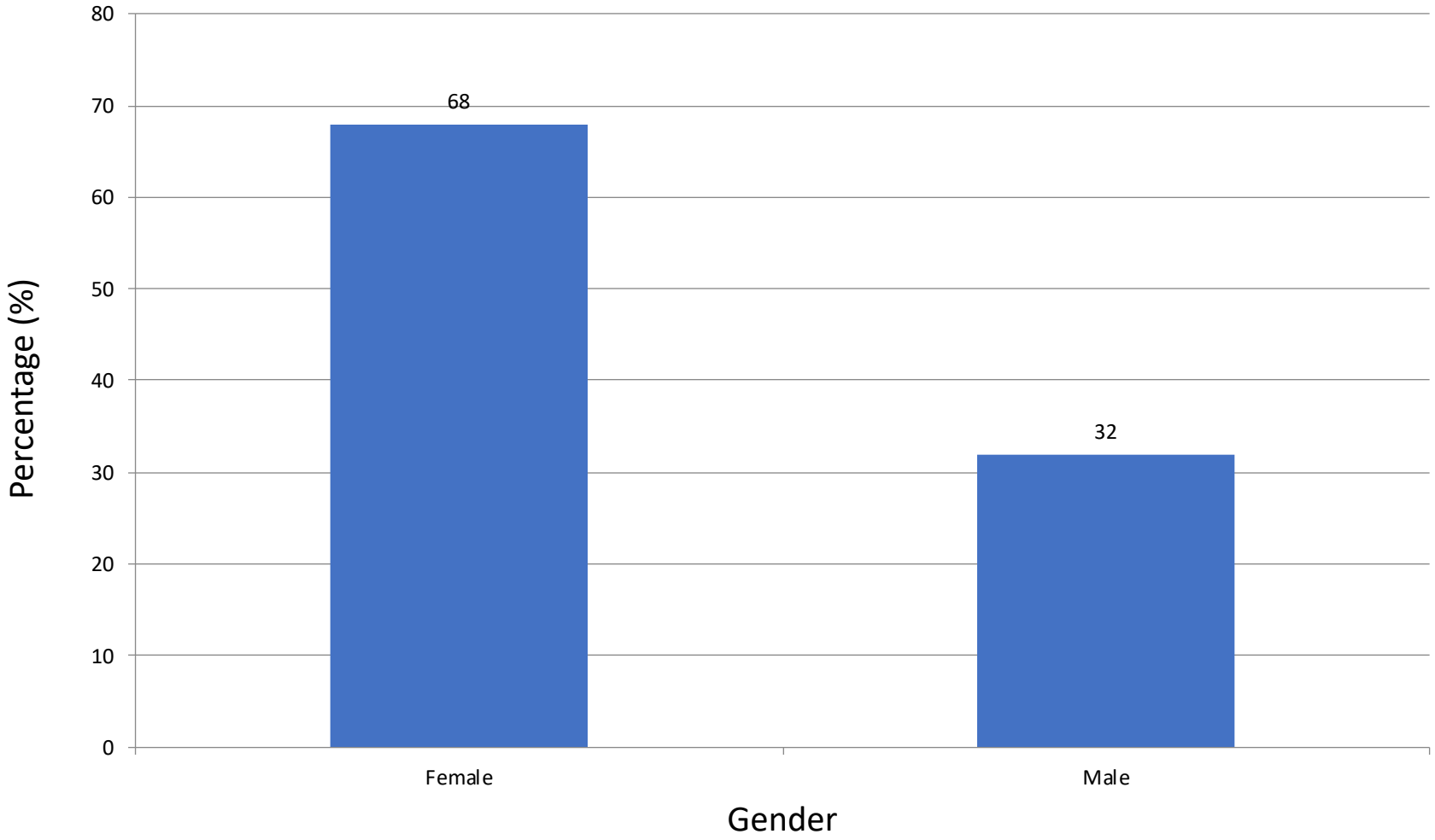
What recording parameters were used for **full field VEP?** (fill in to include the electrode placement and write N against channels not used)

	Active	Reference
18. Channel 1		
19. Channel 2		
20. Channel 3		
21. Channel 4		
22. Channel 5		
23. Other (please state)		

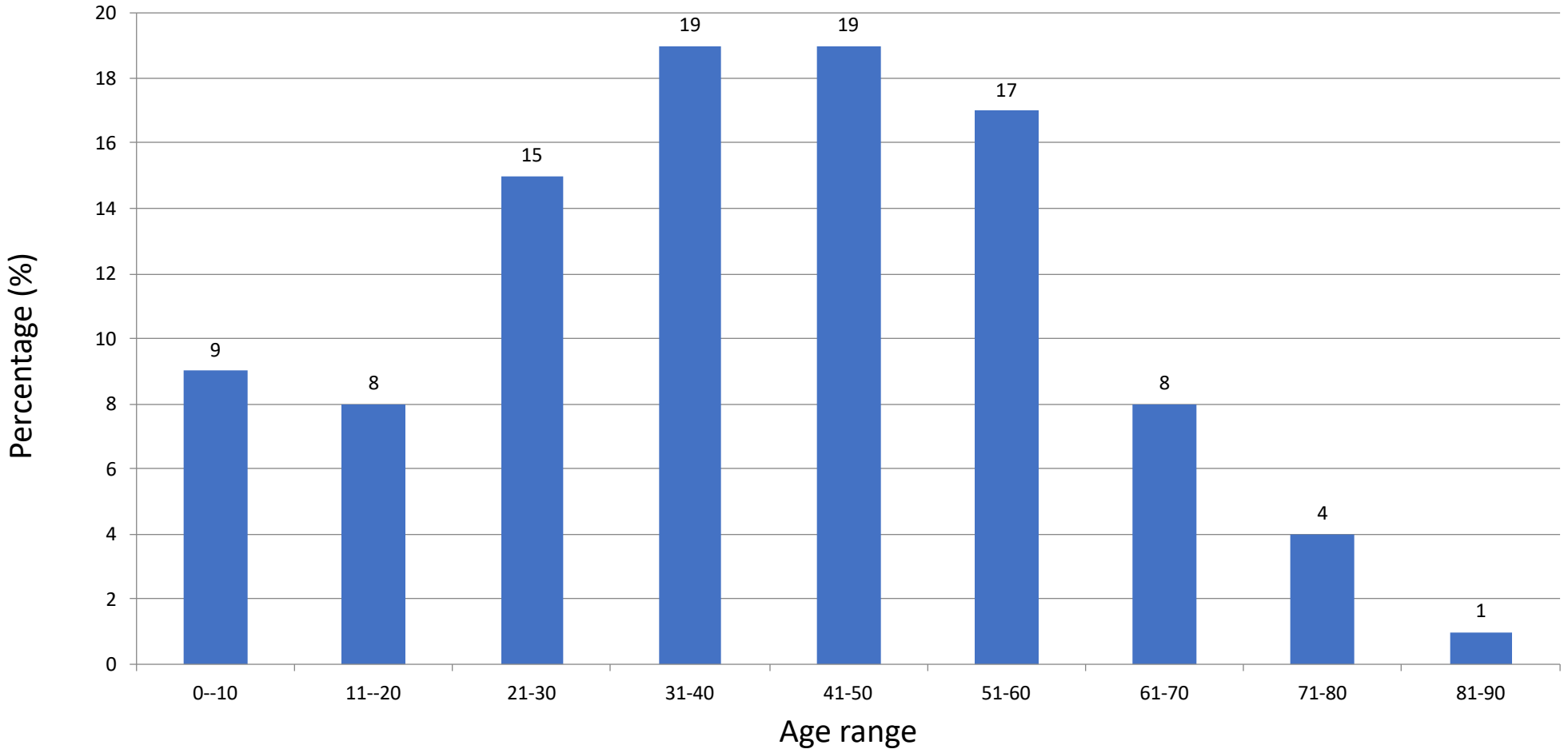
24. Were Half field VEPs recorded?	Yes / No
25. If yes please give reason?	Indicated by referral Indicated by full field VEP results Other – please state
26. Was pattern ERG recorded?	Yes / No
27. If yes, please give reason?	Indicated by referral Indicated by full field VEP results Other – please state
28. Was Flash VEP recorded?	Yes / No
29. If yes, please give reason?	Indicated by referral Indicated by full field VEP results Other – please state
30. Was Flash ERG recorded?	Yes / No
31. If yes please give reason?	Indicated by referral Indicated by full field VEP results Other – please state

PATIENT DEMOGRAPHICS

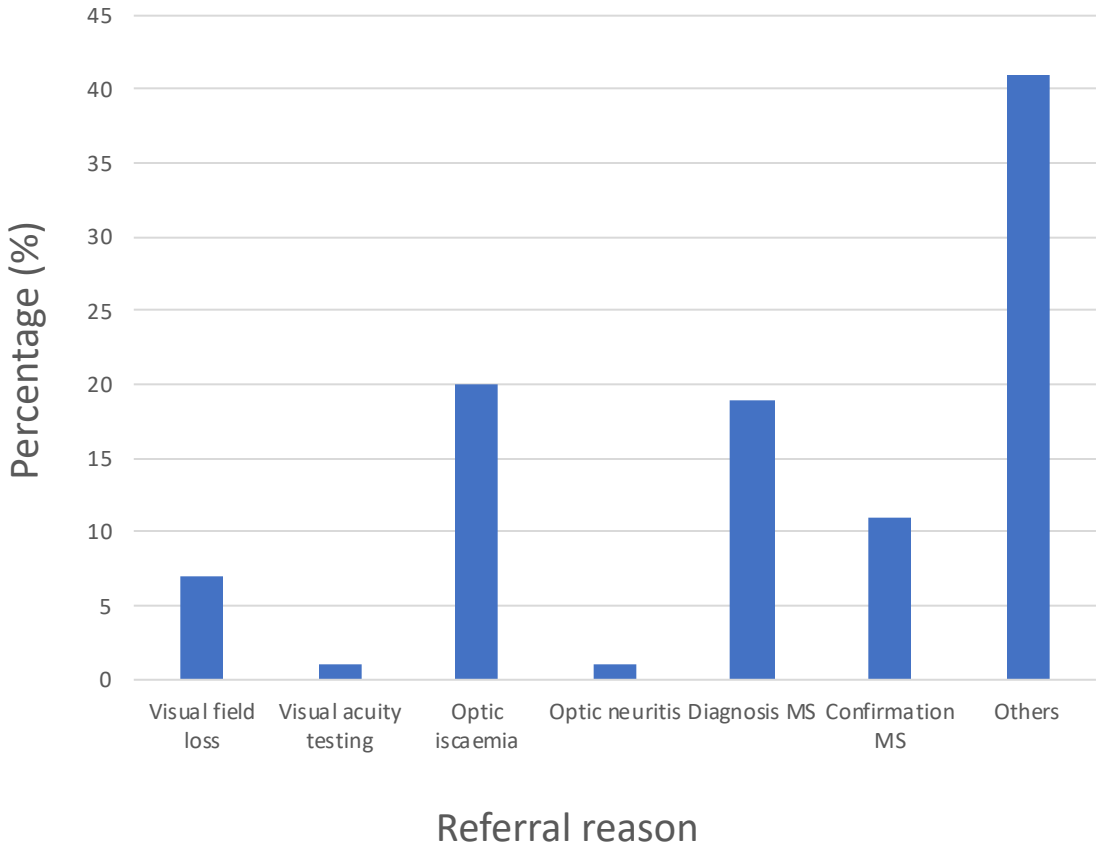
GENDER DISTRIBUTION

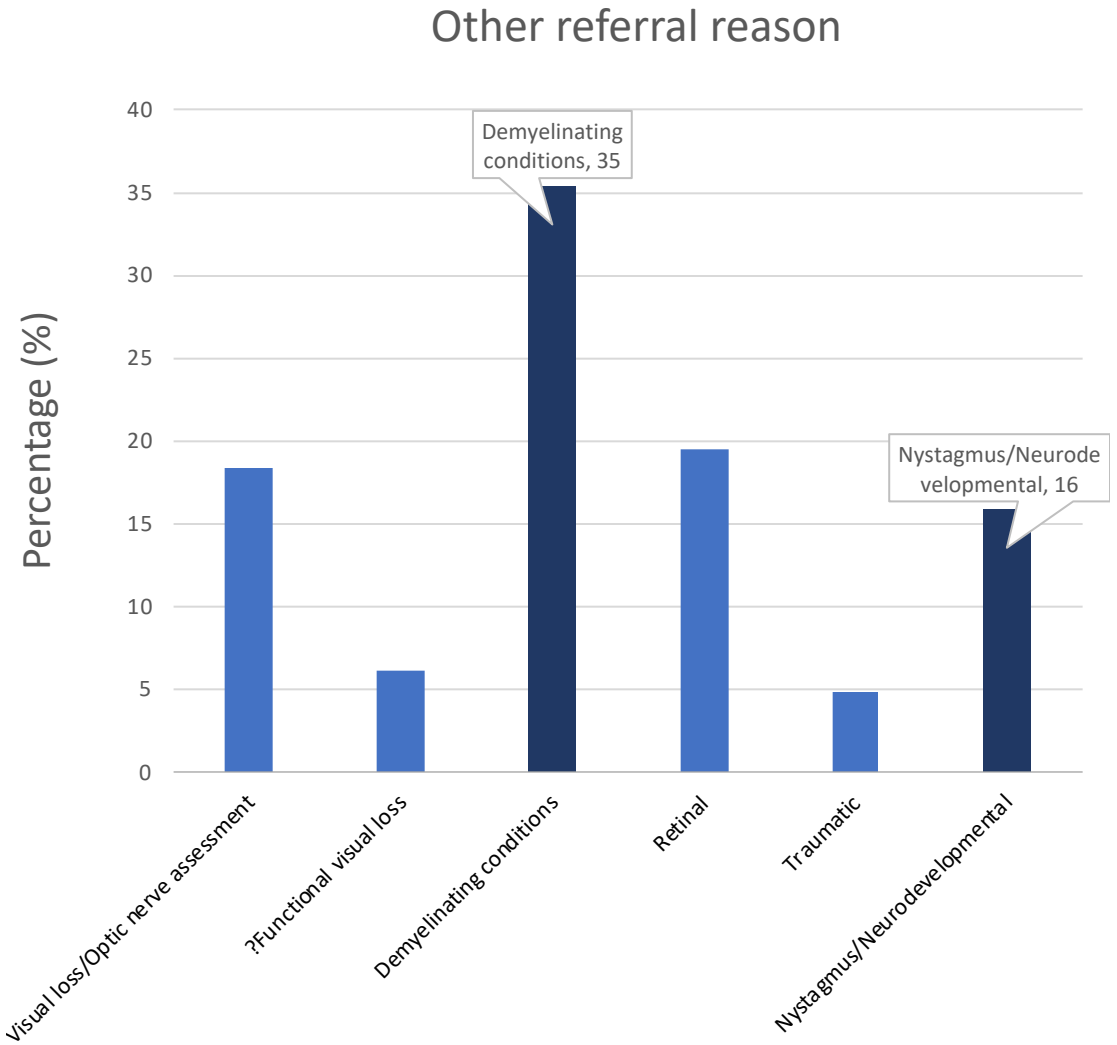


DISTRIBUTION BY AGE



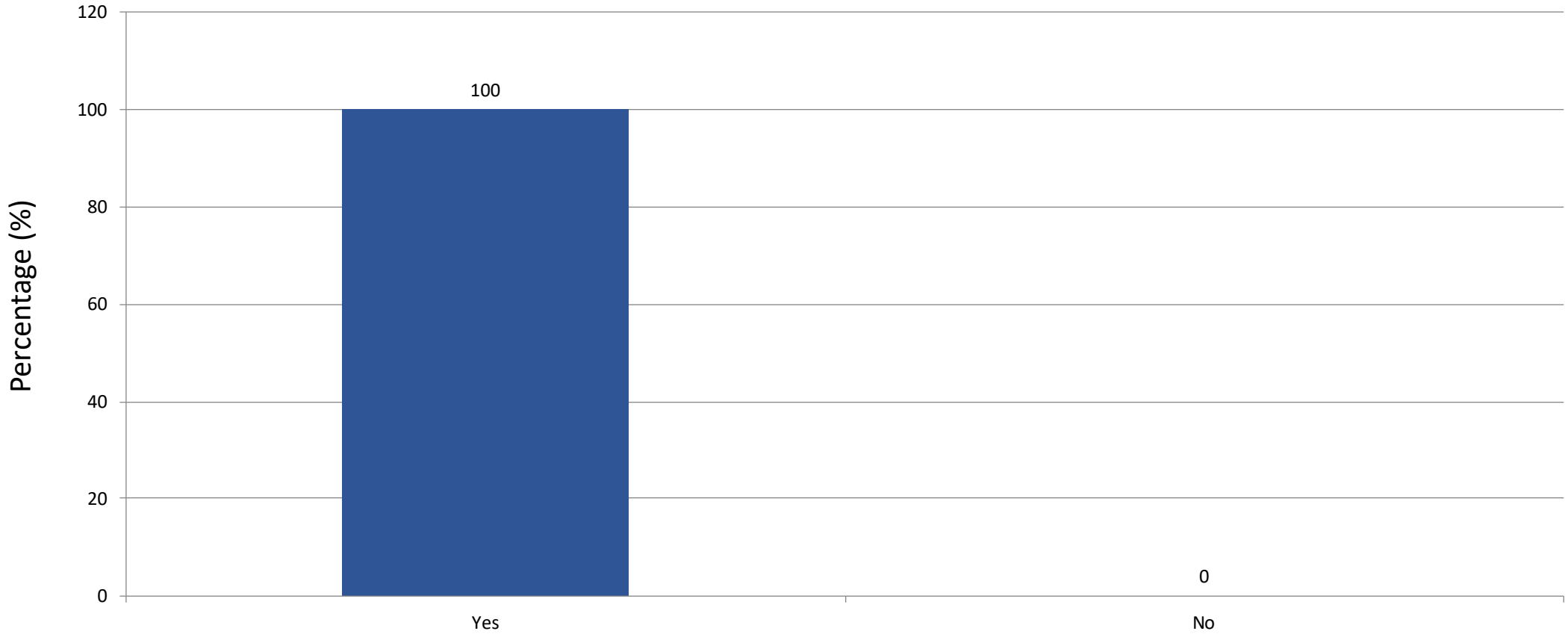
REASON FOR REFERRAL



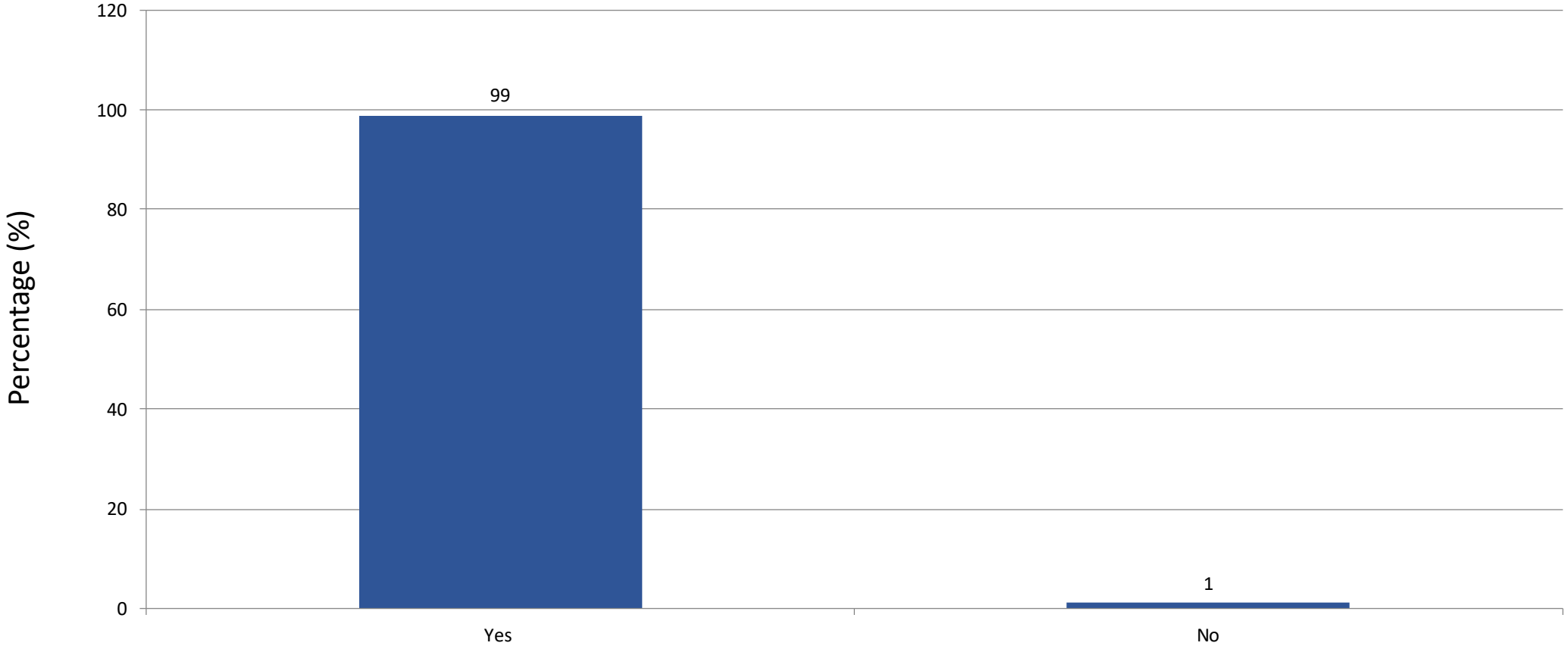


PRE-TESTING INFORMATION

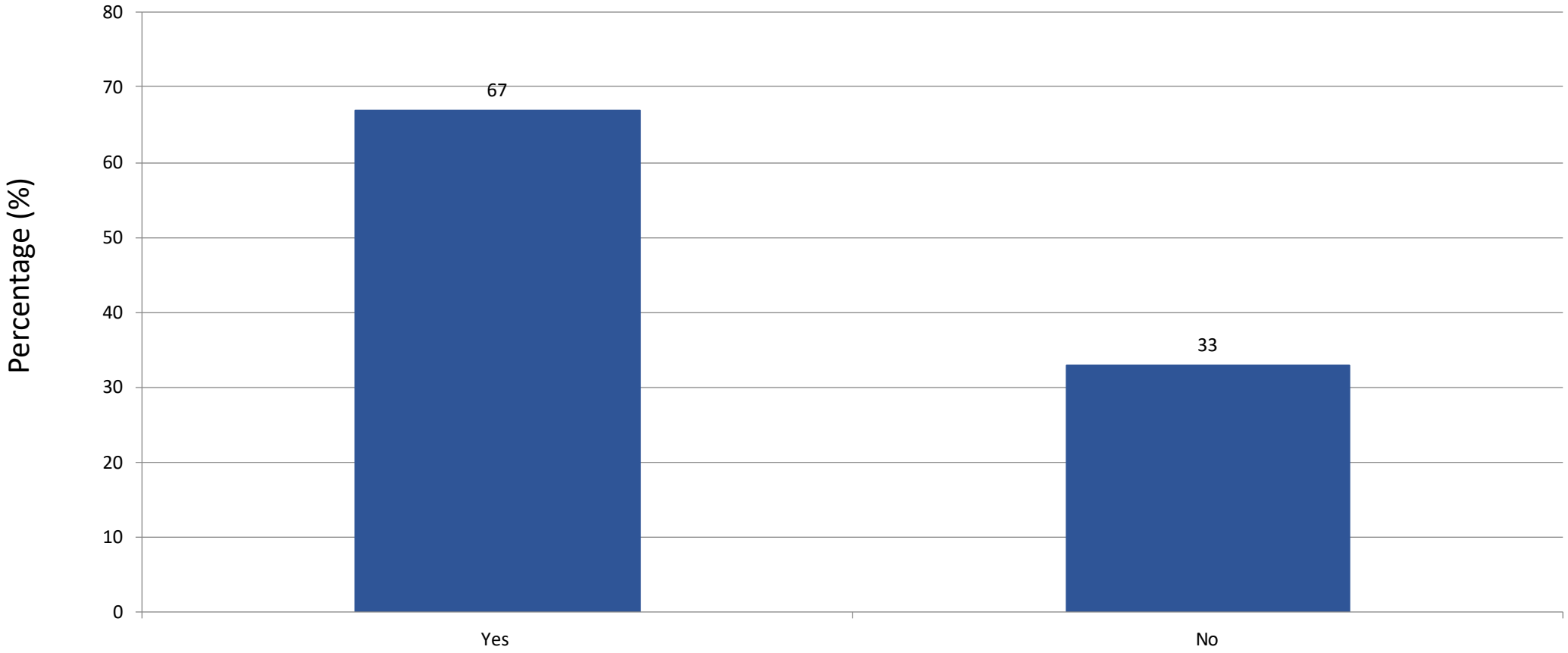
PATIENT IDENTIFICATION AND CLINICAL INFORMATION VERIFIED?



WAS VISUAL ACUITY ASSESSED ?



DOES THE REPORT STATE THAT GLASSES WERE WORN?



PREVALENT PRACTICE AND RECOMMENDATION 1

Before commencing the test, the patient is identified and the clinical information from the referral verified.

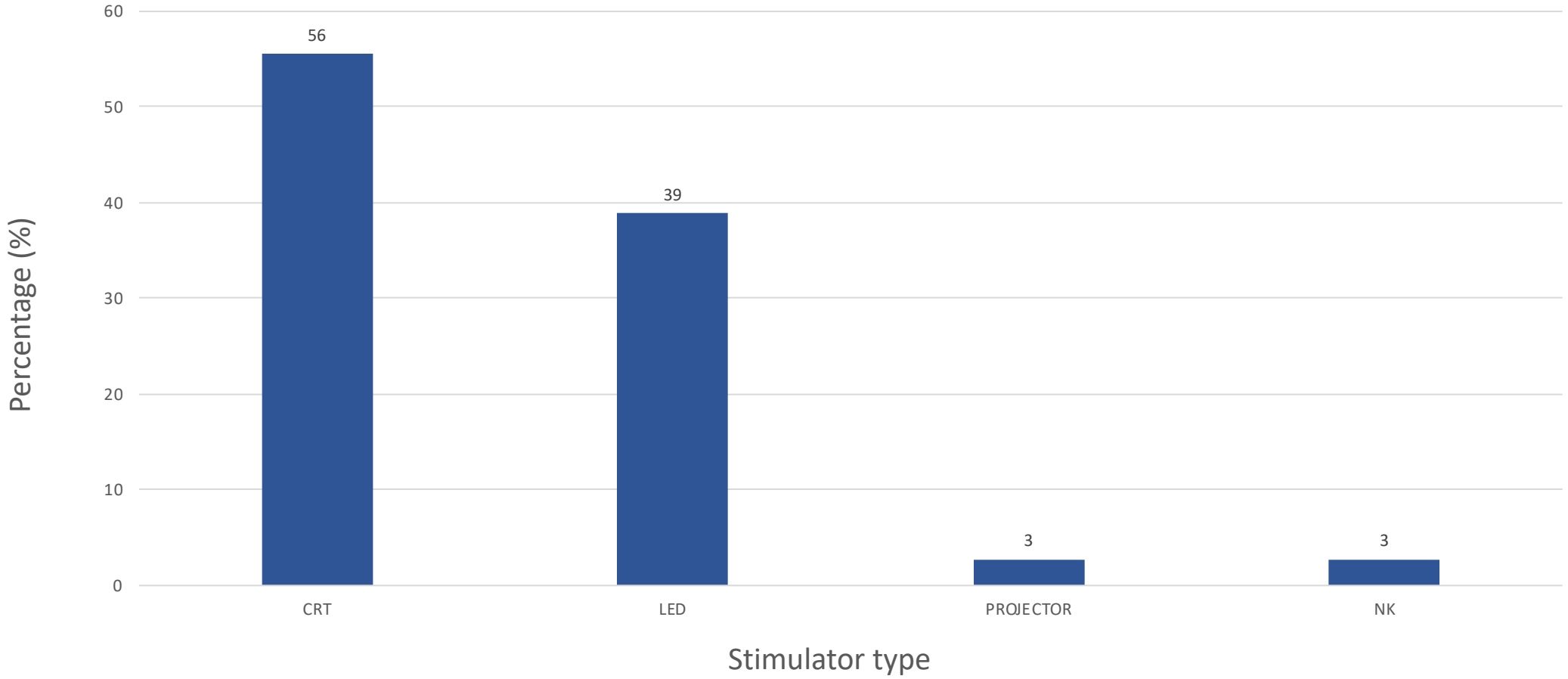
PREVALENT PRACTICE AND RECOMMENDATION 2

The report should document patient visual acuity and if corrective lenses were worn or not.

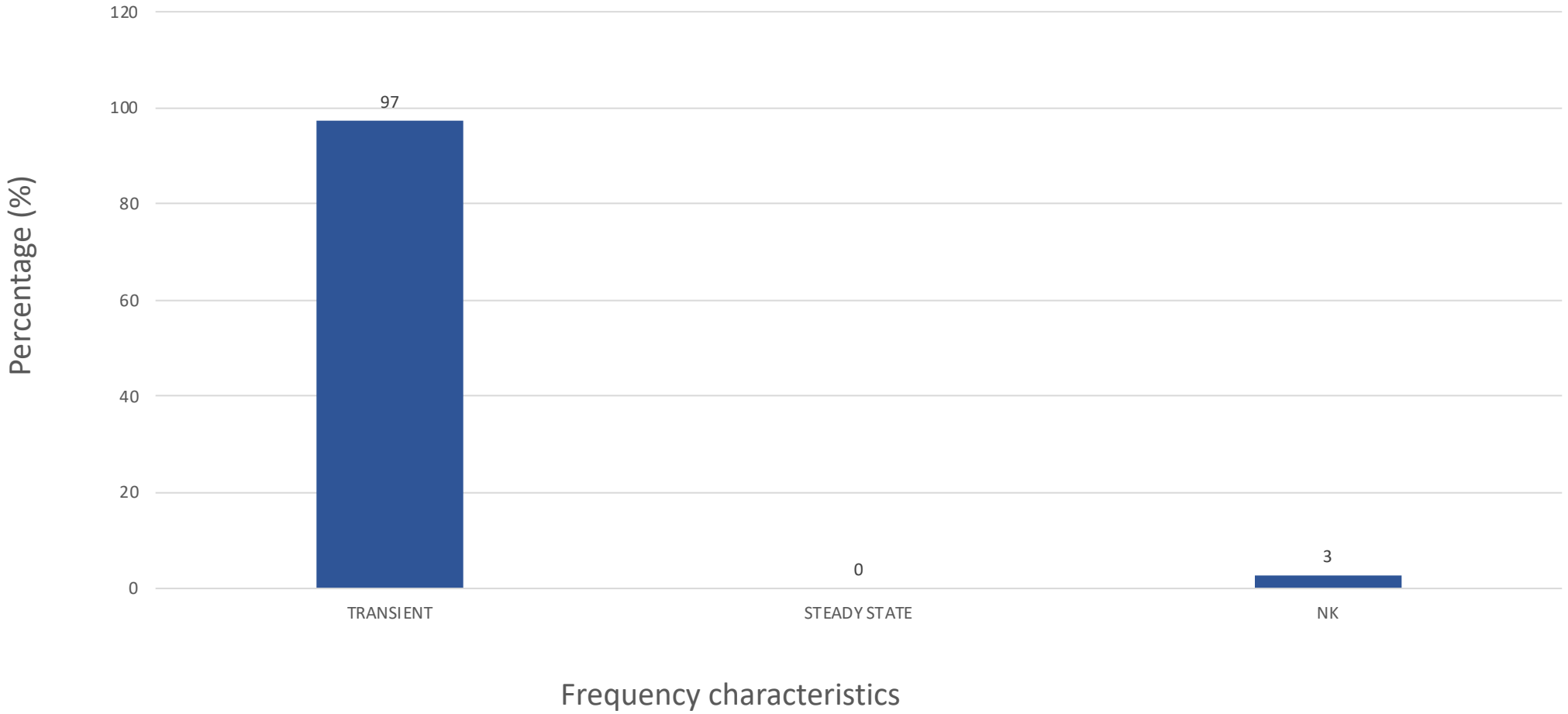
Patient state should be included to indicate cooperation level and behavioural/ophthalmic/neurological cause for poor fixation i.e. nystagmus, poor acuity etc.

TECHNICAL ASPECTS

DISPLAY TYPE OF STIMULATOR USED?



STIMULATION FREQUENCY CHARACTERISTICS?



CURRENT ISCEV STANDARDS

Table 1 ISCEV standard for VEP assessment

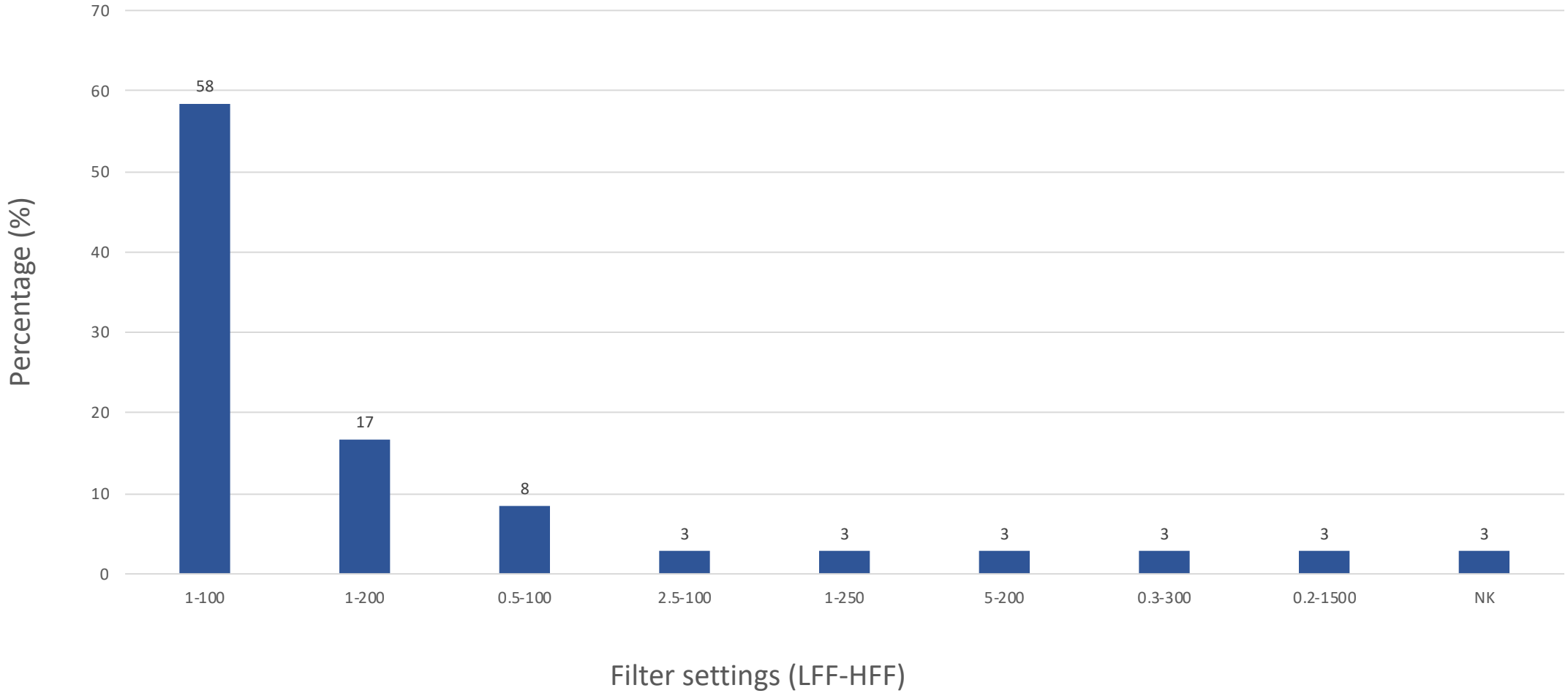
(a) Standard stimuli

Stimulus type	Field size (minimum)	Presentation	Stimulus	Mean luminance (cd · m^{-2})	Michaelson contrast (%)	Presentation rate
Pattern reversal	15°	Monocular	Check widths: 1° (0.8°–1.2°); 0.25° (0.2°–0.3°)	50 (40–60)	≥80	2 (1.8–2.2) reversals/s
Pattern onset/offset	15°	Monocular	Check widths: 1° (0.8°–1.2°); 0.25° (0.2°–0.3°)	50 (40–60)	≥80	1.67 Hz. (1.4–1.67 Hz) (200 ms on; ≥ 400 ms off)
Flash stimulation	≥20°	Monocular	Flash ≥ 20°	3 cd · s · m^{-2} (2.7–3.4)	–	1 (0.9–1.1) Hz

(b) Standard recording

	Electrode montage (international 10/20 channel system)		Filters (−3 dB)		
	Active	Common reference	Low freq	High freq	Sweeps averaged
Pattern stimulation	Oz	Fz	≤1	≥100	≥50
Flash stimulation	Oz	Fz	≤1	≥100	≥50

SIGNAL ACQUISITION/DISPLAY: LFF-HFF



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Pattern stimulation	Oz	Fz	≤1	≥100	≥50
Flash stimulation	Oz	Fz	≤1	≥100	≥50

RECOMMENDATION 3

Ensure the EP recording machine is set up to adequately record the investigated evoked potential.

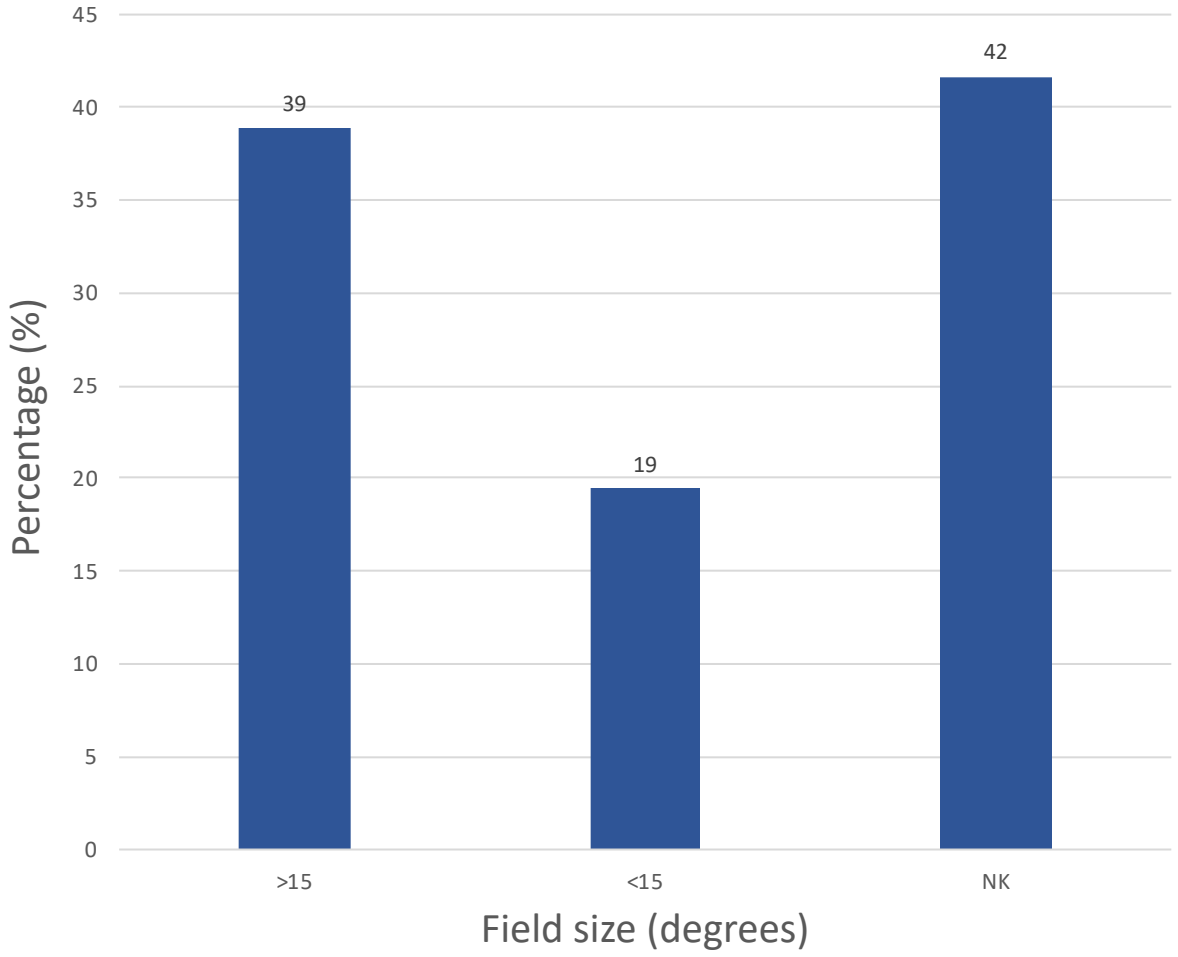
VEP Machine settings

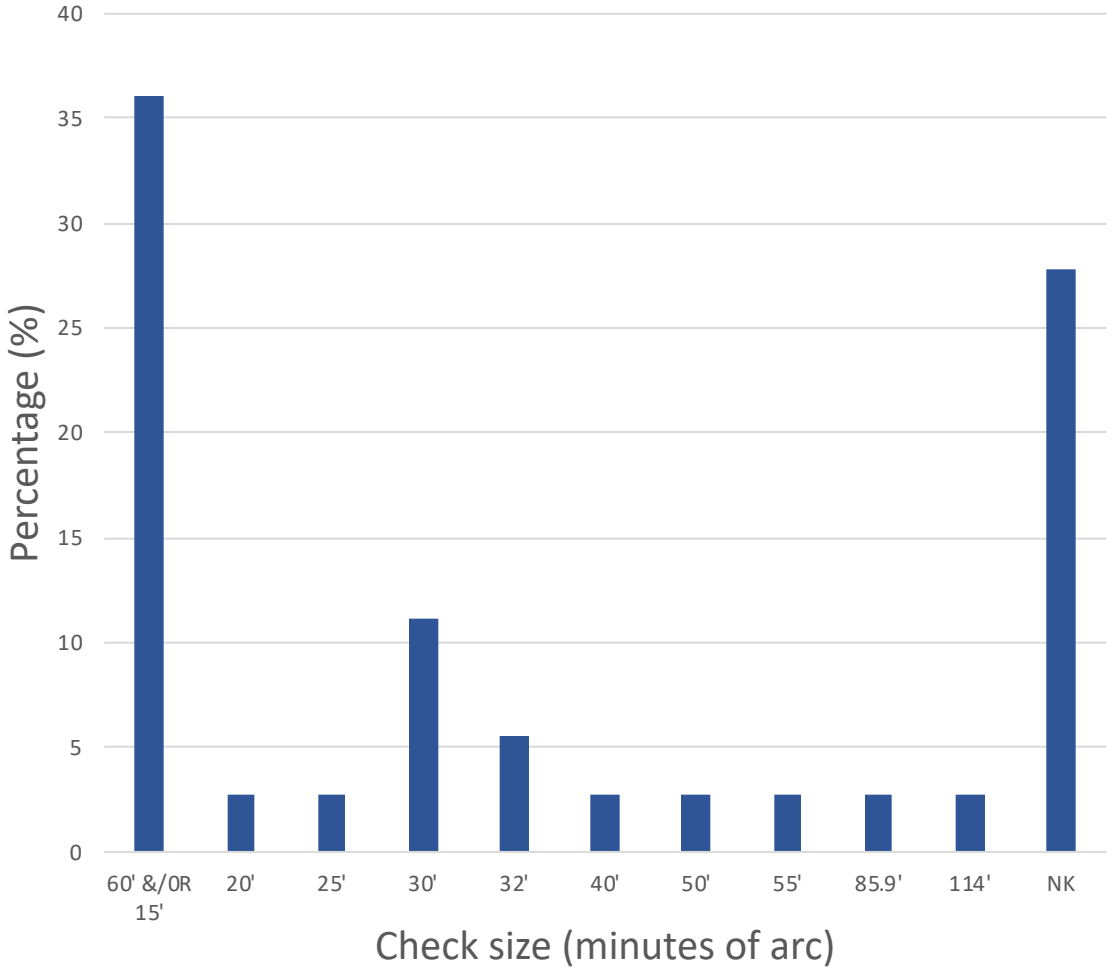
- Luminance 40-60cd.m^{-2}
- Contrast Michelson contrast[2] ≥80%
- Reversal rate 2.0±0.2 reversals per second
- Filters (LFF – HFF) ≤1Hz - ≥100Hz
- Memory time base 500ms

Interpretation should be based on stimulator adjusted normative data

STIMULUS FEATURES

FIELD AND CHECK SIZE





CURRENT ISCEV/IFCN GUIDELINES

Table 1 ISCEV standard for VEP assessment

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Pattern onset/offset	15°	Monocular	Check widths: 1° (0.8°–1.2°); 0.25° (0.2°–0.3°)	50 (40–60)	≥80	1.67 Hz. (1.4–1.67 Hz) (200 ms on; ≥ 400 ms off)

IFCN

Suggest mid-size fields (24-32°)

Recommend the use of more than one check and/or field size

RECOMMENDATION 4

It is recommended to perform monocular stimulation using a field size of ≥15° and using check sizes of 60’ and 15’ for stimulation of both peripheral and central vision, particularly when visual acuity assessment has not been performed or is questionable.

Guideline

If clinical information suggestive of poor PRVEP compliance then additional/alternative VEP stimulation should be considered.

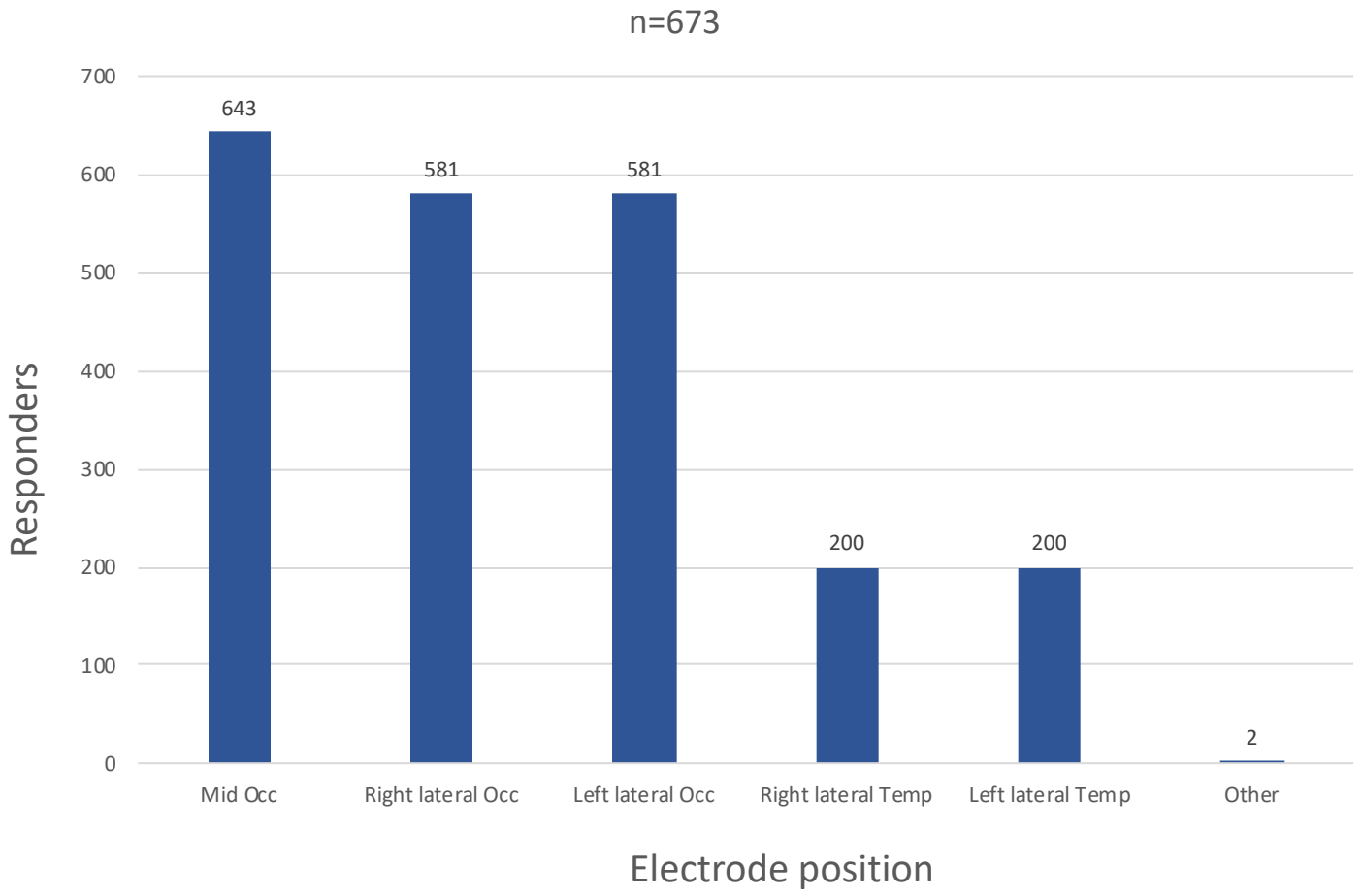
Guideline

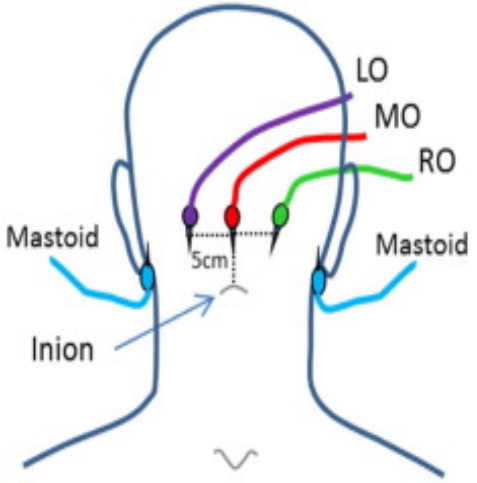
If testing is limited or when stimulation at 15’ is difficult, consider a 30’ check size.

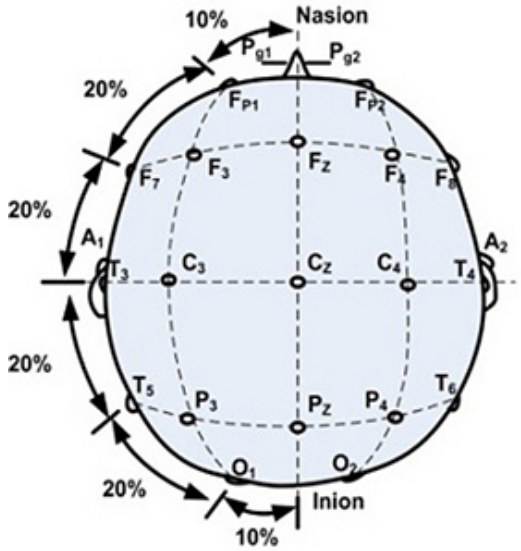
Guideline

Consider binocular stimulation or stimulation with larger check sizes if compliance or acuity is limited

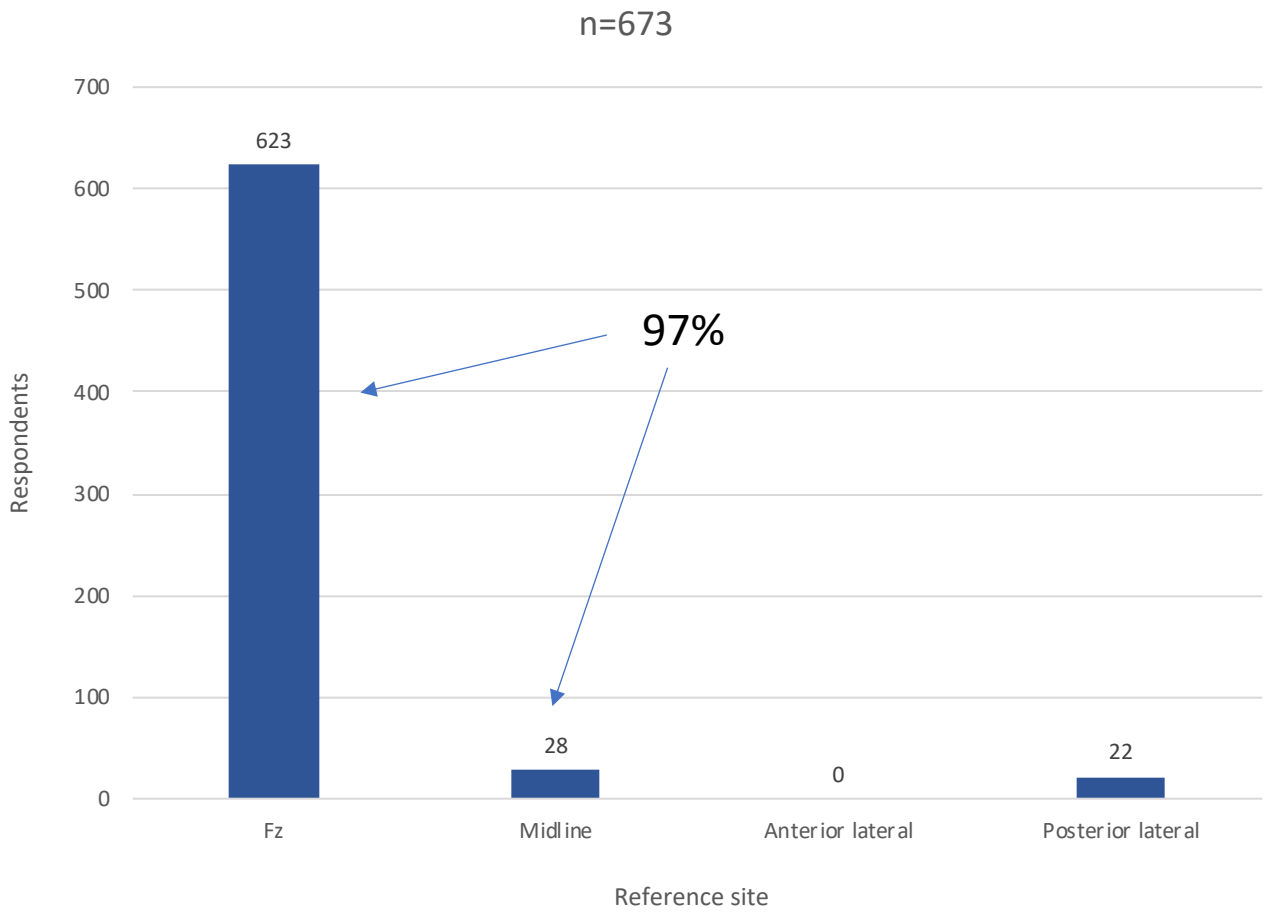
POSITIONING OF RECORDING ELECTRODES

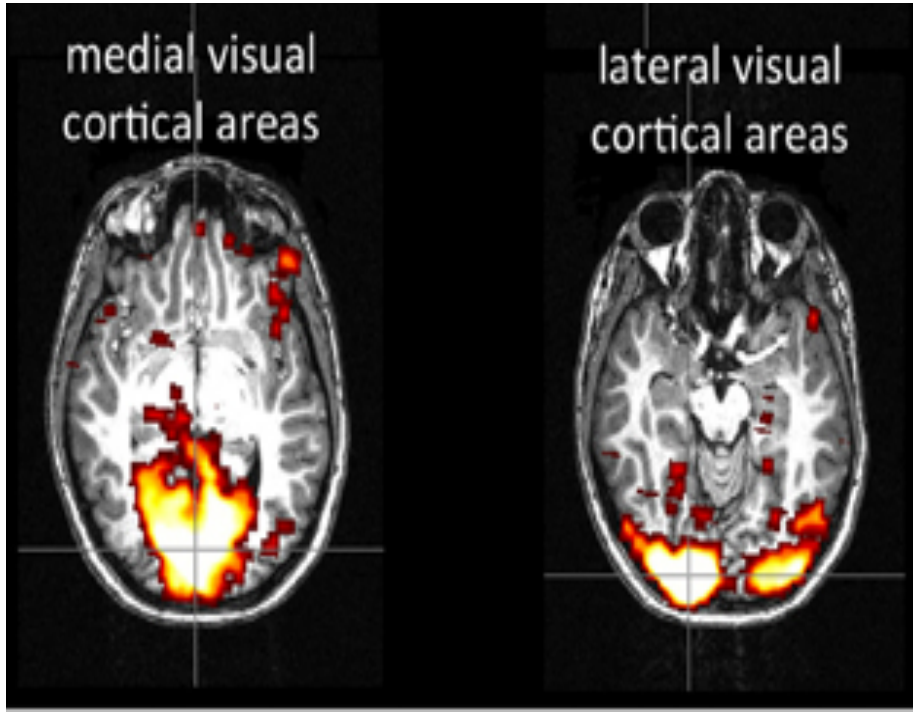






CORTICAL REFERENCE SITE





CURRENT ELECTRODE GUIDELINES

(b) Standard recording

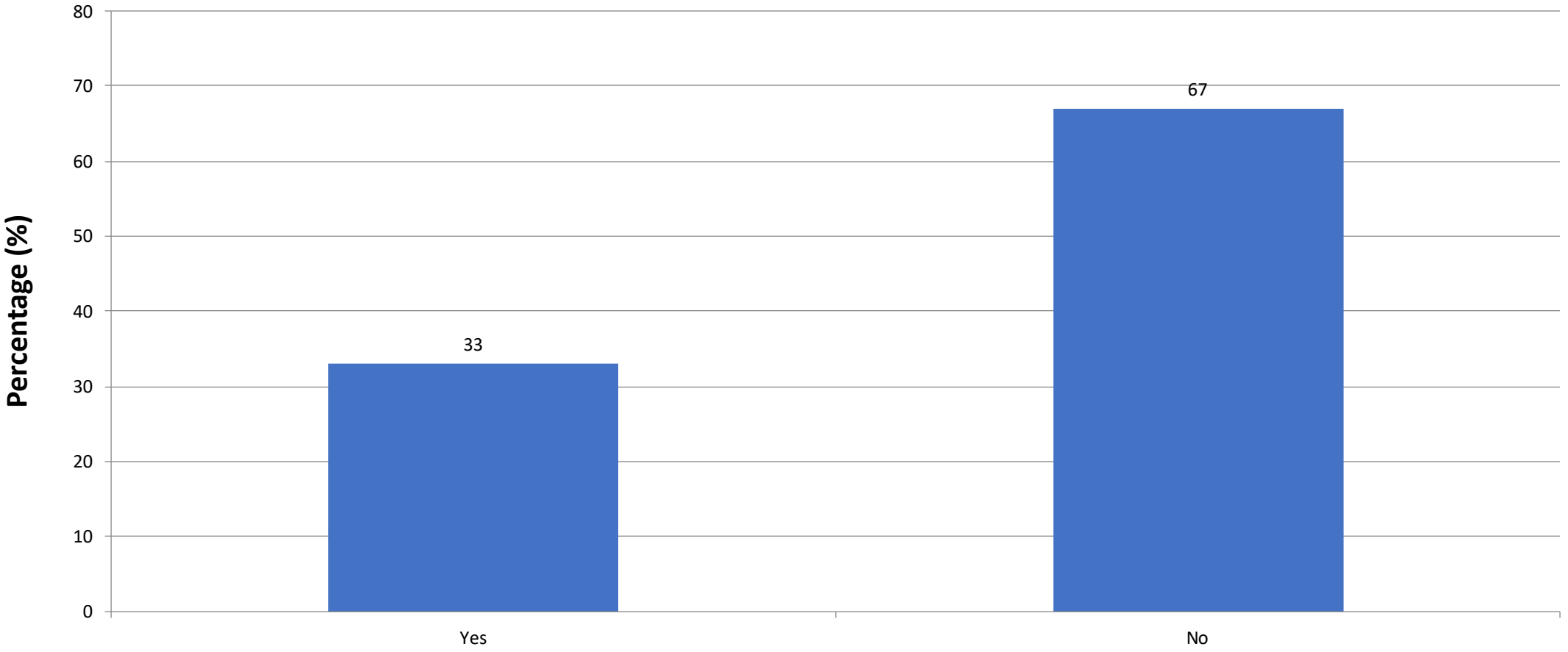
	Electrode montage (international 10/20 channel system)		Filters (−3 dB)		
	Active	Common reference	Low freq	High freq	Sweeps averaged
Pattern stimulation	Oz	Fz	≤1	≥100	≥50
Flash stimulation	Oz	Fz	≤1	≥100	≥50

Recording montage. At least four channels should be recorded. In routine testing, the following montage and derivations are recommended (Fig. 1):

Channel 1: Left occipital to midfrontal = LO-MF
Channel 2: Midoccipital to midfrontal = MO-MF
Channel 3: Right occipital to midfrontal = RO-MF
Channel 4: Midfrontal to ear/mastoid = MF-Al

Use Queens Square measurement system as lateral electrodes placed further from midline

PATTERN ERG RECORDED?



RECOMMENDATION 5

A minimum of 3 channels are recorded as a standard for monocular stimulation;

These should be referenced to a common Fz reference

For standardisation of results it is suggested that electrode placements of Fz, O2, Oz and O1 follow the international 10:20 electrode placement system.

Guideline

Recording a simultaneous pattern ERG response can give objective evidence that fixation is maintained and can improve diagnostic accuracy.

In the presence of an abnormal VEP, a bilateral PERG could be recorded to delineate retinal from optic pathway dysfunction

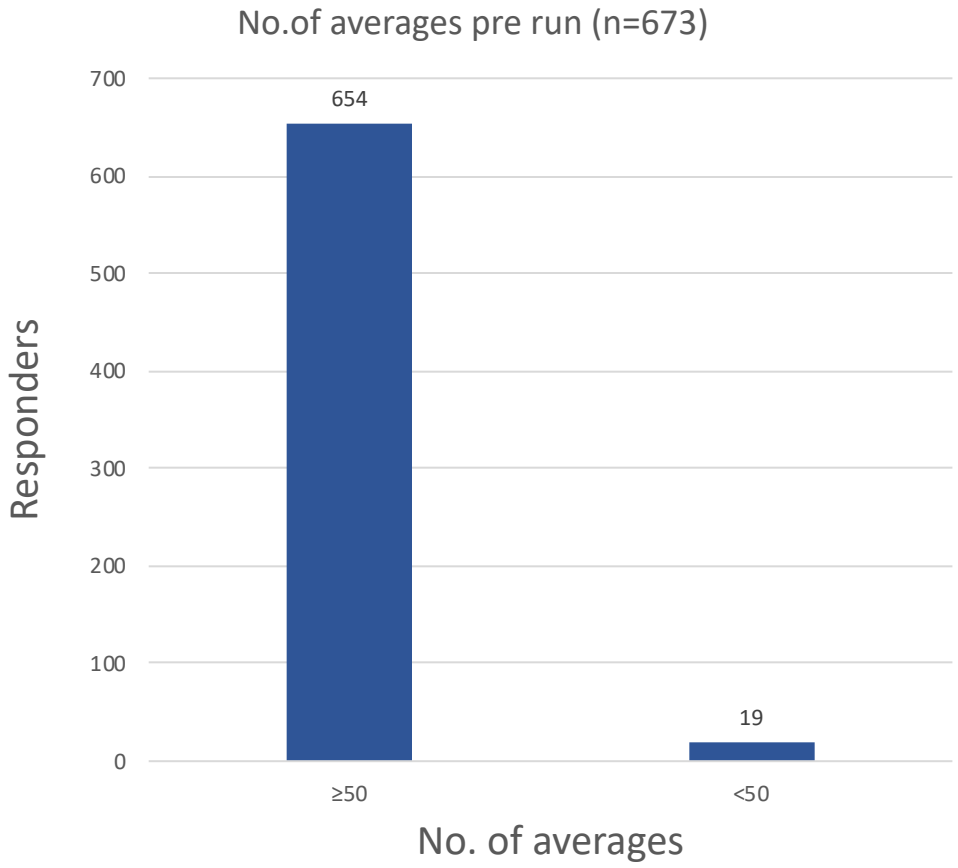
Guideline

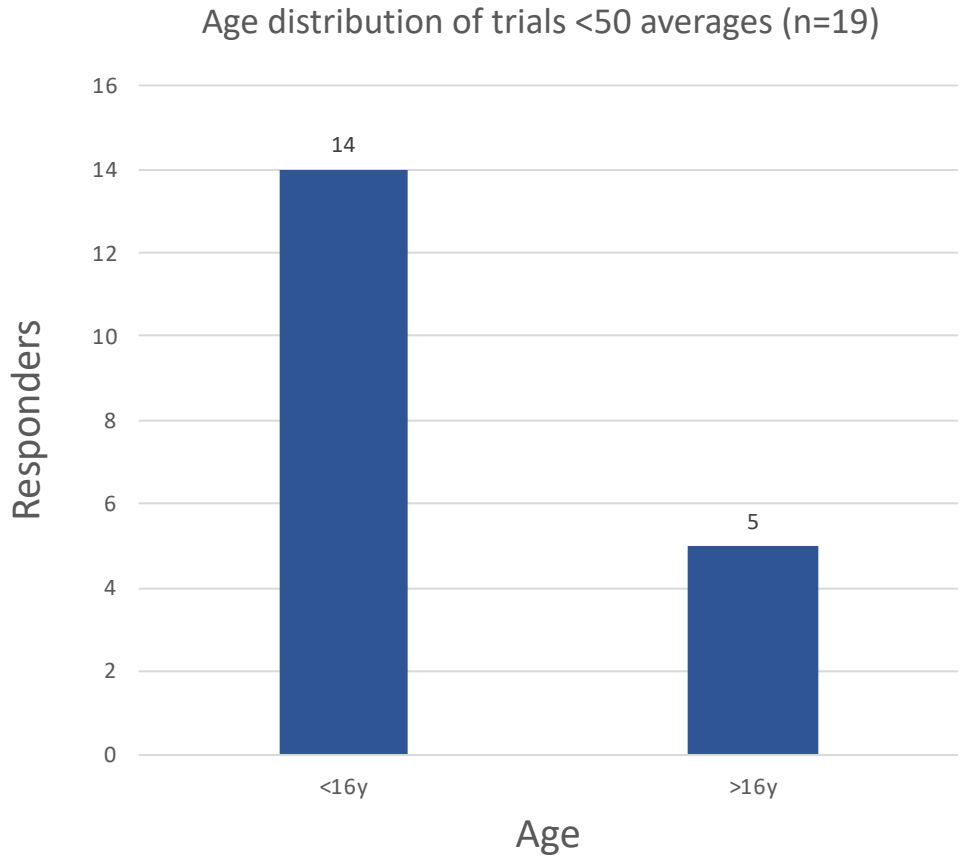
Additional cortical channels may be utilised to identify interhemispheric differences i.e. crossed asymmetry.

Guideline

Consider differential (ipsilateral) referencing position if concerns regarding paradoxical lateralisation.

AVERAGING (NUMBER OF TRIALS PER RUN)





CURRENT GUIDELINES - AVERAGING

(b) Standard recording

	Electrode montage (international 10/20 channel system)		Filters (−3 dB)		
	Active	Common reference	Low freq	High freq	Sweeps averaged
Pattern stimulation	Oz	Fz	≤1	≥100	≥50
Flash stimulation	Oz	Fz	≤1	≥100	≥50

RECOMMENDATION 6

≥50 individual trials are averaged to record reliable cortical P100 potentials. At least 2 averages should be recorded to verify reproducibility of waveforms

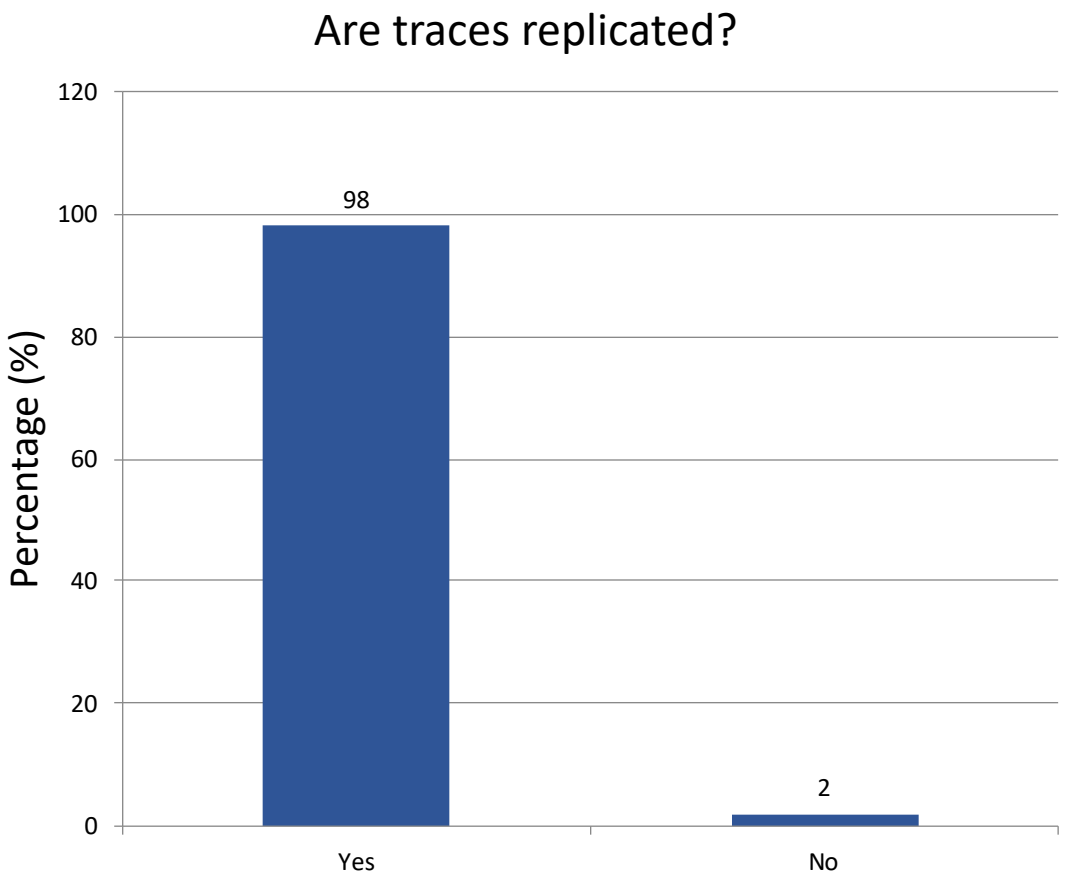
Guideline

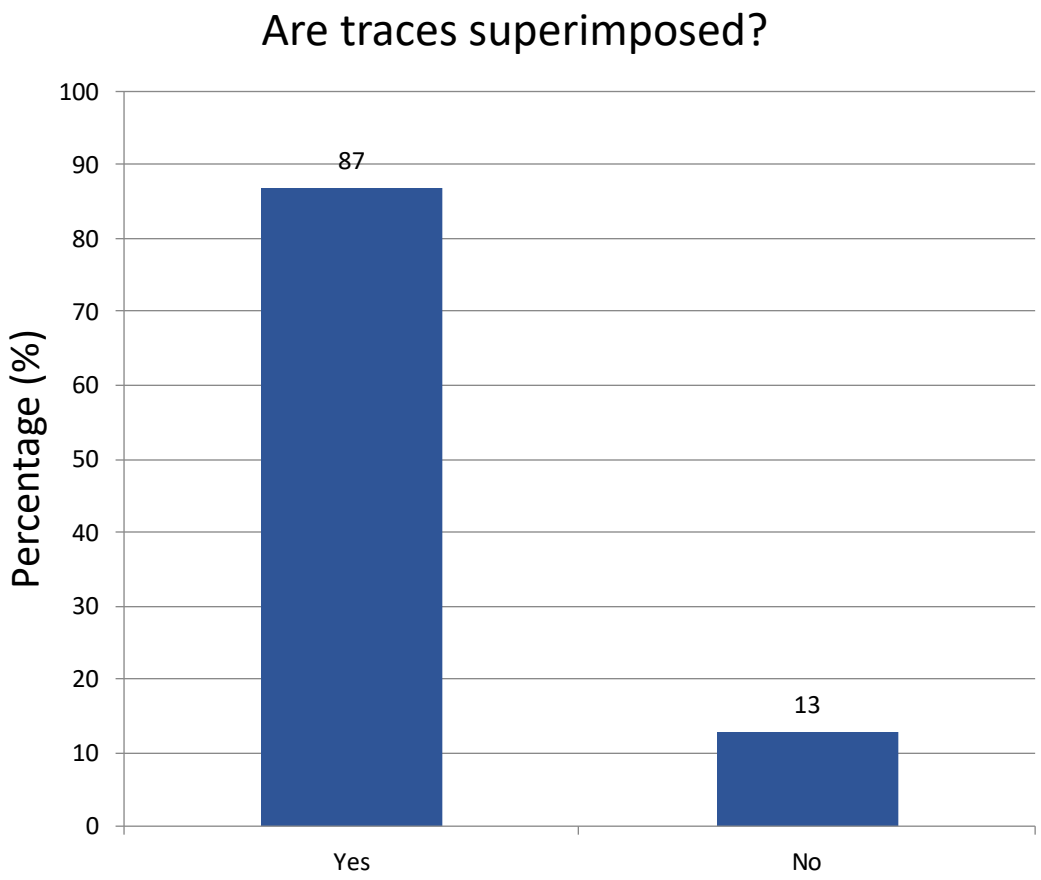
If compliance is limited a reduced average number may be considered as long as responses are reproduced.

Guideline

If waveforms are poorly reproducible then consider averaging >100 with regular breaks to maximise compliance.

REPLICATION AND SUPERIMPOSITION





RECOMMENDATION 7

The evoked potential waveforms are replicated to demonstrate the consistency of the latency and morphology of the component measured. Variability in latency values should be within 0.5-1% of the total sweep time and amplitude reproducibility should be within 15-20%.

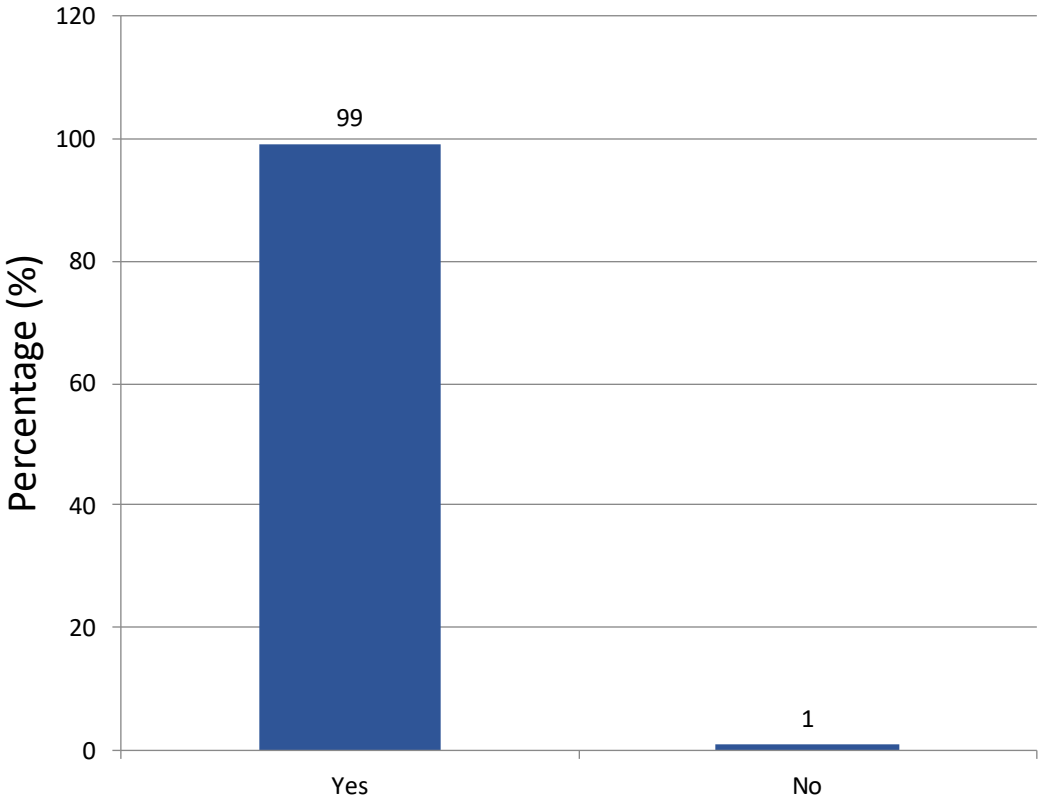
Guideline

Averaged traces are superimposed

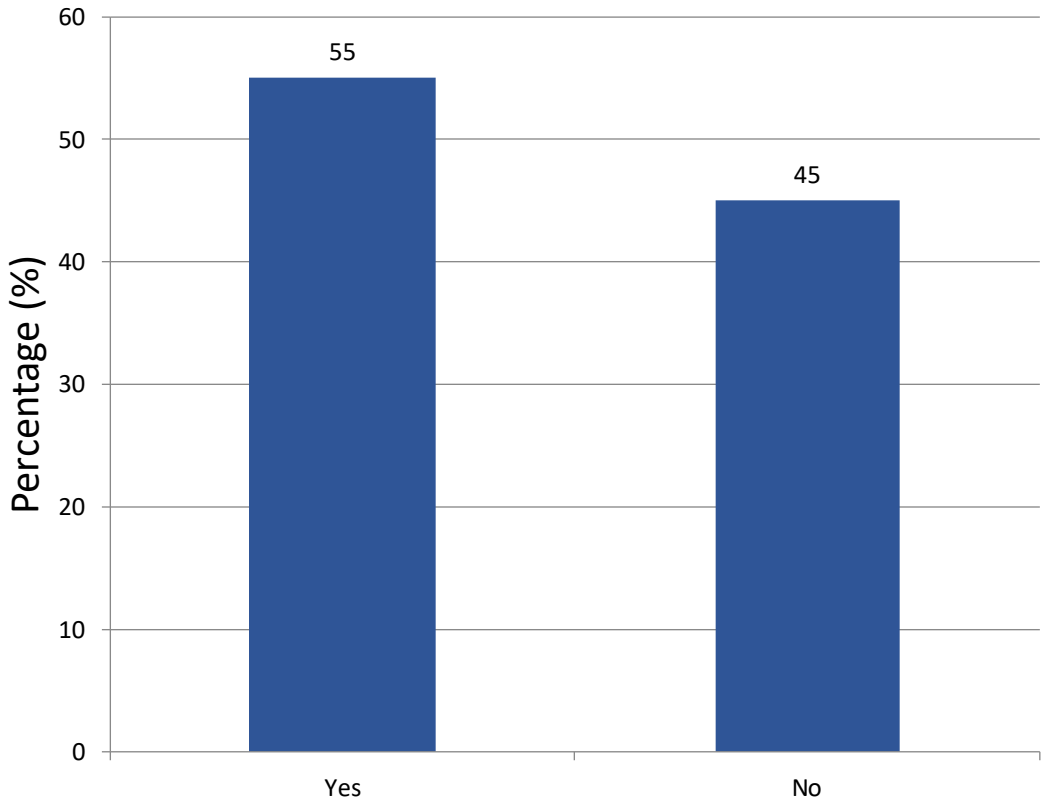
REPORTING

DATA INCLUDED IN THE REPORTS

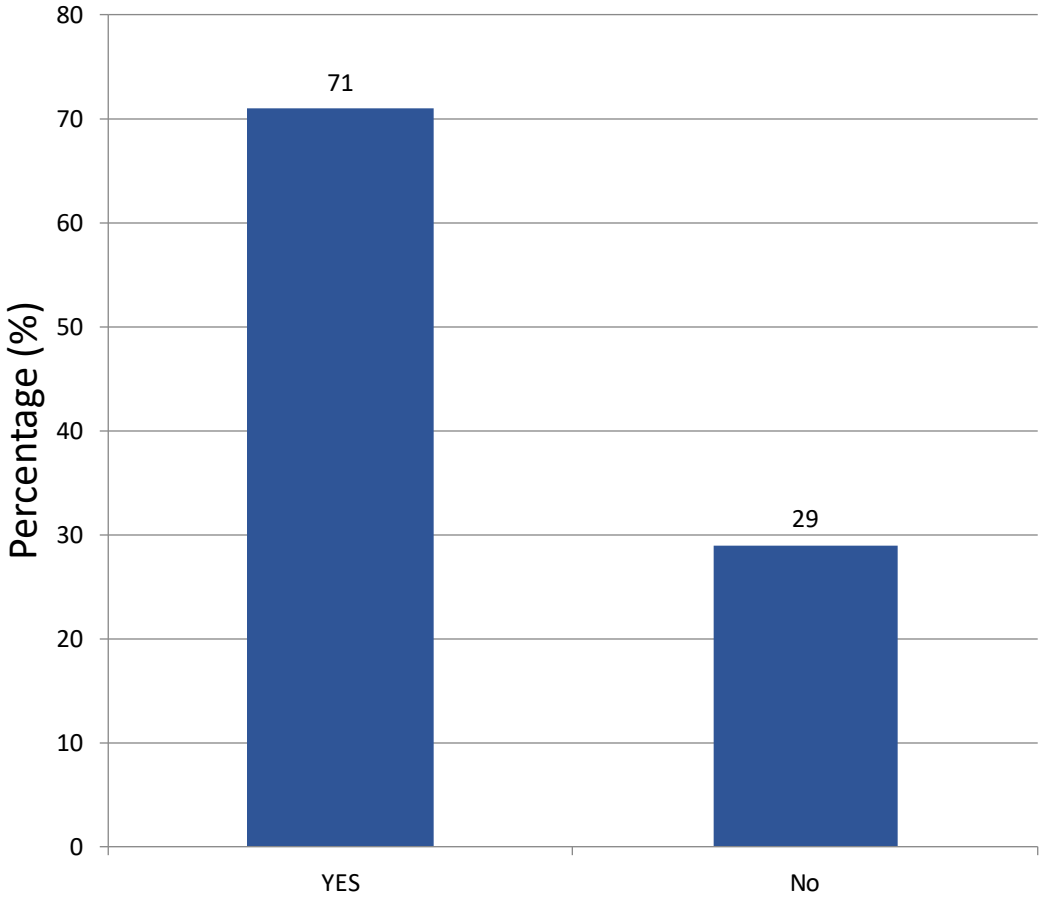
Is the numerical data in the report?



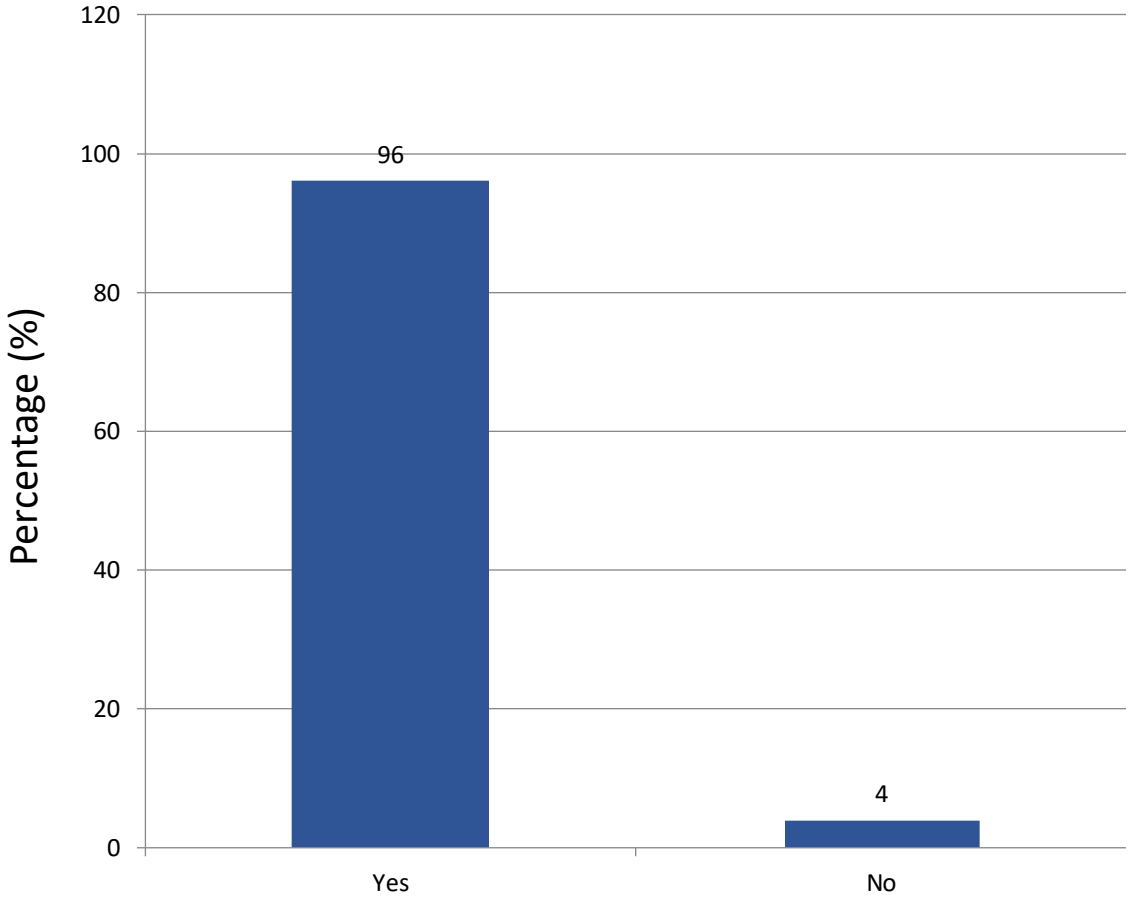
Are waveforms included in the report?



CLINICAL ACCOUNTABILITY



Was the professional status of the clinician PERFORMING the test stated?



Was the professional status of the clinician REPORTING the test stated?

RECOMMENDATION 8

The report of the investigation contains the numerical data.

It makes a statement on any abnormality detected.

The professional status of the clinician performing the investigation and report is identified.

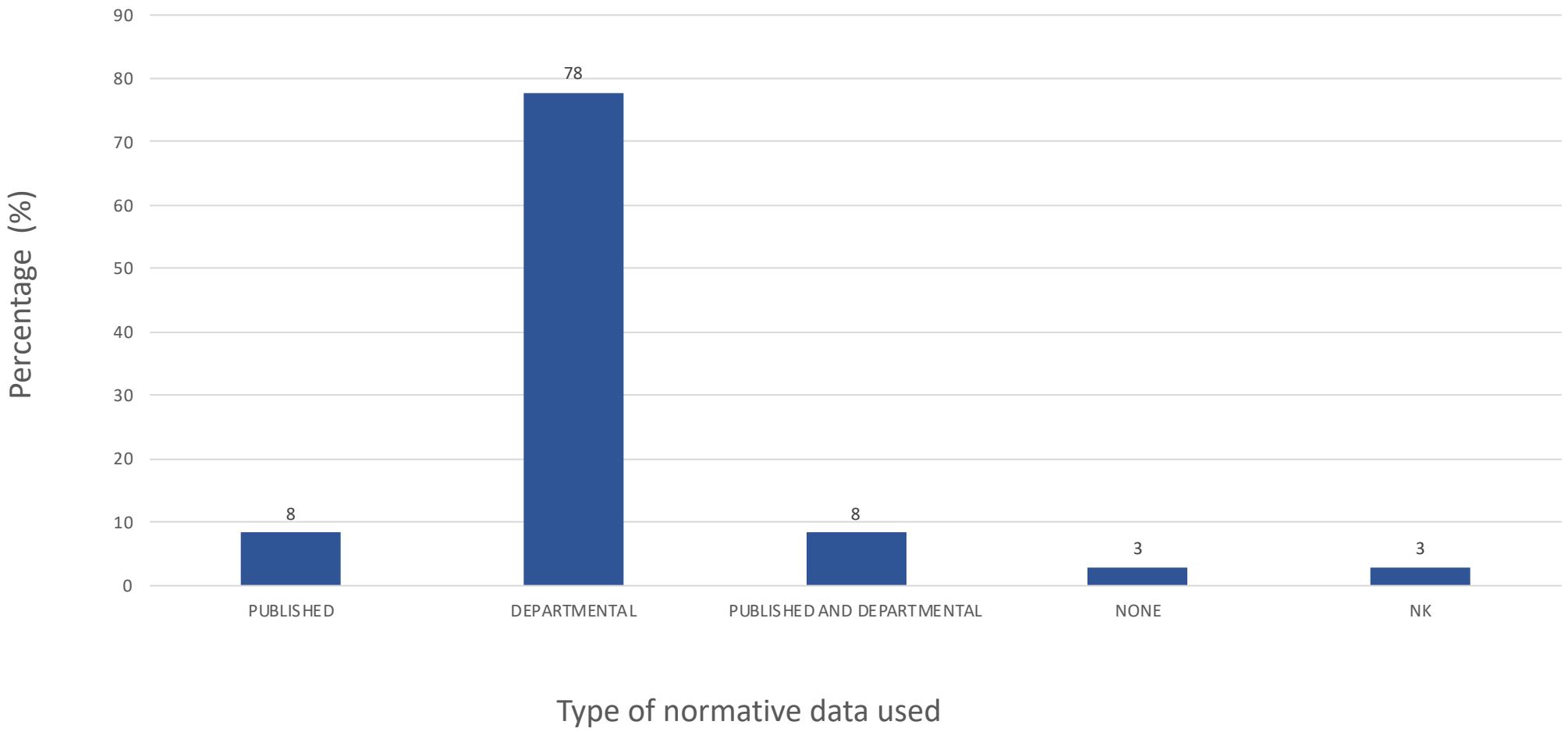
Guideline

The report contains illustrations of recorded waveforms

Guideline

The report contains normative values

NORMATIVE DATA



RECOMMENDATION 9

Data should be reported using locally-adopted matched normative data from either a local or published data set.

If using published values, an audit should be performed to assess whether stimulator and testing characteristics are comparable to those used in the normative study.

RECOMMENDATION 10

The report is signed by the clinician taking medico-legal responsibility for it.

RECOMMENDED STANDARDS

STANDARD 1
Before commencing the test, the patient is identified and the clinical information from the referral verified.

STANDARD 2
The report should document patient visual acuity and if corrective lenses were worn or not.
Patient state should be included to indicate cooperation level and any behavioural/ophthalmological/neurological cause for poor fixation i.e. nystagmus, poor acuity etc.

STANDARD 3
Ensure the EP recording machine is set up to adequately record the investigated evoked potential.

VEP Machine settings

Luminance	40-60cd.m^{-2}
Contrast	Michelson contrast[2] ≥80%
Reversal rate	2.0±0.2 reversals per second
Filters (LFF – HFF)	≤1Hz - ≥100Hz
Memory time base	500ms

Interpretation should be based on stimulator adjusted normative data

STANDARD 4
It is recommended to perform monocular stimulation using a field size of ≥15^{o} and using check sizes of 60’ and 15’ for stimulation of both peripheral and central vision, particularly when visual acuity assessment has not been performed or is questionable.

Guideline
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Guideline
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RECOMMENDED STANDARDS

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These should be referenced to a common Fz reference
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Guideline
The report contains normative values

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