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## **Healing One-fifth of Humanity: Progress and Challenges for China's Health System**

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Progress and Challenges for China's Health System**

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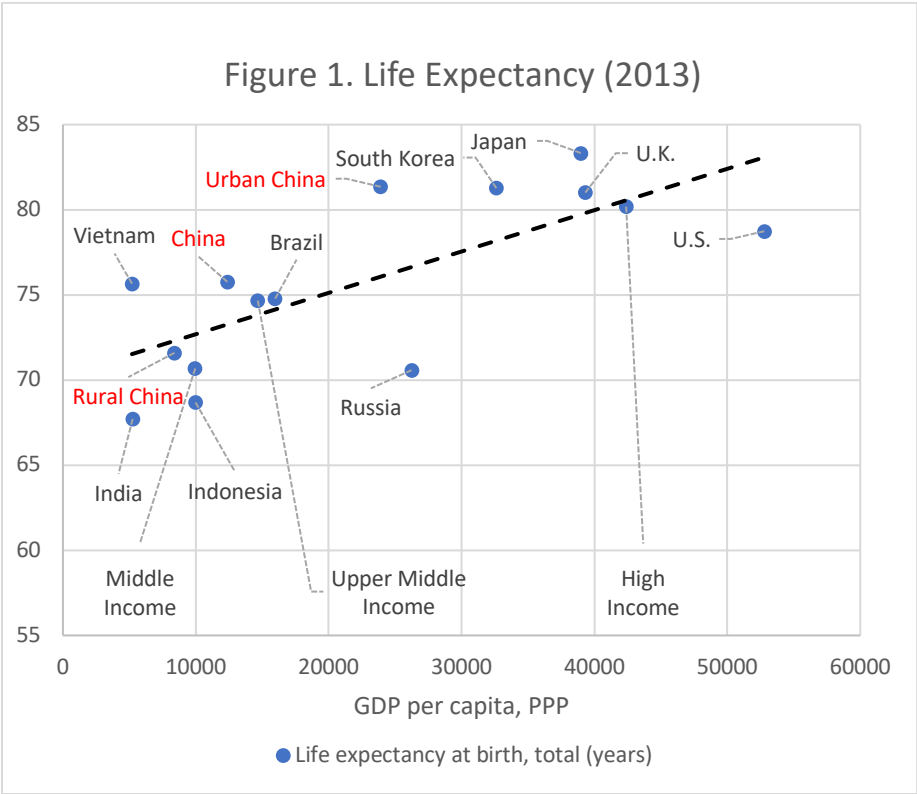
China's national health reforms over the past two decades have brought the system closer to the modern, safe, reliable and accessible health system that is commensurate with China's dramatic economic growth, improvement in living standards, and high hopes for the next generation. Celebrating a decade this year, China's national health reforms of 2009 consolidated a system of social health insurance covering the entire population for basic health services, contributing to a surge in healthcare utilization while reducing out-of-pocket costs to patients – which declined from 56% to 28% of total health expenditures between 2003 and 2017. An expanded basic public health service package, funded by per capita government budget allocations that include a higher central government subsidy for lower income provinces, provides basic population health services to all Chinese. A higher percentage of Chinese accessed hospital admissions in 2017 than in the average high-income (OECD) country – a large increase from the turn of the 21<sup>st</sup> century.<sup>1</sup> A recent re-shuffle of the governance structure consolidates the purchaser role for social health insurance schemes under the newly created National Healthcare Security Administration, with most other health sector functions under the re-christened National Health Commission, among other changes. China's world-leading technological prowess in multiple fields spanning digital commerce to artificial intelligence—and accompanying innovative business models such as WeDoctor that have not yet been fully integrated into the health system—hold promise for supporting higher quality and more convenient healthcare for China's 1.4 billion.

However, many challenges remain, from the political economy of addressing patient-provider tensions and trust in oversight of the medical industry—evidenced by the recent vaccine scandal—to changing provider payment to promote “value” rather than volume, and deciding which new medical therapies qualify as “basic” for the basic medical insurance schemes. To make China’s investments in universal health coverage and the accompanying rapid medical spending growth sustainable in the longer-run, policies need to help the most vulnerable avoid illness-induced poverty, increase health system efficiency, strengthen primary care, and reform provider payment systems, as Hai Fang and other colleagues and I argued recently.<sup>ii</sup>

Moreover, in a country as populous, expansive, and diverse as China, it is not surprising that there are wide disparities in health and healthcare between different population sub-groups distinguished by wealth, education, urban-rural *hukou*, inland-coastal residence, and so on. Health disparities can be assessed in multiple ways, and most tell consistent stories: China has achieved impressive improvements in health and longevity, including for the low-income residents in rural areas; however, significant gaps between the most- and least-privileged Chinese citizens persist, and in some cases are growing. Some of the best estimates of average life expectancy across different regions suggest gaps of 11·8 years for men and 12·8 years for women in 2013, and more recent Global Burden of Disease estimates for 2017 continue to underscore large regional differences.<sup>iii</sup> Moreover, inequalities in access to medical care continue, despite substantial improvements over recent years. For example, the Healthcare Access and Quality (HAQ) Index proposed by the Global Burden of Disease 2016 Healthcare Access and Quality Collaborators (2018) is based on measuring premature mortality from causes that should not occur if the individual had access to high-quality healthcare.<sup>iv</sup> China’s rapid improvement in access and quality as proxied by this HAQ Index is evident from the fact that even China’s lowest region in 2016 was above the 1990 national median. Among 195 countries and territories, China shows the highest absolute change in the HAQ Index during 2000-2016; and China’s HAQ index in 2016 was the highest among all countries with same or lower medical spending per capita. Nevertheless, China also stands out for striking regional disparities. The 43-point regional disparity within China is the equivalent of the difference between Iceland (the highest in the world) and North Korea. China truly entails “multiple countries within one.”

This short article overviews China’s health system reform progress and challenges, with a focusing on disparities in health and healthcare access and evidence-based policies for raising the health of the poorest and thus reducing inequality as China strives to reach its own goals for “Healthy China 2030” and beyond.

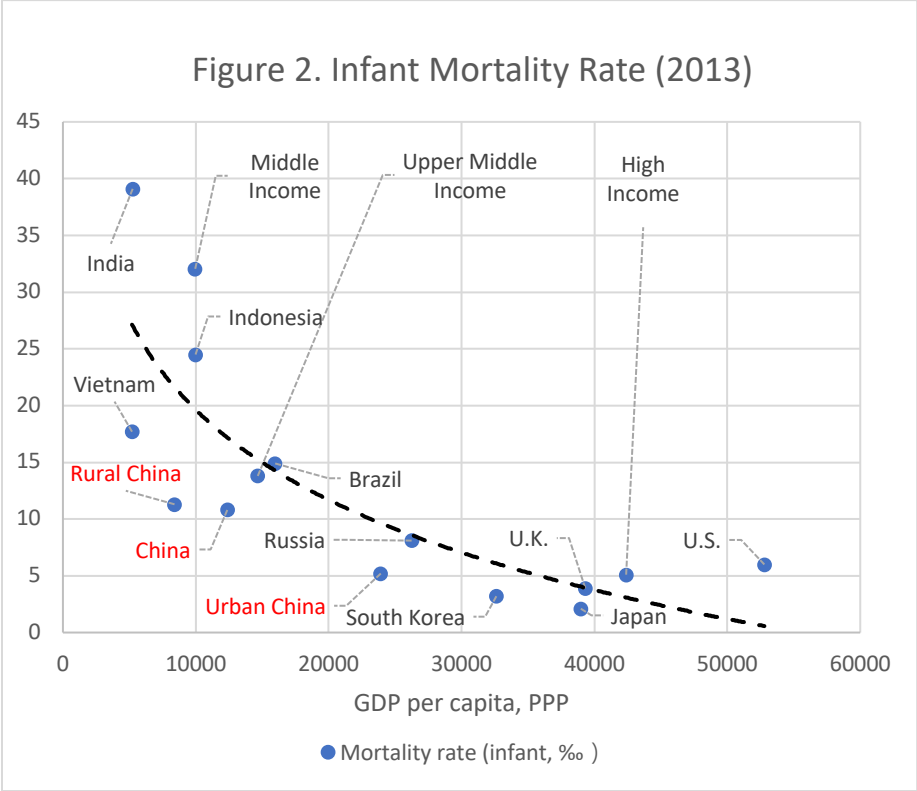
To understand China’s dramatic improvements and continuing challenges regarding population health and health system reform, consider how various metrics of health and survival compare to selected high- and middle-income countries. Figures 1, 2 and 3 draw from the World Development Indicators and the Global Burden of Disease estimates.<sup>v</sup> Each figure plots a given health metric on the vertical axis—life expectancy in Figure 1, infant mortality in Figure 2, and under-5 mortality rates in Figure 3—according to per capita income on the horizontal axis.



Sources: World Development Indicators and the Global Burden of Disease estimates; see text.

Using this comparative data, we can consider, for instance, how China’s national average compares to other countries. We can also disaggregate urban and rural China, as if they are two separate countries on the graph, to illustrate the wide distribution of outcomes across China. Note

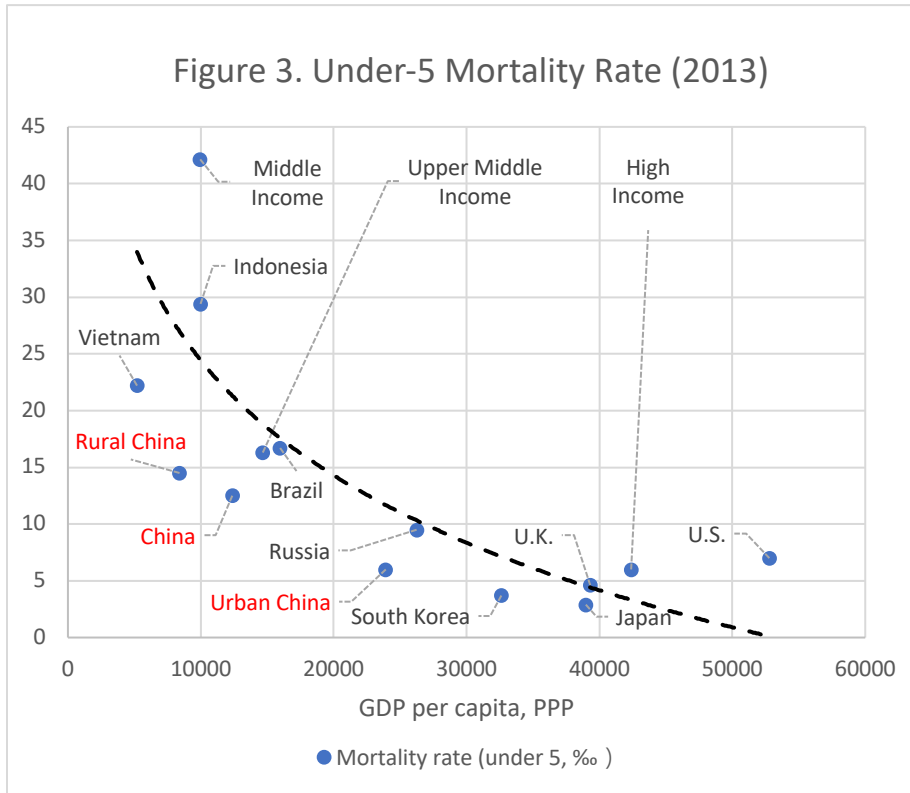
that the figures illustrate internal disparities by showing the average for the top four provinces (Shanghai, Beijing, Tianjin, and Zhejiang — labeled “urban China”— compared to the average for the lowest four provinces (Tibet, Xinjiang, Qinghai, and Guizhou), which are labeled “rural China.”<sup>vi</sup>



Sources: World Development Indicators and the Global Burden of Disease estimates; see text.

A few conclusions are inescapable. The 2013 gap in life expectancy between these proxies for urban and rural China -- almost 10 life years -- is equivalent to the gap between high-income and middle-income countries (see Figure 1). Similar stark gaps are evident between rural and urban China in infant mortality and under-five mortality (Figures 2 and 3), so that residents of the top four provinces enjoy first-world health outcomes, virtually a different country from that of their compatriots in the lowest four provinces. On the positive side, these gaps have already narrowed substantially. For example, in 1990, the gap in life expectancy between the top and bottom provinces was 15.4 years of life; by 2013, the gap was 10.4 years. The average life expectancy in Shanghai and Beijing was 75.3 in 1990, already higher than the year 2013 average life expectancy of 71.5 in the bottom four provinces (Guizhou, Qinghai, Tibet, and Xinjiang); but the

latter increased by more than 11 years (from 59.9 to 71.5) between 1990 and 2013, compared to an increase of less than 7 years for Beijing and Shanghai over that same period (75.3 to 81.9), ameliorating the gap. Urban-rural disparities in maternal mortality, neonatal mortality, and under-5 mortality have also declined, although substantial gaps remain.<sup>vii</sup>



Sources: World Development Indicators and the Global Burden of Disease estimates; see text.

Despite this progress, sizable health disparities remain in China. Health outcomes differ not only between urban and rural areas, but also and along other dimensions, such as between urban regions of higher or lower per capita income, or across individuals with more or fewer years of schooling. The burden of chronic disease is a case in point. For example, diabetes is associated with greater excess mortality in rural China, although prevalence is higher in urban areas.<sup>viii</sup>

An important and urgent question for China's future is to what extent policies will ameliorate disparities, even as an array of forces pushes to widen disparities in health, healthcare use, and burden of medical spending over a lifecycle. Some evidence does suggest that health

investments can ameliorate disparities by compensating for health disadvantages, such as growing up in poverty. One interesting study found that height shrinkage among elderly Chinese is negatively associated with better schooling, current urban residence, and household per capita expenditures. Height is useful as a measure of nutrition and other health inputs throughout the prenatal and childhood years, and this study suggests that it may be possible to compensate for early-life disadvantages with later-life investments.<sup>ix</sup> Those benefiting from population health interventions, those with better education and access to more resources (through their own or their adult children's earned income as well as various transfer programs) may be able to close the gap with their more well-endowed counterparts.

Consider for example the correlation between educational attainment and better health. As multiple studies in different countries and populations have showed, part of this association is causal, and holds even when comparing people with the same income and wealth levels.

In a study with several co-authors, we documented gaps in health and survival-- known as the educational gradient in health--between Chinese with high and low educational attainment, and how they have changed over time.<sup>x</sup> China's educational gradient might be getting less steep in recent years for at least two reasons: those with low schooling may disproportionately benefit from population health investments made during the decades of the PRC (e.g. clean water, better sanitation, infectious disease control), with their life-long impacts on health; and successive generations receive more schooling and its associated health benefits (i.e., they are "moving up the Preston curve"). However, other changes would tend to steepen the educational gradient in health. For example, individuals with more schooling may better understand the importance of healthy lifestyles (such as never smoking) and engage in less risky occupations.<sup>xi</sup> Those with more schooling may also be better equipped to prevent and manage chronic diseases, especially ones with relatively complex treatment regimens that require adherence even when asymptomatic to prevent development of complications.

Based on data from two different nationally representative surveys, my co-authors and I found that better educational attainment is associated with less smoking and drinking, more physical exercise, better self-assessed health, and fewer medical conditions. Unsurprisingly, disparities in

lifespans are also substantial and have increased, primarily because those with high education enjoyed better survival.

Our results are consistent with other studies. For example, Lei et al. document strong educational gradients in self-assessed health, presence of any disability, and in survival expectations (respondents' self-report of possibility of surviving to age 75), using the China Health and Retirement Longitudinal Study (CHARLS) baseline survey, and controlling for per capita expenditures and other economic and location variables.<sup>xii</sup>

In the decades to come, it will become even more important for China to address inequalities in health and education—and in the inter-generational transmission of human capital—because China's development model relies increasingly on innovation and pushing out the global technological frontier.

#### *Inequalities in healthcare and risk protection*

During the health reform era since the beginning of the 21<sup>st</sup> century, China has attained universal health coverage and put in place a series of policies to enhance access to effective medical care while decreasing households' out-of-pocket spending burden. Utilization has greatly increased for healthcare services, especially hospital outpatient department visits and inpatient admissions. The relative decline in utilization at the village or community level has been an unintended consequence, although relatively straightforward to predict: with less of an out-of-pocket burden, patients self-refer to more trusted providers at higher levels, and swell the ranks of those crowding into secondary and tertiary hospitals.<sup>xiii</sup> However, because the insurance coverage of the rural insurance program, the New Cooperative Medical Scheme (NCMS), is less generous than for urban residents and especially relative to insurance for urban employees, the risk of catastrophic medical spending and illness-induced poverty remains higher for rural than urban residents.<sup>xiv</sup>

Recent mergers of insurance risk pools—such as raising NCMS benefit levels to those of the urban resident basic medical insurance—and implementation of catastrophic supplementary insurance within local social health insurance systems are encouraging trends for closing gaps in risk protection. As of the end of 2018, 316.7 million were enrolled in Urban Employees' Basic



Medical Insurance, 897.4 million in Urban-Rural Residents' Basic Medical Insurance, and 130.4 million in "remaining NCMS," according to the National Medical Security Administration. Per capita spending per enrollee ranged from 3,316.7 RMB per urban employee to only 700.3 RMB per person in urban-rural residents' insurance and 627.6 RMB per NCMS enrollee. Thus, urban formal sector employees enjoyed health insurance benefits worth more than 5 times those of rural residents. Closing this gap while continuing to cover new life-saving therapies for all will confront China's medical system with financing challenges for years to come. Ongoing integration of urban residents insurance with remaining NCMS has led to coverage under the "Urban-Rural Residents' Basic Medical Insurance" for the vast majority of Chinese (1.02 billion, according to the NHSA).<sup>xv</sup> However, the level of risk pooling remains local to a given county or municipality, and the level of risk protection they entail still varies widely across localities.<sup>xvi</sup>

Expanding and equalizing catastrophic insurance coverage will be ever more important as medical care technology continues to advance. Breakthrough therapies draw upon increasing biomedical knowledge and "precision medicine" or "personalized therapy" using genetic and other information, especially for cancers but also other major killers. These therapies can be extremely expensive. Providing equitable access to these new treatments poses a challenge for health system financing not only in China, but around the world. Financing experts recommend China explore policies utilized in other middle- and high-income economies, such as expanding the taxation base to assets for health insurance contributions as done in the health systems of South Korea and Taiwan.<sup>xvii</sup> Furthermore, financing long-term care for China's aging population remains a critical issue, building upon ongoing pilots that draw funds from the medical insurance schemes and government allocations in different ways.<sup>xviii</sup>

In addition to expanding insurance coverage, China has put in place multiple policies to address health inequalities. Perhaps most salient was equalization of essential population health services as part of the 2009 national health reforms. Addressing disparities has also been highlighted at the 2016 first national health meeting, in the Healthy China 2030 goals, and in other leadership statements. Such high-level attention is an important first step to continuing progress in reducing disparities. Attention from leadership matters greatly for translating policy rhetoric into effective implementation. To this end, policymakers might consider scaling up policies enhancing local political leadership attention on the vulnerable. For example, in some localities when health

screening detects a low-income resident with serious health problems requiring treatment, then a team including both a local healthcare provider *and* a local official become accountable for making sure that the individual receives appropriate follow-up care. Qingyue Meng and colleagues recommend that local officials' performance evaluations be based in part on local health indicators, among other suggestions.<sup>xix</sup>

The power of the social determinants of health is such that policies outside of the health sector can have greater influence on health and survival than access to medical care. Investments in quantity and quality of schooling may be just as important as health sector investments. As noted, these two dimensions of human capital are reinforcing. For example, with the growing complexity of medical care and importance for self-management for chronic conditions such as diabetes, less educated individuals may be increasingly at a disadvantage in understanding the importance of adherence to medication regimens, dietary adjustments, regular check-ups, and other factors.<sup>xx</sup> Young people received far more education and early-life health investments (nutrition, immunizations, and so on) than their parents and grandparents enjoyed, and should be encouraged to show filial piety by teaching the older generation about healthy lifestyles and investing in their own and the grandchildren's health. High intergenerational human capital growth has several implications for labor force participation and retirement. Educational disparities reinforce health disparities, with those achieving greater educational attainment able to command higher wages, achieve higher lifetime wealth, enjoy more security in retirement while still investing in their children. Healthy aging enables longer working lives and thus also helps to finance the health services that lead to healthy aging (just as longer working lives lead to more sustainable social security/pension financing as well).

Multiple studies have also shown the positive impact of improved old-age security for China's rural elderly by assessing the impact of the rural pension scheme. The new rural pension scheme, although far less generous than urban schemes, enables beneficiaries to take care of own health and medical care and long-term care needs a little better, and to be less dependent on sons and other adult children, perhaps even contributing to reduced mortality.<sup>xxi</sup> Housing and the built environment are also important for health. As China continues to urbanize rapidly, affordable housing and linking to accessible community health services and affordable long-term care services remain challenges.

### *Chronic disease control and healthy aging*

While strengthening infectious disease control, China's primary burdens of morbidity and mortality arise from chronic diseases; thus the focus of much effort to address health inequalities and raise overall population health should be enhancing control of chronic disease.

China has implemented National Demonstration Areas for Comprehensive Prevention and Control of Non-Communicable Diseases, which include some promising ideas for enhancing collaboration across multiple agencies and sectors. Such intersectoral coordination can be critical to address the social determinants health, reduce risk factors, and integrate health education and promotion with effective screening and management of chronic disease.<sup>xxii</sup>

One important step forward for healthy aging would be a renewal of China's commitment to tobacco control, the leading preventable cause of premature mortality. For example, using an earmarked increase in tobacco taxation to invest in health promotion for rural and low-income China would be a win-win policy reform, compensating for the regressivity of such taxation, and perhaps help to close the longevity disparity between men and women as well.<sup>xxiii</sup>

### *Strengthening China's primary health care system*

China's health policies have long supported prevention and primary care, yet as noted above, during the last two decades many reforms had the unintended consequence of promoting hospital-based care rather than primary care. As Professor Meng Qingyue emphasized in his keynote address at a conference on the family doctor system (June 26<sup>th</sup>, 2018 at the Stanford Center at Peking University), increased demand for hospital-based services is an almost inevitable outcome of rising living standards and purchasing power of China's consumers, and their interest in high-quality medical services.

Patients' suspicion of the quality of primary care is certainly not without foundation; well-training physicians are in short supply. Despite efforts to train more general practitioners and enhance primary care, by 2017 only one in ten rural doctors at township health centers had at least five years of medical school (up from 5.6% in 2010).<sup>xxiv</sup> System reforms are needed to put in place the financing and incentives to attract, retain, and motivate qualified physicians, nurses, and other health providers at the primary care level. As highlighted in a recent World Bank report, patient-centered integrated care is one such approach.

Some areas such as Shanghai have implemented a decade or more of variations of the family doctor system and primary-care-based model, gradually gaining the trust and confidence of residents. Xiamen has developed a well-known team-based model that includes a health manager (“*jiankang guanli shi*”) working with a general practitioner (GP) and any specialists the patients may need. Such team-based approaches may expand as the tasks more appropriate for physician assistants (including recordkeeping and basic population health service delivery, follow-up health education and care coordination) are taken over and leave the increasingly well-training primary care physicians with more time to focus on their comparative advantage in clinical management.

Offering a quick and convenient channel for upward referrals to the best urban specialists is one service that patients value. Referral back down to primary care after inpatient treatment has been less systematic, although new forms of provider integration linked to global budgets have given incentives for hospitals to partner with community health centers in follow-up care and rehabilitation. In fact, one of the metrics used by some integrated care systems is whether the number of downward transfers to primary care from hospitals is similar to or greater than the number of upward referrals for hospitalization. Whether improved dual-referrals systematically improve health outcomes while reducing expenditures and out-of-pocket burdens, however, remains unclear.

China’s vibrant e-commerce and digital payment sectors have also been harnessed in preliminary ways to support population health and convenient medical care. In addition to the aforementioned WeDoctor, many local health authorities are also experimenting with iPhone apps to promote healthy lifestyles, self-management of chronic disease, or adherence to clinical recommendations. And many are thinking of ways to enrich the benefit package associated with signing up for the family doctor system, to attract patients into first-contact care at the primary care level. Such services include not only access to specialist referrals when needed but also easier prescription refills, home-based care for the disabled, and so on. Ultimately it will be important to assess whether such programs do achieve better convenience and lower cost without sacrificing quality of care.

Health data platforms and application of AI to healthcare offer many possibilities for deploying big data to support increasing “healthspan” in China (e.g. through appropriate analysis and

decision support tools); but they also must navigate patient privacy and data security issues, assuring that they not exploited for commercial purposes without individuals' consent or official oversight. Here again progress had been rapid, but many issues remain to be addressed.

Unfortunately, there is not yet much rigorous evidence about the impact of improving primary care. Nevertheless, programs such as management of patients with hypertension and diabetes under the essential population health services package may provide a promising way forward. In a recent study with Yiwei Chen and Zhejiang colleagues, we analyze the impact of such a program that gives primary care physicians financial and reputational incentives to identify patients and enroll them in primary care management for their condition.<sup>xxv</sup> We assemble a unique dataset linking administrative and health data at the individual level for all registered residents of a county in Zhejiang province. The data include health insurance claims between 2011 and 2015 and primary care service records for over 70,000 rural Chinese diagnosed with hypertension or diabetes. Our study design utilizes variations in management intensity generated by administrative and geographic boundaries. Utilizing this plausibly exogenous variation, we find that patients residing in a village within a township with more intensive primary care management of chronic disease, compared to neighbors with less intensive management, had more primary care visits, fewer specialist visits, fewer hospital admissions, and lower inpatient spending. No such effects are evident in a placebo treatment year. Exploring the mechanism for reduced specialist and hospital utilization, we find that patients with more intensive primary care management exhibited better drug adherence as measured by medication-in-possession (e.g., the percentage of days in which the patient had a filled anti-hypertensive prescription in 2015).

These results suggest that physician incentives for improved primary care management led to better adherence to medications and primary care visits, and through that pathway reduced inpatient spending. A back-of-the-envelope estimate of welfare suggests that the resource savings from avoided inpatient admissions substantially outweigh the public subsidy costs of the program, even if we ignore the value of any associated improvements in quality of life and survival.<sup>xxvi</sup> Evidence from other programs would be valuable.

#### *Incentives, organization, competition and market power*

One tantalizing set of policy experiments in China involves health alliances or local integrated healthcare organizations based on formal mergers of local government-owned hospitals and

primary care providers. Such integration initiatives may provide health benefits while slowing the rate of expenditure growth, although rigorous evaluation will be needed to see if that is the case. Such integrated care organizations usually unify the drug formulary for different levels of provider, so that patients do not have to go to tertiary hospitals to be prescribed specific medications or renew prescriptions (as had been an unfortunate consequence of the essential medication list policy as implemented in some areas). The next frontier may be in expanding coordination of health services with long-term care services for the elderly and disabled.

In these integrated care system experiments, one challenge will be to find the correct regulatory balance: strict, transparent oversight and regulation can be critical to uphold budget constraints and patient rights as well as to deter malfeasance; but on the other hand, flexibility and autonomy are needed for institutional innovation, and can be well justified as long as the organization is accountable for results. Sometimes the oversight and regulatory structures—such as the personnel employment system (*bianzhi*) or fragmented financing streams—stand in the way of innovations of considerable social value. Some well-intentioned policies lead to unfortunate distortions. For example, controlling spending by constraining per-visit expenditures and per-admission spending may seem intuitive and well designed, but it has unintended consequences: it gives incentive for providers to require more frequent, low-spending visits, with shorter drug prescriptions (and inability to substitute towards treatments that might promote longer-term treatment adherence and health). To avoid undue pressure to distort treatments for the more seriously ill, some places exclude chronic disease patients when reporting per-visit spending, removing the distorted incentives but leaving an incomplete picture of the resource use and effectiveness of cost control. Thus, simple metrics of per-visit or per-admission expenditures are no substitute for rigorous evaluations of whether reforms actually reduce the growth rate of overall medical expenditures.

Healthcare alliances appear promising in some respects, but it is not clear yet what their impact will be overall health outcomes and on disparities. Moving toward prepayment – such as adopting a global budget and/or capitation – does give incentive for prevention and investment in cost-effective settings for management, such as primary care. Yet there is need for balance and careful monitoring, because strong incentives to control medical expenditures also have important unintended effects, including risk selection (turning away expensive-to-treat patients)

and/or under-provision (stinting on care or withholding innovative treatments even when appropriate). The most vulnerable and disadvantaged could be most susceptible to these adverse impacts. Social tensions will also increase if only the rich can afford to “buy out” of under-provision by paying extra for better care. The hard-won trust in primary care could be soon undermined from the opposite direction: rather than (or in addition to) doubting the technical competence of community health centers or village clinics, patients may start to wonder if, in pursuit of lower spending, primary care providers will purposefully withhold referrals up to specialists (or accept a discharge back from a hospital too early). Therefore, reforms toward alternative payment systems and organization forms should be rigorously monitored and evaluated for impact on quality of care and access, especially for the most vulnerable patients.

Moreover, integration of all government-owned providers in a given district or county in effect creates a local monopoly. In such a case, allowing patient choice to go outside the district or county is one of the few remaining options for competitive incentives to promote ongoing creation of public value. Although the role of competition in healthcare is controversial,<sup>xxvii</sup> relatively robust evidence suggests that patient choice (provider competition) in a well-regulated system leads to improvements in quality.<sup>xxviii</sup> Indeed, a famous paper in this literature is entitled “Death by market power,” showing that lack of competition can lead to higher mortality.<sup>xxix</sup> Thus policymakers should be cautious in endorsing claims that local monopoly care organizations can better coordinate care and improve outcomes while controlling spending.

An integrated provider may excel by streamlining services, better coordinating care and investing in efficiency improvements – such as through centralizing procurement, logistics, human resources, and other operations—as well as promoting the appropriate site of care. However, new monitoring and evaluation systems will need to be put into place to make sure these local monopolies live up to social expectations. Those involved may call for mandatory within-network treatment, forced gatekeeping, and not making the local integrated care organization responsible if the empaneled patients seek care elsewhere. While it is true that many health systems have this feature, they also have substantial safeguards in place. There is a social value of allowing patients to “vote with their feet”, even if that means providers cater to patient-observable dimensions of care and not technical quality of care. Evidence from the UK, for example, clearly links competition for patients to hospital management quality.<sup>xxx</sup> When

integrated networks or primary care providers must compete to attract patients with the services they provide, this offers a counterbalance to under-provision, and gives policymakers a key feedback loop for monitoring whether providers are truly meeting people's needs. Moreover, private providers may be squeezed from the market, and without any regulatory structure on ownership and competition or anti-trust, the negative sides of this organizational structure may come to outweigh the benefits if not managed carefully. The success of integrated networks in China will depend on how well policymakers achieve this balance.

Finally, all these policy initiatives may achieve few lasting results unless they are subject to rigorous evaluations, the design of which should be taken into account in the original policy design, and the results of which should guide further incremental reforms.

## **Conclusion**

Equality of opportunity will be even more important as China converges on higher income, slower economic growth, an older age structure, and promotion of innovation to continue raising living standards. Experts across multiple domains have raised red flags about the pressing need for more robust health and retirement security systems and addressing the needs of the most vulnerable, not only because it is the right thing to do but also because lack of such investments may exacerbate social tensions and lead to substantial social strains. China cannot afford to ignore the human capital potential of any of its talented young people. China cannot afford the tensions that could undermine social stability and the “China dream” if the rural, poor, and children of less-educated parents are handicapped by worse health and shorter lives. Carefully designed and thoroughly evaluated policies, including those leveraging artificial intelligence and e-health technologies for prevention and accessible medical care, can support the vulnerable and help to close the health gaps that inhibit full realization of China's potential.

I gratefully acknowledge the excellent research assistance of Yanghe Sha and Rebecca Spencer on the research projects that contributed to the results described in this article.



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<sup>i</sup> For an overview of China's health system reforms, see the June 2019 special collection of articles in BMJ by Professor Qingyue Meng and colleagues of Peking University and their international collaborators, including Meng, Qingyue, Anne Mills, Longde Wang, and Qide Han. "What can we learn from China's health system reform?" *BMJ* 365 (2019): 12349.

<sup>ii</sup> Fang, Hai, Karen Eggleston, Kara Hanson, and Ming Wu. "Enhancing financial protection under China's social health insurance to achieve universal health coverage." *BMJ* 365 (2019): 12378.

<sup>iii</sup> For the latest GBD estimates, see Zhou, Maigeng, Haidong Wang, Xinying Zeng, Peng Yin, Jun Zhu, Wanqing Chen, Xiaohong Li et al. "Mortality, morbidity, and risk factors in China and its provinces, 1990–2017: a systematic analysis for the Global Burden of Disease Study 2017." *The Lancet* (2019). Many other researchers have studied these issues. For but a few examples see discussion in Brixi, Hana, Yan Mu, Beatrice Targa, and David Hipgrave. "Engaging sub-national governments in addressing health equities: challenges and opportunities in China's health system reform." *Health policy and planning* 28, no. 8 (2012): 809-824; or the discussion of health equity progress and challenges in Yang et al. 2018, Tsinghua–Lancet Commission on Healthy Cities in China. [https://www.thelancet.com/journals/lancet/article/PIIS0140-6736\(18\)30486-0/fulltext](https://www.thelancet.com/journals/lancet/article/PIIS0140-6736(18)30486-0/fulltext)

<sup>iv</sup> GBD 2016 Healthcare Access and Quality Collaborators, "Measuring performance on the Healthcare Access and Quality Index for 195 countries and territories and selected subnational locations: a systematic analysis from the Global Burden of Disease Study 2016," *Lancet* 2018; 391: 2236-71.

<sup>v</sup> Data are from the World Bank World Development Indicators. Specifically, the infant and under-5 mortality rates are estimates developed by the UN Inter-agency Group for Child Mortality Estimation (UNICEF, WHO, World Bank, UN DESA Population Division) at [www.childmortality.org](http://www.childmortality.org); and the life expectancy figures come from several sources: (1) United Nations Population Division. World Population Prospects: 2017 Revision. (2) Census reports and other statistical publications from national statistical offices, (3) Eurostat: Demographic Statistics, (4) United Nations Statistical Division. Population and Vital Statistics Report (various years), (5) U.S. Census Bureau: International Database, and (6) Secretariat of the Pacific Community: Statistics and Demography Program.

<sup>vi</sup> See Zhou, Maigeng, et al. "Cause-specific mortality for 240 causes in China during 1990–2013: a systematic subnational analysis for the Global Burden of Disease Study 2013." *The Lancet* 387.10015 (2016): 251-272.

<sup>vii</sup> See for example Wang, Yanping, et al. "Under-5 mortality in 2851 Chinese counties, 1996–2012: a subnational assessment of achieving MDG 4 goals in China." *The Lancet* 387 (2016): 273-283. [http://dx.doi.org/10.1016/S0140-6736\(15\)00554-1](http://dx.doi.org/10.1016/S0140-6736(15)00554-1)

<sup>viii</sup> Bragg F, Holmes MV, Iona A, Guo Y, Du H, Chen Y, Bian Z, Yang L, Herrington W, Bennett D, Turnbull I, Liu Y, Feng S, Chen J, Clarke R, Collins R, Peto R, Li L, Chen Z, 2017. Association Between Diabetes and Cause-Specific Mortality in Rural and Urban Areas of China. *JAMA*. 2017;317(3):280–289. doi:10.1001/jama.2016.19720. Also see Elwell-Sutton, Timothy M., Chao Qiang Jiang, Wei Sen Zhang, Kar Keung Cheng, Tai H. Lam, Gabriel M. Leung, and C. M. Schooling. "Inequality and inequity in access to health care and treatment for chronic conditions in China: the Guangzhou Biobank Cohort Study." *Health policy and planning* 28, no. 5 (2012): 467-479.

<sup>ix</sup> Huang, Wei, et al. "Health, height, height shrinkage, and SES at older ages: evidence from China." *American Economic Journal: Applied Economics* 5.2 (2013): 86-121.

<sup>x</sup> Qiulin Chen, Karen Eggleston, Wei Zhang, Jiaying Zhao, and Sen Zhou, 2017. "The Educational Gradient in Health in China," *The China Quarterly* 230(June 2017): 289-322.

<sup>xi</sup> Data for 2004 suggests that fully 85% of deaths in the construction industry were among migrant workers, who generally have low levels of educational attainment. Yang et al. 2018, Tsinghua–Lancet Commission on Healthy Cities in China. [https://www.thelancet.com/journals/lancet/article/PIIS0140-6736\(18\)30486-0/fulltext](https://www.thelancet.com/journals/lancet/article/PIIS0140-6736(18)30486-0/fulltext).

<sup>xii</sup> Lei, Xiaoyan, Xiaoting Sun, John Strauss, Yaohui Zhao, Gonghuan Yang, Perry Hu, Yisong Hu, and Xiangjun Yin. "Health outcomes and socio-economic status among the mid-aged and elderly in China: Evidence from the CHARLS national baseline data." *The Journal of the Economics of Ageing* 4 (2014): 59-73.

<sup>xiii</sup> For a related discussion, see Duckett, Jane, Kate Hunt, Neil Munro, and Matt Sutton. "Does distrust in providers affect health-care utilization in China?." *Health policy and planning* 31, no. 8 (2016): 1001-1009.

<sup>xiv</sup> Study of NCMS and other health programs provide suggestive but not definitive evidence that they may have contributed to closing the mortality gap between rural and urban China, although the true impact is difficult to untangle from all the other changes affecting survival trends in China; see Maigeng Zhou, Shiwei Liu, Kate Bundorf, Karen Eggleston, and Sen Zhou, 2017. "Mortality in Rural China Declined As Health Insurance Coverage Increased,

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But No Evidence the Two Are Linked,” *Health Affairs* 36(9) (September 2017): 1672–1678. doi: 10.1377/hlthaff.2017.0135.

<sup>xv</sup> *Guojia Yiliao Baozhang Ju* National Medical Security Administration website report for second quarter 2019, [http://www.nhsa.gov.cn/art/2019/7/16/art\\_7\\_1519.html](http://www.nhsa.gov.cn/art/2019/7/16/art_7_1519.html), accessed 31 July 2019.

<sup>xvi</sup> For one perspective on the insurance scheme integration process, see Shan, Linghan, Miaomiao Zhao, Ning Ning, Yanhua Hao, Ye Li, Libo Liang, Zheng Kang et al. "Dissatisfaction with current integration reforms of health insurance schemes in China: are they a success and what matters?" *Health policy and planning* 33, no. 3 (2018): 345-354.

<sup>xvii</sup> Also see discussion (in Chinese) in XIE, Ming-ming, and Ming-lai ZHU. "A Study of the Threshold Effect of Medical Insurance on Medical Expenses." *Journal of Jiangxi University of Finance and Economics* 4 (2016): 8; and ZHU, Minglai, and Xinliang YU. "Tax Incentives' Impacts on Health Insurance Purchase Willingness." *Insurance Studies* 2 (2015): 8.

<sup>xviii</sup> See discussion of the latest policy updates by the National Medical Security Administration at [http://www.nhsa.gov.cn/art/2019/8/1/art\\_26\\_1604.html](http://www.nhsa.gov.cn/art/2019/8/1/art_26_1604.html) [accessed August 1, 2019].

<sup>xix</sup> See aforementioned BMJ collection of June 2019 on ten years of health system reforms in the PRC.

<sup>xx</sup> Goldman, Dana, and James Smith. 2002. "Can patient self-management help explain the SES health gradient?" *Proceedings of the National Academy of Sciences* 99(16), 10929-10934.

<sup>xxi</sup> See for example "The Power of Social Pensions" by Wei Huang, National University of Singapore, and Chuanchuan Zhang, Central University of Finance and Economics, presented at the NBER-SAIF conference on retirement security, Shanghai, PRC, June 30, 2018; Xi Chen, Karen Eggleston, and Ang Sun, 2017. "The Impact of Social Pensions on Intergenerational Relationships: Comparative Evidence from China," *The Journal of the Economics of Ageing*. <http://dx.doi.org/10.1016/j.jeoa.2017.04.001>; and Karen Eggleston, Ang Sun, and Zhaoguo Zhan, 2016. "The Impact of Rural Pensions in China on Labor Migration." *World Bank Economic Review* July 2016: DOI: 10.1093/WBER/LHW032.

<sup>xxii</sup> See for example the April 2018 issue of *Chinese Journal of Epidemiology* (Volume 39 Number 4) for a collection of articles evaluating various aspects of the National Demonstration Areas for Comprehensive Prevention and Control of Non-Communicable Diseases, and the chapter by Dong Jianqun and colleagues forthcoming in *Healthy Aging in Asia in Comparative Perspective: Assessing the Net Value of Chronic Disease Management* edited by Karen Eggleston (Stanford Shorenstein Asia-Pacific Research Center series distributed through Brookings Institution Press, 2019).

<sup>xxiii</sup> For more discussion on tobacco taxation and the political economy of this industry in China, see *Poisonous Pandas: Chinese Cigarette Manufacturing in Critical Historical Perspectives*, edited by Matthew Kohrman, Gan Quan, Liu Wennan, and Robert N. Proctor, Stanford University Press, Stanford, California, 2018.

<sup>xxiv</sup> Qingyue Meng and colleagues BMJ 2019.

<sup>xxv</sup> Yiwei Chen, Hui Ding, Min Yu, Jieming Zhong, Ruying Hu, Haibin Wu, Xiangyu Chen, Chunmei Wang, Kaixu Xie, and Karen Eggleston, "The effects of primary care chronic disease management in rural China," paper presented at the 2018 American Society of Health Economists 7<sup>th</sup> annual conference, Emory University, Atlanta, US, June 12, 2018.

<sup>xxvi</sup> Yiwei Chen, Hui Ding, Min Yu, Jieming Zhong, Ruying Hu, Haibin Wu, Xiangyu Chen, Chunmei Wang, Kaixu Xie, and Karen Eggleston, "The effects of primary care chronic disease management in rural China," paper presented at the 2018 American Society of Health Economists 7<sup>th</sup> annual conference, Emory University, Atlanta, US, June 12, 2018.

<sup>xxvii</sup> See the excellent review by Martin Gaynor and Robert J. Town. "Competition in health care markets." *Handbook of health economics*. Vol. 2. Elsevier, 2011. 499-637.

<sup>xxviii</sup> See for example the keynote address by Carol Propper at the International Health Economics Association 2017 congress (Saturday, July 8, Opening Plenary: "The usefulness of competition and choice in heavily regulated markets," available at <https://www.healtheconomics.org/page/SessionRecordings> [accessed July 4, 2018]) and Cooper, Zack, Stephen Gibbons, Simon Jones, and Alistair McGuire. "Does hospital competition save lives? Evidence from the English NHS patient choice reforms." *The Economic Journal* 121, no. 554 (2011): F228-F260.

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<sup>xxix</sup> Gaynor, Martin, Rodrigo Moreno-Serra, and Carol Propper. "Death by market power: reform, competition, and patient outcomes in the National Health Service." *American Economic Journal: Economic Policy* 5.4 (2013): 134-66.

<sup>xxx</sup>Bloom, Nicholas, et al. "The impact of competition on management quality: evidence from public hospitals." *The Review of Economic Studies* 82.2 (2015): 457-489.