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Editorial

Editorial for the Special Issue on Public Health

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Microbes have a long history of spilling over from animals to humans, resulting in occasional surprise attacks on the global population. One of the most recent of these attacks, coronavirus disease 2019 (COVID-19), led to the most harmful and widespread respiratory infectious disease pandemic during the last century. COVID-19 has not only taken a heavy toll on human life and health around the world, but also introduced formidable challenges to global economic development, technological innovation, social progress, and national and international politics. In addition, the pandemic has fostered new insights into how to understand and prepare for outbreaks of emerging infectious diseases, how to better utilize technological and social interventions to prevent or respond to these outbreaks, and how to implement science-based control and treatment to mitigate their effects.

Healthcare systems are placed under considerable strain by pandemics of respiratory infectious diseases such as COVID-19, as they struggle to cope with large numbers of severe cases, hospitalizations, and deaths along with increased rates of nosocomial infections. These challenges often coincide with high level of community transmission and pandemic-related constraints in medical resources. There can also be some variation in what medical responses are required, given different possible scenarios in terms of disease characteristics, prevention and control measures put in place, the existence or lack of vaccines or effective medications, regional population sizes, and other factors.

Based on current understanding of disease and on a theoretical analysis of the epidemiology of infectious diseases, Zhang et al. improve the susceptible–exposed–infectious–removed (SEIR) transmission dynamic model and construct scenarios according to different situational variables in their article "A Scenario-Based Evaluation of COVID-19-Related Essential Clinical Resource Demands in China" in this special issue. By evaluating the demand for medical resources and proposing response strategies accordingly, this work provides methodological support for adapting health systems during the current or future pandemics.

Pandemic response often involves both non-pharmaceutical interventions, which requires a wide range of public health measures and social policies, and pharmaceutical interventions, which mainly rely on research and development capacities and technological innovations. Non-pharmaceutical interventions have played an essential role in curbing the current outbreak. In the study of Lai et al. titled "Assessing the Effect of Global Travel and Contact Restrictions on Mitigating the COVID-19 Pandemic," an epidemiological metapopulation transmission model is established to simulate the global circulation of COVID-19 and assess the impact of travel and social distancing interventions. Based on epidemiological data and anonymized mobile phone-derived population mobility data across 135 countries and regions in the first wave of the pandemic, model results suggest that global travel and contact restrictions were crucial to outbreak containment. This study finds that, if no interventions had been implemented, the number of infections would have been 97-fold higher by 31 May 2020 than they were in actuality. This study highlights the potential of leveraging novel global "big data" resources to model and evaluate the effectiveness of the pandemic interventions.

Pharmaceutical interventions, particularly vaccination, have recently come into greater focus as a means to address the pandemic in its second year. In this issue, Jiang et al. evaluate the efficacy of the clinical trials of a variety of COVID-19 vaccines currently available. Given that it will be necessary to continue to conduct clinical trials with placebo groups, they call for the consideration of fairness regarding the health of placebo group volunteers, and suggest that a perfected test method be developed that gives full consideration to safety, efficacy, ethics, and other vaccine-related issues. Adopting these recommendations could help produce higher quality research data to guide decision-making and public health practices.

In the context of the limited supply of COVID-19 vaccines, distribution has become a challenge. COVID-19 Vaccines Global Access (COVAX), a worldwide initiative co-led by the World Health

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Organization (WHO), Gavi, the Vaccine Alliance, and the Coalition for Epidemic Preparedness Innovations (CEPI), alongside key delivery partner United Nations International Children's Emergency Fund (UNICEF), promotes equitable distribution of vaccines. COVAX aims to expand COVID-19 vaccine coverage, with the goal of vaccinating 20% of the global population by 2021. Taking the United States as an example, Ferranna et al. from the Harvard T. H. Chan School of Public Health use a mathematical model to assess the impact of several distinct national vaccine-allocation strategies with respect to various policy goals, such as reducing cases of or deaths due to COVID-19. The researchers point out that in addition to health outcomes, economic, social, and ethical factors may be relevant to COVID-19 vaccination policy decisions. This work provides scientific evidence to inform global and national COVID-19 vaccine allocation.

Early COVID-19 convalescents were followed up for 12 weeks by Liu et al., who describe changes in the levels of immunoglobulin M (IgM) and IgG antibodies and in a series of related inflammatory cytokines over time. This study provides a reference for whether people who have recovered from COVID-19 need to be vaccinated, when to vaccinate, and how to optimize choices among different types of vaccines.

While the pandemic continues to rage around the world, our current and future responses can draw on experience gained during early-stage efforts against COVID-19. In the article titled "Facilities for Centralized Isolation and Quarantine for the Observation and Treatment of Patients with COVID-19," the purpose and effectiveness of centralized isolation in China's early response to the COVID-19 pandemic is systematically reviewed for the first time, and the main advantages and characteristics of different types of quarantine sites are discussed. This study summarizes valuable experiences in breaking the chain of family-cluster transmission and effectively alleviating the pressure on healthcare resources, which can be useful for the global community. Another article, titled "Non-Communicable Diseases During the COVID-19 Pandemic and Beyond," explores the prevention and control of non-communicable diseases (NCDs) during the COVID-19 pandemic, and points out that NCDs and COVID-19 share risk factors and are both influenced by a common set of policy and economic determinants. The article titled "The East–West Divide in Response to COVID-19" discusses differences in COVID-19 control and treatment between eastern and western countries in terms of concepts, methods, response times, and epidemic intensity. Reasons for these differences are analyzed, and different vaccine-allocation strategies to achieve herd immunity are proposed.

During such a critical period, as the human race battles COVID-19, *Engineering* will continue to issue public-health-related scientific papers covering, but not limited to, COVID-19. Pharmaceutical and non-pharmaceutical interventions remain key measures in working with global infectious pandemics. Since health issues stem from comprehensive social factors, we advocate a strategy of "Health in all Policies." COVID-19 is the enemy of all of humankind. Addressing the pandemic and its health challenges requires people around the globe to come together and work as one, thereby embodying the ultimate goal of public health: to improve and protect the collective health of the population. Eventually, the concept of "One World, One Health" will be realized.