



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.

Elsevier hereby grants permission to make all its COVID-19-related research that is available on the COVID-19 resource centre - including this research content - immediately available in PubMed Central and other publicly funded repositories, such as the WHO COVID database with rights for unrestricted research re-use and analyses in any form or by any means with acknowledgement of the original source. These permissions are granted for free by Elsevier for as long as the COVID-19 resource centre remains active.



Optimizing preventive medicine to bridge the gap between clinical medicine and public health for disease control in China: A lesson from COVID-19

Wu Zeng^{a,*}, Guohong Li^{b,c}, Vincent Turbat^a, Guoqing Hu^d, Haksoon Ahn^e, Jie Shen^{c,f,**}

^a Department of International Health, School of Nursing & Health Studies, Georgetown University, Washington, DC, USA

^b School of Public Health, Shanghai Jiao Tong University, Shanghai, China

^c China Hospital Development Institute, Shanghai Jiao Tong University School of Medicine, Shanghai, China

^d XiangYa School of Public Health, Central South University, Changsha, China

^e School of Social Work, University of Maryland, Baltimore, MD, USA

^f Shanghai Renji Hospital, Shanghai Jiao Tong University School of Medicine, Shanghai, China

ARTICLE INFO

Keywords

Preventive medicine
Disease control
Public health
Human resources

ABSTRACT

The pandemic of Coronavirus Disease 2019 (COVID-19) highlights the importance of early detection of disease outbreaks, taking swift and decisive public health actions, and strengthening public health systems. Preventive medicine, as a specialty of medicine, trains students on both clinical medicine and public health and is of a particular need in battling against this pandemic. In China, preventive medicine plays a unique role in the disease control system where preventive medicine graduates represent a large share of the workforce. However, there is a shortage of qualified staff in the Chinese disease control system. The reasons for such a shortage are multifaceted. From the human resource perspective, the undergraduate preventive medicine curricula and exclusive public health training for preventive medicine postgraduates limit their clinical capacities. A series of disease control and public health education reforms may further incapacitate preventive medicine graduates' clinical skills, unintentionally widening the gap between public health and clinical medicine and thus posing threats to effective disease detection and control. The authors call for reforming and optimizing preventive medicine to bridge the gap between clinical medicine and public health by strengthening curricula on clinical medicine, diversifying curricula on public health, enhancing preventive medicine residency programs, and rectifying regulations that restrict preventive medicine graduates from practicing curative medicine.

1. Introduction

The pandemic of Coronavirus Disease 2019 (COVID-19) highlights the importance of early detecting disease outbreaks, taking swift and decisive public health actions, and strengthening public health systems. Among many lessons emerging from the onset of the pandemic in China, one is that China needs to strengthen its preventive medicine education to bridge the gap between public health and clinical (curative) medicine. Currently, most clinical physicians in China do not receive public health trainings, and most public health professionals responsible for disease control are not equipped with sufficient clinical skills. This jeopardizes the efficiency of detecting and controlling disease outbreaks and costs people's lives. Preventive medicine that provides trainings to students

on both clinical medicine and public health, if properly designed, has great potential to uniquely address the issue in China.

2. Preventive medicine in China's disease control system

The difference between preventive medicine and public health has not been well recognized in China. Preventive medicine is often treated as a specialty of medicine and thus regards clinical trainings as the foundation with additional trainings on public health (No authors listed Author, 1985). Many developed countries, such as the United States and Canada, entail 2–3 years of residency training on both clinical and public health skills. Trainees often receive their certification in primary care (Peik et al., 2016), which allows them to practice curative

* Correspondence to: W. Zeng, Department of International Health, School of Nursing & Health Studies, Georgetown University, Washington, DC, USA.

** Correspondence to: J. Shen: China Hospital Development Institute, Shanghai Jiao Tong University School of Medicine, Shanghai, China.

E-mail addresses: wz192@georgetown.edu (W. Zeng), shenjie@shsmu.edu.cn (J. Shen).

medicine. Conversely, public health has a multidisciplinary nature, incorporating many professional disciplines including epidemiology, biostatistics, health economics, sociology, political science, etc. (No authors listed [Author, 1985](#)). Public health practitioners do not necessarily have a medical background.

Based on its educational curricula, China does treat preventive medicine as a specialty of medicine. Most undergraduate preventive medicine programs in China entail five years of predominantly clinical and basic science training: four years on basic health science and curative medicine, and one year on public health (e.g. epidemiology, biostatistics, occupational health, environmental health, etc.). Afterwards, the students earn their medical degrees.

Uniquely, China has a long history of deploying preventive medicine professionals as the main workforce for disease control and public health. During the 1950s and 1960s, Hygiene and Anti-Epidemic Stations (HAESs) were established throughout the country at county, prefecture and province levels. HAESs were mainly responsible for controlling infectious diseases rampant in China at the time. During that period until the early 2000s, the Department of Preventive Medicine (DPM), often sat within the School of Medicine, assumed the responsibility of training public health specialists. Prior to the 2000s, preventive medicine graduates could seek employment as clinical physicians in hospitals (e.g. division of infectious diseases) or in health centers to practice curative medicine, while majority of them worked in the HAESs. It was reported that 69.46% of staff in China's disease control system were registered public health (associate) physicians in 2018, which also accounted for 50.18% of public health workforce ([National Health Commission of the People's Republic of China, 2019](#)). The majority of public health physicians are preventive medicine graduates.

3. Disease control system reforms potentially widen the gap between public health and clinical medicine

After witnessing a rapid change in the field of public health and learning the lessons from the outbreak of Severe Acute Respiratory Syndrome (SARS) in 2003, China undertook a series of reforms in its disease control system in the early and mid 2000s. China established the Chinese Center for Disease Control and Prevention (CDC) in 2002, and divided each HAES at various levels into two independent units: a local CDC and a Health Inspection Unit (HIU). HIU is the law enforcement unit to ensure the compliance of various activities, such as food production, to national hygienic standards. Meanwhile, many universities or medical schools established Schools of Public Health (SPHs), and a majority of them were directly transformed from DPMs. Consequently, preventive medicine has become synonymous with public health in China, and the two terms are used interchangeably. SPHs have launched more undergraduate and graduate programs, such as health administration and health inspection and quarantine. Graduates from such programs often receive a science degree rather than medical degree.

The transformation of the disease control system and the public health education system was accompanied with a drastic change of regulations on the eligibility of medical practitioners. The Medical Practitioner Act took effect in 1999, which stipulated the eligibility of health professionals working in the field of clinical medicine, disease prevention, and health promotion ([Standing Committee of the National People's Congress, 1998](#)). Fifteen years later (2014), a supplemental regulation on the eligibility for national medical professional exams further specified that only graduates with a clinical medicine degree were eligible to take the medical board examination to practice clinical medicine. It profoundly affected preventive medicine graduates' career development. Since then, preventive medicine graduates could not practice clinical medicine any more ([National Health Commission of the People's Republic of China, 2014](#)). Nor could they practice in the division of infectious diseases at hospitals where they previously sought employment. When pursuing higher degrees (e.g. masters and doctoral degrees) on preventive medicine, they often received exclusive public

health training but no clinical training. These reforms unintentionally distanced preventive medicine from clinical medicine and potentially widened the gap between public health and clinical medicine.

In sum, although preventive medicine in China is a specialty of medicine based on its training curricula, it functions as a specialty of public health given that preventive medicine graduates cannot practice curative medicine, which generates a disconnection between the curricula and the practice.

4. Fundamental challenges on human resources for disease control in China

With more than half the staff at CDCs being public health (associate) physicians and majority of them trained in clinical medicine and public health, China's disease control system ideally should have taken a leading role in advising the Chinese government to take public health actions in the circumstance like the COVID-19 pandemic. In battling against COVID-19, staff at CDCs worked relentlessly on contact tracing, epidemiological investigation, disinfection of public places, and testing, contributing to the effective control of COVID-19 in China.

Bouey has mentioned many issues regarding China's disease control system, including a shortage in funding, poor collaboration among different health sectors, and the lack of legal and political power of CDCs ([Bouey, 2020](#)). From the human resource perspective, the fundamental challenge of CDCs is the absence of qualified personnel with both strong clinical and public health training. The existing undergraduate preventive medicine programs provide only one to two years of clinical training to students which is not sufficient for them to acquire adequate clinical experience to tackle communicable and non-communicable diseases at the individual and community levels. The dominant public health training for postgraduate programs in preventive medicine ([Ren et al., 2019](#)) and distorted staff promotion criteria that disproportionately incentivize research-oriented activities contribute to the shortage of clinically well-trained preventive medicine physicians at CDCs, undermining effective disease detection and control ([Wang et al., 2019](#)).

An additional related and important reason for the shortage of qualified public health physicians is the absence of clinical settings for them to practice clinical medicine. Most preventive medicine graduates working at grassroot CDCs are largely engaged in non-clinical work and preoccupied with daily routines ([Liu et al., 2019](#)). Their main tasks include reporting and analyzing disease surveillance data, conducting epidemiological investigation, and providing health education to the public. Public health professionals without medical training can perform much of these works. Although public health physicians receive clinical training at medical schools or SPHs, the deprivation of their eligibility to practice clinical medicine and overwhelming non-clinical daily routines prevent them from sharpening their clinical skills for disease control, which often leads to the relative low job satisfaction among disease control technical staff ([Li et al., 2020](#)). Graduates of top preventive medicine programs show little interest in working at CDCs ([Hou et al., 2018](#)). Between 2002 and 2012, the number of personnel working at the disease control system reduced by 11.9% in China ([Li et al., 2016](#)). CDCs face great challenges in attracting qualified staff specialized in disease control.

One may argue that disease detection is more related to the responsiveness of the disease surveillance system and less to clinical skills of preventive medicine graduates working at CDCs. After the SARS outbreak in 2003, China built an integrated web-based disease control and prevention information system, aiming to produce real time disease reporting from villages to the national CDC ([Vlieg et al., 2017](#)). The system does shorten the case reporting time for selected national notifiable infectious diseases once the cases are identified ([Jia and Yang, 2020](#)). However, identification and confirmation of suspected cases may take time under the existing surveillance system. This is particularly true for unknown diseases, such as COVID-19. As no clinically trained CDC staff with extensive disease control experience works in clinical settings,

CDCs' passive reliance on mandatory or voluntary reporting of suspected patients from health facilities will likely cause CDCs to lose golden opportunities to detect abnormal pattern of disease occurrence early.

5. Strengthen preventive medicine for disease control in China

It is imperative to reform preventive medicine training to strengthen the linkage between public health and clinical medicine. To achieve this goal, first, the curricula of clinical medicine for undergraduate preventive medicine programs should be strengthened. The undergraduate program of preventive medicine should have the similar clinical training as that of clinical medicine to ensure that preventive medicine undergraduates are adequately trained in clinical medicine. With enhanced clinical training, the government should rectify the eligibility regulation to allow preventive medicine graduates to obtain a certificate to practice clinical medicine in the field where public health interventions play a significant role in reducing the disease burden, such as infectious diseases, non-communicable diseases, injuries, and maternal and child health.

Second, the government should enhance residency training programs on preventive medicine in China. Although China has launched a pilot project of public health physician standard training in 10 provincial CDCs since 2017, the training programs should incorporate more diverse curricula on public health (e.g. big data, public administration, and emergency responses) and provide more intensive clinical trainings to respond to increasing demand for interdisciplinary skills for disease control. For those who pursue a higher degree on preventive medicine, the training curricula should be more practice-oriented on both clinical medicine and public health.

Finally, it is critical to provide clinical settings for preventive medicine physicians to sharpen their clinical skills for disease control. Public health physicians ought to be on the frontlines to battle diseases in both clinical and public health settings so that they can gain the first-hand experience in detecting and coping with disease outbreaks, designing, implementing, and evaluating public health interventions to control them. As most hospitals for treating infectious or occupational diseases are owned by the government, with more than 50% of disease control staff being public health (associated) physicians, China is in a unique position to create such a setting by integrating these hospitals with CDCs. This would provide a substantive platform for public health physicians to be vigilant detectors of diseases to break the barrier between prevention and treatment.

6. Conclusion

Existing undergraduate and graduate curricula for preventive medicine, the Medical Practitioner Act, and its supplemental eligibility regulations may unintentionally widen the gap between public health and clinical medicine and are potentially detrimental to disease detection and control. Strengthening clinical skills, rectifying the Medical Practitioner Act, and diversifying curricula on public health for preventive medicine graduates could serve as a start to build a more resilient and capable disease control system in combatting unforeseen epidemic of diseases in the future. With COVID-19, it is likely that more SPHs will be established, more students will be interested in disease control, and enrollment in undergraduate and graduate preventive medicine programs will increase in China. Tsinghua University, one of the top universities in China, launched a school of public health in April 2020 (Yuan, 2020), and several other leading universities are in the pipeline to establish one as well. This makes the reform of prevention medicine training more pressing to address potential challenges on

human resources for the disease control system in China.

Funding

Guohong Li and Jie Shen were supported by the Key Research Project in Philosophy and Social Sciences of the Ministry of Education of the People's Republic of China (18JZD044) supported this study. The funder had no role in designing and conceptualizing the study.

Ethical approval

Not Applicable.

Competing Competing Interest

The authors reported no competing interest.

Acknowledgments

None.

References

- Author, 1985. The distinction between public health and community/social/preventive medicine. *J. Public Health Policy* 6, 435–439 (No author listed).
- Bouey, J., 2020. China's health system reform and global health strategy in the context of COVID-19: Testimony presented before the U.S.-China Economic and Security Review Commission on May 7, 2020. Rand Cooperation, Washington, DC. https://www.uscc.gov/sites/default/files/2020-05/Bouey_Written_Testimony_FINAL.pdf. Accessed date: June 26 2020.
- Hou, J., Wang, Z., Liu, X., Luo, Y., Sabharwal, S., Wang, N., Meng, Q., 2018. Public health education at China's higher education institutions: a time-series analysis from 1998 to 2012. *BMC Public Health* 18, 679. <https://doi.org/10.1186/s12889-018-5605-4>.
- Jia, P., Yang, S., 2020. China needs a national intelligent syndromic surveillance system. *Nat. Med.* <https://doi.org/10.1038/s41591-020-0921-5>.
- Li, C., Sun, M., Wang, Y., Luo, L., Yu, M., Zhang, Y., Wang, H., Shi, P., Chen, Z., et al., 2016. The Centers for Disease Control and Prevention system in China: trends from 2002-2012. *Am. J. Public Health* 106, 2093–2102. <https://doi.org/10.2105/AJPH.2016.303508>.
- Li, N., Wang, Y., Yu, E., Xiao, S., Liu, Y., 2020. Job satisfaction of staff in agencies for disease prevention and control in Hainan Province, China. *J. Pak. Med. Assoc.* 70, 523–525. <https://doi.org/10.5455/JPMA.5011>.
- Liu, B.H., Zhao, M.M., Liang, Z., Gao, L.J., Gao, F., Wu, Q.H., Hao, Y.H., Ning, N., 2019. Factors associated with field epidemiology investigation: a cross-sectional study in China. *Biomed. Environ. Sci.* 32, 454–458. <https://doi.org/10.3967/bes2019.060>.
- National Health Commission of the People's Republic of China, 2014. Regulations on Eligibility of Medical Board Examine. National Health Commission of the People's Republic of China, Beijing, China. http://www.law-lib.com/law/law_view.asp?id=446708.
- National Health Commission of the People's Republic of China, 2019. *China Health Statistics Yearly Book*. Beijing Union Medical University Press, Beijing, China.
- Peik, S.M., Mohan, K.M., Baba, T., Donadel, M., Labruto, A., Loh, L.C., 2016. Comparison of public health and preventive medicine physician specialty training in six countries: identifying challenges and opportunities. *Med. Teach.* 38, 1146–1151. <https://doi.org/10.3109/0142159X.2016.1170784>.
- Ren, T., Li, M., Song, J., Qin, X.Y., Wu, Y.Q., Wang, T., Zhang, W.P., Zhu, Y.P., Wu, Y., et al., 2019. Study on the current status of postgraduates training in public health and preventive medicine in China in 2016. *Zhonghua Yu Fang Yi Xue Za Zhi* 53, 625–627. <https://doi.org/10.3760/cma.j.issn.0253-9624.2019.06.016>.
- Standing Committee of the National People's Congress, 1998. *Medical Practitioner Act*. Standing Committee of the National People's Congress, Beijing, China. http://www.law-lib.com/law/law_view.asp?id=447. Accessed date: May 16 2020.
- Vlieg, W.L., Fanoy, E.B., van Asten, L., Liu, X., Yang, J., Pilot, E., Bijkerk, P., van der Hoek, W., Krafft, T., et al., 2017. Comparing national infectious disease surveillance systems: China and the Netherlands. *BMC Public Health* 17, 415. <https://doi.org/10.1186/s12889-017-4319-3>.
- Wang, Z., Jiang, W., Liu, Y., Zhang, L., Zhu, A., Tang, S., Liu, X., 2019. Transforming tuberculosis (TB) service delivery model in China: issues and challenges for health workforce. *Hum. Resour. Health* 17, 83. <https://doi.org/10.1186/s12960-019-0420-2>.
- Yuan, S., 2020. Tsinghua University launches school of public health. *Lancet* 395, 1182. [https://doi.org/10.1016/S0140-6736\(20\)30819-9](https://doi.org/10.1016/S0140-6736(20)30819-9).