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.

The emerging antimicrobial resistance crisis during the COVID-19 surge in China

The antimicrobial resistance crisis has been amplified by the COVID-19 pandemic.[1] However, under its zero-COVID policy, China had a decline in antibiotic consumption,[2] because the intensive non-pharmaceutical interventions aimed at controlling COVID-19 also prevented the spread of other airborne diseases and their subsequent infections. China also tightened drug selling to treat COVID-19-related symptoms as part of its zero-COVID efforts, which contributed to lessened self-medication with antibiotics.[3] Therefore, antimicrobial resistance has not been seen as an urgent issue, at least until China relaxed its zero-COVID policy in early December, 2022. The current surge of SARS-CoV-2 infections across China will lead to an increase in the use of antibiotics, which will exacerbate the irrational use of antibiotics seen before the COVID-19 era.[4]

Due to the widespread accessibility of non-prescription antibiotics at retail pharmacies in China,[5] and the scarcity of antibiotic knowledge, especially in rural areas, the prevalence rate of self-medication with antibiotics was relatively high before the COVID-19 pandemic.[6] A survey done in Wuhan, China in 2019, just before the start of the COVID-19 pandemic, showed that 10·32% of participants reported self-medication with antibiotics in the past 6 months and 72·4% believed antibiotics could treat viral infections.[7] Countries that choose to live with COVID-19 and practiced less-restrictive COVID-19 prevention efforts, had a high prevalence (79%) of antibiotic use among self-medication efforts for COVID-19 prevention and treatment.[8] According to the latest guidelines for COVID-19 control and treatment,[9] patients with no or mild symptoms are suggested to perform self-care at home. The lifting of antibiotic purchase restrictions, such as real-name registration and reporting, could cause an increase in unreasonable or unnecessary self-medication with antibiotics, leading to an increased risk of antimicrobial resistance in China.

Moreover, the increasing number of infections associated with COVID-19 in health-care settings, when combined with excessive and inappropriate antibiotic prescriptions, might further aggravate the antimicrobial resistance crisis. Increasing health-care associated infections coincided with high numbers of COVID-19 hospitalisations, which were caused by overcrowded health-care facilities and a rising risk of invasive procedures for the treatment of severely-ill patients with COVID-19.[10,11] Overuse of antibiotics in health-care settings was more common during the COVID-19 pandemic; although, studies have shown that the proportion of bacterial co-infections or secondary bacterial infections in COVID-19 patients is low (1·2%), antibiotics are often used as an empirical treatment, and around 70% of patients with COVID-19 in these studies have been treated with at least one antibiotic.[12] Notably, in China, before the COVID-19 pandemic, inappropriate antibiotic prescribing was prevalent nationwide. A study that used outpatient prescriptions from a national monitoring database revealed that, between 2014 and 2018, 49·2% of antibiotic prescriptions were inappropriate in secondary-level hospitals and 51·6% were inappropriate in tertiary-level hospitals.[4] We expect that the existing antimicrobial resistance crisis in health-care settings will be exacerbated by the surging hospitalised COVID-19 cases in China again.

Some countries, such as the USA, took action to tackle the antimicrobial resistance crisis during the COVID-19 pandemic.[1] China issued the National Action Plan on Combating Microbial Drug Resistance (2022–25) in October, 2022, well before the easing of its zero-COVID policy. However, greater policy actions are needed in the face of the current surge of COVID-19 cases in China. First, antimicrobial resistance response should be prioritised, and these should be regarded as important countermeasures against COVID-19 and future pandemics. Second, health education for the public, patients, and health-care staff should be strengthened. Increases in personal care have led to greater demands for drug knowledge, presenting an opportunity to improve public attitudes and awareness and address common malpractices. The government should use this opportunity to disseminate knowledge on proper antibiotic use and the harms of excessive and irrational use as widely as possible and in a timely manner. Third, antimicrobial stewardship programmes and activities in both the inpatient and outpatient settings should be reinforced to ensure the

appropriate use of antimicrobials. Online medication consultations should be offered more widely, and regulations on the sale of antibiotics online and in pharmacies should be strengthened, especially in rural areas. Fourth, antimicrobial resistance surveillance should be strengthened, to better assess the effect of the COVID-19 pandemic on epidemiological trends in antimicrobial resistance.

The month-long diverging from the zero-COVID policy has caused peaks of infections, first in urban areas, and now in rural areas where irrational use of antibiotics is very common. China should take immediate action to address antimicrobial resistance crisis in the face of nationwide pandemic, especially in rural areas.

*Zhicheng Wang, Mengke Yu, *Leesa Lin
wangzc61@gmail.com; leesa.lin@lshtm.ac.uk

China Development Research Foundation, Beijing 100009, China (ZW, MY); Department of Infectious Disease Epidemiology, London School of Hygiene & Tropical Medicine, London WC1E 7HT, UK (LL); Laboratory of Data Discovery for Health, Hong Kong Special Administrative Region, China (LL)

1 Patel J, Sridhar D. The pandemic legacy of antimicrobial resistance in the USA. *Lancet Microbe* 2022; **3:** e726–27.

2 Yang Y, Geng X, Liu X, et al. Antibiotic use in China's public healthcare institutions during the COVID-19 pandemic: an analysis of nationwide procurement data, 2018-2020. *Front Pharmacol* 2022; **13:** 813213.

3 Zhu B, Zhao X, Li Y, et al. Impact of the COVID-19 outbreak on the antibiotic use patterns among a rural community population in eastern China. *Antibiotics (Basel)* 2022; **11:** 1544.

4 Zhao H, Wei L, Li H, et al. Appropriateness of antibiotic prescriptions in ambulatory care in China: a nationwide descriptive database study. *Lancet Infect Dis* 2021; **21:** 847–57.

5 Chang J, Xu S, Zhu S, et al. Assessment of non-prescription antibiotic dispensing at community pharmacies in China with simulated clients: a mixed cross-sectional and longitudinal study. *Lancet Infect Dis* 2019; **19:** 1345–54.

6 Cheng J, Coope C, Chai J, et al. Knowledge and behaviors in relation to antibiotic use among rural residents in Anhui, China. *Pharmacoepidemiol Drug Saf* 2018; **27:** 652–59.

7 Yin X, Mu K, Yang H, et al. Prevalence of self-medication with antibiotics and its related factors among Chinese residents: a cross-sectional study. *Antimicrob Resist Infect Control* 2021; **10:** 89.

8 Ayosanmi OS, Alli BY, Akingbule OA, et al. Prevalence and correlates of self-medication practices for prevention and treatment of COVID-19: a systematic review. *Antibiotics (Basel)* 2022; **11:** 808.

9 National Health Commission. Notice on further optimizing the implementation of COVID-19 prevention and control measures. 2022. http://www.gov.cn/xinwen/2022-12/07/content_5730443.htm (accessed Jan 10, 2023).

10 Lastinger LM, Alvarez CR, Kofman A, et al. Continued increases in the incidence of healthcare-associated infection (HAI) during the second year of the coronavirus disease 2019 (COVID-19) pandemic. *Infect Control Hosp Epidemiol* 2022; published online May 20. https://doi.org/10.1017/ice.2022.116.

11 Baker MA, Sands KE, Huang SS, et al. The impact of coronavirus disease 2019 (COVID-19) on healthcare-associated infections. *Clin Infect Dis* 2022; **74:** 1748–54.

12 Karaba SM, Jones G, Helsel T, et al. Prevalence of co-infection at the time of hospital admission in COVID-19 patients, a multicenter study. *Open Forum Infect Dis* 2020; **8:** ofaa578.