In his book “Of the Epidemics” Hippocrates advises physicians that they must “have two special objects in view with regard to disease, namely, to do good or to do no harm” (1). Facing the challenge of the severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) pandemic, this advice remains as pertinent now as it was over 2,400 years ago. In response to the 1919 Spanish flu pandemic, physicians in desperation turned to the antimalarial quinine (2). It is disappointing that 100 years later, despite the emphasis on evidence-based medicine, the same strategy was adopted, owing to the highly emotional need to treat patients with “something.”

Faced with a new disease, numbers of patients that have in many cases vastly overwhelmed healthcare resources, and no available effective treatment, an extraordinary array of experimental therapies have been given to critically ill patients, often in combination. Whether this approach has harmed more patients than it has helped remains to be seen. Desperate times are felt to justify desperate measures. However, in this issue of the Journal, the case series by Du and colleagues (pp. 1372–1379) (3) demonstrates that access to basic critical care support, not experimental therapies, is the most important determinant of the high mortality reported in some SARS-CoV-2 series. Despite acute respiratory distress syndrome in 74% and shock in 81%, only 21% of cases received invasive mechanical ventilation.

Many physicians across the world are recommending treatments even while researchers and regulators claim that the evidence of benefit is limited, and therapies should be tested in a randomized controlled trial. These physicians believe that the chance of potential benefit outweighs the chance of harm. However, safety concerns may be significantly underestimated since most of these drugs have never been properly studied in critically ill patients. For example, many of the experimental therapies used are potentially cardiotoxic, including hydroxychloroquine, ritonavir, lopinavir, IFN-α-2β, azithromycin, and methylprednisolone. As myocarditis is reported as a potential complication of SARS-CoV-2, if all these agents are used in combination, is it a surprise that very high rates of cardiac complications occur, such as the 60% incidence of arrhythmia reported in the case series from Du and colleagues (3) in this issue and by others (4)? IFNs are generally proinflammatory and may be deleterious in patients with hyperinflammation with high plasma IL-6. Anti–IL-6 monoclonal antibodies have been associated with cytokemalvirus reactivation, episodes of bacterial septic shock, and bowel perforation, particularly when combined with high-dose corticosteroids (5, 6). Many of these experimental agents have pharmacologic interactions with a large list of drugs commonly used in critical care, hampering overall management and increasing the risk of toxicity. High-dose steroids, associated with superinfections, such as invasive pulmonary aspergillosis, increased mortality in influenza pneumonia (7), and worse outcomes in the 2009 influenza A pandemic (8), were used in 75% of fatal cases in the series by Du and colleagues (3), and 74% of critical cases in the multicenter study of Feng and colleagues (9), also in this issue of the Journal (pp. 1380–1388). Like hydroxychloroquine, high-dose corticosteroids may be associated with delirium, agitation, and psychosis that often is complicating the weaning of intubated patients with SARS-CoV-2 infection. Patients and their families have a clear right to be informed of the risks of all these experimental therapies so they can provide informed consent for compassionate use. That this is routinely occurring seems unlikely.

Treating all patients with the same therapy regardless of stage of disease or clinical phenotype is also perilous, and properly conducted trials are necessary to select patient characteristics associated with a beneficial response. It is very clear that patients are presenting with different clinical phenotypes causing respiratory failure (10), both with and without evidence of “cytokine storm” (11). It would clearly be unreasonable to expect patients with such different phenotypes to respond similarly to the same experimental interventions. The recent report on compassionate use of remdesivir among 53 patients with severe SARS-CoV-2 infection showed an improvement in oxygen support in 36 (68%) whereas 8 (15%) showed worsening; clinical improvement was less frequent among intubated patients (hazard ratio, 0.33) and patients older than 70 years (hazard ratio, 0.29) (12). With serious adverse events reported in 23% of patients (12), personalized therapy is clearly going to be required.

Another serious problem with routine use of unproven agents for SARS-CoV-2 is that clinical equipoise is lost and an experimental agent becomes de facto standard of care, potentially seriously compromising the ability to do placebo-controlled trials. Inability to complete a controlled trial because of loss of clinical equipoise is a two-edged sword. Even if the intervention has true benefit, it is unlikely detractors will be convinced and lives will be lost because the treatment is still not given. If the intervention has adverse effects not revealed because of the absence of a placebo arm, then lives may be lost because it continues to be used. If experimental agents are given in combination, attribution of effects, both beneficial and adverse, to one of them becomes nearly impossible, given the significant variability in critical care outcomes as a baseline.

Unquestionably, much of the pathogenesis and optimal therapy of SARS-CoV-2 remains unknown, but we strongly believe that it is critically important that, when faced with uncertainty, clinicians stick to standards of care that are proven and robust. The SARS-CoV-2 pandemic is an opportunity to learn how to treat patients and test therapies at the same time (13). Trials of experimental therapies are certainly justified, but only in properly conducted randomized controlled trials where their risks and benefits can be accurately assessed, and certainly not in untried combinations which greatly increase the risk of harm.
Concerns that results from conventional trials can take years is proving false with hundreds of patients enrolled within 6 weeks in at least two SARS-CoV-2–specific clinical trials. Adaptive multicenter trials with interim analyses have the ability to determine if an intervention is superior to placebo and adjust the standard of care and move on to test new therapies in rapid succession. Once a new intervention has become standard of care, it can be tested against alternatives or combinations of drugs. For sites that don’t have the capacity to generate local trials, participation in platform trials like REMAP-CAP (The Randomised, Embedded, Multi-Factorial, Adaptive Platform Trial for Community-acquired Pneumonia) (14) should be encouraged.

In summary, we believe that the widespread use of clearly experimental therapies being reported in patients with SARS-CoV-2 is dangerous and unjustified. There is a real risk that mortality rates are higher than they need to be because of toxic, ineffective therapy. Clinicians must not succumb to the impulse to "do something else" but instead stick to evidence-based therapies and, if possible, enroll their patients into adaptive clinical trials. SARS-CoV-2 is likely to be a problem for years, and we need to develop precision approaches based on high-quality clinical data as fast as we can. Equally, and unfortunately, SARS-CoV-2 will not be the last serious viral pneumonia epidemic humanity faces, and only by having a scientific approach this time can we avoid going back to 1919-era desperation treatments the next time we are faced with this challenge.

Author disclosures are available with the text of this article at www.atsjournals.org.

Grant W. Waterer, M.B. B.S., Ph.D.
School of Medicine
University of Western Australia
Crawley, Western Australia, Australia
and
Northwestern University Feinberg School of Medicine
Chicago, Illinois

Jordi Rello, M.D., Ph.D.
Centro de Investigación Biomédica en Red (CIBERES)
Instituto de Salud Carlos III
Madrid, España

Vall d’Hebron Institute of Research (VHIR)
Barcelona, Spain
and
CHU Nîmes
Université Montpellier-Nîmes
Nîmes, France

Richard G. Wunderink, M.D.
Northwestern University Feinberg School of Medicine
Chicago, Illinois

ORCID ID: 0000-0002-8527-4195 (R.G.W.).

References
1. Adams F. The genuine works of Hippocrates. London: The Sydenham Society; 1849.
2. Shors T, McFadden SH. 1918 influenza: a Winnebago County, Wisconsin perspective. Clin Med Res 2009;7:147–156.
3. Du Y, Tu L, Zhu P, Mu M, Wang R, Yang P, et al. Clinical features of 85 fatal cases of COVID-19 from Wuhan: a retrospective observational study. Am J Respir Crit Care Med 2020;201:1372–1379.
4. Kochi AN, Tagliari AP, Forleo GB, Fassini GM, Tondo C. Cardiac and arrhythmic complications in patients with COVID-19. J Cardiovasc Electrophysiol [online ahead of print] 9 Apr 2020; DOI: 10.1111/jce.14479.
5. Ogata A, Kato Y, Higa S, Yoshizaki K. IL-6 inhibitor for the treatment of rheumatoid arthritis: a comprehensive review. Mod Rheumatol 2019;29:258–267.
6. Komura T, Ohta H, Nakai R, Seishima J, Yamato M, Miyazawa M, et al. Cytomegalovirus reactivation induced acute hepatitis and gastric erosions in a patient with rheumatoid arthritis under treatment with an anti-IL-6 receptor antibody, tocilizumab. Intern Med 2016;55:1923–1927.
7. Moreno G, Rodríguez A, Reyes LF, Gomez J, Solé-Violan J, Díaz E, et al.; GETGAG Study Group. Corticosteroid treatment in critically ill patients with severe influenza pneumonia: a propensity score matching study. Intensive Care Med 2018;44:1470–1482.
8. Ni YN, Chen G, Sun J, Liang BM, Liang ZA. The effect of corticosteroids on mortality of patients with influenza pneumonia: a systematic review and meta-analysis. Crit Care 2019;23:99.
9. Feng Y, Ling Y, Bai T, Xie Y, Huang J, Li J, et al. COVID-19 with different severities: a multicenter study of clinical features. Am J Respir Crit Care Med 2020;201:1380–1388.
10. Gattinoni L, Coppola S, Cressoni M, Busana M, Rossi S, Chiurnello D. COVID-19 does not lead to a "typical" acute respiratory distress syndrome. Am J Respir Crit Care Med [online ahead of print] 30 Mar 2020; DOI: 10.1164/rccm.202003-0817LE.
11. Ye G, Wang B, Mao J. The pathogenesis and treatment of the 'Cytokine storm' in COVID-19. J Infect [online ahead of print] 10 Apr 2020; DOI: 10.1016/j.jinf.2020.03.037.
12. Grein J, Ohmagari N, Shin D, Diaz G, Asperges E, Castagna A, et al. Compassionate use of remdesivir for patients with severe Covid-19. N Engl J Med [online ahead of print] 10 Apr 2020; DOI: 10.1056/NEJMoa2007016.
13. Angus DC. Optimizing the trade-off between learning and doing in a pandemic. JAMA [online ahead of print] 30 Mar 2020; DOI: 10.1001/jama.2020.4984.
14. Angus DC, Berry S, Lewis RJ, Al-Beidh F, Arabi Y, van Bentum-Puijk W, et al. The randomized embedded multifactorial adaptive platform for community-acquired pneumonia (REMAP-CAP) study: rationale and design. Ann Am Thorac Soc [online ahead of print] 8 Apr 2020; DOI: 10.1513/AnnalsATS.202003-192SD.