Scalable hypertension management tools in communities based on novel technologies in China

Shengshou Hu

National Clinical Research Center for Cardiovascular Diseases, State Key Laboratory of Cardiovascular Disease, Fuwai Hospital, National Center for Cardiovascular Diseases, Chinese Academy of Medical Sciences and Peking Union Medical College, Beijing, People's Republic of China

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China has entered a transitional time in the health of its population and the capacity of its health care system to address the country's changing needs. Prior successes in socioeconomic development have led to a large and growing elderly population, as well as rising rates of non-communicable diseases, which has challenged China to reform its health care system. In particular, attention has been turned recently to a more integrated national policy to strengthen the primary health care system, which provides 55.1% of outpatient care and 18.3% of inpatient care, as well as basic public health services to the 1.4 billion citizens in China.[1]

Despite 3.7 million primary health care providers from 0.9 million institutions, prior surveys indicated that the supply and capability of primary health care workforce in China were disproportionately insufficient to meet the increasing societal expectations for responsive, accessible, affordable, and high-quality medical care.[2,3] The Chinese government announced the general practitioner (GP) guideline in 2011.[4] There were only about 100,000 qualified GPs (about 0.8 per 10,000 residents) in 2012.[5] By the end of 2019, China had trained over 300,000 GPs (about 2.2 per 10,000 residents) through in-service training and standardized residency training. However, even if the government achieves its aim of training 5 GPs per 10,000 residents by 2030,[6] the population density of GPs would still be far below that of Western countries, where the number per 10,000 residents was eight in the United Kingdom and 11 in Australia. This is one of the major shortfalls that have been jeopardizing the management of common chronic conditions like hypertension in communities. In two recent nationally representative studies,[7,8] the poor awareness (31.9% and 46.9%) and control rates (9.7% and 15.3%) indicated gaps in both public health service (i.e. population screening) and clinical care (i.e., patient treatments).

Obviously, traditional approaches to tackle the challenges of training primary health care physicians are inadequate. In order to enhance the quality of primary health care throughout the country, China needs to leverage novel technologies, including artificial intelligence, cloud computing, and internet of things, to develop scalable tools based on the national leading knowledge base.

The newly established National Primary Health Care Hypertension Management Office in the National Center for Cardiovascular Diseases (NCCD) in Beijing has set a good example of the pooling of extensive resources and the introduction of new technologies in China. The office developed five key strategies specifically for hypertension management by the primary health care system, including: 1) a new clinical practice guideline; 2) a set of performance indicators; 3) a quality assessment system; 4) training and certification mechanisms; and 5) health education platforms. The fundamental philosophy is that management of clinical conditions commonly encountered by primary health care physicians, like hypertension, is relatively straightforward. Thus it could be standardized using practical guidelines and online training, as well as monitored using simple indicators and real-time data platforms. From 2018 to 2021, more than 2.4 million physicians from 0.32 million primary health care institutions located in all 31 provinces registered for the online training program, 1.6 million of whom were certified after successful completion. Over 75% of the trainees were registered within the first year of the program. In the meantime, the quality monitoring network has covered all primary health care institutions in 143 counties/districts from 4 provinces.

As a step forward, CHESS (a Comprehensive intelligent Hypertension managEment System for Supporting patients and physicians) was developed by NCCD as a multifaceted-intervention system comprising of home blood pressure monitoring, an intelligent reminder and alert system, a clinical decision support system (CDSS), and a data platform. In addition to CDSS which had been previously shown to be a promising tool to improve care quality and efficiency,[9–15] home blood pressure values will be transferred from patients' home to the platform and primary health information system; intelligent reminder and alert system will be triggered according to the patient's characteristics and blood pressure by contacting patients and physicians with voices or messages or apps (depends on whether they

E-mail addresses: huss@fuwaihospital.org, shengshouhu@yahoo.com.

had a smartphone); hypertension management quality (such as the blood pressure control rate) will be measured and sent to physicians or administrators regularly to promote quality improvement.

The basic decision-support functions of CHESS are to provide advice on prescriptions and referral according to guidelines and patients' characteristics, including age, medical histories, current blood pressure, heart rate, medication use, and potential contraindications or adverse reactions to antihypertensive medications. At each clinic, recommendations are generated automatically, while the final decision is in the physician's hands. The advice also includes reminders for dosage adjustments and calculations, alerts for potential contraindications, and prevention of adverse drug reactions. Within the clinical decision-support tool, rigorous algorithms were developed based on the latest clinical guidelines, experience extracted from prior medical documents, and comparative effectiveness research findings generated based on information from everyday practice.

The CDSS could be embedded into the health information system of primary health institutions, which is considered the preferred way, because the recommendation could appear during the clinic process and would be easy to use by physicians without much additional input. Nevertheless, this function, even though developed and maintained by NCCD, requires collaborations with local government, and support from the local information technology companies. It is noteworthy that health information technology systems for primary care are commonly unavailable or are functionally fragmented in China.[3,16,17] Thus in the future, NCCD also plans to develop an online version that could be adapted for areas where primary care HIS is not available.

CDSS completed a pilot study in 3 primary health institutions in Beijing, which involved 15 physicians and 246 patients with uncontrolled hypertension. After a 6-month intervention, the average systolic blood pressure decreased form 149 ± 16 mmHg to 133 ± 11 mmHg, while the blood pressure control rate increased from 0 to 65.8% (unpublished manuscript).

Development of CHESS is almost complete, and its effectiveness will be evaluated by a cluster randomized clinical trial. If it is successful, it will be extended into other chronic diseases, like diabetes mellitus, dyslipidaemia and so on.

Furthermore, this tool is user-friendly and patient-centred, as the goal is to improve the experience of both clinician and patient. The user interface is highly intuitive and requires minimum training. Also, the decision-support function was believed to be more efficient if the information related to the problem the patient is facing was registered and classified in the framework of care episodes, rather than the framework of care venues.

China is in the position of demonstrating how technology could bolster the performance of the primary health care system. The newly established National Medicine Centers should undertake their due obligations to strengthen primary health care institutions and the workforce by summarizing and spreading their knowledge and experience. It is common for hospitals provide support to local primary health care institutions, including expert consultation, technical training, and quality promoting, but this is inevitably limited by their professionals' investment of time and effort. In comparison, scalable tools leveraging aforementioned technology like CHESS could make it possible to influence almost every care primary health care provider quickly, concurrently, and sustainably.

At this stage, the NCCD continues to explore– what the evolution of primary health care system will look like, and what iterations the CHESS will need to meet the medical demands. Generally, China should gradually configure its primary health care system to be a learning platform for knowledge generation in both care strategies and health policy. The learning health system is based on the premise that the data generated in the ongoing delivery of care should be leveraged to produce insights and discoveries that are made available to practitioners to improve care and performance. Tools could consider embedding outcomes research and implementation research, which act as engines to generate and test new knowledge in a rapid cycle, to answer what strategies work in which populations, and how best to ensure that care is optimally delivered. To achieve this, 1) use of centralized health IT systems and standardized data collection in the primary health care system suggested above could lay the groundwork; 2) companies with expertise in artificial intelligence should continue collaborating with professionals to develop digital tools and online platforms; 3) users should be committed to ensure that the tools and platforms are adequately tested; 4) authorities should coordinate efforts and local experiments to determine best practices and to iterate on what is being learned. In future learning primary health care system, physicians and patients are hopefully made partners in the knowledge generation efforts, and the robust research program should propel the science forward – for China and the rest of the world.

Declaration of interests

None.

References

1 National Bureau of Statistics of China. Status of health care facilities and service delivery. http://data.stats.gov.cn/easyquery.htm?cn=C01; 2017. Accessed June 5, 2018.
2 Li X, Krumholz HM, Yip W, et al. Quality of primary health care in China: challenges and recommendations. *Lancet*. 2020;395(10239):1802–1812.
3 Li X, Lu J, Hu S, et al. The primary health-care system in China. *Lancet*. 2017;390(10112):2584–2594.

4 State Council, Central Committee of the Communist Party of China. Guidance of the State Council on the establishment of a general practitioner system. http://www.gov.cn/zwgk/2011-07/07/content_1901099.htm; 2011. Accessed May 2018.

5 Ministry of Health of the People's Republic of China. *China health statistical yearbook 2013*. Beijing: Peking Union Medical College Publishing House; 2014.

6 General Office of the State Council. State Council guidance on reform and development of training and incentive mechanisms for general practitioners. http://www.gov.cn/zhengce/content/2018-01/24/content_5260073.htm; 2018. Accessed May 30, 2018.

7 Li Y, Yang L, Wang L, et al. Burden of hypertension in China: a nationally representative survey of 174,621 adults. *Int J Cardiol*. 2017;227:516–523.

8 Wang Z, Chen Z, Zhang L, et al. Status of hypertension in China: results from the China hypertension survey, 2012-2015. *Circulation*. 2018;137:2344–2356.

9 Montgomery AA, Fahey T, Peters TJ, MacIntosh C, Sharp DJ. Evaluation of computer based clinical decision support system and risk chart for management of hypertension in primary care: randomised controlled trial. *BMJ*. 2000;320(7236):686–690.

10 Anchala R, Kaptoge S, Pant H, Di Angelantonio E, Franco OH, Prabhakaran D. Evaluation of effectiveness and cost-effectiveness of a clinical decision support system in managing hypertension in resource constrained primary health care settings: results from a cluster randomized trial. *J Am Heart Assoc*. 2015;4(1):e001213.

11 Bosworth HB, Olsen MK, Dudley T, et al. Patient education and provider decision support to control blood pressure in primary care: a cluster randomized trial. *Am Heart J*. 2009;157(3):450–456.

12 Hicks LS, Sequist TD, Ayanian JZ, et al. Impact of computerized decision support on blood pressure management and control: a randomized controlled trial. *J Gen Intern Med*. 2008;23(4):429–441.

13 Hetlevik I, Holmen J, Kruger O. Implementing clinical guidelines in the treatment of hypertension in general practice. Evaluation of patient outcome related to implementation of a computer-based clinical decision support system. *Scand J Prim Health Care*. 1999;17(1):35–40.

14 Shelley D, Tseng TY, Matthews AG, et al. Technology-driven intervention to improve hypertension outcomes in community health centers. *Am J Manag Care*. 2011;17(12 Spec No):SP103–SP110.

15 Ajay VS, Jindal D, Roy A, et al. Development of a smartphone-enabled hypertension and diabetes mellitus management package to facilitate evidence-based care delivery in primary healthcare facilities in India: the mPower heart project. *J Am Heart Assoc*. 2016;5(12):e004343.

16 Ouyang T. *Research on the sharing of medical information resource on the basis of bidirectional referral medical care in community health service and tertiary hospital [Master]*. Hefei Industry University; 2010.

17 Wang R. *Research on information technology system in primary health care institutions in Yunnan province [master]*. Yunnan University; 2014.