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.

COVID-19

Lessons Learned, Lessons Unlearned, Lessons for the Future

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The COVID-19 pandemic has affected clinicians in many different ways. Clinicians have their own experiences and lessons that they have learned from their work in the pandemic. This article outlines a few lessons learned from the eyes of CHEST Critical Care Editorial Board members, namely practices which will be abandoned, novel practices to be adopted moving forward, and proposed changes to the health care system in general. In an attempt to start the discussion of how health care can grow from the pandemic, the editorial board members outline their thoughts on these lessons learned. CHEST 2022; ■(■):■-■

The global COVID-19 pandemic has produced cataclysmic changes in society and medicine. Health care systems and individuals have been stressed and overstretched and have had to adapt at multiple levels. We asked members of the CHEST Critical Care Editorial Board to reflect on ways that the pandemic has changed their thinking regarding medicine. Without any additional instructions, we asked for brief individual opinions with answers to these three questions:

1. What single practice do you think you will abandon going forward after the pandemic?
2. What single practice do you think you will adopt going forward?
3. What single change should the health care system adopt to prepare for the next pandemic?

The authors approached the questions in different ways, shaped by diversity in perspectives, disciplines, inclinations, and experiences during the pandemic, and spoke in their own distinctive voices. The open-ended nature of the questions was designed to foster variation, and we consider the diversity of responses and writing styles a strength of the endeavor; this is not intended to be a position paper that reflects a

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TABLE 1] Changes in Thinking Regarding Medicine From the COVID-19 Pandemic

Practices likely to abandon
• Sole reliance on crisis standards of care planning to navigate patient care in high-capacity situations
• Excessive, unnecessary, or routine testing (laboratory, radiological, etc)
• Rapid adoption of anecdotal evidence
• Abandonment of evidence-based care already established in practice
• Need to be called a hero
• Tribalism and siloed critical care among separate ICUs in the same institution
• Disregard for our own mental and physical health
• Prioritizing doing something over learning what to do
Practices likely to adopt
• Active teaching of recognizing the acutely dying patient
• Increase and refine the role of remote monitoring
• Standardization of medication formulations and concentrations across units in the hospital
• Promote a culture of psychological safety in which mistakes can be identified and corrected, knowledge can be gained, and safety of patients and health care workers can be improved
• Reflective practice and debriefing
• Frequent, regular, ongoing education that includes the entire ICU team
• Stronger advocation for science and learning
Changes for the future
• Increase nursing and other ancillary staff (respiratory therapist, physical therapist, occupational therapist, nursing techs, etc): "stockpile" staff over equipment and beds
• Re-examine health care worker roles and responsibilities
• Develop a coordinated response center to coordinate local, regional, state, and national responses in an apolitical and data-driven manner
• Maintain a comprehensive critical drug list with strategy for monitoring shortages and therapeutic alternatives
• Understand and address biases in care, inequities in access, and mistrust of the health care system

consensus among editorial board members. Some themes did recur, however, as summarized in Table 1.

Our hope is for readers to refract these thoughts through their own broad and diverse experience with COVID-19. We intend to stimulate dialog, and to this end, we invite questions, comments, and especially dissenting opinions to share what all have learned and to improve the practice of medicine and the care of patients now and in the future. We are all in this together.

David R. Janz, MD, *New Orleans, Louisiana*

What Single Practice Do You Think You Will Abandon Going Forward After the Pandemic?

Belief That Crisis Standards of Care Planning Is Sufficient to Achieve Success. Planning for potential implementation of crisis standards of care has returned to the forefront in the discussion of how hospitals and governments respond to pandemics.[1-4] Although a necessary preparatory step, it only outlines a plan in the event of complete collapse of a health care system as measured by the exhaustion of quantifiable resources. Planning *only* for this nightmarish, and thankfully rare, scenario ignores what has been known for years in critical care medicine: excess morbidity and mortality occur well before this threshold. ICU strain has been studied for decades, and the data are consistent: even if an ICU has not exhausted a quantifiable resource, strain of existing resources, especially staff, is associated with worse patient outcomes.[5-8] Success in pandemic response lies in our ability to solve the ubiquitous everyday strain problems that present proximal to the rare collapse of a system. Preparatory time should be spent on how to care better for the critically ill adults who remain in the ED because no ICU beds are available, how the ICU nurse and physician adapt to caring for more patients than usual, and how systems should recognize these strains and augment or redeploy resources.

What Single Practice Do You Think You Will Adopt Going Forward?

Actively Teaching How to Recognize the Acutely Dying Patient. Many of us fortunate enough to have trained under giants in critical care often think back to how they taught us a certain concept, yet struggle to remember the specific day when we learned to differentiate a patient we can fix from a one we cannot. We acquired this skill by the slow diffusion of knowledge over time. COVID-19 has highlighted that this skill is too important in the ICU to depend on such a passive approach to its teaching.[9] Lack of timely recognition of the acutely dying patient deprives the patient and their family of the rituals and grace that accompany the dying process: comfort, relief of suffering, sadness, understanding, coming to terms, grief, anger, dignity, closure, and—in pandemics—visitation. Intensivists should be as good at identifying the acutely dying patient as they are at diagnosing disease processes. Actively teaching the skill of recognizing the acutely dying patient can avoid surrounding them with machines and hospital staff, rather than their family, at the end of life.

What Single Change Should the Health Care System Adopt to Prepare for the Next Pandemic?

Focus on Stockpiling People, Not Ventilators. Tangible and easily counted items such as ventilators, rooms, and medications are important, but uncommonly are the first resource to run dry in a pandemic. How do systems stockpile true effectors of care such as nurses and respiratory therapists? How do we stockpile evidence-based medicine in an easily accessible format that can be translated to less-experienced providers? How do we stockpile historical knowledge of critical care, so everyone knows in a future pandemic what will save lives and limited resources? Although practicing evidence-based critical care is a tireless effort, it eliminates rewriting the practice of critical care based on anecdotes. In each of us, how do we stockpile compassion, resilience, focus, and love for our patients, profession, and colleagues? This is my inventory list for future pandemics.

Bram Rochwerg, MD, *Hamilton, ON, Canada*

What Single Practice Do You Think You Will Abandon Going Forward After the Pandemic?

Regular, Low-Yield Testing in Critically Ill Patients, Including Chest Radiography, Electrocardiography, Echocardiography, and Some Laboratory Tests. During the pandemic, we were much more selective in testing for patients with COVID-19 to minimize risk to our nurses, porters, radiologists, technicians, and other health care workers. The concept is not new and is consistent with the values of Choosing Wisely,[10-14] but COVID-19 provided an opportunity to consider more carefully how results of testing might influence pretest probabilities and to ponder carefully the usefulness of all testing in critically ill patients.

What Single Practice Do You Think You Will Adopt Going Forward?

Neuromuscular Blockade for ICU-Based Intubations. Before COVID-19, I seldom used paralytic agents for ICU-based intubations. As an internist, some of this related to comfort, but it was also based on experience. As part of our COVID-19 protected intubation policy, regular use of paralytics for intubation was protocolized, unless a patient was anticipated to have a difficult airway or be difficult to bag-mask ventilate.[15] As such, I have performed a large number of intubations using paralytic agents and am certain this has increased my first-pass success rate. Moving forward, I plan to adopt this approach more widely as part of my routine intubation practice.

What Single Change Should the Health Care System Adopt to Prepare for the Next Pandemic?

Increase ICU Nursing Capacity. With the surges in the number of critically ill patients with COVID-19 experienced during each successive wave of the pandemic, discussion at administrative levels escalated about number of ICU beds, number of ventilators, and number of IV pumps. However, it is not equipment that makes an ICU bed, but availability of experienced and skilled staff, most crucial of which are ICU nurses. Thinking ahead to future stresses on our health care system, we need to ensure that we invest not just in structures and equipment to support surge capacity in critical care, but also the people to support this.

Curtis N. Sessler, MD, Master FCCP, *Richmond, Virginia*

What Single Practice Do You Think You Will Abandon Going Forward After the Pandemic?

Simplify the Practice of Medicine by More Critically Examining Accepted Practice "Norms" that often have limited impact on outcomes, but are performed by convention or to satisfy documentation requirements. For example, performance of "scheduled" testing

unprompted by a specific question or change in patient status adds costs as well as additional testing to resolve unexpected findings. The pandemic magnifies the costs of health care worker exposure and personal protective equipment use. A specific test we have challenged is routine chest radiography, which infrequently brings value unless prompted by a clinical question.[16,17]

What Single Practice Do You Think You Will Adopt Going Forward?

Expand the Role of Remote Communication and Monitoring in Health Care and Beyond, Enhancing Efficiency and Flexibility and Reducing Health Care Worker Exposure With Greater Likelihood of Successful Quarantine. An ICU patient-centric example we implemented is the placement of ventilator control panels outside the patient room. This permits detailed examination of ventilator graphics and allows adjustments to ventilator settings, while reducing clinician exposure and personal protective equipment use. However, remote communication and monitoring may reduce meaningful human interaction that is at the heart of medicine.

What Single Change Should the Health Care System Adopt to Prepare for the Next Pandemic?

Many opportunities exist for improvement given the suboptimal federal response to the greatest health care crisis in generations. From the perspective of individual health systems, opportunity exists to restructure health care worker roles and responsibilities and broaden training to promote flexibility in support of a team-based approach that seamlessly moves people to where they are needed. On a national scale, need exits for a federal entity with resources and empowerment to manage a coordinated effort toward control and elimination of an epidemic threat—a national epidemic response center. The mission of this entity must be apolitical and based on science, data, and common sense, and must address issues related to deployment of personnel, equipment, and supplies; streamlining of drug development; support of patients and workers; and executive capacity to implement change to protect lives.

Mark Malesker, PharmD, FCCP, *Omaha, Nebraska*

What Single Practice Do You Think You Will Abandon Going Forward After the Pandemic?

Quickly Changing Practice Based on Incomplete Information. Mainstream media, social media, and medical journals touted novel and repurposed medications almost continuously early during the pandemic. The decisive conclusions from initial clinical trials were problematic given small sample sizes, single-center designs, and public-health pressures for release of preliminary results without adequate peer review. Given the lack of objective data, inconsistent guideline recommendations, and rapid pace of COVID-19 evolution, clinicians routinely relied on empirical real-time recommendations shared via online seminars and blogs. New information was available almost hourly. This "infodemic" led to delayed decisions and treatment errors, as well as psychological distress resulting from uncertainty about best practices.[18–20]

Rapid progression of new institution-specific protocols related to SARS-CoV-2 infection necessitated changes in admission policies and enhanced communication regarding flow of patients from the ED to hospital setting. Eventually, practical evidence-based treatment recommendations were published. The challenge is to keep current with the rapidly changing pace of new clinical information while following the evidence.

What Single Practice Do You Think You Will Adopt Going Forward?

Standardize Medication Formulations and Concentrations Throughout the Hospital. The pandemic posed new challenges concerning medication administration as existing patient care units were repurposed and new units were opened. Some caregivers were placed in unfamiliar roles, using therapies with which they had little experience. This was particularly challenging for nursing staff, who often were in the shortest supply and were moved between units to cover gaps, sometimes even in the middle of a shift. Consequently, information technology safeguards, including updates to medications in the electronic medical record database, barcode scanners, and smart pumps, are required to minimize dosing errors resulting from changes in concentrations or substituting alternative medications, including oral or enteral routes of administration when possible.

What Single Change Should the Health Care System Adopt to Prepare for the Next Pandemic?

Develop a Comprehensive Critical Drug List and Monitoring Strategy for Medication Shortages and Therapeutic Alternatives. The COVID-19 crisis stressed an already fragile supply chain. Critical care providers experienced prescription drug shortages.[21]

Along with the increased use and subsequent demand, COVID-19 caused illness and shutdown of manufacturers, limiting production and supply chains. Although the exact shortages may have varied locally, medications of different classes used in the ICU were affected. Shortages compromised quality of care. Institutions faced challenges in assuring patient safety while using alternative treatments. Strong communication within health care organizations and individual hospitals was required to alert clinicians about drug shortages, expected duration, temporary alternatives, and conservation strategies.

Geneva Tatem, MD, *Detroit, Michigan*

What single practice do you think you will abandon going forward after the pandemic?

The Need to Be Called a Hero. Each of us do so many courageous things on an individual and collective basis every single day. The hand we hold, the tears we wipe from a face, the words of kindness we express: all are demonstrations of the deep compassion we have for our patients, team members, and—we hope—ourselves. I am re-energized by the strength and power shown in serving others and working to heal the pain and suffering we see. Each of us should be proud of what we have done to help society.

What Single Practice Do You Think You Will Adopt Going Forward?

Continue Focusing on Creating a Culture of Psychological Safety. Part of the trap of being a hero is that this allows no room for imperfection. However, we all know that errors occur and that reducing harm is incredibly important. To deliver high-quality care, our environment must be safe. This requires us to identify problems as early as possible and to address them. The structure and hierarchy of our teams can make it difficult for some to feel comfortable and empowered to bring issues forward. Less experienced team members can feel it is risky to "say something" when they "see something" for fear of being wrong or being viewed badly by peers and supervisors.

Our trainees are learning and by definition do not have enough experience yet to do some things correctly. We grow our knowledge and improve our skills by attempting, testing, seeing how accurately we perform, and subsequently making adjustments. We can reduce errors in our clinical environment substantially if we make it safe for everyone to develop the skills they need, to voice their concerns, and to ensure that they are treated respectfully when doing so.

What Single Change Should the Health Care System Adopt to Prepare for the Next Pandemic?

We must reflect on what we did well—we built dynamic and responsive teams and innovative care models to meet the needs of our patients during rapidly surging demands—and what we could do better. A dire need exists for heightened commitment to providing high-quality care for all. For people of color, inequities around access, bias that impacts the type of care received, and mistrust resulting from the health care system's continued demonstration of disparate treatment must be acknowledged and fixed. The only way to preserve the lives and health of all people is to commit the time, technology, and resources to care for everyone as they are, where they are.

May Hua, MD, *New York, New York*

What Single Practice Do You Think You Will Abandon Going Forward After the Pandemic?

Less Tribalism. I practice primarily as a surgical intensivist in an academic medical center with multiple specialty ICUs. Before the pandemic, many intensivists at my institution were territorial over their ICU beds and practice as patients were triaged to a specialty unit based on the primary problem. However, during the spring 2020 surge in New York City, the rapid influx of ICU patients required all intensivists (as well as other clinicians) to care for patients with COVID-19 and to share the burden. As the pandemic continued, different specialty ICU teams have continued to work together to find appropriate space for patients and have learned about the unique pressures and challenges surrounding each ICU and their operations. Although tribalism is not likely to be eradicated completely, I hope that as we move forward, we remember how we all worked together during this time and that we are reminded that ultimately, we share a common goal of providing the best possible care for all critically ill patients.

What Single Practice Do You Think You Will Adopt Going Forward?

Reflective Practice and Debriefing. The pandemic has affected multiple aspects of health care workers' lives, but many of these stresses have always existed (although perhaps not in the same intensity or manner). Discussions of moral distress and burnout have become more mainstream, and our institution and critical care

division have launched or continued initiatives (eg, scheduled debriefings) aimed at helping health care workers process their experiences. These interventions may be particularly helpful for trainees, who often lack the clinical expertise to contextualize their experiences appropriately and in a meaningful way.

What Single Change Should the Health Care System Adopt to Prepare for the Next Pandemic?

Plans for More Equitable Distribution of Resources Across Larger Health Care Systems. During various surges of the pandemic, hospitals have been highly strained in their ability to care for critically ill patients. In the initial 2020 spring surge, some hospitals fared much worse with regard to their resources (eg, ventilators, personal protective equipment, staffing), and overall, hospitals in some areas behaved in an isolationist and protectionist manner, in which those that had resources hoarded them and those that did not were left to fend for themselves. To prepare for the next pandemic, some centralized entity at a city, state, or national level that allows for resources to be "flexed" to where they are most needed would be instrumental. Most importantly, hospitals need to be able to trust that if they give away their resources, they will receive them in return when they are in need. Examples of resource sharing have been implemented during the pandemic, such as patients within a single health care system often being transferred between hospitals. Also, during the initial surge in New York City, many health care workers, out of goodwill, came from other states to help. A system that facilitates this type of resource sharing would help to ensure that hospitals and health care workers have what they need to care for critically ill patients.

Nida Qadir, MD, *Los Angeles, California*

What Single Practice Do You Think You Will Abandon Going Forward After the Pandemic?

Culture of Perfectionism. The culture of medicine traditionally has been one of stoic perfectionism: an unwavering commitment to patient care that supersedes self-care without complaint. Although more of a mindset than a practice, this is something I am happy to leave behind. High rates of burnout syndrome have been reported among ICU staff caring for patients with COVID-19,[21] but intensivists have described high levels of burnout since well before the pandemic.[22] Although many factors contributing to burnout remain beyond our control, including the persistence of COVID-19 and the inherent stress involved in managing critical illness, "suck it up" culture is modifiable. We must acknowledge our own limitations without shame, normalize rest and self-care, and critically examine our workloads. The duration of this pandemic remains indeterminate and other strains to our medical system will occur in our lifetimes. We will not survive in the long haul without maintaining our own physical and mental health.

What Single Practice Do You Think You Will Adopt Going Forward?

Approach to Education. My approach to education has changed and become more iterative and inclusive. Early in the pandemic, seasoned intensivists and interns alike were learning about a novel virus. Literature on COVID-19 was evolving rapidly. To keep track, we held frequent, regular educational conferences for faculty physicians, trainees, nurses, respiratory therapists, and other members of the multidisciplinary team, a much larger group than usual. Keeping the entire group up to date on pharmacologic therapies and evidence-based management practices for ARDS greatly impacted the quality of care, even during times of strain.

Even before the pandemic, we had seen a disconnect between evidence-based medicine and practice patterns. A number of practice-changing clinical trials, and even recommendations from clinical practice guidelines, were not translated into bedside care.[23] The methods we used for COVID-19 education—consistently updated clinical guidance and frequent, regular, ongoing education involving the entire ICU team—can facilitate the transition of evidence-based medicine to clinical practice well beyond the pandemic.

What Single Change Should the Health Care System Adopt to Prepare for the Next Pandemic?

Increase the Number of ICU-Trained Clinicians. Although equipment shortages have been problematic, the scarcest resource during the pandemic at most hospitals has been ICU personnel. ICU nurses are a particularly precious resource—many hospitals ran out of ICU nurses well before they exhausted their ventilator supply, and the inability to maintain appropriate patient-to-nurse ratios has a dramatic impact on patient outcomes.[24] Going forward, the most important aspect of pandemic preparedness will be increasing the number of ICU-trained clinicians, because our ability to handle future crises is entirely dependent on having a sufficiently sized and appropriately trained ICU workforce.

Steven M. Hollenberg, MD, *Atlanta, Georgia*

What Single Practice Do You Think You Will Abandon Going Forward After the Pandemic?

Prioritizing Action Over Learning. An inevitable tension exists between learning and doing.[25] In the face of uncertainty, a natural tendency is for a clinician to "just do something" based on the judgment that benefits are likely to outweigh harms, even while admitting a paucity of evidentiary support. I have certainly done so.

The COVID pandemic has made me much more skeptical about this. It's not that an unproven therapy might produce unintended harm; even proven therapies balance benefit and risk. The most important downside is the loss of the opportunity to advance the state of the art, to learn what does and does not work.

It took a long time for good randomized data concerning COVID-19 therapies to emerge. Notwithstanding the enormous challenges of randomizing patients in a pandemic, I think we could have enrolled more patients more quickly into clinical trials. My own prioritization of action delayed, at least to some extent, acquisition of actionable knowledge. I will try harder, within my system and without, to study disease in a more rigorous and systematic fashion.

What Single Practice Do You Think You Will Adopt Going Forward?

Advocating for Science and Learning. Even now, too many people are making too many decisions that aren't data driven. Certainly data are lacking in some areas, and the scientific community needs to work to address those gaps. But I must take a more active role in both disseminating the available evidence and in making the case for basing decisions on those actions.

The scope is broader than my own unit, hospital, health care system, or the health care system as a whole. The scientific community has a responsibility to interact with society and to convince people that the use of scientific approaches is imperative. SARS-CoV-2 is not amenable to persuasion; we need to work harder to persuade people that science is the best way to fight it.

We also must make the case that imperfections and uncertainty do not invalidate science. Admitting doubt is part and parcel of the scientific method and should be regarded as strengthening, not weakening, an argument. In short, we must advocate—publicly and locally—for a scientific approach to managing disease. Certainty is not a requisite; rather, questioning, exploring, and learning are necessary.

What Single Change Should the Health Care System Adopt to Prepare for the Next Pandemic?

Prepare for the Next Challenge. The pandemic has exposed many weaknesses in our health care system, from structural challenges to inequities in delivery of care. Few of these are amenable to simple solutions, but we can make progress based on lessons learned. The next crisis may or may not be a pandemic, and many of these issues are broadly applicable to health care.

1. Organizing. You don't want to build a stadium every time you play a match. We need to conduct clinical trials quickly, flexibly, and efficiently to identify the barriers and to address them.
2. Communicating. The internet is a blessing and a curse. The ability to disseminate information rapidly and across national boundaries is a tremendous advantage, but the credibility of that information can be difficult to evaluate. Peer-reviewed journals play a crucial role in filtering and vetting information and are becoming faster and more transparent. But we also need to be able to exchange information among ourselves and leverage the enormous power of large data sets and to reduce impediments to doing so on a local, regional, and national level.
3. Anticipating Challenges. Structures that organize clinical care often are distinct from those that organize research; this impeded rapid initiation of clinical trials for COVID-19 therapies and reinforced a tension between doing and learning. We need to bridge the divide.[26,27] Adaptive platform trials are one way to test multiple therapies and balance practice with learning; both the Randomised, Embedded, Multifactorial, Adaptive Platform Trial for Community Acquired Pneumonia[28-31] and Randomized Evaluation of COVID-19 Therapy[32,33] trials had some success in doing so. Repeating and extending these successes will require attention to collaborative structures, patient and community involvement, and stable funding mechanisms.
4. Unanticipated Challenges. The next big health care challenges will not be predictable. How will we optimize our ability to leverage scientific knowledge to address those challenges? We will need to work together. And we will need to share our insights.

Reflections and Conclusions

The COVID-19 pandemic brought many changes to the practice of medicine and health care delivery. The pandemic also exposed numerous vulnerabilities in our health care system and brought into sharper focus both

conscious and unconscious biases, as well as inequities in care.

Despite a process intended to encourage differences in perspective and style, certain issues resonated through the responses (Table 1). Scarcity of resources and risk to personnel emphasized the importance of streamlining processes and adopting focused diagnostic strategies. The challenges of acquiring and disseminating reliable and actionable information about prevention and treatment during a rapidly moving pandemic remain daunting.

Many recounted how COVID-19 exposed our already mounting personnel shortages and revealed that our capacity limitations are more about personnel than facilities, beds, or equipment. Appropriate attention was raised concerning effects of staff stress and overwork, with sage advice about strategies to address this going forward. Some of this reflected ways to think about ourselves, others reflected methods to support each other.

The safest prediction about the next big health care challenges is that they will not be predictable. How will we optimize our ability to leverage scientific knowledge to address those challenges? We will need to work together, to learn from our past and present, and to update our practices. And we will need to share our insights, failures, and successes. Change will occur through collaboration and discourse. Let us begin.

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