



Errors in LogMAR visual acuity transcription and calculation—an ongoing problem

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We recently conducted a UK multicentre randomised controlled trial (ROSA) using Early Treatment of Diabetic Retinopathy Study best corrected Visual Acuity (VA) measurement, with LogMAR score as an outcome measure [1]. Retrospective review of source documentation identified multiple issues with calculation and recording of LogMAR scores. This finding is pertinent to Ophthalmology and Optometry teams using VA outcomes.

A total of 936 VA tests were performed for the ROSA trial across 23 UK Eye Hospitals, 2012–2017. The retrospective data review identified a mean LogMAR score recording error rate of 25%.

Multiple points of error during the VA test process were identified:

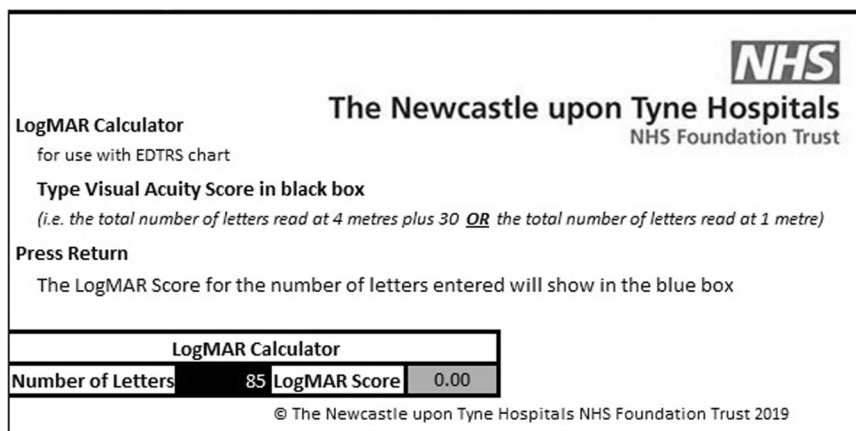
- 19 tests not completed to the instructions in the Trial Specific Procedure. Of these, seven were revised following clarification of procedure. The remaining 12 (from one site) were excluded from the final dataset,

due to discrepant letter and LogMAR score with no possibility of ascertaining which was correct.

- **Recording letter score:** Of the 22 sites included in the dataset, only 5 (23%) showed total accuracy in recording letter score on the Case Report Form. The error rate across the remaining 17 sites ranged from 5 to 57% with transcription and addition errors. The mean letter score error rate across all 22 sites was 12%.
- **Recording LogMAR score:** Only one site (5%) achieved total accuracy of recording the calculated LogMAR score on the Case Report Form, with the error rate across the remaining 21 sites ranging from 6 to 79% with transcription and calculation errors. The mean LogMAR error rate across 22 sites was 25%.
- No site was totally accurate across both of these variables. Independent trial data scoring was therefore undertaken.

A trial specific procedure for VA testing was provided for each site, plus a Visual Acuity source document for

Fig. 1 The LogMAR calculator



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LogMAR Calculator
for use with EDTRS chart

Type Visual Acuity Score in black box
(i.e. the total number of letters read at 4 metres plus 30 OR the total number of letters read at 1 metre)

Press Return
The LogMAR Score for the number of letters entered will show in the blue box

LogMAR Calculator	
Number of Letters	85
LogMAR Score	0.00

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LogMAR score identification chart for use at 4m with a 4m ETDRS chart The total number of letters read refers to the number of letters identified at 4m PLUS the 30 assumed for 1m					
total number of letters read	31	32	33	34	35
	LogMAR 1.08 Snellen 6/60-4	LogMAR 1.06 Snellen 6/60-3	LogMAR 1.04 Snellen 6/60-2	LogMAR 1.02 Snellen 6/60-1	LogMAR 1.00 Snellen 6/60
total number of letters read	36	37	38	39	40
	LogMAR 0.98 Snellen 6/48-4	LogMAR 0.96 Snellen 6/48-3	LogMAR 0.94 Snellen 6/48-2	LogMAR 0.92 Snellen 6/48-1	LogMAR 0.90 Snellen 6/48
total number of letters read	41	42	43	44	45
some sources state 6/36	LogMAR 0.88 Snellen 6/38-4	LogMAR 0.86 Snellen 6/38-3	LogMAR 0.84 Snellen 6/38-2	LogMAR 0.82 Snellen 6/38-1	LogMAR 0.80 Snellen 6/38
total number of letters read	46	47	48	49	50
	LogMAR 0.78 Snellen 6/30-4	LogMAR 0.76 Snellen 6/30-3	LogMAR 0.74 Snellen 6/30-2	LogMAR 0.72 Snellen 6/30-1	LogMAR 0.70 Snellen 6/30
total number of letters read	51	52	53	53	55
	LogMAR 0.68 Snellen 6/24-4	LogMAR 0.66 Snellen 6/24-3	LogMAR 0.64 Snellen 6/24-2	LogMAR 0.62 Snellen 6/24-1	LogMAR 0.60 Snellen 6/24
total number of letters read	56	57	58	59	60
some sources state 6/18	LogMAR 0.58 Snellen 6/19-4	LogMAR 0.56 Snellen 6/19-3	LogMAR 0.54 Snellen 6/19-2	LogMAR 0.52 Snellen 6/19-1	LogMAR 0.50 Snellen 6/19
total number of letters read	61	62	63	64	65
	LogMAR 0.48 Snellen 6/15-4	LogMAR 0.46 Snellen 6/15-3	LogMAR 0.44 Snellen 6/15-2	LogMAR 0.42 Snellen 6/15-1	LogMAR 0.40 Snellen 6/15
total number of letters read	66	67	68	69	70
	LogMAR 0.38 Snellen 6/12-4	LogMAR 0.36 Snellen 6/12-3	LogMAR 0.34 Snellen 6/12-2	LogMAR 0.32 Snellen 6/12-1	LogMAR 0.30 Snellen 6/12
total number of letters read	71	72	73	74	75
	LogMAR 0.28 Snellen 6/9.5-4	LogMAR 0.26 Snellen 6/9.5-3	LogMAR 0.24 Snellen 6/9.5-2	LogMAR 0.22 Snellen 6/9.5-1	LogMAR 0.20 Snellen 6/9.5
total number of letters read	76	77	78	79	80
	LogMAR 0.18 Snellen 6/7.5-4	LogMAR 0.16 Snellen 6/7.5-3	LogMAR 0.14 Snellen 6/7.5-2	LogMAR 0.12 Snellen 6/7.5-1	LogMAR 0.10 Snellen 6/7.5
total number of letters read	81	82	83	84	85
	LogMAR 0.08 Snellen 6/6-4	LogMAR 0.06 Snellen 6/6-3	LogMAR 0.04 Snellen 6/6-2	LogMAR 0.02 Snellen 6/6-1	LogMAR 0.00 Snellen 6/6
total number of letters read	86	87	88	89	90
some sources state 6/5	LogMAR -0.02 Snellen 6/4.8-4	LogMAR -0.04 Snellen 6/4.8-3	LogMAR -0.06 Snellen 6/4.8-2	LogMAR -0.08 Snellen 6/4.8-1	LogMAR -0.10 Snellen 6/4.8
total number of letters read	91	92	93	94	95
	LogMAR -0.12 Snellen 6/3.8-4	LogMAR -0.14 Snellen 6/3.8-3	LogMAR -0.16 Snellen 6/3.8-2	LogMAR -0.18 Snellen 6/3.8-1	LogMAR -0.20 Snellen 6/3.8
total number of letters read	96	97	98	99	100
	LogMAR -0.22 Snellen 6/3-4	LogMAR -0.24 Snellen 6/3-3	LogMAR -0.26 Snellen 6/3-2	LogMAR -0.28 Snellen 6/3-1	LogMAR -0.30 Snellen 6/3
The LogMAR score is calculated by taking the number of letters read, minus the 30 assumed for 1meter, multiply by 0.02 and subtract from 1.10. If less than 4 letters are identified on the first line of the 4m chart the patient would be asked to identify letters at 1m and therefore would not score more than 30, plus the number identified on the first 4m line.					
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Fig. 2 The LogMAR score identification chart

each eye to record the test. This data was transcribed locally to a Case Report Form, and sent to the trial management team. Both the VA document and trial specific procedure contained instructions for recording letters identified during VA testing and the trial specific procedure contained instructions for LogMAR score calculation. The trial specific procedure for LogMAR measurement was taken from a previous national ophthalmology research study [2].

Whilst these issues were identified in the ROSA trial, we cannot assume that they are specific to this trial, plus they have been discussed previously [3]. LogMAR score may not be routinely calculated or recorded, so it could be unfamiliar. Investigations by the authors regarding the methods of LogMAR score calculation, including discussion with trial sites and literature review failed to produce a definitive standardised approach. Use of the VA letter score as an outcome measure without LogMAR calculation has been used in some studies, perhaps because of these calculation issues. If trials intend to use LogMAR score as the outcome measure, we would advocate simpler, standardised procedures which some centres already use, such as the LogMAR Calculator (Fig. 1) and LogMAR score identification chart (Fig. 2). These facilitate accurate calculation. Further audit is required to ensure VA measurement and recording is accurate for best clinical and research decisions.

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Compliance with ethical standards

Conflict of interest The authors declare that they have no conflict of interest.

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