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LETTER

Enhancing intensive care capacity: COVID-19 experience from a Tertiary Center in Israel

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Dear Editor,

The main principals of intensive care unit (ICU) response during a pandemic include increasing capacity through ICU expansion to other areas, surge labor resources, and enhanced infection control practices [1]. Israeli hospitals persistently lack ICU resources [2, 3]. Sheba Medical Center (SMC), a 1900 bed tertiary hospital in Israel, increased ICU surge capacity through rapidly constructing separated COVID-19 ICUs. Disaster preparedness principles and innovative utilization of infrastructure, equipment, and personnel facilitated a fourfold increase in ICU capacity. The key aspects of this plan are outlined below.

Level of care prioritization

Three levels of COVID-19 ICU beds were defined based on personnel qualification and equipment availability: *Level-1, Full ICU*—staffed by certified ICU teams and equipped with comprehensive ICU equipment (including extracorporeal support); *Level-2, Intermediate care*—staffed by experienced anesthesiology and internal medicine teams and equipped with monitoring and mechanical ventilation equipment; *Level-3, Mechanical ventilation and medical support*—staffed with dedicated teams rapidly trained for this task, remotely supported by ICU specialists and equipped from stockpiles and emergency manufacturing. Patient allocation was managed centrally according to patient's condition and prognosis, with detailed criteria for transition between ICU care levels. Once stabilized, patients are moved to a specialized respiratory rehabilitation unit for weaning.

Repurposing existing infrastructure

SMC has an underground parking lot, built with skeleton infrastructure for use as an emergency shelter hospital for non-ICU-level patients in times of war. Within a week of Israel's first COVID-19 patient, fifty Level-1 and seventy Level-2 ICU beds were built using the shelter infrastructure. Clean zones were completely separated from contaminated treatment zones, using double-door vestibules for donning and doffing of personal protection equipment (PPE) and separated air-conditioning systems (Electronic Supplementary Material). Stockpile management of COVID-19 airborne-level PPE strictly enforced the use exclusively during high-risk exposures (respiratory emergency room, COVID-19 department, and ICUs).

Just-in-time training

To increase staff capacity for surge Level-3 ICU care, sixty teams of non-ICU trained physicians, nurses, and bio-technicians underwent rapid simulation-based training for critically ill patient care at the Israel Center for Medical Simulation (MSR) [4]. The surgical trauma team and MSR experts developed and implemented this training program. The sessions were recorded and are now available for training of teams in other centers in Israel and abroad. On-the-job learning and training continued with increasing numbers of patients admitted to the facility and greater need for medical teams (Table 1).

Tele-ICU medicine

To upscale ICU coverage, reduce staff infection risk, and lessen errors related to working in protective gear, complete online patient monitoring is used at all COVID-19 units (Electronic Supplementary Material). A clean zone unit functions as a control tower through constant audiovisual communication with contaminated zone teams.

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Table1 Number of intensive care hospitalization beds and staff by purpose and date—Sheba Medical Center, Tel Hashomer, Israel (March 1, 2020 shows initiation of ICU capacity enhancement plan; April 9, 2020 reflects current status)

	March 1, 2020			April 9, 2020		
	Hospitalization beds	Physicians	Nurses	Hospitalization beds (% change)	Physicians (% change)	Nurses (% change)
General adult ICU	61	58	253	56 (−8%)	36 (−38%)	136 (−54%)
Intermediate ICU	25	34	163	15 (−40%)	16 (−53%)	92 (−44%)
COVID-19 Level 1	–	–	–	77	22	117
COVID-19 Level 2	–	–	–	62	18	116
COVID-19 Level 3	–	–	–	188	64	194
Overall number of ICU hospitalization beds and staff	86	92	416	398 (362%)	156 (70%)	655 (57%)
Overall number of hospitalization beds and staff[a]	1900	1126	2498	1988 (5%)	1127 (0%)	2499 (0%)

ICU intensive care unit

[a] To fully equip and staff the additional critical care beds built as part of the emergency preparedness plan, several beds from the general hospital at Sheba Medical Center were reallocated, in addition to newly built and equipped beds. To adequately staff these beds, personnel with previous training and experience were re-trained and transferred from lower acuity areas. Increasing shift length also increased staff availability

In conclusion, Sheba Medical Center converted existing emergency infrastructure for bomb shelters, to create isolated COVID-19 ICU capacity. Geographic isolation allowed for continued routine care of non-COVID-19 patients at the general hospital, infection control, and staff protection. We recommend reliance on ICU-level structuring, shifting infrastructure resources, and staff conversion by rapid purposed simulation and training for pandemic ICU surge capacity.

Electronic supplementary material
The online version of this article (https://doi.org/10.1007/s00134-020-06097-0) contains supplementary material, which is available to authorized users.

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EL and IMP conceived and wrote the first draft; all authors composed and edited sections and collected data.

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Compliance with ethical standards

Conflicts of interest
None, all authors.

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