Examining clinical capability of township healthcare centres for rural health service planning in Sichuan, China: an administrative data analysis

Kun Zou, Zhanqi Duan, Ziwu Zhang, Jinliang Hu, Juying Zhang, Jay Pan, Chaojie Liu, Min Yang

ABSTRACT

Objective This study aimed to examine the clinical capability of township healthcare centres (THCs), the main primary care providers in rural China, as a basis for rural health service planning. Design Observational study of quantitative analysis using administrative data. Setting Three counties with low, middle and high social economic development level, respectively, in Sichuan province western China. Participants 9 THCs and 6 county hospitals (CHs) were purposively selected in the three counties. Summary of electronic medical records of 31,633 admissions from 1 January 2015 to 30 December 2015 of these selected health institutions was obtained from the Health Information Centre of Sichuan province. Main outcome measures Six indicators in scope of inpatient services related to diseases and surgeries in the THCs as proxy of clinical capability, were compared against national standard of capability building of THCs, among counties, and between THCs and CHs of each county. Results The clinical capability of THCs was suboptimal against the national standard, though that of the middle-developed county was better than that in the rich and the poor counties. THCs mainly provided services of infectious or inflammatory diseases, of respiratory and digestive systems, but lacked clinical services related to injuries, poisoning, pregnancy, childbirth and surgeries. A large proportion of the top 20 diseases of inpatients were potentially avoidable hospitalisations (PAHs) and were overlapped between THCs and CHs. Conclusions The clinical capability of THCs was generally suboptimal against national standard. It may be affected by the economics, population size, facilities, workforce and the share of services of THCs in local health systems. Identification of absent services and PAHs may help to identify development priorities of local THCs. Clarification of the roles of THCs and CHs in the tiered rural health system in China is warranted to develop a better integrated health system.

INTRODUCTION

Primary healthcare (PHC) is vital to provide essential, accessible, equitable and affordable care towards universal health coverage and health-related sustainable development goals. PHC institutions are also the foundation of the three-tiered healthcare system in China, with secondary hospitals (at county-level) and tertiary hospitals (at city-level or provincial-level) at the end. At the bottom of the three-tiered healthcare system, the township healthcare centre (THC) is the main PHC provider for the 650 million rural residents in China, with its main workforce of licensed general practitioners and registered nurses. They are responsible for the national essential public health services, primary outpatient services and inpatient services for common illness for rural residents. Although THCs of 35,762 in total in 2020 provided 1.1 billion episodes of health-care including 34.1 million episodes of inpatient services, accounted for 15% and 14% of that provided by all health institutions in China, the share of inpatient treated in THCs in the

STRENGTHS AND LIMITATIONS OF THIS STUDY

- This study used regional objective electronic medical record (EMR) data to portray clinical capacity of typical township healthcare centres (THCs) with low, middle and high economic level in rural China.
- The clinical capacity of THCs was compared against national standards, between counties with typical social-economic and geographic differences, and with local county hospitals (CHs) for understanding their strengths and limitations.
- This study looks into essential but absent clinical services and potentially avoidable hospitalisations in THCs, and overlapped hospital services between THCs and CHs, which has been rarely investigated previously.
- This study used 2015 data and more recent data is to be used for future research.
- EMR was only available for inpatients, future research may include outpatient data to allow a more comprehensive portrait of clinical capability of THCs.


Prepublication history and additional supplemental material for this paper are available online. To view these files, please visit the journal online (http://dx.doi.org/10.1136/bmjopen-2022-067028).
national healthcare system of China was declining from 26% in 2010 to 17% in 2016.7

The declining in inpatient services in the THCs could have several reasons. First, due to the fast urbanisation and transportation development in China, patients were more likely to bypass primary care facilities to obtain perceived high-quality clinical services from higher-level hospitals if they were highly accessible and financially affordable.8 Second, currently there is no mandatory or legitimated gate-keeping role of the government for THCs. For patients with more severe or complex conditions, THCs are only advised to refer them to visit county or tertiary hospitals for more specialised care.3 5

In most cases, patients are free to visit any county or tertiary hospitals without restriction. Third, the clinical capability of THCs is varied by regions, and is much weaker in remote and mountain areas due to lack of resources and especially qualified health workforce than their counterparts.9 The weakness of capability of THCs would cause more patients losing to higher-level hospitals and thus cause a vicious circle, putting the survival of THCs and health of rural residents at risk.3 Consequently, patients with common chronic illness such as hypertension and diabetes that are supposed to be cared by THCs or PHC providers went to seek care in county or tertiary hospitals, which lead to the underuse of THC resources and soaring hospital expenditure.8 10

There was evidence that clinical capability was the primary reason limiting patient’s choice of primary healthcare,11 and improving the clinical capability including drug availability, medical professional skills and equipment in rural primary care systems can induce potential medical care-seeking, and redirect patient flow from higher level hospitals to primary level in rural China.12 Many extrinsic and intrinsic factors were involved in shaping the clinical capability of THCs. Local economic status, health finance, facilities and health workforce were positively associated with clinical capability and range of clinical services of THCs.13 The serving population was also an important extrinsic factor besides local economics.14 Health policies for reducing maternal and neonatal mortality and ensuring the quality of maternal care in China had promoted hospital delivery in secondary or higher-level hospitals,5 16 which led to terminated maternal services in most THCs.

Understanding the clinical capability of THCs in regions with different social economic development levels would have important implications in rural health service planning and effectively establish gate-keeping role of THCs. To improve the healthcare services in THCs, the government has published the national guideline of THCs capability building and evaluation.17 However, few studies have explored the clinical capability of THCs, and even fewer had compared that between counties with different socioeconomic and health system contexts.2 11 18 The understanding of the role of THCs in rural health systems in China is inadequate. The county hospital (CH), usually one or two located in the county centre in each county, is the first referral destination of the THCs and the main origin of transferring discharged patients down to THCs for post-hospital care.20 To understand the similarity and difference in the clinical capability between the CH and THCs could help health authorities to make guideline for patient centred specific care in the healthcare services, which may consequently lead to better quality and integrated healthcare for rural population.

This study aimed to fill the gaps by examining the clinical capability of THCs and comparing it with local CHs. Considering that clinical capability by definition is a multiple-dimensional system, we previously reported quality of outpatient services of the sampled THCs,21 and of workload in preventive care in the study THCs.25 Hence, this study only focused on scope of inpatient services as a narrow proxy of clinical capability to reflect the coverage of the curative care of THCs. It is known that types of patients clinical services and their complexity may represent the clinical capability of a medical institution. The research questions were (1) what scope of inpatient services the THCs currently provide in terms of disease types and surgery procedures, (2) how much difference in those services provided by THCs and by the local county-level hospitals and (3) how much difference in those services among THCs with different economic status?

METHODS

This is an observational study based on administrative data from the national inpatient electronic medical records (EMRs) system. The EMRs have been established by the Committee of Health and Family Planning of Sichuan province and operated among all levels of hospitals in Sichuan province since 2014 for administrative management. Each inpatient admission has a summary or homepage of the EMRs completed at discharge. Every hospital submits the nationally standardised summary of EMRs electronically at monthly basis. This study used data from January to December 2015. The reliability of the inpatient EMRs database has been verified, on which a number of studies have been conducted and published.23 24

Sample county

Sichuan province lies in the Hu (Heihe–Tengchong) line at southern west China. The Hu line has significant geographic and socioeconomic significance. In the southeast of the line, lived 94% of the population of China with 43% of the Chinese territory, while only 6% population lived in the west of line with 57% of the territory.23 Therefore, Sichuan is a typic province that could reflect China’s demographic, geographic and average socioeconomic variations (online supplemental table 1). According to the 2015 Sichuan Province Health and Family Planning Yearbook, Sichuan had 447 CHs and 5448 primary healthcare facilities, with 4511 (83%) rural THCs and 937 urban community health centres.20

We purposively selected three counties in Sichuan province considering their socioeconomic and health system characteristics. Longquanyi (LQY) represented the richest region located in the plain of Sichuan basin, close to the provincial capital Chengdu (23km) with convenient
transports by bus or metro (about 40min), with GDP per capita of about US$17,590 in 2015, two times higher than the national level at 2015 (online supplemental figure 1). By contrast, Ganluo (GL) represented the poorest remote region located in western mountains, 350km southwest from Chengdu (6hours by bus or train) and 200km from its municipal city Xichang (5hours by bus). Its GDP per capita was about US$1,908, only one-fourth of the national average. Fushun (FS) county represented the middle-developed region located in a hilly area, 215km southeast from Chengdu (3hours by bus), and 37km from its municipal city Zigong, with GDP per capita being half of the national average. Fushun (FS) county represented the middle-developed region located in a hilly area, 215km southeast from Chengdu (3hours by bus), and 37km from its municipal city Zigong, with GDP per capita being half of the national average. Fushun (FS) county represented the middle-developed region located in a hilly area, 215km southeast from Chengdu (3hours by bus), and 37km from its municipal city Zigong, with GDP per capita being half of the national average. Fushun (FS) county represented the middle-developed region located in a hilly area, 215km southeast from Chengdu (3hours by bus), and 37km from its municipal city Zigong, with GDP per capita being half of the national average.

### Participating institutions

We purposively selected three THCs from each of the three sampled counties based on their distance of being close, average and remote to the county centre considering the accessibility of health services, and two CHs in each county were selected for comparison with that of THCs (online supplemental figure 1).

### Data extraction

Under a research agreement with the data management authority, the Health Information Centre of Health Commission of Sichuan Province, the research team obtained the EMRs data electronically for the required period. All patients admitted and diagnosed in the selected THCs and CHs from January to December 2015 were included in the analysis. Overall, the study data had 51,683 admissions, including 66,750 to THCs and 24,958 to CHs. The EMRs contained anonymous information of patients' demographics, admission and discharge status, hospitalisation expense, disease diagnoses coded by the International Classification of Disease (ICD)-10th version, and surgeries coded by the ICD-9-CM.

### Indicators

Given the fact that patients freely choose any hospital for service use in China, inpatients healthcare services represented the most complicated healthcare that would be offered by a health institution for patients to choose from. For the health system assessment, the use of services by patients has been considered an important indicator assessing capacity of primary healthcare institutions by the health authority in the country. Previous study by our team developed a tool to assess clinical care quality of county-level hospitals based on the summary information of EMRs. The tool consisted 25 indicators covering 6 dimensions. The first dimension was clinical capability with types of diseases diagnosed and treated as the key and only indicator. For clinical capability of the THCs in this study, we used six clinical service scopes as a proxy of clinical capability indicators based on the national standard of capability building of THCs, and on the availability of valid information in the data sources:

1. **Coverage of essential clinical services** as listed in the national standard of capability building of THCs, a number count of diseases diagnosed by disease domain.
2. **Coverage of diseases by systems** defined by ICD-10 chapters, a checklist with the number count of diseases diagnosed by disease systems.
3. **Coverage of surgery by systems** defined by ICD-9-CM chapters, a number count of surgery procedures performed by disease systems.
4. **Number of types of diseases** defined by ICD-10 codes.
5. **Top 20 diseases and their relative frequency among all services** defined by ICD-10 codes. From all diseases diagnosed and treated, list the first 20 ranked by counts and relative frequency.
6. **Top 10 surgeries and their relative frequency among all surgeries** defined by ICD-9-CM codes, the same definition to indicator 5 but for surgery services. The basic unit of all indicators is a curative service for disease or surgery at each hospitalisation of a patient who

### Table 1

<table>
<thead>
<tr>
<th>Health resources and characteristics of inpatient admission of sampled township healthcare centres in the three counties 2015</th>
<th>LQY</th>
<th>FS</th>
<th>GL</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of permanent residents, N</td>
<td>180,961</td>
<td>76,326</td>
<td>65,988</td>
<td></td>
</tr>
<tr>
<td>Licensed physician (assistant), N</td>
<td>79</td>
<td>57</td>
<td>24</td>
<td></td>
</tr>
<tr>
<td>Registered nurse, N</td>
<td>62</td>
<td>29</td>
<td>16</td>
<td></td>
</tr>
<tr>
<td>Beds, N</td>
<td>148</td>
<td>119</td>
<td>36</td>
<td></td>
</tr>
<tr>
<td>Admissions, N</td>
<td>1,941</td>
<td>4,042</td>
<td>1,013</td>
<td></td>
</tr>
<tr>
<td>Male inpatient, N (%)</td>
<td>661 (64.0)</td>
<td>2,127 (53.8)</td>
<td>579 (58.2)</td>
<td>≤0.001</td>
</tr>
<tr>
<td>Age of inpatients: mean (SD)</td>
<td>55.1 (20.0)</td>
<td>58.3 (20.3)</td>
<td>45.5 (18.2)</td>
<td>≤0.001</td>
</tr>
<tr>
<td>Length of stay (day)</td>
<td>6.56 (5.3)</td>
<td>5.01 (5.1)</td>
<td>4.99 (1.6)</td>
<td>≤0.001</td>
</tr>
</tbody>
</table>
| Expenditure per admission, RMB | 1160 (769) | 1283 (689) | 450 (154) | ≤0.001 *

*Kruskal-Wallis test for length of day and expenditure per admission.

FS, Fushun county; GL, Ganluo county; LQY, Longquanyi district.
could have several units if admitted to and discharged from a hospital several times during the study period. The larger number of indicators in healthcare institutions reflects wider diseases they treated and more surgeries they operated by three levels: disease domain (indicator 1), disease systems (indicators 2 and 3) and specific diseases (indicators 4, 5 and 6).

Statistical analysis
Indicators of the THCs and CHs were derived separately. The former were grouped by county and compared against those of the CHs within each county. The coverage of essential clinical services of the THCs (indicator 1) was presented against the number in the national guideline and compared among three counties using $\chi^2$ test. Indicators 2 and 3 of the THCs were compared among counties, and to that of the CHs too descriptively using frequency and percentages. The number of types of diseases and surgeries (indicator 4), ranks of diseases (indicator 5) and surveys (indicator 6) were also described and compared among counties using frequency and percentage. Larger numbers of indicators demonstrated a wider scope of inpatient services which suggested higher clinical capability in THCs. Where ever necessary, $\chi^2$ test was used to compare binary indicators between THCs of different counties and between THCs and CHs. One-way analysis of variance was used for continuous variables if they were normally distributed, otherwise Kruskal-Wallis test was used. All analyses were conducted using Stata V.15.0 SE, with two-sided significant level at 0.05.

Patient and public involvement
Patients or the public were not involved in the design, or conduct, or reporting, or dissemination plans of our research.

RESULTS
Health resources of sample THCs
The sampled THCs in LQY, FS and GL served 180,961, 76,326, 65,988 permanent residents, respectively. The number of physicians (including assistant physicians) in the sampled THCs was 79, 57 and 24, the number of registered nurses was 62, 29 and 16, and the number of beds was 148, 119 and 36, respectively, for the three counties in 2017 (table 1).

Characteristics of inpatients
Overall, 31,633 admissions were included in the analysis, including 6996 of THCs and 24,958 of CHs. The patient number of THCs for the LQY, FS and GL was 1941, 4042 and 1013, respectively. Generally, inpatients of THCs in the LQY were significantly older, with more men, longer length of stay and higher expenditure per admission (table 1).

Coverage of essential clinical services in national guideline standard
The coverage of 66 essential clinical services listed in the national guideline of THCs capability evaluation varied substantially among the three counties. While similarities between the rich-LQY (46, 70%) and the middle-developed FS (47, 71%) county, the coverage rate was much lower in the poor GL county (16, 24%). For clinical services of internal medicine, surgery, ENT, gynaecology/obstetrics and stomatology, the coverage rate ranged from 66.7% to 85.7% in the rich county, 57.1% to 84.6% in the middle county and 10% to 50% in the poor county, which were all significantly lower in the poor county than its counterparts. The most absent services were ENT (1/10), gynaecology/obstetrics (1/7) and surgical services (1/17) (table 2).

Coverage of disease systems
The capability of THCs in the middle-developed county was stronger than the other two counties in terms of coverage of disease systems. Among the 19 disease systems classified by the ICD-10, THCs in the middle-developed county covered 18 systems except for perinatal care, the rich county covered 13, absent of perinatal, congenital, mental, blood, eye system and pregnancy/childbirth services, while the poor county covered 14, absent of perinatal, congenital, blood, eye system and pregnancy/childbirth (table 3).

For THCs overall, the top five disease systems with the largest number of admissions were respiratory (50.0%), digestive (14.2%), circulation (7.6%), urinary (7.0%) and mental (6.0%) diseases.

Table 2 Coverage of essential clinical services* against national guideline of capability development of township healthcare centres in the three counties

<table>
<thead>
<tr>
<th>Domain</th>
<th>National standard†</th>
<th>LQY N (%)</th>
<th>FS N (%)</th>
<th>GL N (%)</th>
<th>P value‡</th>
</tr>
</thead>
<tbody>
<tr>
<td>Internal medicine</td>
<td>26</td>
<td>20 (76.9)</td>
<td>22 (84.6)</td>
<td>9 (34.6)</td>
<td>≤0.001</td>
</tr>
<tr>
<td>Surgery</td>
<td>17</td>
<td>9 (52.9)</td>
<td>11 (64.7)</td>
<td>2 (16.7)</td>
<td>0.005</td>
</tr>
<tr>
<td>Ear, nose, throat</td>
<td>10</td>
<td>7 (70.0)</td>
<td>6 (60.0)</td>
<td>1 (10.0)</td>
<td>0.016</td>
</tr>
<tr>
<td>Gynaecology and obstetrics</td>
<td>7</td>
<td>6 (85.7)</td>
<td>4 (57.1)</td>
<td>1 (14.3)</td>
<td>0.027</td>
</tr>
<tr>
<td>Stomatolgy</td>
<td>6</td>
<td>4 (66.7)</td>
<td>4 (66.7)</td>
<td>3 (50.0)</td>
<td>0.792</td>
</tr>
<tr>
<td>Total</td>
<td>66</td>
<td>46 (70.0)</td>
<td>47 (71.2)</td>
<td>16 (24.4)</td>
<td>≤0.001</td>
</tr>
</tbody>
</table>

*Number of diseases diagnosed within each disease domain.
†Number of essential services required by the national guideline of capability building of healthcare centres.
‡$\chi^2$ test to compare among counties.
FS, Fushun county; GL, Ganluo county; LQY, Longquanyi district.
and musculoskeletal (5.1%) systems, while that of CHs were respiratory (25.8%), digestive (16.9%), circulation (10.3%) systems, injury/poisoning (9.2%) and pregnancy/childbirth (8.4%) (online supplemental table 3).

Table 3  Disease system covered by township healthcare centres in the three counties

<table>
<thead>
<tr>
<th>No.</th>
<th>Disease system</th>
<th>LQY</th>
<th>FS</th>
<th>GL</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Respiratory</td>
<td>√</td>
<td>√</td>
<td>√</td>
</tr>
<tr>
<td>2</td>
<td>Digestive</td>
<td>√</td>
<td>√</td>
<td>√</td>
</tr>
<tr>
<td>3</td>
<td>Circulation</td>
<td>√</td>
<td>√</td>
<td>√</td>
</tr>
<tr>
<td>4</td>
<td>Urinary</td>
<td>√</td>
<td>√</td>
<td>√</td>
</tr>
<tr>
<td>5</td>
<td>Infectious/parasitic</td>
<td>√</td>
<td>√</td>
<td>√</td>
</tr>
<tr>
<td>6</td>
<td>Musculoskeletal</td>
<td>√</td>
<td>√</td>
<td>√</td>
</tr>
<tr>
<td>7</td>
<td>Injury poisoning</td>
<td>√</td>
<td>√</td>
<td>√</td>
</tr>
<tr>
<td>8</td>
<td>Cancer</td>
<td>√</td>
<td>√</td>
<td>√</td>
</tr>
<tr>
<td>9</td>
<td>Abnormal</td>
<td>√</td>
<td>√</td>
<td>√</td>
</tr>
<tr>
<td>10</td>
<td>Pregnancy/childbirth</td>
<td>√</td>
<td></td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>Nervous</td>
<td>√</td>
<td>√</td>
<td>√</td>
</tr>
<tr>
<td>12</td>
<td>Ear</td>
<td>√</td>
<td>√</td>
<td>√</td>
</tr>
<tr>
<td>13</td>
<td>Skin</td>
<td>√</td>
<td>√</td>
<td>√</td>
</tr>
<tr>
<td>14</td>
<td>Endocrine</td>
<td>√</td>
<td>√</td>
<td>√</td>
</tr>
<tr>
<td>15</td>
<td>Other contacts</td>
<td>√</td>
<td></td>
<td></td>
</tr>
<tr>
<td>16</td>
<td>Blood</td>
<td>√</td>
<td></td>
<td></td>
</tr>
<tr>
<td>17</td>
<td>Mental</td>
<td></td>
<td>√</td>
<td>√</td>
</tr>
<tr>
<td>18</td>
<td>External causes</td>
<td>√</td>
<td>√</td>
<td>√</td>
</tr>
<tr>
<td>19</td>
<td>Eye</td>
<td>√</td>
<td></td>
<td></td>
</tr>
<tr>
<td>20</td>
<td>Congenital</td>
<td></td>
<td>√</td>
<td></td>
</tr>
<tr>
<td>Total Disease systems covered, n</td>
<td>14</td>
<td>20</td>
<td>15</td>
<td></td>
</tr>
</tbody>
</table>

FS, Fushun county; GL, Ganluo county; LQY, Longquanyi district.

Number of disease and surgery types
THCs in the middle-developed FS county had the largest number of types of diagnosis (430), about three times of that in the rich LQY (136) and the poor GL (101) county. The ratio of number of types of diagnosis of THCs against CHs in the middle-developed county FS (47.8%) was also higher than that of the poor (17.4%) and rich county (15.6%) (table 4).

Top 20 diseases
The top 20 diseases accounted for 69.5% of inpatient admissions in THCs and 42.5% in CHs overall. In THCs, most of the top 20 diseases were infectious or inflammatory diseases belonging to respiratory, digestive and urinary systems. Non-communicable diseases of cardiovascular and musculoskeletal systems were also involved but had a smaller proportion compared with infectious diseases, with even smaller proportion of pregnancy and childbirth services (online supplemental table 4).

In comparison, the top 20 inpatient diseases in CHs included more severe or acute conditions which may require surgeries, such as acute appendicitis (1.6%), cerebral infarction (1.4%), internal haemorrhoids (1.4%), calculus of gallbladder with acute cholecystitis (1.3%), caesarean delivery (1.3%) and age-related cataract (1.0%). There were also more patients with diabetes complications (0.9%) in CHs, which was not among the top 20 diseases in THCs (online supplemental table 5).

Half of the top 20 diseases were the same between THCs and CHs, mainly infectious or inflammatory diseases, including chronic obstructive pulmonary diseases (COPDs), acute or chronic bronchitis, acute tonsillitis and unspecified upper respiratory infections, and unspecified bacterial pneumonia, chronic gastritis and gastroenteritis and colitis, vertebro-basilar artery syndrome, and full-term uncomplicated delivery (online supplemental tables 4 and 5).

It was notable that a large proportion of patients were hospitalised due to potentially avoidable or preventable hospitalisations (PAHs), such as pneumonia, diabetes, hypertension, COPD, pelvic inflammatory disease, ear, nose and throat infections were among the top 20 diseases of hospitalisation. These hospitalisations were considered potentially preventable because that they could be effectively treated at outpatient clinics or managed by primary healthcare. The finding pinpointed areas that warranted improvement and strengthening of primary healthcare (online supplemental tables 4 and 5).

Coverage of surgeries by system
There was no surgery in THCs in the rich and poor counties, and only very few in the middle-developed FS county, which were mainly obstetrical (82, 78.1%) and digestive (15, 12.4%) surgeries. In comparison, CHs provided surgeries covering all disease systems, in which the top five were haemic and lymphatic (32.6%), female genital organs (15.4%), obstetrical (11.5%), male genital organs (8.4%) and eye (8.2%) surgeries, followed by digestive (6.0%) and musculoskeletal systems (6.0%) surgeries (online supplemental table 6).

Table 4  Number of types of diseases and surgeries in township healthcare centres and related county hospitals

<table>
<thead>
<tr>
<th></th>
<th>LQY</th>
<th>FS</th>
<th>GL</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>THC</td>
<td>CHs</td>
<td>%</td>
</tr>
<tr>
<td>Types of disease, n</td>
<td>136</td>
<td>873</td>
<td>15.6</td>
</tr>
<tr>
<td>Types of surgery, n</td>
<td>0</td>
<td>210</td>
<td>0</td>
</tr>
</tbody>
</table>

CHs, county hospitals; FS, Fushun county; GL, Ganluo county; LQY, Longquanyi district; THCs, township healthcare centres.
The number of surgery types in THCs of the middle-developed county was 13 in total, including 4 for female genital organs, 3 for digestive system and 2 for obstetrical procedures. In comparison, CHs in the rich county had the largest number of surgery types (210), followed by the middle (156) and then the poor county (58). Surgical services in CHs of the rich and middle-developed counties covered all disease systems, while surgeries of ear, eye, nose, mouth and pharynx were absent in CHs of the poor county (online supplemental table 7).

**Top 10 surgeries**

The top 10 surgeries accounted for 95.3% of all surgeries in THCs and 54.6% in CHs. The top five surgeries provided by THCs in the middle county were other obstetric operations (43.5%), caesarean section (33.3%), procedures on haemorrhoids (7.4%), repair of hernia (3.7%) and repair of vulva and perineum (1.9%), while that for CHs were caesarean section (11.3%), procedures on haemorrhoids (7.9%), cholecystectomy (7.8%), appendectomy (6.2%) and cataract surgery (5.1%) (online supplemental table 8).

**DISCUSSION**

This study had four major findings. First, we found that the clinical capability of the nine studied THCs, irrespective of economic development status of their regions, was suboptimal against the national standard (coverage of essential clinical services ranged from 24% to 70%). Their main scope of clinical services were infectious or inflammatory diseases of respiratory and digestive systems, but lacked services of injury, poisoning, pregnancy, childbirth and surgeries. Second, THCs in both rich and poor economic development regions had lower clinical capability than those in the middle-development region, suggesting the impacts of economic and social conditions on inpatient services with possibly different mechanisms. Third, there was a large proportion of PAHs in the sampled THCs and CHs, such as pneumonia, diabetes, hypertension, chronic obstructive pulmonary disease, pelvic inflammatory disease, ear, nose and throat infections, which suggested the necessity of strengthening outpatient care of PHC as regard to the management of those diseases. Finally, there was a considerable overlap of inpatient services between the sampled THCs and CHs. Under the current healthcare insurance in China, treatment of the same disease in CHs cost more than in the THCs for both the insurance reimbursement and the number of equipment), number of health workforce were the main factors affected the health workforce were the main factors. In a study in Sichuan province, Ma et al found that local economic status and financial subsidies, facilities (area of business accommodation and the number of equipment), number of health workforce and health personnel expenditures were positively associated with clinical capability of PHC institutions. In a study in An Hui province, Shi and colleagues found that GDP per capita, service population were major external factors influencing health service capacity of township hospitals and human resources were the main intrinsic factor, while the contribution of medical equipment was limited. In a study in Sichuan province, Zhu and colleagues found that local economic status and shortage of health workforce were the main factors affected the number and quality of health service of THCs. In a qualitative study in Xinjiang province, Kade’er and colleagues found that factors affected the capability of THCs from the most important to the least were health workforce, financial input, facility and equipment, policy and transport. Previous research also found that patients were more likely to bypass primary care facilities to obtain perceived high-quality clinical services from higher-level hospitals if they were highly accessible and financially affordable, the underuse of primary care services may further diminish the capability of THCs in turn.

The finding of this study on overlapped ranges of inpatient services between the THCs and the CHs just adds another piece of evidence. Keeping patients in the care of THCs for diseases treatable by both THCs and CHs has a number of important implications in reducing care cost of both patients and insurance agency or government, in establishing a practical gate-keeping procedure of the THCs, in setting up integrated continuous care plan of patients after discharge and in strengthening capability
of THCs. However, realising the implications would involve understanding the difference in quality and safety between hospitals for the specific diseases in the two levels, which presents an important research area in near future.21

As regards disease composition, there were a large proportion of PAHs both in the THCs and CHs.36 This finding was supported by a recent national-wide study in China which found that PAHs due to chronic diseases consisted of a large proportion of hospitalisations—14.09% in primary care institutions and 9.20% in CHs, with COPD, diabetes and hypertension as leading causes.37 38 However, it was a pity that PAHs due to infectious diseases were not measured. Nevertheless, the examination of disease composition from a perspective of PAHs and regional comparisons would help to identify weaknesses and priorities of improvements of primary care and health systems.26 39 On the other hand, the largely overlapped inpatient services of THCs and CHs provide an opportunity or need of integrated care among the two levels of health institutions, which might improve quality of care and patient health outcomes.40 41

The study has several limitations. First, the use of disease spectrum and surgeries based on only inpatients medical records did not reflect quality of care nor a full clinical capability of THCs. Further study on outpatient clinical services and care quality of THCs using standard patients approach is guaranteed. Second, the analyses of spectrum of clinical services were based on inpatient medical records and relevant coding, and the accuracy of coding among different counties might influence the results. Third, the study purposely selected representative THCs and CHs for the investigation and only data from January to December 2015 was obtained and analysed, the number of sampled institutions was small, the findings warrant further verification with larger sample size, the timeliness of this study was limited and further study using data of more recent years would be valuable. In addition, results based on descriptive analysis cannot be generalised beyond the sampled counties, although the approach to explore clinical capability of THCs could be extendable. Finally, the examination of PAHs would be more meaningful if administrative data of all health institutions were obtained and the prevalence be compared between counties, which warrants further investigation.

The findings in our study have clear implications for further primary healthcare and health systems planning in rural China. First, the clinical service of THCs should be strengthened according to the health needs of local people and the guideline of national standard of capability building of THCs. Second, the clinical services provided in the THCs and CHs should be clearly clarified and coordinated so that the two level of institutions do not compete with each other but form more continuous and integrated healthcare systems in improving the health of rural people. Third, the planning of clinical services of THCs in rural China can be different according to the local socioeconomic, demographic and health system contexts. For THCs in remote and less developed areas with poor/difficult transportation, more clinical services might be planned to meet local health needs and improve the accessibility of healthcare, which might include oral clinic services, simple surgeries, lifesaving emergency services, etc. For THCs in top affluent and developed areas, clinical services might be strengthened for management of chronic diseases to prompt reasonable use of health services, sparing hospital services for more severe and urgent conditions, reducing the overall consumption of health resources and curbing the rapid increase of health expenditure.

CONCLUSIONS

The clinical capability of selected THCs was suboptimal according to the national standard, which may be affected by multiple factors including health resources, health workforce of THCs, their shares in local health systems and competition from high-level hospitals, the size of serving population and local economics. The findings also highlighted absent area of clinical services and priorities of clinical capability building of THCs. A large proportion of potentially preventable hospitalisations were among top reasons of admissions in both investigated THCs and CHs, indicating necessities and priorities of improvements of rural primary healthcare and county health systems. The large overlap of inpatient services between THCs and CHs offered opportunities and challenges of integrated care between the two levels of health institutions for better care and health outcomes of rural residents.

Author affiliations

1West China Research Centre of Rural Health Development, West China School of Public Health and West China Fourth Hospital, Sichuan University, Chengdu, China
2Department of Pharmacy, Evidence-Based Pharmacy Center, NMPA Key Laboratory for Technical Research on Drug Products In Vitro and In Vivo Correlation, Key Laboratory of Birth Defects and Related Diseases of Women and Children, Sichuan University West China Second University Hospital, Chengdu, China
3Sichuan Provincial Big Data Center, Chengdu, Sichuan, China
4Institute of Health Policy and Hospital Management Research, Sichuan Academy of Medical Sciences and Sichuan People’s Hospital, Chengdu, Sichuan, China
5Department of Epidemiology and Biostatistics, West China School of Public Health and West China Fourth Hospital, Sichuan University, Chengdu, China
6HEOA Group, West China School of Public Health and West China Fourth Hospital, Sichuan University, Chengdu, China
7School of Psychology and Public Health, La Trobe University, Melbourne, Victoria, Australia
8West China School of Public Health and West China Fourth Hospital, Sichuan University, Chengdu, Sichuan, China
9Faculty of Health, Art and Design, Swinburne University of Technology, Melbourne, Victoria, Australia

Contributors All authors made substantial contribution to this study and proved the final version. MY was involved in conception, design, data collection, writing of the manuscript; ZD, ZZ were involved in data collection and results interpretation; KZ was involved in design, data analysis, writing; JH, JZ, JP, CL were involved in study design and writing. MY is responsible for the overall content as the guarantor.

Funding China Medical Board Training for Research on the Role of Township Hospitals in the Healthcare System (RoTHiS) (16-252).

Competing interests None declared.
open access

Patient and public involvement Patients and/or the public were not involved in the design, or conduct, or reporting, or dissemination plans of this research.

Patient consent for publication Not applicable.

Ethics approval This was a retrospective observational study using secondary administrative data. For working with three specific counties, this study was approved by the Medical Ethics Committee of Sichuan University (K2017034).

Provenance and peer review Not commissioned; externally peer reviewed.

Data availability statement No data are available.

Supplemental material This content has been supplied by the author(s). It has not been vetted by BMJ Publishing Group Limited (BMJ) and may not have been peer-reviewed. Any opinions or recommendations discussed are solely those of the author(s) and are not endorsed by BMJ. BMJ disclaims all liability and responsibility arising from any reliance placed on the content. Where the content includes any translated material, BMJ does not warrant the accuracy and reliability of the translations (including but not limited to local regulations, clinical guidelines, terminology, drug names and drug dosages), and is not responsible for any error and/or omissions arising from translation and adaptation or otherwise.

Open access This is an open access article distributed in accordance with the Creative Commons Attribution Non Commercial (CC BY-NC 4.0) license, which permits others to distribute, remix, adapt, build upon this work non-commercially, and license their derivative works on different terms, provided the original work is distributed in accordance with the terms of the Creative Commons Attribution Non Commercial (CC BY-NC 4.0) license.

ORCID iDs
Kun Zou http://orcid.org/0000-0002-2175-2231
Jay Pan http://orcid.org/0000-0001-9501-1535
Chaojie Liu http://orcid.org/0000-0003-0877-0424

REFERENCES
6. Zhao KJ, Zhao L, Duan ZQ, et al. Development trends of health technicians of township health centers in sichuan province since the new health care reform [in chinese], Modern Preveotive Medicine 2020;47:3732–6. Available: https://kns.cnki.net-net.443.webpvn.scu.edu.cn/kcms2/article/bvptuid=3Q5vqf7ioTikbYiV9ys7i8b0R1PA7P7uujvtJk4dxXoC6dEi0nhen5Yy-kbc-Xs- dR2uk2WazRMOgWkUniplatform=NZKPT
15. Notice of the National health and family planning Commission on strengthening the safety and security of mothers and infants, department of maternal and child health, National health and family planning Commission No. 42, 2017.
16. Guidance on further strengthening Hospital delivery of pregnant women in rural areas, department of maternal and child health of the Ministry of health No. 12, 2009.
18. Wang C, Zhang L, Yu XS, et al. A study on the present situation of the service ability of the primary health care facilities in Chengdu from the perspective of basic medical services [in Chinese], Health Research and Innovation 2018;37:48–51. Available: https://kns.cnki.net/ kcm2article/abstract?v=3QoqahG4C4LYtOAIfrknBkrYV9ys7i8b0R1PA7P7uujvtJk4dxXoC6dEi0nhensf5Yy-kbc-Xs-dR2uk2WazRMOgWkUniplatform=NZKPT