

Man versus Machine - Comparison of naked-eye estimation and quantified capillary refill in children

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Introduction

Capillary refill test (CRT) is often used to assess circulatory status in the pediatric ED patient. CRT is recommended by the World Health Organization and is part of the Pediatric Early Warning Score, although recommendations on upper normal limits differ. The reproducibility between and within observers are unknown for CRT in children. This study investigates inter- and intra-observer agreement for CRT assessments in pediatric emergency patients.

Method

Videos of CRT tests were obtained from 15 pediatric emergency patients aged ≤ 6 , with a variety of chief complaints and CRT values. Quantitative CRT was recovered using polarization spectroscopy and we used this as an objective value when comparing the subjective estimations. Videos were shown in random order to paediatric ED staff (15 physicians, 15 nurses, 16 nurse assistants and 15 secretaries) who were asked to estimate, by naked eye, the capillary refill time in seconds as well as characterize it as “normal”, “definitely slow” and “sluggish”. Three of the videos were repeated without the assessors’ knowledge.

Analysis was made for both time- and categorical estimations. CRT times for each group of assessors were plotted in multiple observer Bland-Altman plots, and 95% limits of agreements (in seconds) were calculated. For inter-observer repeatability for categorical estimations we looked for a consensus ($\geq 50\%$) within each group and then plotted the qCRT from polarization spectroscopy against the category found by majority vote. Intra-observer agreement was calculated as the percentage of exact matching answers for the repeated CRT videos (for both intra- and inter-observer agreement).

Results

Time estimations

Nurse assistants had the lowest limits of agreement (± 1.17 s) of all staff groups, i.e. they had the tightest spread of answers within their group. The nurses came second (± 1.43 s), followed by the physicians (± 1.75 s) and secretaries (± 2.03 s). The intra-observer agreement for repeated viewings was overall low; for nurse assistants 50%, nurses 36%, physicians 27% and secretaries 20%.

Categorical estimations

Nurses proved superior in both inter- and intra-observer repeatability. For inter-observer reliability nurses were the only group able to distinguish qCRT into “Normal” and “Def. slow”. The other professions showed no significant difference between the categories. For intra-observer repeatability nurses came in with 62% repeated categorical estimations, followed by nurse assistants (58%), Doctors (49%) and Secretaries (42%).

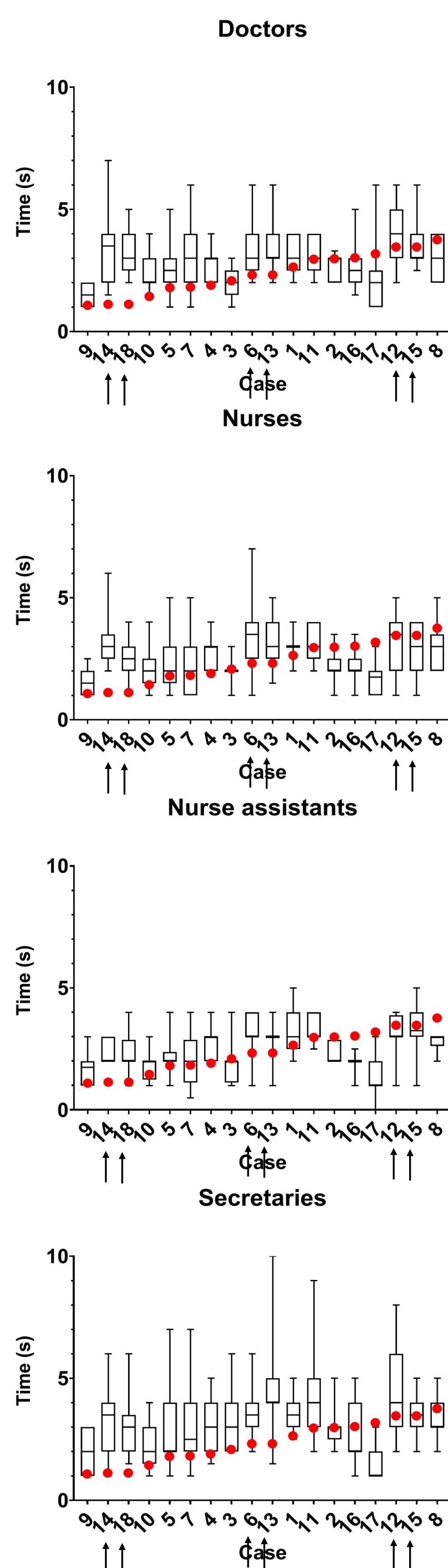


Figure 1. Box plots of the naked-eye estimates of CR time, in seconds, by the four professions (doctors, nurses, assistant nurses and secretaries) and qCR time (red circles) for each video. The values are plotted with the shortest qCR times to the left and the longest times to the right. Videos 14 and 18, 6 and 13, as well as 12 and 15 (arrows) are identical and was shown twice to investigate interobserver variability. The numbers on the X-axis indicate where in the sequence of the film each video was shown to the observers.

Conclusion

The overall agreement between observers in naked-eye estimation of CRT assessment was low. Even within the same observer, different values were often reported upon assessing the same CRT video indicating that naked-eye estimation of CRT is a challenging task. As for categorical estimations we found an improved intra-observer agreement, but only the nurses were able to distinguish “normal” from “Def. slow”.

Further research on the subject, evaluating the impact of other clinical information on the supposed objective factor of refill time will be important to determine the reliability of the CRT

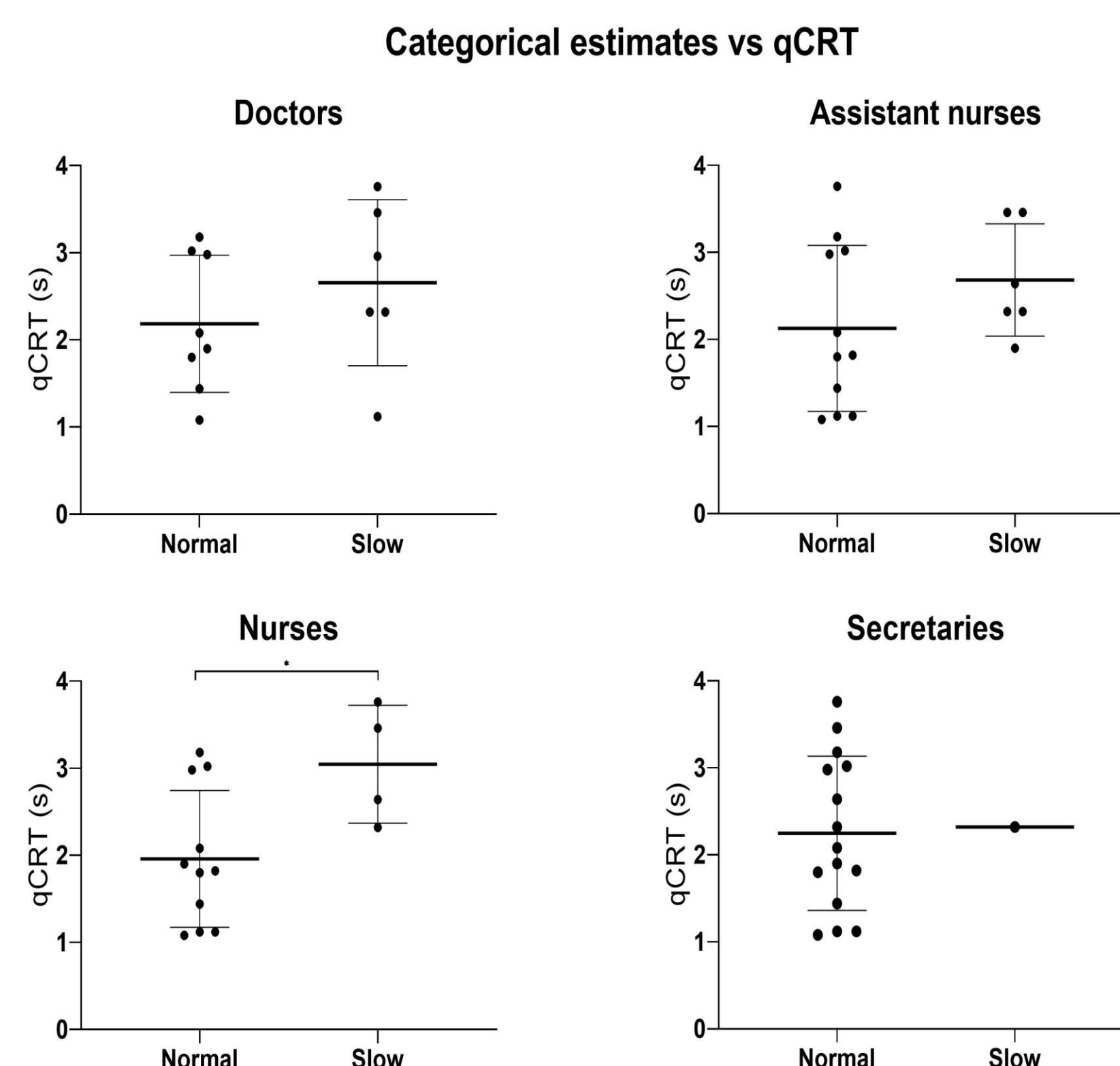


Figure 2. Scatterplots of the categorical estimations of CR time for each profession (doctors, nurses, assistant nurses and secretaries). For inter-observer reliability nurses were the only group able to distinguish qCRT into “Normal” and “slow”. The other professions showed no significant difference between the categories.

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