

Resilience in Health Care



Surviving a Coinciding Pandemic, a Major Deadly Disaster, and an Economic Collapse: What Did We Learn?

Maria Mitri, MD

Francois Abi Fadel, MD

Georges Juvelekian, MD

We are medical practitioners who survived one of the world's largest nonnuclear explosions in history. In the Port of Beirut on August 4, 2020, an estimated 2,750 tons of unsafely stored ammonium nitrate exploded.^{1,2} After the initial wave of the COVID-19 pandemic, these events stressed the urgent need to draft crisis management policies for our own institution. We share and build on the lessons we learned for others who may be affected by such calamities in the future.

No Beirut health care institution was affected more heavily than ours. Saint Georges University Hospital, a 400-bed academic hospital that serves more than 1 million patients annually, was completely destroyed. After this disaster, ambulances were saturated, and other hospitals in the vicinity were overwhelmed by the sheer number of injured. It was extremely difficult to evacuate our hospital, safely relocate >200 patients, and ensure their proper care in a timely fashion. Adding to our professional burdens and personal grief, 17 of our own health care colleagues died, and >100 were injured. These included nurses, physicians, residents, and

AFFILIATIONS: From the Department of Pulmonary and Critical Care Medicine (M. Mitri and G. Juvelekian), Saint Georges University Hospital, and the University of Balamand Medical School (M. Mitri and G. Juvelekian), Beirut Lebanon; and the Respiratory Institute (F. Abi Fadel), Cleveland Clinic, and the Cleveland Clinic Lerner College of Medicine of Case Western Reserve University (F. Abi Fadel), Cleveland, OH.

FINANCIAL/NONFINANCIAL DISCLOSURES: None declared.

CORRESPONDENCE TO: Francois Abi Fadel, MD; email: abifadf@ccf.org

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DOI: <https://doi.org/10.1016/j.chest.2021.06.056>

students. Despite this, we attended to our patients as best we could. For example, that evening, one of our critical care fellows went to the ICU a few seconds after the blast. Despite being in a state of emotional shock, he reflexively secured the ventilators of all patients and readjusted ventilator settings when appropriate.

Duties of medical professionals include rapid assessment of risks and discerning the best course of treatment for each individual patient. Performing those duties while injured and under duress introduced extraordinary challenges to this basic medical commitment. Amid these challenges, the guidance provided by the emergency mass critical care guidelines defined by the CHEST Task Force for mass critical care and the CHEST consensus statement on the Care of the Critically Ill and Injured during Pandemics and Disasters was invaluable.^{3,4}

Examples of our resource challenges included shortages of portable ventilators and ventilator back-up batteries. Ventilator back-up batteries should theoretically last at least 4 hours according to published recommendations, yet ours lasted only 2 hours.⁴ Having only four portable ventilators available led to further delays in patient transfers. These shortages highlighted the importance of adequate critical care equipment, supplies, and pharmaceuticals.

We had no clear policy for evacuation after the complete devastation of our hospital. Both landline and wireless phone services were inoperable. Groups spontaneously formed to search sections of the hospital in pitch black darkness using cellphone lights and portable emergency lights. Other groups secured risk areas like open elevator shafts, gas outlets, exposed electricals, and oxygen tanks. Two of our co-fellows carried a severely injured nurse with massive internal bleeding to seek medical aid. Using a fallen false ceiling tile as a stretcher, they carefully descended 14 flights of stairs because all 16 hospital elevators were out of service.

After the explosion, our hospital ceased its operations for the first time in >140 years. Twenty days later the hospital resumed its activities, only to face another challenge of almost similar magnitude. A second surge of the COVID-19 pandemic hit the country that led to widespread ICU bed shortages. A coincident political and economic collapse led to severe shortages in medical

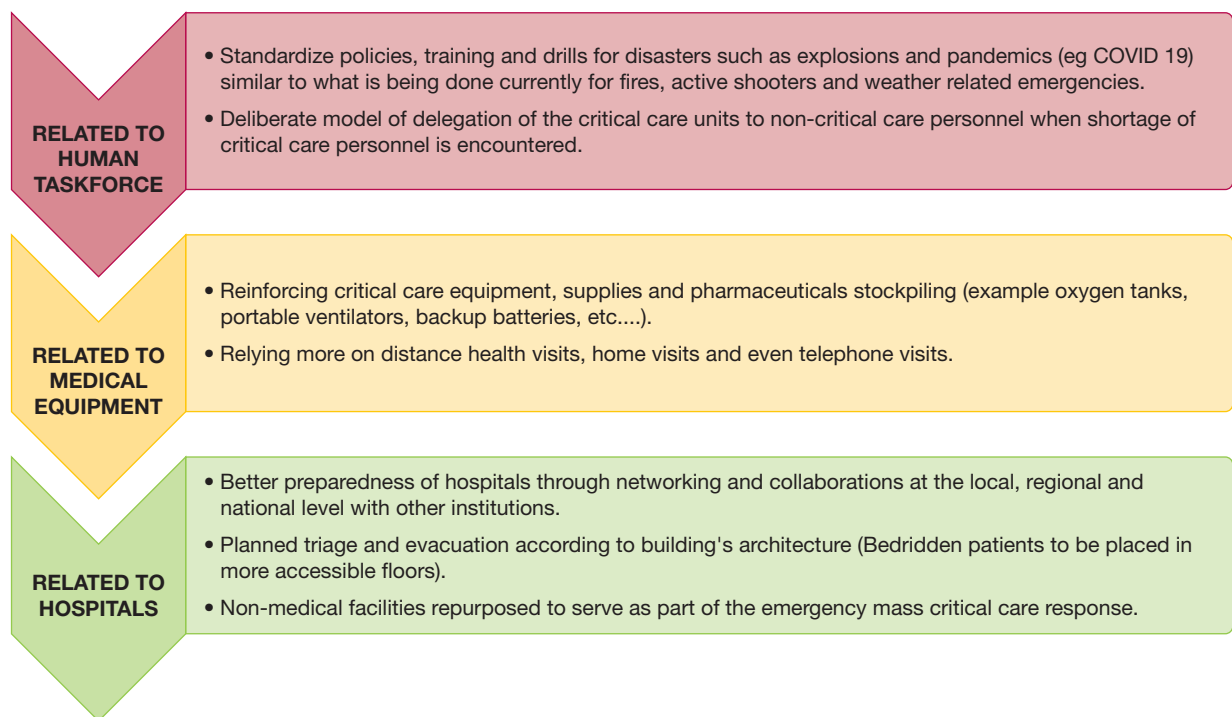


Figure 1 – Lessons learned in the care of critically ill patients in the aftermath of one of the biggest nonnuclear explosion disasters in history that coincided with the COVID-19 pandemic.

supplies, most notably oxygen tanks. Facing all these adversities, a large tent was erected in the hospital parking lot to serve as field hospital. The tent was later transitioned to a COVID-19 vaccination hub, allowing >1,400 daily immunizations.

We created an ER for COVID-19 within days, providing continuous monitoring of the critically ill by noncritical care nurses and residents. This concrete example of caring for the critically ill in noncritical care areas and with noncritical care trained personnel demonstrated the potential for such deliberate model of delegation and the adaptability of our staff. Our model relied on one senior critical care nurse who managed the work of three noncritical care nurses, thereby striving to maintain a safe nurse-to-patient ratio.

We also repurposed nonmedical facilities, as described in the mass critical care response guidelines.^{3,4} What remained of the medical office building was transformed into a fever clinic and observational ward, where less critically ill patients with COVID-19 stayed overnight to receive their required work up and care. Finally, a neighboring government building, previously used to care for the poor and underprivileged population, was acquired by our institution. Refitted, equipped, and refurbished, the building was transformed into a new

COVID-19 unit that included five ICU beds. The medical engineering team worked day and night to establish an in-wall oxygen and air delivery system. Portable ICU monitors provided continuous critical care monitoring.

Just as we hoped that the worst was behind us, we faced the fourth challenge of a severe medical personnel shortage. Many physicians and nurses had left the country, and many others had not yet recovered from their explosion-related injuries.

So what real-life lessons were learned (Fig 1)?

First, we must engage in better triage and evacuation planning. We evacuated critically ill patients first, followed by neonatal and geriatric populations. However, the chaos and lack of planning made us less efficient and more vulnerable as caregivers.

Second, we learned the importance of standardized policies, training, and mass casualty drills. Such rehearsals lead to safer evacuations.^{3,4}

Third, establishing collaborations and agreements with other institutions creates a well-defined disaster network. This network could expedite patient, personnel, and equipment transfers to improve patient care.^{3,4} Hospital networks and preparedness should

transcend geography and academia by incorporating collaborations across private, community, and even federal institutions for disaster planning and preparedness. Even in the United States, very few hospitals had provisions in their bioterrorism response for collaboration with outside entities.⁵

Fourth, prioritize and minimize admissions. Particularly during the COVID-19 surge, we relied on distance health, home, and telephone visits to manage and monitor the less ill patients remotely. This helped to decompress strained ERs and to prevent overcrowded hospitals.³

Fifth, when facing shortages in critical care personnel or bed capacity, delegation to noncritical care staff and repurposing nonmedical facilities as inpatient or even critical care units decompresses already strained hospitals.

Sixth, maintain a robust inventory of critical care equipment, such as portable ventilators, long-lasting batteries, supplies, and pharmaceuticals.

The seventh lesson was the importance of mobilizing the population. Faster vaccine manufacturing, distribution, and administration to all, including third world countries, is essential. More public awareness over the importance of social distancing, masks, and other preventive measures is critical.

Many hospitals and providers would never imagine having to face these four sequential scenarios in a short

period of time. Simulation courses could never evoke such destruction and devastation.

On August 4, 2020, our colleagues had no prior warnings nor any way of knowing what challenge they would next face, yet they demonstrated resilience, dedication to our profession, and commitment to treat patients. In so doing, they overcame their own fears, physical wounds, and emotional injuries.^{2,6}

Reflecting on those formative experiences, we believe our shared oath of service kept us going by caring for our patients despite the tremendous difficulties and sequential challenges.

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