

The primary health-care system in China

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1 **Primary Health Care System in China: Rising to the Challenges of**
2 **Increasing Chronic Non-Communicable Diseases**

3

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18

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20

1 **Summary**

2 China has made remarkable progress in strengthening its primary health care system.
3 Nevertheless, the system still faces challenges in structural characteristics, incentives and
4 policies, and quality of care, which diminish its preparedness to care for one fifth of the
5 world’s population with an aging issue and a growing prevalence of chronic
6 non-communicable disease. These challenges include: inadequate education and qualifications
7 in its workforce, aging and turnover among village doctors; fragmented health information
8 technology systems and a paucity of digital data on everyday clinical practice; financial
9 subsidies and incentives that fail to encourage cost savings and good performance; insurance
10 policies that hamper the efficiency of care delivery; and a lack of a quality measurement and
11 improvement system and poor control of risk factors, such as hypertension and diabetes. As
12 China is deepening its health care reform, it has the opportunity to build an integrated,
13 cooperative primary health care system using sound evidence and comprehensive action plans,
14 bolstered by evidence-based performance indicators and incentives.

15

16

Panel 1: Key messages

1. The primary health care system in China had contributed substantially to a reduction in the burden of diseases and helped to advance the global primary health care movement. Since the launch of the health care reform in 2009, access to and affordability of primary health care have been significantly improved through a series of national efforts, including increased government funding, universal health insurance coverage, and implementation of the basic public health service program and an essential drug system. There remain, however, many challenges.
2. Primary health care doctors in China have low levels of training, commonly lack certification, and experience high rates of burnout. Primary health care professionals are paid low wages and not provided with many job-related social benefits. Moreover, the payment policies do not reward the delivery of high-quality care. Many younger doctors are considering leaving the profession, and a large proportion of doctors in village clinics are past retirement age.
3. Application of information technology (IT) is fragmented, with IT systems for clinical care often unavailable and for those that are available, it is not interoperable. In addition, IT systems for public health service are rarely leveraged in clinical practice. The resulting lack of linked digital data impedes the implementation of decision support and the accurate and timely generation of evidence from everyday primary health care practice.
4. In China's new health care reform, government subsidies are not enough to offset the decline in revenue from drug prescriptions at primary health care institutions, since the institutions are no longer allowed to charge mark-ups above cost of drugs, which might have diminished the incentive to deliver appropriate clinical care.
5. Many health insurance policies provide more generous reimbursement for inpatient care relative to primary health care or outpatient care, which incentivize patients to use the hospital for even minor health conditions and inhibit primary health care providers from

being gatekeepers.

6. The quality of primary health care in China has, in general, been poorly characterized.

In the management of hypertension and diabetes in primary health care settings, there is evidence that only a minority of patients in China are being diagnosed, and among the diagnosed patients, a small number achieve the risk control targets. In addition, inappropriate prescribing is commonly practised in primary health care institutions.

7. The wide range of challenges for primary health care in China requires comprehensive strategies. “The Healthy China 2030 Plan”, a government blueprint, highlighted the important role of primary health care and could provide opportunities to strengthen the primary health care system. Nevertheless, recommendations linked to resources and evidence-based indicators are needed for the implementation.

1

2 **Introduction**

3 The primary health care system in China, which provides basic clinical care and public
4 health services to a fifth of the world’s population, has a notable history. Since its
5 establishment in the early 1950s, it has contributed substantially to a reduction in the burden
6 of communicable, maternal, and neonatal diseases through the 1960s and 1970s,^{1,2} and helped
7 to advance the global primary health care movement enshrined in the Declaration of
8 Alma-Ata in 1978.³ In subsequent decades, this system experienced significant challenges
9 after the market-based reforms in healthcare sector,^{4,5} including inadequate government
10 funding⁶ and weakening of the support of public healthcare providers.⁷ These policy changes
11 led to unintended consequences such as surging costs,⁸ diminished access to care,⁸ widening
12 inequities,⁹ and an erosion of the healthcare workforce.^{10, 11}

13 As part of China’s new health care reform, initiated in 2009,¹² the government
14 increased its subsidies to primary health care institutions from 19 billion RMB (2.8 billion
15 USD) in 2008 to 140 billion RMB (20.3 billion USD) in 2015.^{1, 13} In addition, the government
16 instituted universal health insurance coverage,¹⁰ a basic public health service program,¹⁴ and a

1 national essential drug system,^{15, 16} which improved access to and affordability of primary
2 health care.¹⁷ Acknowledging the increasing pressure exerted by an aging population,
3 behavioural changes,¹⁸ and rapid urbanization,¹⁹ the recent government blueprint “The
4 Healthy China 2030 Plan”²⁰ envisions the primary health care system as a means of
5 addressing the emerging dual burden of growing chronic non-communicable diseases
6 (NCDs)²¹⁻²³ and rising health expenditures.¹ Despite the importance of primary health care in
7 China and its recent reforms, there is a lack of knowledge on both the current system and the
8 impact of recent policy changes.

9 The aim of this review is to evaluate the primary health care system and provide a
10 foundation for policy and practice improvements to ensure efficient delivery of high-quality
11 primary health care, particularly to tackle chronic NCDs. We sought to assess the current state
12 of evidence related to the primary health care system in China, with specific attention towards
13 identifying the challenges in structural characteristics, incentives and policy, and quality of
14 care, according to an assessment framework designed for primary health care system
15 assessment.²⁴ We employed the following methods: narrative literature review of both
16 published and grey literature (Panel 2); a quantitative data analysis of results from a recent
17 national survey of primary health care administrators, providers and patients (Appendix 2);
18 and interviews with national experts to interpret themes that emerged from the literature
19 review and the survey.

20

Panel 2: Search strategies

We searched the PubMed/Medline (1966-2017) and CNKI (China National Knowledge Infrastructure) database in July 2016 to identify relevant studies on seven domains of primary health care (structural, human resources, electronic health record system, financial, insurance, medications, and quality of care) in China. In PubMed/Medline (1966-2017), we used MeSH and free text terms in conjunction to increase sensitivity to potentially appropriate literature. The MeSH terms include "Primary Health Care", "General Practice", "General Practitioners", "Physicians, Family ",

"Community Health Services", "Delivery of Health Care", and terms for each specific domain. Search terms and all their possible synonyms and spellings were identified and used in the search strategy (Appendix 1). Our reference list was modified according to the length limitation.

1

2 **Structural Characteristics**

3 **Infrastructures, Professionals and Services**

4 According to the Declaration of Alma-Ata,²⁵ the primary health care system is designed
5 to provide universally accessible essential health care to individuals and families in the
6 community, as the first level of contact with the national health system. In China, the primary
7 health care system provides generalist clinical care and basic public health services.

8 Primary health care institutions provided 55.1% of outpatient care (4.4 billion visits)
9 and 18.3% of inpatient care (41.7 million hospitalizations) in China in 2016,²⁶ mainly for
10 common clinical conditions (Appendix 4). Clinical care capabilities vary substantially across
11 primary health care institutions. Among the 3602 institutions in our survey, 51.9% (109/210)
12 of community health centres and 84.6% (248/293) of township health centres provided
13 inpatient care, and among these, the median number of beds was 40 [interquartile range (IQR):
14 27-59] and 35.5 (IQR: 19.5-60), respectively. Overall, 46.7% (98/210) of community health
15 centres and 69.6% (204/293) of township health centres had an internal medicine department,
16 38.1% (80/210) and 63.8% (187/293) had a surgery department, and 21.9% (46/210) and
17 47.1% (138/293) had an emergency department. In addition, traditional Chinese medicine
18 (TCM) is widely provided (Panel 3): 76.2% (160/210) of community health centres and 68.6%
19 (201/293) township health centres have a specific TCM department. There were 4.8% (10/210)
20 of community health centres and 9.6% (28/293) of township health centres that could not
21 provide routine blood tests, urine tests, or electrocardiography. Additionally, about two thirds
22 of community health centres and township health centres could not provide chest X-rays.
23 Village clinics demonstrated an even lower coverage of basic clinical tests, where 96.0%

1 (2535/2642) and 90.5% (2391/2642) were not capable of routine blood and urine testing,
2 respectively, and 31.0% (819/2642) and 95.8% (2532/2642) could not provide blood glucose
3 and lipid tests.

4 With respect to government-sponsored basic public health services (Panel 3),
5 community health centres and township health centres take more responsibilities than the
6 institutions one level below them. Meanwhile between community health stations and village
7 clinics, the latter were more commonly involved in these programs (Appendix 5).

8

Panel 3: Definitions and background

Hierarchy of primary health care institutions

The primary health care system in China is divided into urban and rural components, which are organized differently. In 2016, urban components include approximately 9000 community health centres (93% are publicly owned) and, one level below them, 25,000 community health stations (71% are publicly owned); rural components include approximately 37,000 township health centres (99% are publicly owned) and, one level below them, 639,000 village clinics (63% are publicly owned).^{1, 26} In urban areas, the community health stations function as satellite sites of the community health centres. In contrast, in rural areas, village clinics are more independent and have a less formal relationship with the township health centres above them, even though village clinics function as for-profit entities with revenue generated primarily from government subsidies, mainly through the health insurance programs and basic public health service program.

Training and qualification of primary health care doctors

Formal medical training for primary health care doctors has 3 levels: (a) medical college (5 years of medical education after 12 years of primary and secondary education to get a bachelor's degree of medicine); (b) junior medical college (3 years of medical education after 12 years of primary and secondary education); and (c) technical school (3 years of medical education after 9 years of primary and secondary education). Medical

college or junior medical college training is required to become a licensed doctor or a licensed assistant doctor, respectively, both of whom also need to pass the National Practicing Doctor (or Assistant Doctor) Examination and periodic government assessments. Meanwhile, village doctors, with technical school education or continuous practicing experience for more than 20 years in village clinics, are permitted by local health authorities to work only in village clinics with a “village doctor certificate”, rather than a regular license. In 2015, there were about 360,000 licensed doctors or licensed assistant doctors in urban areas, as well as 740,000 licensed doctors or licensed assistant doctors, and 960,000 village doctors in rural areas.¹ There are still unlicensed individuals practicing in urban and rural primary health care institutions.

National basic public health service program

A principal function of the primary health care system in China is to implement basic public health service that aims for equity in access. These services funded by the government and provided all residents for free, regardless of their Hukou. In 2014, Chinese government issued official guidance emphasizing that PHC institutions have the responsibility to provide basic health services to the migrants. For the migrants, they can receive all basic public health services from the PHC institutions in the locations where they work (not just where they are from). The services include vaccination, health education, child health management, maternal health care, elderly health management, TCM health management, reporting of infectious diseases and public health emergencies, and management for hypertension, type 2 diabetes, psychosis and tuberculosis (Appendix 3). However, allied health services that play an important role in wide range of health maintenance have not been fully integrated into the primary health care in China – there is very little information about their use besides the health management and education within the basic public health service program.²⁷ The disease control and prevention agencies, who are in charge of capacity building and performance evaluation for the basic public health service, also provide technical support to primary health care institutions involved in the program.

Traditional Chinese medicine in primary health care system

In China's primary health care system, there are consistent national policies emphasizing equal attention to and the complementary advantages of the traditional Chinese medicine (TCM) and western medicine.²⁸ TCM care is widely provided in primary health care institutions (i.e. 97.5% of community health centres and 94.3% of township health centres in 2016),²⁶ often jointly with western medicine care. On the other hand, TCM health management was specified by the government as one of the national basic public health services. It includes TCM health check and education for residents aged over 65 years or below 3 years.

Financing policies for primary health care

The national policy of “separation between revenue and expenses” in primary health care institutions requires that all government-owned institutions turn in their revenue to the government, while in return, the government provides full subsidies for all of their expenses.^{29,30} This policy created incentives similar to those of the “iron rice bowl” policy (occupation with guaranteed job security and benefits) and has contributed to low productivity in primary health care institutions. Since 2015, some provinces have gradually eliminated the policy. In addition, in an effort to reduce primary health care institutions' incentives to prescribe unnecessary drugs, the government introduced the “zero drug mark-up” policy as part of the national essential drug system.³¹ Under this system, primary health care providers have to sell drugs at cost without including a mark-up.

Social health insurance programs

Social health insurance programs have successfully covered more than 97% of residents in China.^{17,32} There are three social health insurance programs. They are the Urban Employee-Based Medical Insurance (UEBMI), the New Cooperative Medical Scheme (NCMS), and the Urban Resident-Based Medical Insurance (URBMI), established in 1998, 2003, and 2007 respectively. While funds for the two urban programs are pooled at the municipality level, those for NCMS are pooled at the county level. According to

recent national policies, NCMS and URBMI are in the process of merging.^{33,34} Insurance policies, including reimbursement rates, deductibles, and annual caps, vary across regions. Deductibles are the amount paid out-of-pocket for covered health care services before the insurer (i.e. specific government agencies for these programs) starts to reimburse expenses. Annual caps are the maximum amount that the insurer can reimburse per insured individual (or household) each year. Reimbursement rates are the proportion of expenditures the insurer reimburses until the cap is reached.

1

2 **Workforce**

3 Primary health care requires multidisciplinary professional teams, which consist of
4 doctors, nurses, pharmacists, and other health workers. Despite being the backbone of the
5 primary health care workforce, primary health care doctors in China are unevenly distributed
6 across the country, and often inadequately trained. Moreover, these doctors are substantially
7 underpaid, often have no legally mandated social benefits, and are commonly burned out.
8 Village doctors are an older group and commonly report intentions to quit practice.

9 While the number of primary health care professionals is increasing, the regional
10 distribution of primary health care doctors is uneven. Since the new health care reform in
11 2009, the number of primary health care doctors (about 1,730,000) in the four types of
12 institutions has been increasing by 3·3% annually. The annual increases are larger for nurses
13 (9·9%, approximately 472,000 in 2015), but smaller for pharmacists (3·1%, about 109,000 in
14 2015).^{1,13} However, similarly with the substantial disparities in the distribution of doctors in
15 the entire health care system,³⁵ in the primary health care system, there was a two-fold
16 difference across provinces in the number of licensed doctors or licensed assistant doctors per
17 1000 population (from 0·52 to 1·13), and a sixteen-fold difference for village doctors in rural
18 settings (from 0·24 to 3·90) (Figure 1).¹

19 Significant gaps exist in the licensure and education of primary health care doctors,
20 with variation across regions. Similar to results from prior studies,³⁶ our survey revealed that
21 20·9% (1510/7241) of “doctors” practicing in community health centres, township health

1 centres, or community health stations were neither a licensed doctor nor licensed assistant
2 doctor, with a larger proportion in less developed regions [32.7% (773/2361) in Western
3 regions] and an even greater figure for community health stations [37.4% (328/876),
4 P<0.001], even though unlicensed individuals are prohibited to practice by law. *The China*
5 *Health and Family Planning Statistical Yearbook*, from the National Health and Family
6 Planning Commission, reported that in village clinics, 24.4% of doctors held a regular license
7 in 2015,¹ compared with 14.4% in 2010.³⁷ However, in community health centres, township
8 health centres, or community health stations, 30.8% of the doctors' educational levels were
9 below the requirement for licensed assistant doctor (junior medical college), while in village
10 clinics, 12.3% of doctors' educational levels were below the requirement for village doctors
11 (3 years of technical school education after 9 years of primary and secondary education).
12 Continuing education for primary health care doctors is also insufficient. Although annual
13 training is required by authorities, 35.5% (3775/10626) of the primary health care doctors in
14 our survey had received no continuing training courses during the past year, with an even
15 higher rate in Western regions [44.4% (1518/3418)]. Moreover, more than a third of primary
16 health care professionals who received continuing training found that the courses were too
17 short and provided insufficient practice.

18 The pay for primary health care professionals is low, and they often do not receive
19 legally mandated social benefits. In community health centres, community health stations, or
20 township health centres, for doctors with junior professional title, who typically have 2 to 10
21 years of clinical practice experience after graduating from medical college, our survey found a
22 median annual income of 48,000 (IQR: 35,000-65,000) RMB [6969 (IQR: 5081-9437) USD],
23 ranging from 35,000 (IQR: 29,000-45,000) RMB [5081 (IQR: 4210-6533) USD] in the
24 Central regions to 60,000 (IQR: 49,342-83,291) RMB [8711 (IQR: 7163-12,029) USD] in
25 Eastern regions. In village clinics, the figure was much lower: 25,000 (20,000-37,000) RMB
26 [3630 (IQR: 2904-5372) USD]. These figures, consistent with those from prior studies,³⁸⁻⁴⁰
27 are much lower than the income of average employees (62,029 RMB, 9000 USD) in China.⁴¹
28 Compared with general practitioners in the Organization for Economic Cooperation and
29 Development member countries, whose average income is two times higher than that of

1 average employees,⁴² financial incentives are limited for primary health care doctors in China.
2 A prior study noted that 37·5% of 121 doctors in community health centres or community
3 health stations and 62·8% of 180 doctors in township health centres had no pensions,⁴³
4 although the level varied significantly across regions.³⁹ Among community health centres,
5 community health stations, and township health centres in our survey, 22·5% (216/960) do
6 not provide their employees any of the five social benefits mandated by the Chinese
7 government, including pension, health insurance, unemployment insurance, occupational
8 injury insurance, and housing funds. Even in the more affluent Eastern regions, the percentage
9 of employees lacking legally mandated social benefits remained considerable [7·8% (30/386)].
10 Among village clinics, 74·9% (1978/2642) offered no legally mandated social benefit for
11 employees (Figure 2).

12 Low job satisfaction and high occupational burnout also are widespread. The 2011
13 China Primary Care Workforce Survey showed overall job satisfaction of 47·6% among 823
14 primary health care professionals.⁴⁴ As noted in previous studies,⁴⁵⁻⁴⁸ income, social benefits,
15 and career development paths were the areas of lowest satisfaction among this workforce.⁴⁹ A
16 recent systematic review of 13 studies showed a decline in job satisfaction among urban
17 primary health care professionals after the new health care reform starting in 2009.⁵⁰ In
18 addition, as a few previous studies have shown,⁴³ our survey revealed that 40·5%
19 (4307/10626), 37·4% (3974/10626), and 34·0% (3616/10626) of primary health care doctors
20 felt highly exhausted, highly depersonalized, and a high lack of personal accomplishment,
21 respectively. Village doctors, particularly young and middle-age ones, were more likely to
22 report “high lack of personal accomplishment” than their counterparts in other primary health
23 care institutions (45·7% (1546/3385) vs. 28·6% (2070/7241), $P<0\cdot001$).

24 A significant threat to the workforce is the high rate of turnover intention among
25 primary health care doctors, particularly in village clinics. Specifically, according to prior
26 studies identified in our literature review, 56·3% (139/247) of doctors in community health
27 centres,⁵¹ 38·8% (31/80) in community health stations,⁵¹ 34·0% (137/403) in township health
28 centres,⁴³ and 36·8% (695/1889) in village clinics,⁵² were thinking about quitting their jobs.
29 This is also found to be more common among those of younger age or with higher

1 education.^{43, 51} Not surprisingly, the underlying reasons included insufficient remuneration,
2 low job security, and an unclear career development path.⁵² Our survey showed a similar
3 finding that 29·5% (1000/3385) of village doctors reported the intention to quit their jobs. The
4 rate was much higher for young or middle-age doctors (31·3% (636/2035) among those aged
5 <50 years vs. 27·0% (364/1350) among those aged ≥50 years, P=0·007) and among those
6 with a higher level of education (31·2% (814/2607) for technical school or above vs. 23·9%
7 (186/778) for high school or below, P<0·001).

8 Aging of doctors in village clinics could also threaten the primary health care
9 workforce. The *China Health and Family Planning Statistical Yearbook* reported that more
10 than one fifth of village doctors were older than 60 years. Older doctors in village clinics are
11 present in a much higher percentage than for doctors in community health centres (9%) or
12 township health centres (6%).¹ In our survey, the median age was 47 years (IQR: 41-57) for
13 village doctors and 39 years (IQR: 32-46) for doctors in community health centres or
14 township health centres (P<0·001). Overall, 20·7% (700/3385) of village doctors have already
15 exceeded the officially predefined retirement age in China (60 for male and 55 for female),
16 compared with 3·6% (231/6365) of the doctors in community health centres or township
17 health centres (P<0·001).

18

19 **Information Technology Systems and Digital Data**

20 Health information technology (IT) systems for clinical care and basic public health
21 services in China are essential for continuity and coordination of primary health care.
22 Currently, the two systems are separated. IT systems for clinical care are commonly
23 unavailable or are functionally fragmented, whereas the systems for basic public health
24 services are centrally deployed and widely available in primary health care settings. As such,
25 the two systems are rarely linked or interoperable. The resulting paucity of digital data
26 impedes the generation of evidence from everyday primary health care practice.

27 Fragmentation in IT availability and support has constrained the efficient delivery of
28 clinical care within China's primary health care system. Our literature review identified two

1 studies on IT support for clinical care in community health centres or township health centres;
2 findings from both demonstrated that interoperability of the systems was poor.^{53, 54} We found
3 no published studies on IT systems in village clinics in China. Our survey data identified a
4 much wider range of challenges. First, IT systems are not commonly used in primary health
5 care institutions: 54.5% (114/209) of community health centres and 51.0% (146/286) of
6 township health centres had no electronic medical record (EMR) system, and the lack of IT
7 penetration was much worse in village clinics [92.2% (2381/2582)]. Moreover, among village
8 clinics with EMR systems, 39.0% (119/305) of village doctors did not routinely use the
9 system, either because they did not know how to use it or they found it inconvenient to use. In
10 addition, development and deployment of clinical IT systems in primary health care
11 institutions were highly decentralized, without standardized data structures or definitions, or
12 protocols to ensure integration and interoperability. In primary health care institutions with
13 EMR systems, the systems were provided by more than 80 different IT vendors. However,
14 only 40.0% (38/95) of the community health centres and 21.4% (30/140) of the township
15 health centres can link their systems with hospitals in order to facilitate patient referrals.

16 IT systems are often used in rural and urban primary health care institutions for the
17 purpose of collecting public health data in a standardized digital format. Since the launch of
18 the basic public health service program in 2009, the Chinese national Center for Disease
19 Prevention and Control developed and deployed a series of IT systems that cover all
20 community health centres and township health centres, including systems for the Infectious
21 Diseases and Public Health Emergencies Report, and Health Management for Psychosis. In
22 addition, 96.5% (985/1021) of community health centres and 94.6% (1588/1679) of township
23 health centres in prior surveys,⁵⁵ and 94.3% (197/209) of community health centres and 86.0%
24 (246/286) of township health centres in our survey, were using the Resident Health Records
25 System. This is another national basic public health service that documents the history of
26 common chronic NCDs and the relevant treatment of individuals in each local household. An
27 important role of the system is health data management, including tracking individuals' health
28 status and treatment. However, the systems were rarely integrated with delivery of clinical
29 care, and these health data were rarely leveraged in clinical practice.

1 We found no studies on the use of decision support and telemedicine in primary health
2 care institutions in China, with the exception of one ongoing trial.⁵⁶ This demonstrates that
3 China is still at a very early stage in leveraging innovative IT strategies, expanding expertise,
4 and improving performance.

6 **Incentives and Financing Policies**

7 **Financing Policies and Incentives for Care Providers**

8 Despite increased government subsidies for primary health care institutions since
9 China's 2009 reform, their income associated with clinical care has sharply declined, which
10 created challenges to the clinical care delivery in primary health care system. Moreover,
11 incentive policies for primary health care professionals do not reward high-quality clinical
12 care.

13 Since China's market-oriented health care reform in the 1980's, primary health care
14 providers have relied heavily on drug revenue as source of income. Providers were allowed to
15 charge a 15% mark-up on drug sales, leading to incentives to over-prescribe drugs. To reduce
16 primary health care providers' reliance on drug income and incentives on prescribing
17 unnecessary drugs, the government has been increasing its total subsidy for primary health
18 care institutions by 30% every year since 2009.⁵⁷ It also instituted the policies of "zero drug
19 mark-up" and "separation between revenue and expenses" (Panel 3).⁵⁸ These policies have
20 substantially affected primary health care institutions' financial incomes. From 2008 to 2015,
21 the share of government subsidies in total income increased from 18.3% to 34.6% in
22 community health centres and from 17.3% to 44.0% in township health centres, accompanied
23 by dramatic declines in the share of clinical care income, from 77.4% to 59.4% in community
24 health centres and from 81.6% to 52.6% in township health centres.^{1, 13}

25 Prior studies have suggested that, because mark-ups in drug sales are now prohibited,
26 community health centres and township health centres have experienced declines in drug
27 income of about 40% through 2011.^{59, 60} To compensate for these income losses, the

1 government has introduced other funding mechanisms, mainly by subsidizing the use of
2 essential drugs.⁶¹ However, these steps appear insufficient for two major reasons. First, the
3 subsidies are trivial compared with prior drug profits.⁶² Second, the amount of the essential
4 drug subsidy is usually not linked to the quantity or quality of clinical care provided by the
5 institutions.⁶¹

6 Changes in financing policies have also caused unintended consequences. Prior studies
7 showed that some primary health care institutions tried to offset reductions in drug revenue
8 with earnings from other channels, such as unnecessary intravenous infusion therapy or
9 inpatient care.^{59, 63} Other institutions were inclined to provide basic public health services,
10 rather than clinical care, since they can get more subsidies from the basic public health service
11 program. Some of them seek to minimize the amount of clinical care they do, resulting in
12 patients going to hospitals without clinical need.^{63, 64}

13 Prior studies suggest that performance appraisal mechanisms for individual primary
14 health care professionals have failed to encourage delivery of high-quality clinical care.⁶⁵⁻⁷⁰
15 Our survey demonstrated that payments for primary health care doctors do not reward quality.
16 The bonuses for primary health care doctors that constitute 30% (IQR: 20·0-50·0%) of their
17 income could have played a key role in incentivizing quality of care. However, across
18 institutions, these bonuses were most often determined by the quantity of care delivered rather
19 than the quality (Figure 3).

20

21 **Insurance Policies for Care Consumers**

22 Current social health insurance policies, which still largely provide limited coverage for
23 primary health care or outpatient care, through setting low annual caps for total
24 reimbursement, lead to over-use of hospital services even for minor health conditions and
25 have inhibited primary health care providers from effectively playing the role of gatekeeping.
26 This makes it difficult to achieve China's goals of system integration and cost savings.

27 In the social health insurance programs (Panel 3), benefit package (i.e. what services

1 are covered), reimbursement rates and caps affect patients' care-seeking behavior. Prior
2 studies suggest that primary health care-oriented health insurance programs may encourage
3 patients to go to primary health care institutions for their outpatient care.^{71, 72} This goal is
4 particularly important because the cost per outpatient visit at primary health care institutions
5 is only two-fifths of the cost at secondary hospitals and one-quarter of the cost at tertiary
6 hospitals.¹ A study suggested that an increase of 1 USD in outpatient expenditures could lead
7 to a decrease of 6 USD in inpatient expenditures.⁷³

8 In our survey, among the 67 rural sites in our survey, the New Cooperative Medical
9 Scheme (NCMS) on average have higher reimbursement rates for outpatient care than for
10 secondary or tertiary hospitals in 2016 [85% (IQR: 75%-90%) vs. 70% (IQR: 65%-80%) or
11 55% (IQR: 50%-62%), both $P < 0.001$]. However, the effects on patients' financial risk and
12 demand for services have largely been limited by the low reimbursement caps. On average in
13 2016, one patient can get no more than 39 (IQR: 15-58) USD reimbursed annually by NCMS
14 for outpatient care in primary health care institutions, which can cover only 3 to 5 typical
15 outpatient visits [60-98 RMB (9-14 USD) per visit].¹ After the limited annual caps were
16 reached, patients with minor health conditions may choose to go to secondary and tertiary
17 hospitals for outpatient care, particularly when there were specific reimbursement caps for
18 outpatient care in hospitals that were higher than in primary health care institutions (Table 1).
19 On the other hand, the limited reimbursement caps for outpatient care in primary health care
20 institutions could also lead to inappropriate hospital utilization for inpatient and outpatient
21 services,⁷⁴ particularly when the reimbursement rate for inpatient care was relatively high
22 (Table 1). In essence, the government subsidizes hospital care, inpatient and outpatient,
23 instead of favoring the delivery of care in primary health care institutions.

24

25

26 **Quality of Care**

27 The quality of primary health care in China, in general, is poorly characterized. Some

1 evidence, however, points to significant quality gaps in processes and outcomes.

2 There were few studies on the quality of primary health care with respect to outcome
3 measures. Our survey revealed substantial gaps in the management of hypertension and
4 diabetes, two conditions heavily prioritized in the national basic public health service
5 programs. For example, among participants with hypertension who received care from
6 primary health care institutions in a community-based population cohort,⁷⁵ only 69·6%
7 (8539/12,264) knew they had hypertension and only 5·8% (707/12,264) had their blood
8 pressure controlled (<140/90 mm Hg). The conditions were equally bad or even worse in
9 comparison with the hypertensive patients who sought care only from hospitals (67·6%
10 (6435/9517) diagnosed and 7·3% (699/9517) achieved <140/90 mm Hg). These results were
11 but much lower than what has been found in the US (84·3% diagnosed, and 51·8%
12 controlled)⁷⁶. Findings were similar among people with diabetes: only 46·4% (2095/4515) of
13 those usually seeking care from primary health care institutions were diagnosed, and 3·0%
14 (134/4515) had their blood glucose controlled (fasting glucose <7·0 mmol/L), while 53·9%
15 (1889/3502) diagnosed and 5·3% (184/3502) controlled among patients seeking care only
16 from hospitals. This performance is much poorer than in the US (86·8% and 58·8%,
17 respectively).

18 Our literature review revealed consistent gaps in the quality of care according to
19 process measures. A prior incognito standardized patient study in 36 village clinics in the
20 Western regions of China found that 41% of diagnoses were wrong, and 64% of the
21 treatments were unnecessary or harmful.⁷⁷ In addition, a systematic review summarizing 24
22 studies published from 2000 through 2012, showed that the overall weighted average
23 proportion of antibiotic use was 53% among 326,486 outpatient prescriptions from
24 community health centres and township health centres in China, and that more than 15% of
25 prescriptions included more than one antibiotic.⁷⁸ The proportion of antibiotic use was much
26 higher than the performance standard recommended by the World Health Organization (WHO)
27 (30%).⁷⁹ In 14 more recently published studies, involving 2,038,872 outpatient prescriptions,
28 the proportions of antibiotic use ranged from 30% to 85%, with an overall weighted average
29 of 45%.⁸⁰⁻⁹³ The proportions of prescriptions with more than one antibiotic ranged from 10%

1 to 25% (Appendix 6).^{81, 82, 87, 93, 94} In addition, we searched for and reviewed 16 studies on the
2 use of intravenous or intramuscular injections published after 2009, involving 1,051,136
3 prescriptions in primary health care institutions. The proportions of prescriptions that included
4 injections ranged from 23% to 64%, with an overall weighted average of 45%,^{80-90, 94-98} which
5 also exceeded the WHO recommended standard (20%).⁷⁹

6 Prior studies in primary health care settings indicated improved patient satisfaction
7 since the new reform,⁹⁹⁻¹⁰¹ and higher satisfaction compared with hospitals.¹⁰² However in our
8 survey, among the patients who had been to primary health care institutions for clinical care,
9 84.3% (1912/2269) felt “not satisfied at all” or “mostly dissatisfied”. Among the patients who
10 had chosen to bypass primary health care institutions and went to hospitals, the most common
11 reasons include “do not know primary health care institutions well” [13.6% (523/3837)], “do
12 not trust primary health care institutions” [12.8% (493/3837)], “be not satisfied with the
13 quality of care in primary health care institutions” [12.5% (478/3837)].

14 Moreover, there are significant knowledge gaps in the quality of primary health care in
15 China, particularly its changing patterns during the national reform effort. This reality could
16 be due to the fact that no system routinely collects clinical information on quality or officially
17 reports quality measures.

18

19 **Challenges and Opportunities**

20 Even though China has made remarkable efforts and achievements since 2009, the
21 primary health care system still needs to be substantially strengthened to manage both the
22 rising chronic NCD burden and increasing health expenditures.¹⁰³ Despite increasing
23 government financial investments, universal health insurance coverage, basic public health
24 service programs, and the essential drug system,^{104, 105} current policies and technology
25 systems have marked limitations.^{106, 107} These limitations impede the integration of clinical
26 care and public health services within the primary health care system, negate the collaboration
27 between primary health care and other healthcare sectors (e.g., hospitals),¹⁰⁸ and make it

1 difficult to ensure that a sufficient number of professionals have appropriate training,
2 remuneration, and performance.¹⁰⁷ Moreover, the system is not configured to learn from
3 everyday practice and, thereby, promote continuous improvement. As a result, on the supply
4 side, doctors lack adequate technical support and appropriate financial incentives to deliver
5 integrated and high-quality care. On the demand side, patients tend to bypass the primary
6 health care system (i.e. the “gatekeepers”) to go to hospitals for more specialized
7 consultations and higher insurance reimbursements. Moreover in the short term, the possible
8 forthcoming shortage of village doctors could undermine the entire system, as they have
9 provided a quarter of the outpatient care in China,¹ and are expected to act as a first point of
10 consultation for more than 600 million rural residents.

11 The national roadmap “The Healthy China 2030 Plan” highlighted the important role of
12 primary health care,²⁰ which ensured strong political commitments to strengthen the primary
13 health care system. In this critical juncture in the development of primary health care, a
14 forthcoming *Lancet* Commission on primary health care in China will propose
15 recommendations and indicators by pooling global expertise.¹⁰⁹ Further studies will helpfully
16 provide comprehensive insight into root causes to the current challenges by exploring the
17 evolution and socio-economic environment of the primary health care system in China. These
18 actions by the government and academic communities are notable steps for China, as it aims
19 to build an integrated, cooperative primary health care system – one that fully supports its
20 professionals and is accountable for its performance. These strategies and measures are also
21 essential for the entire healthcare sector in China as they would improve the delivery of
22 high-quality care and control rising costs. These experiences may also be helpful for other
23 developing countries facing similar challenges.

24

25 **Conflicts of Interest**

26 The authors declared no relevant conflict of interest.

27

1 **Contributors' Statement**

2 Shengshou Hu, LJ and HMK conceived the review and take responsibility for all
3 aspects of it. XL, JL, LJ and HMK initially designed the survey, with the support from KKC,
4 JDM, QM, EM, DRX and WY. XL and JL wrote the first draft. Shuang Hu and HZ provided
5 data management and statistical expertise. Shengshou Hu, LJ, HMK, KKC, JDM, QM, EM,
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8

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24

25

26

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14

15 **References**

- 16 1. National Commission for Health and Family Planning of the People's Republic of China. China
17 health and family planning statistical yearbook 2016. Beijing: Peking union medical college publishing
18 house; 2017.
- 19 2. Huang Y, Zeng L, Li Y, Zhou X, Liu P, Zhong D. Performance Evaluation on Healthcare Reform Policy
20 in Rural China:A Systematic Review. *Chinese Journal of Evidence-Based Medicine* 2012; **12**(3): 293-304.
- 21 3. Cui W. China's village doctors take great strides. *Bulletin of the World Health Organization* 2008;
22 **86**(12): 914-5.
- 23 4. Blumenthal D, Hsiao W. Privatization and Its Discontents — The Evolving Chinese Health Care
24 System. *New England Journal of Medicine* 2005; **353**(11): 1165-70.
- 25 5. Yip W, Hsiao WC. The Chinese health system at a crossroads. *Health Affairs* 2008; **27**(2): 460.
- 26 6. Duckett J. The Chinese state's retreat from health: Policy and the politics of retrenchment:
27 Routledge; 2012.
- 28 7. Policy Research Department of Ministry of Health. Brigade health facilities could be contract to
29 barefoot doctors. Health News. 1983 Jan 6th.
- 30 8. Hu S, Tang S, Liu Y, Zhao Y, Escobar ML, de Ferranti D. Reform of how health care is paid for in
31 China: challenges and opportunities. *Lancet* 2008; **372**(9652): 1846-53.
- 32 9. Tang S, Meng Q, Chen L, Bekedam H, Evans T, Whitehead M. Tackling the challenges to health
33 equity in China. *Lancet* 2008; **372**(9648): 1493-501.
- 34 10. Meng Q, Yuan J, Jing L, Zhang J. Mobility of primary health care workers in China. *Human*

1 *resources for health* 2009; **7**: 24.

2 11. Zhang D, Unschuld PU. China's barefoot doctor: past, present, and future. *Lancet* 2008;
3 **372**(9653): 1865-7.

4 12. Chen Z. Launch of the health-care reform plan in China. *Lancet* 2009; **373**(9672): 1322-4.

5 13. Ministry of health of the people's republic of China. China health statistical yearbook 2009.
6 Beijing: Peking union medical college publishing house; 2010.

7 14. Ministry of Health, Treasury Department, State Administration of Traditional Chinese Medicine.
8 Announcement on the National Basic Public Health Service Project in 2016. 2016.
9 <http://www.nhfpc.gov.cn/jws/s3577/201606/f29a4659c7f4455ca6f62f8d14eb4b02.shtml> (accessed
10 May 17 2017).

11 15. Ministry of Health. The National Essential Drug List (Version 2012). 2012.
12 <http://www.nhfpc.gov.cn/yaozs/s3580/201303/87a46f5a3b6f46908b5ca18102581533.shtml>
13 (accessed May 17 2017).

14 16. Ministry of Health. Regulations for Management of National Essential Drug List. 2015.
15 <http://www.nhfpc.gov.cn/yaozs/s3581/201504/8147002103b741179217eced1ad77efc.shtml>
16 (accessed May 17 2017).

17 17. Meng Q, Xu L, Zhang Y, et al. Trends in access to health services and financial protection in China
18 between 2003 and 2011: a cross-sectional study. *Lancet* 2012; **379**(9818): 805-14.

19 18. Yang G, Kong L, Zhao W, et al. Emergence of chronic non-communicable diseases in China. *Lancet*
20 2008; **372**(9650): 1697-705.

21 19. Gong P, Liang S, Carlton EJ, et al. Urbanisation and health in China. *Lancet (London, England)*
22 2012; **379**(9818): 843-52.

23 20. CPC Central Committee, State Council. The Plan for "Health China 2030". 2016.
24 http://www.gov.cn/xinwen/2016-10/25/content_5124174.htm (accessed May 17 2017).

25 21. Yang G, Wang Y, Zeng Y, et al. Rapid health transition in China, 1990-2010: findings from the
26 Global Burden of Disease Study 2010. *Lancet* 2013; **381**(9882): 1987-2015.

27 22. Ministry of Health of the People's Republic of China. China Nutrition and Health Survey, 2002.

28 23. Ministry of Health of the People's Republic of China. China national NCD risk factor surveillance,
29 2007.

30 24. Kringos DS, Boerma WG, Bourgueil Y, et al. The european primary care monitor: structure,
31 process and outcome indicators. *BMC family practice* 2010; **11**(1): 81.

32 25. World Health Organization. Declaration of Alma Ata. *Lancet* 1978; **2**(8098): 1040.

33 26. National Health and Family Planning Commission. 2017 China Health and Family Planning
34 Statistical Digest. Beijing: Peking union medical college publishing house; 2017.

35 27. Tang S, Dong D, Ji L, et al. What Contributes to the Activeness of Ethnic Minority Patients with
36 Chronic Illnesses Seeking Allied Health Services? A Cross-Sectional Study in Rural Western China.
37 *International journal of environmental research and public health* 2015; **12**(9): 11579-93.

38 28. State Administration of Traditional Chinese Medicine, Ministry of Health, Ministry of Human
39 Resources and Social Security, State Food and Drug Administration, Department of General Logistics of
40 People's Liberation Army. Comments on the implementation of traditional Chinese medicine service
41 capacity enhancement in primary health care institutions. 2012.
42 <http://www.sda.gov.cn/WS01/CL0852/75414.htm> (accessed Aug 28 2017).

43 29. State Council of the People's Republic of China. Opinions on deepening the health care reform.
44 2009. http://www.gov.cn/jrzq/2009-04/06/content_1278721.htm (accessed May 27 2017).

- 1 30. State Council of the People's Republic of China. Opinions on consolidation and improvement of
2 essential drug system and new operating mechanisms in primary health care system. 2013.
3 http://www.gov.cn/zwggk/2013-02/20/content_2335737.htm (accessed May 27 2017).
- 4 31. Ministry of Health, National Development and Reform Commission, Ministry of Industry and
5 Information Technology, et al. Opinions on the establishment of the national essential drug system.
6 2009. <http://www.nhfpc.gov.cn/zwggk/wtwj/201304/f2a0d9cbc33f45e091a9d4a936c6fe58.shtml>
7 (accessed May 17 2017).
- 8 32. Wagstaff A, Lindelow M, Wang SY, et al. Reforming China's rural health system. *World Bank*
9 *Publications* 2009: 1-248().
- 10 33. Meng Q, Fang H, Liu X, Yuan B, Xu J. Consolidating the social health insurance schemes in China:
11 towards an equitable and efficient health system. *The Lancet* 2015; **386**(10002): 1484-92.
- 12 34. State Council of the People's Republic of China. Opinions on the integration of basic health
13 insurance for urban and rural residents. 2016.
14 http://www.gov.cn/zhengce/content/2016-01/12/content_10582.htm (accessed May 27 2017).
- 15 35. Anand S, Fan VY, Zhang J, et al. China's human resources for health: quantity, quality, and
16 distribution. *Lancet (London, England)* 2008; **372**(9651): 1774-81.
- 17 36. Shan H, Guo Y, Wei H. The Analysis on the Current Status of Community Health Human Resource
18 in Heilongjiang. *Chinese Health Economics (Chin)* 2013; (12): 62-4.
- 19 37. Ministry of health of the people's republic of China. China public health statistical yearbook 2011.
20 Beijing: Peking union medical college publishing house; 2011.
- 21 38. Yang Z. Study On Income level of Community Health Agency of Fengtai District [Master]: China
22 University of Geosciences; 2014.
- 23 39. Zhang H, Wan M, Chen Z, Liu J. A Comparison Survey of Remuneration for Health Professionals in
24 Eastern and Western Rural China. *Chinese Health Service Management (Chin)* 2015; (05): 370-2.
- 25 40. Liu C, Zhang L, Zhang Y, Qin J. Analysis of the Status and Growth Trends of the Staff Salaries of the
26 Community Health Service in Our Country. *Chinese General Practice (Chin)* 2014; (22): 2561-4.
- 27 41. National Bureau of Statistics of China. China Statistical Yearbook 2016. 2017.
28 <http://www.stats.gov.cn/tjsj/ndsj/2016/indexch.htm> (accessed May 30 2017).
- 29 42. OECD. Health at a Glance 2015: OECD Indicators. Paris: OECD publishing; 2015.
- 30 43. Song K. Study on Turnover Intention and Job Preference of Primary Health Workers in Five
31 Provinces of China [Doctoral]: Shandong University; 2014.
- 32 44. Shi L, Song K, Rane S, Sun X, Li H, Meng Q. Factors associated with job satisfaction by Chinese
33 primary care providers. *Primary health care research & development* 2014; **15**(1): 46-57.
- 34 45. Ding H, Sun X, Chang WW, Zhang L, Xu XP. A comparison of job satisfaction of community health
35 workers before and after local comprehensive medical care reform: a typical field investigation in
36 Central China. *PLoS one* 2013; **8**(9): e73438.
- 37 46. Zhang X, Fang P. Job satisfaction of village doctors during the new healthcare reforms in China.
38 *Australian health review : a publication of the Australian Hospital Association* 2016; **40**(2): 225-33.
- 39 47. Wu D, Wang Y, Lam KF, Hesketh T. Health system reforms, violence against doctors and job
40 satisfaction in the medical profession: a cross-sectional survey in Zhejiang Province, Eastern China.
41 *BMJ open* 2014; **4**(12): e006431.
- 42 48. Luo Z, Bai X, Min R, Tang C, Fang P. Factors influencing the work passion of Chinese community
43 health service workers: an investigation in five provinces. *BMC family practice* 2014; **15**: 77.
- 44 49. Shi L, Song K, Rane S, Sun X, Li H, Meng Q. Factors associated with job satisfaction by Chinese

- 1 primary care providers. *Primary health care research & development* 2014; **15**(01): 46-57.
- 2 50. Zhang M, Yang R, Wang W, Gillespie J, Clarke S, Yan F. Job satisfaction of urban community health
3 workers after the 2009 healthcare reform in China: a systematic review. *International Journal for*
4 *Quality in Health Care* 2015: mzv111.
- 5 51. Yao W, Wei G, Xu A, Qiu L, Chen Z, Yu H. Sample Survey of Human Resources and Work Situation
6 of Community Health Services in Guangdong Province. *Chinese General Practice (Chin)* 2011; (16):
7 1779-81.
- 8 52. Fang P, Liu X, Huang L, Zhang X, Fang Z. Factors that influence the turnover intention of Chinese
9 village doctors based on the investigation results of Xiangyang City in Hubei Province. *International*
10 *journal for equity in health* 2014; **13**: 84.
- 11 53. Ouyang T. Research on the sharing of medical information resource on the basis of bidirectional
12 referral medical care in community health service and tertiary hospital [Master]: Hefei Industry
13 University; 2010.
- 14 54. Wang R. Research on Information Technology System in Primary Health Care Institutions in
15 Yunnan Province [Master]: Yunnan University; 2014.
- 16 55. Zhang Y, Chen Q, Yan X, Li J, Hu H. Application Status of Information System Functions in
17 Community Health Service Settings and Township Health Centers in China. *Chinese General Practice*
18 *(Chin)* 2016; (07): 766-70.
- 19 56. Xu L, Fang WY, Zhu F, Zhang HG, Liu K. A coordinated PCP-Cardiologist Telemedicine Model (PCTM)
20 in China's community hypertension care: study protocol for a randomized controlled trial. *Trials* 2017;
21 **18**(1): 236.
- 22 57. China national health development research center. Research on Healthcare Reform. Beijing:
23 People's Medical Publishing House; 2015.
- 24 58. Hu J, Mossialos E. Pharmaceutical pricing and reimbursement in China: When the whole is less
25 than the sum of its parts. *Health Policy* 2016; **120**(5): 519-34.
- 26 59. Yi H, Miller G, Zhang L, Li S, Rozelle S. Intended and unintended consequences of China's zero
27 markup drug policy. *Health affairs (Project Hope)* 2015; **34**(8): 1391-8.
- 28 60. Zhu J. Study on the Influence of Zero-profit Drug Policy on the Economic Operation and Medical
29 Expenses of Primary Health Care Institutions [Master]: Anhui Medical University; 2012.
- 30 61. Ministry of Finance, National Health and Family Planning Commission. Management of subsidy
31 for implementation of national essential drug system in primary health care institutions. 2014.
32 [http://www.mof.gov.cn/zhengwuxinxi/caizhengwengao/wg2014/wg2014010/201504/t20150401_121](http://www.mof.gov.cn/zhengwuxinxi/caizhengwengao/wg2014/wg2014010/201504/t20150401_1211569.html)
33 [1569.html](http://www.mof.gov.cn/zhengwuxinxi/caizhengwengao/wg2014/wg2014010/201504/t20150401_1211569.html) (accessed May 27 2017).
- 34 62. Cao Y, Li S, Gao Q, Sun J. Research into the Related Reforms Progress and Operation in Basic
35 Medical and Health Institutions during the implementation of National Essential Medicine System.
36 *Chinese Health Economics (Chin)* 2012; (11): 54-6.
- 37 63. Qin L, Jiang Z. Public Financial Support and Distorted Behavior of Primary Health Care Institutions
38 in Rural Areas. *Economic Research Reference (Chin)* 2011; (67): 38-42.
- 39 64. Tian L. Research on the Operating Cost and Compensating Mechanism of Basic Medical
40 Institutions in Jilin province [Master]: Jilin University; 2015.
- 41 65. Ge C, Fu J, Chang Y, Wang L. Factors associated with job satisfaction among Chinese community
42 health workers: a cross-sectional study. *BMC public health* 2011; **11**: 884.
- 43 66. Zhou XD, Li L, Hesketh T. Health System Reform in Rural China: Voices of Health Workers and
44 Service-Users. *Social science & medicine (1982)* 2014; **117**: 134-41.

- 1 67. Zhang K, Liu J. Plight of Urban Community Health Service System and Status of Income of General
2 Practitioners in China. *Chinese General Practice (Chin)* 2010; (34): 3837-8+41.
- 3 68. Zhang L, Liu H, Liu L, et al. Community Health Comprehensive Reform From the Perspective of
4 Medical staff. *Chinese Health Economics (Chin)* 2012; (10): 54-7.
- 5 69. Wu R. Research on Performance Salary Reform of Grassroots Medical and Health Institutions in
6 Sheyang [Master]: Shenyang University; 2014.
- 7 70. Zhang Y, Qin J, Zhang L, et al. Comparative Analysis of Community Health Comprehensive Reform
8 of East, Middle and West China in Perspective of Medical Staff. *Chinese General Practice (Chin)* 2013;
9 (01): 10-3.
- 10 71. Tang S, Jiang W, Yip W, Guo Y. Impact of primary care oriented outpatient benefit package design
11 in new rural cooperative medical system on hypertension outpatient services utilization. *Journal of*
12 *Peking University (Medical Sciences Edition)* 2014; **46**(3): 445-9.
- 13 72. Luo Y, Feng H, He G, et al. Effect of Pooling Funds of Outpatient Service in Medical Insurance on
14 Increasing Utilization of Primary Health Care Services for Community Residents. *Chinese General*
15 *Practice (Chin)* 2013; (05): 377-9.
- 16 73. Zhang H, Jian W, Fang H. Analysis of substitutional effect of outpatient expenditure on inpatient
17 expenditure in hypertensive patients with rural new cooperative medical scheme. *Journal of Peking*
18 *University (Medical Sciences Edition)* 2016; **48**(3): 472-7.
- 19 74. Zhang Y, Chen Y, Zhang X, Zhang L. Current level and determinants of inappropriate admissions to
20 township hospitals under the new rural cooperative medical system in China: a cross-sectional study.
21 *BMC health services research* 2014; **14**: 649.
- 22 75. Lu J, Si X, Downing NS, et al. Protocol for the China PEACE (Patient-centered Evaluative
23 Assessment of Cardiac Events) Million Persons Project pilot. *BMJ Open* 2016; **6**(1).
- 24 76. Alabousi M, Abdullah P, Alter DA, et al. Cardiovascular Risk Factor Management Performance in
25 Canada and the United States: A Systematic Review. *Canadian Journal of Cardiology* 2017; **33**(3):
26 393-404.
- 27 77. Sylvia S, Shi Y, Xue H, et al. Survey using incognito standardized patients shows poor quality care
28 in China's rural clinics. *Health Policy & Planning* 2015; **30**(3): 322-33.
- 29 78. Yin X, Song F, Gong Y, et al. A systematic review of antibiotic utilization in China. *Journal of*
30 *Antimicrobial Chemotherapy* 2013; **68**(11): 2445.
- 31 79. World Health Organization. Using Indicators to Measure Country Pharmaceutical Situations. 2006.
32 <http://www.who.int/medicines/publications/WHOTCM2006.2A.pdf> (accessed Jun 30 2017).
- 33 80. Liu L, Lu Z, Zhang X. Analysis of Rational use of Drugs in Community Health Service Facilities.
34 *Chinese Health Economics (Chin)* 2009; (04): 45-7.
- 35 81. Zhao W, Wu N, Zhao X. Influence of Essential Drug System to Rational Drug Use in 5 Primary
36 Health Care Institutions of Jiangxi Province. *Chinese Health Economics (Chin)* 2012; (12): 60-1.
- 37 82. Liu C, Zhang X, Wan J. Public reporting influences antibiotic and injection prescription in primary
38 care: a segmented regression analysis. *Journal of evaluation in clinical practice* 2015; **21**(4): 597-603.
- 39 83. Wang J, Wang P, Wang X, Zheng Y, Xiao Y. Use and prescription of antibiotics in primary health
40 care settings in China. *JAMA internal medicine* 2014; **174**(12): 1914-20.
- 41 84. Qi J. Research of drug use behavior adopted by rural area Elementary institutions of medical &
42 health and residents In Yunnan province [Master]: Chinese Academy of Agricultural Sciences; 2012.
- 43 85. Jia H, Yin W, Zhu L, et al. Studying on The Rational Drug Use of Outpatient Prescription in
44 Community Health Service Centers of Shandong Province in the Essential Pharmaceuticals System.

- 1 *Chinese Health Service Management (Chin)* 2015; (07): 525-7.
- 2 86. Yao Q, Liu C, Ferrier JA, Liu Z, Sun J. Urban-rural inequality regarding drug prescriptions in
3 primary care facilities - a pre-post comparison of the National Essential Medicines Scheme of China.
4 *International journal for equity in health* 2015; **14**(1): 58.
- 5 87. Gong Y, Chen Y, Yin X, et al. The effect of essential medicines programme on rational use of
6 medicines in China. *Health Policy & Planning* 2016; **31**(1): 21.
- 7 88. Yang L, Liu C, Ferrier JA, Zhou W, Zhang X. The impact of the National Essential Medicines Policy
8 on prescribing behaviours in primary care facilities in Hubei province of China. *Health Policy &*
9 *Planning* 2013; **28**(7): 750-60.
- 10 89. Yin X, Gong Y, Yang C, et al. A Comparison of Quality of Community Health Services Between
11 Public and Private Community Health Centers in Urban China. *Medical care* 2015; **53**(10): 888.
- 12 90. Zhang X, Wang L, Zhang X. Application of propensity scores to explore the effect of public
13 reporting of medicine use information on rational drug use in China: a quasi-experimental design.
14 *BMC health services research* 2014; **14**: 492.
- 15 91. Yip W, Powelljackson T, Chen W, et al. Capitation combined with pay-for-performance improves
16 antibiotic prescribing practices in rural China. *Health Affairs* 2014; **33**(3): 502.
- 17 92. Xiao Y, Wang J, Shen P, Zheng B, Zheng Y, Li L. Retrospective survey of the efficacy of mandatory
18 implementation of the Essential Medicine Policy in the primary healthcare setting in China: failure to
19 promote the rational use of antibiotics in clinics. *International journal of antimicrobial agents* 2016;
20 **48**(4): 409-14.
- 21 93. Jiang Q, Yu BN, Ying G, et al. Outpatient prescription practices in rural township health centers in
22 Sichuan Province, China. *BMC health services research* 2012; **12**(1): 324.
- 23 94. Li Y. Evaluation on the Implementation of Zero-profit Essential Medicines in Health Care
24 Institutions of L Province [Master]: Dalian Medical University; 2015.
- 25 95. Dong L, Yan H, Wang D. Drug prescribing indicators in village health clinics across 10 provinces of
26 Western China. *Family practice* 2011; **28**(1): 63-7.
- 27 96. Song Y, Bian Y, Petzold M, Li L, Yin A. The impact of China's national essential medicine system on
28 improving rational drug use in primary health care facilities: an empirical study in four provinces. *BMC*
29 *health services research* 2014; **14**: 507.
- 30 97. Ying G, Lv Y, Gan H, et al. Survey on the Drug Use in Outpatient Prescriptions from Primary Health
31 Care Institutions in Sichuan Province. *Chinese Health Service Management (Chin)* 2010; (10): 665-7.
- 32 98. Ding J. Analysis on Rational Use of Drugs in 12 Community Medical Institutions of Shaoxing.
33 *China Pharmacy (Chin)* 2010; (20): 1913-4.
- 34 99. Li Z, Hou J, Lu L, Tang S, Ma J. On residents' satisfaction with community health services after
35 health care system reform in Shanghai, China, 2011. *BMC public health* 2012; **12 Suppl 1**: S9.
- 36 100. Zhang P, Li N, Ren X. Trend of Residents' Satisfaction Change with Community Health Service in
37 Chengdu City from 2008 to 2012 and Its Influencing Factors. *Chinese General Practice (Chin)* 2014; (22):
38 2579-83.
- 39 101. Kuang L, Liang Y, Mei J, et al. Family practice and the quality of primary care: a study of Chinese
40 patients in Guangdong Province. *Family practice* 2015; **32**(5): 557-63.
- 41 102. Li J, Wang P, Kong X, Liang H, Zhang X, Shi L. Patient satisfaction between primary care providers
42 and hospitals: a cross-sectional survey in Jilin province, China. *International journal for quality in*
43 *health care : journal of the International Society for Quality in Health Care / ISQua* 2016; **28**(3): 346-54.
- 44 103. Beaglehole R, Epping-Jordan J, Patel V, et al. Improving the prevention and management of

- 1 chronic disease in low-income and middle-income countries: a priority for primary health care. *Lancet*
2 2008; **372**(9642): 940-9.
- 3 104. Chen Z. Launch of the health-care reform plan in China. *Lancet* 2009; **373**(9672): 1322-4.
- 4 105. Alderson MR. Data on sickness absence in some recent publications of the Ministry of Pensions
5 and National Insurance. *Br J Prev Soc Med* 1967; **21**(1): 1-6.
- 6 106. Meng Q, Fang H, Liu X, Yuan B, Xu J. Consolidating the social health insurance schemes in China:
7 towards an equitable and efficient health system. *Lancet (London, England)* 2015; **386**(10002):
8 1484-92.
- 9 107. Yip WC, Hsiao WC, Chen W, Hu S, Ma J, Maynard A. Early appraisal of China's huge and complex
10 health-care reforms. *Lancet* 2012; **379**(9818): 833-42.
- 11 108. McCollum R, Chen L, ChenXiang T, et al. Experiences with primary healthcare in Fuzhou, urban
12 China, in the context of health sector reform: a mixed methods study. *The International journal of*
13 *health planning and management* 2014; **29**(2): e107-26.
- 14 109. The Lancet. What to expect for China's health in the future. *The Lancet* 2017; **389**(10066): 226.
- 15 110. Barber SL, Yao L. Development and status of health insurance systems in China. *The International*
16 *journal of health planning and management* 2011; **26**(4): 339-56.
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1 **Figure legends**

2 **Figure 1.** Number of primary health care doctors per 1000 population in urban and rural
3 China in 2015

4

5 **Figure 2.** Social benefits for employees in primary health care institutions

6 * Including township health centres, community health centres, and community health
7 stations

8 # Including pension, health insurance, unemployment insurance, occupational injury
9 insurance, and housing fund

10 PHC indicates primary health care

11 The three economic-geographic regions of China, including Eastern (13 provinces), Central (6
12 provinces), and Western (12 provinces), are categorized according to the official definition.¹

13

14 **Figure 3.** Percentage of institutions reporting each factor that influences doctors' bonuses

15 MR indicates medical record; ED essential drug; HTN hypertension; DM diabetes mellitus

16

17

1 **Tables**

2 **Table 1.** Reimbursement deductibles, rates and annual caps of New Cooperative Medical
3 Scheme in 67 rural sites in 2016

4

	For outpatient care	For inpatient care
Deductible, USD		
PHC institution	0 (0-0)	22 (7-29)
Secondary hospital	0 (0-44)	58 (44-73)
Tertiary hospital	0 (0-73)	116 (87-145)
Rate, %*		
PHC institution	85 (75-90)	85 (75-90)
Secondary hospital	70 (65-80)	70 (65-80)
Tertiary hospital	55 (50-62)	55 (50-62)
Annual cap, USD		
PHC institution	39 (15-58)	21777 (14518-29036)
Secondary hospital	48 (22-218)	21777 (14518-29036)
Tertiary hospital	58 (48-218)	21777 (14518-29036)

5 Median (interquartile range)

6 PHC indicates primary health care; USD United States Dollar

7 * This is the “official” reimbursement rates. The percentages of total expenditure that are
8 reimbursed by insurance (i.e. “actual” reimbursement rates) are typically lower because of the
9 annual caps and that not all services are covered by insurance.¹¹⁰

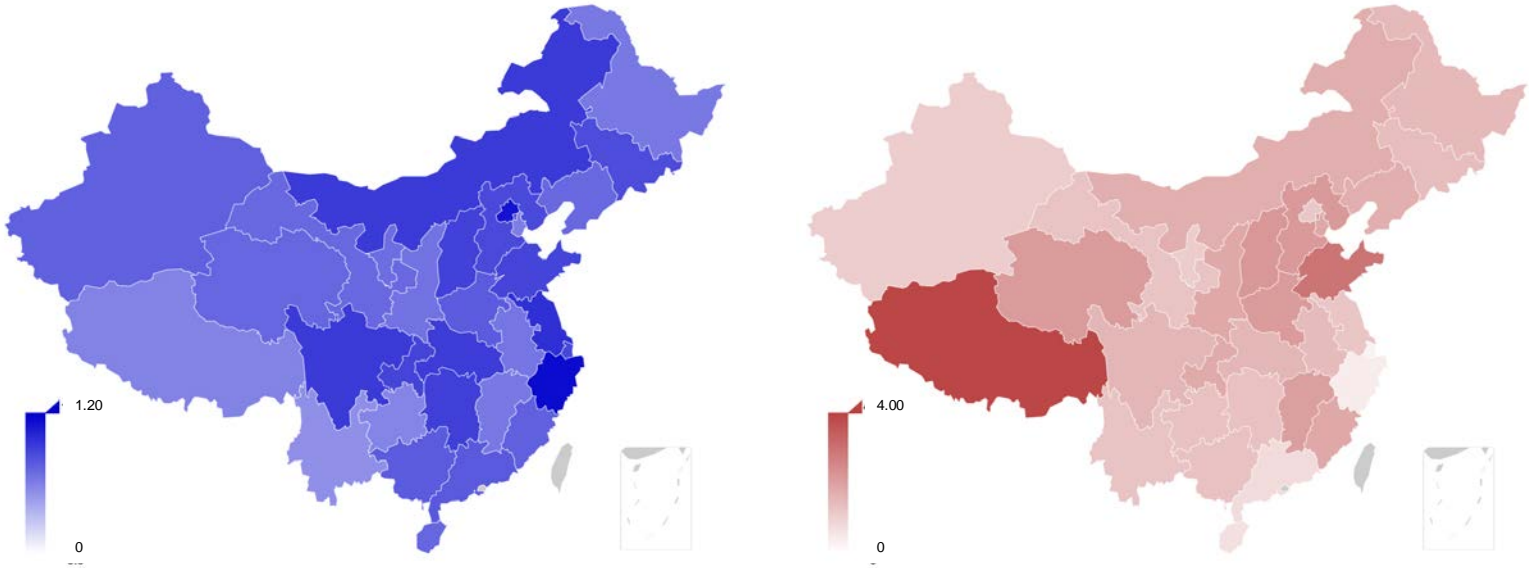
10

1 **Figures**

2

3

Figure 1.



A. Number of licensed or assistant licensed doctors per 1000 population

B. Number of village doctors per 1000 rural population

Figure 2.

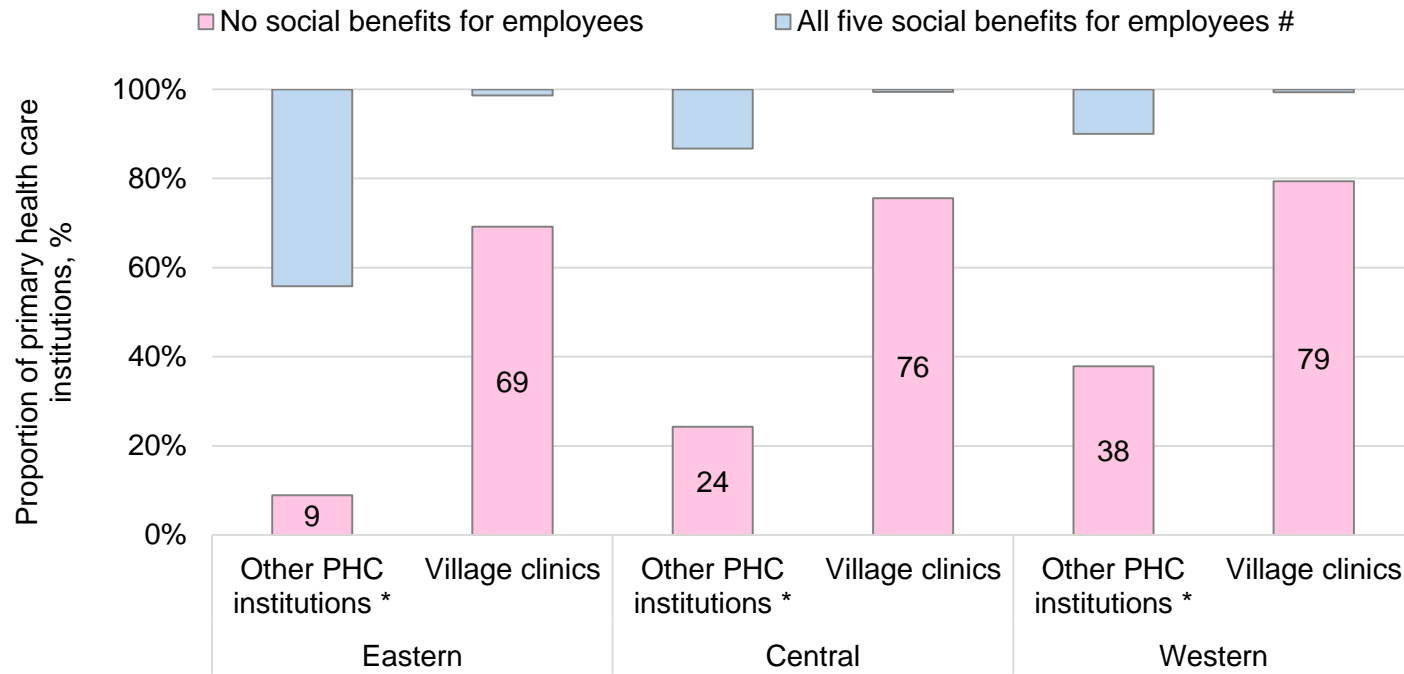


Figure 3.

