

**Imperial College
London**

**The Health System and Health Impacts
of China's Comprehensive Primary
Health Care Reforms since 2009**

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2024

Submitted for the Degree of Doctor of Philosophy

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The co-authors of the publication corresponding to **Chapter 4** are Dr Thomas Hone, Christopher Millett, Shangzhi Xiong, Maoyi Tian, Jin Xu. The study was carried out under the supervision of Dr Christopher Millett and Dr Thomas Hone. CM, TM, and CC conceptualized the study and developed the protocol. CC conducted the data search. CC and SX extracted the data. CC, SX and TH performed the title, abstract, and full-text screening. CC conducted the quality assessment with supports from TH. For the published work, CC wrote the initial draft. CM and TH provided critical comments and edits to the initial draft. All authors contributed to the revision and edits of the subsequent drafts.

Acknowledgement

I am profoundly grateful to my supervisors, Professor Christopher Millett and Dr Thomas Hone, whose belief in my abilities and guidance allowed me to delve into a subject that was initially unfamiliar but deeply compelling to me. Their unwavering support and inspiration propelled me through the challenging time of my PhD, encouraging me to expand my boundaries in academics and life.

My heartfelt appreciation extends to my dedicated colleagues at the Public Health Policy Evaluation Unit, Department of Primary Care and Public Health. Anthony Lavery, Filippos Filippidis, Eszter Vamos, Kiara Chang, Paraskevi Seferidi, Judite Gonçalves, and Jennie Parnham, each of you has been a source of constant inspiration. I am particularly indebted to Kiara Chang for her generous sharing of knowledge and experiences, enriching my understanding of statistics and causal inferences. I am also deeply thankful for the support of my fellow PhD students in and beyond the School of Public Health, whose shared journey has made every triumph sweeter and every setback more meaningful.

My gratitude also goes to my collaborators from Peking University, Harbin Medical University, the Chinese Center for Disease Control and Prevention, and the George Institute for Global Health in Australia and China. Special mention goes to Professor Maoyi Tian for the opportunity to participate in the SAPPHIRE project, which is making real-world impacts. Every conversation with Dr. Jin Xu has been inspiring for me. I thank Professor Timothy Powell-Jackson for facilitating connections within the research community. To Dr Shangzhi Xiong, I extend my heartfelt gratitude for his exceptional collaboration, unwavering support, and genuine friendship throughout this journey.

I am indebted to my teachers, mentors, and friends from Southeast University, Nankai University, and the University of Birmingham, whose encouragement and intellectual stimulation paved the way for my academic pursuits.

Lastly, my deepest appreciation goes to my family, including my grandparents and parents, for their boundless love and unwavering faith in me. My parents have demonstrated resilience and kindness during my upbringing, making me who I am today. I am profoundly fortunate to have them in my life. Thank you to Deni, my supportive, loving partner who went through challenging times with me and celebrated my every small achievement during this PhD.

This thesis would not have been possible without the support and encouragement of each individual mentioned above. Thank you all for being a part of this incredible journey. I truly enjoyed every moment of my PhD because of you all.

Publications arising from this thesis

- **Chapter 4: Cai C**, Xiong S, Millett C, Xu J, Tian M, Hone T., Health and health system impacts of China's comprehensive primary healthcare reforms: a systematic review. *Health Policy and Planning*. 2023 Nov 1;38(9):1064-78., DOI: <https://doi.org/10.1093/heapol/czad058>
- **Chapter 7: Cai C**, Xiong S, Millett C, Xu J, Tian M, Hone T., The impact of China's 2015 primary health care reforms on utilisation, payments, and self-reported health: a quasi-experimental analysis of a middle-aged and elderly cohort 2011-2018, *BMJ Public Health*, under review.

Related publications completed during this thesis

- Xiong S, **Cai C**, Jiang W, Ye P, Ma Y, Liu H, Li B, Zhang X, Wei T, Sun H, Hone T. Primary health care system responses to non-communicable disease prevention and control: a scoping review of national policies in Mainland China since the 2009 health reform. *The Lancet Regional Health–Western Pacific*. 2023 Feb 1;31. <https://doi.org/10.1016/j.lanwpc.2022.100390>
- Xiong S, Jiang W, Meng R, Hu C, Liao H, Wang Y, **Cai C**, Zhang X, Ye P, Ma Y, Liu T. Factors associated with the uptake of national essential public health service package for hypertension and type-2 diabetes management in China's primary health care system: a mixed-methods study. *The Lancet Regional Health–Western Pacific*. 2023 Feb 1;31. <https://doi.org/10.1016/j.lanwpc.2022.100664>

Abstract

Background Comprehensive primary health care (PHC) reforms are infrequently and often poorly studied in low- and middle-income countries. China launched a two-stage, comprehensive PHC reforms (in 2009 and 2015, respectively) to increase the accessibility, affordability, and equity of primary care services. The PhD project aims to evaluate the reform impacts on the health system and health outcomes.

Methods Three components were conducted: 1). A systematic review of the existing studies on the reforms, with quality assessment and narrative synthesis. 2). A difference-in-differences (DiD) study using panel data from 31 provinces (2010-2019) estimating the 2015 reform impacts on PHC inputs, primary care utilisation, costs, and mortalities, and potential pathways. 3). A DiD study using cohort data (age ≥ 45 , N=43,644, 2011-2018) estimating the 2015 reform impacts on primary care utilisation, hospitalisations, out-of-pocket expenditures(OOPEs), and self-reported health.

Results The existing evidence shows that the reforms since 2009 were associated with increased primary care utilisation (N=17), some improved health among people with non-communicable diseases (N=8), and some improved equity(N=8). Evidence on health care costs was mixed. Financial protection and care quality were underexamined. The panel analysis found that the 2015 reforms were associated with increased utilisation of family physicians and prenatal care, higher hospital costs for outpatient check-ups and drugs, and a reduced maternal mortality ratio. The reforms mainly affected under-resourced regions. The cohort analysis found that The 2015 reforms had a short-lived impact on increasing primary care utilisation, OOPEs, and self-reported health. Hospitalisations were not affected. The increased utilisation was mainly among rural/lower-income populations.

Conclusion China's PHC reforms have made some progress in increasing the equitable use of primary care and improving the health of high-risk populations. System-wide reforms are needed to shift away from hospital domination, enhance financial protection and care quality, and improve population health and health equity.

List of Abbreviations/glossary

CS-DID	Callaway and Sant'Anna difference-in-differences estimator
DID	Difference-in-differences
FFS	Fee-for-services
GDP	Gross Domestic Product
GP	General Practitioner
HDI	Human Development Index
HICs	High-income countries
ITS	Interrupted time series
LMIC	Low- and middle-income country
NCD	Non communicable disease
NEMS	The National Essential Medicine Scheme
NEPHP	The National Essential Public Health Package
OOPE	Out-of-pocket expenditure
P4P	Pay-for-performance
PHC	Primary Health Care
RCD	Routinely Collected Data
RCT	Randomised Control Trial
RMNCH	Reproductive, maternal, newborn and child health
RNCMS	The Rural New Cooperative Medical Scheme
SDG	Sustainable Development Goal
TWFE	Two-way fixed effect
UEBMI	The Urban Employee Basic Medical Insurance
UHC	Universal Health Coverage
URBMI	The Urban Resident Basic Medical Insurance
USD	United States Dollar
WHO	World Health Organization

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Chapter 1. Primary health care (PHC) and PHC reforms in low- and middle-income countries (LMICs)

1.1 Health and PHC

1.1.1 Health and health inequalities

All state parties of the United Nations agreed that health rights are one of the fundamental human rights to every human being “without distinction of race, religion, political belief, economic or social condition”.¹ Governments are responsible for safeguarding their people’s health by providing adequate health services.¹ Despite the wide recognition of equitable health as a prerequisite for individual, societal, and economic development,² poor health and health inequalities persist within and across countries.³ There has been a persistent pattern that poorer countries and populations often have a lower life expectancy and higher mortality.^{2,3} Between 2000 and 2009, life expectancy at birth was about 15 years shorter in low-income countries than in high-income countries.⁴

Population health is intricately linked to health systems, which determine the accessibility, affordability, quality, and equity of health care services.⁵ However, in reality, more than half of the world's population could not access essential health services in 2023.⁶ Variations in these factors across population groups and regions contribute to health-related inequalities.⁷ The prevalence of non-communicable diseases (NCDs), multimorbidity, and ageing populations indicates growing health needs globally,⁸ with approximately 41 million deaths (74% of all deaths worldwide) being NCD-related in 2020.⁹ Socioeconomically disadvantaged populations and regions have higher incidence of NCDs,^{10,11} multimorbidity,¹² and Covid-19 mortality¹³. However, a study shows that only 29.9% of people with hypertension received treatment in LMICs during 2005-2016,¹⁴ whilst this number was at most 80% in HICs during the same periods.¹⁵ In LMICs, the richest quintiles had a 36% higher risk ratio of receiving treatment than the poorest quintiles.¹⁴ Strengthening

health systems and improving health inequalities are crucial for the development of every individual and society.

1.1.2 History of PHC

PHC was identified as the key to the achievement of “Health for All” in the Declaration of Alma-Ata in 1978.¹⁶ It was a response to the widespread health inequalities and other challenges faced by hospital-centric delivery. The declaration envisaged a shift from the hospital-centric paradigm of health to a PHC one.¹⁶ A PHC approach prioritises preventive and promotive care over curative care and emphasises community engagement, integrated care, people-centredness, and primary care.¹⁶ It is efficient and cost-effective in delivering essential health care to all people as a response to undesirable phenomena associated with hospital-centric health systems and curative-focused care, such as intensive and costly care¹⁷ and inequalities¹⁸.

The concept of PHC has evolved and enriched over time, reflecting changes in global health priorities and challenges. In 2018, the Declaration of Astana reaffirmed the importance of PHC for achieving universal health coverage (UHC) and the health-related sustainable development goals (SDGs).¹⁹ Building upon the principles established in the Declaration of Alma-Ata, the Declaration of Astana further called for broader engagement beyond the health sector and a whole-society approach to equitable health. By reaffirming the centrality of PHC in achieving UHC and SDGs, the Declaration of Astana signals a renewed commitment to strengthening PHC.

1.1.3 PHC and primary care

This sub-section distinguishes between the concept of PHC and primary care. Understanding of the distinctions between PHC and primary care is crucial as it provides a rationale for a comprehensive evaluation framework adopted throughout the project and guides the scope of this project.

Primary care services are characterised by a range of low-technology, cost-effective preventative health services with a focus on communities and people. These services include preventative, curative, rehabilitative, palliative and promotive health care, such as family planning, immunisation, and care for reproductive, maternal, newborn and child health (RMNCH).^{19,20} According to the Lancet, 80-90% of people's health needs throughout their lifespan can be addressed with primary care.²¹

PHC is not just a collection of various primary care services, but a comprehensive approach that emphasises the integration and people-centredness of care and multisectoral actions.¹⁹ It is a holistic approach to achieving Health for All through engaging individuals, communities, and social and economic facilitators beyond health systems.^{16,19,22} PHC fundamentally shapes how health services are organised, financed, and delivered.

The interconnection of PHC and primary care is evident. Primary care is one of the key pathways to PHC within health systems.²³ Primary care serves as a fundamental entry point for health systems to facilitate universal coverage of essential health care and to enhance health system performance. Primary care resonates with the values of universal access, equity, participation, and intersectional actions promoted by PHC.^{5,22} PHC orientation of health systems underpins the role of primary care as a people-centred approach. Conversely, high-quality primary care can further strengthen PHC, ultimately contributing to improvements in health and equity.

1.2 Health systems and reforms

This PhD project adopts the comprehensive perspective of PHC. In this project, I define PHC reforms as any health reforms and interventions that aimed at PHC strengthening regardless of the targeted components of health systems (e.g., service delivery, financing, or workforce). This focus reflects a broader spectrum of health measures beyond solely primary care services.

This section provides definitions of two key concepts of this PhD project: health systems and health reforms. It demonstrates the complexity of health systems and the significance of comprehensive evaluations of health reforms and system changes.

1.2.1 Health systems and performance

Health systems play a crucial role in people's health throughout their lifespan and are a critical lever for PHC in achieving UHC, SDG, and Health for All. The overall health system goals are to improve health and health equity in ways that are financially fair, effective, and responsive.²⁴

A health system is broadly defined by World Health Organisation (WHO) as “comprising all the organisations, institutions and resources devoted to producing health actions”.⁵ This definition has evolved to encompass “all organisations, people and actions whose primary intent is to promote, restore or maintain health”. Roberts and Hsiao²⁵ gave a comprehensive list of components regarded as parts of health systems: 1) people who deliver health care, 2) the money flows to finance health care, 3) the activities that provide inputs into the health care process (such as medical education institutions, and drug manufacturers), and 4) regulators and plans that influence health care provision, and 5) preventative services. This expanded concept highlighted a diverse range of components and activities integral to health systems.

The complexity of health systems also stems from the interconnected relationship between these components. A health system is not merely a sum-up of health facilities and services but a more complex multifaceted organic system encompassing financing, allocation, delivery, monitoring, and more. Health systems operate as integrated entities, wherein changes in one part can stimulate synergetic impacts on other interconnected components. The broad range and interconnection of health systems underline the value of a holistic perspective for studying health systems and their performance.

1.2.2 Health system challenges and reforms

Health systems are confronted with challenges both inherent and external to the health system themselves. Economic developments, demographic changes (e.g., ageing populations), and the prevalence of NCDs strain health systems with higher expectations and increasing health needs. Global health agendas, such as UHC, SDGs, and PHC, challenge conventional diseases-focused pathways and ideas and require adaptive responses from health systems. Within health systems, limited funds and financial protection, rising healthcare costs, and persisting inequalities pose threats to the system worldwide, particularly those in LMICs. These challenges will be further demonstrated in the next section. To address these challenges, health systems need continuous adjustments and, at times, comprehensive reforms to enhance their performance and resilience.

Roberts and Hsiao define health reforms as “a significant, purposeful effort to improve the performance of the health system”²⁵. They also proposed two dimensions of health reforms: “1) the number of aspects of the health-care system that are changed and 2) how radically the changes depart from past practice”. While minor adjustments on a specific component of health systems can be considered as health reforms, health reforms can be complex when multiple components are involved. Despite the complexity, multi-component health reforms can be more likely to succeed.²⁵ Comprehensive health reforms can bring changes across multiple interdependent components. This holistic approach aligns better with the complex and interconnected nature of health systems and may foster synergistic changes in health systems. In contrast, single-component policies may be insufficient to deliver far-reaching changes which are dependent on the multiple building blocks within health systems.

Comprehensive system-wide PHC reforms have been recognized as a prerequisite for quality improvements and the establishment of high-performing health systems.²⁶ However, very few countries have had comprehensive PHC reforms like those in China. The comprehensiveness reflects on a holistic approach that makes system-wide changes across multiple health system components. These system-wide

actions can introduce synergetic effects on complex issues that straddle different components of health systems, which typically cannot be realised by single-component adjustments.²⁶⁻²⁸ Therefore, the comprehensive approach fits well with the dynamics and interconnected parts of health systems and, is sometimes more desirable than selective single-component adjustments. The comprehensiveness also aligns well with the call for multisector actions for health by WHO and can accelerate progress to build strong health systems and achieve UHC.

1.2.3 A theoretical framework

Health systems and health reforms are interdependent. On the one hand, health reforms are valuable yet rare opportunities for health systems to improve performance.²⁵ On the other hand, health reforms need regular monitoring and evaluations of health systems to inform decision-making and align with local context.^{25,29} Two influential frameworks related to health systems are widely adopted in existing health system research³⁰⁻³³: 1) Donabedian framework for care quality³⁴ and 2) the six building blocks purposed by WHO³⁵.

The WHO health system framework decomposes a health system into six building blocks, including 1) service delivery, 2) health workforce, 3) health information, 4) medical products, vaccines and technologies, 5) financing, and 6) leadership and governance.³⁵ The service delivery block contains all facilities, equipment, and activities related to health service delivery. The health workforce block includes health professionals in the private and public sector for full-/part-time, as well as people for management and support.³⁵ The health information block includes various data sources, such as individual-level, facility-level, and population-level data collected for medical, administrative, or survey purposes. The medical products, vaccines, and technologies block emphasises those essential to basic health needs and includes policies, manufacturers, and activities related to the production, procurement, supply, and storage.³⁵ Health financing refers to the “function of a health system concerned with the mobilization, accumulation and allocation of money to cover the health needs of the people, individually and collectively, in the health system”³⁵. Some typical health financing elements include funds, service

purchasing, and revenue collection.³⁵ The leadership and governance building block is salient and overarches the governance components in the other five building blocks.³⁵ It typically involves bodies and activities regarding regulation, policy making, and oversight.

These six blocks are interconnected, such that changes in one building block can lead to repercussions elsewhere. For example, changes in financing might affect how healthcare providers are paid and their motivation for health service delivery, thereby stimulating repercussions in the health workforce and service delivery. This framework is widely adopted to guide indicator selection for health system performance^{33,35}. In this project, this framework guides the selection of assessed outcomes and constructs the overarching analytical structure.

Within the WHO health system framework, the Donabedian framework is adopted. The Donabedian framework provides a dynamic perspective of health care delivery and quality. This framework has three synergetic parts that are: structure, process, and outcomes^{34,36,37}. The “structure” represents the governance and physical setting of health service provision³⁴. The “process” refers to activities related to health service provision to users and workforce training³⁴. The “outcomes” refer to the changes in health status and satisfaction with care³⁴. With good structure and process, good outcomes are more likely to be achieved. In other words, the structure and process aspects are regarded as intermediate goals, such as coverage, accessibility, and people-centredness, while the ultimate goals of health systems are the achievement of health improvement and equity. The Donabedian framework is a valuable tool for evaluations of health system performance³⁸.

In this PhD project, a combination of these two theoretical frameworks is employed to frame this project and examine the impacts of China’s PHC reforms on the health system and population health (**Figure 1**). The six-building-block framework provides a static lens to decompose the comprehensive reforms into elements and identify reform areas. For each building block, this project assessed the key aspects (highlighted with the blue circles in the “Process” box in **Figure 1**) and available indicators identified by the WHO’s *monitoring the building blocks of health systems*³⁵.

Meanwhile, the Donabedian framework provides a dynamic lens to analyze how reform impacts cascade from inputs and process down to outcomes. This combined framework can provide a better understanding of reform mechanisms and is employed in the following reform description and analytical sections.

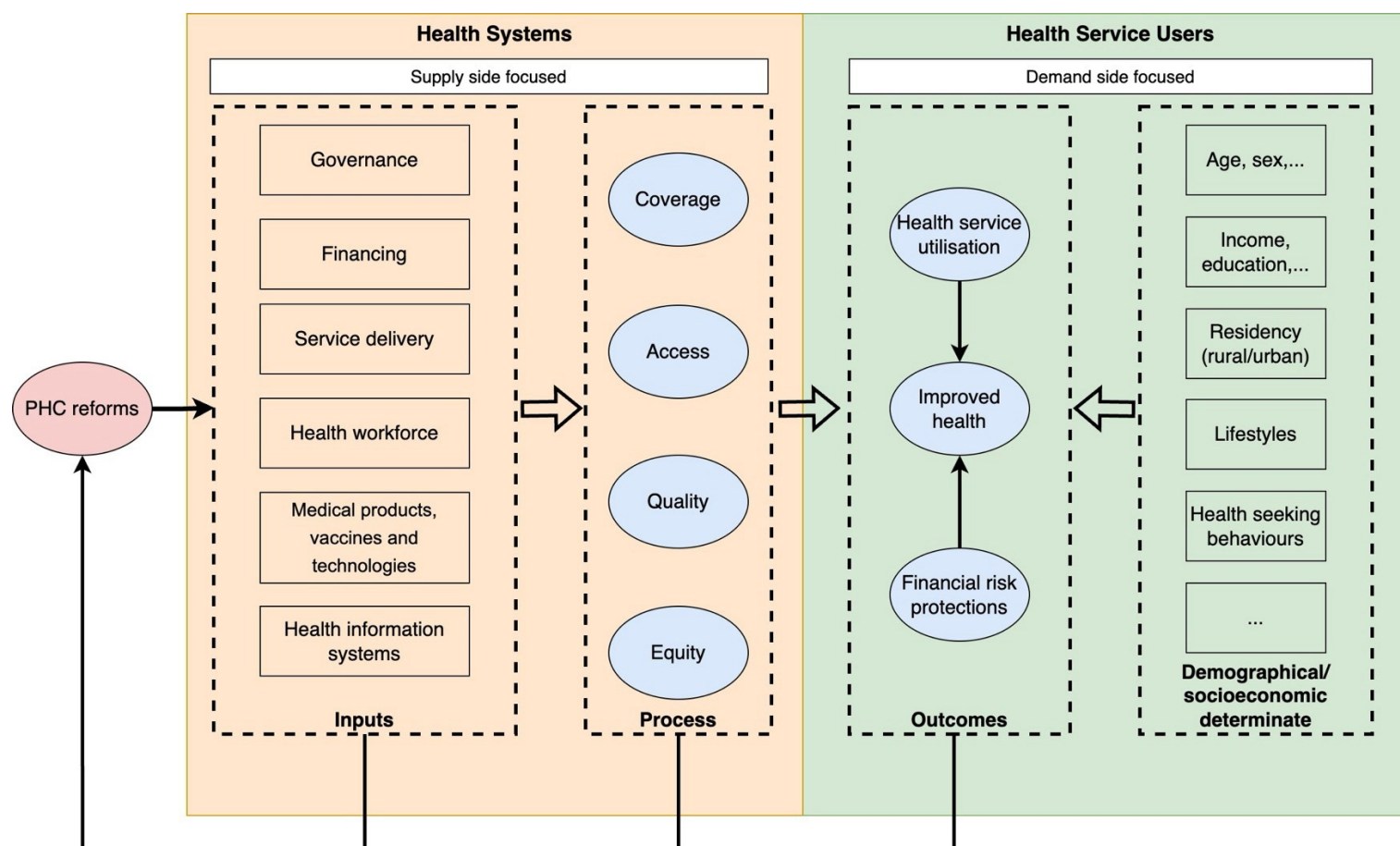


Figure 1 A theoretical framework for analysing the health system and health impacts of primary health care reforms.

Notes: The framework was adapted from WHO's six building block framework and the Donabedian framework. PHC for primary health care.

Source: Author's own work.

1.3 PHC in LMICs: challenges, reforms, and evidence

This section provides an overview of PHC reforms and relevant evidence from LMICs. This specific focus on LMICs originates from shared challenges and paradigms of PHC strengthening in LMICs, which are distinct from those in high-income countries (HICs). Compared with LMICs, HICs have more and better PHC resources and financing, higher essential care coverage, and less catastrophic health spending². Consequently, increasing health service coverage and equity in a low-resourced setting becomes a prioritised agenda in PHC reforms and research in LMICs^{39,40}. For this project, evidence from other LMICs can set benchmarks for the evaluations of China's PHC reforms, adding to generalisable knowledge on effective/ineffective PHC strengthening in LMICs.

1.3.1 Challenges to PHC in LMICs

As mentioned above, PHC in LMICs face various challenges that hinder the achievement of strong PHC and UHC, including insufficient and fragmented financing, scarce and under-trained workforce, poor quality care, persistent inequalities, and inadequate information system.

PHC financing is insufficient and fragmented in LMICs. In 2018, government expenditures on PHC contributed 13% of the total PHC expenditures in low-income countries, whilst this number for HICs was 59%⁴¹. The low-level public funds of PHC incur high individual out-of-pocket expenditures (OOPEs) as an alternative income resource for PHC. Consequently, people are more likely to be exposed to catastrophic health expenditures and impoverishment. In 2015, over 930 million people (12.7% of the global population) spent more than 10% of their household income on paying for health services, and most of them were from LMICs². Additionally, fragmented financing hinders the effective use of PHC funds and the delivery of continuous care. In LMICs, government funds mostly go into outpatient care provision, whilst individual OOPEs and/or private insurances largely contribute to prevention care and medicines and are unregulated⁴¹. The fragmented PHC

financing and spending attributes to the lack of overarching designs for financial pooling and distribution mechanisms.

Primary care providers in LMICs are scarce and undertrained^{42,43}. In 2020, the density of PHC professionals in low-income countries was about 30 per 10,000 population, whilst the density in high-income countries was 6.5 times higher⁴². The lack of skilful primary care providers and increasing health demands result in a heavy workload on the PHC workforce and incur burnout in this group⁴⁴. This adverse effect is prevalent among deprived areas with limited health workforce, such as rural areas⁴⁴. PHC professionals often have with low education levels and are inadequately trained⁴⁵. They also have poor adherence to routine protocols when delivering health services⁴⁵⁻⁴⁷.

The quality of care is poor in LMICs. Macarayan et al. assessed the quality of primary care in ten LMICs⁴⁸ and found low overall quality scores. The levels of evidence-based⁴⁸ and people-centredness care^{48,49} are low. The poor-quality care also reflects on long waiting time⁵⁰, low treatment completion or cure rate⁵¹, inappropriate use of drugs⁵² (e.g., antibiotics)⁵³, and low satisfaction levels^{54,55}. Low-quality care imposes 1.4-1.6 trillion (United States Dollar, USD) every year and counts for 15% of total deaths in LMICs⁵⁶.

Lastly, PHC-related data are limited and have poor quality in LMICs⁵⁷. There is a lack of PHC financing data⁴¹ and data related to patient experience and care quality⁵⁸. This contributes to the lack of clarification and, therefore, quantification of whether PHC goals have been achieved. Inadequate PHC data also prevent standardised monitoring systems for health system performance⁵⁸ and policy evaluations with robust study designs. Low-quality evidence and research can fail to better inform PHC policymaking in LMICs⁵⁹.

1.3.2 PHC reforms in LMICs and impacts

LMICs have made great efforts to address the above challenges through PHC reforms. This section reviews PHC reforms in LMICs in several main areas and relevant evidence on their impacts. These main areas are governance, financing, health service delivery, and workforce. For health service delivery, multiple policies were discussed in detail, including community-based care, essential medicines, and public health services.

- Governance

PHC reforms in LMICs typically involve organisational changes, such as decentralisation⁶⁰ and referral reforms⁶¹. Decentralisation typically encompasses some degree of transfer of administrative, technical or financial responsibilities from central governments to the local ones,⁶² the aim of flexible allocation of health resources and policy adoption. Whilst health service delivery was the most common decentralised domain among LMICs, some countries (e.g., Brazil, Turkey, Colombia) had system-wide decentralisation^{60,63,64}. Some evidence found increased access to health services and medicines and reduced OOPes after decentralisation.^{60,62,65,66} These studies were mostly from Latin America and Caribbean regions.

Referral reforms could involve partial gatekeeping and system integration. Self-referrals were common in LMICs, and first-contact with primary care providers was often not required^{43,67}. Partial gatekeeping was introduced in some LMICs, aiming at increasing first-contact with primary care providers and reducing the overuse of hospitals^{68,69}. Partial gatekeeping was typically non-mandatory and used lower service charges/user charges or higher reimbursements at PHC facilities to incentive visits.^{43,70} However, the impacts of such financial incentive gatekeeping on primary care utilisation were not clear⁷⁰. Additionally, integrations between primary care providers and higher-level hospitals were seen in LMICs^{61,71-73}. Some frequently seen approaches to integrations between primary care providers and hospitals in LMICs included establishing referral systems, collaborations on delivering bundled

care, and health information sharing^{61,72,74}. Evidence on integration had no clear pattern, and the quality was low.^{72,74}

- Financing

Many LMICs have gone through PHC financing reforms, including financial investments and reforms on public health insurance and payment methods. Although LMICs' health expenditures on PHC increased from 41 USD per capita to 90 USD between 2000 and 2017, the share of health expenditures on PHC decreased.⁷⁵ Increased PHC expenditures in LMICs were associated with increased maternal care utilisation and maternal health.⁷⁵ Meanwhile, public health insurance schemes have expanded in LMICs^{76,77}, aiming at increasing universal coverage. However, existing evidence suggests that these efforts to increase government expenditures and insurance coverage might be insufficient and pro-rich⁷⁸⁻⁸⁰. The Organisation for Economic Cooperation and Development (OECD)'s report shows between 2010-2019, government and compulsory health insurance spending as a share of GDPs increased by 0.4% (reaching 2.6% in 2019) but did not change in low- /lower-middle income Asian countries (remaining 1.7%)⁸¹. Health insurance coverage was not associated with catastrophic health expenditures in LMICs⁸². Health insurance enrollment in LMICs was 61% higher in the wealthiest people than that in the poorest⁷⁹.

Financing reforms on payment methods were also introduced in LMICs⁸³⁻⁸⁸. Alternatives for the traditional fee-for-service (FFS) payment include capitation payment, pay for performance (P4P), a blended payment, and removing user fees⁸⁹. However, it is worth noting that the designs of these alternative payment methods varied considerably across LMICs⁹⁰. The heterogeneous policy designs add challenges to evaluations on payment method reforms. Despite the massive body of existing studies on PHC financing reforms, the evidence is mixed. Some weak evidence shows that P4P had positive impacts on maternal and infant care utilisation.⁹¹ However, there is no clear pattern on the effects of P4P or capitation on health service utilisation or health outcomes⁴³. Nevertheless, there is some consistent evidence showing that reduction or removal of user fees is associated

with improved accessibility and efficiency of primary care services, reduced OOPes⁸⁹, and improved health improvements⁹². It is not clear the impacts of differential user fees on first-contact with primary care providers⁷⁰.

- Community-based care through primary care providers

Community-based care is often delivered through primary care providers, such as family physicians and general practitioners²⁰. The establishment and expansion of family physicians and general practitioners have been seen in many LMICs, such as Brazil^{7,84,93-96}, Iran^{97,98}, and Turkey⁹⁹. These primary care physicians aim to be the first contact of the health system for patients and promote universal coverage, community-based primary care, and people-centredness. Family physicians and general practitioners are responsible for delivering primary care services and home visiting, targeting vulnerable populations and people with limited access to essential health care services, such as women, children, and rural residents.^{97,99}

Existing studies on family physicians are mostly country-specific due to policy heterogeneities. Studies from Brazil found the expansion of family physicians was associated with increased access to health services and satisfaction¹⁰⁰ and reduced child/infant mortality^{7,101,102} and cardiovascular mortalities¹⁰³. Similarly, a systematic review from LMICs found that home visiting and counselling can reduce fetal and neonatal mortality¹⁰⁴. In contrast, evidence from Iran is mixed. Studies found that Iran's family physician plan increased maternal care use and birth weights but had no impact on maternal mortality¹⁰⁵, gatekeeping, or cost-saving¹⁰⁶. Additionally, there is some evidence showing that health workers¹⁰⁷ and volunteers¹⁰⁸ had positive impacts on access to selective primary care services.

- Essential medicines and health services

The coverage of essential health services and essential medicines has expanded greatly in LMICs². Essential health services and medicines aim at increasing their affordability and accessibility, particularly for underserved or high-risk populations,

such as the elderly, the poor, rural populations, and people with NCDs². Essential health services include a range of promotive, rehabilitative and preventive care for RMNCH, infectious diseases, and NCDs². The provision of essential medicines is guided by the WHO Model List of Essential Medicines, which updates annually¹⁰⁹. These services are frequently funded by governments, delivered as a package, and free-of-charge for people¹¹⁰, such as those in Mexico¹¹¹, Costa Rica¹¹⁰, Ecuador, South Africa, and Ukraine¹¹². For the least-resourced countries, selective primary care was introduced as an interim strategy for disease control^{113,114}, such as vaccination programs for measles, treatment for malaria, and encouraging breastfeeding.¹¹³

Free-of-charge essential health services can protect vulnerable populations and reduce inequalities in primary care accessibility and mortality¹¹⁵. Although abundant studies examine the accessibility, affordability or cost-effectiveness of essential medicines in LMICs, the evidence is mixed¹¹⁶⁻¹¹⁸. Some evidence suggests that essential health services are cost effective in increasing accessibility^{119,120}.

- Workforce

Reforms on the PHC workforce in LMICs have various strategies, including recruitment, education, training and supervision, incentivization¹²¹⁻¹²³. Existing primary care providers were provided with training opportunities to extend their generalist skills and further their careers^{18,121}, and new general practitioners were recruited from medical students¹²³. Newly trained PHC professionals typically were assigned with supervisors, who support and follow up with their performance, for quality assurance¹²¹. The quantity and quality of health services delivered by PHC professionals were typically monitored, based upon which bonuses and incentives might be offered¹²¹. To address PHC professional shortage in LMIC, some primary care tasks, such as screening for NCDs, were shifted to non-physicians (e.g., health workers or volunteers), known as task-shifting^{43,124}. However, the designs and implementations of these PHC workforce reforms varied greatly across LMICs¹²⁵.

Two systematic reviews from LMICs show that improved PHC workforce performance was associated with improved use of primary care services, quality of care, and biological outcomes¹²¹, and that NCD-related task shifting was associated with reduced blood pressure and increased medicine uptakes¹²⁶. However, evidence on PHC workforce reforms in LMICs is much less than those in HICs, and the quality of evidence was low.^{127,128}

The majority of the PHC reforms mentioned above mainly focused on one or two building blocks of health systems. Additionally, some LMICs pioneered large-scale and system-wide PHC reforms, such as Bolivia,¹²⁹ Iran,⁹⁸ and China. China's comprehensive PHC reforms since 2009 will be discussed in more detail in [Chapter 2](#).

1.3.3 Evidence gaps on PHC reforms in LMICs

The previous section reviewed some evidence on PHC reforms in LMICs. Overall, the existing evidence on PHC reforms in LMICs is mixed and disproportionately focused on health service utilisations. There are substantial evidence gaps in 1) evidence from Asia, 2) robust study designs, and 3) evaluations of comprehensive reforms as a whole.

Two reviews across LMICs found positive impacts of PHC policies in LMICs on increasing access to essential health care to vulnerable populations (e.g., vaccines, care for RMNCH, and human immunodeficiency virus (HIV) diagnosis and treatment) and reducing child mortality^{39,130}. However, broader health service utilisation, hospitalisation, health service costs, care quality, and other health outcomes were understudied^{39,101,130}. Additionally, cross-country evidence on broader health system impacts of LMICS' PHC reforms was commonly mixed^{70,72,74,116-118}. This is reasonable given the great heterogeneities in the designs and implementation of PHC reforms in LMICs. The mixed evidence underscores the need for more country-specific studies accounting for the unique political, cultural, and societal context and adds to the landscape of the evidence maps.

The existing evidence is largely based on Latin America, with low-quality evidence and a lack of comprehensive evaluations. Several cross-country reviews highlight that the existing studies on PHC reforms in LMICs have been aggregated in Latin America^{60,131} and Africa⁷⁹, whilst other LMICs have been underrepresented⁴³.

Multiple reviews also underline evidence on PHC reforms in LMICs is generally with low quality and lacks rigorous study designs.^{39,43,132} Additionally, evidence on comprehensive PHC reforms in LMICs as an entity is scarce⁴³, except for studies from Iran⁹⁸ and Bolivia¹²⁹. This is because comprehensive PHC reforms are rare in LMICs⁴³, and there is a lack of system perspective in relevant studies¹³³. This missing perspective could hinder a better understanding of the underlying reform mechanisms in LMICs^{133,134}.

Understanding of the challenges and existing evidence of PHC reforms in LMICs is pivotal for the evaluation on China's PHC reforms in this project. As one of the LMICs, China's PHC strengthening is anticipated to mirror challenges common to other LMICs. It is intriguing to evaluate how these common challenges have been addressed in China's PHC reforms. The existing studies also highlight areas where further research is needed to better inform future PHC reforms in LMICs, such as the need for evidence beyond essential care utilisation and rigorous studies. These evidence gaps identify research priorities and methodological challenges in the existing studies, providing crucial rationales and guidance on the design of this PhD project.

1.4 Conclusion

Whilst all countries regard health as an essential human right, health challenges and inequalities are prevalent within and across countries. The concept of PHC was purposed to achieve the goals of "Health for All" and has evolved over time to reach boarder engagement, from primary care services to a whole-society approach. The comprehensive PHC approach resonates with the complexity of health systems. PHC in LMICs faced various challenges, including insufficient and fragmented financing, limited skilful workforce, limited financial protection, poor-quality care, inadequate health data, and persistent health inequalities. In response to these

challenges, many LMICs have gone through PHC reforms and achieved encouraging progress in increasing equitable essential health care and gaining some health improvements (e.g., reducing infant mortality). However, existing evidence on PHC reforms in LMICs has substantial gaps in 1) evidence from Asia, 2) studies with rigorous designs, and 3) evaluations of comprehensive PHC reforms as an entity. More in-depth case studies with rigorous designs are needed on PHC reforms in LMICs to better inform policy makers.

The next chapter will introduce China's healthcare system and its comprehensive PHC reforms since 2009, the subject of this evaluation project and offer insights into real-world comprehensive PHC strengthening in a LMIC-setting.

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Chapter 2. China and China's health system

2.1 Introduction of China

China is the world's second most populated and the third largest country, with a population of 1,425.7 million in 2023 (equivalent to 17.8% of the world population) and an area of 9.6 million km². Economically, China is the world's second largest economy, with a total gross domestic product (GDP) of 17,963,171.48 million USD and 12,720.2 USD GDP per capita in 2022. China's Human Development Index (HDI) was at 0.768 in 2021, ranking 79th in the world.

China has 31 provinces, municipalities, autonomous regions and 333 prefectures (the first level division of provinces). The four municipalities, Beijing, Shanghai, Tianjin, and Chongqing, have an administrative level equivalent to that of other provinces. For simplicity, the following sections will refer to the four municipalities as provinces. Defined by the National Bureau of Statistics of China, the 31 provinces are grouped into three regions based on geographical position and socio-economic developments: Eastern, Central, and Western China¹³⁵ (**Figure 2**). There is sizeable variability across the provinces in terms of geographic, population sizes, economic developments, and health resources¹³⁶. In 2022, Beijing had a relatively high GDP per capita, with an average of 41,610.9 Chinese Yuan (6,146.4 USD) per capita GDP, whilst Gansu had a relatively low GDP per capita, with an average of 11,201.6 Chinese Yuan (1654.6 USD) annual per capita GDP.

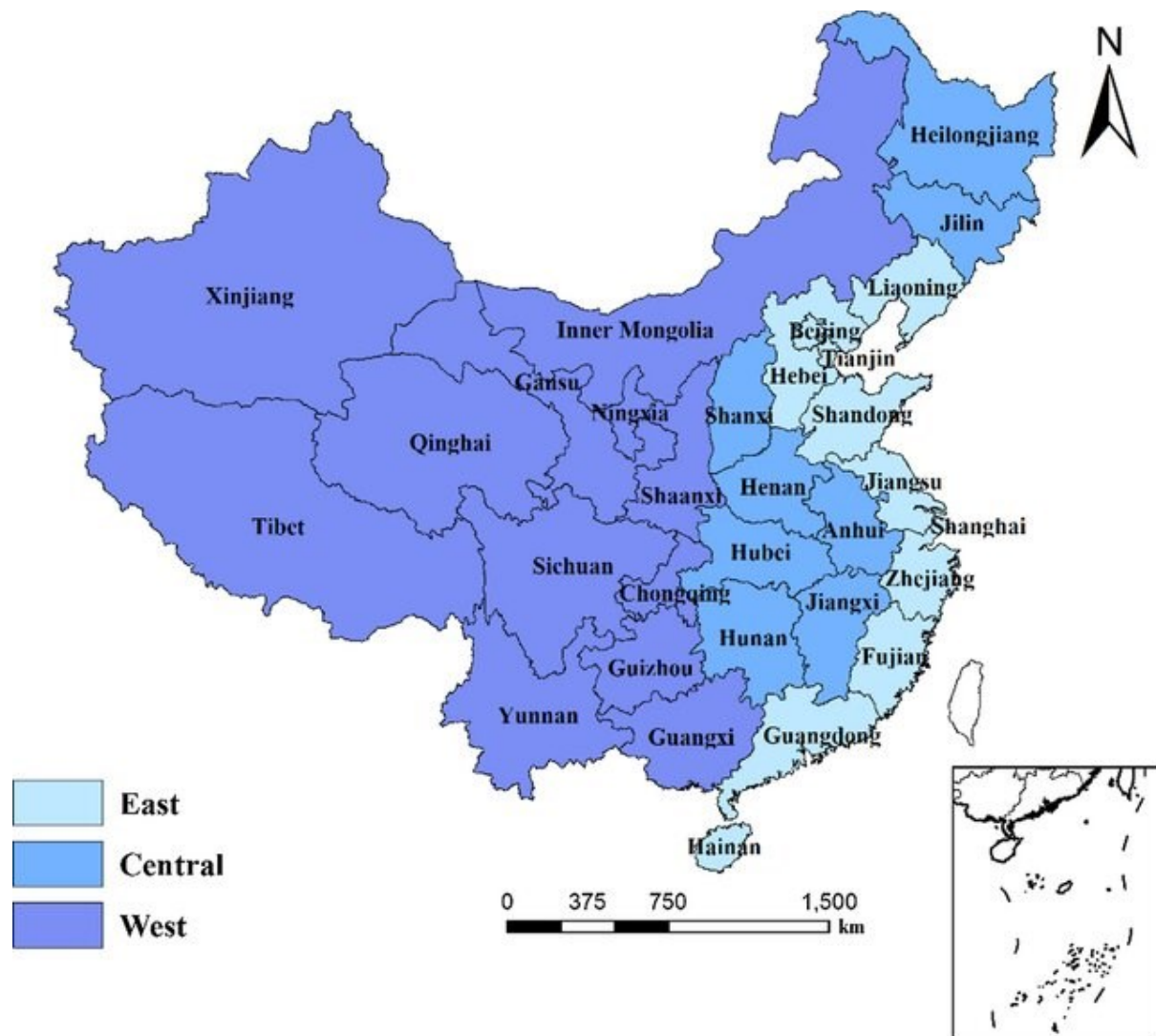


Figure 2 A map of China and the locations of eastern, central, and western regions.

Notes: Eastern China includes Beijing, Tianjin, Hebei, Liaoning, Shanghai, Jiangsu, Zhejiang, Fujian, Shandong, Guangdong, and Hainan. Central China includes Shanxi, Jilin, Heilongjiang, Anhui, Jiangxi, Henan, Hubei, and Hunan. Western China includes Neimenggu, Guangxi, Chongqing, Sichuan, Guizhou, Yunnan, Tibet, Shaanxi, Gansu, Qinghai, Ningxia, Xinjiang.

Source: adopted from Guo (2022)¹³⁷.

China's governance structure has three tiers, including national, provincial, and capital-city governments. At the national level, the National People's Congress, as "the highest organ of state power", has legislation rights. The State Council, led by the Premier, is the central government's executive branch, with affiliated ministries and commissions, to ensure the execution of laws and policies passed by the National People's Congress (**Figure 3**). Among all affiliated ministries under the State Council, the highest health administrative department is the National Health and Family Planning Commission (NHFPC), the former Ministry of Health until 2013. The NHFPC is responsible for formulating and enforcing health policies and regulations. The NHFPC collaborates horizontally with other ministries when relevant responsibilities are involved, such as the Ministry of Finance, the Ministry of Human Resources and Social Security, the Ministry of Civil Affairs, and the National Development and Reform Commission. A similar structure is adopted by provincial and city-level governments, ensuring consistent policy implementation across different administrative levels.

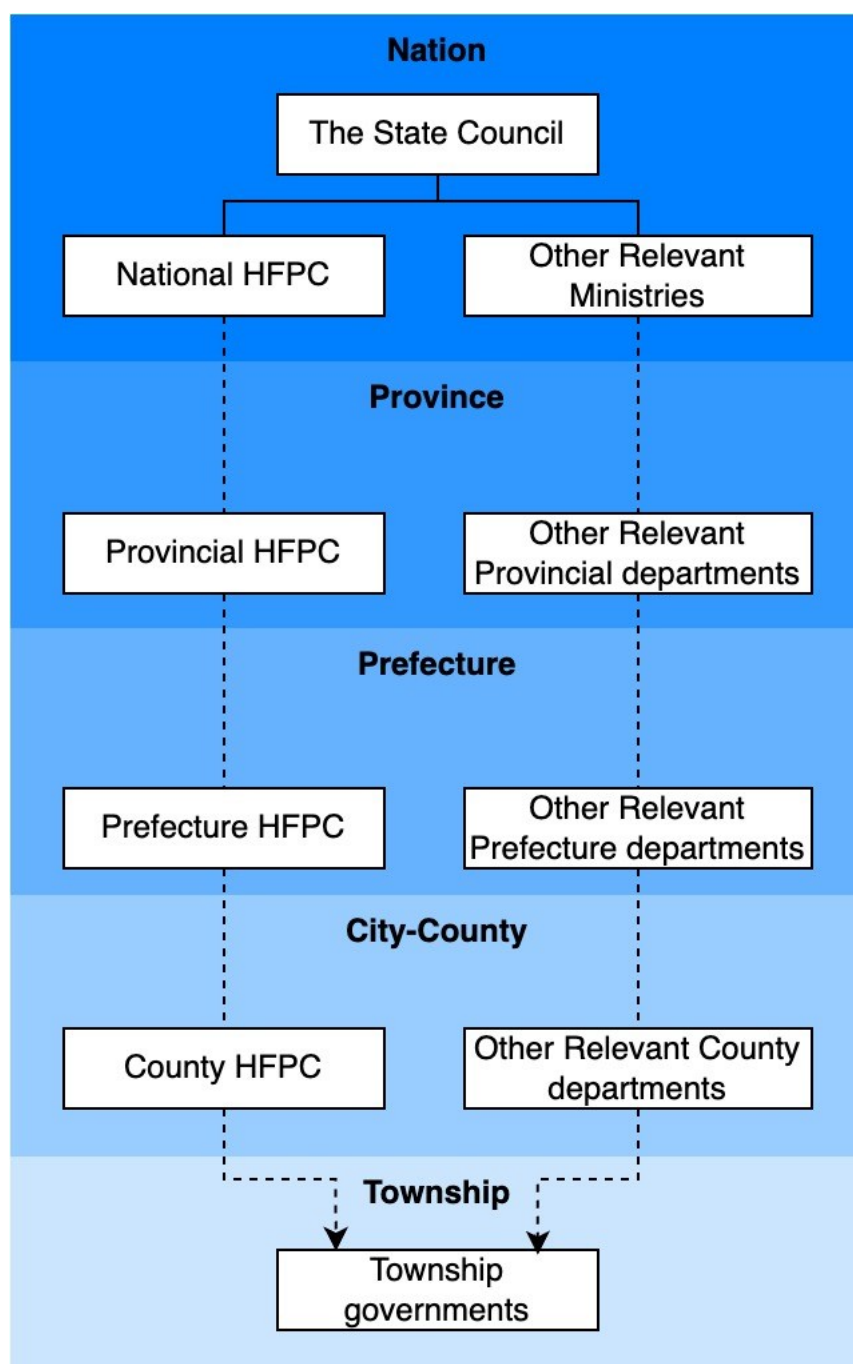


Figure 3 The governance structure of China's health system between 1998 and 2008

Notes: HFPC for Health and Family Planning Commission, the former Ministry of Health. Other relevant ministries include the Ministry of Finance, the Ministry of Human Resources and Social Security, the Ministry of Civil Affairs, and the National Development and Reform Commission. The dash line indicates the existence of decentralisation.

Source: created by the author based on the Notice on Institutional Organisation of the State Council (1998)¹³⁸.

2.2 An overview of China's health system before the reform

2.2.1 Governance

In 1978, China started “the reform and open-up” era when the planned economy transformed into a socialist market with a focus on economic growth. This economic transition had profound implications for the health system. Unlike the previous top-down planned health system, China's health system became largely market-driven in terms of resource allocation and service provision¹³⁹. The government's role in funding weakened, although its power remained regarding price setting for health services.

During the 1980s, the power dynamic between central and local governments also changed. In 1985, the central government decentralised its administrative power¹⁴⁰. Local governments and health providers were granted more health responsibilities and autonomy. On the other side, the central government centralised the fiscal power from local governments, resulting in reduced local government revenue and increased expenditures. These changes directly contributed to dwindled public health funds and posed severe threats to the financial sustainability of the health system. To compensate for the loss of revenue sources, health providers inevitably turned to health service charges for revenue incomes. They gradually transitioned to independent businesses with self-governing operations and financing. Later, in 1989, the market-driven health system was reinforced to expand the coverage of health services¹⁴¹. Health facilities were given large amounts of autonomy in terms of regulation, revenue generation, and operation. These changes gradually transformed health services from publicly-provided to marketable products.

There were no fundamental changes in the decentralised structure of the health system after the 2009 reform. However, this structure created challenges in the administrative and tax-collecting power division, motivating health providers to prioritise revenue generation from health service provision. This motivation fuelled

the crisis of expensive health services, unmet health needs and, eventually, the 2009 reforms.

2.2.2 Financing

The level of public funds for China's health system has been historically low. In 2000, government health expenditures comprised only 15.47% of total health expenditures and 0.71% of gross domestic production (GDP)¹⁴². This was considerably lower than the world's average (57.42% and 4.95%)¹⁴³. Meanwhile, out-of-pocket expenditures contributed 60.13% of total health expenditures, comprising the main funding source¹⁴⁴. Although the share of government health expenditures increased during 2000-2009, it was consistently lower than the world average ([Figure 4](#)). Over half of the government health expenditures were allocated as subsidies to cover the infrastructure, equipment, daily operation, and salary in hospitals, and delivery of some essential public health services.¹⁴²

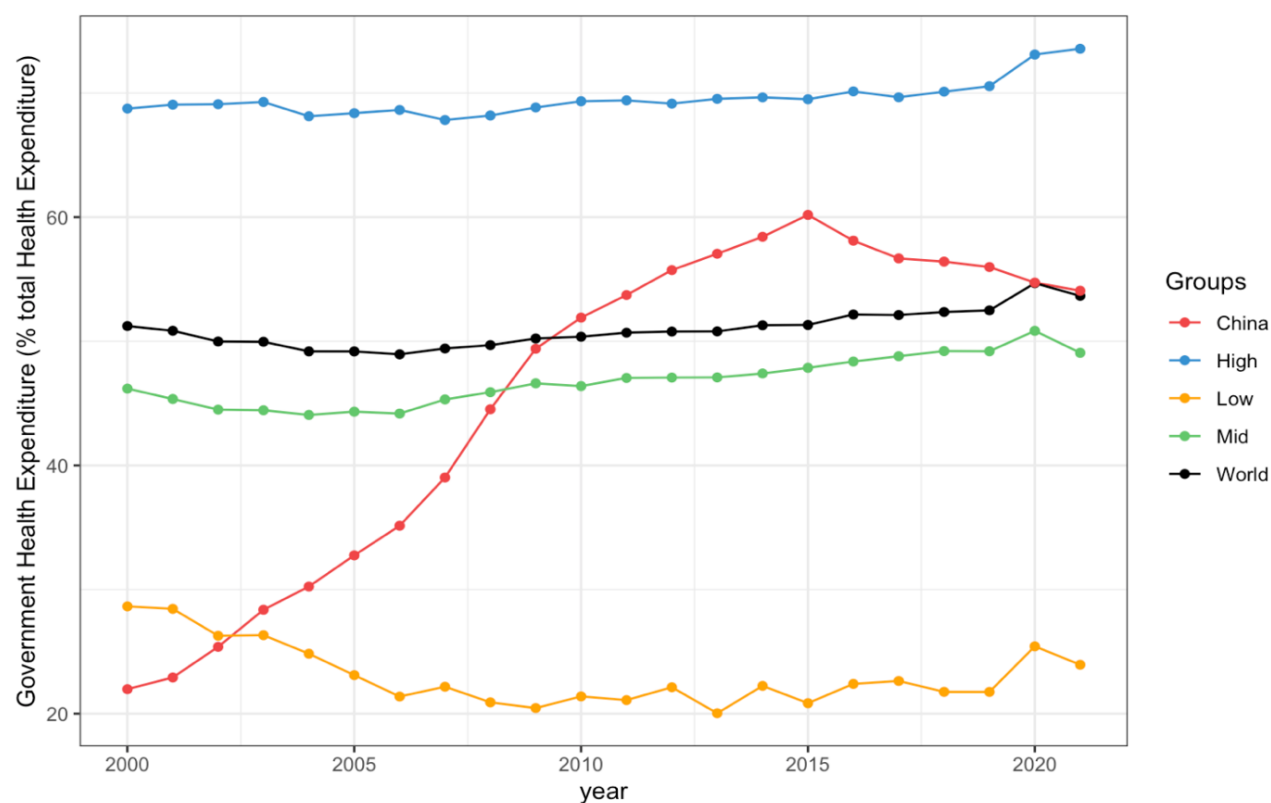


Figure 4 The percentage of government health expenditures among total health expenditures grouped by world average, high-, middle-, low-income countries, and China.

Source: author's own work. Data from World Health Organisation Global Health Expenditure database.¹⁴⁴

In terms of payment methods, fee-for-service (FFS) was the main provider payment mechanism. Health service users had to pay for service charges out of pocket, part of which could be reimbursed for health insurance enrollees. Over 60% of provider incomes were from out-of-pocket payments, while an additional 20% came from basic health insurance.¹⁴⁵ Although health service prices were set under the central government's regulation and at a low level, hospitals compensated for the low regulated prices by over-prescription, overusing technology-intensive services or equipment with high-profit margins (CT scan and X-ray)¹⁴⁶, and unbundling health services¹⁴⁷. Moreover, a drug-sale margin was also added as markup to compensate for the income of hospitals and doctors (15% and 25% for Western and Chinese medicine, respectively)¹⁴⁵. Eggleston and Yip found that in 1999, drug sales and high-value equipment took up 50% and 36% of the total income in government-owned hospitals¹⁴⁶. These behaviours all contributed to costly health services^{145,148}.

Regarding health insurance, the Chinese government established the Urban Employee Basic Medical Insurance (UEBMI) in 1998¹⁴⁹. However, this new scheme did not cover the elderly, children, students, self-employed urban residents, or rural populations. Rural populations were later covered by the Rural New Cooperative Medical Scheme (RNCMS) in 2003,¹⁵⁰ and this scheme further expanded in 2006.¹⁵¹ The uninsured urban residents (e.g., unemployed residents, students, and elderly people in urban areas) were introduced to the Urban Resident Basic Medical Insurance (URBMI) in 2007. After then, the three pillars of China's basic health insurance scheme, UEBMI, URBMI and RNCMS, were established. By the end of 2007, there were 180.20 million enrollees for UEBMI and 31.31 and 42.91 million enrollees for RNCMS and URBMI, respectively¹⁴². These insurance schemes were operated by state-owned companies. Private insurance companies were underdeveloped and had limited coverage¹⁵².

The Urban Employee Basic Medical Insurance (UEBMI) covered employees and retirees in urban areas. The UEBMI provided deductibles, co-payments, and a ceiling setting for a list of prespecified eligible fees for medications, diagnosis, and treatment services in hospitals. The scope of the insurance mainly covered inpatient care in designated hospitals. Coverage for outpatient care and pharmacy services

was extremely low. The UEBMI were funded by employees and employers without contribution from government health expenditures. In 1994, the UEBMI funds were split into individual accounts, work units, and social pooling¹⁵³. Contributions paid by the employee went directly into their personal accounts, whilst the contributions paid by the employers were separated into personal accounts (~30%) and the pooling fund. People who had already retired did not need to pay any contribution. Beneficiaries could access their personal account for regular medical services, and the social pooling was for major diseases.

The URBMI and RNCMS had some similarities. For instance, both schemes were funded by individuals and governments and mostly covered inpatient care, with limited coverage for outpatient care. However, most of the funds for URBMI came from individuals, whilst government subsidisation was the main fund for the RNCMS. **Table 1** shows the variations in the reimbursement, benefits, and ceiling of the RNCMS across regions in 2005. Central and western China had a higher proportion of beneficiaries and covered expenses. The Chinese government set a low annual premium for RNCMS (20 Chinese Yuan in 2003, 2.99 USD)¹⁵⁴ to encourage rural residents to enrol on the health insurance. Although the RNCMS covered 78% of the rural population in China since 2003, the reimbursement rate could be as low as 30%¹⁵⁴.

	Announced benefits under different rural medical systems for inpatient care					Typical actual benefits received for inpatient care		Incidence of payments per year	Typical costs
	Median deductible amount per consultation		Median ceiling on insurance benefits		Median insurance payment	Proportion of expense actually covered by insurance	Actual co-payment	Number of people receiving benefits per year	Actual average per capita inpatient spending
	CNY	Months income	CNY	Months income	%	%	Months income	% of participants	CNY
Nation	305	0.9	10 000	29	70	23.4	9.4	3.3	3 344
East	500	1.1	20 000	44	75	22.4	10.0	3.0	4 539
Central	300	0.9	10 000	31	70	24.3	6.5	3.7	2 147
West	200	0.8	5 000	20	70	28.7	6.3	3.6	1 729

Table 1 Reimbursement, benefit, and ceiling of the RNCMS in 2005

Notes: CNY for Chinese Yuan.

Source: Herd et al. (2010).¹⁴⁷

Challenges posed by health financing were one of the main targets of the 2009 reform. First, the limited public funding and health insurance coverage contributed to limited financial protection and high OOPes^{152,155}. Second, costly health care and distorted price schemes were prevalent due to the self-sustain financing for health providers and the FFS mechanism. The FFS payment method encouraged overtreatment and overprescription, leading to low-efficient treatments and unnecessary health expenses. Third, the fragmented financing system between public and individual funds prohibited efficient budgeting and utilisation of healthcare funds. The “pay first, claim later” model and complex repayment application process were barriers for poor, illiterate, and seriously ill people to access health services¹⁵⁴. All these challenges further resulted in impoverishment,¹⁵⁶ unmet health needs,¹⁵⁷ and substantial inequalities in health care utilisation and health outcomes^{158,159}.

2.2.3 Health service delivery

Before the 2009 reform, China’s health system was heavily hospital-centric, dominated by public hospitals overseen by local health departments. Hospitals dominated health resource allocation and health service provision, particularly in urban areas.¹⁴⁷ Public hospitals greatly outnumbered private hospitals. With the large market share, the number of public hospitals, including both general and special hospitals, increased from 2,600 to 60,429 between 1949 and 1987¹⁶⁰. China’s hospital sector had four administrative levels, including national, provincial, prefecture, and county levels. Hospitals with higher levels often had higher capability and capacity, such as more skilled health professionals and hospital beds.

PHC facilities played a key role in health service delivery in resource-restrained areas (e.g., rural areas)¹⁶¹. However, its development substantially lagged behind that of hospitals. PHC facilities were mostly underfunded, under-equipped, and underused. Village clinics and township health centres were the main health care providers in rural areas. Around 38% of urban PHC facilities had beds for observations in 2007¹⁶².

Figure 5 shows the typical health service delivery system in China before 2009. There was an absence of a referral system, gatekeeping mechanism, or role division across different health care facilities¹⁶¹. Although referrals were possible, they were not formally regulated, guided or mandatory¹⁶¹. PHC facilities and hospitals both provided public health services, such as maternal and child health services, family planning, vaccinations, and other preventative care. Individuals can freely choose between PHC facilities and hospitals without any guidance or triage.

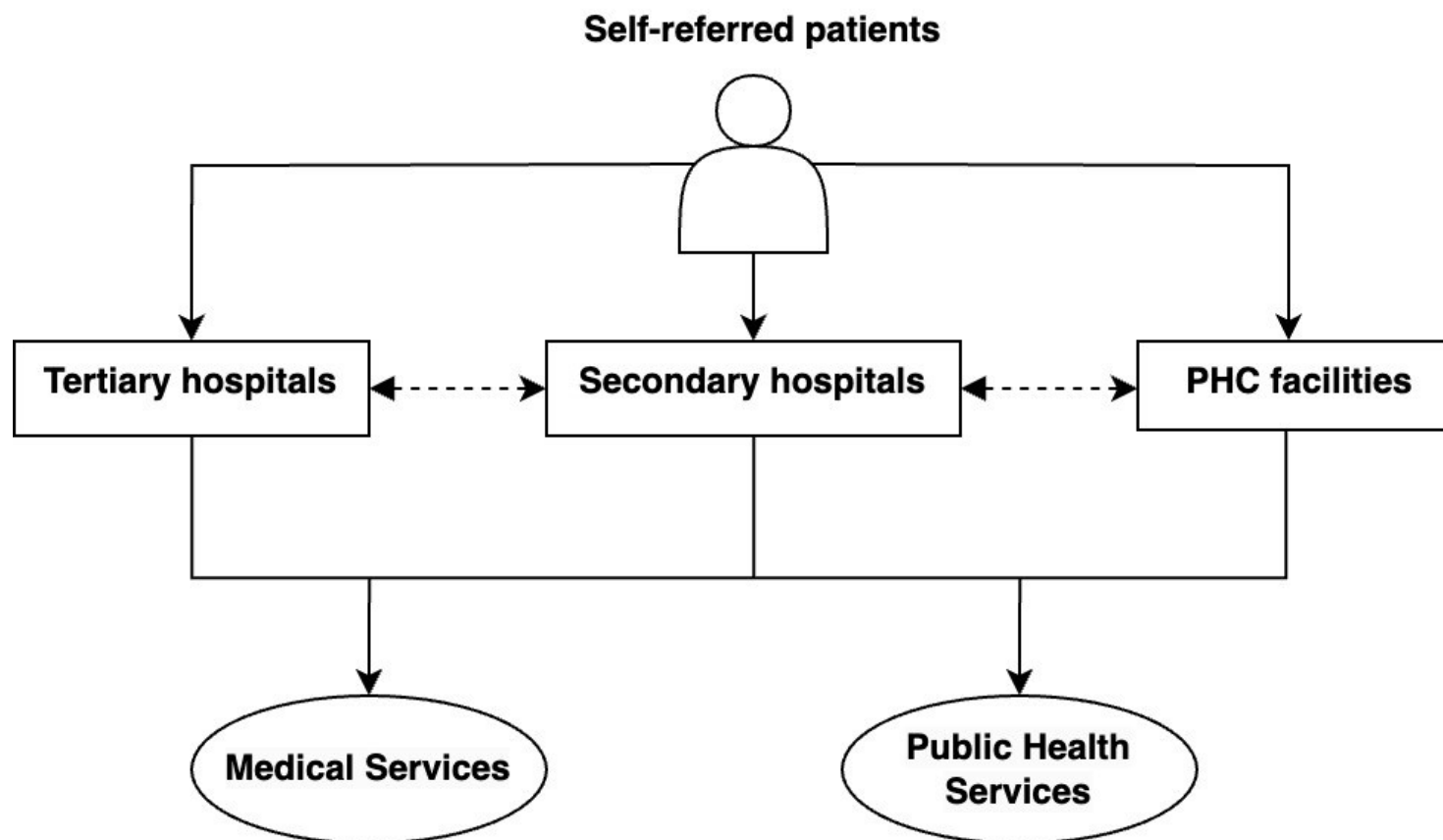


Figure 5 A diagram of health service delivery in China before 2009

Notes: the dash lines indicate the referrals between the two types of health care facilities were possible but without any formal regulation. PHC for primary health care. PHC facilities included community health centres/stations in urban areas and township hospitals and village clinics in rural areas.

Source: Author's own work

The hospital domination and self-referral system posed various challenges to the health system. First, hospital domination suppressed the development and utilisation of the PHC sector. PHC facilities were poorly equipped and unable to carry out regular examinations and tests, such as ECG machines and B-scan ultrasonography. In 2003, there were 1.21 billion visits to hospitals, whilst this number in PHC facilities was 0.074 billion visits¹⁶². In 2008, around 80% of ambulatory care was delivered by hospitals¹⁴⁷. Second, hospitals aggregated in developed regions (e.g., coastal eastern China), accelerating the geographical inequalities in access to health services. People from remote areas or townships experienced long transportation time to visit hospitals. Third, the self-referral system resulted in low efficiency, waste, and inequalities in health care utilisation. Self-referrals were commonly based on affordability, indicating rich people often had better access to quality hospital care. Additionally, people would visit hospitals directly regardless of the type and severity of the disease. For instance, according to Lim's study in three provinces, 20% of outpatient visits in hospitals were for colds and gastroenteritis¹⁶³. Whilst hospitals were crowded out with patients with minor illnesses, patients with severe diseases might not be able to get timely treatments due to long waiting times. This situation was described as “kan bing nan, kan bing gui” (看病难, 看病贵) in Mandarin, meaning health seeking is difficult and expensive. It was one of the main priorities of the 2009 PHC reforms.

2.2.4 Health workforce

Health workforces consist of health professionals in PHC facilities, hospitals, or other health facilities, including licensed (assistant) doctors, registered nurses, pharmacists, and laboratory/radiology technicians. The ratio of health professionals to the population remained consistently low before 2009, less than 4 per 1,000 people¹⁴². These health professionals were mostly specialized, with no general practitioners.

In terms of training and qualification, a licensed doctor was either a medical graduate with a bachelor's degree or from a 3-year medical education training programme.

Either pathway was followed by a supervised 1-year internship at a medical facility¹⁶⁴ and required passing a licensing examination. Nurses followed a similar training pathway, but no examination was needed. However, 61.6% of doctors and nurses were only educated up to secondary school in 2005¹⁴². This percentage was even higher in rural areas (79.0%).

In addition to licensed professionals, village doctors played a crucial role in the delivery of primary care services in rural areas. However, village doctors received no medical training and were not licensed. Village doctors originated from the Barefoot Doctor scheme, which was introduced in 1968 as a solution to the shortage of health personnel in rural areas¹⁶⁵. They were farmers who received around six months of training to provide primary care services to rural residents and were paid by the local collective funds. Their abilities were generally low and variable. In 1985, China replaced the term 'barefoot doctor' with 'village doctor', which has been used continually ever since.

Before the 2009 reform, China's health workforce was confronted with challenges, including a lack of PHC personnel, inadequate training and payments, and imbalanced distribution. The percentage of specialists was disproportionately high, even in PHC facilities.¹⁴⁷ Since general practitioners (GPs) were scarce, specialist doctors could be seen at PHC facilities delivering treatments for patients with minor diseases. The workforce distribution between hospitals and PHC facilities was unbalanced. Skilled health workforces were mostly concentrated in tertiary hospitals, whilst clinically trained health workforces were limited in PHC facilities. Salary and incentives for health professionals were low, resulting in dependence on markups and margins. PHC personnel, such as village doctors, were mostly underqualified without proper medical training. These challenges urge improvements in health workforces, which were underpinned by the 2009 reform.

2.2.5 Geographical variations and inequalities

There were great geographical variations in health resource allocation, health service delivery, and population health, with two primary types: urban/rural and regional (eastern, central, and western). Understanding these heterogeneities is pivotal when evaluating China's health system and reforms.

As mentioned above, rural and urban populations had different insurance schemes with different premiums, coverage, and cost-share¹⁶⁶. The coverage of national health insurance in rural populations was lower than in urban populations^{167,168}. Doctor density in rural areas was only half of that in urban areas in 2005¹⁶⁴. In terms of access to health services, urban populations had better access and less travel time to health facilities,^{136,167,168} better coverage of preventive care and treatment,^{136,168} and less catastrophic health expenditures and medical impoverishment¹³⁶ than their rural counterparts. Rural populations had a higher prevalence of unmet health needs due to limited access to health care,⁸ and financial barriers¹⁶⁹. Additionally, rural populations had low self-reported health¹⁷⁰, higher infant mortality¹⁵⁵, higher rates of coronary heart diseases, hypertension prevalence, and cardiovascular disease deaths⁸ than their urban counterparts.

Eastern China was characterised by high population density, urbanisation¹⁷¹ and better access to health care than central and western regions^{136,168}. Whilst the gaps in access to health services narrowed between eastern and central China,¹³⁶ remote western China remained challenged by low coverage of health facilities, health services, and PHC personnel^{136,172,173}. Catastrophic health expenditures prevailed in all regions¹⁶⁸, and eastern regions had a lower incidence of CHE¹³⁶. Whilst eastern regions had better access to health resources, its accessibility equity was worse than central regions¹⁷².

2.3 The first round of China's PHC reforms (2009-2014)

This section provides a detailed description of China's PHC reforms since 2009, which is the core subject of this PhD project. The reforms are divided into two stages: the first stage of the PHC reforms (2009-2014) aiming at improving the accessibility and affordability of primary care services, and the second stage of the PHC reforms (2015-2020) aiming at establishing a PHC-oriented health system with increased primary care utilisation and quality of care.

2.3.1 Background and aims

In 2009, China launched an ambitious and system-wide health reform aiming at shifting the hospital-centric health system to a PHC-oriented one and providing people with “safe, efficient, convenient, and affordable” health care services¹⁷⁴. The reform emphasised “the grass-root health care service system” (i.e. the PHC sectors) to better reach underserved populations, such as those in rural areas or with financial hardship. This comprehensive health reform covered both the hospital and PHC sectors. The hospital reforms primarily focused on public hospital financing, including increasing government budgets, removal of drug markup, and introducing diagnosis-related group-based payments¹⁷⁵. These policies targeted secondary care and had distinct policy objectives and no direct impacts on the PHC sector. Given that this PhD project focuses on PHC in China, these hospital reforms are not discussed in this project. It is worth noting that the second-round reforms included some system-wide policies that affected the hospitals and PHC sectors, such as integrated referral systems (discussed in the following section). These policies were considered as parts of the PHC reforms and assessed in this project. I use the term “PHC reforms” to refer to China's health reforms that impacted the PHC sector since 2009.

2.3.2 Reform content

The first stage of the PHC reforms focused on enhancing the infrastructure of the PHC sector and increasing the accessibility and coverage of primary care services. Key policies and building blocks targeted during the first stage of PHC reforms were: 1) financing, 2) the National Essential Medicine Scheme, 3) the National Essential Public Health Package, and 4) a general practitioner scheme ([Table 2](#)).

- Financing

During 2009 and 2011, the Chinese government demonstrated a strong commitment to PHC strengthening and invested over 63 billion Chinese Yuan (9.40 billion USD) in the PHC sector. These funds were strategically allocated towards PHC infrastructure, workforce, equipment, operation, and subsidies for basic health insurance. Additional subsidies were offered to construct new PHC facilities and upgrade equipment in under-resourced regions.

To diversify payment methods, the Chinese government introduced a hybrid payment framework, incorporating a blend of global budgeting, capitation, and FFS. Capitation was mostly adopted for essential public health services to broaden coverage and promote equitable access to all populations. Through capitation, health service providers received fixed payments per capita to deliver low-margin or free-of-charge essential health services to people. Meanwhile, global budgeting imposed predetermined financial allocation to health care facilities aiming to restrict overtreatment and to slow down increases in health services costs.

- The National Essential Medicine Policy (NEMP)

The National Essential Medicine Policy (NEMP) was introduced to increase the coverage and affordability of essential medicines¹⁷⁶. A basic package of 205 essential medicines was listed as essential in 2009. As the policy expanded, essential medicines increased from 205 to 417 Western medicines and from 102 to

268 Chinese medicines from 2009 to 2018. Essential medicines can be accessed with prescriptions from all PHC facilities or pharmacies. Essential medicines were partly covered by government subsidies and basic health insurance and had higher reimbursement rates than non-essential medicines.

Critical to the NEMP's success was the establishment of a standardised regulatory framework for procurement, distribution, and pricing. All essential medicines were purchased through public bidding and distributed with a unified allocation system to control drug prices. Local governments monitored and regulated the public procurement, delivery, use, and prices of essential medicines. Provincial governments were involved in price negotiation and quality assurance, such as setting suggested retail prices and distribution charges for essential medicines. Essential medicine providers could set their bidding prices accordingly. Additionally, markup/margins for essential medicine were not allowed at PHC facilities to further control drug expenses and out-of-pocket expenditures. For the long term, the NEMP also aspired to establish a transparent and evidence-based pricing mechanism based on needs.

- The National Essential Public Health Services (NEPHS)

A publicly-funded National Essential Public Health Services (NEPHS) Package was introduced to provide free-of-charge essential public health to all populations, with a particular emphasis on high-risk populations and vulnerable groups (such as children, females, and people with NCDs).¹⁷⁷⁻¹⁷⁹ In 2009, a 15-yuan per capita (2.24 USD per capita) budget was subsidised by local government health expenditures to health service providers, which increased to 20 Chinese Yuan (2.98 USD) in 2011¹⁷⁸. Meanwhile, the central governments provided additional subsidies for delivering NEPHS to underdeveloped regions.

This package included nine essential public health services, including 1) individual health records, 2) health education, 3) vaccination, 4) infectious disease prevention, 5) child care, 6) maternity care, 7) elderly health, 8) chronic disease management,

and 9) care for severe mental illness. The provision of these services was moved down to PHC facilities with free charges after the 2009 reforms¹⁷⁹. Every resident was assigned an individual health profile with unique IDs to record health information, including basic demographic information, disease and medication history, health lifestyles, health examination results, and referral history.

Essential maternity and child care covered in the package were free and delivered by primary care providers. Individual health records were established for newborns and infants from 0-36 months. Newborns were closely monitored through follow-up visits by primary care providers at least four times in the first year and two times in the second and third years. The free-of-charge essential newborn care at PHC facilities included support for breastfeeding, nurturing care, vaccines, psychological and behavioural development, infection prevention, and recognition of danger signs. Pregnant women had a similar protocol, including individual health profiles and a defined health package. The package covered a continuum of care throughout the pregnancy and the 42-day postnatal periods, including establishing individual health records, physical examinations (at least five times prenatal care and two times postnatal follow-up visits), risk screening, and health education. Apart from these free services, other maternal-related costs were covered by a fixed payment covered by the basic health insurance.

The NEPHS also encompassed tailored primary care services for people with non-communicable diseases (NCDs) and the elderly population. People aged 35 and above were provided with health examinations to identify high-risk populations. For people already diagnosed with hypertension and diabetes, health education, regular health examinations, and follow-up visits were provided. People aged 65 and above were registered for individual health profiles. Health examinations and screening were provided for the elderly to identify health risks. Relevant health education, such as self-care and NCD prevention, were also covered in the NEPHS for the elderly.

- A general practitioner scheme

A general practitioner training scheme was established¹⁸⁰ with GP-related medical education and training, care delivery, and payments. The short-term goal of the general practitioner scheme was to have 2-3 GPs per 10,000 residents by 2020.

A “5+3” training model mode was introduced, including 5-year clinical training followed by 3-year general practitioner training. In underdeveloped regions, medical graduates could register as GPs after a shortened period of training (2 years). In addition to newly trained GPs, existing licensed doctors could transition to GPs after 1-2 years of training. GPs could practice in various ways and working sites, including working full-time or part-time at multiple sites (e.g., PHC facilities, hospitals, or private clinics). This employment scheme allowed them to engage in community-level care provision in a flexible way. GPs typically teamed up with nurses or village doctors as general practitioner teams to deliver primary care services to individuals and households. This policy design was the predecessor of the family physician scheme, which will be demonstrated in more detail in the following section.

GPs were remunerated through a capitation-based payment scheme for delivering primary care services. The service charges were annual and covered by insurers, governmental public health funds, and service users. The coverage of services and the level of cost-sharing were determined by local governments according to local public health system capacity, user profiles, and funding capability. The performance of GPs was measured in terms of the quantity of health service provision, medical expenses, and users' satisfaction.

The first phase of the PHC reform (2009 - 2014)

Policy	Content
Infrastructure and financing reforms ^{174,179,181} <i>(March 2009)</i>	Infrastructure investments • Provided new public funds to build new PHC facilities and refurbish and re-equip existing ones;
	Health insurance reforms ^{181,182} • Increased per capita subsidies for enrollees of basic health insurance to raise enrolment rates (from 120 CNY in 2010 to 610 CNY in 2022); • Funds for basic health insurance were pooled and managed at city level; • Expanded coverage of benefit packages in basic health insurance from hospitalisation to primary care services; • Reduced co-payment (to about 50%) for costs of outpatient care and medication for people with NCDs (with a cap).
	Provider payment reforms ^{181,182} • Introduced an evaluation scheme for the performance of PHC facilities, which affects the overall salary of the personnel in each facility. • Combined or replaced fee-for-service with P4P or capitation for the delivery of primary care services.
The NEMP ^{176,183} <i>(August 2009)</i>	• Created a National Essential Medicine List available at all PHC facilities; • Increased the reimbursement rate for all essential medicines; • Mandated unified medicine procurement and distribution at provincial level, and engaged local governments in price negotiation, drug bidding, procurement and quality assurance; • Removed the mark-up of essential medicines as revenue source. • Required PHC facilities to record antibiotic use, injection prescribing rates, and average expenditures for patients in monthly reports and make monthly reports openly accessible to the public.
The NEPHS ¹⁷⁸	• Provided the population with a free-of-charge, defined package of essential health services, including vaccination, health examinations, screening, health management, follow-up visits, prescription and health education (with a priority for people over 65-year-old, with NCDs, 0-6 years old children, and pregnant women); • Provided extra subsidies to PHC facilities for the delivery of the package based on per capita allocation;

(July 2009)	Introduced individual electronic health records for all citizens at all PHC facilities.
A GP scheme¹⁸⁰ (July 2011)	- Established a GP system with standardized training programs for certificated/licensed GPs; - Provided subsidies and free training for medical students who are trained as GPs. - Provided subsidized job training programs for GPs at PHC facilities. - Provided non-medical training focused on nursing skills, using health information technology, leadership and teamwork.

Table 2 Policy content of the first round of China's primary health care reforms (2009-2014)

Notes: PHC for primary health care. The NEMP for National Essential Medicine Policy. The NEPHS for National Essential Public Health Services. GP for general practitioner.

Source: adopted from Cai et al. (2023)¹⁸⁴

2.3.3 Achievement and unsolved challenges

During 2009 and 2014, the reforms focused on the inputs of the PHC system and strengthened the government's role in PHC financing and service delivery. Evidence on the first-round reforms will be robustly assessed in [Chapter 4](#). This section reviews on unsolved challenges after the 2009 reforms, highlighting the main drivers for the second-round reforms in 2015.

First, the structural tension remained between the hospital and PHC sectors remained. The maldistribution of government investments was evident. Between 2009 and 2014, the number of hospitals increased, while the number of PHC facilities decreased¹⁸⁵. Additionally, there were no major interventions to promote integration or collaboration between hospitals and facilities. FFS continued to motivate hospitals to compete with PHC facilities for revenues and market shares¹⁸⁶.

Second, primary care providers were underused. The total visits to PHC facilities increased from 36.1 to 43.6 billion times from 2010 to 2014¹⁴². However, [Figure 6](#) shows that the proportion of health services delivered by primary care providers shrank over time during 2009-2014¹⁸⁷. This shrinking market share suggests that although primary care utilisation increased, its growth still lagged behind that of hospitals. The low utilisation of PHC facilities greatly offset the efforts to increase access to primary care services.

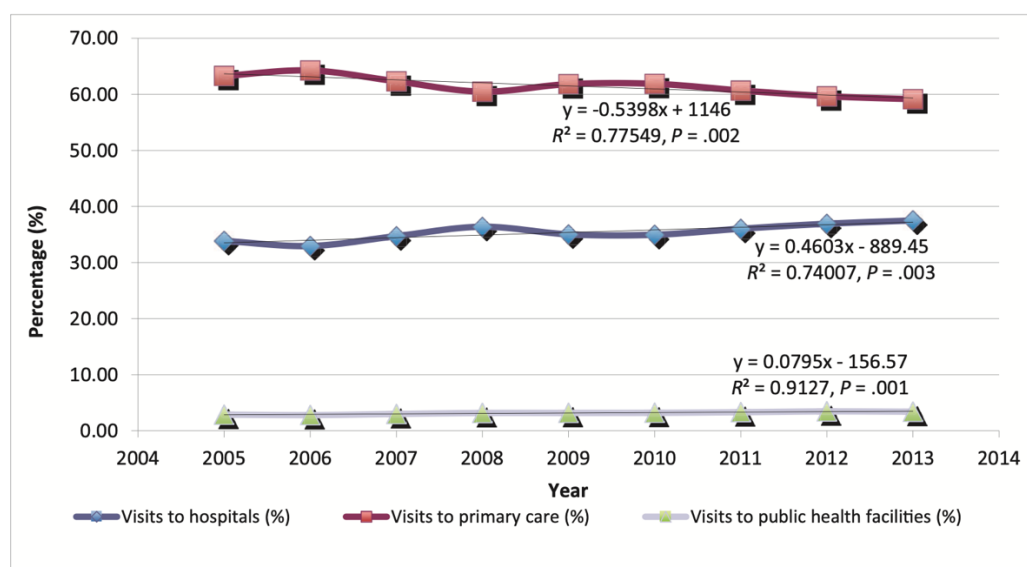


Figure 6 Changes in the percentage of visits to health care facilities between 2005 and 2013 in China by type of facilities

Source: Wu et al. (2016)¹⁸⁷

PHC workforce was scarce and with inadequate education.^{187,188} By the end of 2014, only 34.6% of the total health professionals were at the PHC sectors¹⁴². Around 62.9% of the PHC professionals in urban areas were with a secondary education level or lower, and this percentage was higher in rural areas (88.1%) (Table 3).

Education level	Licensed Doctors or Assistant Doctors			Village Practitioners (Village Clinics)
	THCs	CHCs and CHSs	Village Clinics	
Bachelor's degree or higher	11.9	37.1	0.7	0.1
Postsecondary diploma	43.3	39.5	15.0	4.6
Secondary vocational school	40.7	20.3	79.8	81.4
High school or less	4.1	3.1	4.5	13.9

Table 3 The education level of PHC workforce in China in 2009

Source: Wu et al. (2016)¹⁸⁷

More importantly, low quality of care remained a key challenge in the PHC sector¹⁸⁷⁻¹⁸⁹. A review by Li et al. found low-quality of care in diagnosis procedure, prescribing and NCD management, and overuse of antibiotics.¹⁸⁹ These persisting challenges were the main driving factors for the second stage of the PHC reforms.

2.4 The second stage of China's PHC reforms (2015-2020)

2.4.1 Background and aims

In 2015, the Chinese government initiated the second round of the PHC reforms, aiming at advancing toward a more PHC-oriented health system with improved primary care services¹⁹⁰. The second-round reforms were also known as “Hierarchical Medical System Reform” (“分级诊疗” in Mandarin). Compared with the first stage, the 2015 reforms adopted a more holistic approach and introduced a bundle of PHC-related policies targeting the whole health system. Central to the second round of the reforms were four core policy components: 1) a three-tiered health system with PHC orientation, 2) incentive gatekeeping policy, 3) a community-based family physician scheme, and 4) system integration via a two-way referral system between hospitals and PHC facilities ([Table 4](#)).

2.4.2 Reform content

- A three-tiered health system

A three-tiered health care system was established aiming to optimise health resource allocation and health service delivery.¹⁹⁰ The tiered system delineated the levels, roles and functions of different health facilities based on their capability and responsibilities.

Primary level healthcare facilities were PHC facilities, including community health centres/stations in urban areas and township hospitals and village clinics in rural areas. They served as the frontline providers and provided health care service at the community level. Primary care providers were responsible for delivering treatments for minor diseases, primary care services, regular prescriptions and medications, and essential public health services (e.g., vaccinations, NCD management, primary child and maternity care, and rehabilitation).

Secondary providers comprised secondary and county hospitals, serving as referral points between primary and tertiary health care facilities. Secondary hospitals also were responsible for the diagnoses and specialised treatments for common diseases and upward referrals when necessary. Additionally, they also took discharged patients referred by tertiary hospitals, such as those in recovery periods of acute diseases.

Tertiary providers, as the top of the health system pyramid, were specialist hospitals equipped with high-tech equipment, specialised medical experts, and advanced treatment services. They were responsible for diagnosis and treatment for acute and complex diseases that were not available at lower-tiered facilities.

- Gatekeeping via incentives

A partial gatekeeping policy introduced incentives aiming at redirecting people from hospitals to PHC facilities, increasing the utilisation of PHC facilities, and reducing the burden on higher-level hospitals. **Figure 7** shows the three-tiered health system with partial gatekeeping in China after the 2015 reforms. First contact with PHC facilities was not mandatory. Instead, people were incentivised to choose PHC facilities through a higher reimbursement rate at PHC facilities (i.e., the percentage of healthcare costs covered by the insurers). In other words, people who visit PHC facilities could enjoy higher reimbursement rates for health services and drugs than those who visit hospitals directly. A 5-20% reimbursement gap was introduced between each level of health care providers. For instance, an individual who visited PHC facilities was eligible for a 5-20% higher reimbursement rate than those visiting secondary hospitals without referrals, and an even larger gap of 10-40% for tertiary hospitals. Referrals from a PHC facility were required to be eligible for the higher reimbursement rates at higher levels of care. People could also accumulate their deductible during referrals across different-level healthcare facilities. However, people could still skip PHC facilities by paying out-of-pocket for the 5-20% reimbursement gap.

The reimbursement level and gaps varied across provinces, reflecting regional disparities in socioeconomic developments and health care resources. For example, in 2023, a member of Urban Employee Basic Medical Insurance in Beijing was eligible for 90% reimbursement rates for visits to PHC facilities, whilst this rate was 70% for direct visits to tertiary hospitals. In Gansu, these numbers were 65% and 60%, respectively. To further encourage adherence to the gatekeeping policy, a few provinces required people to have referral letters from PHC facilities to access hospitals.

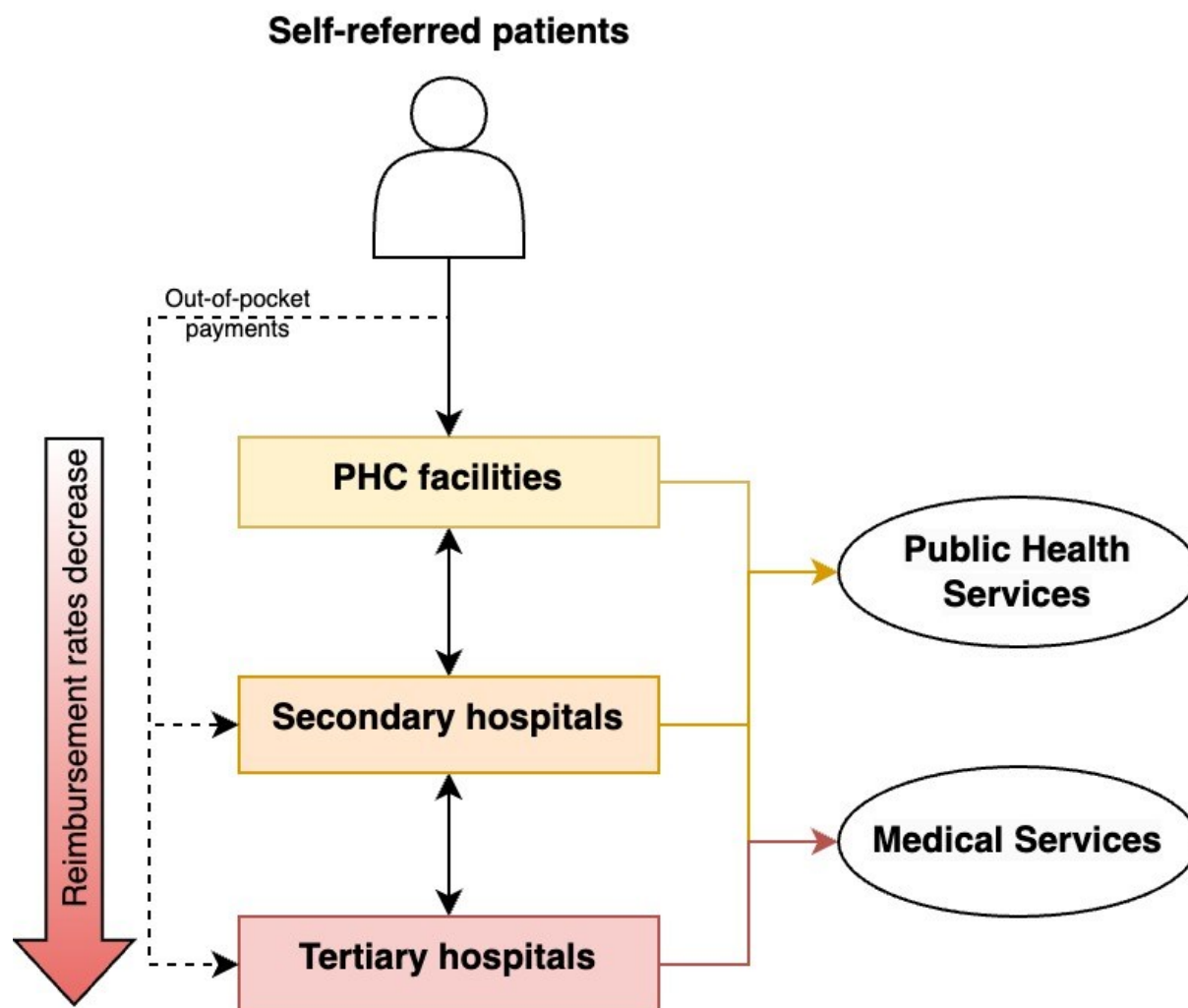


Figure 7 A diagram of health service delivery in the three-tiered health system with partial gatekeeping

Notes: the dash lines indicate that direct visits to the medical facilities were possible with out-of-pocket payments. PHC for primary health care. PHC facilities included community health centres/stations in urban areas and township hospitals and village clinics in rural areas.

Source: Author's own work.

- Family physician

Family physician teams were established at the community level to deliver primary care services and essential public health services to community residents.¹⁹¹

Specifically, the family physician scheme aimed at covering 60% of high-risk populations and 30% of all populations by 2017. However, enrolling with family physician teams was not mandatory for residents or households.

A family physician team was led by registered general practitioners and health professionals at PHC facilities, including newly trained general practitioners and existing ones. Alternatively, in areas with PHC workforce shortage, retired clinical physicians from public hospitals could also lead family physician teams. The teams also included nurses, and public health professionals, as well as pharmacists, health managers, counsellors, and social workers whenever possible. Family physician teams could receive technical supports from doctors from secondary hospitals.

Family physician teams play a key role in two aspects: 1) delivering essential public health services and primary care, and 2) first-contact and referrals. Family physicians were tasked with a comprehensive range of health services, typically including health education, consultations, examinations, home visits, follow-ups, routine prescriptions, and referrals. The coverage, delivery, and duration of the services were discussed and agreed between family physician teams and residents. Family physician teams also served as the initial point of contact for residents to seek health services, providing them with a continuum of care and referrals when necessary. Family physicians could facilitate reservations and referrals to higher-level hospitals for enrolled residents. Enrolled residents or households were eligible to choose one secondary and one tertiary hospital for referrals. Health services and referrals provided by family physicians were eligible for higher reimbursement rates.

Remuneration for family physicians was sourced from insurers, public health service subsidies, and users' out-of-pocket payments. An additional government-subsidised bonus was introduced through capitation payments to incentivise family physicians to

achieve service targets (i.e., the predetermined annual number of residents served). The level and proportion of the payments varied across provinces based on the local health financing level, user characteristics, and price levels.

- System integration

A standardised, two-way referral system between PHC facilities and hospitals was established aiming at strengthening the PHC-oriented health system with improved coordination and effectiveness.^{190,192} Such systems were also referred to as “Medical Alliances” or “Yilianti 医联体” in Mandarin.

Typically, a two-way referral system was organised at the prefecture level and led by one/multiple tertiary hospitals, forming an alliance with adjacent PHC facilities. This system allowed efficient referral and coordination across health care facilities with different levels to deliver continuous care. Vertical collaboration across PHC facilities and hospitals was facilitated with shared health resources (e.g., workforce, techniques, and equipment) and online platforms with shared health information (e.g., diagnosis, treatment plans, prescriptions, and test results). PHC facilities were the first contacts of the referral system, responsible for upward referrals and follow-up care for downward referrals from higher-level hospitals. The two-way referral system facilitated flexible referrals with fewer administrative hurdles and higher reimbursement rates within the system.

The design and governance of these systems were tailored to local health resources and health needs, and the level of integration varied across provinces. Some alliances adopted a centralised approach through shared health resources, global budgeting, and pooled management of personnel and health information. On the other hand, some alliances had loose or decentralised governance that allowed facilities to manage their finances independently while sharing health workforce, techniques and information.¹⁹³

To ensure the accountability and quality of these collaborations and incentive health care providers, the central governments developed a series of indicators to monitor performance. These indicators included health record management rates for high-risk pregnant women, high-risk newborns, primary care visit rates and two-way referral rates among pregnant women, and users' satisfaction.

2.4.3 Staggered roll-out

The second stage of the PHC reforms was implemented in a staggered manner.

Figure 8 shows the accumulative number of provinces under the second-stage PHC reforms between 2013 and 2017. Cities/counties in nine provinces piloted the reform before the national rollout in 2015. The expansion of the reforms sped up after 2015, with the latest province joining the reforms in 2017. There was no clear geographical pattern of the reform roll-out (**Figure 9**).

The staggered rollout of the reforms serves several strategic methodological purposes. First, it allows for a controlled assessment of the reforms by using not-yet-treated provinces as comparators against the treated provinces at different time points. Second, this setup provides a great opportunity for employing advanced difference-in-differences methods to evaluate the causal impact of the reforms and their changes over time. More details on this will be discussed in **Chapter 5** and **Chapter 6**.

The second phase of the PHC reform (2015 - now)	
Policy	Content
A three-tier health system with partial gatekeeping ¹⁹⁴ <i>(September 2015)</i>	- Introduced a three-tier health system, including PHC facilities, secondary hospitals, and tertiary hospitals, and defined the responsibilities for each level of health facilities; - Provided higher reimbursement rates for visits to PHC facilities and referrals from PHC facilities and reduced reimbursement rates or no reimbursement for direct visits to hospitals; - Introduced a new gatekeeping policy that requires referral letters from PHC facilities for hospital visits. This policy was not mandatory and implemented according to the local context;
System integration ¹⁹² <i>(April 2017)</i>	- Established a standardized, dual referral system between PHC facilities and hospitals to integrate preventive-curative services; - Built provider networks to share health resources (e.g., equipment and workforce) and health technology across facilities at different levels; - Established an online platform to share electronic health records across facilities, as well as other health information.
Family physician policy ¹⁹¹	- Introduced a new care model which featured family physician teams led by GPs or village doctors from PHC facilities, delivering primary care services at community level; - Provided subsidies to family physician teams for services delivered based on capitation;

(May 2016)	• Defined a list of basic health services delivered by family physician teams, including health education and examinations, prescription consulting, home visits, and personalised care based on patients' needs; • Introduced benefits to patients who are referred by family physicians, including priority to referrals and reservations and higher reimbursement rates for hospital visits.
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Table 4 Policy content of the second round of China's primary health care reforms (2015-2020)

Notes: 1. PHC for primary health care; 2. NEMP for National Essential Medicine Policy; 3. NEPHS for National Essential Public Health Services. 4. GP for general practitioner. 5. NCDs for non-communicable diseases; 6. P4P for pay-for-performance.

Source: Cai et al (2023).¹⁸⁴

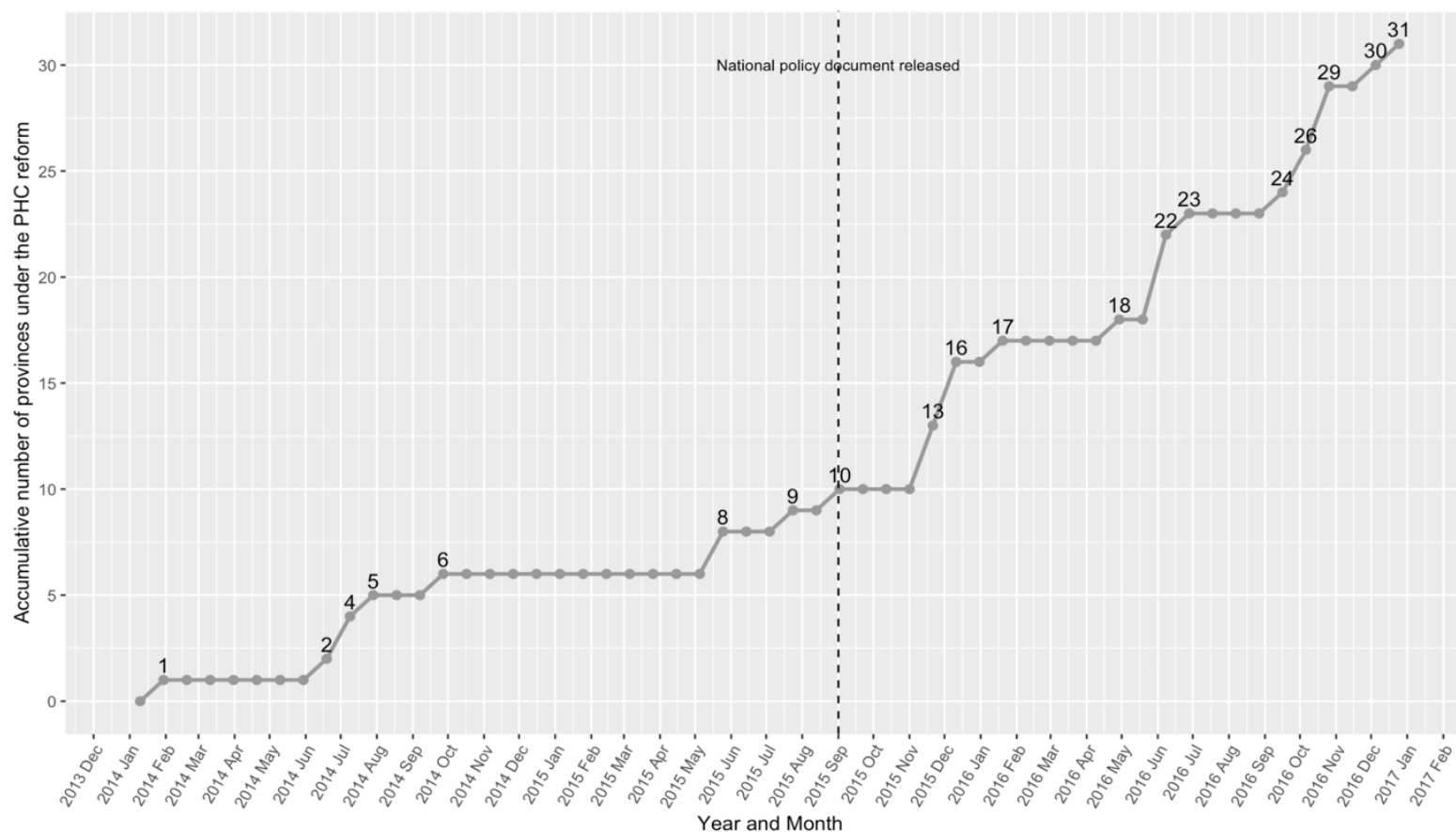


Figure 8 The accumulative number of provinces under China's primary health care reforms in each month between 2013 and 2017

Source: author's own work, and the data obtained from policy documents.

HMS reform implementation time in 31 provinces

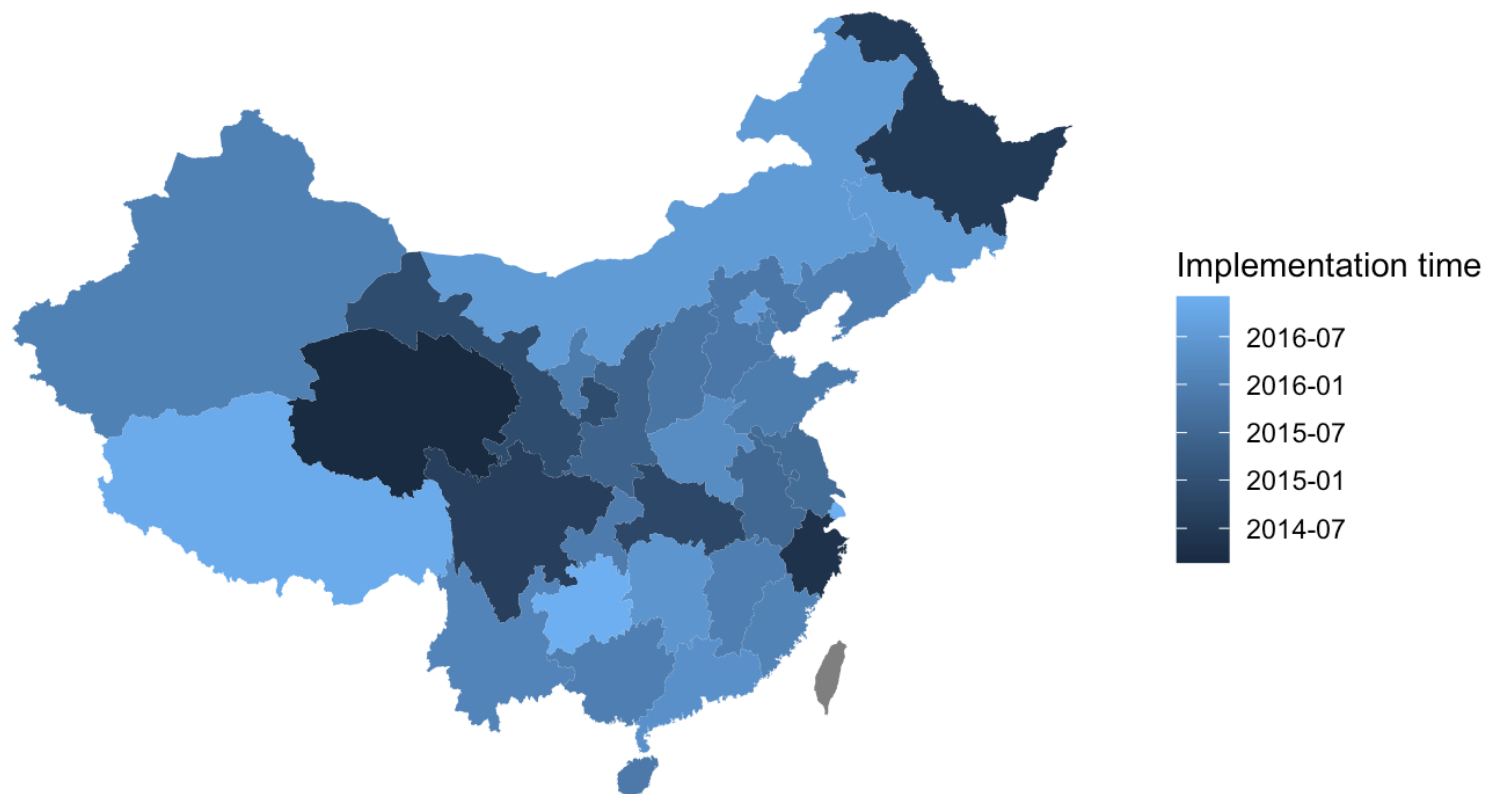


Figure 9 A map of the roll-out of China's primary health care reforms in the 31 provinces between 2013 and 2017

Source: author's own work, and the data obtained from policy documents.

2.5 Significance of China's PHC reforms

China's PHC reforms since 2009 have important implications for PHC strengthening domestically and internationally. The reforms are relevant to the healthcare needs of the 1.4 billion populations, particularly with the ageing demographic and increasing NCD-burdens⁸³. In response to these challenges, the reforms explored effective strategies to achieve a high-quality health system and more efficient financing.

China's PHC reforms are also internationally important for advancing global PHC strengthening. The reforms in China can provide lessons for other LMICs through shared practices and innovative exploration. Common initiatives for PHC strengthening in China and other LMICs (e.g., Brazil, Iran, Turkey, and India) include family physicians, essential medicines, financing incentives, and provider payment reforms. China's evidence on the effectiveness of these policies provides context-specific knowledge and adds to the general knowledge of effective PHC strengthening and how. Such knowledge can contribute to developing replicable models for PHC strengthening that can be adapted by other LMICs.

Hospital domination also poses unique challenges and fosters innovative approaches to PHC strengthening in China. The hospital sector dominates the distribution of health resources and is the main health care provider in China. The hospital domination greatly moderated the impacts of the first-stage PHC reforms, motivating the system-wide approach during the second stage (discussed above). For instance, the establishment of medical alliances was a large-scale exploration of integration between the PHC and hospital sectors. Such attempts could add evidence on effective interventions for integrated care, which is at a low level for many LMICs^{49,54,71,83,195,196}.

China's PHC reforms also stand out for their breadth, depth, and comprehensiveness, which is rare in LMICs. First, the reforms extended beyond minor system tweaks and encompassed vertical and horizontal integration across the health system. System-wide PHC reforms are infrequent in LMICs and often poorly studied^{39,43}. Second, China's PHC reforms adopted a holistic approach and

introduced system-wide changes to strengthen PHC and build a PHC-oriented health system. There is increased awareness that a strong PHC is essential to high-quality health systems and cannot be achieved without system-wide reforms^{26,99}. However, relevant knowledge and experiences are rare. China's PHC reforms provide a valuable case to study whether comprehensive reforms can better achieve PHC orientation and the facilitators and barriers to the reform goals.

2.6 Conclusions

Before the 2009 PHC reforms, China's health system was characterised by decentralised governance, limited public funds, and hospital domination, resulting in high out-of-pocket payments, and inequitable accessibility and quality. Public hospitals have dominated resource allocation and health service provision, whereas the development of PHC has lagged behind. In response to these challenges, a large-scale and comprehensive health reform was initiated in 2009 to strengthen PHC in China, which is the focus of this PhD project. The reforms included two stages: the first round was between 2009 and 2014 and focused on increasing the availability and coverage of primary care services and included four main policy components: 1) financing, 2) the National Essential Medicine Scheme, 3) the National Essential Public Health Package, and 4) a general practitioner training scheme. The second round of the PHC reforms in 2015 shifted the focus to establishing a PHC-oriented health system with improved primary care and included four policy components: 1) a three-tiered health system with PHC orientation, 2) an incentivised gatekeeping policy, 3) a family physician scheme, and 4) a two-way referral system to integrate hospitals and PHC facilities. The large scale and comprehensiveness of China's PHC reforms are rare in LMICs. Such reforms have been poorly studied (discussed above). Evidence on the reforms will benefit future reforms in China and the generalisable knowledge on effective strategies to strengthen PHC in LMICs.

The following chapter outlines the overall aims of the PhD project, as well as specific objectives and research questions for the three original studies presented in [Chapter 4](#), [Chapter 6](#), and [Chapter 7](#).

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Chapter 3. Aims, objectives, and research questions

This chapter outlines the aim, objectives, and research questions addressed in the following three original research chapters ([Chapter 4](#), [Chapter 6](#), and [Chapter 7](#)). Specifically, studies presented in [Chapter 6](#) and [Chapter 7](#) primarily focused on the second round of China's PHC reforms.

3.1 Research aims

The overall aim of this PhD thesis is to understand the impacts of China's PHC reforms since 2009 on the health system and health outcomes.

3.2 Research objectives and questions

3.2.1 Evidence of China's PHC reforms since 2009

Research objective 1 aims to identify existing evidence on the impacts of China's PHC reform since 2009 on the health system and health outcomes, and the results of this original research are presented in [Chapter 4](#). The specific research questions addressed in [Chapter 4](#) are:

- 1) What policies from China's PHC reform have been assessed?
- 2) What have been the impacts of these policies on the health system and health outcomes?
- 3) What is the quality of this evidence?

3.2.2 The reform impacts: an ecological study

Research objectives 2 and 3 focus on evidence gaps identified from the original research in [Chapter 4](#) – the effects of the second round of the PHC reforms.

Research objective 2 aims to provide a comprehensive understanding of the impacts

of the second round of PHC reforms on the inputs, utilisation, and costs of the health systems, population health, and regional inequalities. This objective was investigated by an ecological study using provincial-level yearbook data. The results of this original research are presented in [Chapter 6](#). The specific research questions addressed in [Chapter 6](#) are:

- 1) How did China's second round of PHC reforms affect the health system supply, health service utilisation and costs, and mortality?
- 2) What were the pathways by which the reform impacted mortality?
- 3) Did these pathways vary across regions?

3.2.3 The reform impacts: an individual perspective

Research objective 3 adopts a demand-side perspective and aims to assess the reform's impact on people's use of primary care services, secondary care, payments, and health outcomes. It also investigates whether and how the examined impacts varied across regions and population groups. Research objective 3 was investigated by an individual-level study using a cohort aged 45 and over. The results of this original research is presented in [Chapter 7](#). The specific research questions addressed in [Chapter 7](#) are:

- 1) How did China's second round of PHC reforms affect primary care utilisation, hospitalisation, out-of-pocket expenditures, and self-reported health among middle- and elderly-age populations?
- 2) Did these examined impacts vary across population groups, and if so, how?

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Chapter 4. A systematic review on the impacts of China's PHC reforms since 2009 on the health system and health outcomes

This chapter presents a systematic review on the impacts of China's PHC reforms since 2009 on the health system and health outcomes. This systematic review was conducted in 2021 and published in Health Policy and Planning.

The original work presented in Chapter 4 was the author's own PhD project supervised by Professor Christopher Millett and Dr Thomas Hone, with collaboration screening and data extraction. For more detailed contributions, see [Attribution section](#).

4.1 Introduction

China's significant PHC reforms were illustrated and debated extensively. However, there is no systematic synthesis of the effectiveness of this comprehensive reform. The aim of this study was to assess the impacts of China's PHC reforms since 2009 on the health system and health outcomes based on evaluations that use robust study designs, including randomised control trials, quasi-experimental studies, and controlled before-after studies.

Research questions for Chapter 4

- 1) What policies from China's PHC reform have been assessed?
- 2) What have been the impacts of these policies on the health system and health outcomes?
- 3) What is the quality of this evidence?

4.2 Methods

4.2.1 Search strategy

The protocol of this systematic review was registered on PROSPERO (registration number CRD42021239991).

I searched twelve international databases and three Chinese databases in August 2022. The twelve international databases included MEDLINE, Embase, Web of Science, ScienceDirect, Scopus, CINAHL, Cochrane, HMIC, World Bank Library, WHOLIS, Ecolit, Jstor. The three Chinese databases were CNKI, Wanfang, and cqvip. To reduce publication bias, I searched OpenGrey for grey literature.

I searched for titles or abstracts using the terms ‘primary health care’, ‘family physicians’, ‘ambulatory care’ and their synonyms, together with relevant Mesh terms. Names for specific PHC policies were also searched, including “zero mark-up” and “the National Essential Medicine Policy”. These terms were linked by OR Boolean operators. The search was then restricted using AND Boolean operators and the terms “reform”, “China” and their synonyms. I applied no language restriction in the search.

For studies in Mandarin, I repeated the search using the same terms along with specific policy titles, such as ‘Yilianti’ (part of the integrated delivery system, also known as Medical Alliance in Chinese), ‘Fenjizhenliao’ (partial gatekeeping, also known as Hierarchical Medical System in Chinese) and ‘Xinnonghe’ (abbreviation of New Rural Cooperative Medical Insurance in Chinese). See [Appendix 1](#) for details on the search strategy.

When full-text articles were not available, I contacted the corresponding authors of the identified studies for publication information. I also screened references of the included articles to identify additional studies.

4.2.2 Selection criteria

The inclusion criteria for identified studies are: 1) the study population are Chinese citizens living in China; 2) studies evaluate policies stemming from China's PHC reforms since 2009 and implemented at the city/county level or above; 3) the study design includes a temporal comparator (i.e., periods before the PHC reform) and a control group that either was not exposed to the reform at the evaluation time or received alternative interventions. For instance, studies that assessed capitation payment methods among primary care providers are eligible for inclusion if they used pre-intervention data and have a control group who experienced no changes in the payment methods or switched to other payment methods, such as pay-for-performance. 4) studies examine PHC-related outcomes, including any relevant measures of the PHC system, health service utilisation and expenditures, quality of primary care, health outcomes, or health inequalities. 5) randomised control trials (RCTs) or quasi-experimental studies with controls were included.

The exclusion criteria for identified studies are: 1) examined policies were implemented at the community or village level or clinical trials; 2) studies do not have temporal comparators or control groups, such as cross-sectional studies, uncontrolled before-after studies and uncontrolled interrupted time series studies; 3) assessed outcomes only reflect the hospital sector or do not measure the actual provision of primary care services, such as outcomes from simulated clients and performance assessments for primary care providers; 4) studies with descriptive analysis, qualitative methods, reviews, or commentaries.

I conducted the searches. Shangzhi Xiong, Thomas Hone, and I screened the titles and abstracts of all identified records using Covidence.¹⁹⁷ The same three reviewers performed full-text screening independently. Discrepancies in study inclusions during screening were addressed by discussion with a third author. Shangzhi Xiong and I extracted data from the included studies and cross-checked all extracted data for any manual errors. I assessed the quality of included studies with assistance from Thomas Hone.

4.2.3 Data extraction and analysis

Data on publication year, data source, study designs, study populations, assessed policies, outcomes, effect directions and sizes, statistical significance, and heterogeneity analysis were extracted using a pre-designed standardised table.

For data analysis, a narrative approach was adopted given that the great heterogeneities in assessed policies, study populations and outcomes precluded meta-analysis. Included studies were labelled by assessed policies and outcome measures. Outcomes were grouped into five categories: 1) health expenditures (including both demand and supply sides), 2) health service utilisation, 3) quality of care, 4) health outcomes, and 5) health inequalities.

Data on heterogeneous policy effects were extracted without any pre-specification and analysed using a harvest plot. Harvest plots are often used to narratively summarise the heterogeneous effects of treatments.¹⁹⁸ For clearer analysis and presentation, I further grouped the heterogeneities into three types after extraction: 1) geographical; 2) socio-demographic; 3) people with and without NCDs, including cardiovascular diseases, cancers, chronic respiratory diseases and diabetes.¹⁹⁹

4.2.4 Quality assessment

I performed quality assessment on the included studies using the Cochrane Collaboration's tool for assessing Risk of Bias In Non-randomized Studies of Interventions (ROBINS-I).²⁰⁰ The quality assessment inspected bias across seven domains listed in the ROBINS-I: 1) confounding, specifically baseline confounders across treatment and control groups; 2) selection of participants into the study, 3) classification of intervention (i.e., whether the interventions are clearly defined and the possibility of misclassification), 4) deviation from intended interventions, 5) missing data, 6) measurement of outcomes, and 7) selection of the reported results. Each of the seven domains were rated into one of the five grades: low, moderate,

serious, critical and no information.²⁰¹ An overall grade on risk of bias was given based on the rating on each domains.

ROBINS-I has one distinct advantage compared with other quality assessment tools – it provides comprehensive and rigorous quality assessment for observational studies using a framework adapted from evaluations on RCTs. Despite of the robustness, ROBINS-I often reports higher risk-of-bias and a smaller range of variations in the overall grades.²⁰² This feature is attributed to that ROBINS-I defines a low-risk of bias study as one comparable to “a well-performed randomized trial”.²⁰¹ This definition can be overstrict considering flaws inherited from the nature observational studies – unable to control for assessed interventions. To relax the grading using ROBINS-I, I adjusted the grading whereby the quality of studies was upscaled one level if confounding were addressed using matching or weighting techniques, observation time window was longer than four years, time intervals were less than one year, co-interventions were ruled out, or policies were assigned randomly.

4.3 Results

4.3.1 Descriptive analysis of included study

Study characteristics

The search identified 49,174 records. After removing duplicates, 30,053 studies were screened for titles and abstracts and 347 for full-text (**Figure 10**). In total, 42 reports from 41 studies were included for the analysis. **Table 5** summaries the characteristics of the included 42 reports, of which 31 were in English and 11 in Mandarin with publication years ranging from 2012 to 2022. Among the total 41 studies, 11 were nationally representative, 31 were within provinces, two were across provinces.^{203,204} Most of the included studies from eastern China (18 out of 41), eight from central China²⁰⁵⁻²¹², and five from western China²¹³⁻²¹⁷. About half (N=18) of the studies focused on rural populations, and 15 studies included both rural and urban populations. Eleven studies assessed the reform impact on people

with NCDs, specifically diabetes and hypertension. Majority of the included studies had a duration less than five years (N=36), of which 13 with a duration of two years or less (**Table 5**).

Study designs

All included studies were quasi-experiment studies, except for one matched-pair cluster-randomised control trial.²⁰⁷ Most of the studies adopted difference-in-differences (DiD) study designs (N=38), with seven combining DID with propensity score matching/weighting,^{208,209,218-222} eight using fixed effect panel regression,^{212,215,223-228} three using dynamic DID models,^{217,229,230} and four without statistical inference.²³¹⁻²³⁴ Another four studies employed interrupted time series methods with controls.^{210,211,235,236}

Most studies used untreated populations from similar cities/counties within the province as control groups (N=38), and three studies compared people under policies with different intensity levels^{215,227} or alternative policies²⁰³ (e.g., various combinations of provider payments and primary care delivery) across provinces.

Most studies used secondary data (N=35), such as administrative data from PHC facilities and health insurance data which are routinely collected (N=30). There were 17 ecological studies at the facility level and 22 studies with individual-level data.

Evaluated policies

The 41 studies covered all major elements of China's PHC reform since 2009, of which 37 examined single-component policies. Among the five studies assessing the reform as an entity,^{203,206,224,228,235} three focused on the first stage of the reform^{203,206,235}, and two on the second stage^{224,228}. The National Essential Medicine Policy was the most studied policy (N=15), followed by financing reforms (N=11). More than half of the studies on financing reform focused on demand-side insurance reforms^{205,208,209,221,229,237} (N=6), such as reducing co-payment for consultation/treatments at PHC facilities or NCD-related health services. Two studies

assessed supply-side financing reforms, including P4P,²²⁵ capitation²¹⁶, and government subsidies²¹⁵. Another two studies evaluated a combination of P4P and capitation^{214,236}. Among the five studies on restructuring the health service provision, one assessed gatekeeping²²⁶, and four evaluated the integrated two-way referral system^{213,219,223,230}. Policies related to primary care delivery were the least investigated. Three studies were on the family physician policy,^{204,220,238} and one on the National Essential Public Health Services²³⁹. Additionally, two other studies assessed two micro interventions on the supply side: PHC workforce training²¹⁷ and public reporting on PHC facilities' performance²⁰⁷.

Outcomes

Health expenditures were the most assessed outcome (N=26). Three studies focused on OOPE,^{208,209,218} whilst the rest examined NCD-related service or drug costs in PHC facilities and hospitals^{206,208,209,219,221,237} (N=6) or in PHC facilities alone (N=19). Health service use was examined in 25 studies, including visiting PHC facilities (N=20), using essential public health services^{206,212,216,234,239} (N=5), and hospitalisation^{205,206,208,209,214,227,229,232,237} (N=9). Care quality was evaluated in 13 studies from three facets: perception of care quality and satisfaction^{203,204,206,223,238} (N=5), antibiotic use^{207,211,225,235,236,240-242} (N=8), and delivery of essential medicines²¹². Health status was investigated in ten studies measured by biomarkers^{205,208,209,213,219,223,230,239} (N=8), mortality²²³ (N=1), self-reported health status^{205,238} (N=2), health-related quality of life^{213,220} (N=2). Only one study evaluated the reform impacts on income-related health inequality²²⁴.

Effect sizes and risk of bias

The included studies report modest effect sizes across all outcomes.

Figure 11 summarise the risk-of-bias of the included 42 reports. Risk of bias of the include reports ranged from low to serious, with nine studies graded as high-quality^{207,212,214,217-219,226,241} (i.e., low risk of bias), and 24 as moderate risk of bias. The most common bias was confounders from baseline differences and potential co-interventions (N=31). Baseline differences could lead to violation of parallel trend

assumption which is a crucial assumption for the validity of DID methods. The lack of testing for parallel trends and discussion on concurrent intervention threatens the robustness of the studies. Ten studies had serious risk of bias as they did not adjust for any confounders^{204,205,216,231,235,236,238,242} or have missing pre-intervention data and inconsistent outcome measure²³⁶. Missing data and deviation from the intended interventions were often not discussed in the included studies (N=14 and 23 respectively).

Figure 12 shows the risk of bias, language, and regions of the included studies stratified by the evaluated policies. It shows that there was no low risk-of-bias evaluation study on primary care policies (e.g., family physician or the NEPHS). Most of the high-quality studies (i.e., with low risk-of-bias) were English studies from eastern China.

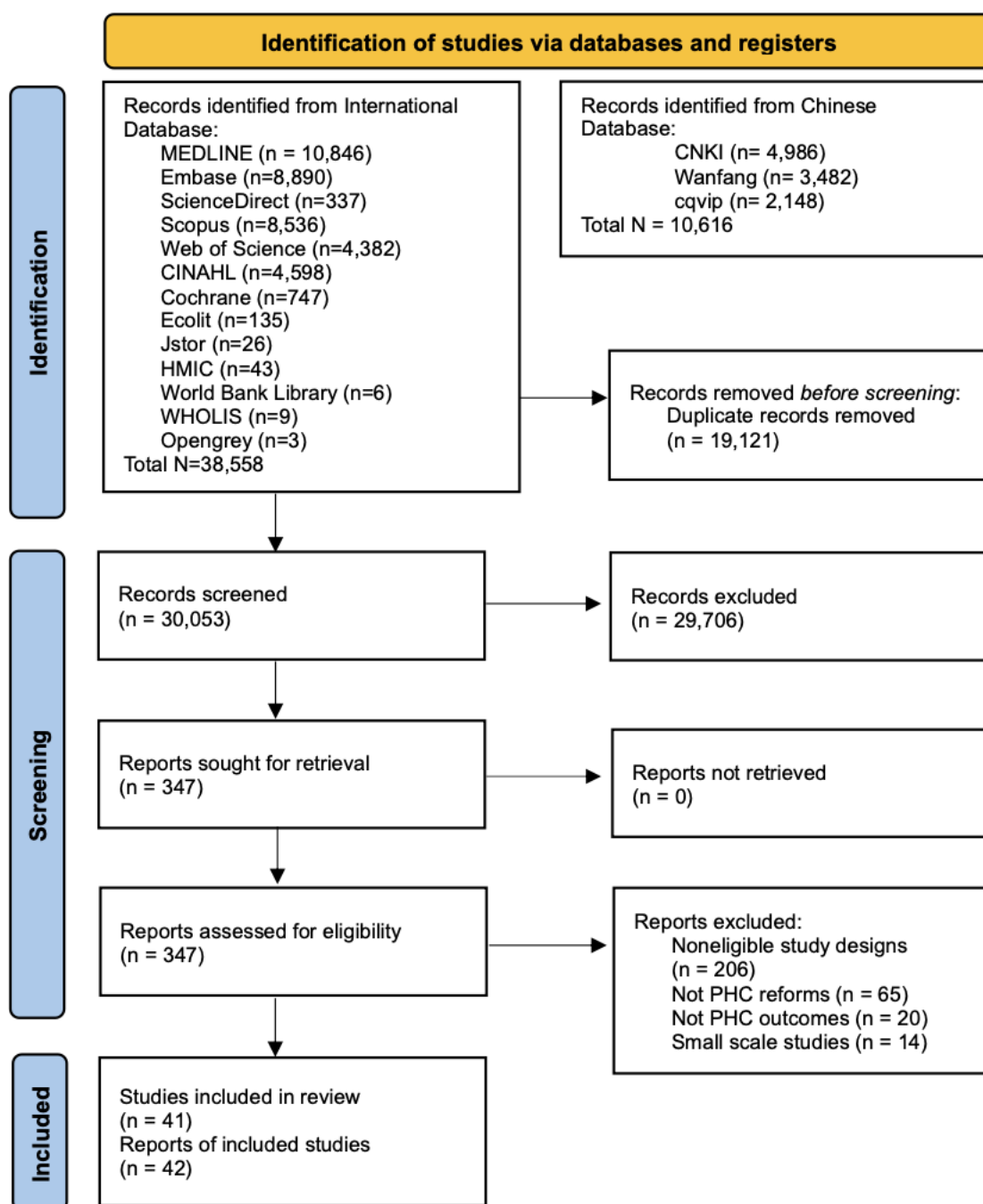


Figure 10 PRISMA diagram for study selection process

Notes: Small-scale studies were defined as studies that assessed interventions implemented within the community or village level.

Source: Cai et al. (2023)¹⁸⁴

Characteristics of the included studies		Number of Studies
Language	Mandarin	11
	English	31
Year of publication	2012-2015	17
	2016-2021	25
Geographical region	Central	8
	Eastern	18
	Western	5
	National	11
Study Duration	Two years or less	13
	3-5 years	23
	More than 5 years	6
Data source	Primary Data	7
	Secondary Data	35
Data types	Cohort	8
	Panel	34
RCD data	No	12
	Yes	30
People with NCDs	No	31
	Yes	11
Urban/rural population	Rural	18
	Urban	9
	Both	15
Unit of analysis	Individual	22
	Aggregated	18
	Both	2
Evaluated Policies	Comprehensive	5
	NEMP	15
	Financing	11
	System Integration	4
	Gatekeeping	1
	Family Physician	3
	NEPHS	1
	Workforce training	1
	Performance reporting	1
Study outcomes	Health expenditures	26
	Health service utilisation	25
	Quality of care	13
	Health outcomes	10
	Health equity	1
Study quality	Low risk of bias	9
	Moderate risk of bias	24
	Serious risk of bias	9

Table 5 Characteristics of the 42 included reports

Notes: 1. NEMP for the National Essential Medicine Policy; 2. NEPHS for the National Essential Public Health Services. 3. RCD for routinely collected data. 4. NCD for non-communicable disease.

Source: Cai et al. (2023)¹⁸⁴.

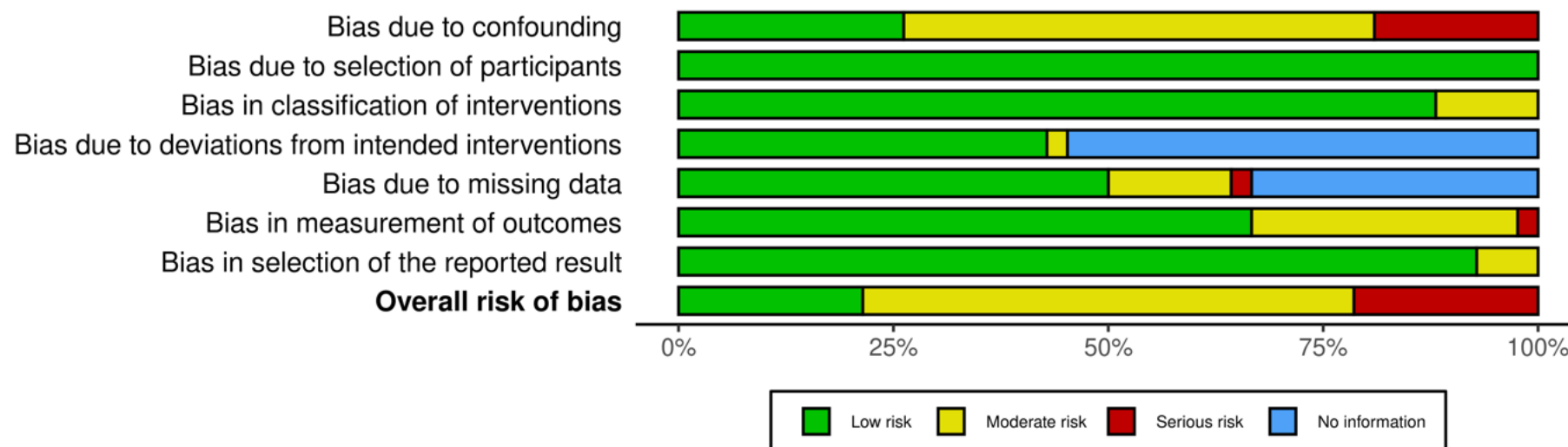


Figure 11 A summary for risk-of-bias assessments on the included 42 studies

Source: Cai et al. (2023)¹⁸⁴

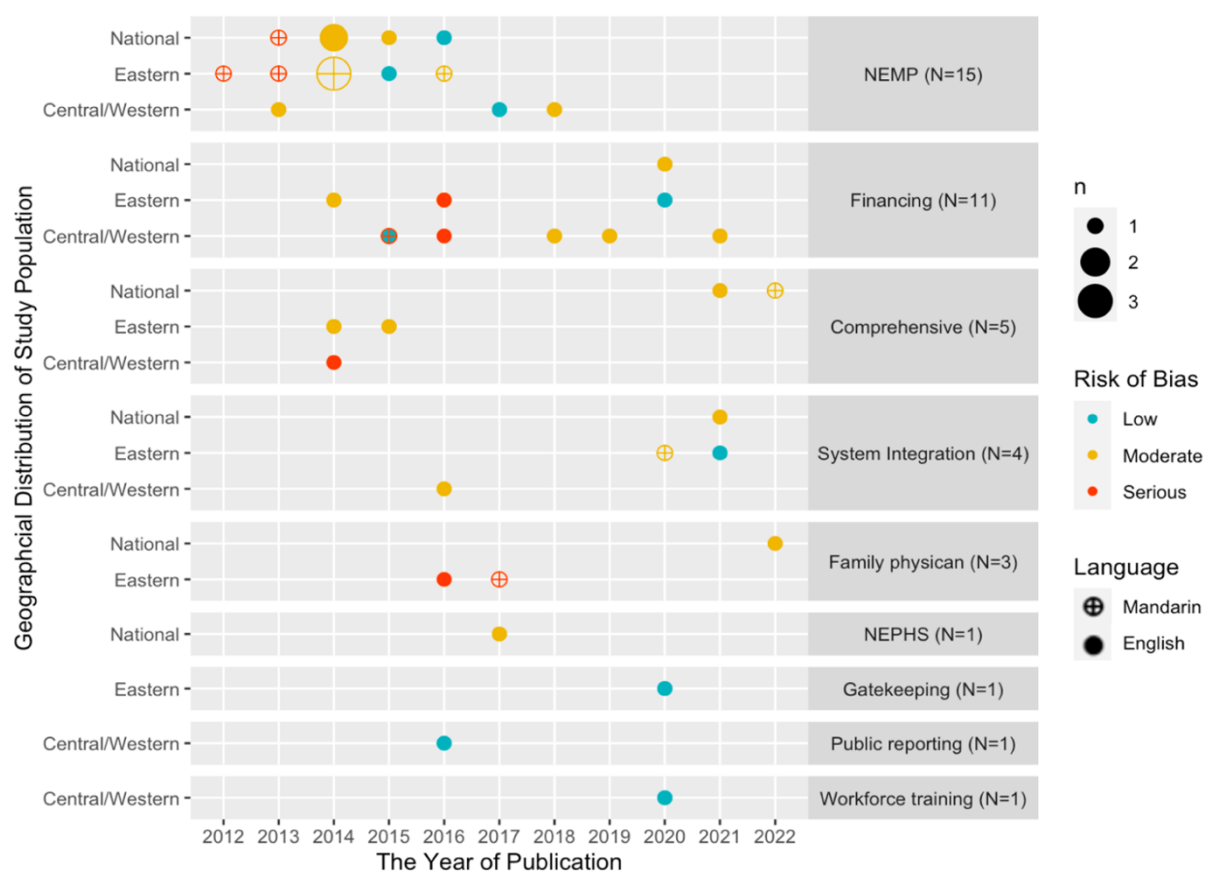


Figure 12 Language, publication year, geographical distribution and risk of bias of the 42 studies over time grouped by policies

Notes: 1. NEMP for the National Essential Medicine Policy; 2. NEPHS for the National Essential Public Health Services. 3. n for the number of studies.

Source: Cai et al. (2023)¹⁸⁴.

4.3.2 Holistic impacts of the PHC reforms

Table 6 presents the estimated direction of the reform impacts and certainty of evidence grouped by assessed policies and outcomes. A total of five studies assessed the comprehensive PHC reform in a holistic approach, of which three focused the first stage of the reform as a whole package^{203,206,235}, and two on the second stage since 2015^{224,228}. There was no conclusion on the holistic reform impacts due to the various geographical locations, study population groups, and assessed outcomes. The quality of evidence was low.

For the first stage of the PHC reform, one study from eastern China showed that drug expenditures and antibiotic usage among children declined after the reforms²³⁵. Another study from central China found that essential health service and hospital utilisation and satisfaction increased, whilst no significant changes were found in outpatient visits to PHC facilities or hospitals²⁰⁶. One study compared two PHC models introduced in two well-resourced provinces in eastern China, and the findings suggests that the model with more government funding for the PHC sector, better-trained health workforces, and primary care services tailored to local health needs were associated with a perception of better care quality²⁰³.

Both studies on the second stage of the reform used nationally representative data and were moderate quality, of which one showed that the second stage of the reform increased primary care utilisation in urban populations but not the rural ones²²⁸, one concluded that the reform reduced income-related health disparity among the elderly²²⁴.

Policy (Number of studies)	Health expenditures			Health service utilisation			Quality of care		Health outcomes		Health inequality
	Health services costs	Drug costs	OOPE	Visits to PHC facilities	Public health services	Hospitalisa- tions	Antibiotic use	Satisfaction/ Quality rating	Biomarkers/ Mortality	SRH/ HRQoL	Income- related
Comprehen- sive (3)		▼		⊖	▲	▲	▼	▲			▼
The NEMP (13)	▼▼▼▼ ⊖⊖⊖⊖	▼▼▼▼▼▼ ⊖⊖⊖⊖	⊖	▲▲▲ ⊖⊖⊖	▲	▲▲	▼ ⊖⊖ ▲				
Financing reforms (11)	▲▲▲▲▲ (NCD) ⊖⊖ (NCD)	⊖	▼ ⊖ (NCD)	▲▲▲▲▲ (NCD) ▼	▲	▼▼▼▼ (NCD) ⊖⊖ ⊖ (NCD)	▼ (NCD) ⊖		▼▼▼▼ (NCD)	▲ (NCD)	
Gatekeeping (1)	⊖			▲							
Integrated delivery system (4)	▼ (NCD) ⊖			▲ (NCD) ▲	⊖			⊖	▼▼▼▼ (NCD) ⊖	▲ (NCD)	
Family Physicians (3)	▼			▲				▲ (NCD) ▼		▲ (NCD) ⊖	
The NEPHS (1)					▲ (NCD)				▼ (NCD)		
Workforce training (1)				▲							
Performance reporting (1)		▼					▼				

Table 6 Estimated effects and certainty of evidence grouped by evaluated policies and outcomes

Notes: 1. Each symbol represents one study on the corresponding assessed policies and outcomes, and studies assessing multiple outcomes have more than one symbol. 2. NEMP for National Essential Medicine Policy; 3. NEPHS for National Essential Public Health Services; 4. OOPE for individual out-of-pocket expenditures; 5. NCD in brackets indicates that the study population were people with NCDs; 6. ▲ for a statistically significant increase; ▼ for a statistically significant decrease; ⊖ for no statistically significant changes. 7. Red indicates the study was rated as serious risk of bias; yellow as moderate risk of bias; green as low risk of bias. 8. Studies that only compared with alternative interventions or did not report overall impacts were not included in Table 3. 9. Biomarkers including indicators from blood pressure and blood sugar tests, and control rates. A decrease symbol in biomarkers indicates better hypertension/diabetes control. 10. SRH for self-reported health, and HRQoL for health-related quality of life.

Source: adopted from Cai et al. (2023)¹⁸⁴.

4.3.3 Impacts of the National Essential Medicine Policy

The 15 studies on the National Essential Medicine Policy (NEMP) found a consistent decline in drug costs. However, the other health system impacts of the policy were mixed, and health outcomes were not studied. Seven ecological studies from various regions showed a decrease in drug costs at PHC facilities following the introduction of the NEMP^{210,211,233,240,241,243,244}, but this change was not significant in two nationwide studies^{240,244}. One high-quality study used individual level insurance data found no impacts on either drug costs or OOPes at PHC facilities among urban population from eastern China²¹⁸. Three studies found that health service costs at PHC facilities decreased after the NEMP, ^{233,240,245} whilst other four found no impacts^{218,243,244}.

Of the six studies on health service utilisation, two showed that the use of primary care services increased in rural populations,^{232,245} one found a decline but with no statistic inference,²³⁴ and other three found no impacts^{218,227,243}. One study on vaccination rates observed an increase in rural areas but without statistical inference.²³⁴ Two studies showed an increase inpatient care utilisation in rural areas.^{227,232}

As an indicator for care quality, antibiotics use was assessed in four studies. One high-quality study found that the NEMP reduced the prescription of antibiotics in urban areas,²⁴¹ whilst two intermediate ones found no impacts.^{211,240} One study observed an increase,²⁴² but the quality of evidence was low.

4.3.4 Impacts of financing policies

The 11 studies on PHC financing found increasing use of primary care across regions and population groups, but the quality of evidence varied. Among the six studies on demand-side financing reforms, five focused on policies targeting at people with NCDs,^{205,208,209,221,237} and one high-quality examined financial incentives for general populations to visit PHC facilities²³⁷. All the six studies found that

reducing copayment increased health service costs,^{205,208,209,221,229,237} except for one low-quality study²⁰⁵. The increasing costs included those both paid by insurers and individuals. OOPes were examined in two studies.^{208,209} Although both studies found a decreasing overall OOPes, but only inpatient OOPes had a significant decline²⁰⁸.

All three studies on primary care utilisation found an increase after copayment reduction.^{208,209,229} All five studies on hospitalisations showed a consistent decline,^{208,209,229,237} except for one low-quality study observing no impacts²⁰⁵. One high-quality study further highlighted that outpatient visits to hospitals decreased concurrently with the increasing visits to PHC facilities.²²⁹

Health outcomes of people with NCDs were examined in three studies,^{208,209} whilst the health impacts among general populations were not studied. All the three studies on people with NCDs showed that reducing copayment was associated with declines in diastolic blood pressure^{208,209} and blood glucose²⁰⁵, as well as increases in self-reported health²⁰⁵.

Supply-side financing reform were evaluated in four studies, including capitation and P4P provider payment reforms with^{214,236} or without^{216,225} a combination of the demand-side interventions demonstrated above. Three studies found an increase in visits to PHC facilities and use of essential health services following provider payment reforms.^{214,216,236} One high-quality study provided further evidence showing that the combination of financing reforms on both sides had no greater effects on visits to PHC facilities than sole demand-side insurance reforms²¹⁴. No significant impacts on inpatient care were found.²¹⁴

None of the four studies found significant financing reform impacts on system costs,^{225,236} antibiotic use,²²⁵ or intensity of treatment,²¹⁴ except for one low-quality study reporting reduced use of antibiotics and injections²³⁶. One DID study with moderate quality of evidence showed that visits to PHC facilities did not simply increase along with increased government subsidies to PHC facilities or even declined.²¹⁵ This unexpected impact might that financing incentives alone were not

sufficient to motivate primary care providers to deliver additional primary care services beyond the set goals.

The health impacts of supply-side financing reforms were not studied.

4.3.5 Impacts of health service delivery policies

Among the five studies on restructuring health service delivery system, one focused on gatekeeping,²²⁶ and four on the integrated referral system^{213,219,223,230}. The high-quality study on gatekeeping showed an increase in primary care utilisation and a concurrent decrease in outpatient visits to hospitals.²²⁶ However, the study found no significant impacts on health costs in PHC facilities.²²⁶ Three of the four studies on integrated referral system were based on people with hypertension or diabetes and showed an increase in control rates for both diseases^{219,230} and self-reported health.²¹³ The high-quality study also found reduced NCD-related health service costs,²¹⁹ and the two moderate-quality found increased NCD-related visits to PHC facilities^{223,230}. One study with moderate quality assessed the impacts of the integrated referral system on general population, and it found no significant impacts on health service costs, essential health service use, satisfaction, self-reported health, or mortality.²²³

Primary care delivery at the community level, including family physician policy^{204,220,238} and the National Essential Public Health Services²³⁹ (NEPHS), were evaluated in four studies, with no high-quality studies. Of the three studies on family physician policy,^{204,220,238} two were low-quality and from eastern China,^{204,238} and one with moderate quality were based on nationwide survey data,²²⁰. One of the two low-quality studies used self-reported measures and found increased visits to PHC facilities, reduced healthcare costs, but also reduced satisfaction and not affected self-reported health.²³⁸ The other two studies found improved perception of care quality²⁰⁴ and health-related quality of life among people with NCDs²²⁰. One moderate-quality study on the NEPHS found increased update of antihypertensive

drugs, blood pressure examinations, and blood pressure control rates among people with hypertension across the country.²³⁹

Two high-quality studies evaluated two minor provider interventions, PHC workforce training²¹⁷ and performance reporting²⁰⁷. The two studies were from western and central China respectively. The one on workforce training showed increased use of primary care services in the intervened PHC facilities,²¹⁷ and the one on public reporting found reduced drug costs and use of combined antibiotics²⁰⁷.

4.3.6 The heterogeneous impacts of the reforms

Heterogeneous reform impacts were examined in 11 studies (**Figure 13**). Regional heterogeneity was the most studied^{211,212,214,217,228,229,239,240} (N=8), including urban/rural and eastern/central/western China, and the findings were mixed. One study found that people from central/western China had a larger increase in medication use, physician examinations, and hypertension after the introduction of the National Essential Public Health Services, compared with those from the eastern China.²³⁹ Similarly, the high-quality study showed that PHC workforce training increased visits to PHC facilities in rural populations but not urban ones.²¹⁷ On the other hand, the delivery rates of essential medicines in rural areas decreased after the NEMP enacted.²¹² The NEMP policy also had no impacts on antibiotic use in neither rural or urban areas.^{211,240} Studies on the second stage of the PHC reforms²²⁸ and co-payment reductions²²⁹ found increased use of PHC facilities in urban areas, but not rural ones. One study on financing reforms found greater increases in PHC facilities utilisation among people living closer to village clinics.²¹⁴

Socio-demographic related heterogeneities were assessed in six studies,^{203,207,214,229,237,240} including three studies comparing people with/without NCDs^{203,237,240}. One study from eastern China showed that people from poor households or with NCDs reported higher quality of primary care services after the first stage of the PHC reforms.²⁰³ In terms of single-component policies, four studies on financing reforms showed consistent evidence that females,^{214,229} the elderly,²²⁹

and people from poor households²¹⁴ or with NCDs^{237,240} were disproportionately benefited in terms of increased use of primary care services. One study on performance reporting also found that elderly populations had greater improvements in rational use of health services.²⁰⁷

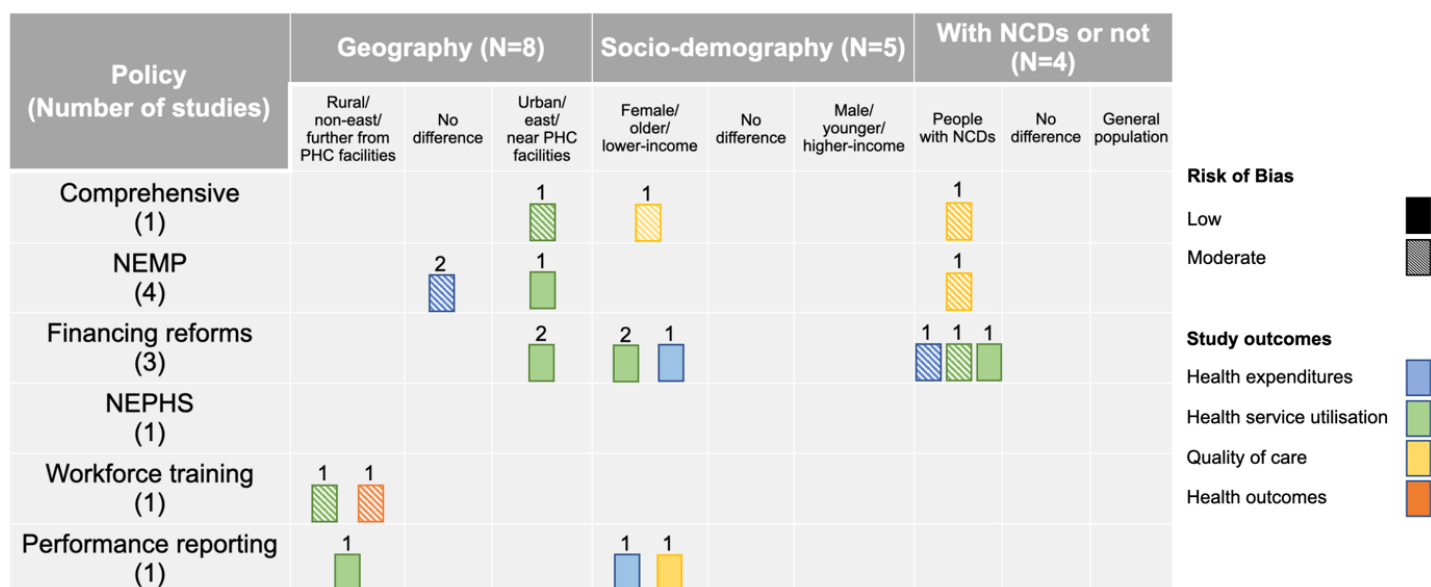


Figure 13 Heterogeneous effects of China's PHC reforms

Notes: 1. The matrix has six rows (one for each PHC policy) and three columns (one for each type of heterogeneities) 2. A bar in the cell indicates that the included study found greater policy effects among the corresponding population groups (defined by the columns) compared to their counterfactuals. The bar in the columns of “No difference” indicates that no differential policy effects were found; 3. The number annotated on the top of each of the bars indicates the number of studies; 4. NEMP for the National Essential Medicine Policy; 5. NEPHS for the National Essential Public Health Services; 6. NCD for non-communicable disease.

Source: adopted from Cai et al. (2023)¹⁸⁴

4.4 Discussion

4.4.1 Key findings

China's PHC reforms since 2009 had some progress in achieving its reform objectives of increasing primary care utilisation and improving the health status of people with NCDs. There was some evidence showing that the PHC reforms disproportionately benefitted vulnerable populations, including females, the elderly, and people with lower incomes or from under-resourced regions (i.e., rural areas and central/western China), suggesting some improvements in disparities in health service utilisation. However, the overall impact of the reform was modest. The reform impacts on financial risk protection, quality of care, and health of general populations were understudied, and evidence on health care system costs was mixed.

Comprehensive PHC reforms have been implemented in a few middle-income countries, such as Brazil,⁷ Mexico,^{246,247} Bolivia,¹²⁹ Turkey,²⁴⁸ and Iran⁹⁸. Existing evaluations of PHC reforms in LMICs have mainly focused on single-component PHC policies, whilst there is a dearth of evidence on comprehensive PHC reforms. Turkey's comprehensive PHC reforms increased infant and maternal health service utilisation and improved health outcomes.^{248,249} Similar impacts were found in Bolivia¹²⁹ and other Latin American countries (discussed in [Chapter 1](#)). Comparably, this systematic review found some evidence of increased use of maternal health general health services in China. However, no study examined how China's comprehensive PHC reforms affected health system costs, health outcomes, and health equity. The small number of studies and low-quality evidence identified in this review highlight a missed opportunity to examine the synergetic effects of China's ambitious PHC reforms.

In terms of single-component PHC policies, the systematic review showed increased primary care utilisation after China's PHC reforms. This finding aligns with evidence from PHC reforms in other LMICS^{70,92,249}. This systematic review found that co-insurance for primary care services,^{214,229} free-of-charge essential public health

services,²³⁹ and the family physician scheme,²³⁸ all increased primary care utilisation in China. For people with hypertension or diabetes, these three interventions increased their use of primary care services, medication, and treatment adherence, reduced their hospitalisation and resultant OOPes^{208,209,239} and improved their health outcomes^{208,209,220,239}. The management of other NCDs, such as cardiovascular diseases, is not investigated.

However, the increased primary care utilisation found in this study should be interpreted with caution. The increases can be a desirable change and might indicate increased access to care given that unmet healthcare needs and undertreated NCDs are prevalent in China^{83,250}. It could also suggest a shift in patient flows from hospitals to PHC facilities^{226,229}. On the other hand, the increased primary care utilisation can also be an undesirable change explained by overuse since the appropriateness of this utilisation was not ascertained. Notably, short-term increases in primary care utilisation after the reforms contradict with national decreases in the preference for PHC facilities^{167,251} and the dwindling patient share of visits to PHC facilities²⁵². This contradiction suggests that the PHC reforms may have been ineffective in achieving sustainable impacts, outpacing the growth of the hospital sectors, or reversing the hospital-centric health system. More in-depth understanding is needed regarding the nature of primary care utilisation (e.g., appropriateness and efficiency), the long-term effectiveness of the reforms, and the relative growth of the PHC sector to the hospital sector.

The review is unable to draw firm conclusions on reform impacts on service quality due to limited and poor-quality evidence and measurements for care quality. The mixed evidence on antibiotic use found in this systematic review is consistent with a recent review from China²⁵³. Similarly, this review also found mixed evidence on quality perception, and the reform impacts on process quality were not studied. This substantial evidence gap could attribute to the lack of quality-oriented performance measurements in China^{189,254}. This gap also hinders strengthening knowledge on quality improvement. The dearth of measurement and knowledge of quality improvement is a common impediment to the achievement of high-performance PHC and UHC in LMICs.

The findings of health improvements in this review were concentrated in high-risk populations (i.e., people with NCDs). The few included studies on general population health showed no significant health impacts. In contrast, evidence from Latin America and other Asian countries showed that the general population's health improved after their PHC reforms^{101,255,256}.

This difference may stem from three reasons. First, China's PHC reforms prioritised NCD management²⁵⁴. Also, some assessed PHC policies targeted people with NCDs, such as copayment reductions^{205,208,209,236,237} and service delivery models²¹³. This priority is sensible given that NCDs in China are poorly managed¹⁸⁹ and are projected to be a significant obstacle to China's progress in achieving UHC²⁵⁷. Second, limited and less sensitive measurements for population health were used. In the included studies, reported health outcomes were selective for hypertension and diabetes. Other health indicators, such as cardiovascular diseases and infant and maternal health, were not assessed. Therefore, the health improvement for general populations, if there was, may not be captured or need longer lag times to show. Third, PHC policies that benefit the wider population may have been hindered by insufficient system-level changes, persisting hospital domination, and limited quality improvement mentioned previously. The fragmented governance and poor coordination between the hospital and PHC sectors in China might inhibit the PHC sector from maximising its health impacts.

The impacts of China's PHC reform on healthcare costs were unclear, and its financial protection impacts were infrequently studied. This systematic review finds that the NEMP reduced medication costs at PHC facilities but did not affect OOPE. This finding is similar to a previous systematic review on NEMP²⁵⁸. The limited impacts on OOPE may be related to insufficient public funds for the PHC sector. PHC facilities often compensate the lost drug markup income with other health service charges²¹⁸ to maintain their revenue stream. This operation could foster some unaffected inappropriate provider behaviours in the review, such as overuse of antibiotics,^{211,225,240} overtreatment,²¹⁴ and unnecessary hospitalisation²²⁷. Expenditures for such inappropriate use of health services and medications could offset the anticipated financial protection. This finding hints at the interactions of

financing with other building blocks of the health system and reiterates the necessity of a holistic perspective for PHC financing to reduce OOPes.

This review shows that China's PHC reforms since 2009 had some pro-equity features. This finding is consistent with evidence from other LMICs^{248,259} and the narrowing inequalities in health service utilisation in China²⁵⁷. All assessed PHC policies disproportionately benefitted vulnerable populations, including females, the elderly, and people with lower incomes or NCDs. This effect aligns with the reform's goal of narrowing the accessibility gaps in health services across different population groups to achieve UHC. These population groups are more likely to use PHC facilities and, therefore, respond to any improved accessibility of primary care services.^{251,260,261}

Equity-focused evidence in this systematic review showed that essential public health services and workforce training delivered benefits to people from rural areas or middle/central China in terms of primary care utilisation and health outcomes. By contrast, financial interventions failed to do so. This contrast suggests that China's PHC reforms in under-resourced regions faced challenges that are more than affordability. For instance, some identified challenges include fragmented financing,²⁶² inefficient purchasing,²⁶³ low trust in primary care providers²⁶⁴ and low accessibility of PHC facilities²⁶¹. These challenges underscore the need for improving accessibility and quality of primary care services in under-resourced areas.

The concentrated studies on financing and primary care utilisation found in this systematic review align with the identified "major policy initiatives" of China's health reform²⁵⁴. These initiatives were considerably strengthened over time²⁵⁴. On the other hand, the scarce evidence on care quality highlighted in this review resonates with the policy gaps in performance improvements^{254,265}. Neglected policy agendas and poor knowledge bases can form a vicious cycle in evidence-based decision making.

The evidence on China's PHC reforms mirrors wider weakness in PHC research in LMICs. These weaknesses include: first, a dearth of evaluations with rigorous study designs, as well as limited and inadequate data and measurement of care quality and health outcomes (discussed in [Chapter 1](#)). Without quality data, robust and insightful research is challenging, and evidence-based policy making is impossible. Second, the majority of the included studies in this review did not discuss how well the reforms were implemented. It is unclear whether there are any deviations during the reform implementations. Because of the lack of such details, it is difficult to identify or conclude ineffective policy designs or poor implementation. Third, existing evaluations on PHC reforms in China and other LMICs often focus on single-component PHC policies. Synthesized evidence and evaluations of comprehensive reforms with a holistic perspective are scarce. Understanding of the long-term effects of such large-scale reforms is limited.

4.4.2 Limitations

This study is subjective of limitations. The conclusions are constrained by the sparse evidence, varied study quality, and the observational nature of studies.

Heterogeneity across studies prevented meta-analysis. The exclusion of small-scale studies, such as experimental studies at the community level, may omit some relevant evidence, but it is a trade-off between internal and external validity of evidence. Well-conducted RCTs can produce robust causal inferences but may not produce the generalisable knowledge needed to inform large-scale reforms.

4.4.3 Strength

This systematic review has key strengths. First, this is the first systematic review on the topic and addresses the evidence gaps in evaluations on comprehensive PHC reforms in Asia and globally. Second, comprehensive search strategies and broad search terms were adopted to minimize the probability of missing eligible studies. Studies were searched for in English and Mandarin. Third, this systematic review only focused on robust evidence robust evidence by applying strict inclusion criteria

for study designs. Only RCTs and controlled before-after studies were included in the data analysis.

4.5 Conclusion

This chapter presents a systematic review on the impacts of China's PHC reforms since 2009 on the health system and health outcomes. By adopting a board search strategy, the systematic review identified a large number of evaluation studies on the PHC reforms. The included studies assessed all major policy components of the reforms, the majority of which focused on the first round of the reforms (2009-2014). For single-component policies, national essential medicine and financing reforms were the most studied policies. By contrast, policies on primary care provision, such as family physicians and national essential public health packages, were rarely studied, and the quality of evidence was low.

Regarding the assessed reform impacts, the systematic review found some consistent evidence that China's PHC reforms since 2009 increased primary care utilisation and improved equity and some health outcomes for people with hypertension and diabetes. These desired changes mark China's progress in reaching the corresponding reform objectives. However, the success of other reform objectives is not clear. A question remains as to whether China's PHC reforms since 2009 have been sufficiently wide-reaching and transformative to achieve its envisioned PHC-oriented health system, given evidence of continued hospital domination. The mixed evidence from China shows that comprehensive PHC reforms might achieve its best success with a strong PHC system and a diversion from hospital centrality.

Overall, existing evaluations on China's PHC reforms lack high-quality studies with rigorous study designs and quality data. This challenge is shared across PHC evaluations in LMICs and impedes strengthening the knowledge base of comprehensive and system-wide reforms in LMICs.

As the initial original research chapter of this project, this chapter provides a comprehensive understanding of existing evaluations on China's PHC reform since 2009. The chapter also highlighted sustainable evidence gaps in the effectiveness of the second round of China's PHC reforms and the lack of robust evaluations. These evidence gaps build the fundamental interests of the two original research chapters ([Chapter 6](#) and [Chapter 7](#)).

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Chapter 5. An overview of DiD methods and key assumptions

This chapter introduced difference-in-differences (DiD) ²⁶⁶ methods used in [Chapter 6](#) and [Chapter 7](#). The section includes 1) the concept of potential outcomes in causal inference, 2) three canonical implementations of DiD methods and their limitations, and 3) some recent tools and alternative DiD methods for diagnosis and robust estimation overcoming the limitations of canonical methods.

5.1 Potential outcomes and causal inference

The concept of “potential outcomes” is fundamental and key for causal inference and all quasi-experimental studies²⁶⁷, including DiD. In policy evaluations, potential outcomes refer to the unobservable outcomes of individuals/groups who received treatment if they were not treated^{268,269}. It is worth noting that potential outcomes are always unobservable, given that the same individual/group cannot be both treated and untreated at the same time.

Given that potential outcomes cannot be observed, it is intuitive to compare the treated units with those not treated to investigate treatment effects. However, researchers should keep in mind the differences between the groups, which can confound true treatment effects. Such confounding can be eliminated with randomised controlled trials (RCTs), which is always the gold standard for causal inference²⁷⁰. However, RCTs are not always feasible due to ethical or cost considerations²⁷⁰, particularly for population-level policies. When RCTs are impossible (i.e., treatments are not randomly assigned), two main types of confounding could arise: 1) baseline differences (i.e. pre-treatment differences) which could diverge before-after changes in the two groups and 2) more problematically, the group differences that could be related to non-randomised treatments assignment, which is known as “selection bias”²⁷⁰. Therefore, addressing these confounders is crucial to constructing “potential outcomes” and examining the causal impacts of non-randomised interventions. By obtaining a control group that is identical to the treated groups, the untreated outcomes of the control groups can be

used as a proxy for the unobservable potential outcomes of the treated. The potential outcomes approach to causal inference lies on a fundamental assumption that there is no interference between treated units, known as the stable unit treatment value assumption (SUTVA)²⁶⁷. This assumption is also required by the three canonical DiD methods discussed below. Average treatment effects are equal to average treatment effects on the treated groups only when treated and untreated groups are identical (i.e., perfectly matched).

5.2 DiD and TWFEs in policy evaluations

5.2.1 DiD, TWFEs, and key assumptions

With the idea of constructing potential outcomes, the canonical DiD method is developed²⁷¹. A canonical 2x2 DiD includes two groups (treatment and control groups) and two periods (before and after interventions) (see equation (1)). The treatment effects can be estimated by comparing the before-after changes between the two groups.

$$Y_{2x2DiD} = (\bar{Y}_{treated}^{Post} - \bar{Y}_{treated}^{Pre}) - (\bar{Y}_{control}^{Post} - \bar{Y}_{control}^{Pre}) \quad (1)$$

Panel regression with two-way fixed effects (TWFE) is regarded as an extension of canonical 2x2 DiD and is used when multiple time points and/or groups are included. TWFE estimates are “variance-weighted average of all possible 2x2 DiD estimators that compare timing groups to each other”²⁷².

$$Y_{it} = \alpha_1 X_{it} + \beta D_{it} + \mu_i + \gamma_t + \varepsilon_{it} \quad (2)$$

where Y_{it} was an outcome of interest for unit i in time t . In equation (2), μ_i was a vector of dummy variables that controlled for time-invariant unit fixed effects, and γ_t was a vector of dummy variables that controlled for unobservable time fixed effects across units. X_{it} were observable time-varying confounders at the unit level. D_{it} is a vector of dummy variables that equal to one when unit i is treated at time t .

Coefficient β is the overall estimated treatment impacts. The residual term e_{it} was the stochastic disturbance term capturing any unobserved confounders that were not associated with treatment assignment and assumed normally distributed and mean zero.

TWFE methods are somewhat advantageous in allowing multiple time points, staggered treatment timing, and, more importantly, controlling for unobservable time-invariant confounders using unit and time-fixed effects^{273,274}. This method is extensively used in policy evaluations²⁷², given its appropriateness in terms of controlling for unobservable confounders that could be associated with treatment assignment. TWFE allows treatments to occur at different times (i.e., staggered treatment implementation), whilst 2x2 DiD can only assess treatments occurring at the same time for all treated units. However, staggered implementation can also bring complexity when estimating treatment effects using TWFE. These complexities will be discussed in more detail in the following section.

5.2.2 Event study

Event study is an extended method from TWFEs to further explore the temporal variation in treatment effects.

$$Y_{it} = \alpha_1 X_{it} + \alpha_2 X_{jt} + \sum_{l=-L}^{-2} \beta_l D_{it}^{lead} + \sum_{l=0}^L \beta_l D_{it}^{lag} + \mu_i + \gamma_t + \varepsilon_{ijt} \quad (3)$$

where Y_{it} was an outcome of interest for unit i in time t . In equation (3), μ_i was a vector of dummy variables that controlled for time-invariant unit fixed effects, and γ_t was a vector of dummy variables that controlled for unobservable time fixed effects across units. X_{it} were observable time-varying confounders at the unit level. $l = -L, \dots, -1, 0, 1, \dots, L$ denoted the relative time periods from the calendar time t to the implementation year of the reform G_i (i.e. $l = t - G$). D_{it}^l was a set of binary variables that equal to one when unit i being l time periods away from the treatment implementation at calendar time t , and zero otherwise. D_{it}^{lead} are a set of dummies

indicating unit i in time t that is l years prior to the reform implementation (i.e., lead terms for pre-treatment periods), whilst D_{it}^{lag} indicates unit i in time t that is l years after the treatment (i.e., lag terms for post-treatment periods). The year prior to the treatment (l_{-1}) was used as the reference group. $\sum_{l=0}^L \beta_l$ summarized the dynamic reform effects. The residual term e_{it} was the stochastic disturbance term, capturing any unobserved confounders that were not associated with treatment assignment and assumed to be normally distributed and mean zero.

The three canonical DiD methods usually make two fundamental assumptions: 1) parallel trend assumption²⁷⁵ and 2) homogeneous treatment effects²⁷². The parallel trend assumption assumes “If, in the absence of treatment, the average outcomes for the treated and control group would have followed parallel paths over time”²⁷⁶. It is worth noting that parallel trend assumption cannot be proven due to the unobservable nature of “potential outcomes”^{267,277}. However, when the parallel trend assumption is satisfied during pre-treatment periods, researchers can be more confident that the control and treatment groups are likely to evolve following a similar pattern during post-treatment periods if the treatment was not enacted²⁷⁷. Additionally, the homogeneous treatment effect assumption applies to treatment effects both across groups and over time. In other words, the TWFE assumes that the estimated treatment effects do not change over time. A violation of the homogeneous treatment effect assumption could result in negative weights and biased estimation of treatment effects^{272,276,278,279} (discussed in more detail below).

5.2.3 Challenges of TWFEs

Despite the advantages, recent econometric literature points out that canonical DiD methods (i.e., 2x2 DiD, TWFE, and event study) have limitations^{275,276,280-282}. If treatment effects are assumed to be homogeneous and constant over time, researchers can be confident that DiD analysis will give the best linear unbiased estimator (BLUE) of the true treatment effects. However, it is obvious that these assumptions are extremely restrictive and almost impossible to hold in reality - the treatment effects are highly likely to vary across groups or over time. When the

assumptions are violated, the estimators that use earlier treated groups as control groups for later adopters can substantially bias the weighted average DID estimator.

Another challenge of TWFE methods is that the weights assigned to each 2x2 estimator are sensitive to group sizes and treatment variations²⁷². The length of the panel/data alone can affect the TWFE estimator substantially, and the groups treated in the middle of the observed periods often get the largest weights²⁷². Such weighting scheme does not reflect any interests of policy evaluations. Specifically, in this project, there is no untreated group, so the estimator from early adopters gets more weights because it uses more data and has a higher treatment variance. However, the weighting assignment cannot be ascertained since the majority of the provinces were treated in the middle of the time window and the group sizes of early adopters are small.

More recent studies on DiD methods highlight that TWFE models might suffer from severe bias when treatments are introduced in a staggered manner and the treatment effects evolve over time.^{272,278,279} This limitation cannot be recovered by other transformations of the standard TWFE method, such as event study²⁸³. In other words, all TWFE-based DiD methods can suffer from these challenges.

5.3 Bacon decomposition diagnosis

Bacon (2021)²⁷² proposed a useful tool to diagnose and decompose TWFE estimators and the assigned weights. For example, the weighted average estimates from TWFE models of a two treatment timing setting with a never-treated group are decomposed into four groups: early/untreated, late/untreated, early/late, and late/early (**Figure 14**). For K treatment timing groups, there is a K^2 matrix for comparisons or K^2 -K comparisons if never-treated groups are not available.

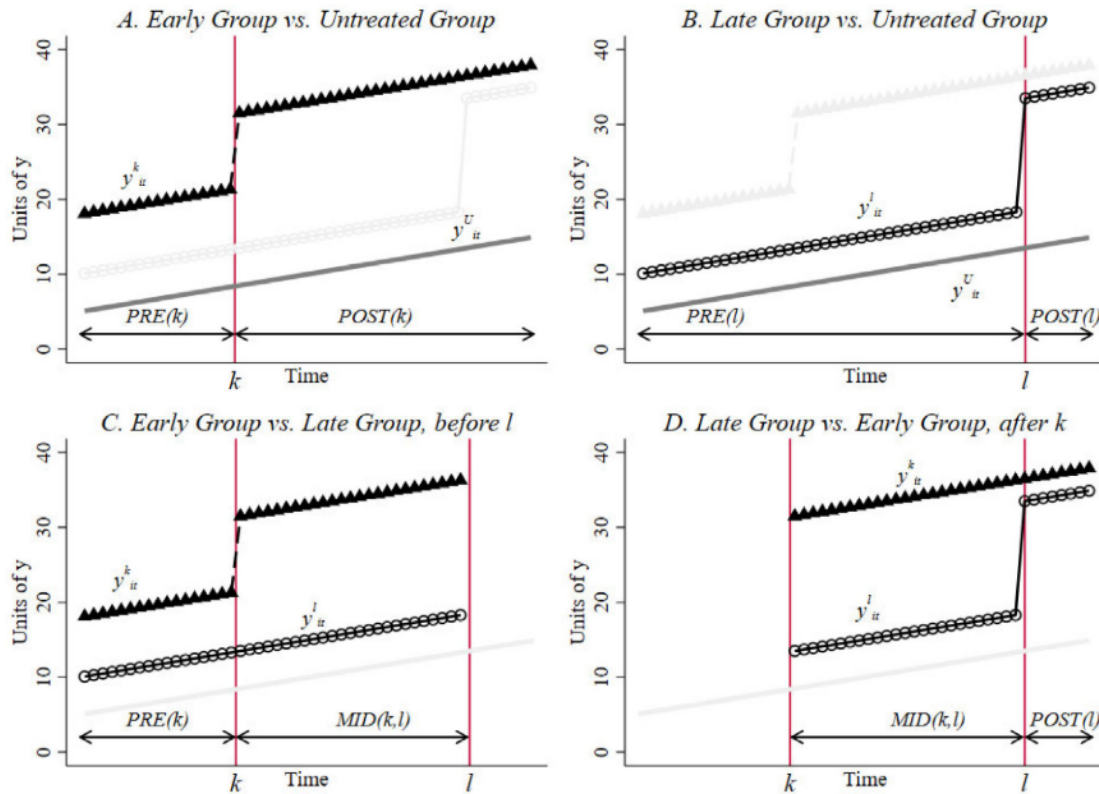


Figure 14 Four plots of outcomes for subgroups used in four 2x2 difference-in-differences estimates in a three treatment timing case

Notes: y_{it}^k indicates the outcomes for the early treated group. y_{it}^l indicates the outcomes for the late treated group. y_{it}^u indicates the outcomes for the never-treated group. k is the treatment time for the early group. l is the treatment time for the late group. Each plots the comparison in one 2x2 DiD.

Source: Goodman-Bacon (2021)²⁷²

The weights on each 2x2 DiD estimate are calculated using the absolute size of the subgroups and their variance of treatment variables. Please see Goodman Bacon (2021)²⁷² for the equations. The TWFE estimator comprised of three estimands: 1) variance-weighted average treatment effect on the treated, 2) variance-weighted command trends, and 3) a variance-weighted sum of the change in the treatment effects²⁷². The last part equals zero when average treatment effects are constant, generating BLUE estimation for the true treatment effects for the treated²⁷². In other words, when the homogeneous treatment effects assumption is violated, the last estimand introduces biased or negative weights when treatment effects grow stronger over time^{272,279}.

5.4 Alternative DiD estimators

To address the challenges of traditional DiD methods mentioned above, a series of literature on alternative DiD estimators rise²⁸², including those proposed by Callaway and Sant'Anna²⁷⁶ (CS-DiD), de Chaisemartin,²⁷⁸ Sun and Abraham,²⁸³ Borusyak²⁷⁹, and Athey and Imbens²⁸⁴.

This section focuses on the alternative DiD estimator proposed by Callaway and Sant'Anna (CS-DiD) which was used in the analysis in [Chapter 6](#) and [Chapter 7](#). The CS-DiD method groups the observations by both treatment timing and absolute time (e.g., calendar years or months) and estimates the group-time average treatment effects. CS-DiD allows for baseline differences in observed characteristics between groups, relaxing the parallel trend assumption. The method offers three identification strategies that developed from previous work, including 1) outcome regression, 2) inverse probability weighting, and 3) doubly-robust estimands²⁷⁶. The outcome regression is to estimate the relationship between the baseline characteristics and the outcome variables before the treatment is introduced using control groups^{285,286}. The inverse probability weighting uses a propensity score to weight each unit to balance the characteristics between the groups and compares the weighted before-and-after changes in the two groups²⁸⁷. The doubly-robust estimands include both procedures used in the other two strategies²⁷². These strategies all generate a propensity-score-like parameter estimate which is used in the estimation of the average group-time treatment effects.

CS-DiD allows for covariates-specific trends, heterogeneous treatment effects, and staggered implementation. CS-DiD also allows estimations of treatment effects to change over time (i.e., changing by the length of exposure)²⁶⁹. This property fits my research interest in how the reform effects varied by the length of exposure to the reform. CS-DiD is robust to bias raised from heterogeneous treatment effects discussed before.

Apart from its robustness, CS-DiD has three other advantages: 1) it emphasises the role of pre-treatment covariates in shaping different trends in outcomes across

groups and allows for conditional parallel trend assumption; 2) it allows time-invariant confounders to be included in the model. This is not feasible in TWFE models since time-invariant confounders will be absorbed due to their collinearity with fixed effects. 3) it allows flexible aggregation of group-time average treatment effects to probe into the source of heterogeneities across groups and time²⁶⁹. These advantages are valuable for my analysis of the population-level PHC reforms with non-randomised and staggered assignment to people clustered in heterogeneous cities/counties.

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Chapter 6. A longitudinal ecological study on the reform impacts on health system and health outcomes

This chapter presents a quasi-experimental ecological study examining the comprehensive impacts of China's PHC reforms on the PHC system and health outcomes. This study used province-level panel data from governmental yearbooks and broadly explored a wide range of health system outcomes and health outcomes measured by all-cause mortality and maternal mortality ratio (MMR). The provincial level data also provided an opportunity to explore the heterogeneous impacts of the reforms across regions.

There are two main analyses presented in this chapter to answer two research questions respectively. First, a DiD study was conducted to examine the causal impacts of the second round of the PHC reforms on the health system and mortality. This DiD method is robust to some potential bias from using traditional two-way fixed effects for policy evaluations which extensively debated in recent econometric literatures. These debates are also further discussed in this chapter. Second, a panel regression with fixed effects was performed to further investigate the association between the assessed health system outcomes and mortality. This specific focus can shed lights on the likely mechanism to explain the health impacts of the reforms. Finally, subgroup analysis was conducted to explore how the association/pathways varied across regions.

Research questions for Chapter 6

- 1) How did China's second stage of PHC reforms affect the health system supply, health service utilisation and costs, and mortality?
- 2) What were the pathways by which the reform impacted mortality?
- 3) Did these pathways vary across regions?

6.1 Introduction

As discussed in [Chapter 1](#), evaluations of PHC reforms in LMICs mostly focused on single-component policies, and the quality of evidence was low. More specifically, the systematic review on China's PHC reforms presented in [Chapter 4](#) found a similar pattern. Disproportional amounts of studies focused on the first round of reforms and single-component policies, such as financing and essential medicines. For the second-round reforms, some studies assessed the impact of the family physician scheme^{204,238} and gatekeeping²²⁶ on primary care utilisation. However, these studies are often from developed provinces, and the health impacts of the reforms are understudied. The comprehensive impacts of the reforms as an entirety were understudied. In terms of assessed outcomes, primary care utilisation was the most investigated outcome, whilst there is scarce understanding of the reform impacts on secondary care utilisation, financial protection, general population health, and health inequalities. There is a dearth of robust studies on the health system and health impacts of the second-round PHC reforms as a whole and its regional heterogeneities.

Despite the substantial evidence gaps in comprehensive evaluations of the reforms as a whole, such evaluations have desirable properties. System-wide health reforms can stimulate synergetic impacts through interconnected building blocks, resulting in both intended and unintended changes. A broad assessment on the health system has a better chance of capturing unintended outcomes than a focused evaluation of the set reform goals. Besides, comprehensive evaluations of diverse outcomes can map out various building blocks of health systems and provide insights into better explanations with mechanisms behind the observed changes.

To address the identified evidence gap in general population health, this study assessed two mortality outcomes: all-cause and maternal mortality. Quality improvement in PHC reduced NCD-related hospitalisation and deaths in Brazil.¹²⁷ Maternal deaths are mostly preventable via cost-effective and low-tech primary care services.^{273,274} For instance, regular check-ups during pre- and post-natal periods can identify and manage high-risk pregnancies and hence reduce MMR.²⁷³ Empirical

evidence from LMICs, such as China, Brazil, and sub-Saharan Africa, suggests that increasing primary care workforce^{275,276}, pre- and post-natal care utilisation²⁷⁷, and home visits²⁷⁸, and community-based care^{72,279,280} have positive impacts on reducing maternal hospital admissions, the MMR, and maternal health-related inequality^{281,282}. Two studies from Brazil and Iran specifically assessed the Family Health Care Strategy, a PHC-oriented reform, and they found the policy was associated with a reduced MMR.^{265,283}

Figure 15 presents the delivery of essential maternal care in the three-tiered health system with a partial gatekeeping in China. The 2015 reforms established an integrated continuum of maternal care provision with clear role divisions and standardised referral procedures. The impacts of these policy changes on population health can be captured by changes in the MMR. China has made impressive progress in reducing the MMR²⁸⁴, from 38 to 20 per 100,000 live births between 2008 and 2019.²⁸⁵ Some studies from China showed that the NEPHS policy increased maternal care use^{286,287} and health expenditures²¹¹ and a reduced MMR²⁷⁷. However, there is little understanding of how the 2015 PHC reforms contributed to the reduced MMR.

Evaluations on such comprehensive and large-scale reform should also consider heterogeneities. As demonstrated in **Chapter 2**, China has a decentralised health system, which allows local governments at the provincial level to adopt and adjust top-down national policy guidance according to the local context. Also, there are notable geographical differences in socioeconomic developments, health resources, and health service provision and utilisation (see **Chapter 2**). It is intriguing to investigate whether and how the reforms affected different regions and populations differently.

Policy evaluations can benefit from routinely collected data (RCD).^{288,289} RCD are often set up for registries or administration purposes. Compared with traditional survey data, RCD have a larger number of observations, better representativeness and generalizability, and more cost-effective collection²⁹⁰. This study used governmental yearbook data systematically collected from PHC facilities and

reported to local governments. The yearbook data include information on health resources, health services delivery, and population health, which can be used to evaluate the health and health system impacts of reforms. Existing studies using yearbook data mostly described trends and disparities in health resource allocation, service delivery, and population health (**Panel 1**). Policy evaluations using yearbook data are rare, and no study evaluated the 2015 health reforms using yearbook data.

Based on the evidence gaps mentioned, this study aims to provide robust evidence on the reform impacts on the health system and health outcomes using RCD and to gain a comprehensive understanding of the reform mechanism.

Panel 1 A literature review of studies using Chinese yearbook data

A search on PubMed was conducted on July 20th, 2023, using the terms “China” and “yearbook” without time or language restriction. The search identified 270 papers using yearbook data.

Most of the papers used data from multiple years, and the most studied topics are 1) NCD-related mortality trends over time, such as maternal, cancer, or diabetes mortality; 2) equity and efficiency studies on health source allocation using DAE, Gini coefficient, or Theil Index. Among these studies, eight studies focused on PHC facilities, workforce, and other resources.^{172,173,284,291-295} One study examined the effects of disparity in health resource allocation on mortality.²⁹⁶ Three papers descriptively analysed the changes in health service allocation and utilisation in PHC sector^{297,298} and the whole health system.²⁹⁹ 3) association between the health reform since 2009 and health resource allocation, health services utilisation, or mortality. This topic aligns with our research interests in reform evaluations.

Among the nine papers on China’s health reform since 2009, three used provincial-level data,³⁰⁰⁻³⁰² with two using fixed effect panel regression,^{300,301} and four adopted ITS study designs and national-level data.^{287,303-305}

Two studies focused on the 2009 health reform. One descriptive study by Feng et al. found an increasing linear trend in the health resource allocation (workforce, funds, and equipment) and provision in the PHC sector at the national level between 2009 and 2018.³⁰⁶ However, this study shows that the PHC sector in China grew slower than the hospital system, and its share shrank over time. Provincial heterogeneities and health impacts of the reform were not studied. One study adopted provincial-level data and fixed effects and showed that the 2009 health reform increased the efficiency of government health expenditures.³⁰⁰ None of the identified studies assessed the health system or health impacts of the 2015 health reforms.

Three studies focused on the PHC workforce. Li’s study used two-way fixed effects and provincial-level panel data and found that the increasing PHC workforce hospitals after the 2015 health reform significantly reduced visits to, but not their

hospital fees or admissions.³⁰¹ This study did not investigate the heterogeneity in this observed impact or how the increase in PHC workforce affected primary care utilisation. The other two studies using ITS showed the 2009 reform increased the number of PHC workforce³⁰⁴ and improved the constructed system capability indicators³⁰³ at the national level.

Two studies assessed the impacts of the essential public health package introduced in 2009 on maternal mortality, of which one was at the national level using interrupted time series ¹⁰ analysis ²⁸⁷ and the other at the provincial level using generalised estimating equation models,²⁵⁴. A study assessed the policy impacts on neonatal mortality using ITS.³⁰⁵ All three studies found that the package increased health management and reduced mortality among pregnant women and infants.

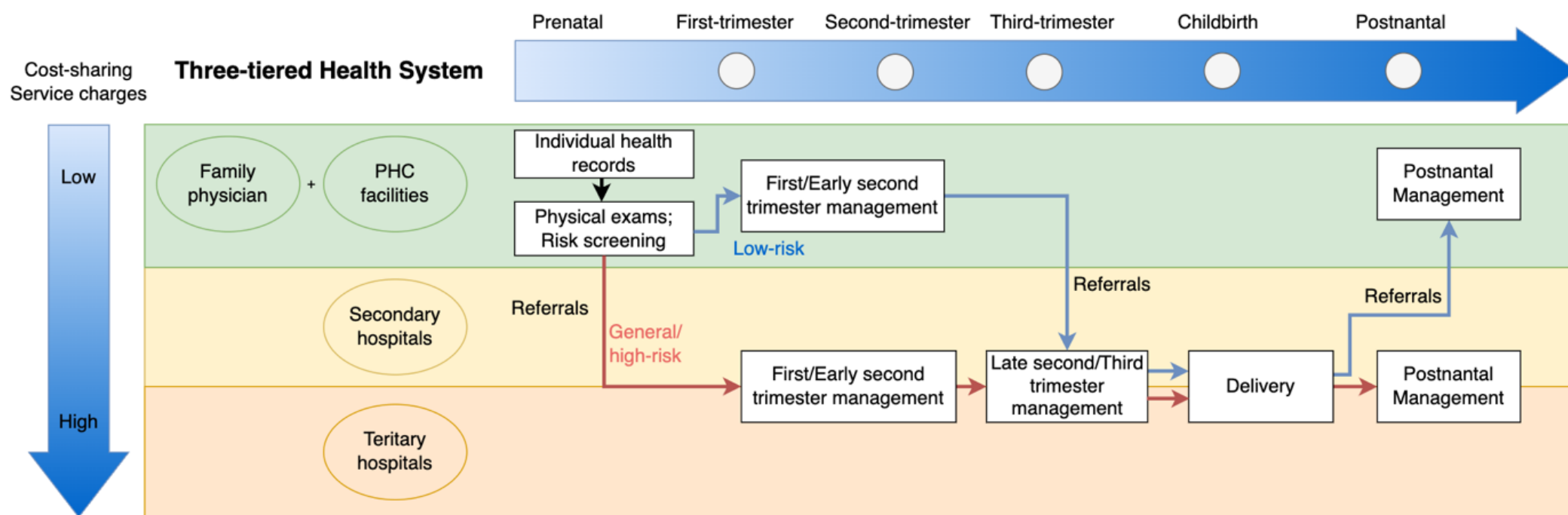


Figure 15 A diagram of the continuum of maternal care during prenatal, childbirth and postnatal periods in China's three-tiered health system

Source: author's own work created based on the Guidelines on the National Essential Public Health Services (2017 version)³⁰⁷ and the Notice on Standards for Pregnancy Risk Assessment and Maternal Management (2017)³⁰⁸

6.2 Methods

6.2.1 Study design

This observational longitudinal ecological study includes two main analyses. Both analyses used one dataset of annual observations for each province from 2010 to 2019. The unit of analysis is province-year.

The first analysis is a CS-DiD study to assess how the second-round PHC reforms affected the inputs and utilisation of health services and mortality. The second analysis is a panel regression with province and year-fixed effects to assess the association between the assessed inputs and utilisation outcomes and mortality. Subgroups were introduced in both analyses to investigate how this association varied across regions.

6.2.2 Data resources

This study used routinely collected data from two government yearbooks, the China Health Statistic Yearbook and the China Statistic Yearbook. The two yearbooks are both compiled by the National Bureau of Statistics of China and published annually. Data in both yearbooks are presented at national and provincial levels and cover all 31 provinces in mainland China.

The China Health Statistic Yearbook includes information on the supply and utilisation of China's health system and population health. Data on primary care services were separated from overall health services in 2010, after the PHC reforms. Since data on the PHC sector have been separately reported in the yearbook only since 2010, this study used relevant data from 2010 to 2019, the year before the Covid-19 pandemic.

The China Statistic Yearbook are available from 1999 to 2022. Data reflect China's and its provincial socioeconomic developments, including demography, employment

and income, government financing, environment and energy, agriculture, industry, construction, trades, health services, population health, etc. This study extracted data on health resource supply, health service delivery, health financing, and mortality from 2010 to 2019.

I web-scraped local governmental websites for the 31 provinces and obtained the corresponding provincial policy documents for the second round of China's PHC reforms. The search used the term "fen ji zhen liao" (分级诊疗) in Mandarin (meaning "hierarchical medical system" in English). A comprehensive search was also conducted on Wolters Kluwer's legal database,³⁵⁵ and three Chinese legal databases - China Government Gazettes Database,³⁵⁶ China Legal Knowledge Database,³⁵⁷ and PKULAW³⁵⁸. The reform implementation dates noted in the provincial policy documents were identified and used as the implementation date of the reforms at the provincial level. The web-scraping was performed using Python 3.7.

6.2.3 Measurements

Table 7 shows the outcomes, covariates, and control outcome used in the analysis.

Outcomes

The primary outcome in this study is population health, measured by the maternal mortality ratio (MMR, number of maternal deaths per 10,000 live births) and all-age all-cause mortality. These two indicators are widely adopted to measure health system performance and population health.³⁰⁹

To better understand the potential pathways of the reform impacts on population health, the study also examined a wide range of health system outcomes that could mediate the reform health impacts. These outcomes can be divided into three aspects: 1) PHC system inputs, 2) health service delivery, and 3) health costs.

Regarding PHC system inputs, three outcomes were assessed: 1) number of PHC facilities per 10,000 people, 2) number of PHC beds per 10,000 people, and 3) number of PHC workforce per 10,000 people. As discussed previously, the lack of PHC resources challenges the strengthening of PHC in China. Additionally, policies like family physicians were expected to affect the supply of PHC workforces.

Regarding health service delivery, this study examined the delivery of primary and maternal care services. Different types of primary care services were measured by three variables, including 1) visits to PHC facilities, measured by the number of family physician services delivered per 10,000 people; 2) family physician services, measured by the number of family physician services delivered per 10,000 people; and 3) maternal health services, measured by prenatal services (%) and postnatal services (%).

Regarding health costs, this study assessed both individual health costs and health costs for health service providers. Individual health expenditures were measured by average annual household health expenditures (Chinese Yuan). For health service costs, hospital outpatient drug fees per visit (Chinese Yuan) and hospital outpatient check-up fees per visit (Chinese Yuan) were examined. Changes in hospital service charges are expected because the system-wide reforms could indirectly affect the hospital sector through changes in the PHC sector and its interconnection with hospitals. For instance, policies like gatekeeping and the two-way referral system can result in changes in the use of hospitals subsequent to increasing/decreasing use of PHC facilities. These values were adjusted for inflation using the consumer price index (CPI, 2010 = 100).

Exposures

A binary variable was constructed to indicate if the province was under the reform each year. A categorical variable was also created to indicate the year when the reform was implemented and account for the temporal variation in reform implementation across provinces. For policy documents released after June, the implementation year was defined as the year after.

Covariates

The two analyses were adjusted for covariates that might affect the reform implementation or the outcomes of interest (**Table 7**). Both analyses adjusted for the provincial socioeconomic development levels using Human Development Index (HDI). HDI is a comprehensive indicator that measures life expectancy and education and income levels of a region³¹⁰ and often associated with the MMR.³¹¹ Health insurance coverage and hospital allocations are also confounders associated with the MMR and primary care utilisation³¹²⁻³¹⁴. These two confounders were adjusted using the percentage of people covered by national basic health insurance and number of hospitals per 10,000 people respectively. The average length of stay in hospitals is often used as an indicator of the quality and efficiency of hospital care³¹⁵ and is associated with mortality³¹⁵. The average length of stay in hospitals was adjusted for in the estimation. Moreover, transportation can affect people's access to health services and then their health,³¹⁴ which was adjusted for using areas of city road per capita (square meters).

Category	Measurements (Units)
Outcomes	
PHC supply	Number of PHC facilities per 10,000 people
	Number of PHC beds per 10,000 people
	Number of PHC workforce per 10,000 people
Primary care	Number of family physician services delivered per 10,000 people
	Visits to PHC facilities per capita
Maternal care	Prenatal Services (%)
	Postnatal Services (%)
Health costs	Hospital outpatient drug fees per visits (Chinese Yuan)
	Hospital outpatient check-up fees per visits (Chinese Yuan)
	Average annual household health expenditures (Chinese Yuan)
Population health	Maternal Mortality Ratio (per 100,000 live births)
	All age all-cause death rates (%)
Covariates	
	Human Development Index
	Percentage of people covered by basic health insurance in all populations (%)
	Number of hospitals per 10,000 people
	Average length of stay in hospitals (days)
	Areas of city road per capita (square meters)
Control outcomes	Traffic deaths (per 10,000 people)

Table 7 Outcomes, covariates, and control outcomes used in the CS-DiD estimations.

Notes: PHC for primary health care.

Source: author's own work.

6.2.4 Statistical analysis

The CS-DiD analysis of reform impacts

The CS-DiD estimator was employed to assess the reform impacts on the health system and population health. The reform impacts were estimated using:

$$Y = \tilde{\alpha}_1^{g,t} + \tilde{\alpha}_2^{g,t} G_g + \tilde{\alpha}_3^{g,t} \cdot \mathbf{1}\{T = t\} + \tilde{\beta}^{g,t} \cdot (G_g \times \mathbf{1}\{T = t\}) + \tilde{\gamma} \cdot X + \tilde{\epsilon}^{g,t}$$

where $\tilde{\beta}^{g,t} = ATT(g, t)$ is group-time average treatment effects for each group g at each time period t . Group g contains observations treated at time g . G_g is a dummy indicating whether a group first received the treatment at time g . $T = t$ indicates the current time. X is a set of pre-treatment covariates conditional on which the parallel trend assumption holds. In this study, the reform implementation is an absorb treatment, meaning that the treatment is irreversible, and people treated will stay treated after the reforms.

For identification, this study used the outcome regression methods, which uses pre-treatment covariates of the control groups to model the expectation of the outcome changes conditional on the covariates. This relies on the assumption of conditional parallel trends (i.e., the outcomes of the treated groups would have evolved following the same patterns as the outcomes of the control groups if the treated groups were not treated). The groups that were not yet treated were used as control groups. Since all groups were treated at the end of the observed periods, the CS-DiD dropped the last treated groups from the estimation. In other words, the reform impacts on the last treated provinces were not estimated. The treatment effect $\tilde{\beta}^{g,t}$ is estimated by first subsetting the data to only include observations at time t and $g - 1$ from group g and groups not-yet-treated by time t (i.e., group $g > t$), and then running a population linear regression using only the extracted data. $t = g - 1$ was used as the reference time period.

These $ATT(g, t)$ were then aggregated into an event study estimation to test parallel trend assumption during the pre-treatment periods. Event study aggregation is done using:

$$\theta_{es}(e) = \sum_{g \in G} \mathbf{1}\{g + e \leq T\} P(G = g | G + e \leq T) ATT(g, g + e)$$

where $e = t - g$ is the relative time period. T is the maximum of T (i.e., the last time period). The data were set as repeated cross sections data. The CS-DiD method uses simultaneous inference procedures done by bootstrapping and reports predictive confidence intervals instead of point-wise confidence intervals.

The heterogeneous treatment effects were explored by stratified analysis between low- and high-HDI provinces.

The panel regression on PHC and MMR

A panel regression with year and province fixed effects were employed to further investigate the association between the assessed PHC determinants, all-cause mortality, and the MMR. The association was estimated using:

$$Y_{it} = \alpha + \alpha_1 X_{1it} + \dots + \alpha_p X_{pit} + \beta_1 Z_{1it} + \dots + \beta_q Z_{qit} + \lambda_i + \delta_t + \varepsilon_{it}$$

where Y_{it} is the outcome of interests of province i at year t . $X_{1it}, \dots, X_{pit}$ are a set of time-varying covariates at the province level. $Z_{1it}, \dots, Z_{qit}$ are the main variable of interests – a set of PHC determinants as independent variables. λ_i and δ_t are province and time fixed effects to control for time-invariant unobservable province-level confounders and time-specific effects respectively. The parameters of interest are $\beta_1, \dots, \beta_q$ which captures the impacts of the assessed health system outcomes on all-cause mortality and the MMR. The residual term ε_{it} was the stochastic disturbance term capturing any remaining unobserved confounders and assumed

normally distributed and mean zero. The robust standard error was clustered at the province level.

The heterogeneous association between PHC determinants and the MMR were investigated in stratified analysis between low- and high-HDI provinces and regions (eastern, central and western China).

All data analysis was conducted in R version 4.2.1.

6.2.5 Robustness checks

Existing studies using the CS-DiD estimator often reports results from both TWFE and CS-DiD methods to compare the discrepancy of the two methods and the degree of bias from the traditional TWFE models³¹⁶. I also followed this practice and assessed the reform impacts on the health system and population health. To further test the sensitivity of the model specifications, multiple TWFE models with different specifications were ran, including time dummies, continuous province-specific time trends, and lag terms (see [Appendix 2](#)). To test whether the traditional TWFE estimation is prone to the challenges raised by time-varying treatment effects in a staggered setup, a Bacon Decomposition Diagnosis (mentioned in [Chapter 5](#)) was conducted. The diagnosis was then used to demonstrate whether alternative DiD methods are more favourable than the canonical ones in this study setting.

The validity of DiD method relies on the parallel trend assumption, which assumes that no systematic time-varying difference exist between the treated and control groups^{266,317}. Although this assumption cannot be proved, studies can be more confident about this assumption if the outcomes trends in the two groups move in parallel during the pre-treatment periods. In this project, the validity of this assumption was tested using two methods. First, an event-study like estimator was constructed to test the reform impacts during the pre-reform periods. Second, a control outcome (i.e., placebo outcome), traffic-related deaths, was used in the CS-DiD estimation. Control outcomes are anticipated to have no treatment effect and

used to assess residual biases and improve interval validity in non-randomised studies³¹⁸. Traffic-related deaths per 10,000 people was used as a control outcome in the CS-DID estimation, and no reform impact on traffic-related death was expected.

6.2.6 The endogeneity in reform implementations

A main concern for large-scale reforms is that the rule of the assignment is unknown and very likely to be non-randomised. As demonstrated above, the PHC reforms rolled out in a non-randomized way, and it is not clear how the pilot cities/counties were selected. In other words, it is reasonable to suspect that the roll-out of the second stage of the PHC reforms was associated with the demographical, socioeconomic or health system characteristics of the cities/counties. When these factors are associated with the outcomes of interest, the estimated reform impacts could be biased. To evaluate this concern, some baseline characteristics between the earlier and later adopters of the reforms were compared to examine the existence of baseline confounders using an independent t-test. To examine how the probability of reform implementation differed across the provinces and test the degree of the endogeneity, a hazard analysis was conducted using cox regression to estimate the probability of a given province enrolling in the PHC reforms.

For the cox regression, 2012/01/01 was set as a fixed starting date for all provinces and constructed a time-to-event variable based on the time intervals between the implementation year of the PHC reform and 2012. A multivariate Cox regression was performed adjusted for baseline characteristics to estimate the hazard ratio (HR) of implementing the reform and its 95% confidence intervals.

The dependent variable is a dummy variable indicating the presence of the PHC reform in each province. Independent variables are seven baseline characteristics (i.e., in the beginning of the observation period, 2012) at provincial level that theoretically might affect the uptake of the PHC reform, including: GDP, HDI, government health expenditures per capita, number of hospitals per 10,000 people,

population sizes, regions (west, east, and central China), percentage of urban populations among all. The cox regression was estimated as follow:

$$h(t|X_i) = h_0(t) \exp (\beta_1 X_{i1} + \beta_2 X_{i2} + \dots + \beta_7 X_{i7})$$

where $h(t|X_i)$ is the hazard function of enrolling in the PHC reforms determined by the seven covariates $X_{i1}, X_{i2}, \dots, X_{i7}$. t represents the survival time (i.e., the time between the fixed starting date and the reform implementation dates in a given city/county i). Coefficients $\beta_1, \beta_2, \dots, \beta_7$ are the effect of covariates $X_{i1}, X_{i2}, \dots, X_{i7}$ on the reform enrollment. The quantities $\exp (\beta_1), \exp (\beta_2), \dots, \exp (\beta_7)$ are the hazard ratio (HR) of interests. Standard errors were clustered at the city level. The mean differences in these selected baseline characteristics between the earlier and later adopters were tested by two-sample/ independent t-test. All data analysis was conducted in R version 4.2.1.

6.3 Results

6.3.1 Descriptive analysis

Changes over time

A total of 310 observations from 31 provinces between 2010 and 2019 were included in the analysis.

Table 8 compares the provincial average of PHC inputs, utilisation, costs, MMR, and all-cause mortality rates before and after the second round of the reforms. The provincial average MMR was 20.92 per 100,000 live births during the first round of the reforms (2010-2014), followed by a steady decline to 14.29 during the second round (2015-2019). The provincial average all-cause mortality rates increased from 5.9‰ to 6.2‰ during the same periods.

For intermediate outcomes, there was no major change in PHC inputs (i.e, PHC facilities, bed or workforce) between 2010 and 2019. However, the use of family physician services and maternity care increased. The average utilisation of family physician services during 2015-2019 (328.4 visits per 10,000 people, SD=347.9) almost doubled compared to that during 2010-2014 but remained at a low level. The large SD of the variable indicates that the use of family physician services varied drastically across provinces. Meanwhile, the average use of pre- and post-natal services both increased by ~2% and had smaller provincial variations, reaching 96.6% and 94.2%, respectively. During the same periods, hospital costs for outpatient care and drugs also saw minor increases, as did household health expenditures.

For covariates, the percentage of people covered by basic health insurances had a noticeable increase from 40.1 (2010-2014) to 72.2 (2015-2019), suggesting it is a key confounder for the co-current reform impacts to be adjusted for in the analysis.

	Before the second round of the PHC reform (N=183)		After the second round of the PHC reform (N=127)	
	Mean	SD	Mean	SD
Outcomes				
Number of PHC facilities per 10,000 people	7.1	3.4	7.1	2.9
Number of PHC beds per 10,000 people	9.1	3.0	10.4	3.7
Number of PHC professionals per 10,000 people	25.5	5.6	28.2	5.6
Number of family physician services delivered per 10,000 people	183.9	125.8	328.4	347.9
Visits to PHC facilities per capita	2.8	0.7	3.0	0.9
Pre-natal care (%)	94.3	6.3	96.6	3.0
Post-natal care (%)	91.8	8.6	94.2	3.9
Hospital outpatient drug fees per visits (Chinese Yuan)	85.5	34.7	88.2	26.8
Hospital outpatient check-up fees per visits (Chinese Yuan)	39.9	11.5	40.9	8.0
Average annual household health expenditures (Chinese Yuan)	888.5	352.0	1327.4	442.6
Maternal Mortality Ratio (per 100,000 live births)	20.9	27.0	14.3	11.5
All age all-cause mortality rates (‰)	5.9	0.8	6.2	0.8
Covariates				
Percentage of people covered by basic health insurance in all populations (%)	0.4	0.2	0.8	0.3
Average length of stay (days)	10.1	1.1	9.3	0.7
Human Development Index	0.7	0.1	0.7	0.1
Areas of city road per capita (square meters)	14.4	4.6	16.7	4.4
Control outcomes				
Traffic deaths (per 10,000 people)	0.45	0.01	0.42	0.01

Table 8 Summary statistics of the 31 provinces before and after the second stage of China's primary health care reforms

Notes: Values of average annual household health expenditures were adjusted for inflation using consumer price index in 2010 (value = 100).

Source: author's own work.

Regional differences

Figure 16 to **Figure 20** compare the change in PHC inputs, health services utilisation, costs, and mortality between low- and high-HDI provinces. In terms of PHC inputs (**Figure 16**), low-HDI provinces always had a higher average number of PHC facilities, beds and workforce per 10,000 people than high-HDI provinces. The PHC workforce had a noticeable increase during 2010 and 2019, and the gap between the low- and high-HDI provinces gradually narrowed after 2015.

Regarding primary care utilisation(**Figure 17**) and maternity care (**Figure 18**), high-HDI provinces always had higher average visits to PHC facilities and maternity care utilisation (i.e. pre- and post-natal care) than low-HDI provinces during 2010 and 2019. However, the gap in visits to PHC facilities expanded over time, whilst the gaps for maternal care narrowed during the same periods. For family physician services, high-HDI provinces had a higher average use than low-HDI provinces until 2017 being surpassed by the later ones.

Regarding costs and mortality (**Figure 19** and **Figure 20**), high-HDI provinces always had higher hospital outpatient costs for check-up and annual average household health expenditures than low-HDI ones between 2010 and 2019. Overall, these expenditures increased in both groups. High-HDI provinces had lower all-cause mortality rates than low-HDI provinces until 2017 surpassed by the latter one. Meanwhile, the MMR in high-HDI provinces was much lower than that in low-HDI provinces, but this gap narrowed remarkably during 2010-2019(from 20 to 10 per 10,000 live births).

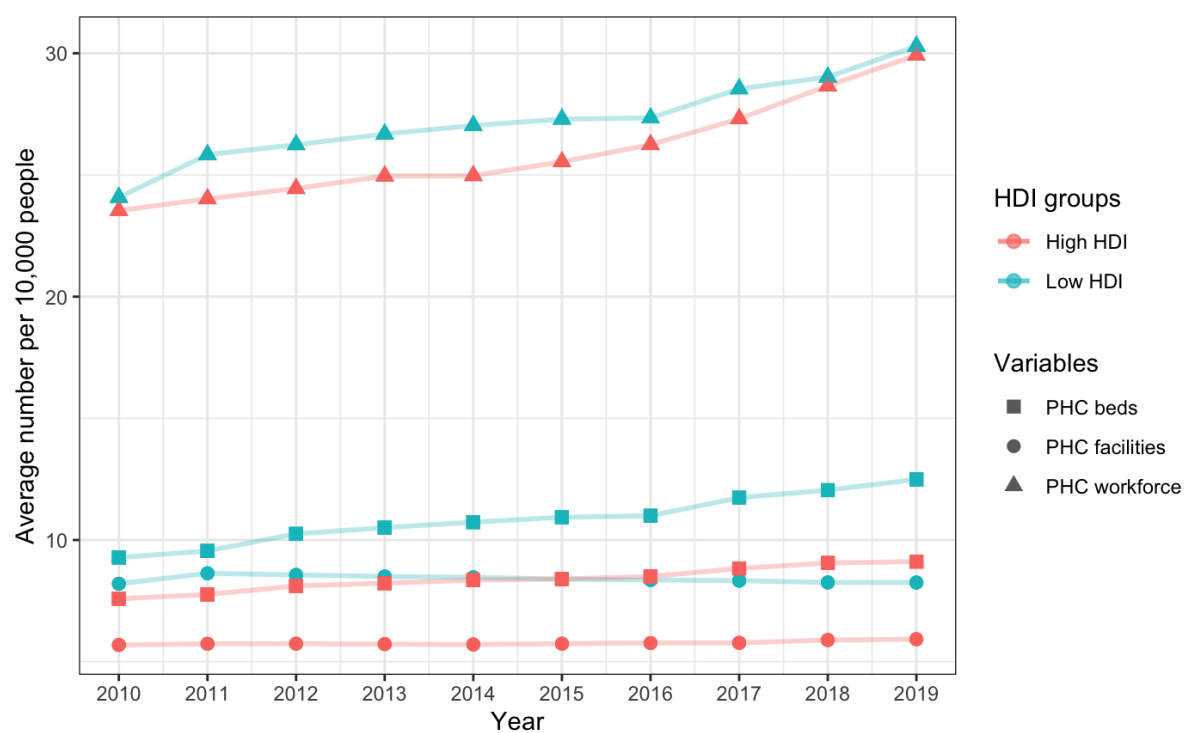


Figure 16 The changes in PHC supplies during 2010-2019 by high-/low-HDI provinces.

Notes: PHC for primary health care. HDI for human development index.

Source: author's own work.

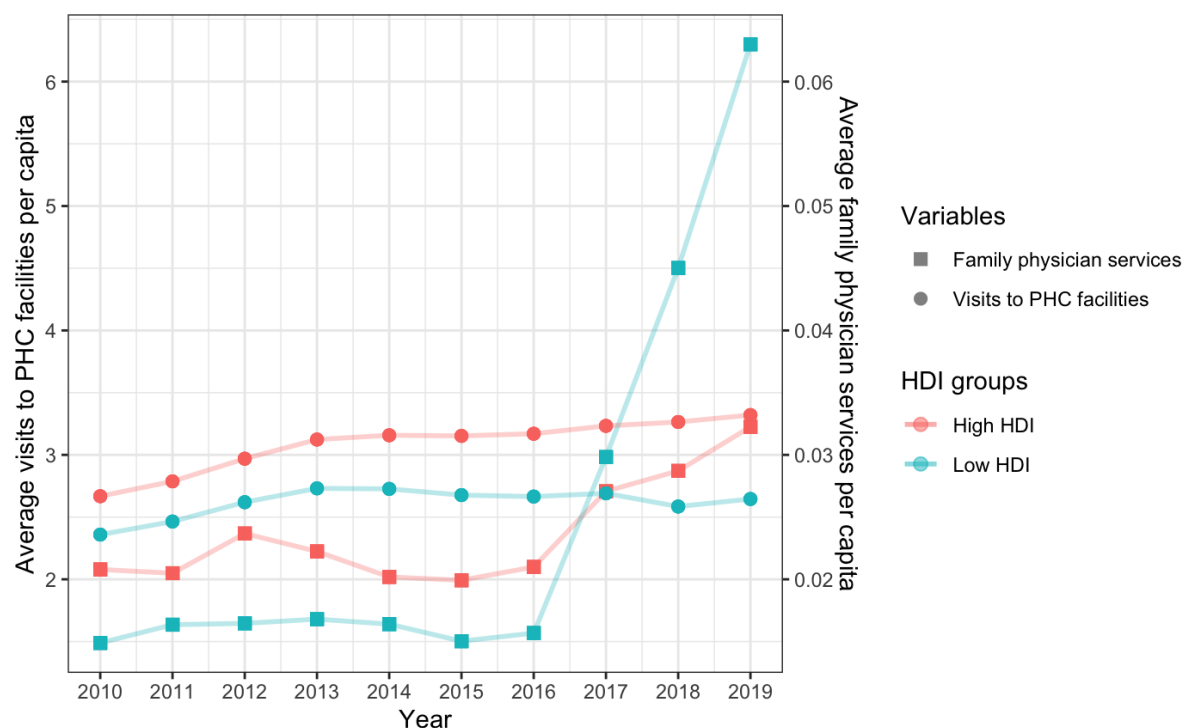


Figure 17 The changes in primary care utilisation during 2010-2019 by high-/low-HDI provinces.

Notes: PHC for primary health care. HDI for human development index.

Source: author's own work.

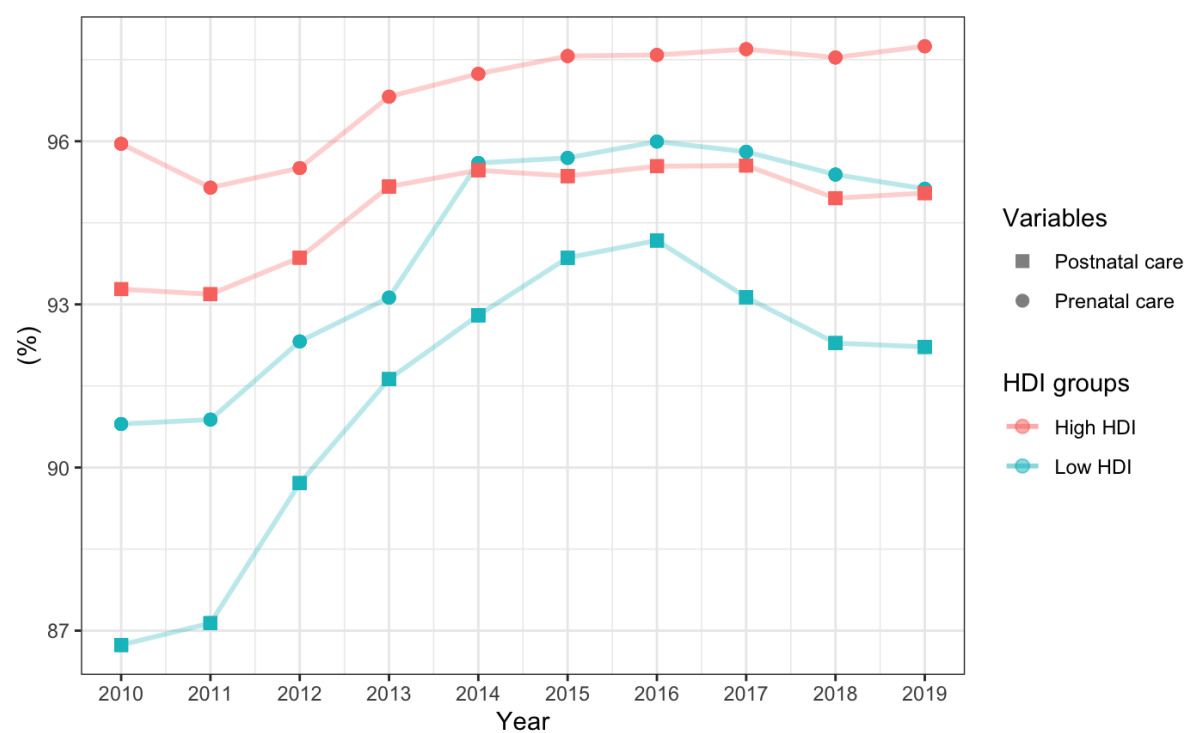


Figure 18 The changes in maternal care utilisation during 2010-2019 by high-/low-HDI provinces.

Notes: HDI for human development index.

Source: author's own work.

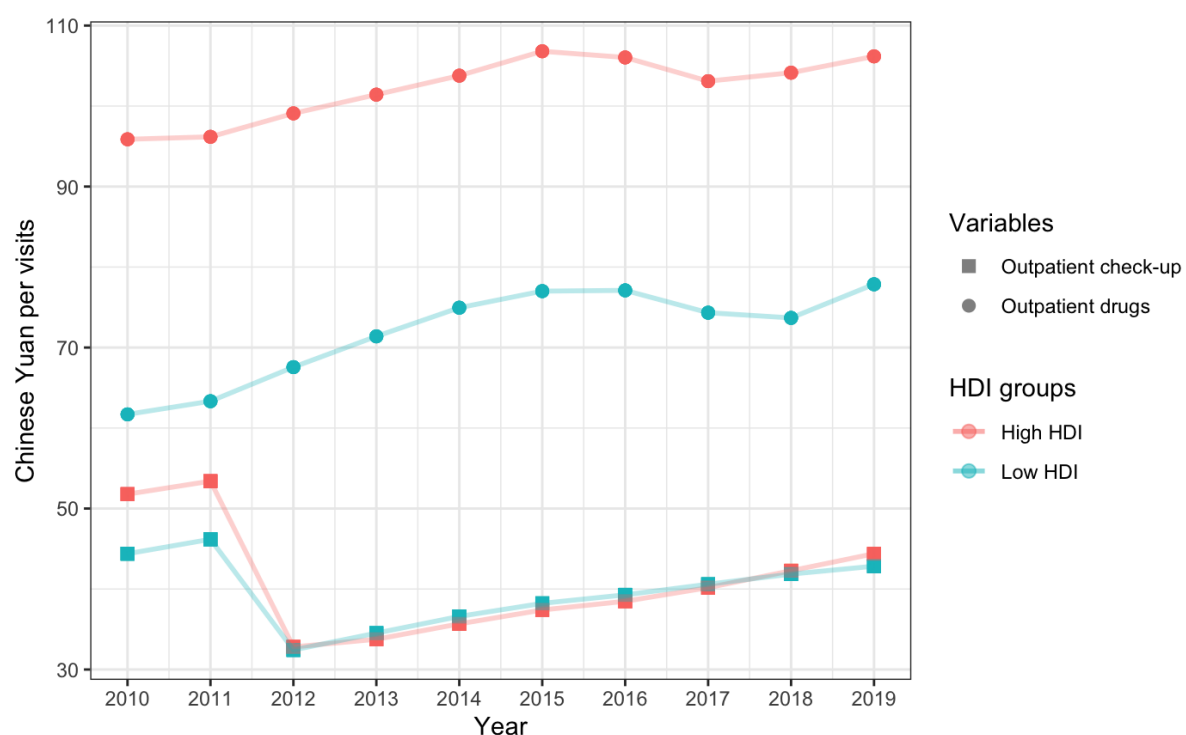


Figure 19 Changes in hospital outpatient costs for check-ups and drugs during 2010-2019 by high-/low-HDI provinces

Notes: HDI for human development index.

Source: author's own work.

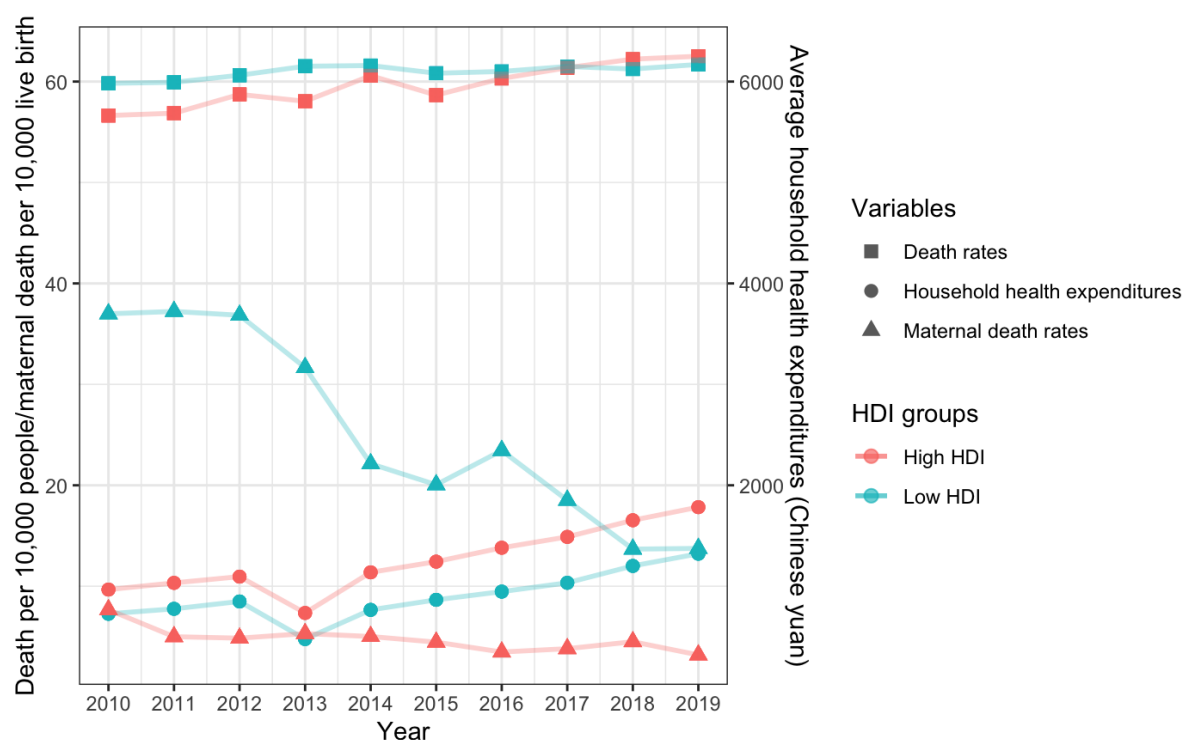


Figure 20 The changes in health expenditures and mortality during 2010-2019 by high-/low-HDI provinces.

Notes: HDI for human development index.

Source: author's own work.

6.3.2 The endogeneity of the reform implementation

To examine the endogeneity of the reform roll-out, the study assessed the relationship between the reform implementation dates and a range of socio-economic characteristics of the 31 provinces. **Figure 21** compares the implementation years of the second-round PHC reforms in the 31 provinces. There is no clear pattern between the implementation year in the provinces and their GDP per capita.

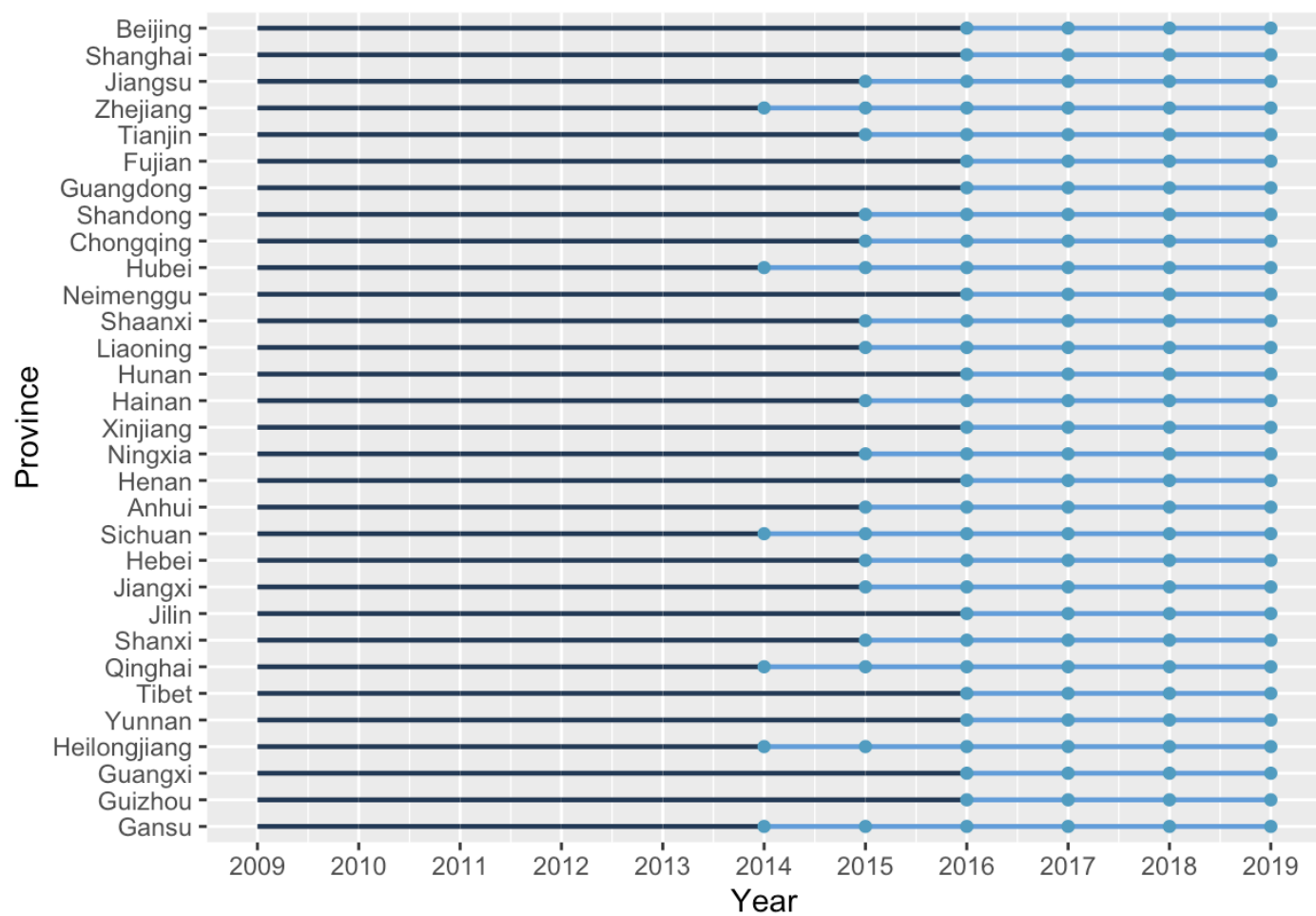


Figure 21 The implementation years of China's second-round PHC reforms in the 31 provinces ordered by gross domestic product per capita

Source: author's own work.

Table 9 presents the results from the two-sample t tests of the baseline differences between the earlier and later adopters. It shows that cities that adopted the reform earlier (i.e., earlier adopters) did not have significant differences compared to those adopted the reform later (i.e., later adopters) in terms of their GDPs, HDI, population sizes, number of hospital beds, or governmental health expenditures.

Table 10 shows the results from the Cox proportional hazard analysis of the association between the above socioeconomic factors and the timing of the reforms. Similar to the results from **Table 9**, these factors were not associated with the timing of reform adoption. This increased the confidence that the estimated reform impacts are less likely to be confounded by the endogeneity of reform implementation related to the tested regional characteristics.

	Earlier Adopters	Later Adopters	Differences in mean	P values on differences
Population sizes	535.49	599.62	-64.13	0.42
GDP per capita	3.54	5.21	-1.67	0.13
Urban populations (%)	0.99	0.99	0.00	0.57
Governmental health expenditures per capita	24.30	39.70	-15.40	0.27
Unemployment rates (%)	0.01	0.01	0.00	0.56
Number of hospital beds per capita	38.67	40.76	-2.09	0.50
Number of medical professionals per capita	17.62	21.38	-3.76	0.13
Number of medical facilities per capita	245.42	272.87	-27.44	0.52
Insured populations (%)	0.31	0.38	-0.06	0.36

Table 9 A t-test to compare the baseline differences in means between earlier and later adopters

Notes: Earlier adopters refer to cities that adopted the reform earlier. Later adopters refer to cities that adopted the reform later.

Source: author's own work.

	Hazard Ratio (Standard Errors)
Region (Eastern China as ref)	-0.013 (0.246)
Population sizes	-1.769 (4.243)
GDP per capita	0.036 (0.055)
Urban populations (%)	4.335 (3.246)
Governmental health expenditures per capita	-0.002 (0.004)
Unemployment rates (%)	13.214 (45.919)
Number of hospital beds per capita	0.021 (0.014)
Number of medical professionals per capita	-0.011 (0.016)
Number of medical facilities per capita	0.000 (0.001)
Insured population (%)	-0.988 (0.648)
AIC	811.7
BIC	838.5
RMSE	0.97

Table 10 Results from the Cox regression on the determinants of the implementation time of China's second round of PHC reforms

Notes: N=108. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$. Ref as reference groups.

Source: author's own work.

6.3.3 The reform impacts and heterogeneities

Columns 1 in **Table 11** shows the estimated reform impacts from the CS-DiD estimation after adjusting for covariates using the full sample. Column 2 and 3 in **Table 11** shows the estimated reform impacts among high-HDI provinces and low-HDI provinces respectively. The second round of PHC reform significantly reduced maternal death by 16.08 per 100,000 live births (95% CI 10.60-21.56). This number was slightly higher than the average provincial MMR between 2015 and 2019. This effect is possible given that the MMR varied drastically across the provinces, and high-MMR provinces drove the declined MMR. A similar but smaller reduction in the MMR was also found in low-HDI provinces (by 9.64 per 100,000 live births, 95% CI 0.28-19.01) following the reform, whilst no significant change in the MMR was found in high-HDI provinces. There was no reform impact on all-cause mortality.

The reform increased the utilisation of family physicians and prenatal care, as well as costs for outpatient drugs and check-ups in hospitals. The reform slightly increased the percentage of pregnant women using prenatal services by 1.09 percentage points (95% CI 0.24-1.93). Similarly, the use of prenatal and postnatal services increased significantly in low-HDI provinces (3.17 percentage points, 95% CI 1.78-4.55 and 6.43 percentage points 95% CI 2.03-10.84, respectively). In contrast, no reform impact on maternal care utilisation was found in high-HDI provinces.

The reform was associated with minor increase in both average outpatient drug and check-up costs in hospitals (by 11.27 Chinese Yuan, 1.68 USD 95% CI 2.65-19.89 and 12.68 Chinese Yuan, 1.89 USD 95% CI 8.63-16.74, respectively). The increased outpatient drug costs in hospitals were found in both high- and low-HDI provinces (8.26 Chinese Yuan, 1.23 USD 95% CI 4.68-11.83 and 23.17, 95% CI 9.62-36.72, respectively). Outpatient check-up costs had a minor increase by 4.98 Chinese Yuan (0.74 USD, 95% CI 2.53-7.43) only in low-HDI provinces.

The reform was associate with an increased number of PHC professionals in high-HDI provinces (by 1.18 per 10,000 people, 95% CI 0.29-2.06). Meanwhile, the

number of PHC professionals decreased in low-HDI province (0.84 per 10,000 people, 95% CI 0.04-1.64). The reform had no significant impact on the number of PHC facilities or beds, visits to PHC facilities, or average household health expenditures.

Outcomes	Full Sample (1)	High-HDI (2)	Low-HDI (3)
PHC inputs			
PHC facilities per 10,000 people	-0.15 [-0.34; 0.04]	-0.03 [-0.12; 0.06]	0.1 [-0.09; 0.3]
PHC beds per 10,000 people	0.02 [-0.28; 0.33]	0.07 [-0.28; 0.42]	0.005 [-0.34; 0.35]
PHC professionals per 10,000 people	-0.62 [-1.78; 0.53]	1.18* [0.29; 2.06]	-0.84* [-1.64; -0.04]
Primary care utilisation			
Family physician services delivered per 10,000 people	54.36* [13.20; 95.52]	-13.39 [-49.92; 23.13]	59.66* [32.82; 86.51]
Number of visits to PHC facilities per capita	-0.01 [-0.14; 0.12]	0.18 [-0.09; 0.44]	-0.03 [-0.13; 0.06]
Maternity care utilisation			
Prenatal Services (%)	1.09* [0.24; 1.93]	-0.34 [-0.78; 0.11]	3.17* [1.78; 4.55]
Postnatal Services (%)	0.87 [-0.34; 2.08]	-0.22 [-0.91; 0.47]	6.43* [2.03; 10.84]
Payments			
Outpatient drug costs (Chinese Yuan)	11.27* [2.65; 19.89]	8.26* [4.68; 11.83]	23.17* [9.62; 36.72]
Outpatient check-up costs (Chinese Yuan)	12.68* [8.63; 16.74]	-0.47 [-2.31; 1.37]	4.98* [2.53; 7.43]
Average annual household health expenditures (Chinese Yuan)	-1.03 [-87.66; 85.6]	-26.81 [-107.24; 53.63]	-1.03 [-96.84; 94.77]
Mortalities			
Maternal Mortality Ratios (per 100,000 live births)	-16.08* [-21.56; -10.60]	2.07 [-0.19; 4.32]	-9.64* [-19.01; -0.28]
All age all-cause mortality rates	0.26 [-0.18; 0.7]	0.48* [0.12; 0.84]	0.48 [0.1; 0.86]

Table 11 The CS-DiD estimations of the 2015 reform impacts of the health system, household health expenditures, MMRs, and all-cause mortality.

Notes: * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$. PHC for primary health care. All models were controlled for human development index, areas of city road per capita, number of hospitals per 10,000 people, and percentage of people covered by basic health insurances. Standard errors were clustered at provincial level. Outcome regression was used as the estimation method to relax parallel trends assumption. 95% confidence intervals were reported.

Source: author's own work.

6.3.4 Association between PHC and MMR and its heterogeneities

Figure 22 presents the association between PHC resources, utilisation and the MMR. It also compares how these associations varied between provinces with high and low HDI. Increases in the number of PHC professionals, family physician services and prenatal care were associated with a reduction in the MMR. An increase in one PHC professional per 10,000 people was associated with a 1.95 reduction in the MMR (per 100,000 live births, 95% CI 0.82-3.08). Utilisation of prenatal services was associated with a lower MMR. One percentage increase in the use of ante-natal services was associated with a 0.94 (95% CI 0.11-1.76) reduction in the MMR. Similarly, an increase in one family physician service delivered per 100 people was significantly associated with a 2.1 per 100,000 live births reduction in the MMR (95% CI 1.42-2.78).

Similar reform impacts were found in low-HDI provinces. In low-HDI provinces, an increase in one PHC professional per 10,000 people was associated with a 2.29 per 100,000 live births reduction in the MMR (95% CI 1.23-3.34). One percentage increase in prenatal care utilisation was associated with a 1.19 per 100,000 live births reduction in the MMR (95% CI 0.64-1.74). An increase in one family physician service delivered per capita was associated with a 1.81 per 100,000 live births (95% CI 0.81-2.81) reduction in the MMR.

There was no significant association between PHC resources or primary care utilisation and the MMR in high-HDI provinces.

Table 12 shows the association between PHC determinants and the MMR in the eastern, central and western China. The estimated association shows a similar pattern to the above analysis. Increases in PHC professional and prenatal care utilisation were significantly association with the reduced MMR in central and western China, whilst use of family physician services had a negative association with the MMRs only in the western China. An increase in one PHC professional per 10,000 people was associated with a 1.57 (95% CI 0.54-2.59) and 0.66 per 100,000

live births (95% CI 0.18-1.15) reduction in the MMR in western and central China respectively. One percentage increase in prenatal care utilisation was significantly associated with 1.68 (95% CI 1.38-1.97) and 0.36 per 100,000 live births (95% CI 0.02-0.71) reduction in the MMR in western and central China respectively. An increase in one family physician per capita was associated with a 2.83 per 100,000 live births reduction in the MMR in western China. No significant association between these PHC determinants and the MMR were found in eastern China.

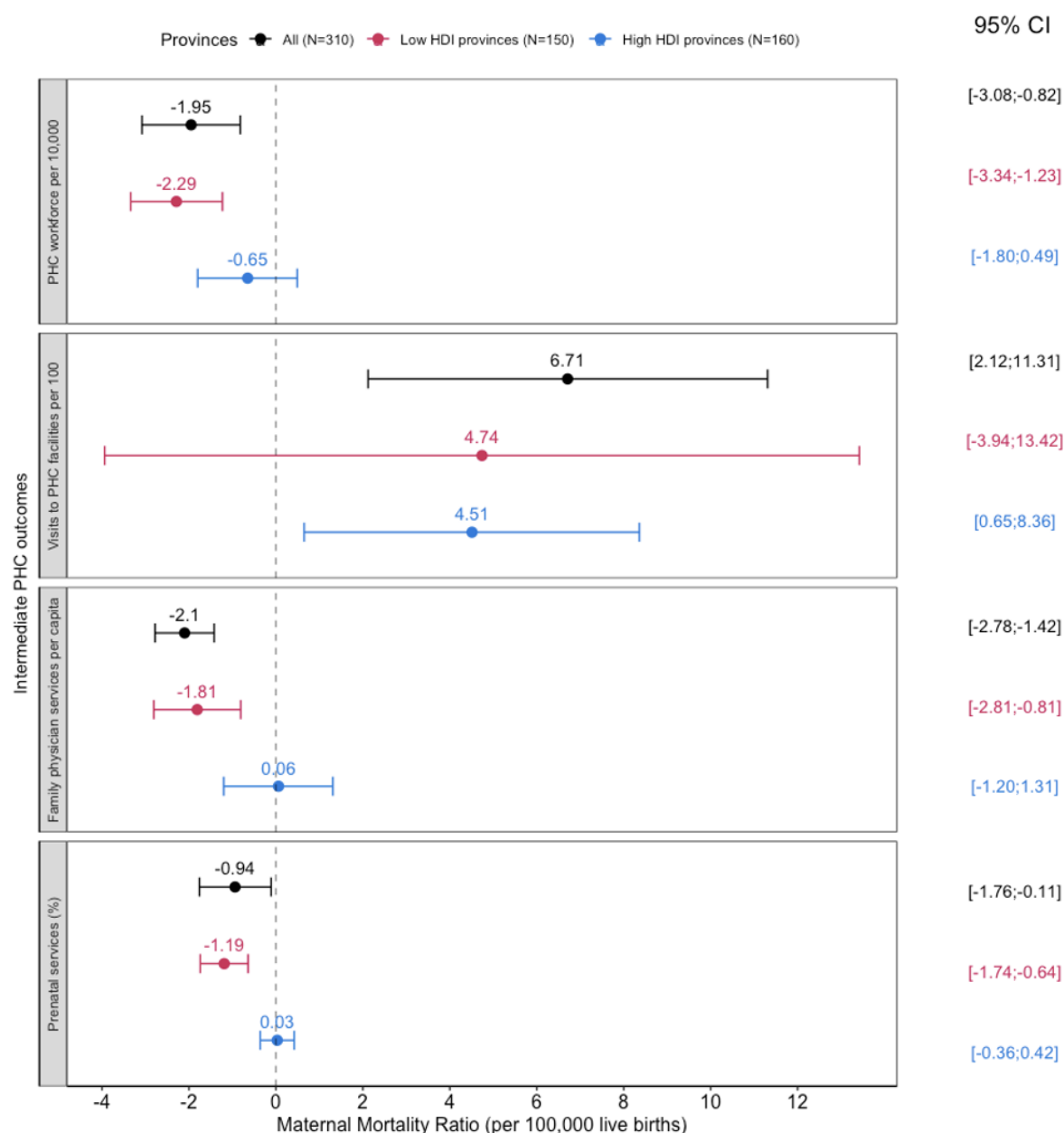


Figure 22 Association between PHC determinants and maternal mortality ratio during 2010-2019 and its regional heterogeneity (high-/low-HDI).

Notes: PHC for primary health care. SE for standard errors. HDI for human development index. The panel models were adjusted for outpatient check-up costs and average length of stays in hospitals, number of hospitals per 1,000 people, basic health insurance coverage (%), human development index, and areas of city roads per capita. Standard errors were clustered at the province level. 95% confidence intervals were reported.

Source: author's own work.

Sample (region)	Maternal mortality rates (per 10,000 live births)		
	East	Central	West
Number of PHC professionals per 10,000	-0.72 [-2.05; 0.61]	-0.66* [-1.15; -0.18]	-1.57** [-2.59; -0.54]
Number of family physician services delivered	-0.2 [-1.45; 1.05]	-0.3 [-0.83; 0.23]	-2.83*** [-3.38; -2.27]
Number of visits to PHC facilities per capita	2.46 [-1.79; 6.70]	4.05 [-1.99; 10.09]	4.44 [-5.62; 14.50]
Prenatal Services (%)	0.19 [-0.07; 0.44]	-0.36* [-0.71; -0.02]	-1.68*** [-1.97; -1.38]
Year fixed effects	Yes	Yes	Yes
Province fixed effects	Yes	Yes	Yes
SE Clustered	by: Province	by: Province	by: Province
Observations	110	80	120
Adjusted R ²	0.77108	0.82955	0.98398
Within R ²	0.22974	0.38087	0.87618

Table 12 Association between PHC determinants and maternal mortality ratio during 2010-2019 and its regional heterogeneity (eastern/central/western China).

Notes: * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$. PHC for primary health care. SE for standard errors. HDI for human development index. The panel models were adjusted for outpatient check-up costs and average length of stays in hospitals, number of hospitals per 1,000 people, basic health insurance coverage (%), human development index, and areas of city roads per capita. Standard errors were clustered at the province level. 95% confidence intervals were reported.

Source: author's own work.

6.3.5 Results from Robustness checks

Figure 23 shows the Bacon decomposition diagnosis for the TWFE models. Each 2X2 DiD estimate was against its weights for each outcome. Given that no never-treatment group is available in this study, there are only two types of 2X2 comparisons: earlier/later (i.e., the groups treated at an earlier time compared with the group not-yet treated) and later/earlier (i.e., the groups treated at a later time compared to groups already treated). The TWFE estimate equals the average of the estimates (the y-axis values) weighted by the corresponding x-axis values. As demonstrated above, the later/earlier comparisons are the “problematic” ones. The results from the diagnosis show that many later/earlier comparisons had large estimates or weights and dominantly influenced the final weighted estimates in the TWFE models. Here, I take estimates for family physician service delivery as an instance. When comparing earlier-treated groups to later-treated ones, all the estimates were close to zero, indicating no reform impacts on the delivery of family physician services. In contrast, estimates from later to earlier comparisons have large positive estimates, resulting in a positive reform impact on the utilisation of family physician services.

Also, estimates from earlier/later comparisons show great heterogeneities, hinting at the violated assumption of time-constant treatment effects. For instance, the earlier-later comparisons for PHC facilities and workforce and all-age all-cause mortality show great variations across 2X2 groups. These variations need further investigation to identify the sources. The results from Bacon Decomposition Diagnosis suggest the existence of bias from time-varying treatment effects and the need for DiD estimates robust to such bias and investigation of heterogeneous treatment effects.

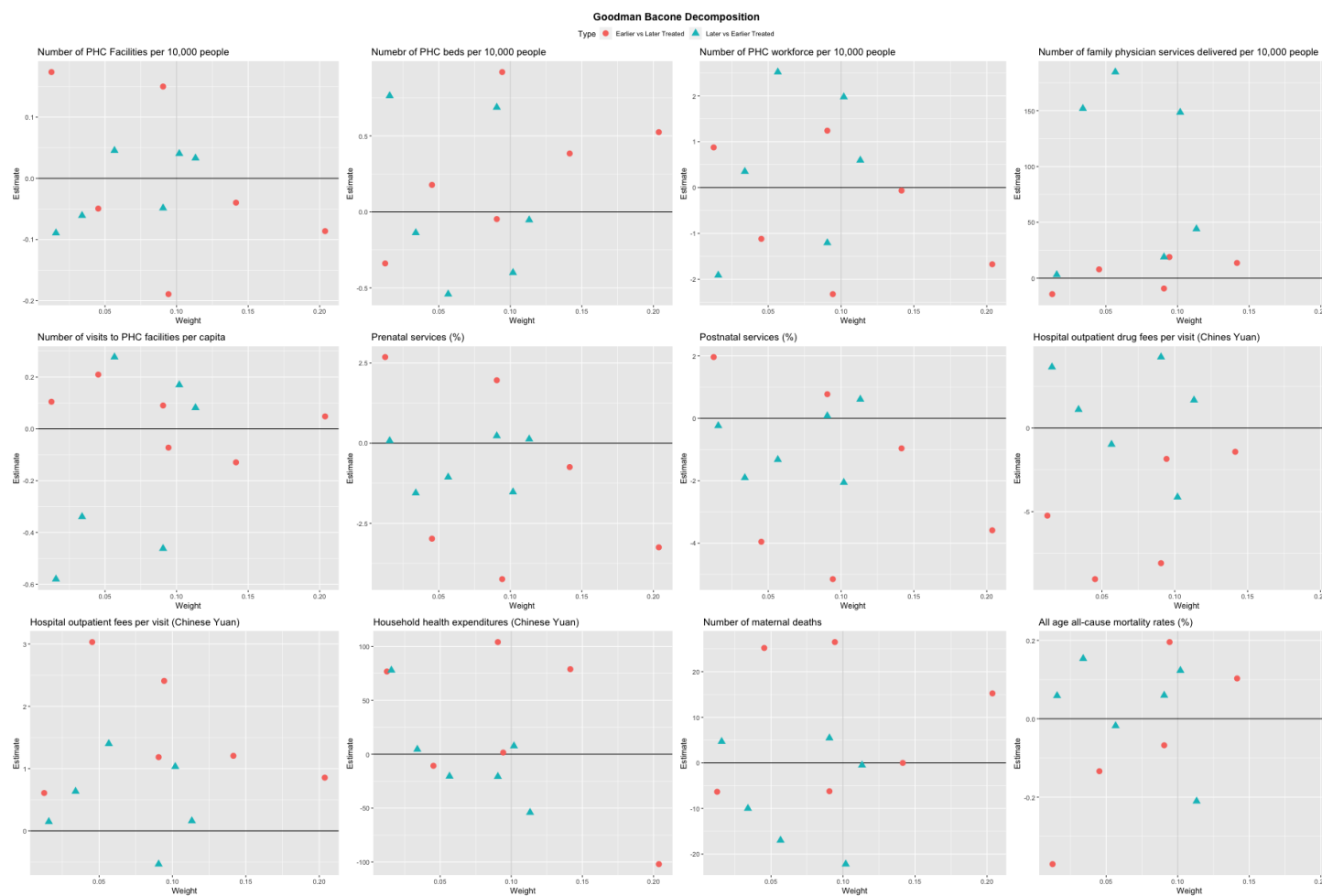


Figure 23 Goodman Bacon decompositions of 2X2 difference-in-differences estimates and their weights for all outcomes from two-way fixed effects models without adjusting.

Source: author's own work.

Two sensitive analyses were conducted for the CS-DiD analysis. First, traffic-related deaths were used as a control outcome for the CS-DiD analysis. **Table 13** shows the estimated reform impacts on the control outcome, traffic-related deaths using the CS-DiD method. There was no significant reform impact on traffic-related deaths.

Control outcome	Full Sample	High-HDI	Low-HDI
	(1)	(2)	(3)
Traffic-related deaths per 10,000 people	-0.16	-0.10	-0.06
	[-0.45; 0.13]	[-0.56; 0.36]	[-0.18; 0.06]

Table 13 The CS-DiD estimations of the 2015 reform impacts on the traffic-related deaths

Notes: . * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$. PHC for primary health care. All models were controlled for human development index, areas of city road per capita, number of hospitals per 10,000 people, and percentage of people covered by basic health insurances. Standard errors were clustered at provincial level. Outcome regression was used as the estimation method to relax parallel trends assumption. 95% confidence intervals were reported.

Source: author's own work.

The second robustness check tested the validity of parallel trend assumption using the pre-treatment periods. The estimated pre-treatment reform impacts were tested using Wald tests. **Figure 24** presents the estimated reform impacts of the assessed outcomes at each pre- and post-reform time points. None of the estimated reform impacts during pre-reform periods were significant, indicating no systematic time-varying differences in the outcomes between the two groups and that the parallel trend assumption is met.

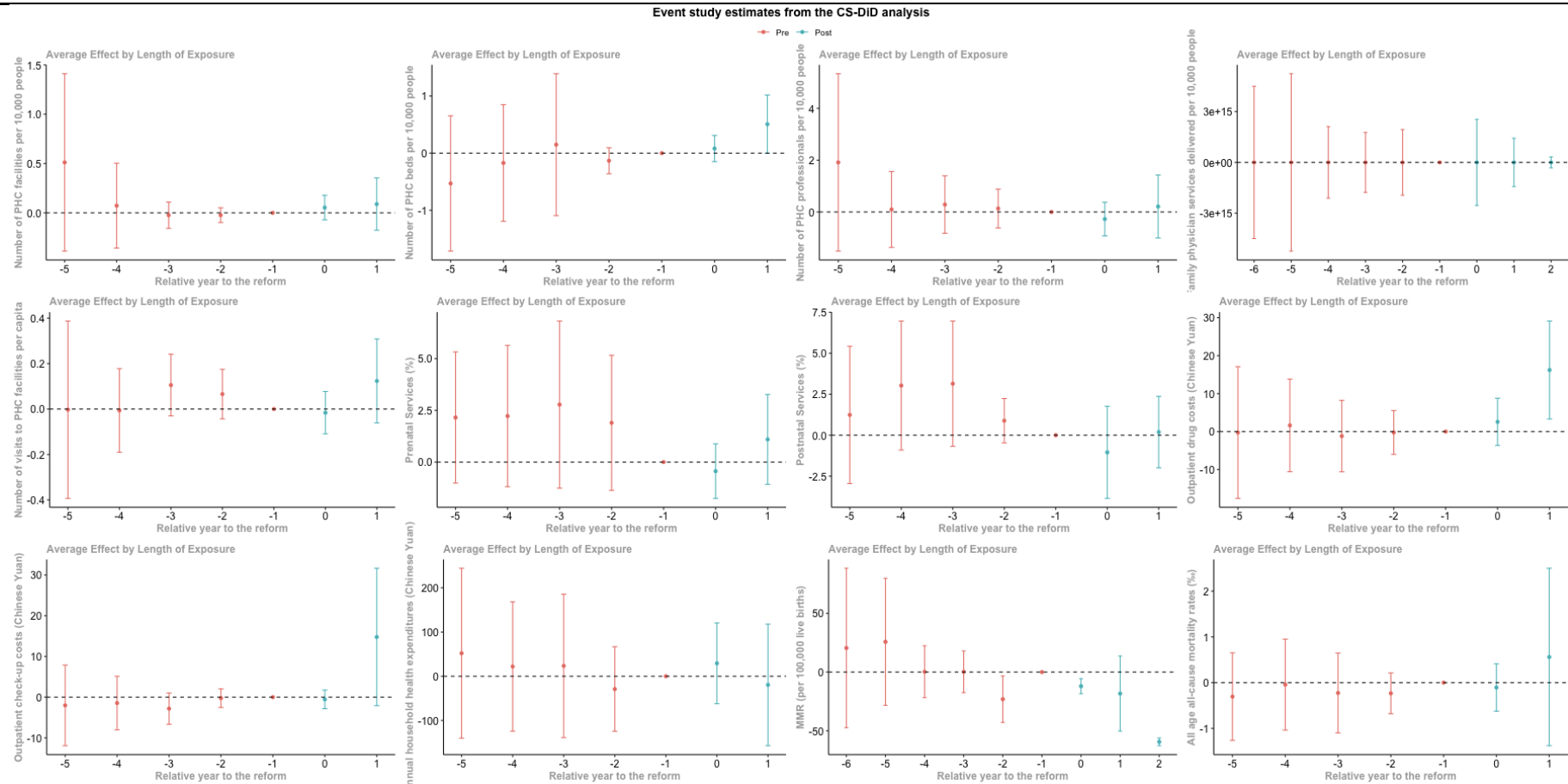


Figure 24 The event study estimators of the reform impacts on PHC inputs, health service utilisation, payments, and mortalities using CS-DiD

Notes: PHC for primary health care. MMR for maternal mortality ratio. Pre for pre-reform periods. Post for post-reform periods. All models were controlled for human development index, areas of city road per capita, number of hospitals per 10,000 people, and percentage of people covered by basic health insurances. Standard errors were clustered at provincial level. Outcome regression was used as the estimation method to relax parallel trends assumption. 95% confidence intervals were reported.

Source: author's own work.

Poisson regression was employed to estimate the panel regression to test any violation of linearity in linear probability regression. **Table 14** compares the results of the estimated associations between PHC determinants and the MMRs using linear probability regression and Poisson regression. The results from passion regression show the same impact directions as the linear probability regression. Increases in PHC professionals, family physician services, and prenatal care utilisation were significantly associated with reduced risk ratios of maternal mortality. Visits to PHC facilities were not significantly associated with the MMR.

	Maternal mortality rates (per 10,000 live births)	
	OLS	Risk Ratios
Number of PHC professionals per 10,000 people	-1.949** [-3.080; -0.818]	0.985* [0.970; 0.999]
Number of family physician services delivered per capita	-2.097*** [-2.776; -1.418]	0.987* [0.975; 0.999]
Number of visits to PHC facilities per capita	6.714** [2.120; 11.308]	1.063 [0.848; 1.332]
Prenatal Services (%)	-0.936* [-1.760; -0.111]	0.991** [0.985; 0.997]
Observations	310	310
R ² /Squared Cor.	0.97	0.99
Within R ² /Pseudo R ²	0.73	0.73

Table 14 The estimated association between PHC determinants and maternal mortality ratio during 2010-2019 and its regional heterogeneity (high-/low-HDI) using linear probability regression and poisson regression.

Notes: . * p < 0.05, ** p < 0.01, *** p < 0.001. PHC for primary health care. SE for standard errors. HDI for human development index. The panel models were adjusted for outpatient check-up costs and average length of stays in hospitals, number of hospitals per 1,000 people, basic health insurance coverage (%), human development index, and areas of city roads per capita. Standard errors were clustered at the province level. 95% confidence intervals were reported.

Source: author's own work.

6.4 Discussion

Chapter 4 identified substantial evidence gaps in evaluating the second round of China's PHC reforms and the reform impacts on financial protection, secondary care, population health, and health equity. Built upon these evidence gaps, this chapter assessed the second round of the reforms on a range of health system outcomes and population health. These assessed outcomes were selected based on the theoretical framework proposed in **Chapter 1**. The intermediate health system outcomes include the inputs of PHC facilities, beds and workforce, the utilisation of primary care services and maternity care, and costs for outpatient care and drugs in hospitals. The ultimate health outcomes were assessed using the MMR and all-cause mortality.

6.4.1 Key findings

China's second round of PHC reforms was associated with the increased utilisation of prenatal care and family physician services and reduced MMR. Meanwhile, the reform also increased the costs of outpatient care and drugs in hospitals. No significant reform impact was found on the inputs of PHC facilities or beds, household health expenditures, or all-cause mortality. The increased prenatal care and family physician services and reduced MMR were mainly found in less-developed regions (i.e., low-HDI provinces and central/western China).

The simultaneous increases in utilisation of prenatal care and family physician services and reduced MMR in this project suggest that these services were likely reform mechanisms that lowered MMR. On the other hand, although this study found a negative association between PHC workforces and MMR in western China, the PHC workforce was not affected by the reform. Therefore, increasing the PHC workforce was unlikely to be a reform mechanism for reducing MMR. The protective impact of prenatal care and family physician services on reducing MMR has been well-established. A large body of evidence from LMICs shows that increasing

community-based healthcare can increase access to maternal health care ^{279,282} and thereby reduce maternal hospital admissions²⁷⁸ and the MMRs^{265,319}.

In China's context, the reform mechanism behind reduced MMR through increased prenatal care and family physician services is plausible: First, family physicians had the responsibility of delivering maternal care at the community level, including health education, screening, examinations, and referrals to higher-level health facilities. Many of these prenatal services, such as screening, could facilitate early diagnosis and interventions of high-risk pregnancy³¹⁴. Second, the incentivised gatekeeping policies introduced higher reimbursement rates for visits to primary care providers (i.e., family physicians and PHC facilities) than hospital care. **Figure 15** shows that for low-risk pregnancies, the majority of the maternity care was delivered by primary care providers, except for childbirth. The higher reimbursements reduced people's financial barriers to obtaining maternal care – one of the key determinates for low maternal care utilisation^{320,321}. Third, evidence from LMICs showed that linked prenatal and postnatal care can reduce MMR³²². The continuum of maternal care in China was based on the integrated, tiered referral system between PHC facilities and hospitals (**Figure 15**). This system aims to allow timely referrals to hospitals for high-risk pregnancies and facility births, thereby reducing the MMR.

This study also underlined that the reform mainly benefited under-resourced regions (i.e. low-HDI provinces and central/western China) in terms of increased use of family physicians and prenatal care and the reduced MMR. This finding is consistent with the greatest decline in MMR in western China among the three regions³²³. The finding highlights the key roles of family physicians and prenatal care in reducing MMR in resource-constrained regions. For remote and under-resourced regions, previous studies from China show that increases in the accessibility of community-based maternal care and skilled professional-attended births could benefit maternal health³²⁴ and reduce the MMRs³²¹. This finding is consistent with the confined association between the utilisation of prenatal care and family physician services and the MMRs in low-resourced regions found in this study. Additionally, studies from China underlined that illiteracy is a key determinant of the MMRs^{314,321}, and women with low education levels often have lower use of maternal care^{325,326}. Family

physicians provided maternal health education and consultations and advocated for prenatal screening and safe birth, which could benefit illiterate pregnant women.

In contrast with the improved equitable maternal care and MMR, this study found limited change in general health resource or service utilisation. The study showed that the reform had no impact on the inputs of PHC facilities or beds, and only increased the number of PHC health professionals in high-HDI regions. The reforms also had no impact on visits to PHC facilities. The unchanged primary care utilisation among general populations suggests that the second round of China's PHC reforms did not shift away from hospital domination in a major way. The reforms also did not increase the PHC inputs or retain the PHC workforce for low-resourced regions. This finding aligns with the persistent large regional inequality in PHC workforce and facilities distribution³²⁷⁻³²⁹ and the worsening GP-to-population ratio in western China after the reform²⁹³. The persistent shortage of the PHC workforce could attribute to insufficient funds, low salaries, limited training and career development for the PHC workforce in western China^{330,331}. Effective policies to better attract, retain and support the PHC workforce in under-resourced regions can further reduce MMR in these regions.

This study found that the reform increased the costs of outpatient care and drugs in hospitals and had no significant impacts on household health expenditures. These unintended outcomes hint at the remaining structural tensions between the hospital and PHC sectors. Although the two-way referral system allowed referrals between the PHC and hospital sectors, there were few incentives or forces that motivated hospitals to collaborate with PHC facilities for general health service provision. Instead, hospitals had to compensate for their lost income from health services redirected to PHC facilities by raising charges for health services and drugs^{186,262}. In addition, the gatekeeping policy introduced tiered reimbursement rates, with increased service charges and reduced reimbursement rates in hospitals. People who visit hospitals directly had to pay more out-of-pocket due to the gatekeeping policy. The increased costs for outpatient care in hospitals could offset the financial protection role of the PHC and explain the limited reform impacts on household health expenditures.

This study found no reform impacts on all-causal mortality, indicating the health benefits of the reforms were confined to high-risk populations (i.e., pregnant women) and did not expand to the general population. Given that the reform did not affect the inputs or utilisation of the PHC sector in a major way, it is not surprising that mortality in general populations was also not affected. Reduction in all-cause mortality often requires system-wide improvements in accessibility and quality of primary care services that cover all populations^{332,333}, as well as health-improving enablers outside health systems³³⁴⁻³³⁶. Achieving such broad coverage and a high level of equity of PHC have been challenging for China^{97,189,337,338} and other LMICs^{26,339-341}.

6.4.2 Limitations

The study presented in this chapter is subject to limitations. The analysis in this study is restrained by the scope and availability of yearbook data. The Chinese Yearbook data used in the analysis only included provincial-level data, and prefecture-level aggregated data were not available. This prevented reform evaluations with higher geographical resolutions, such as those at the prefecture level. More importantly, there was no systematic collection and documentation of PHC-related data in the yearbooks before 2010. Consequently, the limited data availability constrained the time range included in the analysis, and the changes in the assessed outcomes before 2009 PHC reforms were not modelled. It is not possible to conclude how the health system or health service utilisation would have evolved without the 2009 PHC reforms.

The interpretation of the findings was restrained as better measurements were not available. Several outcome measures cannot be further decomposed for in-depth analysis, such as those for mortalities and the use of maternity care and PHC facilities. Regarding mortalities, the yearbooks have no information to explore cause-specific mortality, such as NCD-related ones, or adjusted for ages. Regarding utilisation, the yearbooks do not include any data on effective coverage of maternal health services, such as 4+ times antenatal visits. The assessed numbers of visits to PHC facilities cannot distinguish the different purposes for visiting PHC facilities (e.g., whether to seek for treatments, essential medicines, or referral letters). More

sensitive measurements for the utilisation and mortalities can help better understanding of the reform mechanisms.

This study did not investigate the potential variations in the intensity or coverage of the reforms in the local context (e.g. within provinces). Such variations are expected given that China's health system is decentralised, and some policies were not compulsory (e.g., gatekeeping and family physician services). However, information on the reform intensity is not available from existing data. Future research can probe into these sub-national variations and provide a better understanding of effective policy adoptions and implementations to better align with local context.

Lastly, this study is prone to ecological fallacy. There are remarkable variations in terms of socio-demographical characteristics and health service provision and utilisation within provinces. Therefore, the provincial level aggregated data cannot reflect individual's exposure to the reform or their health service utilisation. The findings from this study should only be interpreted at provincial level and not be used to infer individual-level reform impacts.

6.4.3 Strength

Despite the above limitations, this study has strengths. This study assessed a diverse range of health system outcomes, covering the inputs, utilisation, and payments. This holistic perspective resonates with the comprehensiveness of the reform and interconnection of health systems, providing insights on both intended and unintended outcomes of the reforms. The broad range of assessed outcomes also allows this study to map out several potential pathways of the reforms.

This study also fills several evidence gaps identified in the systematic review in **Chapter 4**, including the understudied second-round reforms, health impacts and health inequality. This study evaluated the second-round PHC reform as an entity and assessed its impacts on the MMRs for the first time. Although many studies explored PHC determinants of the MMRs,^{284,319,342} none of them has drawn the link

between health reforms, PHC determinates, and MMR. It is now known which of them were potentially plausible mechanisms to lower MMR.

This study also investigated how the PHC reforms affected different regions differently. It found that the reforms disproportionately benefited under-resourced (low-HDI provinces and central/western China) regions in terms of increasing utilisation of family physicians and prenatal care and reducing MMR. This heterogeneity analysis provides evidence showing that the reforms were pro-poor and reduced the spatial health inequalities. This study built upon and expanded the existing studies on China's PHC reforms.

In terms of methodology, this quasi-experimental study exploited the staggered reform implementation and employed an advanced DiD method that is robust to varying treatment effects across groups with different treatment timing and over time. This study is also the first study that quantitatively explored the endogeneity of the reform roll-out and baseline differences in the characteristics of earlier and later adopters of the reform. These are critical biases in the existing studies.

Lastly, the study showcases the potential of yearbook data/routinely collected data in policy evaluations. Chinese yearbook data are often used to describe the trend or distribution of health care resources and population health^{291-295,321,343-345} but are rarely used in policy evaluations. These yearbooks cover multi-faceted data of the health system, providing valuable opportunities to assess the health system impacts of large-scale and comprehensive PHC reforms.

6.5 Conclusion

This chapter includes two main analyses. The first analysis comprehensively assessed the impacts of 2015 PHC reforms on a range of health system outcomes (i.e., PHC resource supplies, health service utilisation and costs, household expenditures), MMR, and all-cause mortality. The second analysis investigated the PHC determinates of MMR. The study found that the reforms increased the use of

family physician services and prenatal care, as well as the costs of outpatient care and drugs in hospitals, and reduced MMR. The reform impacts were mainly found in resource-constrained regions (i.e., low-HDI provinces and central/western China). There was no significant reform impact on the supply of PHC facilities or beds, household health expenditures, visits to PHC facilities, or all-cause mortality.

This chapter adds to the research gap on the impacts of China's PHC reform identified in [Chapter 4](#), suggesting that the reform disproportionately benefited high-risk populations and under-resourced regions in terms of increased use of maternity and primary care and reductions in MMR. This study also highlights some areas that need further interventions, including shifting away from hospital domination, strengthening financial risk protection, and expanding health benefits to general populations.

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Chapter 7. A quasi-experimental study on the reforms on health service utilisation, payments, and health outcomes

Chapter 6 examined the reform impacts on the health system and population health at the provincial level. However, due to ecological fallacies, no individual-level impact can be inferred^{346,347}. This chapter adopts a demand-side perspective and assesses how China's second round of PHC reforms affected the health services utilization of middle-aged and elderly people, their health outcomes, and the heterogeneous reform impacts across different populations.

Whilst **Chapter 6** examines the instant impacts of the reforms, this chapter investigates how the reform impacts evolved over time. The dynamic perspective is appropriate for assessing such comprehensive and large-scale reforms for two reasons: first, system-wide and large-scale reforms can take longer time to become effective than minor policy adjustments. Second, the dynamic of reform impacts can provide better insights into the sustainability of the reforms.

The analysis presented in this chapter used a middle-aged and elderly cohort between 2011 and 2018. The unit of analysis is individuals. As mentioned in Chapter 5, a key strength of the CS-DiD method is its robustness to time-varying treatment effects. Exploiting this strength, the analysis in this chapter employed the CS-DiD method to assess how the reform impacts on the cohort changed over time. Various sensitive analyses were also conducted.

Research questions for Chapter 7

- 1) How did China's second round of PHC reforms affect primary care utilisation, hospitalisation, out-of-pocket expenditures, and self-reported health among middle- and elderly-age populations?
- 2) Did these examined impacts vary across population groups, and if so, how?

7.1 Introduction

The individual study in [Chapter 6](#) examined the comprehensive impacts of the reforms on four individual outcomes, including primary care utilisation, hospitalisations, OOPes, and self-reported health. Evaluations of these outcomes are to fill the evidence gaps highlighted in [Chapter 4](#), including the reform impacts on secondary care, financial protection, general population health, and health equity, as well as long-term reform impacts.

The cohort data used in this chapter are people aged 45 and above (i.e., middle-aged and elderly people). Evaluations of the reform impacts on this population group have some significant implications. First, China has one-fifth of the elderly population,³⁴⁸ and these population groups are expected to expand over time due to the ageing population³⁴⁹. In 2024, people aged 60 years or older make up 20.5% of the population in China³⁴⁸ and are anticipated to reach 28% in 2040³⁴⁹. Additionally, the elderly are more likely to have chronic conditions which need regular health management⁸. Economic development and a rapidly ageing population contribute to increased healthcare needs and usage^{8,350}. The percentage of older people who received two-week medical consultation and hospitalisation increased from 25.6% to 40.1% and 6.1% to 24.9% between 1993 and 2018, respectively³⁵¹.

Evaluations of the reform should consider population heterogeneities. [Chapter 2](#) discusses rural-urban differences in health-seeking behaviour, access to health care, and health status. These differences are also observed in middle-aged and elderly people. Additionally, income levels directly determine people's affordability and access to health care services.

Rural and urban populations also had different health-seeking behaviours and health statuses. Rural populations were more likely to use PHC facilities (e.g., township health centres) as first-contact, whilst urban populations bypassed PHC facilities and visit hospitals directly^{167,352,353}.

7.2 Methods

7.2.1 Study design and population

Exploiting the staggered roll-out of the second stage of the PHC reform, a quasi-experimental study was conducted using individual-level longitudinal data from a nationally representative survey of middle-aged and elderly people. This study adopted an advanced difference-in-differences method proposed by Callaway and Sant'Anna to assess the impact of China's 2015 primary healthcare reform on four outcomes: 1) visiting PHC facilities, 2) hospitalisation, 3) out-of-pocket expenditures, and 4) self-reported health among the elderly. Heterogeneous reform impacts were investigated using subgroup analysis between rural/urban populations and people with different wealth levels. Respondents only observed once during the four waves were excluded from the analysis given that they will not contribute to the estimation of the reform impacts. The final sample was a cohort of individuals who were observed at least twice over time. Individuals who were not yet under the PHC reform at the time of the survey were used as control groups.

7.2.2 Data source

Individual-level data were from the China Health and Retirement Longitudinal Study (CHARLS). This survey is a nationally representative, longitudinal survey on Chinese adults aged 45 and older and their spouses.³⁵⁴ The baseline survey started in 2011, followed by three waves in 2013, 2015 and 2018, and included 25,586 individuals from 125 cities/counties in 28 provinces. Regarding geographic coverage, CHARLS covers 28 provinces, 122 prefecture-level cities, and 450 villages/urban communities (For detailed information on the included cities, see [Appendix 3](#)). City IDs were used to identify individuals' residential information. Data at the community level and household level are available. Time variables include interview year and month. The CHARLS tracked the demographic and socio-economic status of the respondents and their health insurance participation, health service utilisation, physical and psychological health, and social networks. This study extracted data on individual

demographic and socio-economic characteristics, health insurance, health service utilisation, and self-reported health.

Province-level data in this study were from two governmental yearbooks published by the National Bureau of Statistics, 2022 China Statistics Yearbooks¹³⁵ and 2021 China Health Statistics Yearbooks.¹⁴² China Statistics Yearbooks cover statistics on the government, population, economy and society, and China Health Statistics Yearbooks contain data on health resources (e.g., finance, workforces, and equipment) and health service provision. The two yearbooks report annual data at the national, regional, and provincial levels.

Data on the reform implementation were extracted from policy documents published by local governments. To obtain the policy documents, I web-scraped the governmental websites of the 125 cities/counties included in CHARLS using Python 3.7. A comprehensive search was also conducted on Wolters Kluwer's legal database,³⁵⁵ and three Chinese legal databases - China Government Gazettes Database,³⁵⁶ China Legal Knowledge Database,³⁵⁷ and PKULAW³⁵⁸. The search used the term “fen ji zhen liao” (分级诊疗) in Mandarin (meaning “hierarchical medical system” in English). A total of 98 policy documents at the city level were identified. The implementation date in the remaining 27 cities was imputed using provincial-level government documents, given that policy implementation at lower-level governments typically aligns with their higher-level governments³⁵⁹.

7.2.3 Measurements

Outcomes

The study assessed four outcomes regarding individual use of health services and health outcomes. First, individuals' primary care utilisation was measured using the question “whether the respondent visited any PHC facilities in the last month” (yes/no). Second, the event of hospitalisations was measured using the question “whether the respondent was hospitalised in the last year” (yes/no). These two outcomes were constructed as dummy variables with yes equal to one. Third, data

on the respondents' out-of-pocket expenditures for all medical health services in the last year were extracted. The OOPes included those for medical services at PHC facilities and hospitals. The value for OOPes was adjusted for inflation using consumer price inflation in 2010. Fourth, individuals' self-reported health was measured using a five Likert-scale question and was dichotomized ("very good", "good", and "fair" equal to one and "poor" and "very poor" equal to zero).

Exposure

The exposure variable in this study was a respondent's exposure to the second stage of the PHC reform. This variable was constructed based on their city/county of residence and interview date. A respondent was defined as exposed if the city/county where they live had implemented the PHC reform at the time of the interview.

Covariates

The analysis controlled for individual and province-level confounders that could be associated with reform implementation and the outcomes (**Figure 25**). Individual-level demographic and socioeconomic confounders that were included were: sex (female=1 or male); marital status (married=1 or unmarried); employed or not; whether enrolled with any public health insurance scheme (i.e., Employee Basic Medical Insurance, Newly Cooperative Medical Scheme, and Urban Resident Basic Medical Insurance); whether diagnosed with any chronic diseases (i.e., hypertension or diabetes); and whether they had secondary education or above. Additionally, age, family size and household wealth were included as continuous variables. The household wealth variable included the total value of cash, deposits, stocks, and savings, subtracting debts, excluding housing wealth, and adjusting for inflation using CPI in 2010.³⁶⁰ The study also controlled for whether the respondents had consumed any alcohol last year, and whether they currently smoked.

Given that socioeconomic development and health resources vary substantially across regions in China^{168,361}, the statistical models also controlled for socioeconomic and health system variables at the province level. These were the

Human Development Index (HDI), the number of hospital beds per 10,000 population, and the number of doctors per 1,000 population. The HDI is a comprehensive indicator of regional development which ranges from zero to one and measures the attainment of longevity, good health, education, and a satisfactory standard of living.³¹⁰

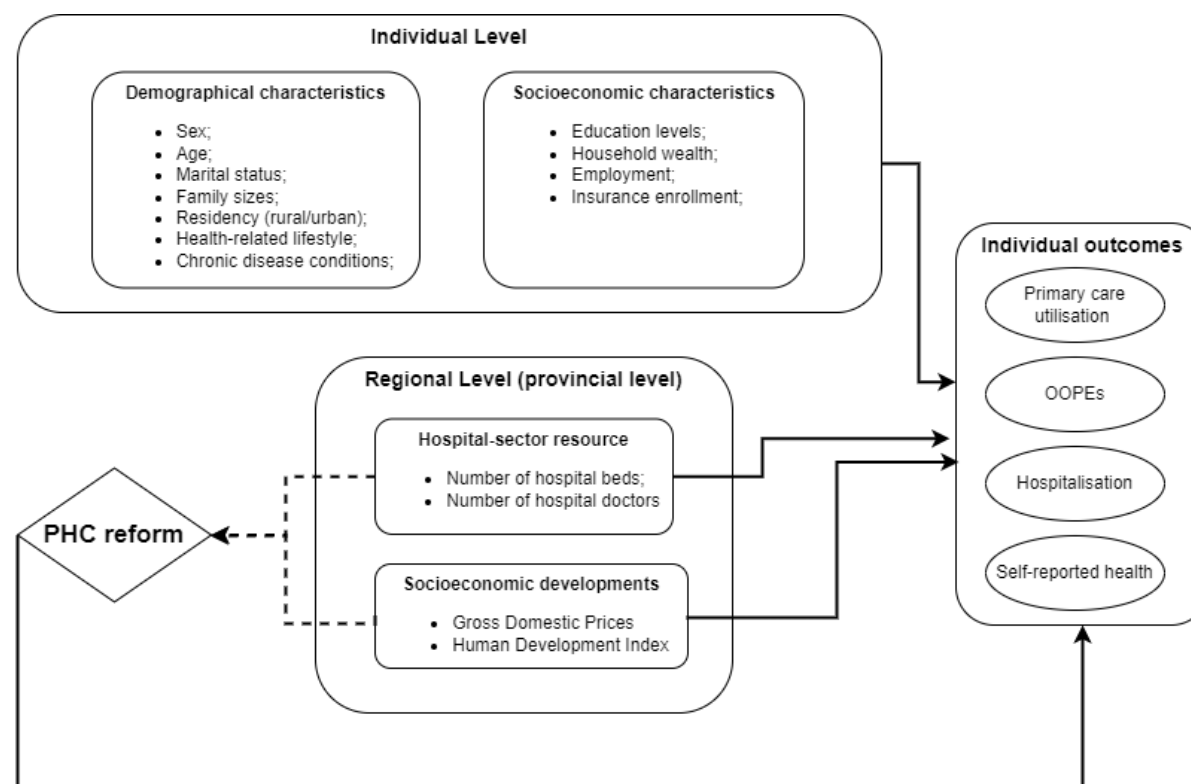


Figure 25 A causal diagram of the reform impacts on individuals' utilisation, out-of-pocket expenditures, and self-reported health and confounders

Notes: solid line with arrows indicates a determinant of the pointed factor, and dashed line with arrows means that it is uncertain whether the variable is associated to the pointed factor and a formal test is needed.

Source: author's own work.

7.2.4 Statistical analysis

Exploiting the staggered implementation of the second stage of the PHC reforms, this study used an advanced DID method introduced by Callaway and Sant'Anna²⁶⁹. Advantages and details of the methods were demonstrated in [Chapter 5](#).

The individuals from CHARLS were first grouped by the implementation date of the reforms in their cities/counties. Then, multiple treatment effects using 2x2 DiD were estimated for each treatment group at each period. For each 2x2 DiD estimation, people not yet treated at that period were used as control groups, and the year prior to the reform was used as the baseline period. The treatment effects were estimated using linear regression. These estimated treatment effects were then aggregated by relative time to the reform implementation to obtain event-study-like estimates. These estimates indicate how the reform impacts changed by the length of exposure to the reform. Periods prior to the reform were defined as pre-treatment periods and used to examine any violation of the parallel trend assumption. The estimates were adjusted for multiple testing using a simple multiplier bootstrap procedure.

The CS-DID model was estimated using:

$$Y = \tilde{\alpha}_1^{g,t} + \tilde{\alpha}_2^{g,t} G_g + \tilde{\alpha}_3^{g,t} \cdot \mathbf{1}\{T = t\} + \tilde{\beta}^{g,t} \cdot (G_g \times \mathbf{1}\{T = t\}) + \tilde{\gamma} \cdot X + \tilde{\epsilon}^{g,t}$$

where $\tilde{\beta}^{g,t} = ATT(g, t)$ is group-time average treatment effects for each group g at each time period t . Group g contains observations treated at time g . G_g is a dummy indicating whether a group first received the treatment at time g . $T = t$ indicates the current week. This effect is estimated by first subsetting the data to only include observations at time t and $g - 1$ from group g and groups not-yet-treated by time t (i.e., group $g > t$), and then running a population linear regression using only the extracted data. $t = g - 1$ was used as the reference time period. Given that the not-yet-treated groups were used as comparison groups and all individuals were treated at the end of the observation periods, the CS-DiD excluded the last treated groups

from the estimation. In other words, the reform impacts on the last treated groups were not estimated.

As demonstrated above, I then aggregated these $ATT(g, t)$ using:

$$\theta_{es}(e) = \sum_{g \in G} \mathbf{1}\{g + e \leq T\} P(G = g | G + e \leq T) ATT(g, g + e)$$

where $e = t - g$ is the relative time period. T is the maximum of T (i.e., the last time period). To address multiple-testing problems, our model used simultaneous inference procedures done by bootstrapping. The reform implementation is an absorb treatment, meaning that the treatment is irreversible, and people treated will stay treated afterwards.

For subgroup analysis, I stratified the sample using their residency status to obtain rural and urban subgroups. For income-related groups, I constructed a wealth quartile using household annual wealth per capita and then dichotomized the quartile into poor and rich population groups (the two poorest quartiles were defined as lower-income groups).

All data analysis was conducted in R version 4.2.1. CS-DID was conducted using *did* package.

7.2.5 Robustness checks

Several robustness checks were performed to test the robustness of the results. Although there are increasing debates on the weakness of traditional DID using two-way fixed effects, this method is widely applied in policy evaluation studies. To shed some lights on how serious these weaknesses affect the results of this study, I also estimate the reform effects using the traditional DID with two-way fixed effects as a comparison to the CS-DID method. I first estimated the DID model using individual and time fixed effects, a standard set up for traditional DID methods. This estimation

reported large confidence intervals given that the variations in the model were limited due to the fixed effects and the binary outcomes. To address this limitation, and more importantly, considering the reform was assigned at the city/county level rather than at the individual level, I replaced individual fixed effects with city fixed effects and re-run the estimation. To test the sensitivity of our models, I repeated the analysis using a sample including individuals who were only observed once across waves. The differences in the coefficients from traditional DID with two-way fixed effects for the four subgroups were tested using Z test statistics³⁶² to conclude whether they are significantly different ([Appendix 3](#)).

I estimated the traditional DID models using linear probability regression for the binary outcomes, including visiting PHC facilities, hospitalisation, and self-reported health, to compare with the magnitude of the estimated reform effects from the main analysis. To test the violation of linearity, I also ran the estimations using logistic regression, which is commonly adopted in medical research.³⁶³

7.3 Results

7.3.1 Descriptive summary

Table 15 compares the characteristic of the study population stratified by rural and urban populations. The analysis included 43,644 observations from 18,988 individuals from 125 cities/counties in 28 provinces ([Figure 27](#)). Among all observations, 62.3% (N=27,175) were from rural areas, and 58.6% (N=25,592) were from the two richest quartiles. Overall, the respondents had a large proportion of people who were female, married, illiterate, with a primary education level, and enrolled in the basic health insurance scheme. Regarding health lifestyle, less than half of the respondents reported drinking last year, ever smoking or being diagnosed with hypertension or diabetes at the time of the interview. Similar demographical characteristics were shared across rural, urban, poor, and rich populations ([Appendix 3](#)).

On average, urban populations had higher non-housing financial wealth (58,803 Chinese Yuan, 8,685.20 USD) than rural populations (17,665 Chinese Yuan, 2609.12 USD). Urban and richer populations also had better geographical availability of doctors and hospital beds, and human development index than rural ones and the poorer ([Appendix 3](#)).

The proportion of respondents who reported any use of health services was small. Less than a quarter of respondents (22.7%, N= 4,303) reported at least one visit to a PHC facility. This number is slightly lower than the number of reported hospitalisations (24.5%, N= 4,650). More than half of the respondents (63.5%) reported their health as fair, good, or very good. The average annual OOPes were 791.6 Chinese Yuan (117.1 USD) ([Table 15](#)).

Compared with urban populations, rural ones had more visits to PHC facilities (4.1%), fewer hospitalisations (1.9%), lower OOPes (171.1 Chinese Yuan, 25.3 USD), and a smaller proportion of people having good self-reported health (7.9%) ([Appendix 3](#)). Compared with richer populations, poorer populations had more visits to PHC facilities (3.6%) and hospitalisation (2.5%) and a smaller fraction of people having good self-reported health (12.5%). The average OOPes were similar among the two groups ([Appendix 3](#)). The rural-urban and income-related disparities in visits to PHC facilities narrowed between 2011 and 2018, whilst the gaps in hospitalisation, OOPes, and self-reported health persisted or even expanded during the same periods ([Figure 28](#) and [Figure 29](#)).

The PHC reform was pioneered in 25 cities/counties from eight provinces before the end of 2014 ([Figure 26](#)). Another 16 cities/counties from four other provinces joined as additional pilot cities before the national rollout in September 2015. The reform then rapidly scaled up, with 79 cities/counties starting the reform before 2017. By March 2018, all included cities/counties had implemented these PHC reforms.

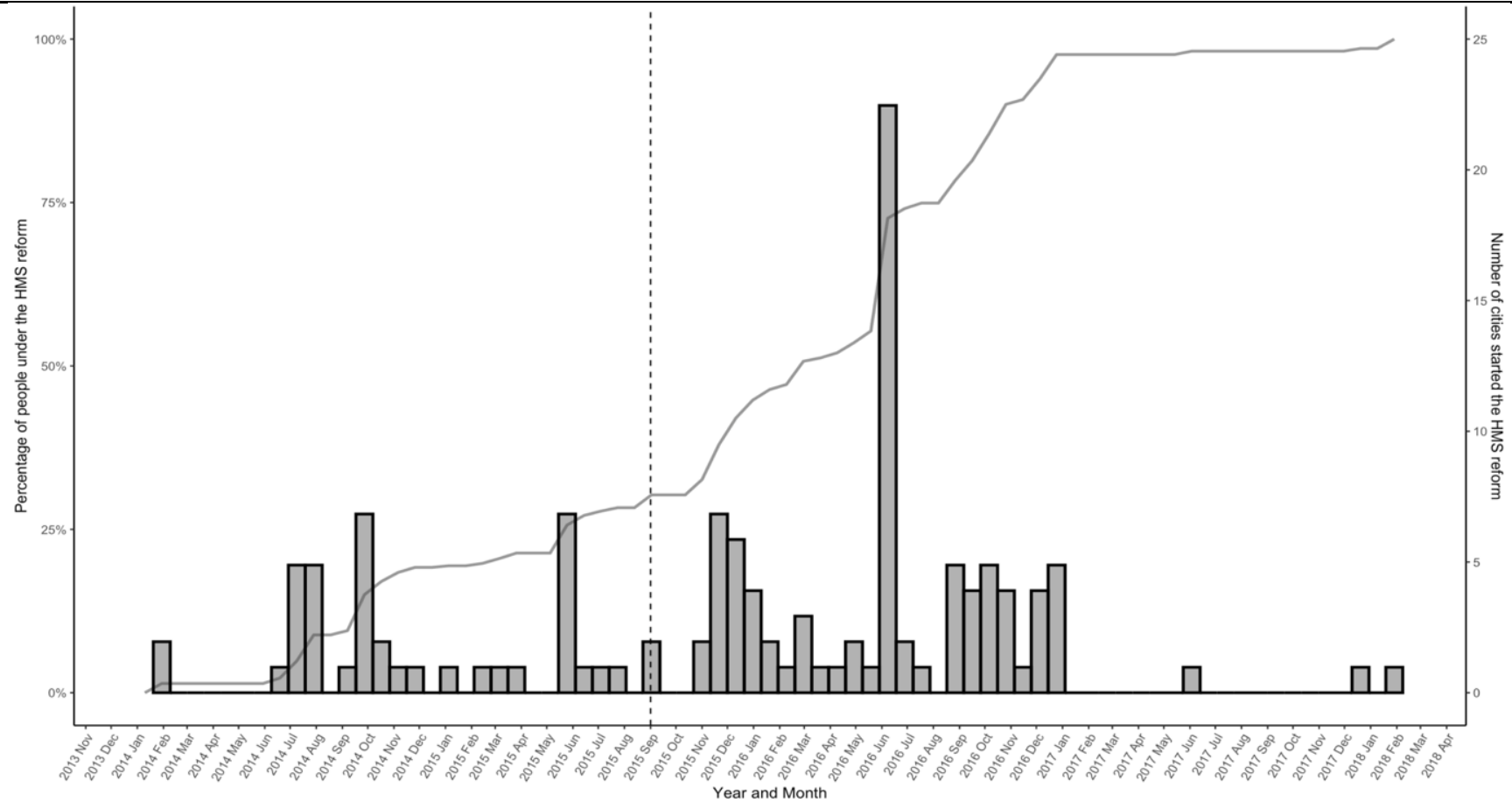


Figure 26 Percentage of the study populations and number of cities/counties under the 2015 PHC reform in each month between 2013 and 2018

Notes: The line plot shows the percentage of the study population under the PHC reform in each month between 2013 and 2018, and the bar plot presents the number of cities/counties that were included in the CHARLS and implemented the PHC reform in that month. The vertical dashed line indicates the published date of the national policy document of the PHC reform. The study populations and cities/counties are from the China Health and Retirement Longitudinal Survey.

Source: author's own work.

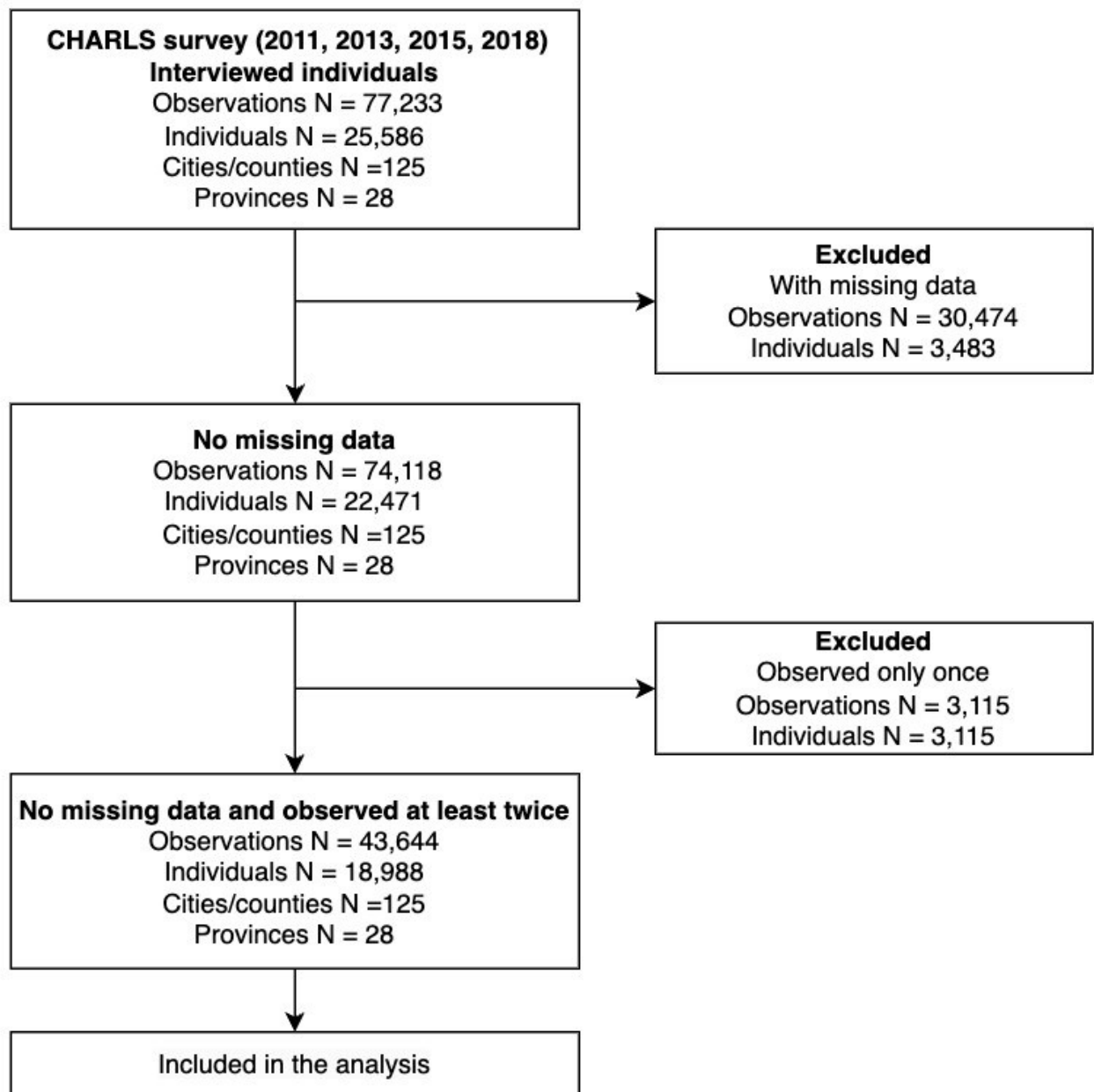


Figure 27 Sample selection process

Source: author's own work.

Study populations		
Age		
Median [Minimum, Maximum]	61	[46, 102]
Gender (Male as ref)		
Female (%)	23,106	(52.9%)
Education (Primary and below/Illiterate (ref)		
Secondary and higher (%)	13,281	(30.4%)
Marital status (Single as ref)		
Married (%)	37,566	(86.1%)
Working (No as ref)		
Yes (%)	27,406	(62.8%)
Drinking last year (No as ref)		
Yes (%)	14,287	(32.7%)
Ever smoking (No as ref)		
Yes (%)	12,170	(27.9%)
Basic health Insurance (No as ref)		
Yes (%)	41,002	(93.9%)
Diagnosed with chronic disease (No as ref)		
Yes (%)	15,737	(36.1%)
Family size		
Median [Minimum, Maximum]	3	[1,16]
Total household net wealth (Chinese Yuan)		
Mean (SD)	27,789.9	(107692.9)
Residence status (Rural/Urban)		
Rural	27,175	(62.3%)
Number of hospital beds per 10,000 population		
Mean (SD)	4.9	(1.1)
Number of doctors per 1,000 population		
Mean (SD)	2.1	(0.5)
Human Development Index (between 0-1)		
Mean (SD)	0.72	(0.04)
Whether visited a PHC facility in the last month?		
Yes (%)	5356	(12.3%)
Whether was hospitalised in the last year?		
Yes (%)	5809	(13.3%)
Overall OOPes (Chinese Yuan)		
Mean (SD)	791.6	(4771.5)
Self-reported health		
Poor/ Very poor (%)	10680	(25.0%)
Fair/ Good/ Very good (%)	32114	(75.0%)

Table 15 Summary statistics of the study population before and after the primary health care reforms in 2015

Notes: SD for standard deviations. Ref for reference groups. PHC for primary health care. OOPes for out-of-pocket expenditures. The values for total household net wealth and overall OOPes were adjusted for inflation using the consumer price index in 2010= 100. The scale of Human Development Index is between 0 and 1.

Source: author's own work.

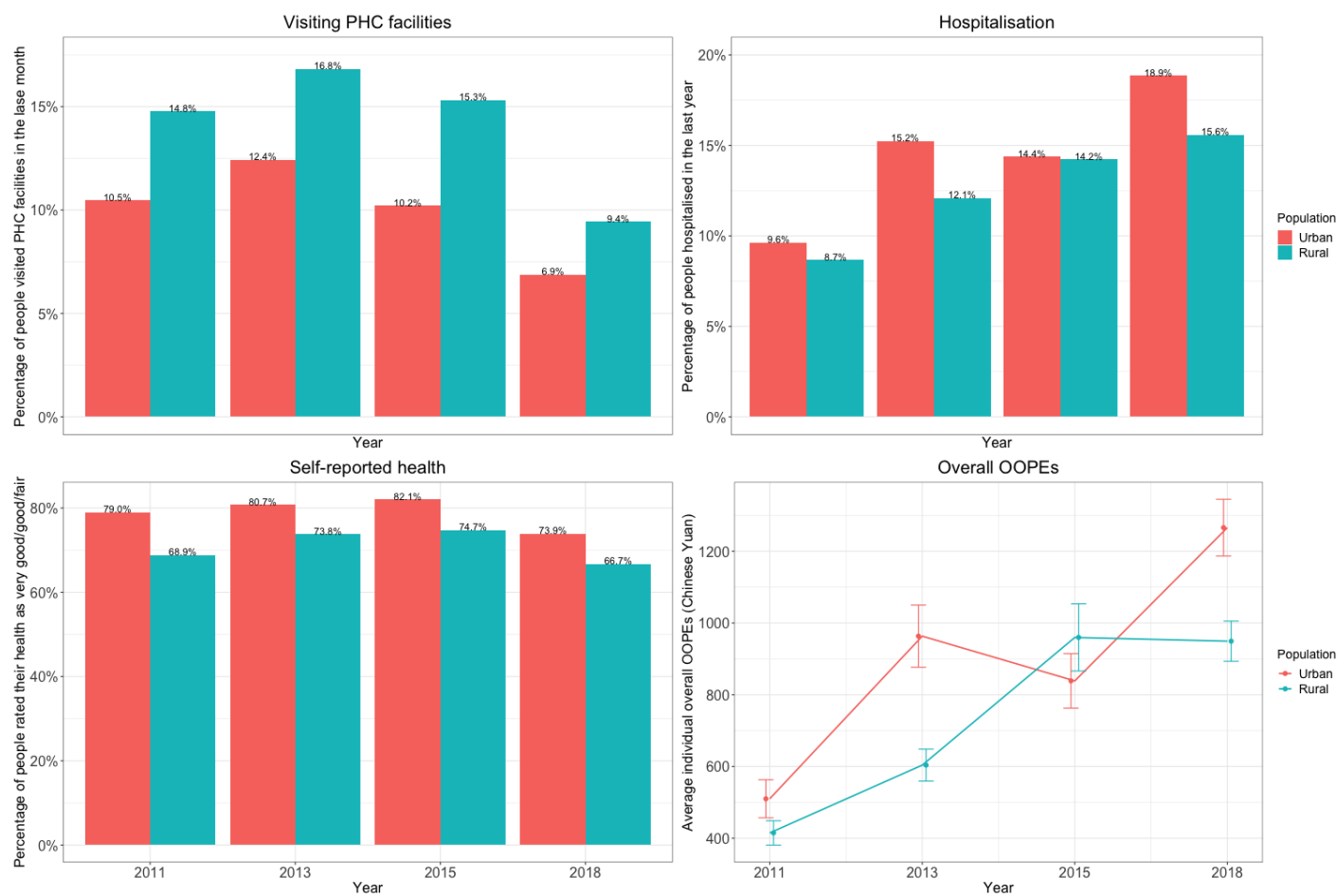


Figure 28 Changes in the outcomes between 2011 and 2018 grouped by rural and urban populations

Notes: OOPes for out-of-pocket expenditures.

Source: author's own work.

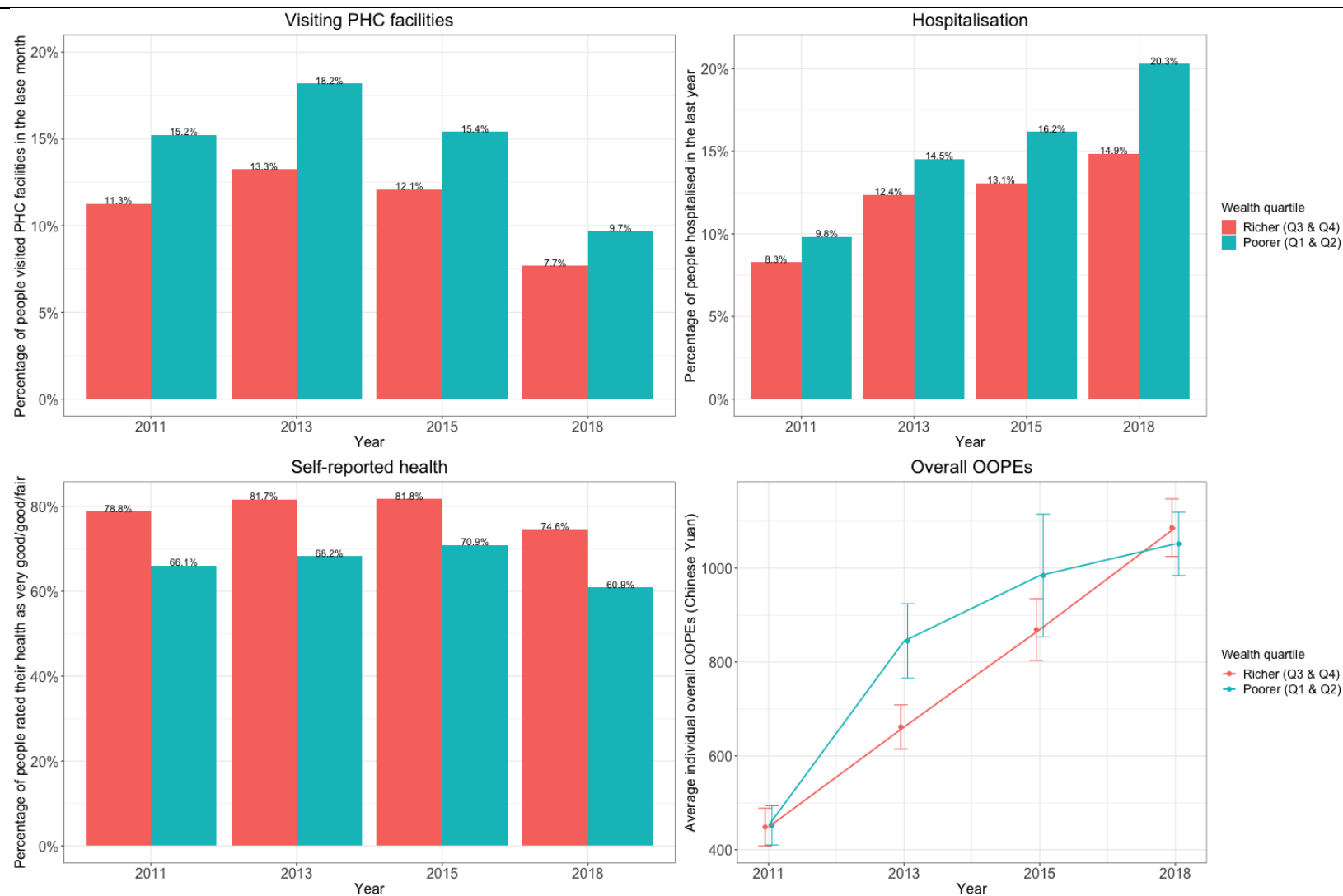


Figure 29 Changes in the outcomes between 2011 and 2018 grouped by poorer and richer populations

Notes: OOPes for out-of-pocket expenditures.

Sources: author's own work.

7.3.2 Reform impacts

Figure 30 shows the impacts of China's second stage of the PHC reforms on the probability of visiting PHC facilities, being hospitalised, and having good-reported health among the elderly populations and their average annual OOPEs. The point estimates of the reform impacts and its 95% confidence intervals are shown in the graph. For periods before the implementation of the reform (i.e., relative time <0), the estimates are close to zero and not statistically significant, suggesting no pre-trends before the reform. The large confidence intervals observed $t = -3$ is due to the small sample sizes for the 2014-2011 and 2015-2012 group-time groups (i.e., the group treated in 2014 and observed in 2011 and the group treated in 2015 observed in 2012). The year prior to the reform implementation (i.e., relative time = -1) was used as the baseline period.

Compared with the year before the reform implementation, the probability of elderly people visiting PHC facilities increased slightly by 7.8 percentage points (95% CI 0.3-15.2) in the implementation year. This effect was short-lived and became statistically non-significant in the following year. The results found no significant reform impacts on hospitalisation during the observed periods. OOPEs for elderly people had a lagged increase by 873.9 Chinese Yuan (129.1 USD, 95% CI 57.9-1689.9) one year after the reform was implemented. The probability of having good self-reported health in elderly populations (i.e., self-reported health rated as fair/good/very good) had a modest increase by 10.1 percentage points (95% CI 10.4-19.2) in the implementation year. However, this improvement became statistically not significant one year after.

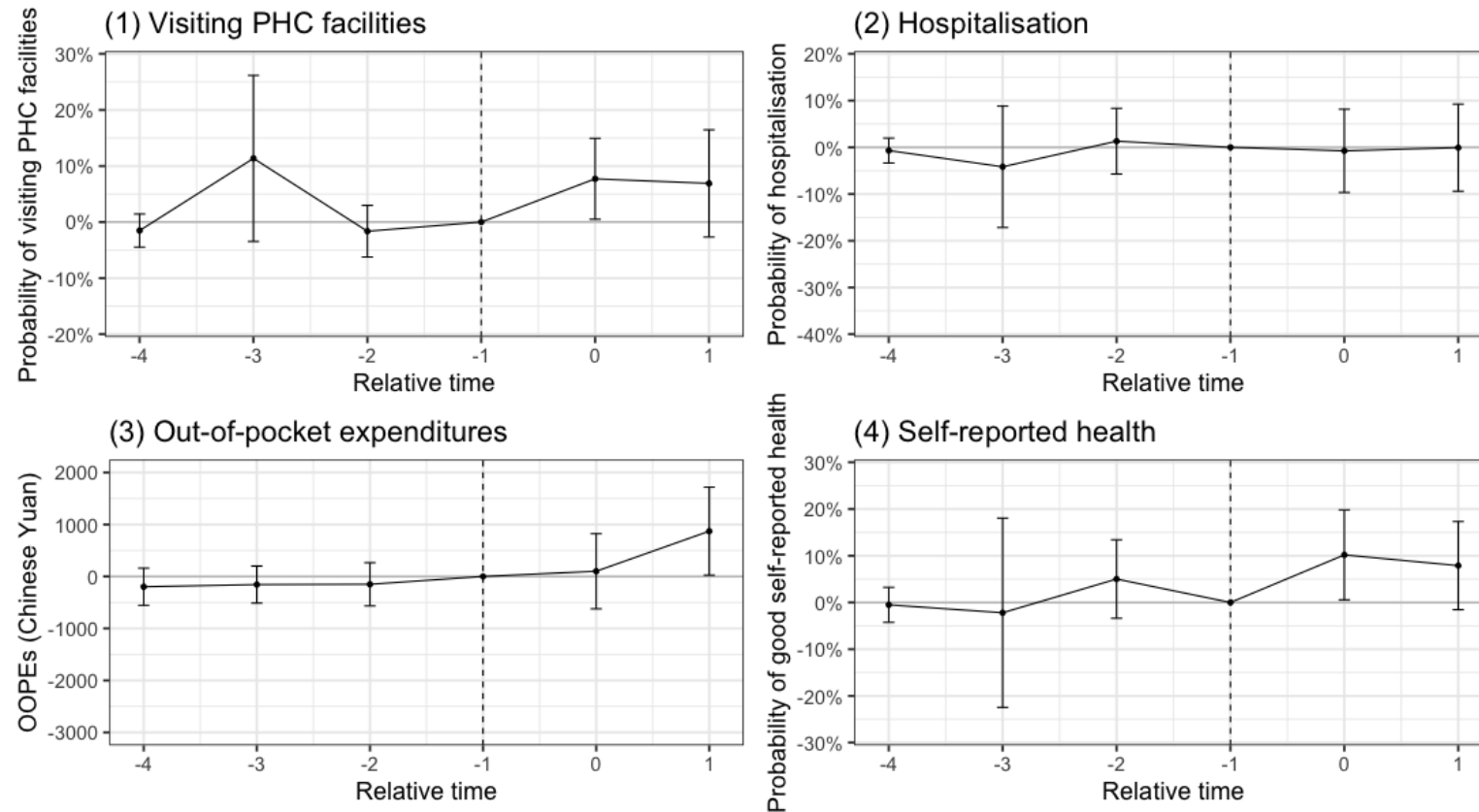


Figure 30 Estimates of the impacts of China's 2015 primary health care reform on utilisation, expenditures, and self-reported health by the length of exposure among the middle-aged and elderly populations.

Notes: The estimates are results from the difference-in-difference analysis described by Callaway and Sant'Anna. PHC for primary health care. The year prior to the reform was used as the reference period (e.g., relative time = -1). Good self-reported health refers to very good/good/fair self-reported health. The model was adjusted for individual sex, age, marital status, employment, health insurance enrolment, education level, family sizes, household financial wealth, smoking, and drinking, as well as the Human Development Index (HDI), the number of hospital beds per 10,000 population, and the number of doctors per 1,000 population. The estimates were adjusted for multiple testing using a simple multiplier bootstrap procedure. Predictive 95% confidence intervals are shown in the figure.

Source: author's own works

7.3.3 Subgroup analysis

Results from subgroup analysis suggest that the increased probability of visiting PHC facilities was mainly driven by rural or lower-income populations (**Figure 31**).

Urban-rural groups

Panel A in **Figure 31** compares the differential reform impacts on rural and urban elderly people in terms of their probability of visiting PHC facilities, being hospitalised, and having good-reported health, as well as their average annual OOPes. For rural populations, their probability of visiting PHC facilities had an increase by 10.2 percentage points (95% CI 0.7-19.6) one year after the reform implemented and became statistically nonsignificant in the following years. Meanwhile, primary care utilisation among urban populations was unaffected. The probability of being hospitalised had no significant changes among neither rural nor urban elderly populations. In terms of OOPes, there was an increase among urban populations but without statistical significance. Probability of good self-reported health showed no significant changes in neither group.

Wealth groups

Panel B in **Figure 31** compares the differential reform impacts on poorer and richer elderly people in terms of their probability of visiting PHC facilities, being hospitalised, and having good-reported health, as well as their average annual OOPes. For poorer populations, their probability of visiting PHC facilities had an increase by 11.2 percentage points (95% CI 0.2-22.2) one year after the reform implemented and became statistically nonsignificant in the following years. Meanwhile, primary care utilisation among richer groups was unaffected. The probability of being hospitalised had no significant changes among neither wealth groups. In terms of OOPes, there was an increase among richer populations but without statistical significance. Probability of good self-reported health had no significant changes in neither wealth group.

Based on the results from the subgroup analysis, the increased primary care utilisation following China's PHC reform was mainly driven by rural and poor populations.

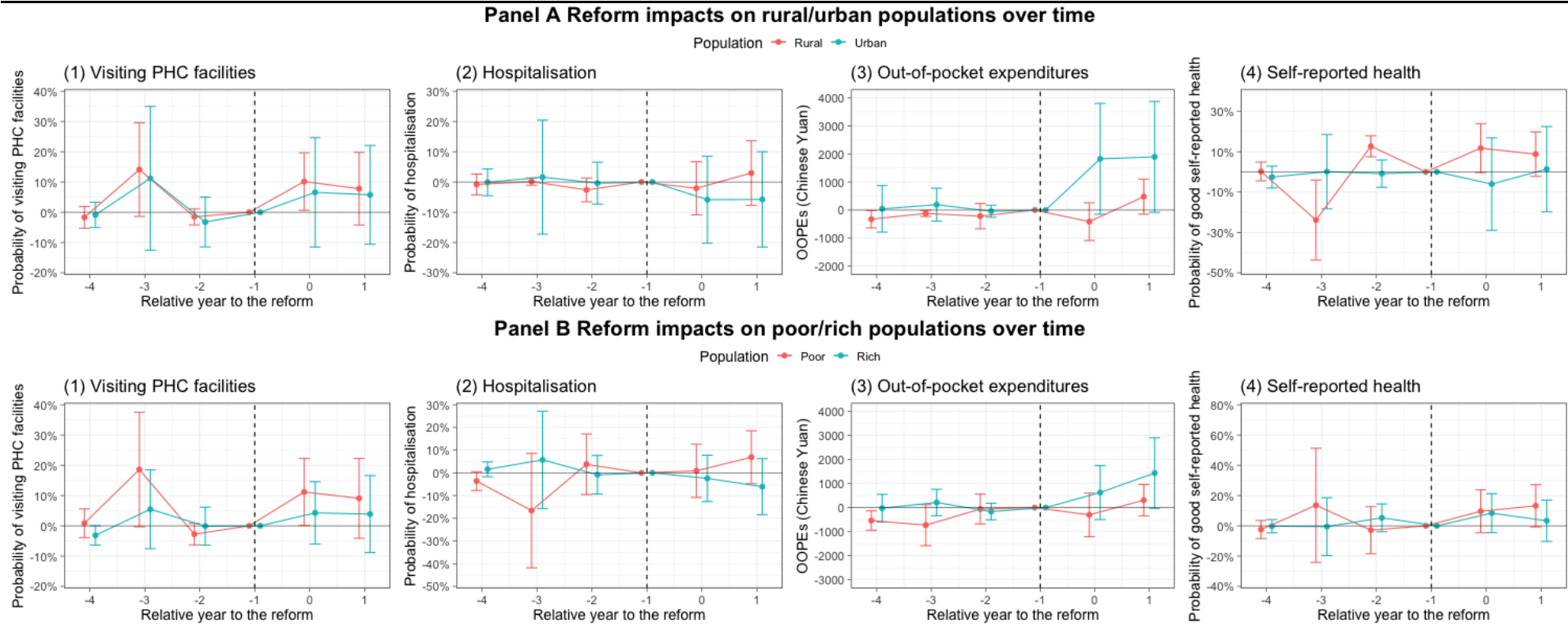


Figure 31 Estimates of the impacts of China's 2015 primary health care reform on utilisation, expenditures, and self-reported health by the length of exposure among the middle-aged and elderly populations grouped by rural/urban status and incomes.

Notes: The estimates are results from the difference-in-difference analysis described by Callaway and Sant'Anna. PHC for primary health care. OOPEs for out-of-pocket expenditures. The year prior to the reform was used as the reference period (e.g., relative time = -1). Good self-reported health refers to very good/good/fair self-reported health. The model was adjusted for individual sex, age, marital status, employment, health insurance enrolment, education level, family sizes, household financial wealth, smoking, and drinking, as well as the Human Development Index (HDI), the number of hospital beds per 10,000 population, and the number of doctors per 1,000 population. The estimates were adjusted for multiple testing using a simple multiplier bootstrap procedure. Predictive 95% confidence intervals are shown in the figure.

Source: author's own work.

7.3.4 Results from robustness checks

Figure 32 shows the estimated reform impacts from the event study models using city and time fixed effects. The results show that compared with the year before the reform, the likelihood of visiting PHC facilities increased by 24% (AOR=1.24, 95% CI 1.02-1.51) in the year the reform was implemented, and this increase continued in the following year but became statistically nonsignificant. The odds of being hospitalised had no significant changes after the reform until the second year, followed by a continuous increase by 35% (95% CI 1.02-1.78) and 67% in the next two years. However, this estimate might be contaminated and an overestimate of the reform effects since there were some pre-trends three years subsequent to the reform. Individual overall OOPes has an increase by 552.63 Chinese Yuan (81.75 USD, 95% CI 115.65-989.61) one year after the reform, which became statistically non-significant in the following years. The reform had no significant impact on the likelihood of reporting good self-reported health for elderly populations.

TWFE model also show similar reform directions on the four assessed outcomes (**Table 16**). The results of TWFE models show that compared with the not-treated groups, the reform was associated with an increased likelihood of visiting PHC facilities by 24% (AOR=1.24, 95% CI 1.04-1.44). There were not significant reform impacts on hospitalisation or OOPes. TWFE models found a significant increase in self-reported health. However, this increase could be a continuous pre-trend, suggested by the CS-DiD analysis and the event study.

The results from subgroup analyses of the event study and TWFE models show a qualitatively similar picture to the CS-DiD estimation (**Appendix 3**).

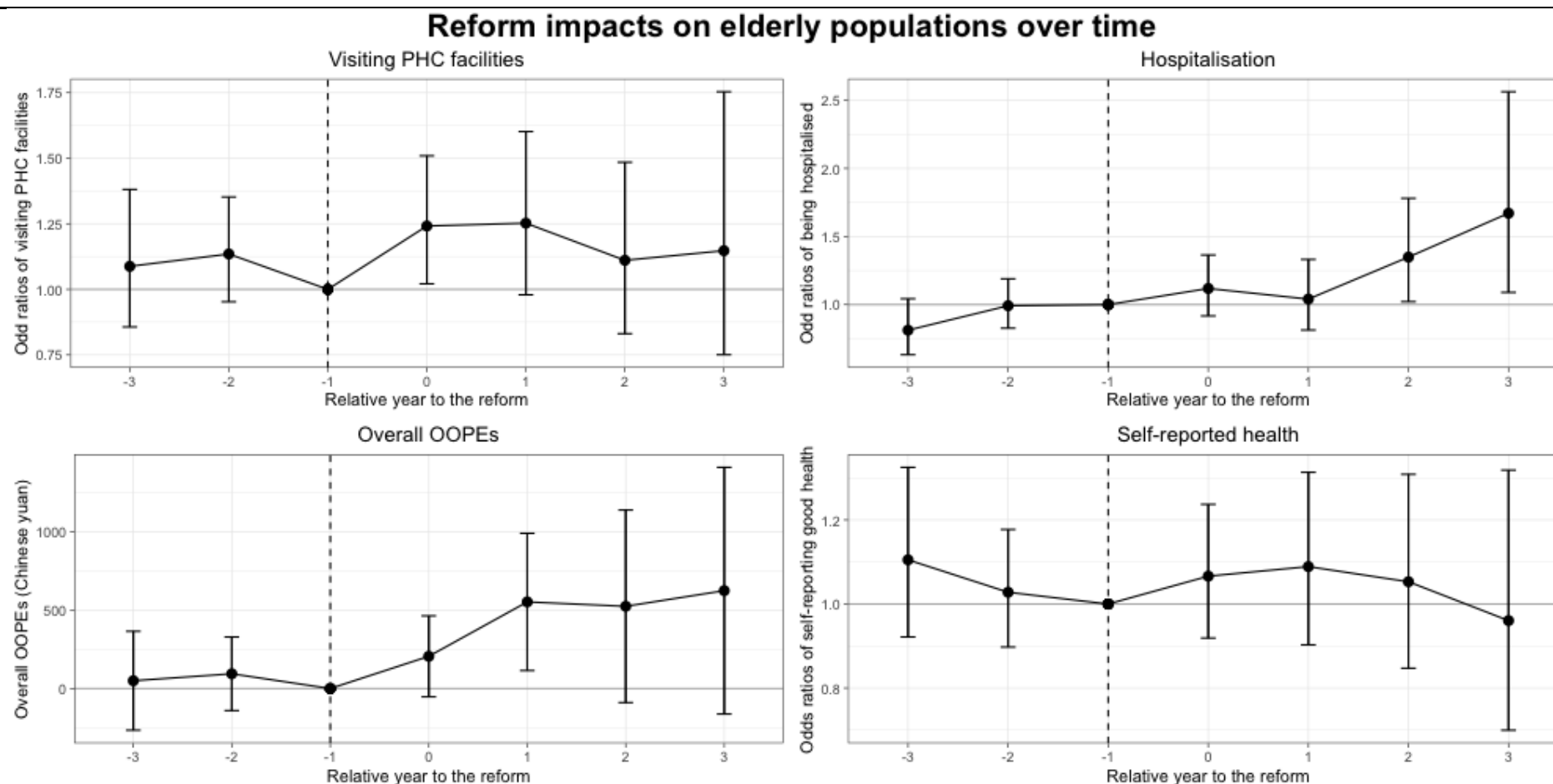


Figure 32 Event study estimates for the reform impacts on utilisation, OOPes, and self-reported health among elderly populations

Notes: PHC for primary health care. OOPes for out-of-pocket expenditures. All line plots show point estimates and 95% confidence intervals. The dashed line indicates the relative time period -1 (i.e., one year prior to the reform) used as a reference group. All models were estimated controlling for city and time-fixed effects and time-varying confounders at individual and provincial levels, and standard errors were clustered by individuals.

Source: author's own work.

	Visiting PHC facilities		Hospitalisation		Overall OOPes		Self-reported health	
Reform	1.24**	1.55**	1.003	0.95	98.78	65.94	1.17*	1.37*
	(1.07, 1.44)	(1.16, 2.06)	(0.86, 1.17)	(0.70, 1.28)	(-143.90, 341.45)	(-198.13, 330.00)	(1.03, 1.33)	(1.03, 1.82)
Observations.	43644	43644	43627	43627	42583	42583	42794	42794
Adjusted R ² .	0.056	-0.577	0.074	-0.488	0.021	0.058	0.096	-0.099
Within R ² .	0.009	0.003	0.051	0.027	0.013	0.008	0.071	0.02
AIC	30693.7	51256.4	31709.3	50951.1	841457.2	852495.1	43488.3	52832.5
Individual fixed effects		✓		✓		✓		✓
City fixed effects	✓		✓		✓		✓	
Time fixed effects	✓	✓	✓	✓	✓	✓	✓	✓

Table 16 Estimated the reform impacts on primary care utilisation, hospitalisation, OOPes, and self-reported health using two-way fixed effects models

Notes: . * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$. PHC for primary health care. OOPes for out-of-pocket expenditures. All models used cluster robust standard errors which cluster at individual level. Outcomes were the odds ratio of visiting any PHC facilities in the last month, being hospitalisation, and having very good/good/fair self-reporting health, and individual out-of-pocket expenditures in the last year (Chinese Yuan). All models were adjusted for individual and provincial covariates: ages, sex (female=1 or male), marital status (married=1 or unmarried), working or not, whether enrolment of public health insurance (i.e., Employee Basic Medical Insurance, Newly Cooperative Medical Scheme, and Urban Resident Basic Medical Insurance), whether diagnosed with chronic diseases (i.e., hypertension or diabetes), and whether received secondary education or above, family sizes, household non-housing financial wealth, whether the respondents had ever drunk any alcohol last year, and whether they currently smoked at individual level, and Human Development Index (HDI), the number of hospital beds per 10,000 population, and the number of doctors (at both PHC facilities and hospitals) per 1,000 population at provincial level. Standard errors were clustered at the individual level.

Source: author's own work.

7.4 Discussion

7.4.1 Key findings

This study used a nationally representative, longitudinal cohort to assess the impacts of China's second round of PHC reforms since 2015 on health service utilisation, OOPe and self-reported health in elderly populations. China's PHC reform since 2015 had a modest and short-term effect that increased primary care utilisation and self-reported health among the elderly but also their OOPes. No reform impacts on hospitalisation were found. The reform disproportionally increased the primary care utilisation in vulnerable populations (i.e., rural populations and those with lower incomes).

Increases in PHC utilisation following PHC reforms, particularly in rural/lower-income populations, is a finding supported by evidence from other LMICs, such as Turkey³⁶⁴ and Brazil³⁶⁵. Evaluations on China's comprehensive PHC reform are rare^{228,366,367} and mostly based on megacities in east China and facility-level data. There is no consistent conclusion on the reform impacts on health service utilisation. The heterogeneous reform impacts across population groups and regions are understudied.

Increased primary care utilisation was one of the state goals of China's PHC reforms and was likely facilitated through the opening of new PHC facilities, higher reimbursement rates at PHC facilities (i.e. reducing costs for patients) and increasing referrals to PHC facilities from family physicians. However, increased primary care utilisation may also result from inappropriate use of primary care³⁶⁸ or visits solely to obtain referrals to higher-levels of care.^{124,226} More nationwide evidence and sensitive measurements on primary care and hospital usage, such as data on the nature of PHC consultations and avoidable admissions, are needed to better scrutinize changes in health-seeking behaviours.

This study found increases in primary care utilisation were driven by rural and lower-income groups. This is in contrast with a previous study in which 36% of participants were under 45 years, suggesting the reforms increased primary care utilisation only in urban residents.²²⁸ A plausible explanation is the age of different study populations. Young adults are the main users of urban PHC facilities,³⁶⁹ in contrast with rural PHC facilities which are mainly used by the elderly.³⁷⁰ This difference might hint that the reform had greater utilisation impacts on frequent users of the PHC sector. Additionally, their study used a traditional two-way fixed effects DID model which is prone to biases raised from heterogeneous reform effects over time.

The disproportional increase in primary care utilisation among rural and lower-income populations is plausible. The rural¹⁶⁹ or poor elderly have greater unmet healthcare needs and more willingness of visiting PHC facilities^{371,372} than their counterparts, likely making them more sensitive to the PHC reform. Additionally, some elements of the reforms were not compulsory, such as first-contact with PHC providers or enrolment with family physicians. Urban and higher-income populations may be more likely to bypass PHC facilities given that they often have better access and preference to hospitals and can afford hospital-based care^{251,353,372,373}.

The short-lived increases in primary care utilisation and lack of impacts on hospitalisations in this study suggest the PHC reforms have not addressed the continued hospital domination in the Chinese health system. This finding is consistent with China's continuously increasing share of patient visits and resourcing consumed by hospitals since 2015.¹⁴² The limited impacts of PHC reforms on hospitalisation were observed in other LMICs.^{364,365} Studies from Turkey³⁶⁴ and Brazil³⁶⁵ showed that PHC-oriented reforms in these countries increased primary care utilisation, but this increase was relatively small compared with hospital care³⁶⁴ and did not lead to decreased avoidable hospitalisation.³⁶⁵

The limited change in hospital domination found in this study highlights policy areas need to be strengthened in future reforms. Despite the reforms, China's PHC sector continues to lag behind the hospital sector,^{298,306,374} remaining under-resourced, lacking a skilled health workforce,^{252,337} and delivering poor quality care.^{298,375,376}

There are few incentives and cross-ministry efforts^{254,376} to encourage collaboration and integration between the PHC and hospital sectors. Quality-oriented performance measurements were also absent from the reform^{97,254} (e.g. monitoring unnecessary hospital use) with hospitals neither accountable nor motivated to collaborate with PHC. There are fragmented financing mechanisms between PHC and hospital sectors,²⁶² which were not addressed by the reforms. As hospitals are under pressure to generate revenue,^{186,262} they compete with PHC facilities for patients and human resources³⁷⁶. For patients, inconvenient reimbursement processes^{124,226,377}, limited availability of health services and essential medicines³⁵², long travel times³⁷¹, inconvenient transportation^{261,352,372,375} discourage use of PHC facilities, and these underlying factors were not targeted during the reforms. Chinese citizens' continue to have a preference for hospital care^{264,378} stemming from low trust in the PHC sector,³⁷⁶ and perceived higher quality care in hospitals³⁷⁶.

This study found that the PHC reform was associated with a lagged increase in OOPes for the elderly, increasing their financial burden. This finding likely stems from similar explanations noted above - the preference for and easy access to hospitals, and incurred fees to bypass PHC facilities and directly access secondary care. On the financing side, the health insurance system provides better coverage for inpatient care,^{167,379} there are insufficient government funds for the PHC sector,²⁹⁷ and PHC as a share of total health expenditures has been shrinking over time – all contributing to the need for increasing OOPes to fund care.²⁶²

Increasing OOPes is worrisome given the existing urban-rural and income-related disparities in catastrophic health expenditures and medical impoverishment in China.^{136,167,168,380} The limited reform impacts on reducing OOPes is not surprising since health insurance design in China remain pro-urban and inpatient care and unaffected by the reform. The basic health insurance for rural populations (i.e., New Rural Cooperative Medical Scheme) had around 10% lower inpatient reimbursement rates¹⁶⁷ and a higher level of outpatient cost-sharing³⁷⁹ compared with the urban ones. Moreover, government funds for China's PHC sector were not insufficient,³⁸¹ and the share for PHC among total health expenditures has shrunk over time.²⁶² Equity-oriented financial risk pooling and payment methods (e.g., capitation, free

vouchers, or a blend) are important policy options^{41,196} that should be a priority in China.

The short-lived increases in self-reported health in this study are unsurprising given, as mentioned above, the lack of sustainable or major changes in primary care utilisation or hospital domination. Health improvements can be challenging and require comprehensive improvements in various aspects, such as care quality, accessibility, and affordability. China's PHC reforms lack quality-oriented incentives and performance measurements,^{97,254} and primary care providers are not motivated to improve care quality.³⁸¹ Inappropriate use and poor-quality care prevent PHC facilities from delivering health benefits to the populations. Moreover, this study found no disproportional health improvements in the vulnerable populations. This finding is worrisome given that higher socio-economic groups and urban populations in China have better self-reported health than their counterfactual even before the reform.^{166,170} Rural/poor populations are disadvantaged by a various range of demographic, socioeconomic and policy factors demonstrated above.

7.4.2 Limitations

The study is subject to limitations. First, the nature of observational studies and the non-randomised assignment of pilot cities prevent us from inferring the causal relationship between the PHC reform and the outcomes. Second, due to the timeliness management of governmental websites, we did not find policy documents on the PHC reform for all cities. For the 27 cities whose policy documents were not found, their estimated implementation dates based on provincial-level documents are likely to precede the actual dates, as cities often subsequently comply with guidance from their higher-level governments. Third, the individual data used in this study have some limitations. The smaller sample size of urban populations, large period intervals, and limited treatment variations at the end of the observed time (i.e., 2018) cause large confidence intervals for the estimated policy effects in the corresponding population groups and periods. The use of binary outcomes in difference-in-differences estimations often result in more imprecise estimation with large confident intervals.³⁸² The measurement of OOPes could not be separated by types of

services or facilities, preventing further decomposition of the observed changes. The measurement of primary care utilisation only included visits to PHC facilities in the last month. Further, although self-reported health is a valuable indicator for mortality,³⁸³ this subject measure can have measurement error for the true health status.³⁸⁴ Other objective and more sensitive health measures, such as cause-specific mortality and infant and maternal mortality, should be examined in the future to provide a better insight into the health impacts of the reforms.

7.4.3 Strength

This quasi-experimental study has several strengths. First, it uses web scrapping for the first time to identify implementation dates of China's PHC reforms at the city level. This reduces spatial and temporal imprecision for evaluating the reforms, reducing measurement bias, and permits robust testing for potential selection bias. Second, the use of a robust DiD estimator which permits assessment of time-varying reform impacts reduces potential biases which challenge traditional DiD methods.^{266,268-270,385,386} Third, this study evaluated this multi-component reform as an entirety. The assessed outcomes such as hospitalisation, OOPes and self-reported health have not been rigorously examined before. Fourth, this study adds evidence on differential reform impacts over time and across population groups (discussed in [Chapter 4](#)). The findings of this study confirmed the PHC reforms was pro-equity and first time highlighted that the reform effects were not sustained.

7.5 Conclusion

China's comprehensive PHC-oriented reform since 2015 has made some modest, short-lived progress in increasing primary care utilisation and self-reported health, predominantly in rural and lower-income populations. However, China's health system remains hospital-centric, and there have been limited improvements in financial protection and health equity. Comprehensive PHC reforms in LMICs must look beyond increasing primary care utilisation and prioritise system-wide synergetic

improvements in governance, PHC systems, financing, information systems, and robust evidence to achieve UHC.

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Chapter 8. Conclusions and Discussion

This chapter provides an overview of all chapters in the thesis and the main findings from the three original research chapters ([Chapter 4](#), [Chapter 6](#), and [Chapter 7](#)). Then, an interpretation of the overall findings from the thesis is given, followed by a discussion on the strengths and limitations of this whole PhD project. Lastly, the chapter discusses the policy implications of this project for future PHC reforms in China and other LMICs.

8.1 Key conclusions from each chapter

[Chapter 1](#) reviewed some critical literature on health, health systems, PHC, and PHC reforms in LMICs. The chapter underlines several PHC challenges in LMICs, including insufficient and fragmented financing, lack of skilled workforce, poor quality care, and inappropriate data. To address these challenges, LMICs have implemented various PHC reforms over the past decades. Existing evidence from LMICs concludes that PHC reforms can improve equitable access to essential health services and health outcomes (e.g., infant mortality). However, many assessed PHC reforms had great heterogeneities across countries, and the evidence is often mixed. The chapter then highlights some substantial evidence gaps in PHC reforms in LMICs, including a lack of evidence from Asia, rigorous study designs, comprehensive perspectives. The substantial evidence gaps in comprehensive PHC reforms underpin the significance and relevancy of China's comprehensive PHC reforms, a key focus of this thesis.

[Chapter 2](#) provides an overview of China's health system prior to the reforms and a detailed description of the two stages of the reforms and the main policy components. The chapter also explicitly describes the regional differences across China and the temporal and spatial variations in the reform implementation, providing fundamental justification for the study designs of the following three original research chapters ([Chapter 4](#), [Chapter 6](#), and [Chapter 7](#)).

Chapter 3 outlines the overall aims of this thesis and the objectives and research questions for each original research chapter.

8.1.1 Evidence on China's PHC reforms since 2009

Chapter 4 presents the first original research in this thesis, a systematic review that narratively synthesises existing evidence on the reform. The systematic review adopted a broad search strategy and focused on quasi-experimental studies with controls. It found that the majority of the included 42 studies are on single-component policies and the first stage of the reform, with essential medicines and financing being the most studied and primary care delivery (family physicians and essential public health package) the least studied. The review found consistent evidence of increased primary care utilisation and some health improvements among people with NCDs. However, the quality of evidence was low, and robust evaluations were scarce. This chapter also mapped out evidence gaps in evaluations of the second round of the reforms as an entity and understanding of the reform impacts on financial risk protection, secondary care, quality of care, general population health, and health equity. This study provides justification for the research questions and designs for the other two original studies in Chapters 6 and 7.

Chapter 5 delves into the methodology employed in the two empirical evaluation studies featured in **Chapter 6** and **Chapter 7**. It provides a comprehensive overview of the application of canonical DiD methods in causal inferences and policy evaluations, including 2x2 DiD, TWFEs, and event study. The chapter then underscores the assumptions and the limitations of these methods when assessing heterogeneous treatment effects with staggered implementations. It also discusses new diagnostic tools and alternative estimators proposed in recent econometric literature, with a specific focus on robust DiD methods used in **Chapter 6** and **Chapter 7**.

8.1.2 The reform impacts: an ecological perspective

Building upon the evidence gaps identified in **Chapter 4**, **Chapter 6**, and **Chapter 7** assessed the impacts of the second-round PHC reforms on various outcomes from both the supply and demand sides using robust evaluation methods.

Chapter 6 adopted a comprehensive perspective and two main analyses using aggregated panel data from yearbooks to assess 1) the impacts of the second reforms on a range of health system outcomes, MMR, and mortality (using the CS-DID analysis) and 2) the association between PHC determinates and MMR (using the panel regression analysis). Subgroup analysis was conducted in low-/high-HDI provinces and eastern/central/western China. The first analysis for this ecological study finds that the second-round reforms increased the utilisation of maternal care and family physician services and reduced MMR, particularly in resource-restrained regions (e.g., low-HDI provinces). However, these improvements were accompanied by increased hospital costs for outpatient care and drugs. The reforms had no significant impacts on the supply of PHC facilities or beds, household health expenditures, visits to PHC facilities, or all-cause mortality. The second analysis shows that whilst the PHC workforce and the use of family physician services and prenatal care were all significant determinates of MMR, the latter two were likely the reform mechanism of the reduced MMR. This reform impact was mainly found in less developed regions (e.g., low-HDI provinces or western China).

This study adds comprehensive evidence to the reform impacts on the health system and population health and explores some potential reform mechanisms. However, due to the limitation of ecological fallacy, these findings cannot infer the reform impacts on individuals.

8.1.3 The reform impacts: an individual perspective

To probe into the reform impacts on individuals, the quasi-experimental study in **Chapter 7** used cohort data on people aged 45 and above to evaluate the second-

round reform impacts on 1) visiting PHC facilities, 2) hospitalisation, 3) OOPes, and 4) self-reported health. The study also investigated how the reform impacts varied across urban-rural populations and people with different income levels. The study found that the reform had some short-lived impacts on increased primary care utilisation and self-reported health among middle-aged and elderly populations, particularly those with lower income or from rural areas. The improvements were accompanied by increased OOPes. No significant reform impact on hospitalisation was found.

8.2 Overall findings and discussion

This section summarises the findings from the three original research chapters ([Chapter 4](#), [Chapter 6](#), and [Chapter 7](#)) and potential interpretations and mechanisms of the observed reform impacts. The three studies comprehensively examined the impacts of China's PHC reforms on the health system, health outcomes, and health equity.

Overall, the findings from this project suggest that China's PHC reforms since 2009 partly increased equitable use of primary care services (in [Chapter 4](#), [Chapter 6](#), and [Chapter 7](#)), disproportionately benefiting under-resourced regions (i.e., low-HDI provinces and western China – in [Chapter 6](#)) and vulnerable/high-risk populations (i.e., people with NCDs - in [Chapter 4](#), pregnant women – [Chapter 6](#), middle-aged and elderly populations, and those from rural areas or with lower incomes – in [Chapter 7](#); see [Table 17](#)). However, the reform made little progress in shifting away from hospital domination, reducing health expenditures for providers or individuals, or improving general population health.

Components	Outcomes	Project 1 Systematic review	Project 2 Ecological study	Project 3 Cohort study
Utilisation	Primary care	Increased	Increased	Increased
	Secondary care	Mixed	Not studied	None
Expenditures	Health service costs	Mixed	Increased	Not studied
	Out-of-pocket expenditures	Understudied	Not studied	Increased
	Household health expenditures	Understudied	None	Not studied
Quality	Quality of care	Understudied	Not studied	Not studied
Health	General populations	Understudied	None	Not studied
	High-risk populations	Improved	Improved	Improved
Equity	primary care utilisation	Increased	Increased	Increased

Table 17 A summary table of the main findings of the three original research

Notes: green indicates desired changes, red indicates undesired changes, and grey indicates the presence of mixed evidence or evidence gaps.

Source: author's own work.

The interpretation of the findings and the relevance to wider PHC research in LMICs have been discussed in detail in each original research chapter. This section provides an overview of interpretations of the findings from this project.

8.2.1 Increased equitable utilisation of primary care

The three original research found consistent evidence that the reform increased primary care utilisation among high-risk populations and disproportionately benefited vulnerable populations and those from under-resourced regions. These findings are expected given that increasing equitable health service utilisation was a primary goal of the PHC reforms and facilitated by various strategies throughout the reforms. The NEPHS provided free-of-charge access to essential primary care for pregnant women, middle-aged and elderly populations, and people with NCDs. The policy incentivised the providers through capitation payments. Later, the expansion of family physicians further strengthened the delivery of the NEPHS at the community level.

Financially, the central government's subsidies for essential health services to central and western China increased from 1,961 to 3,095 billion (Chinese Yuan, 292.69 to 461.94 USD) between 2013 and 2017, taking up 86.3% of the total subsidies in 2017³⁸⁷. Expanded coverage of the health insurance and rising reimbursement rates for PHC facilities also increased the affordability of visiting PHC facilities and relieved financial barriers to primary care services. These policies could be particularly beneficial for people with unmet health needs due to financial difficulties.

The characteristics of vulnerable/high-risk populations also made them more likely to be affected by the reforms. High-risk populations often have greater health needs and more frequent use of the health systems. People in rural/western China or with lower incomes often have limited access to health care services and more unmet health needs. Therefore, the population groups are more sensitive to the reform changes and more likely to respond to improved access to primary care services. In contrast, people in urban areas or with higher income have better access and

stronger preferences to hospitals^{251,352,353,372,373} and better health than those in rural areas or with lower income. Therefore, they are more likely to pay out-of-pocket to skip PHC facilities and are less sensitive to the PHC reforms.

Whilst there has been an increased use of primary care, the quality of care is underexamined, such as appropriateness, efficiency and people-centredness. Multiple studies from China show that overuse or misuse of primary care services is common,³⁶⁸ and people sometimes visit PHC facilities for referral letters rather than treatments.^{124,226} Moreover, this project found that the increased primary care utilisation did not sustain, indicating persistent hospital domination in China.

8.2.2 Persistent hospital domination

Interpretations of the limited reform impacts on hospital domination are multifaceted. First, despite China's strong political commitment to PHC strengthening, some PHC policy designs and implementation are still weak. For instance, non-compulsory policies (e.g., gatekeeping and family physician scheme), a complicated reimbursement process^{226,377}, and the limited availability of health services and drugs²²⁶ can discourage people from using PHC facilities. The reform had weak horizontal coordination across government departments²⁵⁴ to support strong implementation. An overarching and integrated governance framework for PHC can hold governmental departments accountable and facilitate coordination. More importantly, the reforms have noticeable policy gaps in quality improvements,^{97,254} and the quality of care in the PHC sector remains poor.^{298,375}

Second, hospitals remain dominant in resource allocation and health service provision after the reforms,^{298,306,374} and lack motivation to coordinate with the PHC sector. During 2013-2017, governmental subsidies for public hospitals increased by 83.8% and reached 2,738 billion (Chinese Yuan, 408.85 USD), while those for PHC facilities were 70.7% and 1,808 billion³⁸⁷. Meanwhile, hospitals remain pressured to compete with PHC facilities for market share and health service incomes (discussed in [Chapter 7](#)).

Third, the PHC sector remains under-resourced and provides poor-quality care.^{252,337} Lower salaries, heavy workloads, inappropriate training of PHC workforces¹⁸⁷, and poor working environments and career opportunities had adverse impacts on recruiting the PHC workforce¹⁸⁸ and their motivation for quality improvement.

The demand-side barriers to shifting away from hospital domination are not addressed. For instance, people have low trust in primary care providers and strong preference towards hospitals.^{264,376,378} Poor doctor-patient relationships can often be found in PHC settings^{185,378}. Even worse, the unsolved issues of the PHC sector mentioned above can reinforce these perceptions and further drive people away from PHC facilities.

These long-established characteristics of China's health system and health service users were not changed in a systematic, major way and could prohibit a further shift away from hospital domination.

8.2.3 Limited financial protection and general health improvements

The limited reform impact on financial protection is disappointing. More concerning, hospital costs for outpatient care and drugs increased, so did OOPes for middle-aged and the older populations. This finding is expected. In 2017, governmental expenditures only contributed 44.2% of the total incomes of PHC facilities³⁸⁷. Without sufficient funds for PHC facilities, they have to top up their income through health service provision. The increased OOPes could stem from three sources: The gatekeeping policy introduced a lower reimbursement rate for hospital visits. Meanwhile, hospitals increased their service charge to compensate for the lost income from drug mark-ups. For the demand side, overuse or inappropriate use of primary care services was prevalent and could result in unnecessary health expenses.

The systematic review in [Chapter 4](#) found some consistent evidence on health improvement among people with NCDs after the reforms. Similarly, the two

evaluation studies in [Chapter 6](#) and [Chapter 7](#) also found improvements in maternal mortality and self-reported health among middle-aged and elderly populations. These health improvements are not surprising given that this project found increased use of maternal care and increased primary care utilisation among the middle-aged and older people.

However, this project does not find significant reform impacts on general visits to PHC facilities or all-cause mortality. These findings suggest that the impacts of China's PHC reform on health improvement might be confined to high-risk populations but made little progress in delivering health benefits to border populations. However, the measurements of primary care utilisation and health status of general populations used in this project have limitations (discussed below). It is possible that these potential changes are not picked up by the analyses in this project due to the data limitations. Outside the health system, unaddressed societal barriers can also prevent health improvements among general populations, such as inconvenient transportation^{261,352,371,372,375}

8.2.4 Relevance and generalisability to literature in LMICs

The wider literature on PHC reforms in LMIC was reviewed in [Chapter 1](#). It identified several key evidence gaps: lack of evidence from Asia, robust studies, and evidence on comprehensive reforms. This project fills some of these evidence gaps with evidence from China.

This project adds to the evidence on comprehensive PHC reforms from an Asian country and reaffirms the positive role of PHC reforms in increasing equitable use of essential health services and improving health. The increased equitable use of primary care (e.g. care for RMNCH) aligns with two previous reviews in LMICs by Macinko et al.¹³² and Kruk et.al³⁹, respectively. The reduced MMR found in this project is consistent with those from HICs^{388,389} and LMICs¹³², such as Bangladesh¹³², Mexico⁷⁹ and Iran⁷³. Two LMIC-based systematic reviews underline some potential effective PHC interventions for reducing MMR, including expansion of

home visiting, health education and counselling, and essential newborn care.^{72,75} These findings from LMICs and this project suggest that increasing the accessibility and utilisation of these essential primary care can be a potential pathway of PHC reforms to improved health.

The increased equitable access to essential primary care found in this project and other LMICs also underlines the pivotal role of financing in reducing inequalities. The essential care mentioned in the previous paragraph was typically delivered as a defined package, financed by government health budgets, and provided for free/at a reduced charge across populations in LMICs (discussed in [Chapter 1](#)). By purchasing these services collectively, governments pooled the funds to address some shared health risks and realise effective health management across populations^{390,391}. The free provision effectively eliminates people's financial barriers to accessing these services. Providers are typically paid through capitation payments, which incentive them to expand the coverage of essential primary care.

This project also reiterates some common challenges for PHC in LMICs discussed in [Chapter 1](#), including insufficient and fragmented financing, lack of skilful workforce, poor quality care, persistent health inequalities, and inadequate data. These interconnected challenges underscore the urgent need for system-wide, holistic PHC reforms in LMICs.

Financial challenges are fundamental to PHC reforms in LMICs. The study by Hanson et al. in 2022 shows that PHC sectors in LMICs remain heavily dependent on OOPes⁴¹. Therefore, it is not surprising that the PHC reforms in LMICs had limited financial risk protections. In addition to a lack of sufficient funds, the financing strategy of PHC in LMICs lack of incentives for cost-effectiveness and quality improvements.³⁹²

Poor-quality care can hinder the effectiveness of PHC reforms in LMICs, explaining the missing improvements in population health and health equity. Poor-quality care is typically a result of multiple dysfunctional building blocks of a health system, such as the absence of quality-oriented payments, under-trained PHC professionals, and

fragmented service delivery (discussed in [Chapter 1](#)). The integration level of essential care is low in LMICs^{49,125}, and the referral systems remain fragmented^{393,394}. There is a general lack of quality-oriented payment mechanisms in PHC in LMICs.³⁹⁵

As stated by the OECD, “there is no access to care without strong quality”.³⁹⁰ Kruk et al. also note that UHC as a strategy for health improvement is contingent on quality care in LMICs⁵⁷. In 2016, 5.0 million excess deaths (58.1% of the total excess deaths) were due to poor quality of care⁵⁷. For LMICs with better access to health care, quality of care is a more evident factor in bridging UHC and better health outcomes³⁴¹. Without system-wide actions on these various building blocks, quality improvement cannot be guaranteed.²⁶ Without high-quality care, PHC reforms in LMICs cannot realise their full potential in improving population health and health equity³⁹⁰.

Inadequate PHC data prevent in-depth examinations of reform mechanisms, such as effective levellers^{43,256}, ineffective policy designs, or patchy implementation³⁹⁶. A systematic review by Das finds that P4P is an effective strategy to improve the quality of prenatal care in LMICs, but its pathways are unclear.¹⁰⁴ Previous studies from LMICs show that appropriate digital information systems and measurement tools can help decision making and improve the coverage and quality of care^{133,390}. However, LMICs acutely lack of such information systems and actionable indicators, preventing evidence-based decision-making.^{57,58,390} The success of PHC reforms in LMICs needs actions to address this crucial policy gap.

This project also highlights some specific challenges of PHC strengthening in hospital-centric health systems. This project found limited changes in hospital domination in China after the reforms. This finding is similar to evidence from Turkey³⁶⁴ and Brazil³⁶⁵. Although government investments in PHC sectors increased in some hospital-centric health systems in LMICs, this increase still lagged behind those for hospital sectors^{306,364}. These studies underline the importance of a holistic approach and understanding wider health systems beyond PHC sectors.

Beyond health systems, demand-side drivers can also affect the outcomes of PHC reforms (shown in [Figure 1](#)). People's low trust and poor perception of primary care providers can result in bypassing PHC sectors.^{43,371} Redefining and reigniting people's perceptions and trusts of primary care providers can dignify PHC professionals³⁹⁷, increase the use of primary care services, and attract incomes for PHC sectors⁴¹. Additionally, people's health literacy level and awareness of the policies could affect their health-seeking behaviours,^{281,398} moderating the reform outcomes.

8.3 Limitations and future work

Limitations of the three original studies were discussed in detail in [Chapter 4](#), [Chapter 6](#), and [Chapter 7](#), respectively. This section discusses the limitations of this PhD project, paving the way for key areas of future research.

First, conceptualising comprehensive reforms as a whole is a trade-off between accounting for the synergetic impacts and closer examinations of policy mechanisms. While this project assesses the overall impacts of the comprehensive PHC reforms, the contribution of each policy component to the observed synergetic impacts and their interaction have yet to be known. Unveiling this 'black box' can better inform future PHC strengthening in China and other LMICs.

Second, the impacts of co-occurrent health reforms on the broader health system cannot be ruled out, likely confounding the true reform impacts. The PHC reforms were part of a broader health reform, and this project focused on its PHC-related elements. The public hospital reforms during the similar periods (mentioned in [Chapter 2](#)) could have indirect impacts on the assessed outcomes. Future research should aim to better identify and isolate these confounding impacts.

Third, imprecise reform implementation remains, even though this project for the first time identified the reform implementation at the city level. Policies like gatekeeping and family physician scheme are not mandatory, and the individual-level exposure to

these policies is unknown. Whether individuals adhered to these policies and to what extent need future research to identify patchy implementations. Additionally, the project does not investigate the implementation variations of the reforms at the city level due to the unavailability of such information (e.g., intensity of or deviations from the planned reforms). However, such information is valuable for distinguishing patch implementations with ineffective policy designs. The implementation variations also allow a more in-depth investigation on how the reform effects could vary with these variable implementations. These knowledge gaps can be explored by future research at subnational level.

Fourth, this project is subject to the limitations of using secondary data, such as the survey data and administrative records. These data are not specifically designed and collected to answer the research questions for this project, restraining the scope and depth of this project. For instance, primary care utilisation in a longer time span, avoidable hospitalisation, cause-specific mortality are sensitive measurements for changes in both the quantity and quality of primary care^{255,278}. However, these indicators were not examined in this project due to the data availability. Similarly, important aspects of care quality and PHC performance, such as efficiency, appropriateness, responsiveness, continuousness, or user satisfaction, were not assessed. These missed indicators are key to identify the pathways and barriers between primary care and ultimate health goals. Future studies should scrutinise the reforms with more comprehensive and sensitive measurements for health system performance and health outcomes.

Last, whilst this project employed robust quantitative methods to evaluate the reforms, no qualitative study was done, except for the systematic review. Compared with quantitative health research, qualitative research can better narrate and explain how and why of policies and phenomena³⁹⁹. Qualitative research is also a significant approach to incorporate variable perspectives of patients and the public, which is increasingly expected in health research.⁴⁰⁰ Interviews with health service users, policy makers, care providers, and stakeholders would be particularly useful for this project to illuminate the nuances of the reform implementation across China. Such

qualitative data can help identify effective levers for the observed reform effects and, equally important, the obstacles behind the missing goals.

8.4 Strengths

The review of PHC reforms in LMICs in [Chapter 1](#) and the systematic review in [Chapter 4](#) highlighted various methodological flaws in the existing studies, including a lack of rigorous studies, evidence from Asia and understudied comprehensive reforms. Some of these limitations are addressed in this project.

First, this project provides a comprehensive picture of the effectiveness of China's PHC reforms based on both existing studies and new evidence from this project. It provides robust nationwide evidence of the reform impacts on various outcomes related to the health system, health outcomes, and health equity. Comprehensive PHC reforms in LMICs is a relatively underexplored area, and evaluations on China's PHC reforms are primarily based on megacities in eastern regions^{226,228,366,367}. Prior to this project, there was no synthesised evidence on the reform impacts of health service utilisation or health outcomes. The heterogeneous reform impacts across population groups and regions have also been largely overlooked.

Second, this project fills the evidence gaps in PHC research in Asia⁴³. Despite the value of cross-country studies in monitoring global efforts in PHC strengthening, it is equally important to study country-specific PHC reforms and their subnational implementation. Effective PHC strengthening approaches are not “one-size-fits-all” and necessitate better knowledge of on the contextual complexity in reform implementations and effectiveness. This project adds country-specific knowledge on the impacts of PHC strengthening under the cultural and socioeconomic context of China.

This project employed rigorous evaluation methods and placebo outcomes to address potential bias from heterogeneous reform effects with the staggered implementation. The CS-DiD method allows adjusting for time-varying and

unobservable time-invariant confounders, a remarkable advantage inherit from the traditional DiD method. It also addressed the potential biases raised from the unknown weighting scheme of traditional TWFE methods. This project also performed various sensitive analyses to test the endogeneity of the reforms. The reform impacts were assessed using both aggregated and individual data, addressing the potential ecological fallacy to some extent.

This PhD project consists of three-subprojects using different data source and methodologies to comprehensively evaluate the reforms. This project systematically reviewed existing studies on the reforms. With a focus on the identified evidence gaps, the project further assessed the reform impacts on the supply and utilisation of primary care services and health outcomes. By joining the three original studies, this project investigated multiple aspects of health systems mapped out in the theoretic framework in [Chapter 1 \(Figure 1\)](#), adding to the richness of the findings.

8.5 Policy implications

This project re-affirms the pivotal role of PHC reforms in promoting equitable access to essential health services with evidence from China. LMICs are in different positions in the progress of achieving UHC and have different policy priorities. Some LMICs emphasise on laying the foundations of their PHC systems and increasing service coverage. Meanwhile, some other LMICs, like China, aim to shift their overused, low-efficient hospital-centric health systems to a PHC-oriented one. The latter LMICs are often middle-income countries that already achieved a relatively high level of UHC, but this progress has slowed down, and inequalities remain substantial². The consistent evidence from China and other LMICs suggests that LMICs should continue PHC strengthening regardless of their stage of UHC.

This project also underscores that the current progress in expanding partial gatekeeping and primary care is insufficient for a fundamental shift away from hospital domination, system-wide changes that sustain, or health improvements for all populations. Several building blocks can be further enhanced to facilitate comprehensive PHC reforms in China and other LMICs.

First, PHC strengthening needs an overarching governance framework led by top-level policy makers and stronger accountability and cross-ministry level collaborations²⁵⁴. An overarching PHC governance framework can ensure strong and forceful policies and encourage horizontal collaborations. Such governance framework holds both government and healthcare providers accountable, alleviating administrative costs for reform implementation.^{254,376} It also enables responsive decision-making, which allows reforms to quickly adapt to the identified barriers and bottlenecks in the local context during the implementation.^{25,401}

Second, PHC reforms in LMICs need more public funds and equity- and quality-oriented payment mechanisms. Such mechanisms are important for improvements in financial risk protection and the performance of PHC sectors. More public funding is needed for underfunded PHC sectors globally to reduce the reliance on OOPs⁴¹. In addition to increasing PHC funds, policy makers in LMICs should proactively explore financial strategies to better reach those who need the most. For instance, equity-oriented payment methods, such as capitation, free vouchers, or a blend, can ensure reaching vulnerable and marginalised groups and those who need health services the most.^{41,196} Adjusting these financial strategies based on local demographical and socioeconomic development levels is also key. This customisation can better reach those with the greatest health needs and vulnerable groups. Additionally, quality-oriented incentives and payment methods are needed to motivate primary care providers to deliver quality care and improve quality of care.

Third, stronger regulation on gatekeeping is needed to further shift people's utilisation away from hospitals, and quality improvements must not be left out. As mentioned above, a sole increase in utilisation without quality improvements is underpowered to improve health or health equity. Whilst forceful gatekeeping can improve the underuse of primary care providers, the poor-quality of care could worsen people's experiences and perception of PHC sectors and their relationship with PHC professionals. A weak PHC system cannot deliver high-quality care or improve people's perception of primary care services. High-quality primary care can be achieved via workforce training, quality-oriented incentives and performance measurements. Investments to improve primary care quality are also needed to

attract skilled health professionals, deliver cost-effective improvements in health outcomes, and increase the desirability of services for patients. Investments in healthcare professionals through training and medical education are key to this. High-quality care is pivotal to the achievement of a strong PHC that can benefit the health for all populations.

Fourth, an integrated, standardised, and transparent data system should be established and made available for researchers. Such information system is crucial for effective monitoring and evaluations. In-depth, frequently-updated data and systematic collection are needed to better monitor health system performance, identify unexpected policy outcomes, and hold governments and providers accountable.^{20,25,390,401} With adequate real-life data and systematic collocation, we can better distinguish between patchy implementation and ineffective policy designs, identify facilitators, barriers, and unexpected outcomes, and ascertain the reform mechanisms.^{390,401} Adequate data and measurement tools can help investigate the identified evidence gaps in the reform mechanisms in this project, informing evidence-based policy making in LMICs.

Fifth, a holistic perspective is crucial for PHC reforms in LMICs and understanding reform mechanisms. There have been an increasing recognition of the importance of building strong PHC via a holistic approach.^{390,402} This project shows how PHC reforms were implemented in a hospital-centric health system. Hospital domination underlies the resource allocation and service delivery in China, which could moderate the reform effects. Future PHC reforms should take into account the role of hospitals in PHC strengthening⁴⁰³ and address any imbalance between the two sectors. Fragmented health service delivery in LMICs also needs a holistic, integrated view to link the PHC and hospital sectors. China's PHC reforms explored some innovative vertical integration between the two sectors. For instance, the medical alliance was a holistic approach to addressing the fragmented and unequal delivery system between the hospital and PHC sectors, and promoting coordination and continuous care.

Last, policy makers need to consider wider health systems and beyond. Comprehensive reforms can be complicated by diverse interests from different stakeholders, the interconnected parts of the health system, and its path dependency on hospitals and specialised care. Additionally, these reforms should better engage the demand side's perspectives. For instance, actions are needed to gain people's familiarity and trust to PHC sectors, to alter people's pro-hospital health-seeking behaviours. Identifying these enablers and barriers outside health systems is beneficial for the ongoing reforms to make timely and evidence-based adjustments.

The findings from this project have important implications for comprehensive PHC reform in LMICs, particularly for those middle-income countries with hospital-centric health systems representing overuse and low-efficiency that wanted to shift to a PHC-oriented one.

8.6 Conclusions

PHC is the most effective and efficient approach to achieving UCH and SDGs. However, evidence of PHC reforms in LMICs has been lack of rigorous study designs, understanding of comprehensive reforms and evidence from Asia. This project systematically reviews existing evidence on China's comprehensive PHC reforms since 2009. Building upon the identified evidence gaps and methodological challenges, the project performed two quasi-experimental studies on the second round of the reforms using individual and aggregated data.

The existing evidence and findings from this project show that China's ambitious PHC reform since 2009 has increased primary care utilisation and disproportionately benefited high-risk (pregnant women or middle-aged and elderly population) or vulnerable groups (i.e., the poor and rural populations) and under-resourced regions (low-HDI provinces and western China). However, China's health system has remained hospital-centric and seen little progress in improving financial protection or population health.

This project has important policy implications for policy makers in China and other LMICs. The PHC approach is effective to increase equitable use of primary care services. However, for the optimal success of health improvements and equity, PHC reforms in LMICs need stronger cross-department governance, shifts away from hospital domination, more and equity-oriented PHC financing, adequate health information systems, quality improvements, and multisectoral efforts beyond health systems.

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Appendix 1

Appendix 1 includes supplement materials for Chapter 4.

1. PRISMA checklist



PRISMA 2020 Checklist

Section and Topic	Item	Checklist item	Whether reported
TITLE			
Title	1	Identify the report as a systematic review.	Yes
INTRODUCTION			
Rationale	3	Describe the rationale for the review in the context of existing knowledge.	Yes
Objectives	4	Provide an explicit statement of the objective(s) or question(s) the review addresses.	Yes
METHODS			
Eligibility criteria	5	Specify the inclusion and exclusion criteria for the review and how studies were grouped for the syntheses.	Yes
Information sources	6	Specify all databases, registers, websites, organisations, reference lists and other sources searched or consulted to identify studies. Specify the date when each source was last searched or consulted.	Yes
Search strategy	7	Present the full search strategies for all databases, registers and websites, including any filters and limits used.	Yes
Selection process	8	Specify the methods used to decide whether a study met the inclusion criteria of the review, including how many reviewers screened each record and each report retrieved, whether they worked independently, and if applicable, details of automation tools used in the process.	Yes
Data collection process	9	Specify the methods used to collect data from reports, including how many reviewers collected data from each report, whether they worked independently, any processes for obtaining or confirming data from study investigators, and if applicable, details of automation tools used in the process.	Yes
Data items	10a	List and define all outcomes for which data were sought. Specify whether all results that were compatible with each outcome domain in each study were sought (e.g. for all measures, time points, analyses), and if not, the methods used to decide which results to collect.	Yes

Section and Topic	Item	Checklist item	Whether reported
	10b	List and define all other variables for which data were sought (e.g. participant and intervention characteristics, funding sources). Describe any assumptions made about any missing or unclear information.	Yes
Study risk of bias assessment	11	Specify the methods used to assess risk of bias in the included studies, including details of the tool(s) used, how many reviewers assessed each study and whether they worked independently, and if applicable, details of automation tools used in the process.	Yes
Effect measures	12	Specify for each outcome the effect measure(s) (e.g. risk ratio, mean difference) used in the synthesis or presentation of results.	Yes
Synthesis methods	13a	Describe the processes used to decide which studies were eligible for each synthesis (e.g. tabulating the study intervention characteristics and comparing against the planned groups for each synthesis (item 5)).	Yes
	13b	Describe any methods required to prepare the data for presentation or synthesis, such as handling of missing summary statistics, or data conversions.	Yes
	13c	Describe any methods used to tabulate or visually display results of individual studies and syntheses.	Yes
	13d	Describe any methods used to synthesize results and provide a rationale for the choice(s). If meta-analysis was performed, describe the model(s), method(s) to identify the presence and extent of statistical heterogeneity, and software package(s) used.	Yes
	13e	Describe any methods used to explore possible causes of heterogeneity among study results (e.g. subgroup analysis, meta-regression).	Yes
	13f	Describe any sensitivity analyses conducted to assess robustness of the synthesized results.	Yes
Reporting bias assessment	14	Describe any methods used to assess risk of bias due to missing results in a synthesis (arising from reporting biases).	NA
Certainty assessment	15	Describe any methods used to assess certainty (or confidence) in the body of evidence for an outcome.	NA
RESULTS			
Study selection	16a	Describe the results of the search and selection process, from the number of records identified in the search to the number of studies included in the review, ideally using a flow diagram.	Yes
	16b	Cite studies that might appear to meet the inclusion criteria, but which were excluded, and explain why they were excluded.	Yes
Study characteristics	17	Cite each included study and present its characteristics.	Yes
Risk of bias in studies	18	Present assessments of risk of bias for each included study.	Yes
Results of individual studies	19	For all outcomes, present, for each study: (a) summary statistics for each group (where appropriate) and (b) an effect estimate and its precision (e.g. confidence/credible interval), ideally using structured tables or plots.	Yes

Section and Topic	Item	Checklist item	Whether reported
Results of syntheses	20a	For each synthesis, briefly summarise the characteristics and risk of bias among contributing studies.	Yes
	20b	Present results of all statistical syntheses conducted. If meta-analysis was done, present for each the summary estimate and its precision (e.g. confidence/credible interval) and measures of statistical heterogeneity. If comparing groups, describe the direction of the effect.	Yes
	20c	Present results of all investigations of possible causes of heterogeneity among study results.	Yes
	20d	Present results of all sensitivity analyses conducted to assess the robustness of the synthesized results.	NA
Reporting biases	21	Present assessments of risk of bias due to missing results (arising from reporting biases) for each synthesis assessed.	NA
Certainty of evidence	22	Present assessments of certainty (or confidence) in the body of evidence for each outcome assessed.	NA
DISCUSSION			
Discussion	23a	Provide a general interpretation of the results in the context of other evidence.	Yes
	23b	Discuss any limitations of the evidence included in the review.	Yes
	23c	Discuss any limitations of the review processes used.	Yes
	23d	Discuss implications of the results for practice, policy, and future research.	Yes
OTHER INFORMATION			
Registration and protocol	24a	Provide registration information for the review, including register name and registration number, or state that the review was not registered.	Yes
	24b	Indicate where the review protocol can be accessed, or state that a protocol was not prepared.	Yes
	24c	Describe and explain any amendments to information provided at registration or in the protocol.	Yes
Support	25	Describe sources of financial or non-financial support for the review, and the role of the funders or sponsors in the review.	Yes
Competing interests	26	Declare any competing interests of review authors.	Yes
Availability of data, code and other materials	27	Report which of the following are publicly available and where they can be found: template data collection forms; data extracted from included studies; data used for all analyses; analytic code; any other materials used in the review.	Yes

Table 1 PRISMA checklist for the systematic review

Source: author's own work.

Domains	Number	Keywords
Primary health care	1	“primary health care”[Title/Abstract] OR “primary care”[Title/Abstract] OR “primary health*”[Title/Abstract] OR “primary medical care”[Title/Abstract] OR “PHC”[Title/Abstract] OR “primary health service*”[Title/Abstract] OR “primary level care”[Title/Abstract] OR “primary-level care”[Title/Abstract] OR “primary level facilit*”[Title/Abstract] OR “primary-level facilit*”[Title/Abstract] OR “primary practice*”[Title/Abstract] OR “community care” [Title/Abstract] OR “community health*” [Title/Abstract] OR “village clinic” [Title/Abstract] OR “township health*” [Title/Abstract] OR “outpatient care” [Title/Abstract] OR “out-patient care”[Title/Abstract] OR “outpatient*” [Title/Abstract] OR “home care” [Title/Abstract] OR “basic medical care” [Title/Abstract] OR “basic healthcare” [Title/Abstract] OR “basic health care” [Title/Abstract] OR “basic health service*” [Title/Abstract] OR “home healthcare”[Title/Abstract] OR “home care” [Title/Abstract] OR “home-care” [Title/Abstract] OR “home healthcare” [Title/Abstract] OR “home health care” [Title/Abstract] OR “ambulatory care” [Title/Abstract] OR “ambulatory medical*”[Title/Abstract] OR “ambulatory health*”[Title/Abstract] OR “ambulatory service*”[Title/Abstract] OR “ambulatory facilit*”[Title/Abstract] OR “ambulatory center*”[Title/Abstract] OR “ambulatory centre*”[Title/Abstract] OR “ambulatory patient*”[Title/Abstract] OR “ambulatory practice*”[Title/Abstract] OR “primary health care” [Mesh] OR "Ambulatory Care"[Mesh] OR "Community Health Nursing"[Mesh] OR "Ambulatory Care Facilities"[Mesh] OR "Primary Care Nursing"[Mesh] OR "Home Care Services"[Mesh] OR "Community Medicine"[Mesh] OR "Community Health Services"[Mesh] OR "Continuity of Patient Care"[Mesh]
General Practice	2	“family physician” [Title/Abstract] OR “family practice”[Title/Abstract] OR “family care” [Title/Abstract] OR “family medic*” [Title/Abstract] OR “general practice” [Title/Abstract] OR “general practitioner*”[Title/Abstract] OR “family doctor*” [Title/Abstract] OR “contract*” [Title/Abstract] OR “GP” [Title/Abstract] OR “GPs” [Title/Abstract] OR “usual source of care” [Title/Abstract] OR "Home Care Services"[Mesh] OR "General Practice"[Mesh] OR "General Practitioners"[Mesh] OR "Physicians, Primary Care"[Mesh] OR "Nurses, Community Health"[Mesh] OR "Family Nurse Practitioners"[Mesh] OR "Physicians, Family"[Mesh] OR "Family Practice"[Mesh]
Interventions	3	reform*[Title] OR evaluat*[Title] OR intervention*[Title] OR polic*[Title] OR pilot*[Title] OR project*[Title] OR program*[Title] OR strateg*[Title] OR scheme*[Title] OR impact*[Title] OR effect*[Title] OR assess*[Title] OR affect*[Title] OR influenc*[Title] OR plan*[Title] OR "new rural cooperative" [Title/Abstract] OR "cooperative medical scheme" [Title/Abstract] OR "NRCMS" [Title/Abstract] OR "NCMS" [Title/Abstract] OR "urban resident basic medical insurance" [Title/Abstract] OR "urban employee basic medical insurance scheme" [Title/Abstract] OR "UEBMI" [Title/Abstract] OR "URBMI" [Title/Abstract] OR "URRMI" OR "Health Policy"[Mesh] OR "Health Planning"[Mesh] OR "Health Care Reform"[Mesh] OR "Evaluation Studies as Topic"[Mesh] OR "Program Evaluation"[Mesh] OR "Health Care Quality, Access, and Evaluation"[Mesh]

Location	4	"China" [Title/Abstract] OR "People's Republic of China" [Title/Abstract] OR "PRC" [Title/Abstract] OR "Chinese" [Title/Abstract] OR "China"[Mesh]
Limits	5	Time: 2009/01/01 – the date of search
	6	1 OR 2
	7	6 AND 3
	8	7 AND 4
	9	8 AND 5

STable 2 Search strategy for MEDLINE (via PubMed)

Source: author's own work.

Domains	Number	Keywords
Primary health care	1*	TI = (初级医疗 + 初级保健 + 初级卫生 + 基层医疗 + 基层卫生 + 基层保健 + 社区医疗 + 社区卫生 + 乡村医疗 + 乡村卫生 + 乡镇卫生中心 + 乡镇卫生院 + 村卫生室 + 家庭医生 + 全科医生)
Referral system and gatekeeping	2	1* AND TI = (分级诊疗 + 分级医疗 + 双向转诊 + 基层首诊 + 社区首诊 + 门诊统筹 + 急慢分治 + 转诊 + 医疗资源下沉 + 分工) [done:354]
System integration	3	1* AND 医联体 + 医疗联合体 + 医共体 + 县域一体化 + 县域分级 + 对口支援 + 医改 + 改革
Financing	4	1* AND 经费 + 资金 + 财政 + 支出 + 收入 + 收支 + 补偿 + 拨款 + 拨付 + 预付 + 资源配置 + 医疗资源
Medication	5	1* AND 药品零差 + 药品零加成 + 药品加成 + 基本药物 + 基药 + 药品供应 + 药品定价 + 药政 + 药品管理 + 集中采购
Information	6	1* AND 健康档案 + 数据 + 信息系统 + 信息技术 + 电子病历 + 一卡通
Workforce	7	1* AND 人力资源 + 人员流动 + 薪酬 + 激励 + 职业发展 + 职业规划 + 培训 + 技能 + 人员能力 + 教育 + 轮转 + 绩效 + 工资制 + 聘用制
Insurance	8	1* AND 医保 + 保险 + 自付 + 个人筹资 + 总额预算 + 总额预付 + 条目预算 + 预付 + 后付 + 报销 + 新农合 + 新型农村合作医疗 + 封顶 + 起付 + 救助 + 临床路径 + 按人头 + 按项目支付 + 按病种 + 病历支付 + 支付方式 + 支付制度 + 支付体系 + 支付方法
Financial protection	9	1* AND 医疗费用 + 诊疗费用 + 费用负担 + 经济负担 + 医疗支出 + 医疗负担
Quality	10	1* AND 医疗质量 + 服务质量 + 患者满意 + 满意度 + 患者态度 + 用药合理性 + 合理用药 + 医疗安全 + 服务效率 + 依从性 + 循证 + 同质 + 医疗可及性 + 服务可及性 + 就医行为 + 医疗服务利用 + 医疗服务使用 + 以人为本 + 以病人为中心 + 连续性 + 持续性 + 连贯性 + 公平 + 平等

Health outcomes	11	1* AND 健康状况 + 自评健康 + 健康水平 + 人口健康 + 健康不平等 + 健康促进
Limits	12	Time: 2009/01/01 to the date of search
	13	2 AND 12
	14	3 AND 12
	15	4 AND 12
	16	5 AND 12
	17	6 AND 12
	18	7 AND 12
	19	8 AND 12
	20	9 AND 12
	21	10 AND 12
	22	11 AND 12

STable 3 Search strategy for CNKI

Source: author's own work

Study No	Author and Year	Confounding	Selection of participants	Classification of interventions	Deviations from intended interventions	Missing data	Measurement of outcomes	Selection of the reported result	Overall
1	He, 2014	Moderate - potential for co-intervention	Low	Low	No info	No info	Low	Low	Moderate
2	Zhu, 2017	Serious - substantial baseline difference among participants in the two groups	Low	Low	No info	Low	Moderate - All outcome variables were self-reported, and participants were aware of the treatment	Low	Serious
3	Han, 2016	Moderate - potential for baseline difference and co-intervention	Low	Low	No info	No info	Low	Low	Moderate
4	Ma, 2014	Moderate - potential for co-intervention	Low	Low	No info	No info	Low	Low	Moderate
5	Wang, 2014	Moderate - potential for baseline difference and co-intervention	Low	Low	No info	No info	Low	Low	Moderate
6	Chen, 2013	Serious - baseline difference was not controlled and potential for co-intervention	Low	Low	No info	No info	Moderate - data were collected via institutional questionnaire and participated institutions were aware of the treatment.	Low	Serious

Study No	Author and Year	Confounding	Selection of participants	Classification of interventions	Deviations from intended interventions	Missing data	Measurement of outcomes	Selection of the reported result	Overall
7	Li, 2012	Serious - baseline difference was not controlled and potential for co-intervention	Low	Low	No info	No info	Low	Low	Serious
8	Duan, 2020	Moderate - potential for baseline difference	Low	Low	No info	Moderate - the distribution of missing data was unclear	Low	Low	Moderate
9	Tan, 2015	Serious - potential for baseline difference, which also affected treatment assignment.	Low	Low	No info	No info	Moderate - data were collected via questionnaire and participants were aware of the treatment.	Low	Serious
10	Jin, 2013	Serious - baseline difference was not controlled	Low	Low	No info	Low	Low	Low	Serious
11	Chen, 2014	Moderate - potential for co-intervention.	Low	Low	No info	Low	Low	Low	Moderate
12	Ding, 2015	Low	Low	Low	No info	Low	Low	Low	Low

Study No	Author and Year	Confounding	Selection of participants	Classification of interventions	Deviations from intended interventions	Missing data	Measurement of outcomes	Selection of the reported result	Overall
13	Gong, 2016	Low	Low	Low	No info	No info	Low	Low	Low
14	Jiang, 2016	Serious - substantial difference at baseline characteristics and potential uncontrolled self-selection bias.	Low	Moderate - the treatment received or not and the time of receiving were self-reported	Low	Low	Moderate - Outcome were subjective and participants were aware of the treatment.	Low	Serious
15	Liang, 2014	Moderate - baseline characteristics for the two groups were not described.	Low	Low	Low	Moderate - substantial missing data from pre-trending in the intervention group	Low	Moderate - The results for subgroups were not reported	Moderate
16	Liu, 2014	Serious - substantial baseline difference across the groups. Failed to separate the time trend of the outcomes.	Low	Low	Low	Moderate - a substantial amount of data on satisfaction score were missing.	Moderate -Outcome were subjective and participants were aware of the treatment.	Moderate - the study did not clearly stage what outcome variables will be assess in the method session	Serious
17	Shen, 2020a	Low	Low	Low	Low	Low	Low	Low	Low

Study No	Author and Year	Confounding	Selection of participants	Classification of interventions	Deviations from intended interventions	Missing data	Measurement of outcomes	Selection of the reported result	Overall
18	Sun, 2016a	Moderate - Potential for co-intervention.	Low	Low	Low	Serious - large number of cases with pre-intervention data were excluded	Serious - The measurements of outcome were inconsistent and pre- and post-intervention data were from data resources.	Low	Serious
19	Tang, 2018	Moderate - Potential baseline confounding	Low	Low	Low	No info	Moderate - The outliers suggested potential measure bias.	Low	Moderate
20	Wei, 2015	Moderate - Potential for baseline difference., and pre-intervention trend was not tested	Low	Low	No info	Low	Moderate - Outcome were subjective and participants were aware of the treatment.	Low	Moderate
21	Xu, 2020	Low	Low	Low	Low	Low	Low	Low	Low
22	Yang, 2017	Low	Low	Low	No info	Low	Low	Low	Low
23	Yang, 2013	Moderate - potential bias on treatment assignment.	Low	Low	Low	No info	Low	Moderate - results from statistic tests were not presented	Moderate

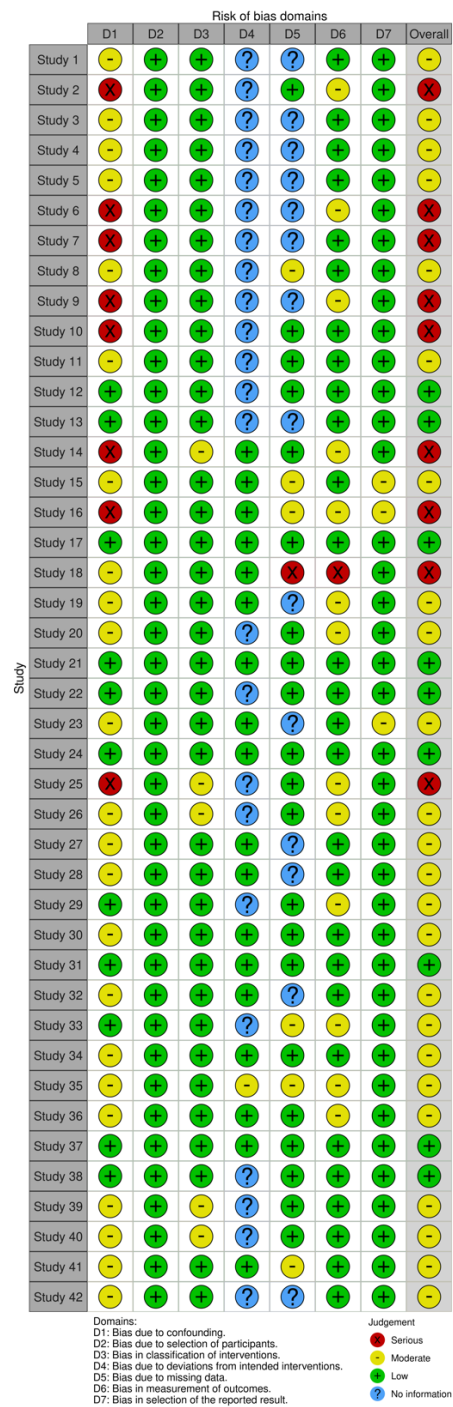
Study No	Author and Year	Confounding	Selection of participants	Classification of interventions	Deviations from intended interventions	Missing data	Measurement of outcomes	Selection of the reported result	Overall
24	Yao, 2020	Low	Low	Low	Low	Low	Low	Low	Low
25	Yin, 2016	Serious - substantial baseline difference. No control of time-varying confounding.	Low	Moderate - Based on the location of the participants, less accurate.	No info	Low	Moderate - Outcome were subjective and participants were aware of the treatment.	Low	Serious
26	Zhang, 2017	Moderate - Potential for baseline difference.	Low	Moderate - Based on retrospective questions from the survey	No info	Low	Moderate - possible recall bias on medication uses and BP monitoring	Low	Moderate
27	Zhang, 2014a	Moderate - Potential for baseline difference.	Low	Low	Low	No info	Low	Low	Moderate
28	Zhang, 2014b	Moderate - Potential of co-intervention	Low	Low	Low	No info	Low	Low	Moderate
29	Zhou, 2021	Low	Low	Low	No info	Low	Moderate - Outcome were subjective and participants were aware of the treatment.	Low	Moderate
30	Miao, 2019	Moderate - Outcome variable was used in PSM.	Low	Low	Low	Low	Low	Low	Moderate

Study No	Author and Year	Confounding	Selection of participants	Classification of interventions	Deviations from intended interventions	Missing data	Measurement of outcomes	Selection of the reported result	Overall
31	Powell-Jackson, 2015	Low	Low	Low	Low	Low	Low	Low	Low
32	Shen, 2020b	Moderate - potential baseline difference	Low	Low	Low	No info	Low	Low	Moderate
33	Yi, 2015	Low	Low	Low	No info	Moderate - substantial missing data	Moderate - the study reported falsified health service records.	Low	Moderate
34	Miao, 2018	Moderate - potential baseline difference, time-varying confounding, and bias from co-intervention	Low	Low	Low	Low	Low	Low	Moderate
35	Sun, 2016b	Moderate - potential baseline difference	Low	Low	Moderate – one treatment group switched to a treatment group different from the original plan	Moderate - substantial missing data on post-intervention periods	Moderate - Outcome were subjective and participants were aware of the treatment.	Low	Moderate
36	Miao, 2016	Moderate - potential baseline difference	Low	Low	Low	Low	Moderate - Outcome were subjective and participants were aware of the treatment.	Low	Moderate

Study No	Author and Year	Confounding	Selection of participants	Classification of interventions	Deviations from intended interventions	Missing data	Measurement of outcomes	Selection of the reported result	Overall
37	Liu, 2016	Low	Low	Low	Low	Low	Low	Low	Low
38	Hu, 2021	Low	Low	Low	No info	Low	Low	Low	Low
39	Wang, 2022	Moderate - potential bias from co-intervention	Low	Moderate – potential cut-off point inaccuracy	No info	Low	Low	Low	Moderate
40	Yuan, 2021	Moderate - potential baseline difference	Low	Moderate - how the intervention was identified were not well-described	No info	Low	Low	Low	Moderate
41	Shen, 2021	Moderate - potential bias from co-intervention	Low	Low	Low	Moderate - cases with missing values were excluded	Low	Low	Moderate
42	Pan, 2022	Moderate - potential baseline difference	Low	Low	No info	No info	Low	Low	Moderate

Table 4 A table for ROBINS-I quality assessment on the included 42 studies

Source: author's own work.



SFigure 1 A traffic light plot for risk-of-bias assessments on the included 42 studies

Source: author's own work.

Study information				Data			Study population				Policy	Study design		
Author and Year	Duration	Period	Language	Data	Routinely collected	Cohort/	Geography	Age	Urban/Rural	With NCDs	Policy Label	Comparator	Statistic models	Unit of analysis
He, 2014	2010-2011	2	CH	Secondary	Yes	Panel	Eastern	NA	Rural	No	NEMP	No exposure	DID with no test	Facilities
Zhu, 2017	2013, 2014	2	CH	Primary	No	Panel	Eastern	All age	Urban	No	Family physician	No exposure	DID	Individual
Han, 2016	2012-2013	2	CH	Secondary	Yes	Panel	Eastern	NA	Rural	No	NEMP	No exposure	DID	Facilities
Ma, 2014	2009-2010	2	CH	Secondary	Yes	Panel	Eastern	NA	Both	No	NEMP	No exposure	DID with no test	Facilities
Wang, 2014	2009-2010	2	CH	Secondary	Yes	Panel	Eastern	NA	Rural	No	NEMP	No exposure	DID with no test	Facilities
Chen, 2013	2007 and 2010	4	CH	Secondary	Yes	Panel	National	NA	Both	No	NEMP	No exposure	DID with no test	Facilities
Li, 2012	2009-2010	2	CH	Secondary	Yes	Panel	Eastern	NA	Rural	No	NEMP	No exposure	DID	Facilities
Duan, 2020	2010-2014	5	CH	Secondary	Yes	Panel	Eastern	NA	Urban	No	System Integration	No exposure	DID with FE	Facilities
Tan, 2015	2011-2013	3	CH	Secondary	Yes	Panel	Western	NA	Both	No	Financing	No exposure	DID	Facilities
Jin, 2013	Eight months	1	CH	Secondary	Yes	Cohort	Eastern	Mainly <18 (All age)	Rural	No	NEMP	No exposure	DID	Individual
Chen, 2014	2007-2010	4	EN	Secondary	Yes	Panel	National	NA	Both	No	NEMP	No exposure	DID	Facilities
Ding, 2015	2008-2010	3	EN	Secondary	Yes	Panel	Eastern	Age Mean= 58.7 (18+)	Urban	No	NEMP	No exposure	DID with PSM	Individual
Gong, 2016	2007-2011	5	EN	Secondary	Yes	Panel	National	NA	Urban	No	NEMP	No exposure	DID	Facilities

Jiang, 2016	one year	1	EN	Primary	No	Panel	Central	Aged 40–70 years	Rural	Yes	Financing	No exposure	DID	Individual
Liang, 2014	2008–2010	3	EN	Secondary	Yes	Cohort	Eastern	Children younger than 5 years of	Urban	No	Comprehensive	No exposure	ITS with control	group
Liu, 2014	2009 and 2010	2	EN	Primary	No	Cohort	Central	Age Mean= 33.6 (All age)	Rural	No	Comprehensive	No exposure	DID	Individual
Shen, 2020a	2013–2015	3	EN	Secondary	Yes	Panel	Eastern	17.78% 60+ (18+)	Urban	No	Financing	No exposure	Event study	Individual
Sun, 2016a	2008–2012	5	EN	Secondary	Yes	Panel	Eastern	~ 80% 18–65 years (All age)	Both	No	Financing	No exposure	ITS with control	Both
Tang, 2018	2011–2013	3	EN	Secondary	Yes	Panel	Central	NA	Both	No	NEMP	No exposure	ITS with control	Facilities
Wei, 2015	2011, 2013	3	EN	Primary	No	Cohort	Eastern	Age ≥ 60 (18+)	Urban	No	Comprehensive	Alternative	DID	Individual
Xu, 2020	2012–2014	3	EN	Secondary	Yes	Panel	Eastern	Age Mean= 46.9 (18+)	Rural	No	Gatekeeping	No exposure	DID with FE	Individual
Yang, 2017	2011–2013	3	EN	Secondary	Yes	Panel	Central	NA	Both	No	NEMP	Alternative + no exposure	DID with FE	Facilities
Yang, 2013	2009–2011	3	EN	Secondary	Yes	Panel	Central	NA	Both	No	NEMP	No exposure	ITS with control	Facilities
Yao, 2020	2012–2016	5	EN	Secondary	Yes	Panel	Western	NA	Both	No	Workforce training	No exposure	Event study	Facilities
Yin, 2016	2011, 2013	3	EN	Primary	No	Cohort	Eastern	Aged ≥18 years	Urban	Yes	Family physician	No exposure	DID	Individual
Zhang, 2017	2011–2013	3	EN	Secondary	No	Panel	National	Adults 45 years and older	Both	Yes	NEPHS	No exposure	DID with PSW	Individual
Zhang, 2014a	2010 and 2011	2	EN	Secondary	Yes	Panel	Eastern	~45% Age between 61 and	Rural	Yes	Financing	Intensity + no exposure	DID with PSM	Individual
Zhang, 2014b	2009 and 2010	2	EN	Secondary	Yes	Panel	National	NA	Rural	No	NEMP	No exposure	DID	Facilities
Zhou, 2021	2012, 2014,	7	EN	Secondary	No	Panel	National	Age≥16 years	Both	No	Comprehensive	No exposure	DID with FE	Individual

Miao, 2019	2015, 2017	3	EN	Secondary	Yes	Panel	Central	Age Mean = 65.0 ± 5.1(18+)	Rural	Yes	Financing	No exposure	DID with PSM	Individual
Powell-Jackson,	2009, 2011	3	EN	Primary	No	Panel	Western	About 30	Rural	No	Financing	Alternative + no exposure	DID	Individual
Shen, 2020b	2015-2016	2	EN	Secondary	Yes	Panel	National	above 18 (not specified in the	Urban	Yes	Financing	No exposure	DID	Individual
Yi, 2015	2004, 2007,	8	EN	Secondary	No	Cohort	National	Age Mean= 65.0 ± 5.1 (18+)	Rural	No	NEMP	Intensity	DID with FE	Both
Miao, 2018	2015, 2017	3	EN	Secondary	Yes	Panel	Central	Age Mean= 66.4 ± 7.9 (18+)	Rural	Yes	Financing	No exposure	DID with PSM	Individual
Sun, 2016b	2011, 2012	2	EN	Secondary	Yes	Cohort	Eastern	NA	Rural	No	Financing	No exposure	DID with FE	Individual
Miao, 2016	2012, 2014	3	EN	Primary	No	Panel	Western	Age Mean= 66.3 ± 10.7 (18+)	Rural	Yes	System Integration	No exposure	DID	Individual
Liu, 2016	2012-2014	3	EN	Secondary	Yes	Cohort	Central	Age Mean =37.96 (All age)	Rural	No	Public reporting	No exposure	DID	Individual
Hu, 2021	2012-2016	5	EN	Secondary	Yes	Panel	Eastern	Elderly	Both	Yes	System Integration	No exposure and alternative	DID with PSM	Individual
Wang, 2022	2013,2015,2018	6	EN	Secondary	No	Panel	National	Elderly	Both	Yes	Family physician	No exposure	DID with PSM	Individual
Yuan, 2021	2009-2018	10	EN	Secondary	Yes	Panel	National	NA	Both	Yes	System Integration	Alternative + no exposure	DID with FE	Facilities
Shen, 2021	2009-2017	9	EN	Secondary	Yes	Panel	Western	NA	Rural	No	Financing	percentage - continuous variables	DID with FE	Facilities
Pan, 2022	2011-2018	8	CN	Secondary	No	Panel	National	Elderly	Both	No	Comprehensive	No exposure	DID with FE	Individual

Table 5 Study characteristics of the included 42 studies

Notes: DID for difference-in-differences models; DID with no test for studies that used difference-in-differences models but did not conduct any statistic tests; PSM for propensity score matching; PSW for propensity score weighting; ITS for interrupted time series analysis; FE for fixed effects with multiple time points. NA for not applicable.

Source: Author's own work.

Author and Year	Estimated effects
He, 2014	<u>Health service utilisation:</u> The number of visits to PHC facilities (visits): DID= 4055.43 The number of inpatient care visits (visits): DID= 1061.43 Notes: no statistic tests were done.
Zhu, 2017	<u>Perceptions/awareness:</u> Policy awareness rates (%): (DID= 0.063, P<0.001) <u>Health care costs:</u> Agreement on family physician policy reducing health care costs (%): (DID= 0.21, P=0.099) <u>Satisfaction:</u> Supportive attitude on first-contact with PHC facilities (DID= -0.04, P=0.025) <u>Health service utilization:</u> Self-reported first contact with community health stations (DID= 0.159, P<0.001)
Han, 2016	<u>Health expenditure:</u> Expenditures for outpatient visits to PHC facilities per capita (yuan) DID= -30.350 (P< 0.001) <u>Health service utilization:</u> The number of outpatient care visits in PHC facilities per month (visits) DID= 135.067 (P=0. 017)
Ma, 2014	<u>Health expenditure:</u> Health service costs for outpatient care per visits(providers) (yuan): DID= -61.37 Medical expenditures for outpatient care per visits (patients) (yuan): DID= 3.12 Drug costs per outpatient care visits (patients) (yuan): DID= -64.48 Notes: no statistic tests were conducted.
Wang, 2014	<u>Health service utilization:</u> Total number of outpatients visits to PHC facilities per year (visits): DID = -1902.00, Total number of vaccines per year (visits): 1448.00; Notes: no statistic tests were conducted.

Author and Year	Estimated effects
Chen, 2013	<u>Health expenditure:</u> Medical expenditures per visit to PHC facilities (yuan): DID= -10.3 Notes: no statistic tests were conducted.
Li, 2012	<u>Health service utilization:</u> Total number of outpatient visits to PHC facilities (visits): DID= -1165.59(P=0.82) Total number of inpatient visits to PHC facilities (visits): DID= -26.78 (P= 0.92) <u>Health expenditure:</u> Drug expenditures for outpatient care per capita (yuan): DID= -7.11(P=0.04) Medical expenditures for outpatient care per capita (yuan): DID= 0.79 (P=0.76) Drug expenditures for inpatient care per capita (yuan): DID= -227.20 (P=0.02) Medical expenditures for inpatient care per capita (yuan): DID= -6.86 (P=0.94)
Duan, 2020	<u>Health service utilisation:</u> The number of people under diabetes management:-0.086(0.054) The number of people under hypertension management:-0.071(0.062) Elderly health management:-0.049(0.056) Total number of visits to PHC facilities per capita (visits): 0.362*** (0.133) <u>Health expenditure</u> Health care costs for outpatient visits to PHC facilities per visits (yuan):-9.705(8.233) <u>Health outcomes</u> Diabetes incidence rates(%): 0.002(0.006) Hypertension incidence rates(%): -0.020(0.014) The number of deaths:1.490(11.820) <u>Quality of care:</u> Patient satisfaction (%): 0.002(0.024) Notes: Coefficient (SE), *, ** and *** for significance at p <= 0.1, 0.05, 0.001, log for log-transformed outcomes

Author and Year	Estimated effects
Tan, 2015	<u>Perceptions/awareness:</u> Policy awareness rates (%): DID= 8.5(SE=3.77 , P=0.039) Type 2 diabetes/ hypertension awareness rates(%): DID = 8.97 (SE= 1.8, P= 0.001) <u>Health service utilization:</u> Prenatal checkup rates(%): DID= 10.25(SE=5.09 , P=0.040) Postnatal visit rates(%): DID= 12.09(SE= 5.66, P=0.048) Health examination rates among 0-6 years old children(%): DID= 9.84(SE= 9.79, P=0.330) Health examination rates among people with NCDs(%): DID= 6.55(SE=2.92 , P=0.001) Health examination rates among elderly people aged 60 or over(%): DID= 12.36(SE=3.84 , P=0.005) Vaccination rates among 0-6 years old children(%): DID= 6.49(SE=3.38 , P=0.073) Examination rates among people with serious psychiatric illness (%): DID= 13.69(SE=5.75 , P=0.030)
Jin, 2013	<u>Quality of care:</u> Antibiotic use - Whether there is a joint use of antibiotics, steroids, and intravenous infusion. DID odd ratio= 2.46**(P<0.001) DID Risk ratio= 2.27** (P<0.001) – The treatment groups had 1.27 times higher chance of the joint use.
Chen, 2014	<u>Health service costs:</u> Urban: Average prescription expenditure (yuan): DID= -0.31, SE=0.55 Rural: Average prescription expenditure (yuan): DID= -0.21, SE=0.21 <u>Quality of care:</u> Urban: Proportion of prescriptions contained two or more antibiotics (%): DID= 4.56, SE=9.48 Rural: Proportion of prescriptions contained two or more antibiotics (%): DID= -6.60, SE=5.09
Ding, 2015	<u>Health service utilisation:</u> The number of annual outpatient visits (visits): DID=0.010, RSE= 0.027, P= 0.707 The number of annual outpatient visits in PHCs (visits): DID= 0.019, RSE=0.032 , P= 0.533 <u>Health expenditures:</u> The total annual health care expenditure per capita (\$): DID=0.042 , RSE= 0.042 , P= 0.331 The annual health care expenditure per capita in PHCs (\$): DID=0.038 , RSE=0.048 , P= 0.446

Author and Year	Estimated effects
	The annual drug expenditure per capita (\$): DID= 0.087 , RSE=0.056 , P= 0.138 The annual drug expenditure per capita in PHCs (\$): DID=0.062 , RSE=0.071 , P= 0.395 The annual OOP expenditure per capita (\$): DID= 0.065, RSE= 0.035 , P= 0.074 The annual OOP expenditure per capita in PHCs (\$): DID=0.068, RSE= 0.043 , P= 0.133 Notes: RSE for robust standard error. Only results after propensity score matching were included.
Gong, 2016	<u>Quality of care:</u> Percentage of prescription with antibiotics: -7(2)***(95% CI: -10, -4); Percentage of prescription with >1 antibiotics: -2(1)**(95% CI: -3, 0); Percentage of prescription with injection: -2(2); <u>Health expenditures:</u> Expenditures per prescription (yuan): -8(3)***(95% CI: -14, -2) Notes: coefficients (SE), *P<0.10; **P<0.05; ***P<0.01.
Jiang, 2016	<u>Health service utilisation:</u> Seen at county or higher level hospital (binary): base line OR=0.78 (P=0.56, 95% CI: 0.35–1.76), follow-up OR= 0.77 (P=0.85, 95% CI: 0.34–1.72); Number of hospital visits: OR=1.01 (P=0.70 ,95% CI:0.95–1.07) <u>Health outcomes:</u> SF–12 Physical: OR=1.06 (P= 0.01 ,95 % CI: 1.01–1.10) SF–12 Mental: OR=1.01 (P=0.40 ,95 % CI:0.98–1.05) EQ–5D Health scale: OR= 0.97 (P=0.06 ,95 % CI: 0.94–1.00) The haemoglobin A1c (HbA1c): OR= 0.74 (P=0.02 95 % CI: 0.56–0.99) <u>Health expenditures:</u> The feeling of burdensome (binary): baseline OR=1.37 (P=0.36, 95 % CI: 0.64–2.92), follow-up OR=0.83 (P=0.90, 95 % CI: 0.37–1.83);
Liang, 2014	<u>Quality of care:</u> Proportion of patients receiving antibiotic use per month (%): Group* level change -0.0434; Group* trend change

Author and Year	Estimated effects
	–0.0103 Proportion of patients receiving two or more antibiotics per month (%): Group* level change –0.0734*; Group* trend change –0.0084 <u>Health expenditures:</u> Average monthly costs of antibiotics per patient (yuan): Group* level change 0.1101; Group* trend change –0.1377* Average monthly cost of medications per patient (yuan): Group* level change 0.0867; Group* trend change –0.0477*
Liu, 2014	<u>Health service utilisation:</u> Outpatient attendance rates in past 2 weeks (%): Treated group: in 2009: 61.3 (55.1 to 67.4) in 2010: 59.5 (52.6 to 67.0); Control group: in 2009:37.6 (29.7 to 45.5), in 2010: 51.4 (42.4 to 60.4) Hospitalisation rates (%): Treated group: in 2009: 28.2 (24.0 to 32.5), in 2010: 58.0 (50.7 to 65.3)*; Control group: in 2009: 79.8 (78.1 to 81.4), in 2010: 87.3 (75.8 to 98.8) Antenatal exam rates in the past year (%): Treated group: in 2009: 69.0%, (65.8 to 73.1), in 2010: 75.8%, (72.2 to 79.4) Control group: in 2009: 62.4%, (56.0 to 68.8), in 2010: 57.6%, (50.3 to 64.9) Postpartum visit rates (%): Treated group in 2009: 37.2%, (32.6 to 41.8), in 2010: 29.9, (23.8 to 36.0)**; Control group: in 2009: 23.9, (14.8 to 33.0), in 2010: 26.9 (17.9 to 36.4) Health examinations rates among respondents 60 years and older (%): Treated group: in 2009: 65.5 (61.5 to 69.5), in 2010: 89.7 (86.9 to 92.5)**; Control group: in 2009: 38.0 (32.4 to 43.6) 2010: 54.1 (47.5 to 60.7)** <u>Quality of care:</u> Satisfaction score: Treated group 2009: 21.4 (21.1 to 21.7) 2010: 22.1 (21.7 to 22.4) t= 2.754; P= 0.006; Control group 2009:20.6 (20.1 to 21.1) 2010: 20.2 (19.7 to 20.8) t=0.943 ; P= 0.347 Notes: 95% CI were shown in the parathesis. ** for P<0.001, * for P<0.05.
Shen, 2020a	<u>Health service utilisation:</u> Total number of outpatient visits (visits): 0.018*** (0.004) Number of outpatient visits at primary care providers (visits): 0.036*** (0.003) Number of outpatient visits at non-primary care providers (visits): –0.018*** (0.003) Number of visits for overall care, including hospitalisation (visits): –0.004 (0.050) Hospitalisation days for overall care, including hospitalisation (days): –0.004 (0.050) Hospitalisation days for ambulatory care sensitive conditions (ACSCs) (days): 0.123 (0.113)

Author and Year	Estimated effects
	Number of visits for ACSCs (visits): 0.003 (0.021) <u>Health expenditures:</u> Total health care spending per month (yuan): -0.0001 (0.013) Spending per month at primary care providers (yuan): 0.132*** (0.009) Spending per month at non-primary care providers (yuan): -0.106*** (0.011) Spending per visit for overall care (yuan): 0.001 (0.007) Spending per visit for ACSCs (yuan): 0.022 (0.228) <i>Notes: Standard errors were shown in parentheses. ***$p < .01$. **$p < .05$. *$p < .10$.</i>
Sun, 2016a	<u>Healthcare utilization:</u> Number of OP visits to PHC facilities per month (visits): Level change: 46 895 (0.004, 15 795~77 994); Trend change: 673 (0.74, -3453~4799) <u>Health expenditure:</u> Total expenditures per visit (yuan): Level change: -15.40 (0.16, -36.95~6.15); Trend change: -0.81 (0.48, -3.10~1.47) <u>Quality of care:</u> The percentage of visits with at least one antibiotic (%): Level change: -1.11 (0.76, -8.34~6.11); Trend change: 1.52 (0.02, 0.21~2.83) The percentage of visits with at least one injectable (%): Level change: -7.38 (0.03, -14.08~-0.68); Trend change: -0.92 (0.06, -1.89~0.05) <i>Notes: Coefficient (P value, 95% CI)</i>
Tang, 2018	<u>Health expenditures:</u> Total cost for antibiotics per month (million yuan): Level change: - 8.31, [- 18.68, 2.06], $P = 0.114$; Trend changes - 1.56 [- 2.96, - 0.15], $P = 0.030$ <u>Quality of care:</u> Total defined daily dose for antibiotics per month (in million): level changes: - 0.32 [- 3.92, 3.27], $P = 0.857$; Trend changes - 0.51 [- 0.97, - 0.05], $P = 0.031$ <i>Notes: Coefficient [95% CI]</i>
Wei, 2015	<u>Quality of care:</u>

Author and Year	Estimated effects
	<i>First contact:</i> Utilization: DID= 0.255 (0.176 to 0.333); Accessibility DID= -0.030 (-0.082 to 0.022) <i>Continuity of care:</i> DID= 0.233 (0.166 to 0.300) <i>Coordination:</i> Services DID= 0.083 (-0.009 to 0.175); Information DID= 0.233 (0.147 to 0.320) <i>Comprehensiveness:</i> Service availability DID= 0.325 (0.262 to 0.388); Service provided DID= 0.454 (0.362 to 0.546) <i>Patient-focused care:</i> DID= 0.098 (-0.027 to 0.222) <i>Overall quality score:</i> DID= 1.651 (1.266 to 2.037) Notes: Coefficient (95% CI).
Xu, 2020	<u>Health service utilisation:</u> Average ambulatory care visits to PHC facilities per enrollee per quarter: DID= 0.142, 95% CI= (0.071 to 0.212), P=0.001 Average ambulatory care visits to hospitals per enrollee per quarter: DID= -0.026, 95% CI= (-0.051 to 0.001), P= 0.040 <u>Health expenditure:</u> Total ambulatory care expenditure to PHC facilities per enrollee per quarter (yuan): DID= 0.840, 95% CI= (-11.126 to 12.806), P=0.884 Total ambulatory care expenditure to hospitals per enrollee per quarter (yuan): DID= -22.600, 95% CI= (-139.167 to 6.034), P= 0.011
Yang, 2017	<u>Health service utilisation:</u> The delivery rates of essential medicines in urban areas (%): Medicine-tied model: DID=6.32, P=0.10, 95%CI= -1.15, 13.80 The delivery rates of essential medicines in rural areas (%): Medicine-tied model: DID=-7.78, P=0.00, 95%CI= -11.25, -4.31 Recipient-tied model: DID=-19.85, P=0.00, 95%CI= -24.85, -14.84 Recipient-medicine-tied model DID=3.99, P=0.24, 95%CI= -2.67, 10.65
Yang, 2013	<u>Health expenditures:</u> Average expenditure per prescription (yuan): level change= -18 (p<0.03)

Author and Year	Estimated effects
	<u>Quality of care:</u> Percentage of prescriptions requiring antibiotics (%): non-significant change, the values were not reported. Percentage of prescriptions requiring injections (%): non-significant change, the values were not reported
Yao, 2020	<u>Health service utilisation:</u> <i>Rural:</i> Total annual number of visits to PHC facilities (visits) in rural areas: Coefficient = 0.105* (1.973) Annual number of outpatient visits to PHC facilities (visits) in rural areas: Coefficient = 0.141** (2.196) The share of total visits to PHC facilities among all medical institutions in rural areas (%): Coefficient = 0.0395** (2.429) <i>Urban:</i> Total annual number of visits to PHC facilities in urban areas: -0.0914 (-0.914) Annual number of outpatient visits to PHC facilities (visits) in urban areas: -0.122 (-1.172) The share of total Visits to PHC facilities among all medical institutions in urban areas (%): -0.0160 (-0.630) Notes: T-statistics were shown in the parathesis. *** p<0.01, ** p<0.05, * p<0.1
Yin, 2016	<u>Quality of care:</u> First contact utilization: DID= 0.21 (0.11, 0.31)***; First-contact accessibility DID= 0.04 (-0.05, 0.12) Continuity of care DID= 0.04 (-0.06, 0.14) Coordination of services: DID= 0.27 (0.12, 0.42)***; Coordination of information: DID= 0.10 (0.01, 0.20)* Comprehensiveness service availability: DID= 0.01 (-0.08, 0.10); Comprehensiveness service provided: DID= 0.06 (-0.01, 0.12) Family centeredness: DID= -0.04 (-0.17, 0.09) Community orientation: DID= 0.18 (0.06, 0.31)** Cultural competence: DID= 0.44 (0.25, 0.62)*** Total scores: DID= 1.30 (0.74, 1.87)*** Notes: Coefficients (95% CI), *P < 0.05; **P < 0.01; ***P < 0.001.
Zhang, 2017	<u>Health outcomes:</u> Hypertension control rate (%): 8.1* (3.4)

Author and Year	Estimated effects
	<u>Health service utilisation:</u> Medication use rate (%): 9.1* (3.8) Blood pressure monitoring rate (%): 9.5* (3.8) Notes: Coefficients (SE), *P < 0.05; **P < 0.01; ***P < 0.001. Results after propensity-score weighting were included.
Zhang, 2014a	<u>Health service utilisation:</u> Ratio of visits by outpatients to different health institutions Village clinic: DID = -0.434 t-value=-0.29 Township health centres: DID =5.985*** t-value= 4.55 County-level hospital: DID = 2.341*** t-value= 1.97 <u>Health expenditure:</u> Annual total outpatient medical expenditure: When yearly maximum reimbursement amount increased by 40 yuan: DID =0.087***, t-value= 3.13 When yearly maximum reimbursement amount increased by 100 yuan: DID =0.157*** , t-value= 4.71 Notes: * P < 0.1; **P< 0.05; ***P< 0.01.
Zhang, 2014b	<u>Health expenditure:</u> Average drug expenditures for outpatients: DID: -0.119 (0.058) FE: -0.123 (0.062) Average drug expenditures for inpatients: DID: -0.266** (0.067) FE: -0.258** (0.064) Average inpatient medical expenditures per capita: DID: -0.113* (0.041) FE: -0.106* (0.036) Average outpatient medical expenditures per visit: DID: -0.042 (0.044) FE: -0.043 (0.042) <u>Health service utilisation:</u> Average number of inpatients stay per certified doctor per day: DID= 0.213 (0.184), FE: 0.171 (0.165) Average number of visits per certified doctor per day: DID= -1.262 (1.129), FE: -1.152 (0.962) Notes: FE for results from fixed effect models; Robust SEs in parentheses; *P<0.05, **P<0.01.
Zhou, 2021	<u>Health service utilisation:</u> Whether respondents usually go to PHC facilities to seek health services when they are sick? (Binary): Urban OR = 1.261 (95% CI= 1.013 to 1.571, P < 0.05), Rural OR = 0.894 (95% CI= 0.734 to 1.090, P = 0.269) Whether respondents usually go to PHC facilities to seek health services when they are sick? (2 years after HMS

Author and Year	Estimated effects
	implementation): Urban OR= 1.498 (95% CI= 1.068 to 2.102, P < 0.05) Rural: OR= 0.968 (95% CI=0.712 to 1.317, P = 0.836)
Miao, 2019	<u>Health Expenditure:</u> Per capita annual total outpatient expenditure (yuan): 81.2*, relative effects= 31.8% Per capita annual total inpatient expenditure (yuan): -475.4*, relative effects= -40.7% Per capita annual total expenditure (yuan): -394.2*, relative effects= -27.7% Per capita annual total out-of-pocket expenditure (yuan): -201.9*, relative effects= -29.9% <u>Health service utilisation:</u> Per capita outpatient visits to PHC facilities (visits): 3.3**, relative effects= 81.0% Per capita annual inpatient visits to PHC facilities (visits): -0.075**, relative effects= -60.0% Per capita annual visits to PHC facilities (visits): 3.225**, relative effects= 76.8% <u>Health outcomes:</u> Diastolic blood pressure (mmHg): -2.9*; Systolic blood pressure (mmHg): -7.9. The prevalence of complications increased slightly during this 1-year intervention in general, but the difference was not statistically significant (p>.05). Notes: *P<0.05, **P<0.01, ***P<0.001. Information on CIs or SEs were not reported.
Powell-Jackson, 2015	<u>Health service utilisation:</u> Doctor visits in past 2 weeks: Benefit package: 0.015 (0.037); Benefit package + provider incentives: 0.036 (0.038) Self-treated or no treatment sought: Benefit package: -0.015 (0.037); Benefit package + provider incentives: -0.036 (0.038) Outpatient visits to at village clinics: Benefit package: 0.053 (0.026)**; Benefit package + provider incentives: 0.060 (0.030)** Outpatient visits to township health centres: Benefit package: -0.001 (0.024); Benefit package + provider incentives: 0.021 (0.022) Outpatient visits to country hospitals: Benefit package: 0.010 (0.020); Benefit package + provider incentives: -0.008 (0.024)

Author and Year	Estimated effects
	Outpatient visits to provincial hospitals: Benefit package: -0.031(0.015)**; Benefit package + provider incentives: -0.007(0.013) Inpatient care in past year (any): Benefit package: -0.004 (0.006); Benefit package + provider incentives:0.003 (0.005) Inpatient care at township health centre (any): Benefit package:0.000 (0.003); Benefit package + provider incentives: 0.002 (0.003) Inpatient care at county hospital (any): Benefit package: -0.001 (0.004); Benefit package + provider incentives: 0.002 (0.004) Inpatient care at provincial hospital (any): Benefit package: -0.003 (0.003); Benefit package + provider incentives:-0.001 (0.002) Number of admissions in past year: Benefit package: -0.003 (0.009); Benefit package + provider incentives: 0.008 (0.009) <u>The intensity of treatment:</u> Injection during outpatient visits in the past 2 weeks (any): Benefit package: 0.116 (0.039)***; Benefit package + provider incentives: 0.090 (0.044)** IV drip during outpatient visits in the past 2 weeks (any) : Benefit package: 0.116 (0.051)**; Benefit package + provider incentives: 0.053 (0.045) Notes: Robust standard errors clustered at the village level are reported in parentheses. *P<0.1, **P<0.05, ***P<0.01. Intervention type 1 only introduced benefit package, whilst the type 2 was a combination of benefit package and provider incentives.
Shen, 2020b	<u>Health expenditures:</u> Outpatient care spendings among people with hypertension only: DID MD= -9.0 (-11.8, -6.1), P< 0.0001 Outpatient care spending among people with diabetes only: DID MD= -8.9 (-15.7, -2.1), P= 0.01 Outpatient care spending among people with both hypertension and diabetes: DID MD= -7.5 (-12.0, -3.0), P= 0.001 <u>Health service utilisation:</u> Monthly hospitalization rate among people with diabetes only: DID OR= 0.962 (0.691, 1.341), P= 0.82 Monthly hospitalization rate among people with hypertension only: DID OR= 1.047 (0.901, 1.218), P= 0.54

Author and Year	Estimated effects
	Monthly hospitalization rate among people with both hypertension and diabetes: DID MD= 0.891 (0.743, 1.068), P= 0.21 <i>Notes: No Overall impacts were reported. Standard errors are clustered at the individual level.</i>
Yi, 2015 ⁴⁰	<u>Health service utilisation:</u> Number of annual inpatient visits to township health centres (THCs): DID= 1.27* (0.05) Number of annual outpatient visits to THCs: DID= -0.19 (0.52) Probability of seeking outpatient services at THC for most recent episode of illness: DID= 0.02 (0.47) Probability of seeking inpatient services at THC for most recent of episode of illness: DID= -0.00 (0.74) <u>Health expenditures:</u> Medical inpatient expenditure at THCs: DID= -0.05 (0.89) Medical outpatient expenditures at THCs among those not referred elsewhere: DID= -0.09 (0.70) <i>Notes: p-values were shown in the parenthesis; *** p<0.01, ** p<0.05, * p<0.1.</i>
Miao, 2018	<u>Health service utilisation:</u> Per capita annual outpatient care visits (visits): DID= 3.3 (P=0.008), relative effects= 81.0% Per capita annual inpatient care visits (visits): DID= -0.075 (P=0.000), relative effects= - 60.0% Total number of visits for medical services (visits): DID= 3.225 (P=0.001), relative effects= 76.8% <u>Health expenditures:</u> Per capita annual medical expenditures for outpatient care (yuan): DID=81.2 (P=0.048), relative effects= 31.8% Per capita annual medical expenditures for inpatient care (yuan): DID=-475.4 (P=0.027), relative effects= - 40.7% Total annual medical expenditures per cap: DID=-394.2 (P=0.013), relative effects= -27.7% Patient per capita annual out-of-pocket expenditures for outpatient care (yuan): DID=-9.1 (P=0.518) Patient per capita annual out-of-pocket expenditures for inpatient care (yuan): DID=-192.8 (P=0.027), relative effects = - 36.7% Patient per capita annual out-of-pocket expenditures for total medical care (yuan): DID=-201.9 (P=0.022), relative effects= - 29.9% <u>Health Outcomes:</u> Systolic blood pressure: DID=-2.9 (P=0.011) Diastolic blood pressure: DID=- 7.9 (P=0.508)

Author and Year	Estimated effects
Sun, 2016b	<u>Health expenditures:</u> Total costs for consultation and medicines at township health centres (yuan): -7.001; relative effects (%) = -0.160; (SE= 10.582; P= 0.561) Total costs for consultation and medicines at village clinics (yuan): -3.158; relative effects (%) = -0.107; (SE= 4.694; P= 0.535) <u>Quality of care:</u> Whether a prescription contained antibiotic at township health centres (%): -0.050; relative effects (%) = -0.105; (SE= 0.058; P=0.356) Whether a prescription contained 2 or more antibiotics at township health centres: -0.076; relative effects (%) = -0.511; (SE= 0.040; P= 0.074) Whether a prescription contained intravenous injection at township health centres: -0.096; relative effects (%) = -0.269; (SE= 0.075; P= 0.194) Whether a prescription contained antibiotic at village clinics: -0.033; relative effects (%) = -0.056; (SE= 0.074; P= 0.635) Whether a prescription contained 2 or more antibiotics at village clinics: 0.055; relative effects (%) = 0.485; (SE= 0.049; P= 0.304) Whether a prescription contained intravenous injection at village clinics : -0.066; relative effects (%) = -0.184; (SE= 0.060; P= 0.284) Notes: SE were adjusted for clustering at the township level. Adjustment for small number of clusters using wild bootstrapping.
Miao, 2016	<u>Health outcomes:</u> Health-related quality of life SF-36 <i>scale</i> scores: DID = 4.591; SE =1.794; P =0.011 Blood pressure (mm Hg): systolic blood pressure: DID = -5.62; SE =16.49; P =0.019, Diastolic blood pressure: DID = -5.43; SE =15.07; P =0.028
Liu, 2016	<u>Quality of care:</u> Whether a prescription requires antibiotics or not (%): DID OR = 1.089 (1.067,1.110); P <0.001 Whether a prescription requires combined antibiotics or not (%): DID OR = 0.870 (0.850,0.890); P <0.001 Whether a prescription requires injections (%): DID OR = 1.258 (1.234,1.283); P <0.001

Author and Year	Estimated effects
	<u>Health expenditures:</u> Average drug expenditures per prescription (yuan): DID = -0.051 (-0.057, -0.045); P < 0.001 Notes: 95%CI were shown in the parathesis.
Hu, 2021	<u>Health expenditures:</u> The total treatment costs per capita (yuan): hypertension group: DID= -380.530*** (16.632), diabetes groups: DID= -1117.247*** (54.917) <u>Health outcomes:</u> Control rates (%): hypertension: DID OR=1.407*** (0.007), Diabetes: DID OR= 1.333*** (0.011) Notes: SEs were shown in parathesis. * P< 0.1 ** P< 0.05 *** P< 0.01
Wang, 2022	<u>Health outcomes:</u> Health-related quality of life scores: DID= 14.10 (SE = 0.044), P<0.05
Yuan, 2021	<u>Health service utilisation:</u> <i>Type 1 intervention - loose collaboration</i> The number of annual outpatient visits to PHC facilities: 0.120 (-0.027, 0.266) The number of annual admissions in PHC facilities: 0.251 (-0.134, 0.636) The number of annual outpatient visits to hospitals: -0.043 (-0.220, 0.134) The number of annual admissions in hospitals: -0.070 (-0.182, 0.042) The ratio of outpatient visits between PHC facilities and hospitals (%): 3.456 (-1.241, 8.154) The ratio of admissions between PHC facilities and hospitals (%): 3.269 (-1.373, 7.911) <i>Type 2 intervention - tight integration</i> The number of annual outpatient visits to PHC facilities: 0.187 (-0.228, 0.601) The number of annual admissions in PHC facilities: 0.808 (0.503, 1.113)*** The number of annual outpatient visits to hospitals: -0.095 (-0.398, 0.209) The number of annual admissions in hospitals: -0.074 (-0.197, 0.048) The ration of outpatient visits between PHC facilities and hospitals (%): 4.855 (-2.241, 11.950) The ratio of admissions between PHC facilities and hospitals (%): 9.263 (2.257, 16.270)* <u>Health outcomes:</u> <i>Type 1 intervention - loose collaboration</i>

Author and Year	Estimated effects
	Control rates of hypertension (%): 12.970 (2.816, 23.124)* Control rates of diabetes (%):14.018 (5.837, 22.199)** <i>Type 2 intervention - tight integration</i> Control rates of hypertension (%): 24.699 (16.560, 32.838)*** Control rates of diabetes (%):17.655 (6.559, 28.752)** Notes: 95% CI were shown in the parathesis. *** p<0.001, ** p<0.01, * p<0.05.
Shen, 2021	<u>Health service utilisation:</u> The number of outpatient visits: DID= -0.012*** (p< 0.001).
Pan, 2022	<u>Health equity:</u> Centred index to measure income-related health inequality: DID = - 0.0192*** (t= -7.2457), p = 0.001

STable 6 Estimated policy effects in the included 42 studies

Notes: SE for standard error; CI for confident interval; log for log-transformed; DID for difference-in-differences.

No	Excluded studies	Reasons for exclusion
1	Feng X, Feng W, Shen P, Wang Z, Shen J, Wang B. The effect of the integrated delivery system on managing hypertension in rural areas of China. <i>Ann Palliat Med</i> . 2021;10(1):434-42.	Noneligible study design
2	Guo Z, Guan X, Shi L. The impacts of implementation of National Essential Medicines Policies on primary healthcare institutions: a cross-sectional study in China. <i>BMC Health Serv Res</i> . 2017;17(1):723.	Noneligible study design
3	He J, Chen D, Tang Z, Cong L, Tian Y, Xie C, et al. How the health institution combinative contracting mechanism influences community residents' patient experiences in Shanghai: A comparative study of data from two cross-sectional surveys. <i>Int J Health Plann Manage</i> . 2019;34(3):1036-54.	Noneligible study design
4	Hu S. Essential medicine policy in China: pros and cons. <i>J Med Econ</i> . 2013;16(2):289-94.	Noneligible study design
5	Hu XY, Yang XJ. Early Intervention Practices in China Present Situation and Future Directions. <i>Infant Young Child</i> . 2013;26(1):4-16.	Noneligible study design
6	Hu Y, Luo S, Tang X, Lou L, Chen Y, Guo J, et al. Does introducing an immunization package of services for migrant children improve the coverage, service quality and understanding? An evidence from an intervention study among 1548 migrant children in eastern China. <i>BMC Public Health</i> . 2015;15:664.	Noneligible study design
7	Huang J, Lu W, Wang L, Zhang T, Liu C, Liu S, et al. A preliminary effect analysis of family doctor and medical insurance payment coordination reform in Changning District of Shanghai, China. <i>BMC Fam Pract</i> . 2019;20(1):60.	Noneligible study design
8	Huang J, Zhang T, Wang L, Guo D, Liu S, Lu W, et al. The effect of family doctor-contracted services on noncommunicable disease self-management in Shanghai, China. <i>Int J Health Plann Manage</i> . 2019;34(3):935-46.	Noneligible study design
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301	李婷, 林其意, 黄涛, 易春涛. 慢性病长处方政策对签约患者医疗质量的短期影响及政策建议. 中国全科医学. 2017;20(25):3084.	Small scale studies
302	沈艺. 医联体全科团队对居民家庭医生签约意愿的研究. 中国社区医师. 2020.	Small scale studies
303	莫瑞豪, 曾润颜, 黄胜海, 邹敏莉, 亢黎莉. 深圳市福田区家庭医生制服务对居民社区首诊率的影响研究. 中国全科医学. 2015;18(10):1142.	Small scale studies
304	赵文穗, 季黎明, 邱琼, 李黎, 潘向东, 于爱华, et al. 家庭医生制下糖尿病双向转诊效果评估. 中华全科医学. 2015.	Small scale studies
305	赵桂萍, 陈思羽, 胡蕊. 医院-社区联合干预对哺乳期避孕节育的效果评价. 护理研究: 中旬版. 2015;29(8):2889-90.	Small scale studies

STable 7 The 305 excluded studies after full-text screening and reasons

Source: author's own work.

Appendix 2

Appendix 2 includes supplementary materials for Chapter 6.

For traditional DiD methods, three alternative model specification was performed: 1) a TWFE model with province and year fixed effects, estimated by the following equation:

$$Y_{it} = \alpha + \beta_1 Reform_{it} + \beta_0 X_{it} + \mu_i + \gamma_t + \varepsilon_{it}$$

2) a panel regression model using province-specific time trends, estimated by the following equation:

$$Y_{it} = \alpha + \beta_1 Reform_{it} + \beta_0 X_{it} + \mu_i + t * Province + \varepsilon_{it}$$

3) a panel regression model using province-specific trends and a lag term, estimated by the following equation:

$$Y_{it} = \alpha + \beta_1 Reform_{it} + \beta_2 Reform.lag_{it} + \beta_0 X_{it} + \mu_i + t * Province + \varepsilon_{it}$$

where $Reform_{it}$ is a dummy that equals to one when the province i is under the primary health care reforms at year t , μ_i and γ_t are province and time fixed effects respectively. t is a continuous time variable. The parameter of interest are β_1 which captures the instant reform impacts on the outcomes of interests and β_2 which captures the reform impacts one year after the implementations. Time-varying covariates at the province level, X_{it} respectively. The residual term ε_{it} was the stochastic disturbance term capturing any remaining unobserved confounders that were not associated with the implementation of the reform and assumed normally distributed and mean zero. The robust standard error was clustered at the provincial level.

	Number of PHC facilities per 10,000 people	Number of PHC beds per 10,000 people	Number of PHC workforce per 10,000 people
Reform	-0.052 [-0.156; 0.052]	0.191 [-0.238; 0.621]	-0.441 [-1.025; 0.143]
FE: Year	Yes	Yes	Yes
FE: Province	Yes	Yes	Yes
Observations	310	310	310
Adj. R2	0.9	0.9	0.9
AIC	192.4	710.7	1,158.40
Reform	-0.007 [-0.160; 0.146]	-0.052 [-0.248; 0.144]	0.104 [-0.504; 0.713]
FE: Province	Yes	Yes	Yes
Observations	310	310	310
Adj. R2	0.9	0.9	0.9
AIC	128.3	297	935.1
Reform	0.025 [-0.047; 0.098]	-0.065 [-0.233; 0.102]	0.078 [-0.306; 0.462]
Reform.lag1	0.033 [-0.065; 0.130]	-0.042 [-0.233; 0.149]	0.124 [-0.270; 0.518]
FE: Province	Yes	Yes	Yes
Observations	279	279	279
Adj. R2	0.9	0.9	0.9
AIC	-310.3	254.5	673.3

STable 8 The estimated reform impacts on PHC inputs using the TWFE models

Notes: * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$. PHC for primary health care. Reform.lag1 for a lag term (one year after the reforms implementation). All models were controlled for human development index, areas of city road per capita, number of hospitals per 10,000 people, and percentage of people covered by basic health insurances. Standard errors were clustered at provincial level. 95% confidence intervals were reported.

Source: author's own work.

	Maternal Care		Primary care service delivery	
	Prenatal	Postnatal	Number of family physician services delivered per 10,000 people	Number of visits to PHC facilities per capita
Reform	-0.990	-1.615	-8.42	-0.002
	[-2.934; 0.955]	[-4.300; 1.071]	[-73.628; 56.788]	[-0.101; 0.097]
FE: Year	Yes	Yes	Yes	Yes
FE: Province	Yes	Yes	Yes	Yes
Observations	310	310	310	310
Adj. R2	0.718	0.717	0.6	0.9
AIC	1,539.6	1,719.6	4,085.20	-102.2
Reform	-0.992	-1.889*	53.004*	-0.166***
	[-2.216; 0.233]	[-3.630; -0.147]	[4.323; 101.684]	[-0.242; -0.090]
FE: Province	Yes	Yes	Yes	Yes
Observations	310	310	310	310
Adj. R2	0.819	0.854	0.8	1
AIC	1,419.2	1,530.9	3,911.60	-253.8
Reform	-0.623	-1.006	1.227	-0.089**
	[-1.767; 0.520]	[-2.415; 0.404]	[-46.763; 49.217]	[-0.150; -0.028]
Reform.lag1	-1.314	-1.870*	96.592*	-0.119***
	[-2.913; 0.285]	[-3.599; -0.142]	[0.124; 193.061]	[-0.181; -0.058]
FE: Province	Yes	Yes	Yes	Yes
Observations	279	279	279	279
Adj. R2	0.8	0.9	0.8	0.9
AIC	-220.9	3,681.90	3,490.80	-287.5

STable 9 The estimated reform impacts on the utilisation of materal and primary care using the TWFE models

Notes: * p < 0.05, ** p < 0.01, *** p < 0.001. PHC for primary health care. Reform.lag1 for a lag term (one year after the reforms implementation). All models were controlled for human development index, areas of city road per capita, number of hospitals per 10,000 people, and percentage of people covered by basic health insurances. Standard errors were clustered at provincial level. 95% confidence intervals were reported.

Source: author's own work.

	Hospital care		Health-related household expenditures
	Outpatient drug costs	Outpatient checkup	
Reform	-2.156 [-5.363; 1.051]	0.296 [-0.730; 1.322]	19.232 [-45.976; 84.440]
FE: Year	Yes	Yes	Yes
FE: Province	Yes	Yes	Yes
Observations	310	310	310
Adj. R2	0.9	0.9	0.9
AIC	1,800.00	1,554.90	3,838.20
Reform	-5.512*** [-7.826; -3.197]	7.900*** [5.806; 9.994]	187.942*** [103.485; 272.399]
FE: Province	Yes	Yes	Yes
Observations	310	310	310
Adj. R2	0.9	0.8	0.9
AIC	1,689.30	1,946.70	4,086.90
Reform	-3.591*** [-5.514; -1.669]	5.512*** [3.711; 7.314]	127.772** [49.995; 205.549]
Reform.lag1	-4.599*** [-5.969; -3.228]	5.005*** [2.648; 7.362]	191.396*** [118.734; 264.059]
FE: Province	Yes	Yes	Yes
Observations	279	279	279
Adj. R2	0.9	0.7	0.9
AIC	1,459.50	1,753.00	3,681.90

STable 10 The estimated reform impacts on hospital outpatient costs and household health expenditures using the TWFE models

Notes: * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$. Reform.lag1 for a lag term (one year after the reforms implementation). All models were controlled for human development index, areas of city road per capita, number of hospitals per 10,000 people, and percentage of people covered by basic health insurances. Standard errors were clustered at provincial level. 95% confidence intervals were reported.

Source: author's own work.

	Mortality	
	Maternal death	All age all-cause mortality rates
Reform	2.443 [-1.242; 6.128]	0.017 [-0.138; 0.171]
FE: Year	Yes	Yes
FE: Province	Yes	Yes
Observations	310	310
Adj. R2	0.9	0.9
AIC	2,164.40	55.2
Reform	1.071 [-0.377; 2.518]	-0.051 [-0.179; 0.077]
FE: Province	Yes	Yes
Observations	310	310
Adj. R2	0.9	0.9
AIC	1,710.60	-46.1
Reform	-0.297 [-1.833; 1.238]	-0.063 [-0.183; 0.057]
Reform.lag1	1.505* [0.121; 2.889]	0.004 [-0.092; 0.100]
FE: Province	Yes	Yes
Observations	279	279
Adj. R2	0.9	0.9
AIC	1,501.60	-120.3

STable 11 The estimated reform impacts on mortalities using the TWFE models

Notes: * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$. Reform.lag1 for a lag term (one year after the reforms implementation). All models were controlled for human development index, areas of city road per capita, number of hospitals per 10,000 people, and percentage of people covered by basic health insurances. Standard errors were clustered at provincial level. 95% confidence intervals were reported.

Source: author's own work.

Appendix 3

Appendix 3 includes supplement materials for Chapter 7.

Province	Total number of	The number of prefecture-level cities	Name of prefecture-level cities (included in CHARLS)	The number of communities
Anhui	16	7	Anqing; Bozhou; Chaochu; Fuyang; Huainan; Liuan;	21
Beijing	/	/	/	3
Chongqing	/	/	/	6
Fujian	9	4	Fuzhou; Ningde; Putian; Zhangzhou	12
Gansu	14	4	Dingxi; Lanzhou; Pingliang; Zhangye	12
Guangdong	21	7	Chaozhou; Foshan; Guangzhou; Jiangmen; Maoming; Qingyuan; Shenzhen	33
Guangxi	14	4	Guilin; Hechi; Nanning; Yulin	15
Guizhou	9	2	Qiandongnan; Qiannan	6
Hebei	11	4	Baoding; Cangzhou; Chengde; Shijiazhuang	18
Heilongjiang	13	4	Harbin; Jiamusi; Jixi; Qiqihar	12
Henan	17	8	Anyang; Jiaozuo; Luoyang; Pingdingshan; Puyang; Xinyang; Zhengzhou; Zhoukou	33
Hubei	13	4	Enshi; Huanggang; Jingmen; Xiangfan	12
Hunan	14	6	Changde; Changsha; Loudi; Shaoyang; Yiyang; Yueyang	21
Jiangsu	13	7	Lianyungang; Suqian; Suzhou; Taizhou; Xuzhou; Yancheng; Yangzhou	21
Jiangxi	11	7	Ganzhou; Jian; Jingdezhen; Jiujiang; Nanchang; Shangrao; Yichun	27
Jilin	9	2	Jilin; Siping	9
Liaoning	14	5	Anshan; Benxi; Chaoyang; Dalian; Jinzhou	15
Neimenggu	12	5	Chifeng; Hinggan; Hohhot; Hulunbuir; Xilingol	18
Qinghai	8	1	Haidong	3
Shaanxi	10	4	Baoji; Hanzhong; Weinan; Yulin	15
Shandong	16	9	Binzhou; Dezhou; Jinan; Liaocheng; Linyi; Qingdao; Weifang; Weihai; Zaozhuang	33
Shanghai	/	/	/	3
Shanxi	11	4	Linfen; Xinzhou; Yangquan; Yuncheng	12
Sichuan	21	10	Chengdu; Ganzi; Guangan; Liangshan; Meishan; Mianyang; Nanchong; Neijiang; Yibin; Ziyang	36
Tianjin	/	/	/	3
Xinjiang	14	1	Akesu	3
Yunnan	16	6	Baoshan; Chuxiong; Kunming; Lijiang; Lincang; Zhaotong	27
Zhejiang	11	6	Hangzhou; Huzhou; Jiaxing; Lishui; Ningbo; Taizhou	21
Total: 28		122+4		450

Table 12 Prefecture-level cities included in CHARLS

Source: author's own work.

	Rural populations		Urban populations	
Age (years)				
Mean (SD)	61.1	(10.0)	61.1	(10.0)
Gender (male as ref)				
Female (%)	14259	(52.5%)	8847	(53.7%)
Education (Illiterate/primary and below as ref)				
Secondary and higher (%)	6244	(23.0%)	7037	(42.7%)
Marital status (single as ref)				
Married (%)	23311	(85.8%)	14255	(86.6%)
Working				
Yes (%)	19388	(71.3%)	8018	(48.7%)
Drinking last year				
Yes (%)	8784	(32.3%)	5503	(33.4%)
Ever smoking				
Yes (%)	7945	(29.2%)	4225	(25.7%)
Basic health Insurance				
Yes (%)	25704	(94.6%)	15298	(92.9%)
Diagnosed with chronic disease				
Yes (%)	9104	(33.5%)	6633	(40.3%)
Family size				
Mean (SD)	3.3	(1.7)	3.1	(1.5)
Total household net wealth (Chinese Yuan)				
Mean (SD)	17665	(103379)	58803	(990262)
Number of hospital beds per 10,000 population				
Mean (SD)	4.9	(1.1)	4.9	(1.1)
Number of doctors per 1,000 population				
Mean (SD)	2.1	(0.5)	2.2	(0.6)
Human Development Index				
Mean (SD)	0.72	(0.04)	0.73	(0.04)
Whether visited a PHC facility in the last month				
Yes (%)	3756	(13.8%)	1600	(9.7%)
Whether was hospitalised in the last year				
Yes (%)	3413	(12.6%)	2396	(14.5%)
OOPes (Chinese Yuan)				
Mean (SD)	727.1	(4825)	898.2	(4680)
Self-reported health (poor/very poor as ref)				
Fair/ Good/ Very good (%)	19183	(70.6%)	12931	(78.5%)

STable 13 Summary statistics of the study population grouped by rural/urban residency

Notes: SD for standard deviations. ref for reference groups. PHC for primary health care. OOPes for out-of-pocket expenditures. The values for total household net wealth and overall OOPes were adjusted for inflation using consumer price index in 2010= 100. The scale of Human Develop Index is between 0 and 1.

Source: author's own work.

	Poor populations	Rich populations
Age (years)		
Mean (SD)	62.9 (10.5)	59. (9.5)
Gender (male as ref)		
Female (%)	10121 (56.1%)	129 (50.7%)
Education (Illiterate/primary and below as ref)		
Secondary and higher (%)	3743 (20.7%)	953 (37.3%)
Marital status (single as ref)		
Married (%)	13890 (76.9%)	236 (92.5%)
Working		
Yes (%)	10716 (59.4%)	166 (65.2%)
Drinking last year		
Yes (%)	8784 (32.3%)	917 (35.9%)
Ever smoking		
Yes (%)	5200 (28.8%)	697 (27.2%)
Basic health Insurance		
Yes (%)	16759 (92.8%)	242 (94.7%)
Diagnosed with chronic disease		
Yes (%)	6608 (36.6%)	912 (35.7%)
Family size		
Mean (SD)	3.3 (1.8)	3.2 (1.5)
Total household net wealth (Chinese)		
Mean (SD)	17665 (103379)	547 (801138.3)
Residence status (urban as ref)		
Rural (%)	12679 (70.2%)	144 (56.6%)
Number of hospital beds per 10,000		
Mean (SD)	4.8 (1.1)	5.0 (1.1)
Number of doctors per 1,000 population		
Mean (SD)	2.1 (0.5)	2.2 (0.5)
Human Development Index		
Mean (SD)	0.71 (0.04)	0.7 (0.04)
Whether visited a PHC facility in the last		
Yes (%)	2602 (14.4%)	275 (10.8%)
Whether was hospitalised in the last year		
Yes (%)	2669 (14.8%)	314 (12.3%)
OOPes (Chinese Yuan)		
Mean (SD)	796 (5168.2)	788 (4473.5)
Self-reported health (poor/very poor as ref)		
Fair/ Good/ Very good (%)	11951 (67.7%)	201 (80.2%)

STable 14 Summary statistics of the study population grouped by wealth quartiles (Q1 and Q2 as poor)

Notes: SD for standard deviations. ref for reference groups. PHC for primary health care. OOPes for out-of-pocket expenditures. The values for total household net wealth and overall OOPes were adjusted for inflation using consumer price index in 2010= 100. The scale of Human Develop Index is between 0 and 1.

Source: author's own work.

	Rural	Urban	Rural	Urban	Rural	Urban	Rural	Urban	Rural	Urban	Rural	Urban	Rural	Urban	Rural	Urban
Reform	1.40***	0.98	1.76***	1.12	1.04	0.97	0.98	0.91	-136.68	639.91*	-146.25	548.36+	1.03	1.74***	1.02	3.49***
	(1.17, 1.67)	(0.72, 1.33)	(1.27, 2.45)	(0.63, 2.01)	(0.85, 1.26)	(0.75, 1.26)	(0.67, 1.42)	(0.56, 1.50)	(-369.82, 96.45)	(63.06, 1216.76)	(-401.50, 108.99)	(-81.08, 1177.80)	(0.89, 1.19)	(1.35, 2.25)	(0.74, 1.41)	(1.90, 6.40)
Observations	27175	16469	27175	16469	27161	16466	27161	16466	26528	16055	26528	16055	26683	16111	26683	16111
Adjusted R ²	0.054	0.055	-0.469	-0.827	0.068	0.081	-0.498	-0.475	0.018	0.032	0.059	0.059	0.095	0.091	-0.05	-0.221
AIC	20653.3	9925.7	32063.9	19189.9	19139.6	12551.4	30771.3	20157.4	524903.3	316520.2	531540.6	320842.7	28701	14550.9	33270.9	19544.9
Control variables	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
FE: ID			✓	✓			✓	✓			✓	✓			✓	✓
FE: city_eng	✓	✓			✓	✓			✓	✓			✓	✓		
FE: wave	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

STable 15 Alternative model specifications for estimating the overall reform impacts on primary care utilisation, hospitalisation, OOPes, and self-reported health stratified by rural and urban populations using two-way fixed effects models

Notes: * p < 0.05, ** p < 0.01, *** p < 0.001. PHC for primary health care. OOPes for out-of-pocket expenditures. All models used cluster robust standard errors which cluster at individual level. Outcomes were the odds ratio of visiting any PHC facilities in the last month, being hospitalisation, and having very good/good/fair self-reporting health, and individual out-of-pocket expenditures in the last year (Chinese yuan). All models were adjusted for individual and provincial covariates: ages, sex (female=1 or male), marital status (married=1 or unmarried), working or not, whether enrolment of public health insurance (i.e., Employee Basic Medical Insurance, Newly Cooperative Medical Scheme, and Urban Resident Basic Medical Insurance), whether diagnosed with chronic diseases (i.e., hypertension or diabetes), and whether received secondary education or above, family sizes, household non-housing financial wealth, whether the respondents had ever drunk any alcohol last year, and whether they currently smoked at individual level, and Human Development Index (HDI), the number of hospital beds per 10,000 population, and the number of doctors (at both PHC facilities and hospitals) per 1,000 population at provincial level.

Source: author's own work.

	Rich	Poor	Rich	Poor	Rich	Poor	Rich	Poor	Rich	Poor	Rich	Poor	Rich	Poor	Rich	Poor
Reform	1.11	1.22*	1.2	1.35*	0.94	1.06	0.92	1.14	125.11	-356.37*	80.72	-489.96*	1.22**	1.04	1.56**	1.04
	(0.93, 1.32)	(1.04, 1.42)	(0.89, 1.61)	(1.04, 1.75)	(0.79, 1.12)	(0.91, 1.24)	(0.69, 1.23)	(0.88, 1.47)	(-109.97, 360.19)	(-700.62, -12.12)	(-163.00, 324.43)	(-884.45, -95.48)	(1.05, 1.42)	(0.93, 1.17)	(1.15, 2.10)	(0.81, 1.34)
Observations.	32833	32718	32833	32718	32765	32643	32765	32643	32027	31654	32027	31654	31751	31221	31751	31221
Adjusted R ²	0.05	0.054	-0.437	-0.293	0.07	0.072	-0.316	-0.241	0.024	0.022	0.054	0.062	0.088	0.077	-0.049	0.053
AIC	21220.4	25078.7	32087	34264.9	22979	25276.3	32514.4	33824.1	630739.9	643607.5	637908.3	650361.7	28705.4	35778.8	33022.2	36717.7
Control variables	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Individual fixed effects			✓	✓			✓	✓			✓	✓			✓	✓
City fixed effects	✓	✓			✓	✓			✓	✓			✓	✓		
Time fixed effects	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

STable 16 Alternative model specifications for estimating the overall reform impacts on primary care utilisation, hospitalisation, OOPes, and self-reported health stratified by the rich and poor using two-way fixed effects models

Notes: * p < 0.05, ** p < 0.01, *** p < 0.001. PHC for primary health care. OOPes for out-of-pocket expenditures. Individuals were defined as the rich if their household wealth was in the two highest quartiles (Q3 and Q4), and the poor if their household wealth was in the two lowest quartiles (Q1 and Q2). All models used cluster robust standard errors which cluster at individual level. Outcomes were the odds ratio of visiting any PHC facilities in the last month, being hospitalisation, and having very good/good/fair self-reporting health, and individual out-of-pocket expenditures in the last year (Chinese yuan). All models were adjusted for individual and provincial covariates: ages, gender (female=1 or male), marital status (married=1 or unmarried), residency status (rural=1/urban), working or not, whether enrolment of public health insurance (i.e., Employee Basic Medical Insurance, Newly Cooperative Medical Scheme, and Urban Resident Basic Medical Insurance), whether diagnosed with chronic diseases (i.e., hypertension or diabetes), and whether received secondary education or above, family sizes, whether the respondents had ever drunk any alcohol last year, and whether they currently smoked at individual level, and Human Development Index (HDI), the number of hospital beds per 10,000 population, and the number of doctors (at both PHC facilities and hospitals) per 1,000 population at provincial level.

Source: author's own work.

Z test statistics for coefficients from two-way fixed effects models

The estimated reform effects on visiting primary health care (PHC) facilities, hospitalisation, out-of-pocket expenditures, and self-reported health among rural and urban populations were compared using Z test statistics.¹⁸⁵ The same analysis was also conducted on wealth quartiles.

I used results from the canonical difference-in-differences (DID) model with city and time fixed effects to run the Z test statistics. Although the coefficients from the canonical DID estimation show that the reform affected the subgroups differently, the difference in these coefficients needs to be tested to conclude whether they are significantly different.

The Z test statistics for comparing the coefficients for urban and rural populations is:

$$Z = \frac{\beta_{rural} - \beta_{urban}}{\sqrt{(SE\beta_{rural})^2 + (SE\beta_{urban})^2}}$$

The Z test statistics for comparing the coefficients for the poor (Q1 and Q2) and the rich (Q3 and Q4):

$$Z = \frac{\beta_{poor} - \beta_{rich}}{\sqrt{(SE\beta_{poor})^2 + (SE\beta_{rich})^2}}$$

Where β are the coefficients and $SE\beta$ are the standard errors of the coefficient β . The Z test statistics were then converted to p-values for reporting.

The results from Z test statistics are shown below:

Outcomes	Rural		Urban		Z test		
	Estimate	SE	Estimate	SE	Coef diff	zdiff	P value
Visits to PHC facilities	0.33	0.08	-0.02	0.15	0.35	1.98	0.04
Hospitalisation	0.03	0.09	-0.03	0.13	0.06	0.37	0.70
OOPEs	-136.68	118.93	639.91	294.27	-776.59	-2.44	0.01
Self-reported health	0.03	0.07	0.55	0.13	-0.52	-3.49	< 0.001

STable 17 The results from Z test statistics between rural and urban populations

Notes: SE for standard errors. Coef diff for coefficient differences. Zdiff for z score differences.

Source: author's own work.

Outcomes	Poor		Rich		Z test		
	Estimate	SE	Estimate	SE	Coef diff	zdiff	p value
Visits to PHC facilities	0.19	0.07	0.10	0.08	0.09	0.77	0.43
Hospitalisation	0.06	0.08	-0.05	0.09	0.12	0.96	0.33
OOPEs	-356.36	175.62	125.11	119.92	-481.48	-2.26	0.02
Self-reported health	0.04	0.06	0.20	0.07	-0.15	-1.62	0.10

STable 18 The results from Z test statistics between the richer and poorer

Notes: SE for standard errors. Coef diff for coefficient differences. Zdiff for z score differences.

Source: author's own work.