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Explaining the declining utilization of village clinics in rural China over time: A decomposition approach

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ABSTRACT

With a goal of improving health system quality and efficiency, reforms of China's health system over the past decade have sought to strengthen primary healthcare in lower-level clinics and health centers. Despite these wide-ranging reforms and initiatives, population-based studies have documented dramatic declines in patients' use of primary care facilities during this period. In this paper, we explore the determinants of this trend in China's rural areas using detailed longitudinal data following a nationally-representative sample of rural households and village clinics from 2011 to 2018. We estimate that between 2011 and 2018, the probability that individuals sought care at village clinics when ill dropped by 44%. At the same time, the utilization of outpatient services in county hospitals increased by 56% and patient self-treatment increased by 20%. Detailed Kitagawa-Oaxaca-Blinder decompositions suggest four primary drivers of this trend: the shifting burden of disease in rural areas, changes in how patients choose to seek care given different disease conditions, declining drug inventory in village clinics, and the decreasing importance of remoteness as a determinant of healthcare seeking behavior. Our results highlight the deteriorating role of village clinics in the rural healthcare system and the increasing importance of self-treatment and higher-tier primary care services.

1. Introduction

Over the past decade, China has implemented wide-ranging health reforms with the goal of improving the quality of healthcare and addressing sources of inefficiency in its health system (Chen, 2009; Yip et al., 2012, 2019). One challenge that these reforms have aimed to address is that, without gatekeeping, patients frequently bypass local primary care providers and seek services directly in higher-level hospitals (Hsiao, 1995). This phenomenon is believed to be a source of significant inefficiencies in healthcare delivery as it contributes to the overutilization of higher-tiered hospitals and underutilization of primary care at lower-level facilities (Eggleston et al., 2008). Consequences include, for example, increased social costs, diversion of medical resources from more serious illnesses, over-provision of expensive services with little benefits, and exacerbation of patient dissatisfaction towards the healthcare system (Eggleston et al., 2008; Li et al., 2017; Yip et al., 2019). To address bypassing, China's reforms have included numerous initiatives to strengthen the infrastructure of grassroots facilities and improve referral systems between health system tiers. Yet, despite these investments, recent evidence has shown that bypassing has nevertheless continued to increase over time (Ta et al., 2020; Wan et al., 2021; Zhang et al., 2020).

This study explores changes in the use of primary care in China's rural areas during this period of broad-based health system reform. Our primary aim is to explore how different factors have contributed to changes in village clinic use over time. In rural China, there have been dramatic changes in both demand- and supply-side factors over the last decade that may have affected the utilization of village clinics, possibly in countervailing ways. On the supply-side, there have been substantial government investments in primary care with the goal of establishing a primary-care based integrated delivery system. Between 2008 and 2015, government subsidies to primary healthcare institutions increased from ¥19 billion (US$2.8 billion) to ¥140 billion ($20.3 billion) (Li et al., 2017). These funds provided supply-side subsidies to primary healthcare facilities to deliver public health services, build infrastructure, and train primary care providers. However, to what extent these investments in resources and infrastructure at the grassroots level have translated into effective services and have attracted patients is unclear. Widespread

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gaps in the quality of primary care providers still exist (Li et al., 2020). Evidence from recent studies suggests significant deficits in the quality of care delivered in rural clinics and health centers (Guo et al., 2020; Sylvia et al., 2015, 2017).

From the demand-side, rising wealth in rural areas has plausibly increased demand for higher quality services, leading patients to seek care at high-tiered hospitals where perceived quality of care is higher. Population level changes in demographics and disease patterns, such as aging and a shifting disease burden toward non-communicable diseases (Yang et al., 2008), may have also had significant effects on patient utilization patterns across health system tiers, though the direction of these effects is unclear. Additionally, the Targeted Poverty Alleviation program in China, launched in 2014, initiated a combination of policies and interventions to eradicate poverty, emphasizing the infrastructure investment in roads and bridges to solve the problem of "last mile" connectivity (Xiao et al., 2022). Along with broader effects on the rural economy, it may change patient facility choices, making remoteness a less important determinant. Given that various factors may have shifted the patient choice in different directions, understanding their relative contributions to the observed demand change for primary care in the past decades provides evidence for future policy responses.

To examine how these and other factors have contributed to changes in the use of village clinics over the past decade, we analyze a longitudinal, nationally-representative survey of rural households and health facilities spanning 2011 to 2018, a critical period of health system reform. This survey provides data linking patient healthcare seeking decisions to detailed data on patients, clinic resources, and local communities. We explore factors underlying changes in village clinic utilization over time using decomposition methods pioneered by Kitagawa (1955), Oaxaca (1973), and Blinder (1973). These methods have been used most widely to analyze factors underlying differences in outcomes between groups of individuals, such as gender wage differentials, by decomposing group-level differences into a part due to changes in determinants and a part due to their changed impacts (Fortin et al., 2011). Here, we use this approach to decompose the evolution of utilization over time into structural changes in patient and facility characteristics and changes in how individuals respond to characteristics.

In our analysis, we account for the possibility that changes in the use of village clinics may be due to either 1) changes in bypassing (where individuals may be more likely to seek medical advice and treatment at higher-level health facilities) or 2) changes in self-treatment (largely by purchasing drugs at pharmacies). Both are possible to the extent that the goods and services provided through village clinics (i.e., medical advice, drugs, and other treatments) are substitutes for those provided through pharmacies and higher-level health facilities. Thus, how much of the change in village clinic utilization is attributable to demand shifting to higher-level facilities and/or pharmacies – or overall decreasing demand for healthcare – depends on both structural changes in different factors (henceforth, "compositional effects") as well as changes in how individuals respond to these factors ("changing coefficients").

In line with previous research, we find a dramatic and persistent decline in village clinic utilization in rural China from 2011 to 2018. While the probability that individuals report being ill in the past year did not change significantly over time, village clinic utilization conditional on being ill decreased by 14.6 percentage points between 2011 and 2018, a 44% decrease from a base of 33% in 2011. Over the same period, the use of higher-level facilities (primarily county hospitals) increased by 7.1 percentage points (56%) and self-treatment increased by 7.3 percentage points (20%). With the caveat that we are examining associations, not necessarily causal relationships, our decomposition analysis suggests that compositional effects (structural changes in factors) account for 29% of the change in village clinic use, while changes in coefficients (how demand for village clinic services is associated with different factors) account for 71%. A detailed decomposition, associating compositional and coefficient effects to individual factors, points to shifts in disease burden and decreased village clinic drug availability, as well as changes in individual responses to diseases/symptoms and remoteness (distance to hospitals) as primary determinants.

Additionally, we independently decompose changes in the probability that individuals seek care in formal health facilities (vs. self-treat) and the probability that individuals seek care at village clinics (vs. upper-level facilities) conditional on seeking formal healthcare. We find that while changes in self-treatment are fully driven by changing coefficients, changes in bypassing are equally driven by both compositional and coefficient effects. Primary factors driving self-treatment are individual responses to disease composition/symptoms, remoteness, and village clinic resources, while increased bypassing is driven by changes in disease burden and village clinic drug inventory, as well as changing coefficients on disease composition, remoteness, and village doctor qualifications.

Taken together, our findings suggest that declines in village clinic utilization have been driven by a combination of structural changes and the changing nature of demand for healthcare. As village clinic utilization has decreased, demand has shifted to both self-treatment and county hospitals. Structural changes have primarily contributed to bypassing, while the changing nature of demand for healthcare has contributed to increasing rates of both bypassing and self-treatment. While speculative, our findings are consistent with the hypothesis that individuals increasingly view pharmacies (and other complements of self-treatment) and upper-tier health facility services as substitutes for those provided through village clinics.

This study contributes to existing literature exploring changes in the utilization of China's primary care facilities. Ta et al. (2020) and Wan et al. (2021) assessed trends in healthcare utilization using the nationally representative data from the China Family Panel Studies and found a decreasing trend in utilizing primary care facilities from 2010 to 2018. Wan et al. (2021) explored the possible factors underlying this decline and found evidence that decreasing utilization was associated with changes in population health and the increased prevalence of chronic diseases. Similarly, Zhang et al. (2020) saw a steady decline in primary care utilization among middle-aged and older individuals from 2011 to 2015 using the data from the China Health and Retirement Longitudinal Survey. Supplementing household survey data with province-level data from statistical yearbooks, Zhang et al. find associations between primary care utilization and hospital and licensed provider density, socioeconomic status, healthcare needs.

We build upon these studies in four ways. First, we focus on the rural areas of China and examine the patterns of primary care utilization between 2011 and 2018 using a nationally-representative panel survey of rural communities. Given the considerable variation in the regional rollout of the health reforms, our data allow us to capture changes in primary care utilization in rural villages at a national scale over this critical period. Second, we account for the possibility that declining village clinic utilization may be due to both bypassing or increasing rates of self-treatment. Third, we include detailed information on rural clinics themselves, allowing us to explore the relative contribution of supply-side features of the health system. Fourth, our application of decomposition methods yields more detailed insights into factors driving changes in utilization over time. In particular, we are able to analyze the relative role of supply-side factors that have been the targets of reforms and other factors such as demographic and epidemiological dynamics.

2. Background

The rural health delivery system in China operates as a three-tiered structure: village clinics, township health centers, and county hospitals. Village clinics serve village populations and provide preventive and primary care. Township health centers, as the middle level, supervise village clinics while providing both curative and primary care. County hospitals, as the highest level of the rural health system, serve as referral centers for townships and villages but also provide primary care services

(Eggleston et al., 2008; Hsiao, 1995). Doctors working at county hospitals and township health centers typically register as licensed doctors after formal medical training, while village doctors – often former barefoot doctors, village workers, and traditional practitioners – may practice with a village doctor certificate (rather than a regular license). Local health authorities permit village doctors to obtain a village doctor certificate to practice only in local village clinics (Li et al., 2017).

There is no strict gatekeeping mechanism in China. The general population is free to access any level of health care facilities. Patients can bypass primary care facilities and go directly to higher-tiered (and more) expensive hospitals even for minor conditions. Allowing for free patient choice may be better for population health given better-qualified doctors working in higher-tier facilities; however, unnecessary bypassing has long been of concern to the government as it undermines the efficiency of the health system, for example, driving high transportation and medical costs when illnesses could be managed in nearby primary care facilities, taking up medical resources for treating serious illnesses, or deteriorating patient-doctor relationship in hospitals overloaded with patients (Eggleston et al., 2008).

Economic and demographic trends in recent years have also posed formidable challenges to the delivery of quality healthcare in China's rural areas. As a result of large-scale migration of the working-age population to cities for work, a large portion of the population in rural areas are elderly, young children, or working-age adults too ill to work (Hu et al., 2008). At the same time, the number of providers working in rural villages and townships has decreased as existing providers retire and many younger clinicians have access to higher wages and living standards in urban areas (Anand et al., 2008; Li et al., 2017; Xue et al., 2016). Among village and township clinicians who remain, recent studies have documented substantial deficits in the quality of primary care provided (Guo et al., 2020; Sylvia et al., 2015, 2017). One of the more notable deficits is the diagnostic competency of providers: as core function of rural primary care is to appropriately triage patients to upper-level facilities, poor diagnostic ability has substantial implications for both public health and the efficiency of the health system generally. Moreover, perceived poor quality of care in village clinics relative to higher level facilities is likely an important proximate driver of bypassing (Sylvia et al., 2017).

In response to these challenges and others in rural areas, China announced wide-ranging health reforms in 2009 (Chen, 2009). The five major targets of the health reform – a primary-care based integrated delivery system, a basic public health service program, a government-instituted universal health insurance coverage, a national essential drug system, and the reform of public hospitals – have been designed to jointly address the health system inefficiency, the unaffordable medical expenses, and the growing inequalities in access to health care between rural and urban areas (Yip et al., 2012, 2019). With "improving primary health care services through a renewed system of grassroots providers" identified as one of five key reform priorities, the government has made significant investments into primary healthcare institutions (Li et al., 2017). In 2015, the government issued guidelines for operationalizing a tiered healthcare delivery system, encouraging coordinated and integrated care across levels (Yip et al., 2019). In 2016, the government launched a "family doctor contract system" where residents could register for a family doctor team for primary care services, though demand has been low and few primary health providers are qualified as gatekeepers to provide high-quality services (Fu et al., 2020; Yip et al., 2019).

Although these policies aim to strengthen primary care and direct patient flow towards the lower-tiered facilities, recent studies document a persistent decline in primary care utilization over time (Ta et al., 2020; Wan et al., 2021; Zhang et al., 2020). One possible reason is that the multiple (and potentially conflicting) policy interventions have non-uniform and countervailing effects on primary healthcare provision and patient choice of providers. For example, the implementation of a basic public health service program has required primary care providers to deliver public health services, including the management of non-communicable diseases, as one of their primary responsibilities. While this policy may have improved the capacity of grassroots facilities to detect and treat non-communicable diseases, evidence shows that increased public health duties of village clinicians require significant time investment and may negatively impact curative care provision in villages (Ding et al., 2013). Similarly, the so-called "zero-markup" policy has required primary care providers to only stock drugs on national and provincial essential drug lists and sell with no markup from wholesale to retail. The intention of this policy was to remove financial incentives to overprescribe drugs; however, without accompanying government subsidies to compensate for losses, unintended consequences have included a brain drain of experienced primary care providers, decreased medical resources in primary care, and a growing patient flow to higher-tiered hospitals with greater costs (Zhou et al., 2014). Another example is the expansion of the New Cooperative Medical Scheme (NCMS), a subsidized health insurance scheme for rural residents with over 95% coverage by 2012. Babiarz et al. (2010) found that village clinicians were often required by the local health bureau to spend considerable time performing NCMS mandate while village clinics were excluded from the NCMS reimbursement policy. As NCMS does not cover outpatient services in many counties, some patients could be incentivized to seek inpatient care in higher-tier facilities.

These supply-side policies, while significant, are only a subset of the factors that may be contributing to trends in patient bypassing, however. Along with the implementation of these policies, trends in environmental and demographic characteristics are also likely to have affected demand for care and patient choice of providers. A more complete understanding requires empirical evidence on how patient-level characteristics and primary care sources have changed and how these changes may drive changes in demand for primary care over time.

3. Data

3.1. Data source: the China Rural Development Survey

We use data from the China Rural Development Survey (CRDS), a nationally-representative survey of rural residents and infrastructure conducted by the Chinese Academy of Sciences and Peking University. The CRDS survey was first conducted in 2005 and surveyed a random sample of 100 villages from 25 rural counties across five Chinese provinces of Jiangsu, Sichuan, Shaanxi, Jilin, and Hebei. The same 100 villages were followed up in 2008, 2012, 2016, and 2019. Twenty households in each village were surveyed since the second wave, and the same 20 households were revisited in later waves. When a household was lost to follow-up, it was replaced with a household from the same village, keeping the total in the sample at 20 for that village. Table A1 shows that demographic and socioeconomic trends are similar for the followed and newly-added sample households.

To ensure the sample was nationally-representative, the five provinces chosen by the research team represent each of China's major agricultural and ecological zones: Jiangsu in the low lying south-eastern coastal regions, Sichuan in the poor south-western mountainous region, Shaanxi in the north-western arid region, Jilin in the north-eastern temperate region, and Hebei in the northern plain region. Five counties were selected within each province, with each representing one of five strata of per capita income. Two townships from each county were randomly selected, with one from the top and one from the bottom half of the distribution, and two villages from each township were chosen using the same sampling procedure. The detailed sampling procedures and the demonstration of sample representativeness are available in Babiarz et al. (2010) and Yi et al. (2015). All waves of surveys were consistently delivered in the early months of the year so that the last year's information was collected. This paper includes datasets from the latest three waves in 2012, 2016, and 2019. We do not consider the previous waves because some survey modules differed,

complicating comparisons.

The CRDS collected extensive information on village communities, clinics, clinicians, and households within all sampled villages for each wave. For this study, we link every household member's healthcare-seeking decision to patient-level data on disease severity and health status, household-level data on economic status, clinic-level data on infrastructure and drug inventory, and clinician-level data on qualification and medical practice.

As we focus on healthcare seeking among rural residents, we excluded individuals who reported residing outside of the county or migrating out for work during the preceding year. We further excluded child observations to focus our analysis on healthcare seeking among adults as decision-making regarding when and where to seek healthcare for children is likely to be distinct. Among the remaining adult rural residents across three waves, about 63%–67% of individuals reported being ill in the preceding year for each wave. We include in our sample all individuals reported as being sick, yielding 9862 total observations for analysis. The detailed sample exclusion rules and determination of the analysis sample are in Appendix A2.

3.2. Variable definitions

Our analysis focuses on individual decisions to seek primary care in village clinics. The CRDS includes information on every household member's healthcare-seeking decision for the previous year's last illness. If the respondents reported being ill in the past year, they were asked whether they consulted a doctor for the last sickness and at what facility they sought initial care. Based on this information, we define a dichotomous outcome variable as one if the individual visited local village clinics and zero if otherwise, including self-treatment (or buying medicines in the pharmacy), township health centers, county hospitals, or hospitals outside of the county.

We then consider a wide range of determinants on individuals, households, communities, and village providers guided by the Andersen/Aday Health Behavior Model (Aday and Andersen, 1974). According to this model, health care utilization is determined by health need factors, predisposing factors, enabling factors, and delivery systems. Health need factors are the most immediate cause of health service use, including the disease type of the last illness and the self-reported health status of last year. The disease type consists of nine categories: acute respiratory infection, non-communication diseases, infectious diseases, digestive system diseases, muscular-skeletal diseases, cerebral diseases, cancer, injuries, and other diseases. Among them, non-communicable diseases refer to heart diseases, hypertension, diabetes, hyperlipemia, and chronic respiratory diseases. Predisposing factors, including age, gender, and the highest level of education, refer to an individual's characteristics, and these properties normally exist before the onset of illness. Enabling variables describe the individual resources for health services. We consider two variables – NCMS participation status with three categories (not participating, participating without village clinic coverage, and participating with village clinic coverage) and the family wealth index constructed using a pooled polychoric principal component analysis based on household asset goods.

Delivery system factors on the supply-side comprise two elements – organization and resources. The delivery organization is represented using whether the living village has a clinic and the distance to the nearest township health center and county hospital. Given that all township health centers and county hospitals are located in township or county seats, the two distance variables also measure the remoteness of the rural household lives from the community centers. To proxy delivery resources available to the village, we use the village clinic equipment index, number of drugs, number of village doctors per 1000 population, whether the village has licensed doctors, and medical practicing years of village doctors. We construct the village clinic equipment index using a pooled principal component analysis based on the village clinic equipment indicators. We impute zeroes for resource variables if patients live in villages without clinics (6.36%). The inclusion of the access variable – whether the living village has clinics controls for such imputations. Table A3 in the Appendix gives a detailed description of the variables considered in this analysis.

4. Estimation strategy

Our analysis uses methods pioneered in economics by Kitagawa (1955), Oaxaca (1973), and Blinder (1973) that decompose the differences in the main outcome of interest between two groups or time periods into a part due to differences in characteristics ("compositional effects") and a part explained by differences in the associations with characteristics ("changing coefficients").

The standard Kitagawa-Oaxaca-Blinder linear decomposition is based on a linear regression framework and requires coefficient estimates from the linear regression and sample means of the explanatory variables. Although we may apply non-linear decomposition techniques with a binary outcome variable, several complications arise when estimating the individual contribution of each variable (Fortin et al., 2011). Thus, we carry out the linear decomposition in the main text and estimate the Fairlie non-linear decomposition (Fairlie, 1999, 2005) in the Appendix (Table A4) for comparison. The results from the non-linear decomposition are qualitatively similar to the results from the linear decomposition in the main text.

The first step of the linear decomposition is to estimate the probability of seeking care in village clinics using a linear probability model. The model controls for county fixed effects with standard errors clustered at the village level. Using the estimates from the linear probability model, we decompose the mean difference in the probability of visiting village clinics between the two waves as follows:

$$\overline{P}^{T_2} - \overline{P}^{T_1} = \left[\left(\overline{X}^{T_2} - \overline{X}^{T_1}\right)\widehat{\beta}^{T_2}\right] + \left[\overline{X}^{T_1}\left(\widehat{\beta}^{T_2} - \widehat{\beta}^{T_1}\right)\right]$$

where $\overline{P}$ is the average probability of utilizing village clinics in each wave, $\overline{X}$ is a mean vector of explanatory variables on health need factors, predisposing factors, enabling factors, and health care delivery system (described above), and $\widehat{\beta}$ is a vector of coefficient estimates. We apply the techniques suggested in Oaxaca and Ransom (1994) to use the coefficients from the pooled sample of the two waves.

This equation presents the results from the "aggregate decomposition". The first bracketed term represents the proportion of the trend change explained by the changes in all the characteristics X, while the second term represents the amount of the trend change that stems from differences in the returns of characteristics β as well as unobserved determinants. The first term is also known as the "compositional effects" – the contribution of the entire set of explanatory variables to the trend change in using village clinics, and the second term is labeled as "changing coefficients" – the contribution of the changed impact of all the explanatory variables on patient choice of primary care. Similarly, the linear decomposition identifies the individual contribution of each explanatory variable, known as "detailed decomposition". As in Jann (2008), we normalize the coefficients for categorical variables to address its identification problem in the detailed decomposition. The standard errors of the decomposition results are calculated using the delta method and are clustered at the village level.

Our primary decomposition analyzes changes in village clinic utilization among all individuals in the sample who reported being ill in the previous year. In addition, we conduct two additional decompositions, separately analyzing 1) changed probability of seeking care in the formal health system (either in village clinics or upper-level facilities vs. self-treatment) and 2) changed probability in bypassing (village clinics vs. upper-level facilities). The first uses the full sample of individuals who reported being ill in the past year, and the second limits the sample to those who chose to seek care at a formal health facility.

5. Results

5.1. Trend in village clinic utilization

In each survey wave, between 63% and 67% of respondents reported being ill in the preceding year, without significant changes across the waves. Fig. 1 shows a continued and significant drop in village clinic utilization among those who reported being ill during the preceding year, from 33.0% in 2011 to 22.8% in 2015 and 18.4% in 2018. This overall 14.6 percentage-point (44%) reduction is remarkable considering the policy efforts of improving the greater use of grassroots providers. Over the same period, self-treatment increased by 7.3 percentage points, and the use of higher-level facilities (primarily county hospitals) increased by 7.1 percentage points. The proportion of patients initially choosing to self-treat – largely indicating that they purchased medicines in the pharmacy for self-treatment without prior consultation with a doctor – has increased from 36.2% in 2011 to 37.7% in 2015 to 43.5% in 2018. Patients indicating that they sought care at county hospitals also increased by 56%, from 12.6% in 2011 to 17.4% in 2015 and 19.7% in 2018. County hospitals, as the highest level of the rural health system, provided more primary care services than village clinics in 2018 (19.7% and 18.4%, respectively). Township health centers, as the middle level, have not experienced significant changes in their utilization share over this period, implying that those choosing to bypass village clinics also bypassed township health centers. Similarly, the use of other hospitals outside of the county mainly remained unchanged, serving about 6% of rural patients.

5.2. Changes in determinants over time

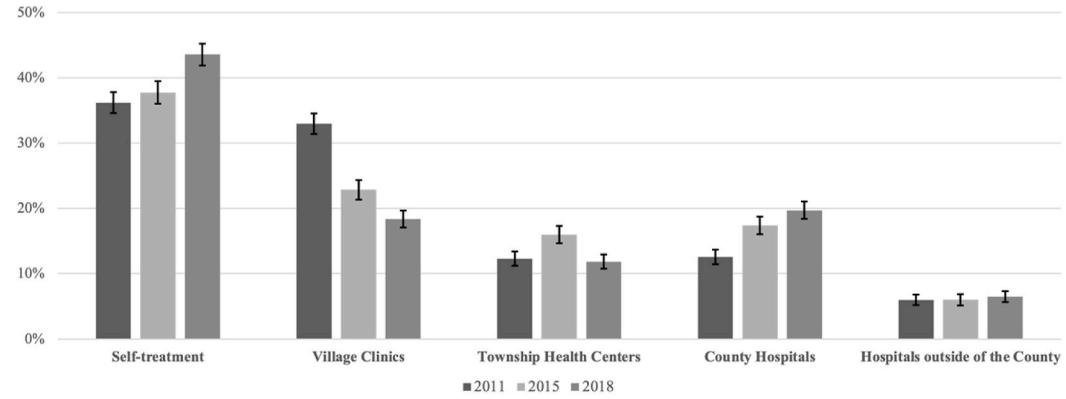
Declining village clinic utilization may be due to shifts in the distribution of determinants of healthcare-seeking choices (compositional effects) or to changes in individual response to these various determinants (coefficient effects). In this section, we describe how the distribution of various potential determinants has changed in the sample over time. In the following sections, we then explore changes in how these determinants are associated with village clinic utilization and decompose the relative contributions of compositional and coefficient effects.

Table 1 shows that considerable changes in the distribution of a few core determinants occurred in rural China between 2011 and 2018. First, there is a significant decrease in the proportion of individuals younger than 50, from 44% in 2011 to 29% in 2018. Considering the natural aging of a longitudinal sample, we compare the followed and newly-added households in each wave of our sample (Table A1) and find similar trends in their demographic and socioeconomic changes. This trend is consistent with the population demographic change in recent years. The latest 2020 population census has demonstrated that China's population is aging rapidly, with millions of young rural migrants living and working in urban areas. The composition of the population remaining in rural areas, therefore, is increasingly elderly and implies a deteriorating health status and an increasing demand for health services. Consistent with this, patients in 2018 in our sample reported worse health. The share of non-communicable diseases has significantly increased from 14% in 2011 to 19% in 2018, while acute respiratory infection has decreased from 58% to 52%. Though cerebral diseases also have statistically significant increases over time, the magnitude of the rise is minimal, with only two percentage points. This trend implies that the changes in disease composition, especially the large increase in non-communicable diseases, could have contributed to the changes in patient choice. We note that, given that all waves of surveys were consistently delivered in the early months of the survey years and asked about the last illness of the previous year, the disease composition in this study may only reflect the disease pattern in later months of the year.

In terms of "predisposing" and "enabling" factors, we observed an improvement in rural residents' living standards. The household wealth index in 2018 was significantly higher than in 2011. Gender composition and the education level were largely unchanged, with less than 5% with education higher than high school. About 60–62% of patients participated in NCMS with village clinic coverage, without significant changes over time. Table A5 also shows insignificant changes in NCMS reimbursement coverage across 100 villages.

Surprisingly, we observed a significant decrease in healthcare access and resources in the sample rural villages despite policy support. First, the average drug inventory in village clinics available to the patients has significantly decreased. Second, Table 1 shows a significantly reduced number of village doctors per 1000 population and a slight (insignificant) increase in the share of patients living in a village with nationally-licensed doctors in 2018 (32%–40%). Most rural residents still lived in villages equipped with locally certified village doctors with inadequate medical training and long medical practice years. The village clinic equipment index and the distance to the nearest township health center and county hospital were mostly unchanged as expected.

The descriptive results suggest that the decreased utilization of village clinics has been accompanied by large changes in demographics, disease burden, household wealth, and the primary care system. Whether and how these changes have contributed to the shift in patient choice for primary care, however, depends not only on how these potential determinants may have changed but also on how responsive utilization patterns are to these changes, as we explore below.



Note: Error bars represent 95% CIs.

Fig. 1. Changes in Healthcare-seeking Decisions of Rural Patients in China, 2011–2018.

Table 1
Summary statistics by year.

	2011	2015	2018	P-value
Number of observations	3438	3021	3403	
Village clinic user (0/1)	1133 (33%)	690 (23%)	626 (18%)	<0.001
Health Need Variables				
Disease type				
Acute Respiratory Infection (0/1)	1992 (58%)	1455 (48%)	1768 (52%)	<0.001
Non-communicable Disease (0/1)	496 (14%)	766 (25%)	631 (19%)	<0.001
Infectious Disease (0/1)	12 (<1%)	15 (<1%)	10 (<1%)	0.389
Digestive System Disease (0/1)	202 (6%)	162 (5%)	200 (6%)	0.579
Musculo-skeletal Disease (0/1)	230 (7%)	212 (7%)	262 (8%)	0.113
Cerebral Disease (0/1)	71 (2%)	99 (3%)	140 (4%)	<0.001
Cancer (0/1)	21 (1%)	22 (1%)	45 (1%)	0.021
Injury (0/1)	79 (2%)	63 (2%)	63 (2%)	0.605
Other diseases (0/1)	335 (10%)	227 (8%)	284 (8%)	0.008
Self-reported health status				
Excellent (0/1)	716 (21%)	619 (20%)	569 (17%)	0.004
Good (0/1)	1124 (33%)	697 (23%)	1137 (33%)	<0.001
Ordinary (0/1)	852 (25%)	907 (30%)	817 (24%)	<0.001
Bad (0/1)	635 (18%)	636 (21%)	768 (23%)	<0.001
Poor (0/1)	111 (3%)	162 (5%)	112 (3%)	0.005
Predisposing Variables				
Age				
18–34 years (0/1)	493 (14%)	294 (10%)	349 (10%)	<0.001
35–49 years (0/1)	1016 (30%)	620 (21%)	652 (19%)	<0.001
50–64 years (0/1)	1278 (37%)	1231 (41%)	1317 (39%)	0.024
>=65 years (0/1)	651 (19%)	876 (29%)	1085 (32%)	<0.001
Male (0/1)	1558 (45%)	1368 (45%)	1508 (44%)	0.239
Education				
Not educated (0/1)	649 (19%)	585 (19%)	573 (17%)	0.002
Primary school (0/1)	1186 (34%)	1063 (35%)	1232 (36%)	0.227
Middle school (0/1)	1186 (34%)	971 (32%)	1135 (33%)	0.030
High school (0/1)	266 (8%)	261 (9%)	306 (9%)	0.046
Junior college or technical school (0/1)	100 (3%)	102 (3%)	123 (4%)	0.204
College or above (0/1)	51 (1%)	39 (1%)	34 (1%)	0.196
Enabling Variables				
NCMS Insurance Participation				
Not participating in NCMS (0/1)	195 (6%)	155 (5%)	218 (6%)	0.223
NCMS without village clinic coverage (0/1)	1177 (34%)	982 (33%)	1096 (32%)	0.914
NCMS with village clinic coverage (0/1)	2066 (60%)	1884 (62%)	2089 (61%)	0.899
Family wealth index (0–10 scale points)	5.8 (2.3)	6.7 (2.3)	6.6 (2.0)	<0.001
Healthcare Access				
Living in village with a village clinic (0/1)	3305 (96%)	2701 (89%)	3229 (95%)	0.076
Distance to the nearest township health center (km)	4.9 (4.4)	5.0 (5.1)	5.1 (5.9)	0.460
Distance to the nearest county hospital (km)	23.6 (20.1)	24.2 (21.1)	24.8 (24.1)	0.059
Village Healthcare Resources (Based on patients who live in a village with village clinics)				
Village clinic equipment index (0–10 scale points)	8.2 (1.5)	8.2 (1.4)	8.5 (1.3)	0.115
				<0.001
Number of drugs available in the living village	288.4 (210.2)	216.9 (183.9)	189.9 (150.4)	
Number of village doctors per 1000 population	2.1 (2.0)	1.3 (0.8)	1.2 (0.7)	<0.001
Having nationally-licensed doctor (0/1)	1057 (32%)	985 (36%)	1295 (40%)	0.289
Medical practicing years of village doctors (years)	25.0 (10.7)	26.9 (11.1)	29.8 (11.0)	<0.001

Note. Data are n (%) for binary variables and mean (SD) for continuous variables. F-statistic p-values are inferred from regressing the year indicator on each variable with clustered standard errors at the village level.

5.3. Changes in the association with determinants over time

Table 2 explores the association between potential determinants and village clinic utilization and how these associations change over time from the linear probability model, controlling for county fixed effects with standard errors clustered at the village level. Table A6 estimates the logit model and shows similar results. Many of the determinants showed diminishing effects over time. Patients with diseases other than acute respiratory infections were more likely to bypass the village clinics, but the differential effects of disease severity decreased over time. Other determinants, such as being the elderly, having higher education, participation in NCMS with village clinic coverage, distance to higher-tiered healthcare facilities, all displayed similar diminishing effects. Drug availability was the only exception, showing an increasing association with the use of village clinics over time.

While Table 2 presents determinants of village clinic use, Tables A7 and A8 explore how determinants were correlated with the decision to visit a formal facility (vs. self-treat) and the decision to utilize village clinics conditional on choosing to visit a formal facility. One notable finding is that drug availability was not strongly associated with the decision to see a doctor over visiting a pharmacy; however, once conditional on doctor visits, drug availability was strongly associated with less bypassing. Additionally, those with more severe diseases were less likely to self-treat and, conditional on choosing to see a doctor, were significantly more likely to bypass.

5.4. Decomposition results

5.4.1. Decomposition of the trend in village clinic utilization

Table 3 examines the drivers of the overall change in the local village clinic utilization. The decomposition analysis presents two types of results: the aggregate decomposition estimates the contribution of changes in the entire set of explanatory variables, and the detailed decomposition identifies the individual contribution of each determinant to the demand change. The aggregate decomposition indicates that the 14.6 percentage point decrease in the probability of using local village clinics between 2011 and 2018 is mainly attributable to the changes in coefficients (71.0%), including differential effects of the explanatory variables and unobserved factors, while the compositional effects in the explanatory variables account for the remaining 29.0%.

Moving to the detailed decomposition results, the first two columns show individual contributors from the compositional effects, and the next two columns show coefficient effects. In terms of the compositional effects, the decreased drug availability was the largest contributor to the reduced use of village clinics (21.2%), followed by the change in disease composition (9.6%) and the decreased village doctor availability (6.8%). On the other hand, the aging of patients has had an opposite effect, promoting greater patient retention at village clinics (−5.5%).

Turning to the changes in coefficients, we find the main contributors to be the decreased impacts of disease severity, distance to higher-tiered healthcare facilities (remoteness), and having nationally-licensed doctors in villages (48.6%, 38.4%, and 32.2%, respectively). On the other hand, the increasing influence of drug availability has contributed to

Table 2
Correlates of village clinic utilization by year.

Dependent Variables: Village Clinic User (Y = 1/N = 0)	Linear Probability Model		
	2011	2015	2018
Health Need Variables			
Disease type (Base category: Acute Respiratory Infection)			
Non-communicable Disease	−0.210***	−0.214***	−0.158***
Infectious Disease	−0.247*	−0.217***	−0.084
Digestive System Disease	−0.246***	−0.168***	−0.187***
Musculo-skeletal Disease	−0.298***	−0.229***	−0.178***
Cerebral Disease	−0.382***	−0.262***	−0.198***
Cancer	−0.400***	−0.265***	−0.177***
Injury	−0.312***	−0.202***	−0.218***
Other diseases	−0.251***	−0.224***	−0.138***
Self-reported health status (Base: Excellent)			
Good	0.022	−0.017	−0.075***
Ordinary	0.037	0.005	−0.049*
Bad	0.049	0.006	−0.079***
Poor	0.020	−0.022	−0.064
Predisposing Variables			
Age (Base: 18–34 years)			
35–49 years	0.120***	−0.020	0.056**
50–64 years	0.120***	0.006	0.057**
>=65 years	0.152***	0.008	0.094***
Male (0/1)	−0.017	−0.007	0.006
Education (Base: not educated)			
Primary school	−0.027	−0.025	−0.012
Middle school	−0.060**	−0.041	−0.005
High school	−0.021	−0.072**	0.001
Junior college or technical school	−0.110**	−0.130***	−0.032
College and above	−0.165***	−0.295***	−0.053
Enabling Variables			
NCMS Insurance participation (Base: Not participating)			
Participating in NCMS without village clinic coverage	0.062	0.021	0.000
Participating in NCMS with village clinic coverage	0.138***	0.099**	0.067*
Family wealth index (0–10 scale points)	0.005	0.008*	−0.001
Healthcare Access			
Living in village with a village clinic (0/1)	−0.163	−0.197*	−0.251*
Distance to the nearest township health center (km)	0.008**	0.005**	0.001
Distance to the nearest county hospital (km)	0.001	−0.001*	0.000
Village Healthcare Resources			
Village clinic equipment index (0–10 scale points)	0.011	0.014	−0.012
Number of drugs available in the living village	0.058**	0.048***	0.118***
Number of village doctors per 1000 population	0.004	0.014	0.001
Having nationally-licensed doctor (0/1)	0.094***	0.034	−0.029
Medical practicing years of village doctors (years)	0.000	−0.000	−0.003**
County Fixed-effects	Yes	Yes	Yes
Observations	3438	3021	3403

Note. Standard errors account for clustering at the village level. *p < 0.10, **p < 0.05, ***p < 0.01.

Table 3
Decomposing the declining utilization of village clinics, 2011 to 2018.

	Contribution of Changes in Determinants (Compositional Effects)		Contribution of Changes in the Impact of Determinants (Changes in Coefficients)	
	Estimates (1)	Explained Change (2)	Estimates (3)	Explained Change (4)
The Change in VC Utilization				
Initial Proportion	0.330	–	–	–
End Proportion	0.184	–	–	–
Total Change	**−0.146**	–	–	–
Aggregate Decomposition				
Total contribution	**−0.042*** **	**29.0%**	**−0.103*** **	**71.0%**
Detailed Decomposition				
Disease composition	−0.014***	9.6%	−0.071***	48.6%
Health status	−0.001	0.7%	−0.003	2.1%
Aging	0.008***	−5.5%	−0.008	5.5%
Gender	0.000	0.0%	0.010	−6.8%
Education	−0.000	0.0%	−0.017	11.6%
Insurance	0.001	−0.7%	−0.019	13.0%
Household wealth	0.002	−1.4%	−0.038	26.0%
Village clinic availability	0.003	−2.1%	−0.084	57.5%
Distance to higher-tiered health facilities	0.002*	−1.4%	−0.056***	38.4%
Medical equipment availability	0.001	−0.7%	−0.186	127.4%
Drug availability	−0.031**	21.2%	0.293*	−200.7%
Doctor availability	−0.010**	6.8%	0.002	−1.4%
Doctor qualification	0.002	−1.4%	−0.047***	32.2%
Doctor medical practicing year	−0.006	4.1%	−0.078	53.4%
County fixed-effect	0.001	−0.7%	−0.003	2.1%

Note. *p < 0.10, **p < 0.05, ***p < 0.01.

patient retention at village clinics (−200.7%). Although we observed significant changes in associations with other variables, these are not significant contributors after controlling for other determinants.

Tables A9 and A10 examine the decomposition results by province. All five provinces experienced decreased utilization of village clinics between 2011 and 2018 to varying extents, from 8.2 to 26.6 percentage points. Among them, aggregate decomposition results were largely consistent across four, with changes in patient responses to determinants explaining the majority of the decline (63%–82%). The last province suggests a major contribution from the compositional changes in determinants (70%). However, the detailed decomposition shows substantial variation across regions without identifying consistent individual contributors for all provinces. This heterogeneity may stem from considerable regional differences in supply- and demand-side characteristics and their impacts on healthcare utilization. We also note that this heterogeneity should be interpreted cautiously given more limited statistical power within province subsamples.

5.4.2. Decomposition of the trends in seeking formal care and bypassing

Table 4 examines the drivers of the change in patient decisions to seek care at a formal facility over self-treatment (first two columns) and the utilization of village clinics conditional on seeking formal care (i.e., bypassing – columns 3 and 4). The aggregate decomposition indicates that the decrease in patients choosing to seek formal care from a doctor (or the increase in self-treatment) is fully attributable to the changes in coefficients (108.3%). The detailed decomposition suggests that primary factors driving increasing self-treatment are changes in responses to disease type, remoteness/distance, village clinic equipment availability, and village doctor experience.

Bypassing of village clinics in favor of higher-level facilities, on the other hand, appears to have been driven by a combination of compositional effects and coefficient effects. Compositional effects are estimated to have accounted for 51.8% of the decline in village clinic use among those seeking formal care, while changes in coefficients accounted for the remaining 48.2%. The detailed decomposition suggests that the change in disease composition is the largest contributor to bypassing (33.0%), followed by decreased drug availability (21.5%).

6. Discussion and conclusion

This study sought to provide insight into the declining utilization of village clinics in rural China, using a nationally-representative panel

Table 4
Decomposing trend changes in seeking formal care and bypassing, 2011 to 2018.

	Selection into formal care		Selection into VC utilization conditional on seeking formal care	
	Estimates (1)	Explained Change (2)	Estimates (3)	Explained Change (4)
The Change in Utilization				
Initial Proportion	0.638	–	0.516	–
End Proportion	0.565	–	0.326	–
Total Change	**−0.074**	–	**−0.191**	–
Aggregate Decomposition				
Compositional Effects	**0.006**	**−8.3%**	**−0.099*** **	**51.8%**
Changes in Coefficients	**−0.080*** **	**108.3%**	**−0.092*** **	**48.2%**
Detailed Decomposition (Compositional Effects)				
Disease composition	0.007*	−9.5%	−0.063***	33.0%
Health status	0.006***	−8.1%	−0.005***	2.6%
Aging	0.003	−4.1%	0.013***	−6.8%
Gender	0.000	0.0%	0.000	0.0%
Education	−0.000	0.0%	0.000	0.0%
Insurance	0.001	−1.4%	−0.002	1.0%
Household wealth	0.007**	−9.5%	−0.003	1.6%
Village clinic availability	0.001	−1.4%	0.003	−1.6%
Distance to higher-tiered health facilities	0.001	−1.4%	0.000	0.0%
Medical equipment availability	−0.000	0.0%	0.001	−0.5%
Drug availability	−0.009	12.2%	−0.041***	21.5%
Doctor availability	−0.011*	14.9%	−0.006	3.1%
Doctor qualification	0.000	0.0%	0.003	−1.6%
Doctor medical practicing year	−0.002	2.7%	−0.007	3.7%
County fixed-effect	0.003	−4.1%	0.007	−3.7%
Detailed Decomposition (Changes in Coefficients)				
Disease composition	−0.064***	86.5%	−0.042	22.0%
Health status	−0.008	10.8%	−0.002	1.0%
Aging	0.004	−5.4%	−0.015*	7.9%
Gender	0.018*	−24.3%	−0.002	1.0%
Education	−0.004	5.4%	−0.021	11.0%
Insurance	−0.007	9.5%	−0.024	12.6%
Household wealth	−0.036	48.6%	−0.022	11.5%
Village clinic availability	0.112	−151.4%	−0.218	114.1%
Distance to higher-tiered health facilities	−0.048*	64.9%	−0.049*	25.7%
Medical equipment availability	−0.232*	313.5%	−0.068	35.6%
Drug availability	0.080	−108.1%	0.360*	−188.5%
Doctor availability	0.042**	−56.8%	−0.044	23.0%
Doctor qualification	−0.017	23.0%	−0.047**	24.6%
Doctor medical practicing year	−0.104***	140.5%	−0.005	2.6%
County fixed-effect	−0.001	1.4%	−0.004	2.1%

Note. *p < 0.10, **p < 0.05, ***p < 0.01.

survey following rural households and village clinics from 2011 to 2018. We analyzed the changes in demand- and supply-side determinants of village clinic use over time and applied decomposition techniques to quantify their contributions in explaining the evolution of village clinic bypassing over this period of large-scale health reform.

Overall, we find a 14.6-percentage-point decrease between 2011 and 2018 in the probability that ill patients utilize village clinics. This result is in line with previous studies that have found a decrease in primary care utilization since the national reform (Ta et al., 2020; Wan et al., 2021; Zhang et al., 2020). Building on this evidence, we show that this decline in village clinic utilization was accompanied by increases in rates of bypassing as well as self-treatment. On the one hand, this finding contrasts with recent policy attempts to direct patients to primary care institutions. The increase in patients seeking initial care in county hospitals represents an increasing burden for county hospitals to provide outpatient services over time. On the other hand, the fact that more patients choose to go to the pharmacy for self-treatment seems to imply an increasingly important role of pharmacies in the rural healthcare system.

Our decomposition analyses suggest that several factors have contributed to this trend. We highlight four primary drivers: First, the shifting disease burden, while increasing demand for formal care, has shifted this demand to higher-level facilities. The prevalence of non-communicable diseases, for instance, increased dramatically over this period (Zhou et al., 2019). Our results show that village clinic utilization has decreased largely because those with diseases of increasing prevalence are systematically more likely to seek care in higher-level facilities than those with diseases that have decreased in prevalence.

Second, patients have responded differently to disease severity/type. Our results show that this change has contributed to declining village clinic utilization in two ways. On the one hand, those with common diseases (such as acute respiratory infections) were increasingly more likely to self-treat. In our data, 42% of those with acute respiratory infections in 2011 chose to self-treat, while 59% did so in 2018. On the other hand, those with more severe diseases were increasingly likely to bypass village clinics, conditional on choosing to seek formal care. Individuals reporting non-communicable diseases, for example, were 55% more likely to visit a township or county hospital in 2018 than in 2011 (48% vs. 31%). The probability of those with acute respiratory infections did not change over the same period (13% vs. 12%). In short, patients with less severe ailments (such as common colds) have become more likely to self-treat. In contrast, those with more serious or chronic conditions have become less likely to do so but increasingly visit higher-level facilities rather than village clinics.

The third major factor is the declining drug inventory in village clinics. According to our survey, the average number of drug types available in village clinics decreased from 288 in 2011 to 190 in 2018. Interestingly, our decomposition suggests that this decrease has not led to an increase in self-treatment (or directly purchasing drugs at pharmacies) but rather increased bypassing rates. Although we do not have data on the specific types of drugs obtained by patients, this pattern could reflect decreasing availability of drugs treating chronic or more serious conditions unavailable in local pharmacies or complementary with medical advice.

Fourth, the use of village clinics has decreased due to the declining importance of distance in determining where individuals seek care. Though an important determinant in 2011, the correlation between the distance to the nearest town or county seat and the village clinic use was small and insignificant by 2018. This diminishing correlation has contributed to the declines in the use of formal care as well as the increased rates of bypassing. A likely cause of this pattern is the investment in improved transportation infrastructure: as the time needed to travel to towns and county seats decreased, the costs to individuals of visiting higher-level facilities and pharmacies also reduced over time.

We offer these results with two important limitations. First, the estimates presented should not be interpreted as causal relationships. Though not necessarily causal, we believe the results are nevertheless informative of the relative importance of determinants in shaping changes in patient choice in rural China. Second, as we find significantly increased patient visits to pharmacies for self-medication, we lack information on pharmacies in the sampled areas. Future research is needed to further explore what appears to be an increasing role of pharmacies as part of the health system in rural areas.

Overall, our study highlights the deteriorating role of village clinics in the rural healthcare delivery system over the past decade. Gatekeeping has been proposed as a potential means to address the

inefficient use of healthcare facilities in China in recent years. Our findings show that the investment in infrastructure and the workforce at lower-level facilities in rural villages remain insufficient to meet the needs of rural patients, given broader trends in disease burden, demographic changes, and other trends in rural China.

Credit author statement

Yunwei Chen: Conceptualization, Methodology, Software, Formal analysis, Data Curation, Writing - Original Draft, Writing - Review & Editing, Visualization. **Sean Sylvia:** Conceptualization, Methodology, Validation, Writing - Review & Editing, Supervision. **Paiou Wu:** Data Curation, Writing - Review & Editing, Visualization, Funding acquisition. **Hongmei Yi:** Conceptualization, Writing - Review & Editing, Supervision, Project administration, Funding acquisition.

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Appendix A. Supplementary data

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