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Authors

Ambulkar, Reshma
Rana, Pankaj Singh
Starr, Nichole
et al.

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INTRODUCTION

The World Health Organization (WHO) declared coronavirus disease (COVID)-19 a pandemic in March 2020, affecting most countries worldwide.[1] High-income countries (HICs) like Australia, France, Switzerland, the United Kingdom (UK), the United States of America (USA) and Portugal were better equipped to slow the spread of the virus by imposing lockdown and scaling up preventive, diagnostic and treatment modalities in a well-developed health care system. In contrast, many lower-middle-income countries (LMICs), including India, were less well equipped, which has had devastating effects on these countries' economies and healthcare systems.[2,3] Regardless of income status, safeguarding frontline healthcare workers (HCWs) for the ongoing provision of essential health services, including surgery, became a key priority in ensuring a functioning health system.[4,5]

To safeguard HCWs, personal protective equipment (PPE) must be available with appropriate training and safety protocols effectively implemented. We conducted a global survey of surgical facilities and perioperative providers to assess the availability of pulse oximeters for patient monitoring, and PPE for safety processes for preventing the transmission of severe acute respiratory syndrome coronavirus-2 (SARS-CoV-2) in the perioperative setting, in collaboration with Lifebox Foundation, the UK, Smile Train, New York, the USA, Jhpiego, Baltimore, the USA.

METHODS

Online cross-sectional surveys (Annexure 1) were created and to ensure cross-disciplinary and broad geographic input and content validity, the questionnaires were developed by representatives from anaesthesia, surgery and nursing disciplines from Ethiopia, India, Cambodia, Nigeria, Rwanda, the USA and the UK. The online surveys were translated into nine languages (English, Bahasa, French, Spanish, Khmer, Mandarin, Portuguese, Vietnamese, Hindi), and responses were collected from October 1 to November 1, 2020 with all data being anonymised via Survey Monkey. This survey is a secondary analysis of a previously published survey on perioperative provided safety in low- and middle-income countries.[6] Quantitative data were analysed in Stata v15.1 using descriptive statistics and chi-square and t-tests, with alpha set at 0.05. Qualitative data were initially coded by three research team members, then the second group of three authors applied codes in a blinded manner from the codebook and determined inter-rater reliability. The group iteratively reviewed and reached a consensus on discordantly coded excerpts until code themes were finalised. Primary outcomes were provider reported PPE availability, COVID-19–related training and protocol usage, surgical facility COVID-19 testing and pulse oximeter availability as reported by a facility respondent.

Ethical approval was obtained from Boston Children's Hospital. As this was safety data collection and analysis, no other country's ethical approval was taken.

RESULTS

We received 127 facility survey responses (administrators) and 277 individual perioperative providers' (anaesthetists, surgeons, nurses) responses from 20 LMICs. Of these, 45 (35.4%) facilities and 120 (43.3%) provider responses were from India. The availability of essential PPE (N95 masks, gown, eye protection and gloves) across India was found to be higher as compared to other countries in the same income group [Table 1]. N95 masks were available in 102 (85%) facilities in India vs 85 (54.1%, $P < 0.001$) in the other grouped LMICs. Approximately 60% of providers in India reported reusing N95 respirators after decontamination; most of these providers were using the 'wait and reuse' method. Surgeries were scaled down in many of the facilities, including 57 (70%) of facilities in other LMICs as compared to 36 (80%, $P = 0.24$) in India. A separate operation theatre (OT) was designated for COVID-19 positive patients in 25 (56%) facilities in India vs 19 (23%, $P < 0.001$) in other LMICs. There was a higher availability of COVID-19 tests in India, 44 (98%) vs. 58 (71%) ($P < 0.001$) in other LMIC facilities. Pulse-oximetry was reportedly available in 37 (82%) Indian post-anaesthesia care units (PACUs) (not exclusive to COVID-19 patients) vs. 45

Table 1: COVID-19 resource availability and Surgical Patient Checklist use and impact on perceived safety

Perioperative clinical provider survey	LMIC*	India	*P*
n	157	120	
Region			<0.001
East Asia and Pacific	31 (19.7%)	0 (0.0%)	
Central Asia	1 (0.6%)	0 (0.0%)	
Latin America and Caribbean	29 (18.5%)	0 (0.0%)	
Middle East and North Africa	1 (0.6%)	0 (0.0%)	
South Asia	18 (11.5%)	120 (100.0%)	
Sub-Saharan Africa	77 (49.0%)	0 (0.0%)	
Hospital Level			0.23
First Level/District	2 (2%)	3 (7%)	
Second Level/General	15 (18%)	4 (9%)	
Third Level/Referral	36 (44%)	19 (42%)	
	29 (35%)	19 (42%)	
Hospital Location			0.34
Urban	17 (21%)	15 (33%)	
Semi-Urban	8 (10%)	7 (16%)	
Rural	0 (0%)	2 (4%)	
	57 (70%)	21 (47%)	
Designated COVID-19 Care Centre			0.44
No	70 (85%)	36 (80%)	
Yes	12 (15%)	9 (20%)	
Number and respondent type			0.30
Surgery	45 (28.7%)	41 (34.2%)	
OB/Gyn	7 (4.5%)	3 (2.5%)	
Anesthesia	85 (54.1%)	69 (57.5%)	
Nursing	15 (9.6%)	5 (4.2%)	
Other	5 (3.2%)	2 (1.7%)	
Personal Protective Equipment availability			
N95	85 (54.1%)	102 (85.0%)	<0.001
Gowns	95 (60.5%)	99 (82.5%)	<0.001
Gloves	120 (76.4%)	101 (84.2%)	0.11
Eye protection	102 (65.0%)	96 (80.0%)	0.006
N95 Reuse & Decontamination			
Reuse without decontamination	8 (7.0%)	8 (7.6%)	0.86
Appropriate method (Wait & reuse, UVC, H_2O_2, heat)	20 (17.6%)	46 (40%)	<0.001
Inappropriate method (Alcohol, bleach, soap and water)	23 (20.2%)	8 (7.6%)	0.007
Training and Implementation COVID-19 protocols			
COVID-19 protocol	77 (61.6%)	76 (73.8%)	0.051
COVID-19 Surgical Checklist	52 (41.3%)	72 (69.9%)	<0.001
PPE Donning and doffing	94 (75.8%)	96 (93.2%)	0.032
OR protocol use	65 (52.8%)	90 (85.7%)	<0.001
COVID Surgical Checklist use	33 (26.2%)	71 (67.0%)	<0.001
COVID-19Transfer use	59 (47.6%)	79 (76.7%)	<0.001
Perceived safety managing COVID-19 patients			
Unsafe	56 (45.5%)	38 (36.5%)	0.37
Facility			
n	82	45	
Stopped or delayed surgery due to COVID-19	57 (70%)	36 (80%)	0.24
Laboratory testing available for SARS-CoV-2	58 (71%)	44 (98%)	<0.001
Designated OR for COVID-19 + patients	19 (23%)	25 (56%)	<0.001
Pulse oximeter available for each recovery bed	45 (55%)	37 (82%)	0.002

*Excluding India (Bangladesh, Benin, Egypt, Cambodia, Ghana, Honduras, Kenya, Laos, ElSalvador, Myanmar {Burma}, Nepal, Nigeria, Pakistan, Philippines, Senegal, Tanzania, Vietnam, Zambia, Zimbabwe). COVID: Coronavirus disease; OR: Operating room; SARS-CoV-2: Severe acute respiratory syndrome coronavirus; PPE: Personal protective equipment; UVC: Ultraviolet- C; H_2O_2: Hydrogen peroxide

(55%, $P = 0.002$) in other LMICs. Training in COVID-19 operation theatre (OT) protocols was reported by 76 (73.8%) providers in India vs 77 (61.6%, $P = 0.051$) in other LMICs provider respondents. COVID-19–

specific protocol implementation was reported by 90 (85.7%) Indian providers vs 65 (52.8%, $P < 0.001$) other LMIC respondents. It was concerning, however, that 56 (45.5%) of the healthcare providers reported feeling unsafe caring for COVID-19 patients in LMICs, whereas 38 (36.5%) reported the same in India.

DISCUSSION

COVID-19 pandemic caused large-scale outbreaks in many LMICs including India causing economic and social disruption. With a population of around 1.4 billion, India's response to COVID-19 has a direct impact that has affected the world economy. India has vulnerabilities typical of LMICs: That of an overburdened healthcare system, lack of uniform access to healthcare facilities, illiteracy and higher unemployment rates.

This survey suggests that India was relatively better resourced than other LMICs with regards to the availability of PPE and training, pulse oximetry availability, and COVID-19 protocols and checklists.[7-9] Despite these resources, India was not prepared to address the surge of cases of the second wave because of the large population which led to higher caseload and mortality. This may be related to people letting down their guard, vaccine hesitancy and widespread viral transmission at social and religious gatherings.[10,11]

The risk of HCWs becoming infected while caring for COVID-19 positive patients in the OT is disproportionately high in LMICs including India, with the increased transmissibility and vaccine resistance of the Omicron variant intensifying these risks. The latest WHO guidelines (22nd December 2021) on Omicron variant advocate appropriate mask use as being critical in reducing the risk of transmission to HCWs. To date, many HCWs all around the world have lost their lives after becoming infected with COVID-19. It is the need of the hour to protect our HCWs working endlessly to save other peoples' lives.

Based on these early study findings, we recommend ongoing interventions which can be implemented in OTs of LMICs including India to protect HCWs. Help from the global community, including organizations such as the WHO, United Nations, and non-governmental organisations such as Lifebox, Smile Train, Jhpiego can donate PPE and sanitary items to HCWs to overcome the existing shortage of PPEs.

Training and implementation of COVID-19–related OT protocols and checklists, keeping in mind local variations, are an important mechanism to minimise infection risk while caring for surgical patients during the pandemic. Surgical hospitals in India were reasonably superior to other LMICs with respect to training and implementation of COVID-19–related OT protocols, patient transfer protocols, PPE donning and doffing, reuse of PPE and COVID-19 checklist. Yet, there is a need to train all HCWs in LMICs, through online training as we stare at the next wave of COVID-19. Allaying the anxiety and uncertainties among perioperative HCWs is also essential. Most of the HCW concerns relate to becoming infected or infecting loved ones and the subsequent consequences. These anxieties should be addressed by providing support for emotional and psychological needs,[12,13] providing PPEs, vaccinating HCWs and their family members and providing timely healthcare access.

CONCLUSION

India as compared to other LMICs has done well in fighting the COVID-19 pandemic with its available resources. The ongoing protection with PPE and training of HCWs is paramount to prevent their infection and allow the ongoing provision of essential surgical services, which remain a critical part of the healthcare system. The results of this survey can be used to identify areas of need and inform strategies to safeguard healthcare providers as the pandemic rages on. HCWs in India and elsewhere must have the appropriate masks, other PPE, safer reuse strategies in times of PPE shortage, in addition to receiving training and implementing safety protocols in the OT to protect themselves. LMIC resilience and preparedness to fight the next wave of COVID-19 will be crucial in order to mitigate the further loss of life.

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Conflicts of interest

Dr Ambulkar, Dr Singh and Dr Moore have nothing

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Reshma Ambulkar, Pankaj Singh Rana, Nichole Starr[1,2], Jolene Moore[3,4]

Department of Anaesthesia Critical Care and Pain, Tata Memorial Centre, Homi Bhabha National Institute, Dr. Ernest Borges Road, Parel, Mumbai, Maharashtra, India, [1]Department of Surgery, University of California, San Francisco, California, [2]Lifebox Foundation, Inc, New York, [3]Department of Anaesthesia, University of Aberdeen, Aberdeen, Scotland, [4]World Federation of Societies of Anaesthesiologists, London, United Kingdom

Address for correspondence:
Dr. Reshma Ambulkar,
Department of Anaesthesia, Critical Care and Pain, Tata Memorial Hospital and Homi Bhabha National Institute, Parel, Mumbai - 400 012, Maharashtra, India.
E-mail: rambulkar@hotmail.com

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