Since January 2020 Elsevier has created a COVID-19 resource centre with free information in English and Mandarin on the novel coronavirus COVID-19. The COVID-19 resource centre is hosted on Elsevier Connect, the company's public news and information website.

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1. Martinez DA, Levin SR, Klein EY, et al. Early prediction of acute kidney injury in the emergency department with machine-learning methods applied to electronic health record data. *Ann Emerg Med*. https://doi.org/10.1016/j.annemergmed.2020.05.026.
2. Hodgson LE, Sarnowski A, Roderick PJ, et al. Systematic review of prognostic prediction models for acute kidney injury (AKI) in general hospital populations. *BMJ Open*. 2017;7:e016591.
3. Wang HE, Muntner P, Chertow GM, et al. Acute kidney injury and mortality in hospitalized patients. *Am J Nephrol*. 2012;35:349-355.
4. Diamond GA. What price perfection? calibration and discrimination of clinical prediction models. *J Clin Epidemiol*. 1992;45:85-89.

Emergency Physician Work Environments During the COVID-19 Pandemic

To the Editor:

Because of the combined stressors of critically ill patients, limited resources, and increased personal risk, the well-being of frontline health care workers has emerged as an issue of critical importance in the coronavirus disease 2019 (COVID-19) pandemic.[1,2] To better understand these conditions and their effects, we surveyed a nationwide cross-section of emergency medicine attending and resident physicians.

We obtained a convenience sample of US emergency physicians through the Emergency Medicine Residents' Association e-mail distribution list. The survey included questions covering 4 topics: demographics, workplace environment, COVID-19 exposure, and a validated instrument on burnout and professional well-being, the Stanford Professional Fulfilment Index. Survey data were collected from April 29 to May 13, 2020.[3]

Approximately 7% of survey recipients opened the survey email with 443 participants beginning the survey. We excluded 75 incomplete submission and 72 submissions by medical students leaving 296 completed surveys for analysis. Further demographic information can be found in Appendix E1 (available online at http://www.annemergmed.com). Regarding pandemic work conditions, 39% of respondents were moderately or extremely concerned for their safety in the workplace (Appendix E1 [Table 2], available online at http://www.annemergmed.com). Personal protective equipment reuse was reported by 93% of respondents. Two thirds (66%) of respondents reported that they had rationed medical resources other than personal protective equipment; among this subset, 69% had rationed medications, 39% had rationed noninvasive ventilation, and 21% had rationed ventilators. Of all respondents, 26% reported having had symptoms of COVID-19, 26% had been tested, and 7% had tested positive for it. Median Professional Fulfilment Index scores were consistent with work exhaustion and burnout.

We report several key differences in measures for respondents practicing in self-reported COVID-19 hot spots. Not surprisingly, a greater proportion of physicians in hot spots had rationed medical resources compared with non–hot spot respondents (82% versus 56%) (Table 1). Of physicians in hot spots who had rationed resources, 35% had rationed ventilators compared with 10% of non–hot spot respondents. Emergency physicians in hot spots also had a higher positive test-result rate for COVID-19: 40% of those tested in hot spots tested positive, whereas 17% of those tested had positive results in non–hot spots. The kind of COVID-19 test used was not specified by respondents.

Our survey suggests that a concerning proportion of emergency physicians have rationed medications, critical interventions, and basic personal protective equipment during the pandemic. These findings underscore a fact that is intuitive yet warrants emphasis: when COVID-19 caseloads exceed relative clinical capacities, both the safety of physician and the quality of patient care become compromised. Building rapidly scalable clinical capacity and controlling the rate of pandemic spread are critical to avoid future compromise as additional hot spots emerge.

The authors acknowledge the Emergency Medicine Residents' Association (EMRA) Board of Directors for their support of the study; EMRA staff members Todd Downing and

Table. Work environment and COVID-19 exposure stratified by hot spot.

	Hot Spot		
	Yes, N=114, No. (%)	No/Unsure, N=180 No. (%)	Difference in Proportion (95% CI)
Adequate supply of personal protective equipment			
No	40 (35)	55 (31)	4.5 (−6.5 to 15.6)
Yes	74 (65)	125 (69)	
PPE reuse			
No	5 (4)	16 (9)	4.5 (−1.1 to 10.1)
Yes	109 (96)	164 (91)	
Equipment reused[*†]	(N=109)	(N=164)	
Glasses/goggles/face shields	97 (89)	148 (90)	1.3 (−6.2 to 8.6)
Surgical mask	45 (41)	112 (68)	27.0 (15.3 to 38.7)
N95/p100/etc	102 (94)	160 (98)	3.9 (−1.2 to 9.1)
Gowns	34 (31)	32 (20)	11.7 (1.1 to 22.3)
Rationing of resources[‡]			
No	21 (18)	79 (44)	25.7 (15.5 to 35.9)
Yes	93 (82)	100 (56)	
Items rationed[*†]	(N=93)	(N=100)	
Ventilator	32 (34)	8 (8)	26.4 (15.4 to 37.4)
Noninvasive ventilation	43 (46)	33 (33)	13.2 (0 to 26.9)
Medication	66 (71)	67 (67)	4.0 (−9.1 to 17.0)
Staff attention	69 (74)	49 (49)	25.2 (12.0 to 38.4)
Other medical supplies	52 (56)	41 (41)	14.9 (1.0 to 28.9)
Dedicated COVID-19 area of ED[‡]			
No	47 (42)	60 (34)	8.4 (−3.2 to 19.9)
Yes	65 (58)	119 (67)	
Are you aware of any existing institutional policies regarding the residents' role in the care of known or suspected COVID-19 at your hospital(s)?[†]			
No	35 (31)	61 (34)	3.6 (−7.4 to 14.5)
Yes	79 (69)	117 (66)	
Are residents permitted to provide face-to-face care for patients with known or suspected COVID-19 at your institution?[†]			
No	4 (4)	22 (12)	9.0 (3.1 to 15.0)
Yes	109 (96)	153 (88)	
Are residents permitted to intubate patients with known or suspected COVID-19 at your institution?[†]			
No	20 (18)	51 (29)	11.1 (1.3 to 20.9)
Yes	91 (82)	124 (71)	
Are residents staffing the dedicated COVID-19 area?[†]			
No	5 (8)	28 (24)	16.5 (6.3 to 26.8)
Yes	59 (92)	87 (76)	

Table. Continued.

	Hot Spot		
	Yes, N=114, No. (%)	No/Unsure, N=180 No. (%)	Difference in Proportion (95% CI)
Is resident staffing of the COVID-19 area of the ED voluntary?†			
No	53 (90)	66 (76)	14.0 (2.1 to 25.8)
Yes	6 (10)	21 (24)	
Is attending physician staffing of the COVID-19 area of the ED voluntary?†			
No	10 (83)	36 (78)	5.1 (−19.1 to 29.3)
Yes	2 (17)	10 (22)	
How have your work hours been affected by the COVID-19 pandemic in the last 4 wks?			
Work less	21 (18)	67 (37)	
Work hours have not changed	64 (56)	98 (54)	
Work more	29 (25)	15 (8)	
Unnecessary exposure to possible or confirmed COVID-19 patient?‡			
No	77 (68)	133 (75)	7.2 (−3.5 to 17.9)
Yes	37 (33)	45 (25)	
What was the situation(s)?*†	(N=37)	(N=45)	
Possible COVID-19 patient	24 (65)	39 (87)	21.8 (3.4 to 40.1)
Confirmed COVID-19 patient	26 (70)	14 (31)	39.2 (19.2 to 59.2)
Have you provided in-person care for patients who have tested positive for COVID-19?			
No	4 (4)	17 (9)	5.9 (0 to 11.4)
Yes	110 (97)	163 (91)	
Have you had any symptoms of COVID-19 unexplained by other illnesses or cause(s)?			
No	74 (65)	144 (80)	15.1 (4.5 to 25.6)
Yes	40 (35)	36 (20)	
Have you been tested for COVID-19?			
No	76 (67)	143 (79)	12.8 (2.3 to 23.3)
Yes	38 (33)	37 (21)	
Did you test positive or negative?†	(N=37)	(N=38)	
Positive	15 (40)	5 (14)	26.0 (6.9 to 45.0)
Negative	23 (61)	32 (87)	
Have you been asked to self-quarantine at any point because of test results, symptoms, travel, or exposures?*			
Symptoms	23 (20)	15 (8)	11.8 (3.4 to 20.2)
Travel	3 (3)	9 (5)	2.4 (−1.9 to 6.7)
Exposure	7 (6)	17 (9)	3.3 (−2.8 to 9.4)
Test results	5 (4)	5 (3)	1.6 (−2.9 to 6.1)
Not asked to self-quarantine	80 (70)	144 (80)	9.8 (0 to 20.1)

Table. Continued.

	Hot Spot		
	Yes, N=114, No. (%)	No/Unsure, N=180 No. (%)	Difference in Proportion (95% CI)
Has a family member or loved one tested positive for COVID-19?			
No	93 (82)	158 (88)	6.2 (−2.4 to 14.8)
Yes	21 (18)	22 (12)	
	(N=21)	(N=22)	
Within 2 wk before diagnosis	7 (33)	5 (23)	10.6 (−16.1 to 37.3)
Within 2 wk after diagnosis	6 (29)	2 (9)	19.5 (−3.3 to 42.2)
No contact	13 (62)	17 (77)	15.4 (−11.8 to 42.5)

CI, Confidence interval; *PPE*, personal protective equipment.
*Totals greater than 100% because more than 1 answer permitted.
†Denotes questions that were not presented to all participants but only to select ones according to answers to previous answers. Percentages for these columns represent the percentage of the sample who were in the hot spot or were not in it.
‡Question presented to all participants but not all responded; if greater than or equal to 5 participants did not respond, revised n=hot spot and n=not hot spot are noted.

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1. Rodriguez RM, Medak AJ, Baumann BM, et al. Academic emergency medicine physicians' anxiety levels, stressors, and potential stress mitigation measures during the acceleration phase of the COVID-19 pandemic. *Acad Emerg Med*. 2020;27:700-707.
2. Shanafelt T, Ripp J, Trockel M. Understanding and addressing sources of anxiety among health care professionals during the COVID-19 pandemic. *JAMA*. 2020;323:2133-2134.
3. Harris PA, Taylor R, Minor BL, et al. The REDCap consortium: building an international community of software platform partners. *J Biomed Inform*. 2019;95:103208.

Can HEART Criteria Be Used as an Ideal Tool for Multilayer Clinical Outcome Predictions?

To the Editor:

HEART criteria (HEART score, HEART Pathway, or both; HEART refers to history, electrocardiogram, age, risk factors, and troponin) were initially developed to determine the risk of acute coronary syndrome and predict major adverse cardiac events in chest pain patients in the emergency department (ED).[1,2] Its use has been expanded to predict different clinical outcomes, including hospital admissions, emergency cardiac imaging tests, hospital readmissions, and major adverse cardiac events. We laud this study conducted by Stopyra et al,[3] who investigated all these outcomes together. Under such circumstances, we have evidence to compare the different values of using HEART criteria predicting different clinical outcomes. In addition, from this pre- and postimplementation comparison, we are shown the potential value of using a clinical decision support system from the electronic health record to aid physicians'