

Fear of electrocardiogram interpretation (ECGphobia) among medical students and junior doctors

INTRODUCTION

Accurate interpretation of the electrocardiogram (ECG) is a core clinical competency for a medical school graduate. ECG misinterpretation can result in inappropriate clinical management and significant morbidity.^[1-3] A study found that 49% of missed acute myocardial infarctions in the emergency department could have been avoided with improved ECG interpretation skills or a better recognition of ischaemic pain.^[4] Further, a study on ECG interpretation among students found that only 32% of key ECGs were correctly interpreted,^[1] while a study on internal medicine interns reported that only half of all ECGs were correctly interpreted.^[1,2]

To the best of our knowledge, there have been no studies on the fear of ECG interpretation among students and doctors. Anecdotally, we found that the need to accurately interpret an ECG in a time-sensitive setting may lead to negative sentiments about the ECG. This study hypothesised that the fear of ECG interpretation, or what we termed 'ECGphobia', was present among students and junior doctors. Through this study, we sought to describe the perception of difficulty, barriers experienced, practices and the components contributing to difficulties with ECG interpretation. We also aimed to identify possible strategies to remedy this fear.

METHODS

This was a cross-sectional survey conducted between 3 April 2020 and 3 May 2020. Students and junior doctors from a tertiary academic institution in Singapore were surveyed using a convenience sampling method. The average medical school duration in Singapore is five years. Junior doctors comprised house officers (Postgraduate Year 1 doctors), medical officers (Postgraduate Year 2 and above) and registrars (doctors in specialty training). The breakdown of the study participants in these three groups was based on the number of formal ECG didactic training that they would have received during the course of their training.

The questionnaire consisted of five parts. Part 1 evaluated the participants' perceived level of difficulty and confidence in interpreting the ECG. Part 2 evaluated the participants' perception of their knowledge in ECG interpretation and their strategies in approaching ECGs. Part 3 evaluated the participants' interest in learning ECGs. Part 4 assessed the reasons behind the difficulty experienced by the participants with ECG interpretation. We used a Likert scale to assess participants' responses from a scale of 1 (strongly disagree) to

4 (strongly agree). In the final part of the survey, participants reported the types of ECG they experienced the most difficulty with and how, in their opinion, ECG training could be improved.

The main study outcome was the reported fear of ECG interpretation. The secondary outcomes were to determine which participants were more likely to completely rely on computer interpretation and which participants were likely to corroborate their findings with someone more experienced with ECG interpretation.

Categorical variables were expressed as number (percentage) and continuous variables were expressed as median values (interquartile range). Pearson's Chi-square tests (or Fisher's exact test, where appropriate) were used to examine categorical variables, while Mann-Whitney *U* test was used to evaluate continuous variables. Multivariable logistic regression analysis was performed for participants who reported fear of ECG interpretation. Regression analysis was also performed for participants who would rely on computer interpretation and those who would want to corroborate with somebody more experienced. A *P* value < 0.05 was deemed statistically significant. All statistical analyses were performed using IBM SPSS Statistics Version 25.0 for Windows (IBM Corp, Armonk, NY, USA).

Participants were provided a self-administered online survey, disseminated via mailing lists and online messaging services. Completion of the voluntary questionnaire implied their consent for participation.

This study was exempted from ethics review, as it involved a survey without identifiers (NHG DSRB Ref: 2019/00394).

RESULTS

There were 219 respondents in this study. The study group consisted of 115 (52.5%) junior doctors and 104 (47.5%) students. The median age of the students was 22 (interquartile range [IQR] 21–23) years and that of the doctors was 28 (IQR 26–29) years.

The majority of doctors were from Postgraduate Years 1–3 (*n* = 68, 59.2%). Most were medical officers (*n* = 85, 73.9%), followed by house officers (*n* = 18, 15.6%) and registrars (*n* = 12, 10.4%). The majority of junior doctors were internal medicine trainees (*n* = 98, 85.2%). Of 104 students, 49.0% were in Year 3, followed by 25.0% in Year 4 and 21.2% in Year 5.

The prevalence of ECGphobia was 57.5%. More students than doctors reported having ECGphobia. Multivariable logistic regression found that the independent predictors of fearing ECG interpretation were a lack of knowledge about what to look out for in the ECG (OR 4.376, 95% CI 2.175–8.805, $P < 0.001$), nervousness about interpreting ECGs in an acute setting (OR 6.093, 95% CI 1.736–21.383, $P = 0.005$) and difficulty interpreting ECGs consistently (OR 2.704, 95% CI 1.238–5.908, $P = 0.013$) [Table 1].

With regard to the perception of difficulty in ECG interpretation, a minority of participants agreed or strongly agreed that “learning the ECG is easy” (15.4% students vs. 33.0% doctors, $P = 0.002$) or “remembering specific details and criteria for ECG interpretation is easy” (17.3% students vs. 23.5% doctors, $P = 0.259$). The majority agreed or strongly agreed with the statements “interpreting the ECG is difficult” (82.7% students vs. 62.6% doctors, $P = 0.001$), “it is difficult to interpret the ECG signs consistently” (85.6% students vs. 63.5% doctors, $P < 0.001$) and that they were “more nervous interpreting ECG in the acute setting” (98.1% students vs. 69.6% doctors, $P < 0.001$) [Figure 1].

Participants who were nervous interpreting ECGs in an acute setting reported lower actual mean time in interpreting

ECGs, compared with those who did not feel nervous (mean difference -8.4 , 95% CI -16.3 to -0.5 , $P = 0.038$). When dealing with an uncertain ECG, most participants would adopt a stepwise approach to interpretation and use computer interpretation as an aid to diagnosis or corroborate their findings with somebody more experienced. Compared with doctors, students were more likely to not know what to look out for in an ECG (76.0% students vs. 40.0% doctors, $P < 0.001$), rely on computer interpretation completely (28.8% students vs. 11.3% doctors, $P = 0.001$) or as an aid (88.5% students vs. 72.2% doctors, $P = 0.003$), or corroborate with a more experienced person (97.1% students vs. 59.1% doctors, $P < 0.001$) [Figure 2].

The top three most challenging ECGs identified were channelopathies ($n = 196$, 89.5%), bundle branch blocks, bifascicular or trifascicular blocks ($n = 160$, 73.1%) and non-cardiac conditions such as drug overdose effects ($n = 124$, 56.6%).

The top reasons cited by students for difficulty in ECG interpretation were that they were worried of making mistakes (98.1%) and that they did not have enough supervised practice (97.1%). They also felt that the teaching curriculum

Table 1. Multivariable logistic regression analysis for participants ($n=219$).

	Odds ratio (95% confidence interval)	<i>P</i>
Participants who reported fear of ECG interpretation		
Age	0.924 (0.780-1.094)	0.359
Male gender	0.685 (0.342-1.372)	0.285
Occupation, medical student	0.813 (0.268-2.465)	0.715
Do not know what to look out for	4.376 (2.175-8.805)	<0.001
Encountering ECG I have never seen before	1.922 (0.934-3.957)	0.076
More nervous interpreting in acute setting	6.093 (1.736-21.383)	0.005
I am worried to make a mistake	1.124 (0.212-5.960)	0.891
Difficult to interpret ECGs consistently	2.704 (1.238-5.908)	0.013
Participants who would rely wholly on computer interpretation		
Age	0.915 (0.730-1.148)	0.444
Male gender	1.160 (0.544-2.476)	0.701
Occupation, medical student	0.987 (0.236-4.129)	0.986
Do not know what to look out for	3.384 (1.067-10.729)	0.038
Encountering ECG I have never seen before	4.900 (1.317-18.233)	0.018
More nervous interpreting in acute setting	2.549 (0.232-27.979)	0.444
I am worried to make a mistake	0.162 (0.019-1.399)	0.098
I am afraid of ECG interpretation	2.869 (0.913-9.016)	0.071
Participants who would want to corroborate with somebody more experienced		
Age	0.960 (0.799-1.153)	0.662
Male gender	0.466 (0.191-1.136)	0.093
Occupation, medical student	9.496 (1.877-48.044)	0.007
Do not know what to look out for	3.109 (1.207-8.012)	0.019
Encountering ECG I have never seen before	1.647 (0.682-3.976)	0.267
More nervous interpreting in acute setting	2.776 (0.947-8.139)	0.063
I am worried to make a mistake	2.106 (0.504-8.807)	0.308
I am afraid of ECG interpretation	2.155 (0.830-5.596)	0.115

ECG: electrocardiogram

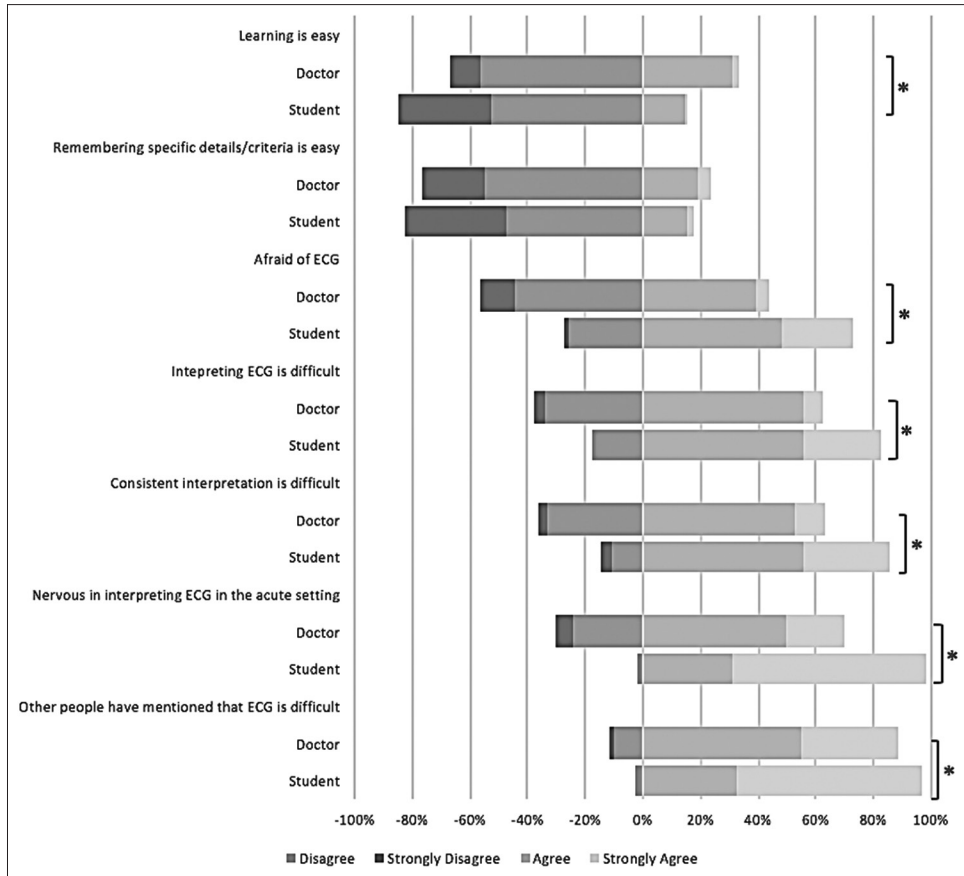


Figure 1: Chart shows perception of difficulty in electrocardiogram interpretation between doctors and medical students (n = 219). *p < 0.05.

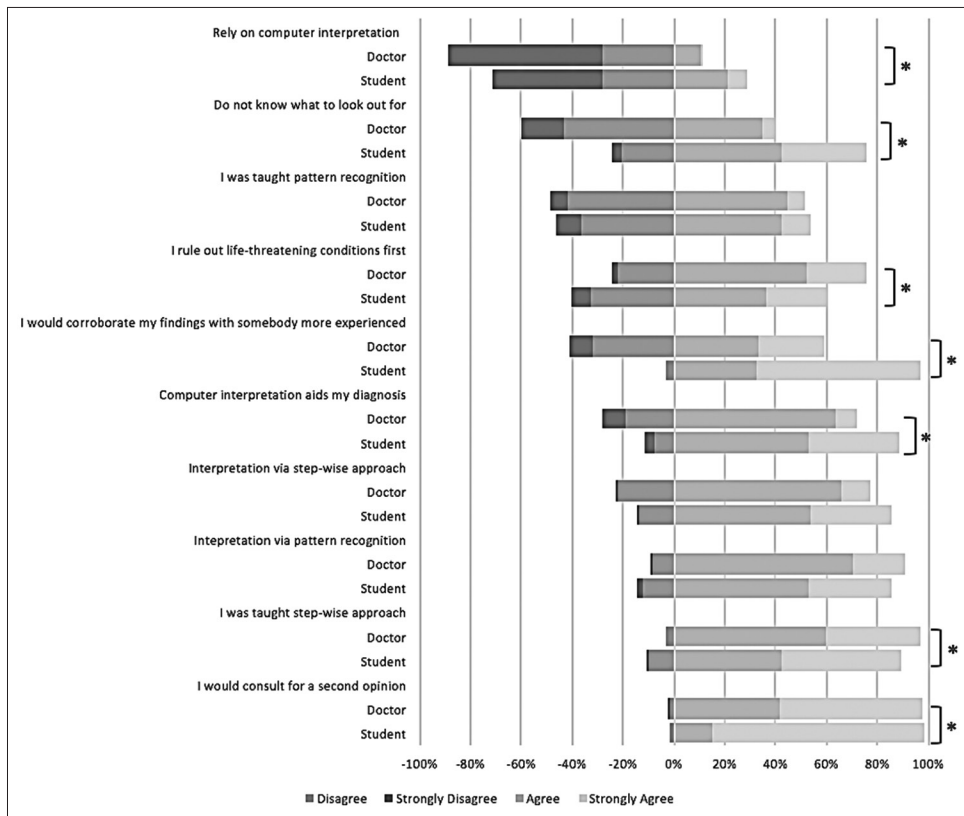


Figure 2: Chart shows perception of knowledge regarding electrocardiogram interpretation between doctors and medical students (n = 219). *p < 0.05.

was disorganised (73.1%) and that there was insufficient teaching (62.5%).

Junior doctors were more concerned about making mistakes (87.8%) and not having enough supervised practice (60.0%) than having inadequate or disorganised teaching. Nevertheless, 66% of junior doctors agreed or strongly agreed that there was a lack of teaching regarding ECG interpretation in the hospital.

In a subgroup analysis of students and doctors from a single medical school ($n = 181$, 82.6%), participants were further divided into three groups: Year 1–3 students (Group 1; $n = 56$); Year 4–5 students and Postgraduate Year 1 doctors (Group 2; $n = 62$); and Postgraduate Year 2 and above (Group 3; $n = 63$). The highest prevalence of ECGphobia was found in the most junior group of students, i.e., Group 1 (83.9%), followed by Group 2 (61.3%) and lastly, Group 3 (30.2%). With Group 3 used as reference, there was a statistically significant increase in ECGphobia prevalence in Groups 1 (OR 12.094, 95% CI 4.950–29.548, $P < 0.001$) and 2 (OR 3.667, 95% CI 1.746–7.701, $P = 0.001$).

Multivariable logistic regression analysis showed that participants would completely rely on computer interpretation if they did not know what to look out for (OR 3.384, 95% CI 1.067–10.729, $P = 0.038$) and encountered ECGs that they had never seen earlier (OR 4.900, 95% CI 1.317–18.233, $P = 0.018$), after adjusting for other factors such as age, gender, medical student/junior doctor status, and responses such as “(being) *more nervous interpreting an ECG in the acute setting*”, “*I am more worried to make a mistake*” and “*I am afraid of ECG interpretation*” [Table 1].

When asked about possible strategies that might improve their confidence in ECG interpretation, most participants agreed that more clinical and practical exposure ($n = 191$, 87.2%), followed by more supervision during interpretation ($n = 166$, 75.8%) and more online resources such as interactive guides or practice questions ($n = 118$, 53.9%) would be beneficial.

DISCUSSION

To the best of our knowledge, this is the first study to define the phenomenon ‘ECGphobia’ as the self-reported fear of ECG interpretation in our study cohort of students and junior doctors. The main findings of the study were as follows: (a) the fear of ECG interpretation was prevalent in this study cohort, with a significantly higher prevalence among students than doctors; (b) some learners who did not know what to look out for in ECGs or when encountering ECGs that they have not seen earlier would completely rely on computer interpretation to aid diagnosis; and (c) key factors that contributed to the difficulties regarding ECG interpretation revolved around the lack of ECG practice in terms of time, opportunities and supervision.

Our study revealed that the majority of junior doctors and students, many of whom provide first-line medical care to acutely ill patients in hospitals, report ECGphobia. Our study findings corroborated with a previously published study in the US on the competency of ECG interpretation among graduating students, which demonstrated that the graduating students seemed inadequately prepared to interpret important ECG abnormalities such as life-threatening arrhythmias when they were provided classical ECGs for interpretation.^[1,5] A review by Vogel *et al.*^[6] identified that a structured training, provision of feedback and self-directed learning were effective methods of helping learners acquire practical skills.

One of the main contributors to ECGphobia is interpreting ECGs in an acute setting. Our study found that trainees who were nervous interpreting ECGs in the acute setting, those who did not know what to look out for in ECGs and those who found it difficult to interpret ECGs consistently were more likely to corroborate the findings with somebody more experienced in interpreting ECGs. This could be attributable to the weight of the clinical decision made based on ECG interpretation, time constraint in making a decision during an acute setting,^[7] the difficulty in transferring knowledge into practice, performing under stress and expectations of one’s responsibilities.^[8] A solution to this could be helping junior colleagues gain situational awareness in their uncertainties and knowing when to escalate a clinical situation.^[9] It is essential to recognise that learning is a continuum.^[10] Educational strategies could involve recreating simulated stressful environments for which the junior trainee can learn safely and gain confidence. The current method of ECG interpretation relies heavily on textbook reading and large-group lectures, which may lack relevance or applicability. A combination of multimedia presentations with case-based and simulation scenarios may be more effective for helping juniors learn.^[11,12]

The principle of continuous learning is reinforced by the significant stepwise decrease in ECGphobia prevalence throughout the progression of medical training. Our study subgroup of students and graduates from a medical school in Singapore underwent structured and systematic didactic lectures on ECG interpretation from Year 4 to 5 of medical school and Postgraduate Year 1. Formal ECG training involved theoretical lectures and guided ECG interpretation workshops. Consequently, this group of participants showed improved confidence in ECG interpretation when compared to their junior counterparts, who were exposed to ECG only during their rotations, with no formal teaching. The senior group showed further improvement in confidence, perhaps owing to increased practice from the necessity of interpretation in the course of their daily work. This emphasises the importance of learning as a continuum even after graduation.^[10,13]

Another important issue was the reliance on automated ECG computer interpretation. Participants who were more likely

to completely rely on computer interpretation were less likely to have been taught a step-wise systematic approach to ECG interpretation (OR 0.186, 95% CI 0.041–0.846, $P = 0.030$). The step-wise systematic approach to ECGs should be adopted by both undergraduate and postgraduate teaching in an attempt to standardise the current variability of confidence and competency in ECG interpretation. Computerised interpretation of ECG was initially introduced to assist with correct ECG interpretation, ultimately aiding decision-making in health care. However, a pitfall of computerised ECG interpretation is its limitations in diagnostic accuracies, especially when the inexperienced ordering physician fails to pick up these interpretation mistakes and follows the computerised interpretation without proper confirmation. Computerised interpretation of ECGs remains an aid to diagnosis; however, it may bear risks to the patient if it is relied on completely without scrutiny.^[14]

The key components related to the perceived difficulty in interpreting ECGs revolved around lack of practice, which may predispose trainees to the risk of encountering ECGs that they have not observed earlier. We propose that ECG interpretation be taught early in medical school so that learners are exposed to the concepts, with a gradual build-up of difficulty through the years, even after graduation. This can be a key strategy in mitigating this fear.^[10] As far as possible, ECGs should be incorporated into junior doctor training programmes through case-based lectures,^[15] e-learning courses,^[16] simulations with advanced life support manikins^[17] and teaching-objective structured clinical examinations.^[18] With the ever-changing educational landscape, the emergence of web-based learning may also be able to offer new ways of learning and exposure to ECG training.^[19]

Overall, although the perception of having a phobia is surrounded by negative connotations, it may serve as an important protective mechanism in understanding one's limitations and alerting for help. It should be emphasised to trainees that in medical practice, it is inevitable that one would face situations that they are unfamiliar with, but help is just a phone call away. Similarly, seniors should recognise that juniors require help in such situations and should provide this help expeditiously.

This study has some limitations. We acknowledge that there may be different interpretations of fear, which may stem from insecurities, lack of confidence or nervousness. Future studies may help to shed light on the different characteristics of this 'fear' with regard to ECG interpretation. As this study relied on a convenience sample, the results may not be generalisable in different clinical contexts. This study preliminarily characterises this phenomenon, but we did not assess the actual competency of respondents in terms of reading ECGs. Hence, correlations between perceived fears and actual performance could be the focus of future studies. Further, this

sample of learners had an underrepresentation of emergency medicine physicians who are likely to encounter more cardiac emergencies and the surgical specialties that are less likely to encounter such scenarios. Further studies could also evaluate this phenomenon of ECGphobia among fully qualified senior physicians.

In conclusion, our study describes the phenomenon of ECGphobia among medical students and junior doctors. Better strategies are needed to improve ECG interpretation skills, which may translate into better clinical care.

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Conflicts of interest

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Ching-Hui Sia^{1,2,*}, MBBS, MRCP, Nicholas Wen Sheng Chew^{1,*}, MBChB, MRCP, Clarissa Wei Shuen Cheong³, MBBS, Tin Wei Yuen³, MBBS, Erica Lauren Soong³, MBBS, Yi-Jing Ong³, MBBS, Tiong-Cheng Yeo^{1,2}, MBBS, MRCP, Kian-Keong Poh^{1,2}, FRCP, FACC, Shirley Beng Suat Qoi^{4,5}, MBBS, FRCSED, William Kok-Fai Kong^{1,2}, MBChB, FESC

¹Department of Cardiology, National University Heart Centre Singapore, ²Department of Medicine, ³Yong Loo Lin School of Medicine, ⁴Department of Surgery, Yong Loo Lin School of Medicine, National University of Singapore, ⁵Emergency Medicine Department, National University Hospital, Singapore
*These authors contributed equally as first authors in this work.

Correspondence: Dr Ching-Hui Sia, Associate Consultant, Department of Cardiology, National University Heart Centre Singapore, 1E Kent Ridge Road, NUHS Tower Block Level 9, 119228, Singapore. E-mail: ching_hui_sia@nuhs.edu.sg

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