

Rapid training of non-intensivists using an online critical care course during COVID-19

Dear Editor,

The coronavirus disease 2019 (COVID-19) pandemic has seen a rapid surge in demand for intensive care unit (ICU) capacity around the world.^{1,2} Data suggest that about 5% of those infected require critical care.^{3,4} As the pandemic continues to evolve, with numerous countries experiencing a second COVID-19 surge, many hospitals are left with the task of rapidly equipping non-intensivists to support critical care services.⁵

We planned for a peak ICU surge of 175 beds in our institution, the Singapore General Hospital. Our surge model was similar to the tiered staffing model proposed by the Society of Critical Care Medicine, US, with intensivists providing overall supervision to ICU teams led by non-intensivists.⁶ To rapidly upskill non-ICU physicians, we developed a critical care course on ICU management using online videos. This approach avoids the need for face-to-face teaching sessions and allows for rapid mass education.

In this study, we aimed to evaluate the effectiveness of a critical care online course by comparing confidence levels of participants before and after the course. We also sought to identify physician factors associated with poor confidence in managing critically ill patients. Our team comprised an interprofessional faculty of intensivists, respiratory therapists and advanced practitioner nurses who developed a series of videos focused on specific areas of ICU management. These were uploaded onto our hospital's Learning Management System (LMS). The LMS course was divided into 7 lessons. Each lesson was followed by a quiz that participants had to pass before they could progress to the next topic. An ICU handbook was also provided for reference and to reinforce concepts taught in the videos.

We enrolled non-intensivists from the divisions of Medicine and Anaesthesiology who had ICU experience prior to the online course. Data starting from enrolment on 6 April to 31 May 2020 were analysed. A pre-course questionnaire was used to collect participants' demographic information and perceptions about their ability to manage critically ill patients. Answers were graded using a Likert scale⁷ of 0 to 5 (0: not confident at all and 5: very confident). In a similar post-course questionnaire, participants were asked to rate their perceived confidence level after attending the course. Comparisons were made between pre- and post-

course confidence levels for each ICU topic using the Wilcoxon signed-rank test. Univariate and multivariate logistic regression analyses were performed to evaluate the association between physician factors and poor confidence levels in ICU management. All statistical analyses were performed using SPSS Statistics software version 22 (IBM Corp, Armonk, US).

A total of 261 physicians were enrolled in the course and the majority (89.8%) was from medical specialties. At the time of analysis, 187 (71.6%), physicians had completed the online course, of whom the majority (68.4%) had ≤ 3 months of prior ICU experience, with only 22 (11.8%) having >6 months of prior ICU experience. Renal replacement therapy (70.1%), ventilator set-up and management (61.7%), and airway management and intubation (30.3%) were the most common topics highlighted by participants as areas of ICU care that they had poor confidence in managing. The association between physician factors and poor confidence with ICU management is illustrated in Table 1.

A prior ICU experience of ≤ 3 months was independently associated with poor confidence in renal replacement therapy, and ventilator set-up and management. Conversely, having a prior ICU experience of >6 months was independently associated with increased confidence in airway management and intubation. Confidence scores for all topics significantly improved after completion of the course (Table 2). When participants were analysed based on prior ICU experience of ≤ 3 months and >3 months, both groups continue to demonstrate a significant improvement in confidence scores in all critical care topics. Finally, when asked to rate the usefulness of the course using a Likert scale of 0 to 5 (0: not useful at all, 5: very useful), 47.1% and 37.4% of physicians awarded a rating of 4 and 5, respectively.

Notably, participants with prior ICU experience of ≤ 3 months appeared to have a larger improvement in confidence scores. An increase in confidence scores of ≥ 2 was observed in a higher proportion of participants with less ICU experience (≤ 3 months) compared to participants with more ICU experience (>3 months), in all critical care topics including airway management (23.4% versus 5.1%, $P=0.002$), ventilator set-up and management (33.6% vs 13.6%, $P=0.004$), and renal

Table 1. Univariate and multivariate analyses for factors associated with perceived incompetence for specific ICU topics

Physician factors	Univariate analysis		Multivariate analysis	
	Odds ratio (95% CI)	P value	Odds ratio (95% CI)	P value
Airway management and intubation				
Seniority of physician				
Senior resident	0.47 (0.24–0.91)	0.024	1.00	
Junior resident	2.64 (1.41–4.91)	0.002	2.09 (0.78–5.56)	0.141
Consultant or attending	0.67 (0.35–1.29)	0.234	1.50 (0.55–4.13)	0.433
Working experience as a doctor				
5–6 years	0.95 (0.46–1.96)	0.881	1.00	
≤4 years	2.91 (1.41–6.02)	0.004	1.68 (0.60–4.66)	0.323
≥7 years	0.45 (0.28–0.83)	0.010	0.59 (0.20–1.75)	0.340
Duration of prior ICU experience				
>3 and ≤6 months	0.56 (0.27–1.16)	0.118	1.00	
≤3 months	4.84 (2.50–9.37)	<0.001	2.18 (0.98–4.86)	0.056
>6 months	0.07 (0.02–0.25)	<0.001	0.19 (0.04–0.80)	0.024
Duration since last ICU posting				
>6 and ≤24 months	1.26 (0.62–2.56)	0.515	1.00	
>24 months	1.42 (0.77–2.65)	0.254	1.61 (0.57–4.58)	0.371
≤6 months	0.58 (0.32–1.07)	0.083	0.62 (0.25–1.56)	0.309
Basic ventilator set-up and management				
Seniority of physician				
Senior resident	1.46 (0.68–3.14)	0.331	1.00	
Junior resident	1.23 (0.65–2.34)	0.531	0.64 (0.19–2.16)	0.476
Consultant or attending	0.56 (0.28–1.12)	0.100	0.23 (0.06–0.95)	0.042
Working experience as a doctor				
5–6 years	1.15 (0.52–2.56)	0.734	1.00	
≤4 years	1.23 (0.60–2.50)	0.576	0.96 (0.32–2.93)	0.949
≥7 years	0.77 (0.41–1.47)	0.431	0.68 (0.18–2.48)	0.554
Duration of prior ICU experience				
>3 and ≤6 months	0.41 (0.20–0.88)	0.021	1.00	
≤3 months	7.28 (3.59–14.78)	<0.001	4.03 (1.67–9.76)	0.002
>6 months	0.08 (0.03–0.23)	<0.001	0.35 (0.09–1.30)	0.116
Duration since last ICU posting				
>6 and ≤24 months	1.74 (0.77–3.92)	0.183	1.00	
>24 months	2.83 (1.37–5.87)	0.005	2.42 (0.60–9.72)	0.214
≤6 months	0.26 (0.13–0.50)	<0.001	0.32 (0.11–0.89)	0.028

Table 1. Univariate and multivariate analyses for factors associated with perceived incompetence for specific ICU topics (Cont'd)

Physician factors	Univariate analysis		Multivariate analysis	
	Odds ratio (95% CI)	P value	Odds ratio (95% CI)	P value
Renal replacement therapy				
Seniority of physician				
Senior resident	0.61 (0.28–1.32)	0.211	1.00	
Junior resident	1.85 (0.88–3.88)	0.106	2.60 (0.83–8.15)	0.101
Consultant or attending	0.80 (0.36–1.72)	0.562	0.52 (0.15–1.78)	0.303
Working experience as a doctor				
5–6 years	0.57 (0.25–1.28)	0.173	1.00	
≤4 years	1.78 (0.75–4.18)	0.184	1.72 (0.53–5.49)	0.365
≥7 years	0.96 (0.47–1.96)	0.912	1.81 (0.53–6.92)	0.344
Duration of prior ICU experience				
>3 and ≤6 months	0.37 (0.17–0.82)	0.020	1.00	
≤3 months	3.61 (1.73–7.55)	0.001	2.94 (1.19–7.27)	0.020
>6 months	0.39 (0.15–1.02)	0.052	1.92 (0.51–7.23)	0.355
Duration since last ICU posting				
>6 and ≤24 months	1.24 (0.52–2.94)	0.627	1.00	
>24 months	2.49 (1.10–5.63)	0.028	2.63 (0.71–9.78)	0.149
≤6 months	0.37 (0.18–0.77)	0.008	0.51 (0.15–1.78)	0.193

CI: confidence interval; ICU: intensive care unit

replacement therapy (46.8% vs 18.6%, $P < 0.001$). Differences in improvement of scores were not observed when participants were grouped according to seniority (consultants vs residents).

The results highlight the feasibility and utility of an online critical care course, capable of refreshing the ICU knowledge of non-intensivists. With increasing demand for critical care services during a pandemic, one recommended model is the use of a tiered staffing model.⁶ This involves augmenting the ICU team with non-intensivists, leaving intensivists to perform supervisory roles. Non-intensivist physicians will then need to be equipped with the necessary skills⁸ to function efficiently and safely in a critical care team. The need for mass education and avoidance of face-to-face training during a pandemic makes conventional teaching methods (through the use of task trainers and simulation sessions) logistically difficult. Worldwide, response to disrupted medical education caused by the pandemic has been the accelerated adoption of technology.⁹ E-learning can be rapidly scaled up, and content can

be updated to keep pace with an evolving pandemic situation.¹⁰ Beyond the current pandemic, the face of medical education is likely to change, with the accelerated digitisation of learning resources, resulting in an integrated approach with the use of blended learning.¹¹

The results from our study will serve to refine critical care training programmes embedded within the framework of our Junior Residency Programme. We identified specific ICU topics (airway and ventilator management, and renal replacement therapy) that non-intensivists commonly lack confidence in managing—areas where future critical care educational efforts should focus on. In addition, of the various physician factors analysed, a shorter duration of prior ICU experience appeared to be independently associated with poorer confidence levels, but also a greater improvement in confidence scores in all critical care topics. These results suggest that prior ICU experience (rather than seniority level) is a significant influence on existing confidence levels as well as potential benefit

Table 2. Comparison of pre- and post-course survey results of 187 physicians based on specific ICU topics

	Not confident at all					Very confident					Median scores (IQR)	P value
	0	1	2	3	4	5						
Airway management and intubation												
Pre-course	6 (3.2)	13 (7.0)	26 (13.9)	72 (38.5)	53 (28.3)	17 (9.1)	3 (3–4)	<0.001				
Post-course	0 (0)	2 (1.1)	2 (1.1)	54 (28.9)	103 (55.1)	26 (13.9)	4 (3–4)					
Basic ventilator set-up and management												
Pre-course	7 (3.7)	22 (11.8)	34 (18.2)	72 (38.5)	40 (21.4)	12 (6.4)	3 (2–4)	<0.001				
Post-course	0 (0)	1 (0.5)	5 (2.7)	53 (28.3)	102 (54.5)	26 (13.9)	4 (3–4)					
Transport ventilator set up												
Pre-course	19 (10.2)	29 (15.5)	40 (21.4)	58 (31.0)	31 (16.6)	10 (5.3)	3 (1–3)	<0.001				
Post-course	0 (0)	0 (0)	6 (3.2)	63 (33.7)	93 (49.7)	25 (13.4)	4 (3–4)					
Assessment and management of haemodynamic instability												
Pre-course	3 (1.6)	12 (6.4)	19 (10.2)	75 (40.1)	63 (33.7)	15 (8.0)	3 (3–4)	<0.001				
Post-course	0 (0)	2 (1.1)	1 (0.5)	37 (19.8)	114 (61.0)	33 (17.6)	4 (4–4)					
Managing sedation and analgesia												
Pre-course	4 (2.1)	14 (7.5)	23 (12.3)	78 (41.7)	56 (29.9)	12 (6.4)	3 (3–4)	<0.001				
Post-course	0 (0)	2 (1.1)	1 (0.5)	36 (19.3)	117 (62.6)	31 (16.6)	4 (4–4)					
Renal replacement therapy												
Pre-course	15 (8.0)	33 (17.6)	46 (24.6)	55 (29.4)	26 (13.9)	12 (6.4)	2 (1–3)	<0.001				
Post-course	0 (0)	1 (0.5)	6 (3.2)	61 (32.6)	96 (51.3)	23 (12.3)	4 (3–4)					
Transport of the critically ill patient												
Pre-course	5 (2.7)	17 (9.1)	28 (15.0)	69 (36.9)	54 (28.9)	14 (7.5)	3 (2–4)	<0.001				
Post-course	0 (0)	2 (1.1)	3 (1.6)	41 (21.9)	116 (62.0)	25 (13.4)	4 (4–4)					
General ICU care												
Pre-course	7 (3.7)	14 (7.5)	26 (13.9)	90 (48.1)	43 (23.0)	7 (3.7)	3 (2–4)	<0.001				
Post-course	0 (0)	1 (0.5)	3 (1.6)	46 (24.6)	116 (62.0)	21 (11.2)	4 (3–4)					

ICU: intensive care unit; IQR: interquartile range
Data are presented as number (percentage) or median (IQR)

from an online critical care course. Rapid upskilling efforts (for critical care surge capacity) should perhaps focus on non-intensivists with less ICU experience.

Limitations of the study include the relatively small sample size and the setting, as a cross-sectional study with convenience sampling at a single institution. Also, improved confidence levels in learners do not necessarily translate to an improvement in clinical performance and competency. Particularly for critical care management, audiovisual guides may never completely replace hands-on practice and experience. Further studies are needed to establish the effectiveness of online critical care courses with respect to clinical performance.

Acknowledgements

The authors wish to thank Dr Alvin Tng, Dr Goh Qingyuan, Dr Lie Sui An, Dr Irene Wong and Mr Selvam Jayakumar for their contributions towards the Critical Care Refresher Course.

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