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Residents' Willingness towards First-contact with Primary Health Care under Uncertainty in Healthcare: A Cross-sectional Study in Rural China

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Abstract

Objective

To estimate rural residents' willingness degree of initially contacting Primary Health Care (PHC) under uncertainty in healthcare, and to explore its influencing factors.

Design

Cross-sectional.

Setting

This study collected primary data from rural residents in Dangyang, Hubei province in China.

Participants

701 rural residents responded to the survey in 2022 and 674 of them were included as effective sample.

Methods

Residents' willingness was reflected by Threshold of Disease Severity for PHC (TDSP), the individual maximal disease scope for considering PHC based on their decision-making process. TDSP was measured through scenario tests and curving fitting. Univariate analysis and unordered multiple logistic regression was used to explore the influencing factors of three-level TDSP: low, general and high.

Results

26.1% respondents had low TDSP refusing considering PHC for mild diseases, and

only 28.2% had high willingness towards PHC. Respondents who were younger than 40, rich, highly risk-averse, made medical decision by others and had no experience of PHC within half year tended to have low willingness towards PHC. Compared to general TDSP, no factors were found to significantly influence respondents' high TDSP.

Conclusions

TDSP can be a good indicator of residents' willingness under healthcare uncertainty and the choice freedom, and it suggests that generally rural residents' willingness of first-contact with PHC is relatively low. Results demonstrate the necessity of intervening residents to remedy their judgement towards PHC and improve their willingness to seek primary care for better promoting the healthcare system.

Strengths and limitations of this study

- To the best of our knowledge, this study is the first nationwide study to analyse Chinese rural patients' willingness to use primary care services with their thoughts and choices under uncertainty considered.
- The measurement method in this study is innovative by combining the disease spectrum with the patients' decision-making framework.
- The measurement of this study is mainly single item of scenario test, and results might be biased due to the limited number of scenarios
- Though the topic and methodology may be widely applicable, the criteria for the level of willingness to seek primary care in this article are set according to Chinese policy, which may be a little technical to the Chinese context.

Introduction

Uncertainty is an important issue in healthcare, pervading virtually every health-related activity from disease prevention and diagnosis, to treatment. In these activities, uncertainty of various types arises in patients' minds, and further influences their thoughts, feelings and behavior[1]. Especially under the increasingly emphasized freedom of choice of doctors in many countries and regions, residents' potential responses to uncertainty can be extended when they are empowered with the freedom to approach the medical service they expect[2-6]. For example, in China, residents are free to determine the healthcare providers, but they also take the responsibility of initially estimating the disease risk and making medical choices by themselves instead

of being guided by general practitioners or family doctors. Moreover, due to asymmetric medical information, great uncertainty in individual resident's prediction of disease risk and treatment may increase their judgement deviation and influence their choices[7]. As a result, residents always subjectively contact high-level hospitals first even for minor diseases[8]. There are inevitably a waste of limited resources and inequities arising from it when everyone wants to get access to quality health care.

To solve this problem, the tiered healthcare delivery system characterized by centralized hospitals, fragmentary PHC institutions and two-way referral aiming at ensuring the sequential medical appointments has been extensively promoted, so that residents may go to appropriate medical institutions in terms of their health needs[9-12]. Currently, PHC is capable of assuming the responsibility of residents' initial contact with the national health system as the recommended gatekeeper cause most common diseases can be effectively treated there after the strengthening of primary institutions[13-15]. However, generally the tiered healthcare delivery system does not perform satisfactory after years of efforts. In Korea, 15% outpatient visits that were eligible for primary institutions chose high-level hospitals[16]. Under Japanese free-access healthcare system, undertaking the gatekeeping function of PHC was also a challenge[5]. The situation can be more serious in China. There were 4.25 billion visits of PHC institutions in 2021, accounting for 50.12% of all medical visits, 3.95% lower than the proportion in 2017[17]. In rural China, the tiered healthcare delivery system has divided medical institutions geographically into three levels: county

hospital, township health centers (THC) and village clinics. Many rural residents only consider county hospitals or above for first-contact regardless of their actual situation, though they are encouraged to visit PHC (PHC includes village clinics and THC) first[18]. It can be seen that the function of only strengthening PHC in directing patients flow and establishing the tiered healthcare delivery system is limited, and the prominent problem is that residents' subjective demand for healthcare may not overlap perfectly with government's ideal design[10]. Residents' considerations when making medical decisions under uncertainty can be the key points about their decision to contact with PHC first or not.

Therefore, it is necessary to understand residents' decision-making process. According to Andersen's behavioral model, under the freedom of choice of doctors, residents make subjective judgments based on symptoms of discomfort[19]. Then residents compare the perceived illness severity with the perceived capacity of PHC, which is the prerequisite decision-making process for generating willingness towards PHC, though residents may still ultimately go to other institutions weighing up situational factors such as urgency[10]. Since individual resident's perceived capacity of PHC, the overall perception of PHC comprehensive ability to treat diseases, is often biased but relative stable, the estimation of his(er) illness severity can be the core requisite for generating willingness towards PHC. However, under the uncertainty in healthcare field, residents' perception of the illness severity is inevitably biased from reality[7]， and the degree of deviation varies with personal

characteristics and disease conditions. Assuming that a resident is exposed to the spectrum of diseases, there exists a similar severity of some objective diseases that in the resident's perception is so serious that the maximum capacity of PHC exactly cannot handle. We call this objective and abstract upper limit of severity the Threshold of Disease Severity for Primary Health Care (TDSP). Therefore, in the antecedent decision-making framework for PHC, TDSP can represent the maximal and most severe disease scope for individual resident considering PHC. More importantly, it is a reflection and measurement of residents' degree of willingness towards PHC.

Although previous studies have noticed the importance of residents' first-contact with PHC, few studies have considered the possible impact of spectrum of diseases and different disease severity on residents' willingness towards PHC in reality, which can be rigorous and instructive faced with complex actual options[20,21]. Moreover, few studies exploring residents' willingness towards PHC under the institutional goal of the tiered healthcare system are concerned about how residents think, especially their decision-making process for making consultation choice based on the uncertainty[22]. Therefore, this study applied theoretically standardized framework and tools to measure TDSP among rural residents through scenario tests. Our study has two objectives: (1) to describe rural residents' willingness towards PHC under uncertainty through their corresponding TDSP level; (2) to explore the influencing factors of TDSP to provide reference with respect to the future modification of rural residents'

willingness towards PHC.

Materials and Methods

Principle of TDSP

According to the connotation, TDSP is generated based on two essential factors: residents' perceived disease severity and perceived capacity of PHC (this research refers specifically to THC) which together describe the antecedent decision-making framework (Figure 1). In Figure 1, the horizontal and vertical axes both represent standardized disease severity which values from 0-1 represents an objective and standardized measure of the severity of diseases in the disease spectrum. The capacity of PHC can be understood as the maximum severity of the disease that can be treated by PHC, so vertical axis connects the disease severity with the capacity of PHC. The curve that depicts the trend of residents' perceived disease severity as disease severity increases is L1, which in practice tends to be higher than diagonal and to increase to the upper right due to disease perception bias. Resident's perceived capacity of PHC is L2, and the horizontal coordinate of the intersection P of L2 and L1 is TDSP.

TDSP from 0-1 is an antecedent factor for generating willingness towards PHC. Only when the actual disease severity is lower than the TDSP will the resident includes PHC as an alternative plan. The higher the TDSP, the more likely the resident is to consider first-contact with PHC when the disease is relatively serious, and the higher willingness degree towards PHC. For example, for an individual with a TDSP value of 0.4, she will consider PHC if the disease scope is between 0-0.4 severity, and her

willingness to attend PHC is higher than those with an TDSP of 0.2.

Standardized tool for TDSP

This study applied a standardized disease severity framework developed already based on the incidence of common diseases and the basic underlying clinical pathways[23,24]. The principle is to equate the standardized disease severity with the difficulty of treating the disease, and to roughly grade it through standard treatment provisions including examinations like CT, operations and the performing medical institutions. The increasing complexity of treatment provisions is indicative of the increasing standardized disease severity addressed. As for a patient's single consultation, the treatment provisions are roughly combined and categorized into 9 situation from the mildest small outpatient clinic (0.1), general outpatient clinic (0.2), to the extremely severe Acute and Critical Care (0.9) (as shown in Annex 1). A situation represents a range of disease severity (±0.05), not a specific degree, and the severity of corresponding diseases can be adjusted for specific treatment difficulty and duration. The most complex situation within the capacity of PHC is minor inpatient surgery (0.6), which means that excluding the critical value (0.6) with ambiguity, PHC is capable of treating diseases of 0-0.55 severity.

Measurement of TDSP

To estimate patients' perception of disease severity and plot L1, scenario tests were conducted based on 10 diseases including common cold (D1), gastritis (D2), gastroenteritis (D3), urticaria (D4), otitis media (D5), furuncle (D6), hemorrhoids (D7), fracture (D8), coronary heart disease(D9), acute simple appendicitis (D10)

among respondents. Clinicians in different departments selected those typical 10 diseases according to the given situation categorizations. Specific treatment difficulties were taken into account to differentiate disease severity. In the scenario tests, residents were assumed to suffer from the given symptoms of each of 10 diseases and were asked to choose the intended treatment, for example, they wanted to take medicine or transfusion for curing cold (Annex 2 for details). To draw L1, horizontal coordinate from 0.1 to 0.55 was established according to different severity of the 10 diseases from D1 to D10 with 0.05 being the interval, and the vertical coordinate was the perceived disease severity of 10 diseases in line with individual resident's choice. For example, a cold normally required only a small outpatient medication prescription with a severity of 0.1, and the resident believed that the cold required an X-ray with a perceived severity of 0.4, the point (0.1, 0.4) was one of the 10 bases for fitting curve L1. For each individual, a total of 10 points were generated to simulate L1.

As for curve fitting, L1 was fitted using each of the four functions: linear, logarithmic, exponential and power functions. These four functions basically covered the possible shapes of L1. The fitting results were screened according to the following criteria: (1) the function with outliers was excluded; (2) $R^2 \geqslant 0.7$, and the function with the largest R^2 was selected; (3) when (1) and (2) were not met, the case was separately checked and analyzed to adjust the fitting function.

To estimate resident's perception of the capacity of PHC and plot L2, residents were asked to choose the maximum treatment provisions they would like to utilize in PHC, which also demonstrated the maximum standardized disease severity they wanted to be treated by PHC. Moreover, in order to measure their perceived capacity of PHC more accurately, for each treatment combinations they chose, residents could express their attitude of three levels: strong, medium and weak (Table 1).

Table 1 Estimation of residents' perceived capacity of PHC

Situation Categorization	Treatment provisions utilization	Attitude	Standardized disease severity
Standard Outpatient Clinic	Willing to do minor examinations + general outpatient treatment + medication in PHC	weak	0.25
		medium	0.3
		High	0.35
Outpatient Surgery	Willing to do minor examinations + minor operations + outpatient medication in PHC	weak	0.35
		medium	0.4
		High	0.45
Inpatient Internal Medicine	Willing to accept inpatient monitoring, care and treatment services in PHC	weak	0.45
		medium	0.5
		High	0.55
Minor inpatient surgery	Willing to accept minor surgery + inpatient monitoring, care and treatment services in PHC	weak	0.55
		medium	0.6
		High	0.65

To make the connotation of TDSP clear, TDSP was divided into three level: low TDSP (0-0.3), general TDSP (0.3-0.55) and high TDSP (>0.55) according to corresponding willingness degree. Residents whose actual disease only needed a standard outpatient clinic (=0.3) refusing to visit PHC had low TDSP and low willingness for PHC. Residents who suffered from relatively serious disease that required minor inpatient surgery (=0.55) or more still considered visiting PHC had relatively high willingness towards PHC and belonged to the group of high TDSP. While residents who scored 0.3-0.55 had actually low but reasonable willingness

towards PHC because different PHC institutions that accessed by different residents were inconsistent in quality and service scope.

Research setting and Data Sources

We conducted a cross-sectional study in Dangyang, a typical rural area in Hubei Province located in central China, with a rural population of 331,349 and a gross domestic product per capita higher than the national average[25]. We used the stratified sampling method to randomly select 3 villages from each of the 10 townships in Danyang. Household survey was conducted in the selected villages with reasonable incentives, with roughly 70 residents selected from each village. Respondents were investigated through face-to-face questionnaire interview by uniformly trained investigators. Inclusion criteria: (1) >18 years of age; (2) permanent residents of the area (living in Dangyang for ≥ 6 months); (3) voluntary participation in the study. Exclusion criteria: presence of cognitive impairment. In total, 701 residents responded to the survey. 27 respondents disregarded PHC and chose county hospitals for any disease severity, so they did not fit into the general decision-making framework and were excluded. The effective sample size for this study was 674.

Questionnaire design and Variables

The questionnaire was self-designed based on government guidelines, previous literature and expert consultations. We conducted a pilot study to verify the consistency between TDSP and residents' self-assessed willingness towards PHC and to test the reliability and validity of the questionnaire. The final version of the questionnaire contained three sections: fundamental personal characteristics,

estimation of perceived capacity of PHC and scenarios tests of 10 diseases. Fundamental personal characteristics identified as independent variables were mainly from three aspects: (1) sociodemographic characteristics including gender, age, education, marital status, employment, economic status and chronic disease status; (2) health-seeking objective factors including county hospital acquaintance, and medical decision maker; (3) health-seeking subjective factors including expected price for curing cold, watching health video frequency, attitudes towards tiered delivery healthcare system, level of risk aversion, and experience of visiting PHC within 6 months. Since village clinics here were sufficient and administrative, PHC in this research referred specifically to THC. While the dependent variable was the three-level TDSP.

Statistical Analysis

The software SPSS 26.0 was used to create a database and analyze data with a double check to ensure the quality and accuracy. Sample description were listed to depict the fundamental characteristics of respondents. Univariate analysis was performed using Chi-square test and variance analysis. Unordered multiple logistic regression method was used to analyze the predictors of three-level TDSP.

Results

Description of TDSP and willingness degree

TDSP distribution was shown in Figure 2. Among 674 valid respondents, the mean of TDSP was roughly 0.434±0.179, with an upper quartile of 0.285 and a lower quartile of 0.559. The two frequency peaks of TDSP occurred in the intervals of 0.15-0.2 and

0.5-0.55, and the percentage of TDSP below 0.2 and below 0.55 was 19.0% and 71.8% respectively. Only 190 (28.2%) residents had high TDSP more than 0.55, and 176 (26.1%) residents had low TDSP less than 0.3. The distribution of the whole TDSP plot showed a left-skewed character. Generally, the overall level of TDSP was relatively low, and a significant proportion of respondents had extremely low TDSP with apparently low willingness towards PHC.

Baseline characteristics and univariate analysis of TDSP level

Table 2 presents the baseline characteristics of respondents and the results of univariate analysis of TDSP level. Among 674 respondents, elders over 60 years of age accounted for 49.9%, and respondents under 40 tended to have higher possibility of low TDSP. As for economics, rich respondents were more likely to have low TDSP, while average and poor respondents tended to occupy a higher proportion of general and high TDSP. When faced with the consultation choice, the vast majority of respondents made decisions by themselves. 68.5% respondents had no experience for PHC within six months. Moreover, 15.9% respondents had strong level of risk aversion, and they were more likely to have low TDSP. In addition, results showed that there were no statistically ($p>0.05$) significant differences for gender, chronic diseases, expected price for curing cold and attitudes towards the tiered healthcare delivery system.

Table 2 Respondents' baseline characteristics and univariate analysis of TDSP level

Characteristic	N (%)	TDSP level			$\chi 2$	P
		Low (%)	General (%)	High (%)		

Sex					5.174	0.075
Female	328(48.7)	98(55.7%)	146(47.4)	84(44.2)		
Male	346(51.3)	78(44.3)	162(52.6)	106(55.8)		
Age					29.154	0
<40	77(11.4)	37(21)	23(7.5)	170(8.9)		
40-59	261(38.7)	63(35.8)	125(40.6)	73(38.4)		
60-74	270(40.1)	69(39.1)	121(39.3)	80(42.2)		
>=75	66(9.8)	7(4)	39(12.7)	20(10.5)		
Education					25.283	0
Primary school	263(39)	42(23.9)	140(45.5)	81(42.6)		
Junior school	245(36.4)	77(43.8)	101(32.8)	67(35.3)		
Senior school	129(19.1)	42(23.9)	55(17.9)	32(16.8)		
College and above	37(5.5)	15(8.5)	12(3.9)	10(5.3)		
Marital status					10.138	0.038
Married	620(92)	157(89.2)	287(93.2)	176(92.6)		
Unmarried	22(3.3)	12(6.8)	5(1.6)	5(2.6)		
Divorced or widowed	32(4.7)	7(4)	16(5.2)	9(4.7)		
Employment					21.594	0.001*
Farming or migrant workers	381(56.5)	82(46.6)	190(61.7)	109(57.4)		
Individual business, work in enterprises and institutions	143(21.2)	48(27.3)	54(17.5)	41(21.6)		
Retirement	136(20.2)	36(20.5)	61(19.8)	39(20.5)		

Others	14(2.1)	10(5.7)	3(1)	1(0.5)		
Economics					13.778	0.008
Rich	101(15)	38(21.6)	33(10.7)	30(15.8)		
Average	483(71.7)	120(68.2)	224(72.7)	139(73.2)		
Poor	90(13.4)	18(10.2)	51(16.6)	21(11.1)		
Chronic diseases					6.017	0.198
0	340(50.4)	102(58)	144(46.8)	94(49.5)		
1 or 2	277(41.1)	60(34.1)	136(44.2)	81(42.6)		
More than 2	57(8.5)	14(8)	28(9.1)	15(7.9)		
County hospital acquaintance					6.515	0.038
Yes	122(18.1)	43(24.4)	50(16.2)	29(15.3)		
No	552(81.9)	133(75.6)	258(83.8)	161(84.7)		
Medical decision maker					11.199	0.024
Oneself	541(80.3)	128(72.7)	253(82.1)	160(84.2)		
Partner	70(10.4)	22(12.5)	29(9.4)	19(10)		
Parent/child	63(9.3)	26(14.8)	26(8.4)	11(5.8)		
Expected price for outpatient					15.291	0.018
50 yuan	286(42.4)	63(48.1)	148(39.5)	75(42.4)		
100 yuan	246(36.5)	80(29.2)	90(40)	76(36.5)		
300 yuan	103(15.3)	25(16.9)	52(13.7)	26(15.3)		
500 yuan	39(5.8)	8(5.8)	18(6.8)	13(5.8)		
Watching health video					10.048	0.04

Always	104(15.4)	34(11.4)	35(18.4)	35(15.4)		
Occasionally	227(33.7)	65(34.1)	105(30)	57(33.7)		
Rarely	343(50.9)	77(54.5)	168(51.6)	98(50.9)		
Attitudes towards tiered healthcare system					6.448	0.168
Agree	588(87.2)	145(89.3)	275(88.4)	168(87.2)		
Disagree	50(7.4)	18(5.5)	17(7.9)	15(7.4)		
Indifferent	36(5.3)	13(5.2)	16(3.7)	7(5.3)		
Level of risk aversion					13.43	0.009
Strong	107(15.9)	42(13)	40(13.2)	25(15.9)		
Middle	413(61.3)	104(62.7)	193(61.1)	116(61.3)		
Low	154(22.8)	30(24.4))	75(25.8)	49(22.8)		
Experience of PHC within half year					12.582	0.002
Yes	212(31.4)	37(36.4)	112(33.2)	63(31.5)		
No	462(68.6)	139(63.6)	196(66.8)	127(68.5)		

* cases where the expected value is less than 5, corrected with Fisher's exact test

Predictors of TDSP level of First-contact with PHC

Table 3 presents the results of the multiple unordered logistic regression model and identifies the predictors of TDSP level. Compared with respondents with general TDSP, factors including age, economics, medical decision maker, level of risk aversion and experience of PHC within 6 months significantly contributed to low TDSP of respondents. Respondents aged under 40, 40-60 and 60-75 were respectively 7.34, 2.51 and 4.18 times more likely to have a low TDSP compared to respondents

aged 75 and over. Compared with respondents who just finished primary school, those who completed junior school had significantly lower TDSP level (OR=2.50, p<0.01). Moreover, rich respondents were 1.91 times more likely to have low TDSP than respondents of average economic level. Respondents who were strongly risk-averse were 1.96 times more likely to have a low TDSP than those who were low risk-averse. While respondents with no experience for PHC were twice as likely to have a low TDSP as those with experience for PHC. However, compared with respondents with general TDSP, we found no factors that could have a significant effect on high TDSP level.

Table 3 Predictors of TDSP level in the multiple unordered logistic regression model

Characteristic	Category	Low TDSP				High TDSP			
		β	OR	95% CI	P	β	OR	95% CI	P
Age (*>=75)	<40	1.994	7.344	2.463-21.894	0	0.233	1.262	0.486-3.274	0.633
	40-59	0.919	2.508	0.978-6.429	0.056	0.002	1.002	0.516-1.947	0.995
	60-74	1.43	4.181	1.68-10.405	0.002	0.266	1.304	0.692-2.458	0.411
Education (*Primary school)	junior school	0.913	2.491	1.501-4.136	0	0.112	1.053	1.053-0.361	0.924
	Senior school	0.553	1.739	0.923-3.273	0.087	-0.089	0.915	0.512-1.635	0.764
	College and above	0.319	1.376	0.484-3.914	0.55	0.052	1.119	0.716-1.747	0.621
Economics (*Average)	Rich	0.649	1.913	1.083-3.379	0.025	0.42	1.521	0.867-2.67	0.144
	Poor	-0.201	0.818	0.441-1.517	0.524	-0.453	0.636	0.363-1.114	0.114
Medical decision maker (*oneself)	Parent/child	1.007	2.738	1.386-5.411	0.004	-0.387	0.679	0.316-1.46	0.322
	Partner	0.709	2.032	1.071-3.856	0.03	0.135	1.145	0.613-2.139	0.672
Level of risk aversion (*Low)	Strong	0.672	1.958	1.016-3.774	0.045	-0.09	0.914	0.482-1.731	0.782
	Middle	0.135	1.144	0.683-1.917	0.609	-0.13	0.878	0.567-1.36	0.56
Experience of PHC within half year (*Yes)	No	0.741	2.098	1.316-3.346	0.002	0.138	1.148	0.773-1.705	0.494

*** indicates the reference group**

Discussion and conclusion

Discussion

Respondents' overall TDSP was relatively low indicating their willingness to seek primary care was deficient. More than 70% respondents did not have high TDSP, while 26.1% respondents had low level of TDSP, and even 19.0% respondents had TDSP less than 0.2, which meant they no longer included PHC in the alternative plans confronting a mild disease at the disease severity of 0.2, approximately for gastroenteritis. Although no research directly proved the results, previous research corroborated the findings of this study. Research stated that patients' health condition and disease perception could influence their willingness to seek primary care[26], and that patients' willingness to firstly visit PHC was insufficient and even continuously decreasing[10,27,28]. Under the freedom of choice of doctors without strict stipulation about referral or triage of patients, the advocacy of the tiered healthcare delivery system cannot effectively guide patients' decision-making process. Though residents' distrust of the capacity of PHC has been regarded as the most immediate reason for residents to skip PHC[29,30], residents' perceptual biases based on uncertainty, especially the misconceptions about disease severity and institutional capacity, are perhaps the more essential and fundamental reasons for them bypassing PHC. The overestimation of disease severity and the underestimation of primary capacity together manifest as low TDSP, which underscores residents' preferences and habitual choices for larger hospitals even for treating mild diseases[31,32], and explains their insufficient willingness of first-contact with PHC in China.

Low TDSP level is the focus of this study. Compared with respondents with general TDSP, age, education, economics, medical decision maker, level of risk aversion and experience for PHC significantly influenced low TDSP. Respondents who were older than 75 years old were more willing to go to PHC firstly with common diseases. As people age, they become more tolerant of the disease severity. PHC can be more convenient for them in terms of the consultation frequency, distance and medical cost, but these advantages are not similarly attractive to young residents. As for economics, the probability of low TDSP for poor respondents was less than half that of rich respondents who were inclined to consider PHC only when undergoing really minor disease. Research also proved that better economic condition was positively correlated with residents' willingness towards high-level hospitals[33]. High income is conductive to afford the medical costs, and apart from income itself, it prevailingly symbolizes social status which can possess quality health resources and simplify the decision-making process directing to high-level hospitals[34]. Moreover, high risk-averse respondents were more than twice as likely to have low TDSP as low risk-averse respondents. Although risk aversion attitude is rarely reported as associated with healthcare choice, it can act on the disease uncertainty which affect disease judgment and the decision-making process[32,35]. Patients tend to choose high-level hospitals to bear high financial cost and avoid the risk of medical delay, which is to "pay for peace of mind". We also found that respondents who had experience of PHC within six months were less likely to have low TDSP. Personal

experience may modify residents' understanding towards PHC institutions and accordingly mitigate their perceived risk of seeking primary care. However, this study found no significant relationship between individual chronic disease condition and their TDSP level. Chinese government has dedicated to constructing PHC for managing chronic diseases sustainably, which has also been treated as an opportunity to develop the gatekeeping function of PHC[36,37]. In accordance with the goal, previous study found that rural residents with chronic diseases had stronger acceptance of the tiered healthcare system and were less likely to skip PHC[38]. As for our findings, chances are that the management of chronic diseases has not been fully underlined in study areas.

Results also suggested that 28.2% respondents had high TDSP, which meant they continuously considered PHC when their disease was relatively severe. The high willingness towards PHC is beneficial to residents' sequential and effective utilization of medical resources that underpins the advocacy of the tiered healthcare delivery system. However, compared with respondents with general TDSP, we did not find factors that could significantly influence high TDSP. Possibly, residents' high DTP is mainly due to individual perception rather than other objective factors. One point of concern is that though the construction of PHC has indeed greatly improved residents' health accessibility, residents with high TDSP might be unduly tolerant to disease severity and have the risk of delaying treatment of serious diseases in PHC. Special attention needs to be paid to provide appropriate referral that leads those residents to

high-quality health services when necessary.

Generally rural residents' low willingness towards PHC based on perception bias reflects the dilemma of "matching supply and demand" in establishing the tiered healthcare delivery system. On the one hand, the category of PHC in rural areas depends on the geographical location, rather than the disease varieties[39], indicating that PHC may remain ambiguous in its capacity to residents after being strengthened. The little confidence towards PHC that residents' hold also validates the objective gap between the service scope of PHC and residents' health demands. On the other hand, under the freedom of choice of doctors, residents are responsible for determining their healthcare providers, but their perception of disease severity is inherently biased and difficult to match with standardized treatment provisions they truly deserve. The shift in their health concepts from seeking comfort to avoiding any possible risk may amplify this bias. Therefore, in essence, encouraging residents to seek primary care first is somewhat in conflict with their freedom to choose medical institutions under great uncertainty and risk aversion.

To modify rural residents' willingness towards PHC, we make the following recommendations. Firstly, a well-established mechanism of general practitioners as "gatekeepers" in England can avoid similar dilemma[40,41], so the establishment of a disease triage mechanism with both professionalism and accessibility is a feasible solution. Internet healthcare consultation can be an effective form of triage for

upgrading the tiered healthcare system[42,43]. Video and graphic consultations can eliminate the restriction of time and space and efficiently facilitate doctor-patient interactions if accompanied by patient training of devices techniques and remote communication skills[44]. Secondly, in addition to the recommendation above, it is more intrinsic and necessary to lead residents to make rational decisions since the problem mostly lies in how residents think and choose. Due to risk aversion, residents' preference for high-level hospital can occur[45,46], so narrowing down the distance between residents' perceived health demands and their objective health needs can be favorable to increase their rational first-contact with PHC[47]. Promoting the scientific knowledge of common diseases and the rational understanding of modern medicine among rural residents can probably relieve their psychological stress about disease severity and motivate them to contact PHC for minor diseases. Moreover, in reality, a good experience at PHC may reverse the trend of residents' preference for first-visit in high-level hospitals. Reinforcing residents' accurate cognition of PHC may promote their rational access to PHC.

Limitations

This study also has several limitations. First, the connotation of disease severity is ambiguous, so in most previous studies, disease severity has been referred to by descriptive ratings. Although the methodology is not yet perfect, this paper has attempted to quantify the concept of disease severity and tried to optimize it by integrating most treatment situations in PHC, clinical experts' opinions and

government guidelines. Second, only 10 diseases were selected for scenario tests in this study. Each disease severity was represented by one disease, which was susceptible to be impacted by patients' preference for a certain disease. Third, this study estimated the capacity of PHC according to treatment provisions from government guidelines, but the guidelines may not be as objective and comprehensive in the estimation, which may also give rise to some deviation.

Conclusions

TDSP can be a good indicator of residents' willingness towards PHC under uncertainty and freedom of choice in healthcare based on residents' decision-making process. In general, residents' overall TDSP was relatively low with low willingness towards PHC, and a small percentage of residents had high TDSP with high willingness of visiting PHC. Age, education, economics, medical decision maker, level of risk aversion and experience for PHC within six months were the predictors of low TDSP level. Those results may intervene in future improvement for modifying resident's medical decisions and rationally promoting their willingness towards PHC.

Contributors

Song Fei and Wei Ran contributed equally to this paper

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Competing interests

None declared.

Data availability statement

Data are available upon reasonable request. Data are available upon request. To obtain data, please email the corresponding author.

Ethics statements

Patient consent for publication

Not required.

Ethics approval

This study involves human participants. The study was approved by the Ethics Committee of Tongji Medical College of Huazhong University of Science and Technology. The ethics number was IORG0003571.All the respondents were voluntary to be interviewed and signed the informed consent form.

References:

[1] Han, P. K., Klein, W. M., & Arora, N. K. (2011). Varieties of uncertainty in health care: a conceptual taxonomy. Medical decision making : an international journal of the Society for Medical Decision Making, 31(6), 828 – 838. https://doi.org/10.1177/0272989x11393976

[2] Zhang Y, Tang WX, Sun XW, et al. [Studying on the influence of residents' seeing a doctor freely on the integration of health service system in China]. *The Chinese Health Service Management*. 2014;31(09):678-680.

[3] Simões J, Augusto GF, Fronteira I. Introduction of freedom of choice for hospital outpatient care in Portugal: Implications and results of the 2016 reform. *Health Policy*. 2017;121(12):1203-1207. doi: 10.1016/j.healthpol.2017.09.010.

[4] Yoon KJ, Oh YH, Lee SH, Ha SY, Yeo JY, Kim JH, Lee KJ. [Issues and Improving Strategies on Korea Healthcare Delivery System]. *Korea Institute for Health and Social Affairs*; Sejong, Korea: 2014

[5] Aoki T, Yamamoto Y, Ikenoue T, et al. Effect of Patient Experience on Bypassing a Primary Care Gatekeeper: a Multicenter Prospective Cohort Study in Japan. *J Gen Intern Med*. 2018;33(5):722-728.

[6] Hillen, M. A., Gutheil, C. M., Strout, T. D., Smets, E. M. A., & Han, P. K. J. (2017). Tolerance of uncertainty: Conceptual analysis, integrative model, and implications for healthcare. Social science & medicine (1982), 180, 62–75. https://doi.org/10.1016/j.socscimed.2017.03.024

[7] Arrow KJ. Uncertainty and the welfare economics of medical care. 1963. J *Health Polit Policy Law.* 2001;26(5):851-83. doi: 10.1215/03616878-26-5-851. PMID: 11765268.

[8] Zhang Y. [Research on the evaluation and mechanism of the multi-institutional readmission service integration in rural China: township-county hospitals]. Wuhan: Huazhong University of Science and Technology.

[9] Bull State Council People's Repub China. [State Council's guiding opinions on promoting the construction of the tiered healthcare delivery system]. 2015; 27:27-31 http://www.gov.cn/zhengce/content/2015-09/11/content_10158.htm

[10] Zhao X, Xiao J, Chen H, et al. Patient preferences and attitudes towards first choice medical services in Shenzhen, China: a cross-sectional study. *Brit Med J Open*. 2022;12(5):e057280. doi:10.1136/bmjopen-2021-057280

[11] Eggleston K, Ling L, Qingyue M, Lindelow M, Wagstaff A. Health service delivery in China: a literature review. *Health Econ*. 2008; 17(2):149-165. doi:10.1002/hec.1306

[12] Wang X, Yang H, Duan Z, Pan J. Spatial accessibility of primary health care in China: A case study in Sichuan Province. *Soc Sci Med*. 2018;209:14-24. doi:10.1016/j.socscimed.2018.05.023

[13] Yang J, Siri JG, Remais JV, et al. The Tsinghua-Lancet Commission on Healthy Cities in China: unlocking the power of cities for a healthy China. *Lancet*. 2018;391(10135):2140-2184. doi:10.1016/S0140-6736(18)30486-0

[14] World Health Organization. The world health report 2008: primary health care

now more than ever: introduction and overview. Geneva, 2008. https://apps.who.int/iris/ handle/10665/69863

[15]Bull State Council People's Repub China. [State Council guidance on the promotion and development of medical consortium]. 2017; 13:14–8. http://www.gov.cn/gongbao/content/2017/content_5191699.htm

[16]Kim AM, Cho S, Kim HJ, et al. Primary Care Patients' Preference for Hospitals over Clinics in Korea. *Int J Environ Res Public Health*. 2018;15(6):1119. doi:10.3390/ijerph15061119

[17]National Health Commission of the People's Republic of China. [China health statistics yearbook]. 2021; https://www.yearbookchina.com/navibooklist-n 3020013080-1.html

[18]Li X, Lu J, Hu S, et al. The primary health-care system in China. *Lancet.* 2017;390(10112):2584-2594. doi:10.1016/S0140-6736(17)33109-4

[19]Andersen R, Newman JF. Societal and individual determinants of medical care utilization in the United States. *Milbank Mem Fund Q Health Soc*. 1973;51(1):95-124.

[20]Song H, Zuo X, Cui C, Meng K. The willingness of patients to make the first visit to primary care institutions and its influencing factors in Beijing medical alliances: a comparative study of Beijing's medical resource-rich and scarce regions. *BioMed Central Health Serv Res*. 2019;19(1):361. doi:10.1186/s12913-019-4184-0

[21]Li X, Zhang L, Li Z, Tang W. Patient Choice and Willingness Toward Gatekeepers as First-Contact Medical Institutions in Chinese Tiered Healthcare Delivery System: A Cross-Sectional Study. *Front Public Health.* 2021;9:665282.

doi:10.3389/fpubh.2021. 665282

[22]Liu C, Qiu L, Wang H. Willingness rate of the first visit to primary healthcare services and the associated factors in China: a meta-analysis. *Aust J Prim Health*. 2022;28(6):459-468. doi:10.1071/PY21296

[23]Zhang Y, Wang C, Lu S, et al. [Governance Logic of Hierarchical Medica al System and The Effect of Cognitive Bias of Rural Residents]. *Chinese Journal of Health Policy*, 2022,15(12):24-30.

[24]National Health Commission of the People's Republic of China. [Notice on the issuance of three service capacity standards including the service capacity standards for township health centres]. Published 2022. http://www.nhc.gov. cn/jws/s7874/202207/03f2e43540384209b67cce25a6cd9ae2.shtml

[25]Wang C, Lu S, Zhang Y. Drivers of high-cost persistence in rural China: A population-based retrospective study. *Front Public Health*. 2022;10:988664. doi:10.3389/fpubh.2022.988664

[26]Kang L. [Determinants of residents' health seeking willingness in rural areas of China]. *Chinese Rural Health Service Administration.* 2020,40(05):319-323.

[27]Tang J, Liu YN, Liao Y, et al. [Analysis of the choice and influencing factors of the first visit hospitals for 6619 urban and rural residents in Liaoning Province]. *Chinese Hospitals*, 2021,25(11):24-27.

[28]Teng L, Li Y. Analysis on the willingness and influencing factors of choosing primary healthcare institutions among patients with chronic conditions in China: a cross-sectional study. Brit Med J *Open*. 2022;12(3):e054783.

doi:10.1136/bmjopen-2021-054783

[29]Zhang L, Cheng G, Song S, et al. Efficiency performance of China's health care delivery system. *Int J Health Plann Manage*. 2017;32(3):254-263. doi:10.1002/hpm.2425

[30]Li J, Wang P, Kong X, Liang H, Zhang X, Shi L. Patient satisfaction between primary care providers and hospitals: a cross-sectional survey in Jilin province, China. *Int J Qual Health Care*. 2016;28(3):346-354. doi:10.1093/intqhc/mzw038

[31]Xiao Y, Qiu QM, Huang YX, Zhu SY. Patients gather in large hospitals: the current situation of Chinese hospitals and the direction of medical reform. *Postgrad Med J*. 2022;98(1166):e43. doi:10.1136/postgradmedj-2021-140147

[32]Mishel M, Braden C. Finding meaning: antecedents of uncertainty in illness. *Nursing Research*, 1988, 37(2):98-103.

[33]Liu Y, Kong Q, Yuan S, van de Klundert J. Factors influencing choice of health system access level in China: A systematic review. *PLoS One*. 2018;13(8):e0201887. Published 2018 Aug 10. doi:10.1371/journal.pone.0201887

[34]Zeng Y, Wan Y, Yuan Z, Fang Y. Healthcare-Seeking Behavior among Chinese Older Adults: Patterns and Predictive Factors. *Int J Environ Res Public Health.* 2021;18(6):2969. doi:10.3390/ijerph18062969

[35]Li H, Xu H. Can medical insurance policies promote the realization of hierarchical medical treatment: An Empirical Analysis Based on Medical Demand Behavior[J]. *Comparative Economic&Social Systems*, 2018(01):28-35.

[36]Beaglehole R, Epping-Jordan J, Patel V, et al. Improving the prevention and

management of chronic disease in low-income and middle-income countries: a priority for primary health care. *Lancet.* 2008;372(9642):940-949. doi:10.1016/S0140-6736(08)61404-X

[37]Sun X, Meng H, Ye Z, Conner KO, Duan Z, Liu D. Factors associated with the choice of primary care facilities for initial treatment among rural and urban residents in Southwestern China. *PLoS One*. 2019;14(2):e0211984. doi:10.1371/journal.pone.0211984

[38]Sun H, Miao CX, Jiang JX, et al. [Residents' approval and influencing factors of hierarchical diagnosis and treatment system, Xuzhou]. *Modern Preventive Medicine.* 2019;46(19):3548-3551+3569.

[39]Wang Y, Wu X, Yin M, Jin L. Patient capability: Justice and grassroots healthcare delivery in China. *Dev World Bioeth.* 2022;22(3):170-178. doi:10.1111/dewb.12328

[40]Pan XD, Yu XS, Shan HYn. [Research Progress and Prospects of Incentive Mechanisms for General Practitioners in China and Abroad]. *Chinese General Practice.* 2023,26(01):14-20

[41]Hu L. [Reform and enlightenment of British National medical service system]. *Health Economics Research* .2011;3:3.

[42]Cao B, Huang W, Chao N, Yang G, Luo N. Patient Activeness During Online Medical Consultation in China: Multilevel Analysis. *J Med Internet Res*. 2022;24(5):e35557. doi:10.2196/35557

[43]He C, Zhou Q, Chen W, et al. Using an Internet-Based Hospital to Address

Maldistribution of Health Care Resources in Rural Areas of Guangdong Province, China: Retrospective and Descriptive Study. *JMIR Med Inform*. 2018;6(4):e51. doi:10.2196/medinform.9495

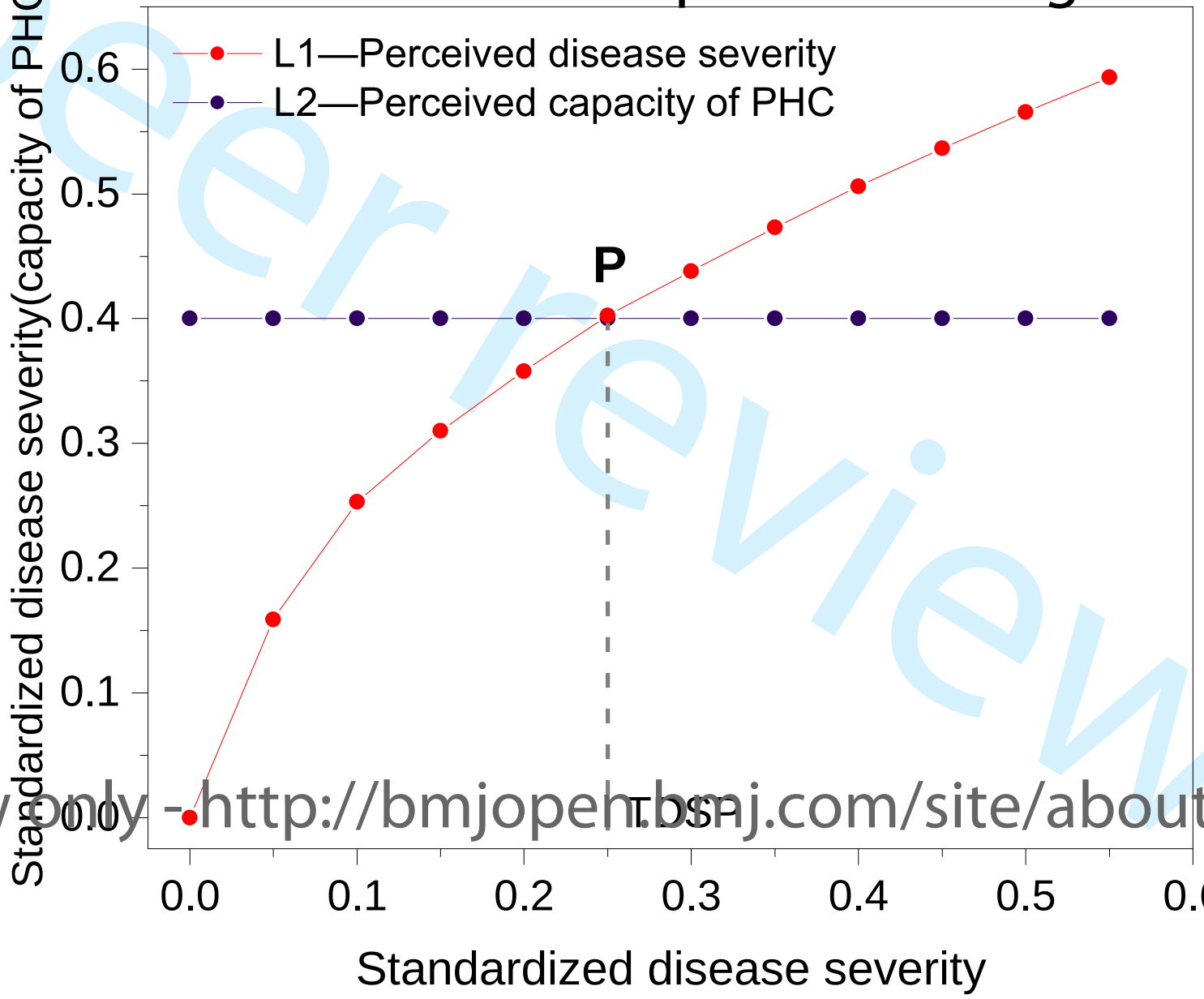
[44]Guo A, Wang P. The Current State of Doctors' Communication Skills in Mainland China from the Perspective of Doctors' Self-evaluation and Patients' Evaluation: A Cross-Sectional Study. *Patient Educ Couns.* 2021;104(7):1674-1680. doi:10.1016/j.pec.2020.12.013

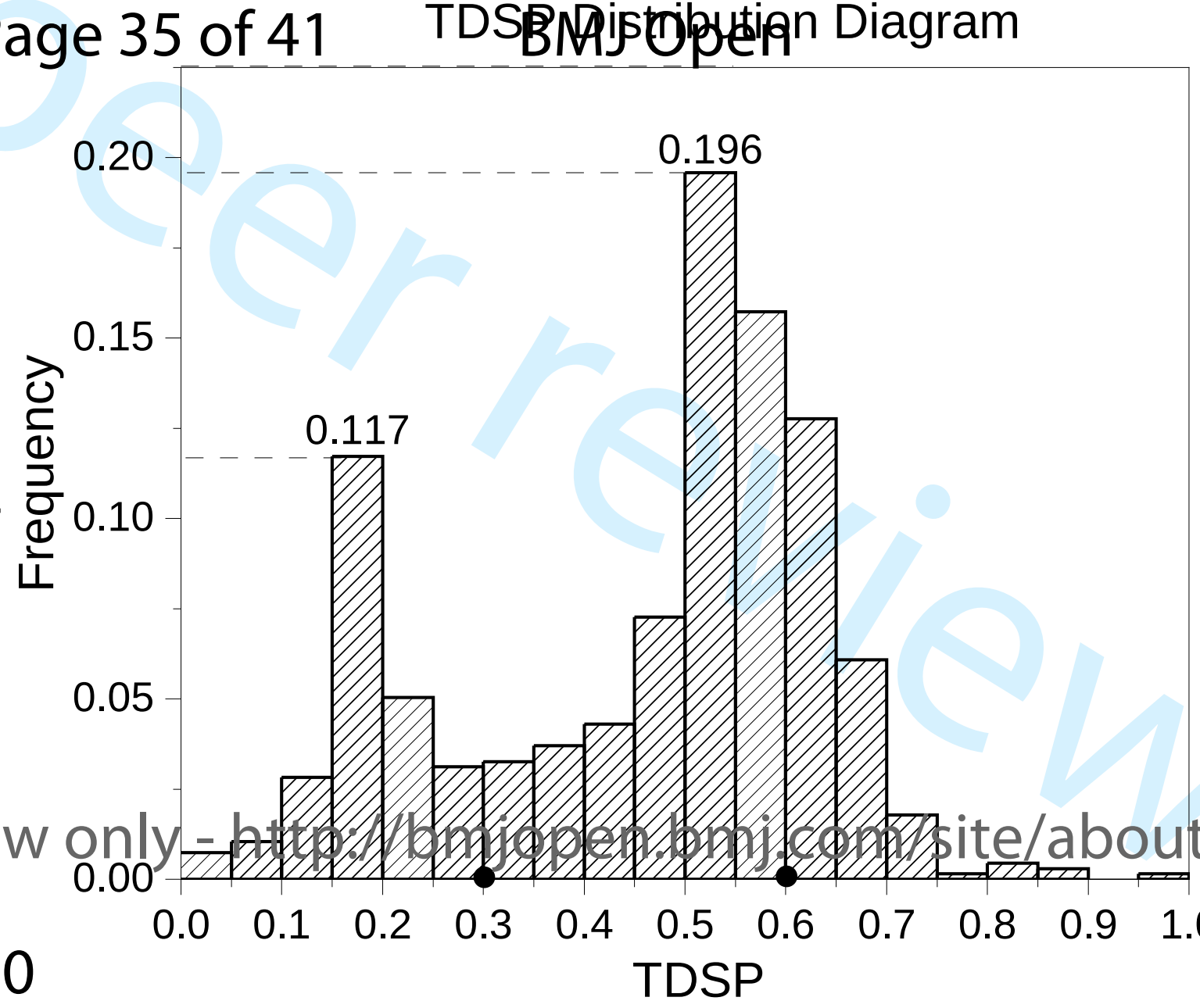
[45]Jia HN, Chen RH, Teng BJ, et al. [Analysis on the Medicine Purchase Decision-making Process of Rural Residents' Self-medication from the Perspective of Behavioral Economics]. *Chinese Health Economics.* 2021,40(07):21-23.

[46]Gao QF. [Medical-care-seeking behavior and concentration]. *Health Economics Research.* 2007, No.228(01):36-37.

[47]Rodriguez Santana I, Mason A, Gutacker N, Kasteridis P, Santos R, Rice N. Need, demand, supply in health care: working definitions, and their implications for defining access. *Health Econ Policy Law*. 2023;18(1):1-13. doi:10.1017/S1744133121000293

TDSP schematic diagram





Annex 1

Situation Categorization	Combination of treatment provisions	Typical diseases	Standardized disease severity (±0.05)	Level of medical institution
Ⅰ Small Outpatient Clinic	Outpatient prescribed medication	Common cold; indigestion; gastritis	0.1 (0.05-0.15)	Village clinics
Ⅱ General Outpatient Clinic	General outpatient treatment + outpatient prescribed medication	Acute gastroenteritis	0.2 (0.15-0.25)	Village clinics
	Minor examination + outpatient prescribed medication	Urticaria		Weak THC
Ⅲ Standard Outpatient Clinic	Minor examination + general outpatient treatment + outpatient prescribed medication	Otitis media; urinary tract infections;	0.3 (0.25-0.35)	Weak THC
Ⅳ Outpatient Surgery	Minor examinations + minor operations + outpatient prescribed medication	Excision of body surface masses (boils, haemorrhoids); fracture repositioning and fixation	0.4 (0.35-0.45)	General THC
V Inpatient Internal Medicine	Inpatient monitoring, care and treatment services	Hospitalisation for progressive chronic disease (coronary heart disease); hospitalisation for pneumonia	0.5 (0.45-0.55)	Central THC
VI Minor surgery inpatient/ suspected high risk diagnosis	minor surgery + inpatient monitoring, care, treatment services	appendicitis	0.6 (0.55-0.65)	Central THC
	Suspected high risk: major examination + outpatient prescribed medication + general outpatient treatment operations	Gastroscopy for suspected gastrointestinal high-risk disease		Community Hospitals/ Quality THC
VII Major internal medicine admission	Major examination + inpatient monitoring, care, treatment services	Stroke attack , Progressive cirrhosis of the liver	0.7 (0.65-0.75)	County Hospitals
VIII Major surgery admissions	Major surgery + inpatient monitoring, care,	Major lobectomy of the lungs Liver and kidney transplantation	0.8 (0.75-0.85)	Tertiary Hospitals

	treatment services + major investigations			
IX Acute and Critical Care	Critical care resuscitation and monitoring	Acute heart attack stenting; haemorrhage and shock; respiratory failure	0.9 (0.85-0.95)	Grade IIIA hospital

Annex 2

Number	Scenario symptoms	Prediagnosis judgement	Score
D1-common cold	It's been three days since I had a sore throat, runny nose, sneezing, coughing and lack of energy, and it's still not getting better.	Take your own medication without going to the doctor?	0.05
		Do you go to the doctor? *	0.1
		Is it necessary to see a doctor at a county hospital?	0.6
		Do you need a blood test?	0.2
		Do you need a transfusion?	0.3
		Do you need a X-ray to check for pneumonia?	0.4
D2-gastritis	In the last ten days, I have felt uncomfortable stomach, often bloating, stomachache, hiccups and bad appetite.	Take your own medication without going to the doctor?	0.05
		Do you need to see a doctor and take some medicine? *	0.15
		Is it necessary to see a doctor at a county hospital?	0.6
		Is it necessary to have a gastroscopy now that I can have a full check-up for stomach disorders?	0.65
D3-gastroenteritis	I had diarrhea five times a day, and my stomach was very painful. I didn't feel well all day.	Take your own medication without going to the doctor?	0.05
		Do you go to the doctor?	0.1
		Is it necessary to see a doctor at a county hospital?	0.6
		Do you need a blood test?	0.2
		Do you need a transfusion?	0.3
		Do you need a stool test?	0.4
		Is a colonoscopy necessary now to see if there are any other serious diseases of the intestines?	0.65
D4-urticaria	Basically every day I get an itch and I scratch it and I break out in a rash and it goes away on its own.	Take your own medication without seeing a doctor?	0.05
		Do I need to see a doctor to see what's going on and get some medication? *	0.25
		Do I need to see a dermatologist or a general internist?	0.6
		Do I need to have a blood test?	0.3
		Do I need to test for allergens to see what I am allergic to?	0.65
D5-otitis media	In the last week, there was pain and tinnitus in the ears, and pus flowing out of the ears.	Use your own medication without seeing a doctor?	0.05
		Do you need a doctor to look at your ears and deal with the pus? *	0.3

		Is it necessary to have an ear, nose and throat specialist or is a general practitioner of internal and external medicine sufficient?	0.6
D6-furuncle	A hard bump on the neck, the size of a fingernail, but painful, growing larger and larger. It has been there for a week.	Use your own medicine without going to the doctor?	0.05
		Do you need to see a doctor?	0.1
		Do you need a doctor to cut you open and drain the pus? *	0.35
		Is it necessary to go to a doctor at a county hospital to do this?	0.6
		Do I need to have the contents examined to see if it is benign or malignant after the incision?	0.65
D7-hemorrhoids	The bowel movements have been painful and bloody in the last week.	Take your own medication without seeing a doctor?	0.05
		Do you need to see a doctor to get checked out and take minor opeartions when necessary? *	0.4
		Is it necessary to see a doctor at a county hospital?	0.6
		Do I need a proctoscopy to rule out rectal cancer?	0.65
D8-fracture	I fell off my bike and my hand fell to the ground. It was very sore and swollen, and I couldn't move it. I've had half a day off.	Buy your own medicine without going to the doctor?	0.05
		Do you want to go to the hospital to have a X-ray taken for possible surgery? *	0.45
		Is it necessary to have a CT so that you can see it better?	0.55
		Is it necessary to go to the doctor at the county hospital to see the X-ray for diagnosis?	0.6
D9-coronary heart disease	Twice in the last month I have had angina with chest tightness, dizziness and profuse sweating, relieved after half an hour.	Take your own medication without seeing a doctor?	0.05
		Do I need to see a doctor for an ECG inpatient monitoring?*	0.5
		Is it necessary to see a doctor at a county hospital?	0.6
		Do I need more accurate heart tests? For example, cardiac magnetic resonance imaging, coronary CT	0.65
D10-acute simple appendicitis	severe pain in the lower right side of the stomach, not getting better all the	(Would you have surgery for appendicitis? Where would you have it done?) No surgery ?	0.4

	time, possibly appendicitis	Township health centre?*	0.55
		County hospital ?	0.65

STROBE 2007 (v4) Statement—Checklist of items that should be included in reports of *cross-sectional studies*

Section/Topic	Item #	Recommendation	Reported on page #
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract	2
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what found	3
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	5
Objectives	3	State specific objectives, including any prespecified hypotheses	8
Methods			
Study design	4	Present key elements of study design early in the paper	9
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	12
Participants	6	(*a*) Give the eligibility criteria, and the sources and methods of selection of participants	12
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	12
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	13
Bias	9	Describe any efforts to address potential sources of bias	12
Study size	10	Explain how the study size was arrived at	11
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	13
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding	12
		(*b*) Describe any methods used to examine subgroups and interactions	
		(*c*) Explain how missing data were addressed	12
		(*d*) If applicable, describe analytical methods taking account of sampling strategy	12
		(*e*) Describe any sensitivity analyses	
Results			

Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	12
		(b) Give reasons for non-participation at each stage	12
		(c) Consider use of a flow diagram	
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	13
		(b) Indicate number of participants with missing data for each variable of interest	12
Outcome data	15*	Report numbers of outcome events or summary measures	13
Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	14
		(*b*) Report category boundaries when continuous variables were categorized	14
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	
Discussion			
Key results	18	Summarise key results with reference to study objectives	17
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	22
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	19-20
Generalisability	21	Discuss the generalisability (external validity) of the study results	20
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	24

*Give information separately for cases and controls in case-control studies and, if applicable, for exposed and unexposed groups in cohort and cross-sectional studies.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at www.strobe-statement.org.

BMJ Open

Residents' Willingness towards First-contact with Primary Health Care under Uncertainty in Healthcare: A Cross-sectional Study in Rural China

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Residents' Willingness towards First-contact with Primary Health Care under Uncertainty in Healthcare: A Cross-sectional Study in Rural China

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Abstract

Objective

To estimate Chinese rural residents' willingness degree of initially contacting Primary Health Care (PHC) under uncertainty in healthcare, and to explore its influencing factors.

Setting

This study collected primary data from rural residents in Dangyang, Hubei Province in China.

Participants

714 rural residents participated, and 701 finished the survey. The response rate was 98.18%. 674 respondents who passed the internal consistency test were included as an effective sample.

Design

In this cross-sectional study, residents' willingness was reflected by the Threshold of Disease Severity for PHC (TDSP), the individual maximal disease scope for considering PHC based on residents' decision-making framework. TDSP was measured through scenario tests. Univariate analysis and unordered multiple logistic regression were used to explore the influencing factors of three-level TDSP: low, general, and high.

Results

Only 28.2% of respondents had high TDSP and high willingness towards PHC. Compared to general TDSP, respondents who were younger than 40, rich, highly risk-averse, had substitute medical decision-maker, and had no visits to PHC in the last 6

months tended to have low TDSP and low willingness towards PHC. Compared to general TDSP, no factors were found to significantly influence respondents' high TDSP.

Conclusions

TDSP can be a good indicator of residents' willingness. TDSP results demonstrate rural residents' generally low willingness towards first-contact with PHC that some residents refuse to consider PHC even for mild diseases. This study provides practical significance for elaborating the underutilization of PHC from resident decision-making and offers advice to policy-makers and researchers for future modifications.

Strengths and limitations of this study

- To the best of our knowledge, this study is the first nationwide study to analyze Chinese rural patients' willingness towards first-contact with PHC with residents' medical decision-making under uncertainty considered.
- The measurement method in this study is innovative by taking the disease spectrum and patients' decision-making framework simultaneously into account.
- The measurement of this study is mainly single item of scenario tests, and results might be biased due to the limited number of scenarios.
- Though the topic and methodology may be widely applicable, the criteria for the level of willingness to seek primary care in this article are set according to Chinese guidelines.

Introduction

Uncertainty in healthcare, which signals an unknown probability of risk, pertains to nearly every health-related activity such as whether a patient has a particular disease and how that condition will evolve[1]. Uncertainty can trigger cognitive and affective responses in patients including increased risk perception and increased judgmental bias, which may bring about defensive decision-making and behavior[2,3]. Moreover, residents' reactions to uncertainty can be further extended with the increasing freedom of choice of doctors, which has been emphasized by many countries and regions for

promoting institutional competition and patients' satisfaction[4-7]. Residents can freely determine their healthcare providers according to their estimations, even though governments have encouraged them to first visit primary health care (PHC), the gatekeeper of the national health system, for initial diagnosis and referral suggestions. As a result, residents always subjectively bypass PHC and contact high-level hospitals first even for minor diseases[8]. In Korea, 15% of outpatient visits that were eligible for primary institutions chose high-level hospitals[9]. Under the Japanese free-access healthcare system, undertaking the gatekeeping function of PHC was also a challenge[6]. The underuse of PHC can be more serious in China, especially in rural areas. There is inevitably an increased burden on patients, a waste of limited healthcare resources, and inequities among patients when everyone wants to directly get access to quality healthcare.

In rural China, a tiered healthcare delivery system geographically consisting of county hospitals, township health centers (THC), and village clinics (PHC includes village clinics and THC) has been extensively promoted to provide a full range of health services to local residents[10-12]. Those medical institutions have different responsibilities. PHC institutions are expected to provide preventative and initial care for residents, as well as treatment of common diseases, whereas county hospitals are responsible for intractable diseases and emergency issues[13]. Residents' first-contact with PHC is the key to ensuring the fulfillment of the tiered healthcare delivery system and residents' sequential medical appointments. However, there were 4.25 billion visits of PHC institutions in 2021, accounting for 50.12% of all medical visits, 3.95% lower

than the proportion in 2017[14]. Many rural residents only consider county hospitals or above for first-contact regardless of their actual disease situation even if PHC is well capable after years of improving quality and enlarging service scope[15-18]. It is evident that only strengthening PHC in directing patient flow and enhancing the tiered healthcare delivery system is insufficient. The prominent problem is that residents have the freedom to make medical choices, but their considerations and subjective demands for healthcare under uncertainty may not overlap perfectly with the government's ideal expectation[13].

Therefore, it is necessary to understand residents' decision-making process in China. According to Andersen's behavioral model, residents identify their health demands first before utilizing health services, which means they primarily make subjective judgments about the disease condition and its severity[19]. Then residents compare the perceived disease severity with the perceived capacity of PHC, a stable perception of PHC's ability to treat diseases. Residents may be willing to visit PHC first only when they perceive that PHC is capable of treating their diseases, which is the prerequisite decision-making process for generating willingness towards PHC, though residents may still ultimately go to other institutions weighing up situational factors under the freedom of choice of doctors[13].

This study invents a new method to reflect residents' willingness towards PHC based on their decision-making framework. Due to inadequate medical knowledge and avoidance responses caused by uncertainty in healthcare, residents' perceptions of

disease severity often deviate from their objective disease severity, and the degree of deviation varies with personal characteristics[1]. Assuming that a resident is exposed to a spectrum of diseases of different severity, there exists an approximate severity of objective diseases that in the resident's mind is so serious that the maximum capacity of PHC exactly cannot handle. We call this objective and abstract upper limit of severity the Threshold of Disease Severity for Primary Health Care (TDSP), and we measure this by what we call standardized disease severity. Therefore, TDSP can represent the objective and maximal disease scope for individual resident to consider PHC. More importantly, it is a reflection of residents' degree of willingness towards first-contact with PHC.

Although previous studies have noticed the importance of residents' first-contact with PHC, few studies have noticed the possible impact of the spectrum of diseases and different disease severity on residents' willingness towards PHC[20,21]. Moreover, despite the continuous focus on patients' underuse of PHC and patients' low willingness towards first-contact with PHC, the problem has not been ameliorated[14-18]. This study primarily summarizes residents' decision-making process of medical choices under uncertainty, and attempts to essentially elaborate the gap between residents' current status of PHC utilization and policy expectations in order to provide references for improving willingness towards PHC from the perspective of residents[22]. Therefore, this study applied a theoretical framework and standardized tools to measure TDSP among rural residents through scenario tests. Our study has two objectives: (1) to describe rural residents' willingness towards PHC under uncertainty

through their corresponding TDSP level; (2) to explore the influencing factors of TDSP to make future recommendations.

Materials and Methods

Principle of TDSP

TDSP is generated based on two factors: residents' perceived disease severity and perceived capacity of PHC (Figure 1). In Figure 1, the horizontal and vertical axes both represent standardized disease severity with values from 0-1. The capacity of PHC can be understood as the maximum severity of the disease that can be treated by PHC, so the vertical axis connects the disease severity with the capacity of PHC. The curve that depicts the trend of residents' perceived disease severity as disease severity increases is L1, which in practice tends to be higher than diagonal due to disease perception bias. The resident's perceived capacity of PHC is L2, and the horizontal coordinate of the intersection P of L2 and L1 is TDSP.

TDSP with an interval between 0-1 is the antecedent factor for generating willingness towards PHC. Only when the objective disease severity is lower than the TDSP will the resident include PHC as an alternative plan. The higher the TDSP, the more likely the resident is to consider first-contact with PHC when the disease is relatively serious, and the higher the willingness degree towards PHC. For example, an individual with a TDSP value of 0.4 will consider PHC if the disease scope is between 0-0.4 severity, and her willingness to attend PHC first is higher than those with a TDSP of 0.3 or 0.2.

Standardized tool for TDSP

This study applied a standardized disease severity framework already developed based on the incidence of common diseases, clinical pathways, and government guidelines[23,24]. The principle is to equate the standardized disease severity with the difficulty of treating the disease and to roughly grade it through standard treatment combinations including examinations, operations, and the performing institutions. The increasing complexity of treatment combinations is indicative of the increasing standardized disease severity addressed. As for a patient's single consultation, the treatment combinations are categorized into 9 situations from the mildest small outpatient clinic (0.1), general outpatient clinic (0.2), to the extremely severe Acute and Critical Care (0.9) (see Annex 1). A single situation represents a range of disease severity (±0.05), not a specific degree, and the disease severity can be specially adjusted for treatment complexity and duration. The most complex situation within the capacity of PHC is minor inpatient surgery (0.6) according to government guidelines, which means that PHC is capable of treating diseases of 0-0.55 severity when the critical value (0.6) is removed to be conservative.

Measurement of TDSP

To estimate patients' perception of disease severity and plot L1, scenario tests were conducted among respondents based on 10 diseases including common cold (D1), gastritis (D2), gastroenteritis (D3), urticaria (D4), otitis media (D5), furuncle (D6), hemorrhoids (D7), fracture (D8), coronary heart disease(D9), acute simple appendicitis (D10). Clinicians selected those typical 10 diseases according to situation

categorizations. Specific treatment complexity was taken into account to differentiate disease severity. In scenario tests, residents were assumed to suffer from the given symptoms of each of the 10 diseases and were asked to choose their intended treatment, for example, they wanted to get a transfusion or only take medicine to cure colds (Annex 2 for details). To draw L1, a horizontal coordinate from 0.1 to 0.55 was established according to 10 diseases with 0.05 being the interval, and the vertical coordinate was the perceived disease severity of the 10 diseases in line with individual resident's choice. For example, a cold normally required a small outpatient medication prescription with a severity of 0.1, but the resident believed that the cold required an X-ray with a perceived severity of 0.4, so the point (0.1, 0.4) was one of the 10 bases for fitting curve the resident's L1. For each individual, a total of 10 points were generated to simulate L1.

As for curve fitting, L1 was fitted respectively based on four basic functions: linear, logarithmic, exponential, and power functions, yielding four functional expressions for individual L1. The four functions can mainly cover the possible directions and shapes of L1. Then the fitting results were screened according to the following criteria: (1) the function with outliers was excluded; (2) $R^2 \geqslant 0.7$, and the function with the largest R^2 was selected; (3) when (1) and (2) were not met, the case was separately checked and analyzed to adjust the fitting function.

To estimate resident's perception of the capacity of PHC and plot L2 for each individual, residents were asked to choose the most complex treatment combinations they would

like to utilize in PHC, which demonstrated the maximum standardized disease severity they might want to be treated by PHC. Moreover, to measure residents' perceived capacity of PHC accurately, for each treatment combination they chose, residents could express their intention of three levels: strong, medium, and weak (Table 1).

Table 1 Estimation of residents' perceived capacity of PHC

Situation Categorization	Treatment combinations utilization	Attitude	Standardized disease severity
Standard Outpatient Clinic	Willing to do minor examinations + general outpatient treatment + medication in PHC	weak	0.25
		medium	0.3
		High	0.35
Outpatient Surgery	Willing to do minor examinations + minor operations + outpatient medication in PHC	weak	0.35
		medium	0.4
		High	0.45
Inpatient Internal Medicine	Willing to accept inpatient monitoring, care and treatment services in PHC	weak	0.45
		medium	0.5
		High	0.55
Minor inpatient surgery	Willing to accept minor surgery + inpatient monitoring, care and treatment services in PHC	weak	0.55
		medium	0.6
		High	0.65

TDSP was divided into three levels: low TDSP (0-0.3), general TDSP (0.3-0.55), and high TDSP (>0.55) because the willingness degree reflected by TDSP intervals can be more accurate and practical than specific values. According to government guidelines for PHC construction, the cut-off value of 0.3 (standard outpatient clinic) represents the lower limit of the capacity of PHC. Residents who had such minor diseases and refused to consider visiting PHC were classified as having low TDSP and low willingness. The cut-off value of 0.55 (minor inpatient surgery) represents the upper limit of the capacity of PHC. Residents who had diseases more serious than 0.55 and still considered visiting PHC were classified as having high TDSP and high willingness. While residents who

scored 0.3-0.55 had low but reasonable willingness towards PHC because different PHC institutions accessed routinely by residents were inconsistent in capacity.

Research setting and data sources

We conducted a cross-sectional study in Dangyang, a typical rural area in Hubei Province in central China, with a rural population of 331,349 and a gross domestic product per capita higher than the national average[25]. We used the stratified sampling method to randomly select 3 villages from each of the 10 townships in Dangyang. The household survey was conducted in the selected villages. Respondents were investigated through face-to-face questionnaire interview by uniformly trained investigators. Inclusion criteria: (1) >18 years of age; (2) permanent residents of the area (living in Dangyang for ≥ 6 months); (3) voluntary participation in the study. Exclusion criteria: presence of cognitive impairment. Among 714 residents who participated, 701 respondents finished the survey, and the response rate was 98.18%. Moreover, 27 respondents did not pass the internal consistency test, so the effective sample size for this study was 674.

Questionnaire design and variables

The questionnaire was self-designed based on government guidelines, previous literature, and expert consultations. We conducted a pilot study to verify the consistency between TDSP and residents' self-assessed willingness towards PHC and to test the reliability and validity of the questionnaire. The final version of the questionnaire contained three sections: fundamental personal characteristics, scenario tests, and

estimation of residents' perceived capacity of PHC. Fundamental personal characteristics identified as independent variables were mainly from three aspects: (1) sociodemographic characteristics including gender, age, education, marital status, employment, economic status and chronic disease status; (2) health-seeking objective factors including county hospital acquaintance and substitute medical decision-maker; (3) health-seeking subjective factors including expected price to cure colds, watching health video frequency, attitudes towards the tiered healthcare delivery system, level of risk aversion, and experience of visiting PHC in the last 6 months. The dependent variable was the three-level TDSP. Since village clinics here were numerically sufficient and more of administrative functions, PHC in this research referred specifically to THC.

Patient and public involvement

Patients were not involved in the design and conduct of this research; however, the public were involved in the design and conduct of this research.

Statistical analysis

The software SPSS 26.0 was used to create a database and analyze data with a double check to ensure the quality. Sample descriptions were listed to depict the fundamental characteristics of respondents. Univariate analysis was performed using the Chi-square test and variance analysis. The unordered multiple logistic regression method was used to analyze the predictors of three-level TDSP.

Results

Description of TDSP and willingness degree

TDSP distribution is shown in Figure 2. Among 674 valid respondents, the mean of TDSP was roughly 0.434±0.179, with an upper quartile of 0.285 and a lower quartile of 0.559. The two frequency peaks of TDSP occurred in the intervals of 0.15-0.2 and 0.5-0.55, and the percentage of TDSP below 0.2 and 0.55 was 19.0% and 71.8% respectively. Generally, the overall level of TDSP was relatively low. Only 190 (28.2%) respondents had a high TDSP more than 0.55, and there were 176 (26.1%) respondents who had low willingness towards first-contact with PHC with TDSP less than 0.3.

Baseline characteristics and univariate analysis of TDSP level

Table 2 presents the baseline characteristics of respondents and the results of univariate analysis of their TDSP level. Among 674 respondents, elders over 60 years of age accounted for 49.9%. Moreover, respondents under 40 tended to have a higher possibility of low TDSP. As for economics, rich respondents were more likely to have low TDSP, while average and poor respondents tended to occupy a higher proportion of general and high TDSP. When faced with consultation choice, the vast majority of respondents made decisions by themselves. 68.5% of respondents had no visits to PHC in the last 6 months. 15.9% of respondents had a strong level of risk aversion, and they were more likely to have low TDSP. In addition, results showed that there were no statistically ($p>0.05$) significant differences for gender, chronic diseases, expected price to cure colds, and attitudes towards the tiered healthcare delivery system.

295 Table 2 Respondents' baseline characteristics and univariate analysis of TDSP level

Characteristic	N (%)	TDSP level			$\chi 2$	P
		Low (%)	General (%)	High (%)		
Sex					5.174	0.075
Female	328(48.7)	98(55.7%)	146(47.4)	84(44.2)		
Male	346(51.3)	78(44.3)	162(52.6)	106(55.8)		
Age					29.154	0
<40	77(11.4)	37(21)	23(7.5)	170(8.9)		
40-59	261(38.7)	63(35.8)	125(40.6)	73(38.4)		
60-74	270(40.1)	69(39.1)	121(39.3)	80(42.2)		
>=75	66(9.8)	7(4)	39(12.7)	20(10.5)		
Education					25.283	0
Primary school	263(39)	42(23.9)	140(45.5)	81(42.6)		
Junior school	245(36.4)	77(43.8)	101(32.8)	67(35.3)		
Senior school	129(19.1)	42(23.9)	55(17.9)	32(16.8)		
College and above	37(5.5)	15(8.5)	12(3.9)	10(5.3)		
Marital status					10.138	0.038
Married	620(92)	157(89.2)	287(93.2)	176(92.6)		
Unmarried	22(3.3)	12(6.8)	5(1.6)	5(2.6)		
Divorced or widowed	32(4.7)	7(4)	16(5.2)	9(4.7)		
Employment					21.594	0.001*
Farming or migrant workers	381(56.5)	82(46.6)	190(61.7)	109(57.4)		
Individual business, work in enterprises and institutions	143(21.2)	48(27.3)	54(17.5)	41(21.6)		
Retirement	136(20.2)	36(20.5)	61(19.8)	39(20.5)		
Others	14(2.1)	10(5.7)	3(1)	1(0.5)		
Economics					13.778	0.008
Rich	101(15)	38(21.6)	33(10.7)	30(15.8)		
Average	483(71.7)	120(68.2)	224(72.7)	139(73.2)		
Poor	90(13.4)	18(10.2)	51(16.6)	21(11.1)		
Chronic diseases					6.017	0.198
0	340(50.4)	102(58)	144(46.8)	94(49.5)		
1 or 2	277(41.1)	60(34.1)	136(44.2)	81(42.6)		
More than 2	57(8.5)	14(8)	28(9.1)	15(7.9)		
County hospital acquaintance					6.515	0.038
Yes	122(18.1)	43(24.4)	50(16.2)	29(15.3)		
No	552(81.9)	133(75.6)	258(83.8)	161(84.7)		
Substitute medical decision maker					11.199	0.024
No (Oneself)	541(80.3)	128(72.7)	253(82.1)	160(84.2)		
Partner	70(10.4)	22(12.5)	29(9.4)	19(10)		

Parent/child	63(9.3)	26(14.8)	26(8.4)	11(5.8)		
Expected price for outpatient					15.291	0.018
50 yuan	286(42.4)	63(48.1)	148(39.5)	75(42.4)		
100 yuan	246(36.5)	80(29.2)	90(40)	76(36.5)		
300 yuan	103(15.3)	25(16.9)	52(13.7)	26(15.3)		
500 yuan	39(5.8)	8(5.8)	18(6.8)	13(5.8)		
Watching health video					10.048	0.04
Always	104(15.4)	34(11.4)	35(18.4)	35(15.4)		
Occasionally	227(33.7)	65(34.1)	105(30)	57(33.7)		
Rarely	343(50.9)	77(54.5)	168(51.6)	98(50.9)		
Attitudes towards tiered healthcare system					6.448	0.168
Agree	588(87.2)	145(89.3)	275(88.4)	168(87.2)		
Disagree	50(7.4)	18(5.5)	17(7.9)	15(7.4)		
Indifferent	36(5.3)	13(5.2)	16(3.7)	7(5.3)		
Level of risk aversion					13.43	0.009
Strong	107(15.9)	42(13)	40(13.2)	25(15.9)		
Middle	413(61.3)	104(62.7)	193(61.1)	116(61.3)		
Low	154(22.8)	30(24.4))	75(25.8)	49(22.8)		
Experience of visiting PHC in the last 6 months					12.582	0.002
Yes	212(31.4)	37(36.4)	112(33.2)	63(31.5)		
No	462(68.6)	139(63.6)	196(66.8)	127(68.5)		

* cases where the expected value is less than 5, corrected with Fisher's exact test

Predictors of TDSP level of First-contact with PHC

Table 3 presents the results of the multiple unordered logistic regression model and identifies the predictors of TDSP level. Compared with respondents with general TDSP, factors including age, economics, medical decision maker, level of risk aversion, and experience of visiting PHC in the last 6 months significantly contributed to low TDSP of respondents. Respondents aged under 40, 40-60, and 60-75 were respectively 7.34, 2.51, and 4.18 times more likely to have a low TDSP compared to respondents aged 75 and over. Compared with respondents who just finished primary school, those who completed junior school had significantly lower TDSP (OR=2.50, p<0.01). Moreover, rich respondents were 1.91 times more likely to have low TDSP than respondents of

average economic level. Respondents who were strongly risk-averse were 1.96 times more likely to have a low TDSP than those who were low risk-averse. While respondents with no experience of visiting PHC in the last 6 months were twice as likely to have a low TDSP as those who had such experience. However, compared with respondents with general TDSP, we found no factors that could significantly contribute to high TDSP.

Table 3 Predictors of TDSP level in the multiple unordered logistic regression model

Characteristic	Low TDSP				High TDSP			
	β	OR	95% CI	P	β	OR	95% CI	P
Age (*>=75)								
<40	1.994	7.344	2.463-21.894	0	0.233	1.262	0.486-3.274	0.633
40-59	0.919	2.508	0.978-6.429	0.056	0.002	1.002	0.516-1.947	0.995
60-74	1.43	4.181	1.68-10.405	0.002	0.266	1.304	0.692-2.458	0.411
Education (*Primary school)								
junior school	0.913	2.491	1.501-4.136	0	0.112	1.053	1.053-0.361	0.924
Senior school	0.553	1.739	0.923-3.273	0.087	-0.089	0.915	0.512-1.635	0.764
College and above	0.319	1.376	0.484-3.914	0.55	0.052	1.119	0.716-1.747	0.621
Economics (*Average)								
Rich	0.649	1.913	1.083-3.379	0.025	0.42	1.521	0.867-2.67	0.144
Poor	-0.201	0.818	0.441-1.517	0.524	-0.453	0.636	0.363-1.114	0.114
Substitute medical decision maker (*oneself)								
Parent/child	1.007	2.738	1.386-5.411	0.004	-0.387	0.679	0.316-1.46	0.322
Partner	0.709	2.032	1.071-3.856	0.03	0.135	1.145	0.613-2.139	0.672
Level of risk aversion (*Low)								
Strong	0.672	1.958	1.016-3.774	0.045	-0.09	0.914	0.482-1.731	0.782
Middle	0.135	1.144	0.683-1.917	0.609	-0.13	0.878	0.567-1.36	0.56
Experience of visiting PHC in the last 6 months (*Yes)								
No	0.741	2.098	1.316-3.346	0.002	0.138	1.148	0.773-1.705	0.494

*** indicates the reference group**

Discussion and conclusions

Discussion

Respondents' overall TDSP was relatively low indicating their willingness to seek primary care was deficient. More than 70% of respondents did not have a high TDSP.

The general overestimation of disease severity and the underestimation of PHC capacity together manifest as low TDSP, which explains residents' preferences and habitual visits to larger hospitals first even for treating mild diseases[26,27]. Although no research directly proved the results, previous research corroborated the findings of this study. Research stated that patients' health condition and disease perception could influence their willingness to seek primary care and that patients' willingness to first visit PHC was insufficient and even continuously decreasing[13,28-30]. Under the freedom of choice of doctors without strict stipulations about referral or triage of patients, the advocacy of the tiered healthcare delivery system cannot effectively guide patients' decision-making process. Residents' lack of awareness of PHC capacity results in the distrust of PHC, which has been regarded as the most immediate reason for residents to skip PHC[31,32]. In addition, residents' misconceptions about disease severity under uncertainty are perhaps also essential and fundamental reasons for them bypassing PHC.

Low TDSP level is the focus of this study. Compared with respondents with general TDSP, age, education, economics, substitute medical decision-maker, level of risk aversion, and experience for visiting PHC significantly influenced low TDSP. Respondents older than 75 years old with common diseases were more willing to go to PHC first. As people age, they become more tolerant of diseases, and PHC can be more convenient for them in terms of their visit frequency, distance, and medical costs. However, these advantages are not similarly attractive to young residents. As for economics, rich respondents' probability of low TDSP was more than twice that of poor

respondents. Rich respondents were inclined to consider PHC only when undergoing a really minor disease. Research also proved that better economic condition was positively correlated with residents' willingness towards high-level hospitals[33]. Higher income represents insensitivity to healthcare costs and high demand for quality health resources which can simplify the decision-making process directed to high-level hospitals[34]. Moreover, high risk-averse respondents were more likely to have low TDSP. Residents' aversive reactions to uncertainty and its unknown risk can lead to an increased focus on their disease severity and a careful decision-making process[27,35]. Patients would rather choose high-level hospitals to bear high financial costs than take the little risk of medical delay, which is to "pay for the peace of mind". We also found that respondents who had no visits to PHC in the last 6 months tended to have low TDSP. Personal experience may modify residents' understanding of PHC institutions and mitigate their perceived risk of seeking primary care. However, this study found no significant relationship between individual chronic disease condition and their TDSP level. The Chinese government has dedicated itself to constructing PHC for managing chronic diseases sustainably, which has also been regarded as an opportunity to develop the gatekeeping function of PHC[36,37]. By the goal, a previous study found that rural residents with chronic diseases had stronger acceptance of the tiered healthcare system and were less likely to skip PHC[38]. As for our findings, chances are that the management of chronic diseases has not been fully underlined in study areas.

Results also suggested that 28.2% of respondents had high TDSP, which meant they continuously considered PHC first when their disease was relatively severe. The high

willingness towards PHC is beneficial to residents' sequential and effective utilization of medical resources according to the advocacy of the tiered healthcare delivery system. However, compared with respondents with general TDSP, we did not find factors that could significantly influence high TDSP. Possibly, residents' high TDSP is mainly due to individual estimates of disease severity rather than other factors. However, residents with high TDSP might underestimate severe diseases and have the risk of delaying treatment in PHC, even though PHC brings convenience and good health accessibility to them[12]. Special attention needs to be paid to providing serious patients with appropriate referrals to high-level hospitals.

Rural residents' average low willingness towards first-contact with PHC reflects the dilemma of "matching supply and demand" between residents and the government. The conflict lies in the fact that the government makes plans based on the population's probability of disease and group objective health needs, while the individual resident moves based on her subjective judgment and perceived health demand[39]. Under the freedom of choice of doctors residents are responsible for determining their healthcare providers, but their perception of disease severity is inherently biased and difficult to match with the treatment combinations they truly deserve. Moreover, the category of PHC in rural areas depends on the geographical location, rather than the disease varieties, indicating that PHC may remain ambiguous in its quality and service scope to residents[40]. In this way, residents' preference for high-level hospitals can arise due to risk aversion and insufficient confidence towards PHC[41,42].

To modify rural residents' willingness towards PHC in an attempt to promote health equity and the efficient use of health resources, we make the following recommendations. Firstly, the example of the UK's well-established gatekeeping mechanism provides meaningful references[43]. The establishment of a disease triage mechanism with both professionalism and accessibility is a feasible solution, and web-based intelligent healthcare consultation can be an effective form of triage[44,45]. Video and graphic information can eliminate the restriction of time and space, and the consultation suggestions given by intelligence can help control residents' uncertainty. By narrowing down the gap between residents' perceived health demands and their objective health needs, it can guide residents to make rational medical decisions and accordingly increase their willingness towards first-contact with PHC, so that the tiered healthcare delivery system can be facilitated efficiently[46]. Secondly, what residents think and perceive plays an intrinsic role in leading their rational decision-making. Promoting the scientific knowledge of common diseases and the accurate cognition of PHC among rural residents can probably relieve their psychological stress about common diseases and motivate them to contact PHC first for minor diseases. Thirdly, empowering general practitioners by promoting basic clinical skills and in-depth doctor-patient communication may improve patients' experience of visiting PHC and make residents trust PHC more[47]. A good experience at PHC may change residents' impressions and shift the previous habitual visits to high-level hospitals.

Limitations

This study also has several limitations. First, the connotation of disease severity is

ambiguous, so in most previous studies, disease severity has been referred to by descriptive ratings. Although the methodology is not yet perfect, this paper has attempted to quantify the concept of disease severity and tried to optimize it by integrating actual treatment situations, clinical experts' opinions, and government guidelines. Second, only 10 diseases were selected for scenario tests in this study. Each disease severity was represented by one disease, which was susceptible to be impacted by patients' preference for a certain disease. Third, this study estimated the capacity of PHC according to its achievable treatment combinations from government guidelines, but the guidelines may not be objective and comprehensive enough, which may also give rise to some deviation.

Conclusions

TDSP can be a good indicator of residents' willingness towards first-contact with PHC under uncertainty and freedom of choice in healthcare based on residents' decision-making process. Residents' overall TDSP was relatively low with low willingness towards PHC, and a small percentage of residents had high TDSP with high willingness to visit PHC. Age, education, economics, substitute medical decision-maker, level of risk aversion, and experience of visiting PHC in the last 6 months were the predictors of low TDSP level. Those results may intervene in future improvement for modifying residents' medical decisions and rationally promoting their willingness towards PHC.

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Footnotes:

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Data availability statement

Data are available upon reasonable request. Data are available upon request. To obtain data, please email the corresponding author.

Ethics statements

Patient consent for publication

Not required.

Ethics approval

This study involves human participants. The study was approved by the Ethics Committee of Tongji Medical College of Huazhong University of Science and Technology. The ethics number was IORG0003571. All the respondents were voluntary to be interviewed and signed the informed consent form.

References:

1. Arrow KJ. Uncertainty and the welfare economics of medical care. 1963. J *Health Polit Policy Law*. 2001;26:851-83. 10.1215/03616878-26-5-851

2. Han PK, Klein WM, Arora NK. Varieties of uncertainty in health care: a conceptual taxonomy. *Med Decis Making*. 2011;31:828-38. 10.1177/0272989x1139 3976

3. Zhang Y, Tang WX, Sun XW, et al.. [Studying on the influence of residents' seeing a doctor freely on the integration of health service system in China]. *The Chinese Health Service Management*. 2014;31:678-680

4. Simões J, Augusto GF, Fronteira I. Introduction of freedom of choice for hospital outpatient care in Portugal: Implications and results of the 2016 reform. *Health Policy*. 2017;121:1203-1207. 10.1016/j.healthpol.2017.09.010

5. Yoon KJ, Oh YH, Lee SH, et al.. [Issues and Improving Strategies on Korea Healthcare Delivery System]. *Korea Institute for Health and Social Affairs*; Sejong, Korea: 2014

6. Aoki T, Yamamoto Y, Ikenoue T, et al.. Effect of Patient Experience on Bypassing a Primary Care Gatekeeper: a Multicenter Prospective Cohort Study in Japan. *J Gen Intern Med*. 2018;33:722-728. 10.1007/s11606-017-4245-1

7. Hillen MA, Gutheil CM, Strout TD, et al.. Tolerance of uncertainty: Conceptual analysis, integrative model, and implications for healthcare. *Soc Sci Med.* 2017;180:62-75. 10.1016/j.socscimed.2017.03.024

8. Zhang Y. [Research on the evaluation and mechanism of the multi-institutional readmission service integration in rural China: township-county hospitals]. Wuhan: Huazhong University of Science and Technology

9. Kim AM, Cho S, Kim HJ, et al.. Primary Care Patients' Preference for Hospitals over Clinics in Korea. *Int J Environ Res Public Health*. 2018;15:1119. 10.3390/ijerph15061119

10. Bull State Council People's Repub China. [State Council's guiding opinions on promoting the construction of the tiered healthcare delivery system]. 2015;27:27-31 http://www.gov.cn/zhengce/content/2015-09/11/content_10158.htm

11. Eggleston K, Ling L, Qingyue M, et al.. Health service delivery in China: a literature review. *Health Econ*. 2008; 17:149-165. 10.1002/hec.1306

12. Wang X, Yang H, Duan Z, et al.. Spatial accessibility of primary health care in China: A case study in Sichuan Province. *Soc Sci Med*. 2018;209:14-24. 10.1016/j.socscimed.2018.05.023

13. Zhao X, Xiao J, Chen H, et al.. Patient preferences and attitudes towards first choice medical services in Shenzhen, China: a cross-sectional study. *Brit Med J Open*.

2022;12(5):e057280. 10.1136/bmjopen-2021-057280

14. National Health Commission of the People's Republic of China. [China health statistics yearbook]. 2021; https://www.yearbookchina.com/navibooklist-n-3020013080-1.html

15. Yang J, Siri JG, Remais JV, et al.. The Tsinghua-Lancet Commission on Healthy Cities in China: unlocking the power of cities for a healthy China. *Lancet*. 2018;391:2140-2184. 10.1016/S0140-6736(18)30486-0

16. World Health Organization. The world health report 2008: primary health care now more than ever: introduction and overview. Geneva, 2008. https://apps.who. int/iris/handle/10665/69863

17. Bull State Council People's Repub China. [State Council guidance on the promotion and development of medical consortium]. 2017; 13:14–8. http://www.gov.cn/gongbao/content/2017/content_5191699.htm

18. Li X, Lu J, Hu S, et al.. The primary health-care system in China. *Lancet*. 2017;390:2584-2594. 10.1016/S0140-6736(17)33109-4

19. Andersen R, Newman JF. Societal and individual determinants of medical care utilization in the United States. *Milbank Mem Fund Q Health Soc*. 1973;51:95-124

20. Song H, Zuo X, Cui C, et al.. The willingness of patients to make the first visit to primary care institutions and its influencing factors in Beijing medical alliances: a comparative study of Beijing's medical resource-rich and scarce regions. *BioMed Central Health Serv Res*. 2019;19:361. 10.1186/s12913-019-4184-0

21. Li X, Zhang L, Li Z, et al.. Patient Choice and Willingness Toward Gatekeepers as

First-Contact Medical Institutions in Chinese Tiered Healthcare Delivery System: A Cross-Sectional Study. *Front Public Health.* 2021;9:665282. 10.3389/fpubh.2021.665282

22. Liu C, Qiu L, Wang H. Willingness rate of the first visit to primary healthcare services and the associated factors in China: a meta-analysis. *Aust J Prim Health*. 2022;28:459-468. 10.1071/PY21296

23. Zhang Y, Wang C, Lu S, et al.. [Governance Logic of Hierarchical Medica al System and The Effect of Cognitive Bias of Rural Residents]. *Chinese Journal of Health Policy*, 2022,15:24-30

24. National Health Commission of the People's Republic of China. [Notice on the issuance of three service capacity standards including the service capacity standards for township health centres]. Published 2022. http://www.nhc.gov.cn/jws/s7874/202207/03f2e43540384209b67cce25a6cd9ae2.shtml

25. Wang C, Lu S, Zhang Y. Drivers of high-cost persistence in rural China: A population-based retrospective study. *Front Public Health*. 2022;10:988664. 10.3389/fpubh.2022.988664

26. Xiao Y, Qiu QM, Huang YX, et al.. Patients gather in large hospitals: the current situation of Chinese hospitals and the direction of medical reform. *Postgrad Med J*. 2022;98:e43. 10.1136/postgradmedj-2021-140147

27. Mishel M, Braden C. Finding meaning: antecedents of uncertainty in illness. *Nursing Research*, 1988, 37(2):98-103

28. Kang L. [Determinants of residents' health seeking willingness in rural areas of

China]. *Chinese Rural Health Service Administration.* 2020,40:319-323

29. Tang J, Liu YN, Liao Y, et al.. [Analysis of the choice and influencing factors of the first visit hospitals for 6619 urban and rural residents in Liaoning Province]. *Chinese Hospitals*, 2021,25:24-27

30. Teng L, Li Y. Analysis on the willingness and influencing factors of choosing primary healthcare institutions among patients with chronic conditions in China: a cross-sectional study. *Brit Med J Open*. 2022;12:e054783. 10.1136/bmjopen- 2021-054783

31. Zhang L, Cheng G, Song S, et al.. Efficiency performance of China's health care delivery system. *Int J Health Plann Manage*. 2017;32:254-263. 10.1002/hpm.2425

32. Li J, Wang P, Kong X, et al.. Patient satisfaction between primary care providers and hospitals: a cross-sectional survey in Jilin province, China. *Int J Qual Health Care*. 2016;28:346-354. 10.1093/intqhc/mzw038

33. Liu Y, Kong Q, Yuan S, et al.. Factors influencing choice of health system access level in China: A systematic review. *PLoS One*. 2018;13:e0201887. 10.1371/journal.pone.0201887

34. Zeng Y, Wan Y, Yuan Z, et al.. Healthcare-Seeking Behavior among Chinese Older Adults: Patterns and Predictive Factors. *Int J Environ Res Public Health.* 2021;18:2969. 10.3390/ijerph18062969

35. Li H, Xu H. [Can medical insurance policies promote the realization of hierarchical medical treatment: An Empirical Analysis Based on Medical Demand Behavior]. *Comparative Economic&Social Systems*, 2018:28-35.

36. Beaglehole R, Epping-Jordan J, Patel V, et al.. Improving the prevention and management of chronic disease in low-income and middle-income countries: a priority for primary health care. *Lancet.* 2008;372:940-949. 10.1016/S0140- 6736(08)61404-X

37. Sun X, Meng H, Ye Z, et al.. Factors associated with the choice of primary care facilities for initial treatment among rural and urban residents in Southwestern China. *PLoS One*. 2019;14:e0211984. 10.1371/journal.pone. 0211984

38. Sun H, Miao CX, Jiang JX, et al.. [Residents' approval and influencing factors of hierarchical diagnosis and treatment system, Xuzhou]. *Modern Preventive Medicine.* 2019;46:3548-3551+3569.

39. Coube M, Nikoloski Z, Mrejen M, et al.. Inequalities in unmet need for health care services and medications in Brazil: a decomposition analysis. *Lancet Reg Health Am*. 2023;19:100426. 10.1016/j.lana.2022.100426

40. Wang Y, Wu X, Yin M, et al.. Patient capability: Justice and grassroots healthcare delivery in China. *Dev World Bioeth.* 2022;22:170-178. 10.1111/dewb. 12328

41. Jia HN, Chen RH, Teng BJ, et al.. [Analysis on the Medicine Purchase Decision-making Process of Rural Residents' Self-medication from the Perspective of Behavioral Economics]. *Chinese Health Economics*. 2021,40:21-23.

42. Gao QF. [Medical-care-seeking behavior and concentration]. *Health Economics Research.* 2007;228:36-37.

43. Wheat HC, Barnes RK, Byng R. Practices used for recommending sickness certification by general practitioners: a conversation analytic study of UK primary care consultations. *Soc Sci Med.* 2015;126:48-58. 10.1016/j.socscimed.2014.12.006

582 44. Cao B, Huang W, Chao N, et al.. Patient Activeness During Online Medical
583 Consultation in China: Multilevel Analysis. *J Med Internet Res*. 2022;24:e35557.
584 10.2196/35557
585 45. He C, Zhou Q, Chen W, et al.. Using an Internet-Based Hospital to Address
586 Maldistribution of Health Care Resources in Rural Areas of Guangdong Province,
587 China: Retrospective and Descriptive Study. *JMIR Med Inform*. 2018;6:e51.
588 10.2196/medinform.9495
589 46. Rodriguez Santana I, Mason A, Gutacker N, et al.. Need, demand, supply in health
590 care: working definitions, and their implications for defining access. *Health Econ*
591 *Policy Law*. 2023;18:1-13. 10.1017/S1744133121000293
592 47. Guo A, Wang P. The Current State of Doctors' Communication Skills in Mainland
593 China from the Perspective of Doctors' Self-evaluation and Patients' Evaluation: A
594 Cross-Sectional Study. *Patient Educ Couns*. 2021;104:1674-1680.
595 10.1016/j.pec.2020.12.013

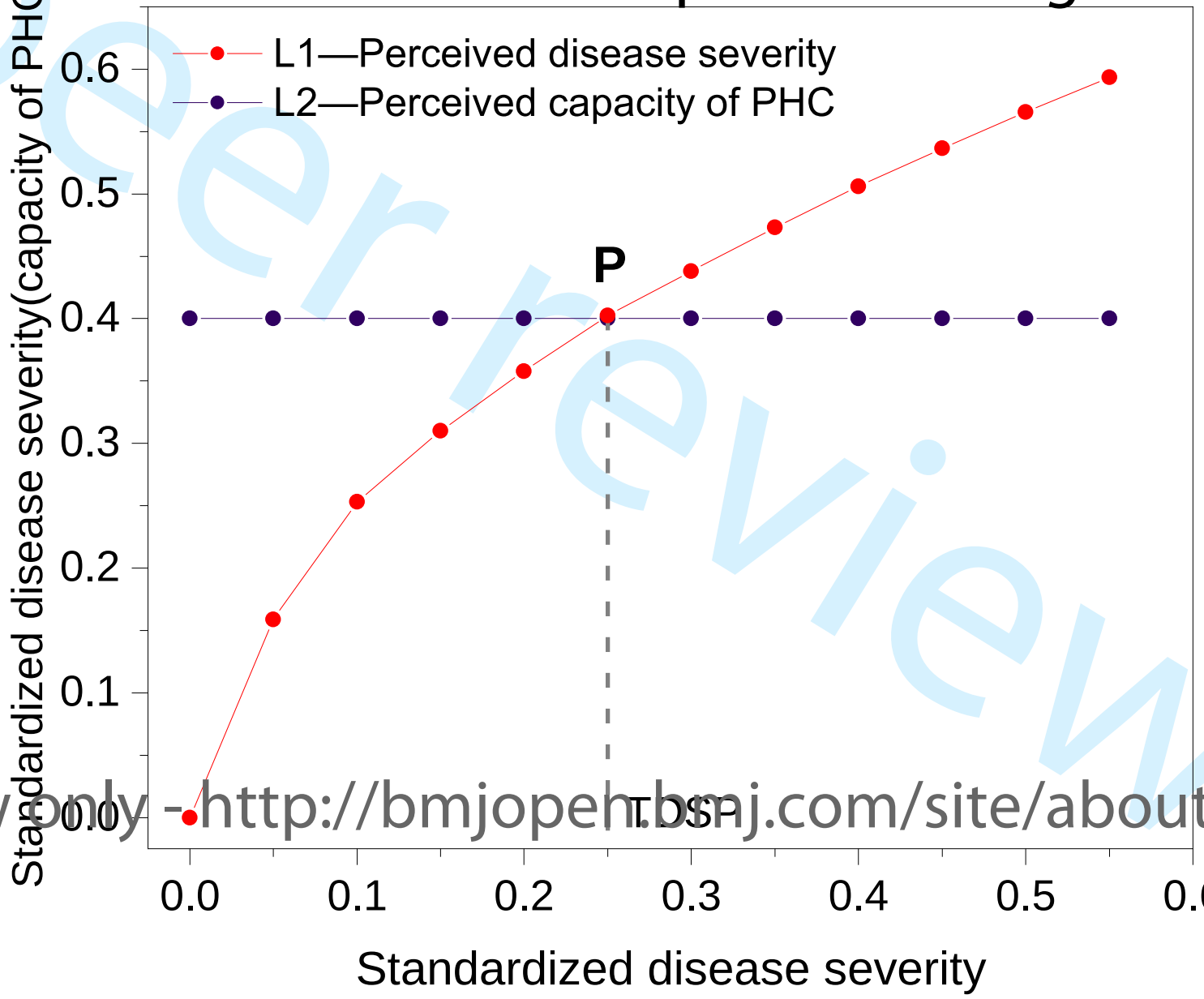
596

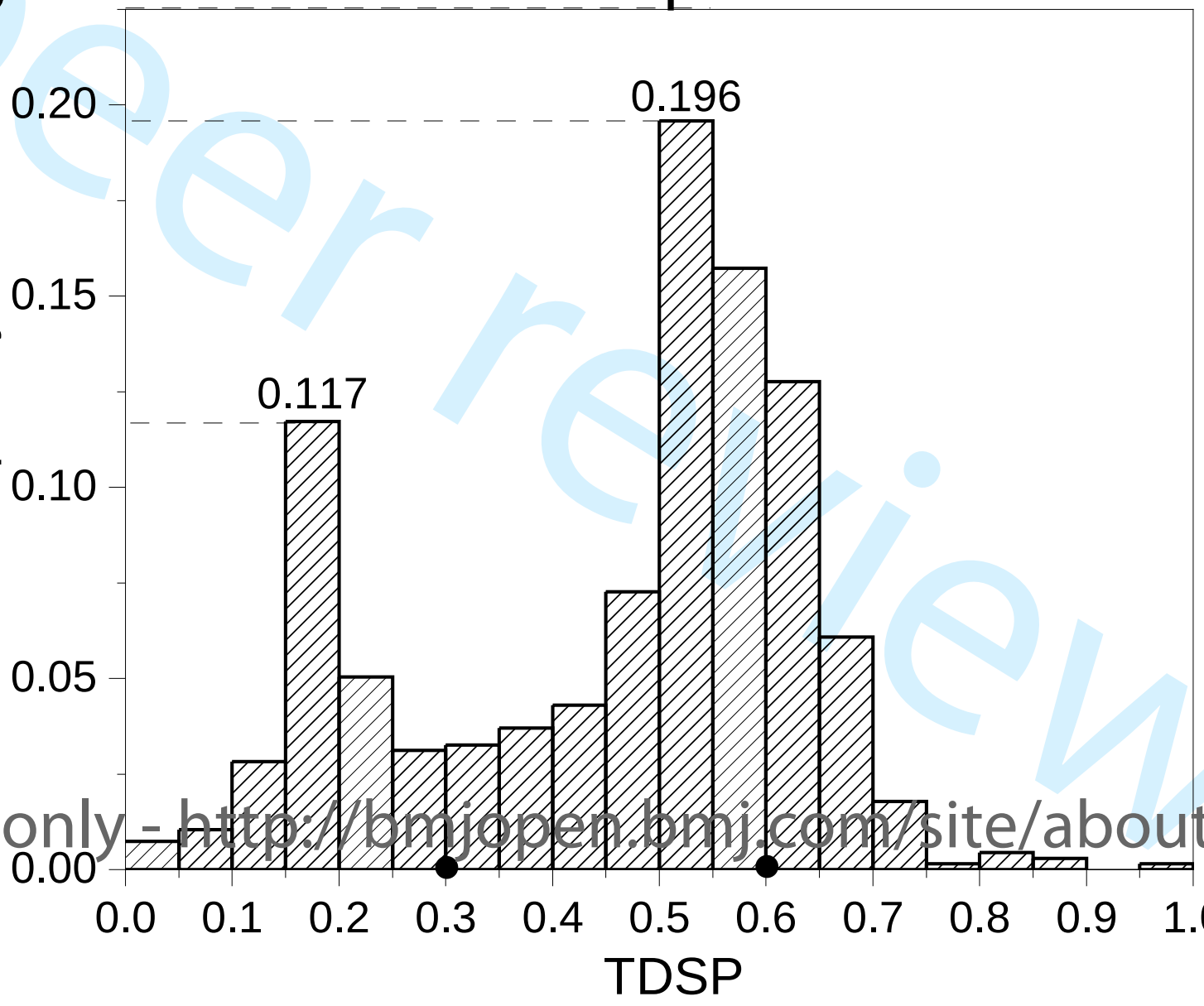
597 Figure 1 TDSP schematic diagram

598 Figure 2 TDSP distribution diagram

599

TDSP schematic diagram





Annex 1

Situation Categorization	Treatment combinations	Typical diseases	Standardized disease severity (±0.05)	Level of medical institution
ISmall Outpatient Clinic	Outpatient prescribed medication	Common cold; indigestion; gastritis	0.1 (0.05-0.15)	Village clinics
IIGeneral Outpatient Clinic	General outpatient treatment + outpatient prescribed medication	Acute gastroenteritis	0.2 (0.15-0.25)	Village clinics
	Minor examination + outpatient prescribed medication	Urticaria		Weak THC
IIIStandard Outpatient Clinic	Minor examination + general outpatient treatment + outpatient prescribed medication	Otitis media; urinary tract infections;	0.3 (0.25-0.35)	Weak THC
IVOutpatient Surgery	Minor examinations + minor operations + outpatient prescribed medication	Excision of body surface masses (boils, haemorrhoids); fracture repositioning and fixation	0.4 (0.35-0.45)	General THC
V Inpatient Internal Medicine	Inpatient monitoring, care and treatment services	Hospitalisation for progressive chronic disease (coronary heart disease); hospitalisation for pneumonia	0.5 (0.45-0.55)	Central THC
VI Minor surgery inpatient/ suspected high risk diagnosis	minor surgery + inpatient monitoring, care, treatment services	appendicitis	0.6 (0.55-0.65)	Central THC
	Suspected high risk: major examination + outpatient prescribed medication + general outpatient treatment operations	Gastroscopy for suspected gastrointestinal high-risk disease		Community Hospitals/ Quality THC
VII Major internal medicine admission	Major examination + inpatient monitoring, care, treatment services	Stroke attack, Progressive cirrhosis of the liver	0.7 (0.65-0.75)	County Hospitals
VIII Major surgery admissions	Major surgery + inpatient monitoring, care,	Major lobectomy of the lungs Liver and kidney transplantation	0.8 (0.75-0.85)	Tertiary Hospitals

	treatment services + major investigations			
IX Acute and Critical Care	Critical care resuscitation and monitoring	Acute heart attack stenting; haemorrhage and shock; respiratory failure	0.9 (0.85-0.95)	Grade IIIA hospital

Annex 2

Number	Scenario symptoms	Prediagnosis judgment	Score
D1-common cold	It's been three days since I had a sore throat, runny nose, sneezing, coughing and lack of energy, and it's still not getting better.	Take your own medication without going to the doctor?	0.05
		Do you go to the doctor? *	0.1
		Is it necessary to see a doctor at a county hospital?	0.6
		Do you need a blood test?	0.2
		Do you need a transfusion?	0.3
		Do you need a X-ray to check for pneumonia?	0.4
D2-gastritis	In the last ten days, I have felt uncomfortable stomach, often bloating, stomachache, hiccups and bad appetite.	Take your own medication without going to the doctor?	0.05
		Do you need to see a doctor and take some medicine? *	0.15
		Is it necessary to see a doctor at a county hospital?	0.6
		Is it necessary to have a gastroscopy now that I can have a full check-up for stomach disorders?	0.65
D3-gastroenteritis	I had diarrhea five times a day, and my stomach was very painful. I didn't feel well all day.	Take your own medication without going to the doctor?	0.05
		Do you go to the doctor?	0.1
		Is it necessary to see a doctor at a county hospital?	0.6
		Do you need a blood test?	0.2
		Do you need a transfusion?	0.3
		Do you need a stool test?	0.4
		Is a colonoscopy necessary now to see if there are any other serious diseases of the intestines?	0.65
D4-urticaria	Basically every day I get an itch and I scratch it and I break out in a rash and it goes away on its own.	Take your own medication without seeing a doctor?	0.05
		Do I need to see a doctor to see what's going on and get some medication? *	0.25
		Do I need to see a dermatologist or a general internist?	0.6
		Do I need to have a blood test?	0.3
		Do I need to test for allergens to see what I am allergic to?	0.65
D5-otitis media	In the last week, there was pain and tinnitus in the ears, and pus flowing out of the ears.	Use your own medication without seeing a doctor?	0.05
		Do you need a doctor to look at your ears and deal with the pus? *	0.3
		Is it necessary to have an ear, nose and throat specialist or is a general practitioner of internal and external medicine sufficient?	0.6

D6-furuncle	A hard bump on the neck, the size of a fingernail, but painful, growing larger and larger. It has been there for a week.	Use your own medicine without going to the doctor?	0.05
		Do you need to see a doctor?	0.1
		Do you need a doctor to cut you open and drain the pus? *	0.35
		Is it necessary to go to a doctor at a county hospital to do this?	0.6
		Do I need to have the contents examined to see if it is benign or malignant after the incision?	0.65
D7-hemorrhoids	The bowel movements have been painful and bloody in the last week.	Take your own medication without seeing a doctor?	0.05
		Do you need to see a doctor to get checked out and take minor opeartions when necessary? *	0.4
		Is it necessary to see a doctor at a county hospital?	0.6
		Do I need a proctoscopy to rule out rectal cancer?	0.65
D8-fracture	I fell off my bike and my hand fell to the ground. It was very sore and swollen, and I couldn't move it. I've had half a day off.	Buy your own medicine without going to the doctor?	0.05
		Do you want to go to the hospital to have a X-ray taken for possible surgery? *	0.45
		Is it necessary to have a CT so that you can see it better?	0.55
		Is it necessary to go to the doctor at the county hospital to see the X-ray for diagnosis?	0.6
D9-coronary heart disease	Twice in the last month I have had angina with chest tightness, dizziness and profuse sweating, relieved after half an hour.	Take your own medication without seeing a doctor?	0.05
		Do I need to see a doctor for an ECG inpatient monitoring?*	0.5
		Is it necessary to see a doctor at a county hospital?	0.6
		Do I need more accurate heart tests? For example, cardiac magnetic resonance imaging, coronary CT	0.65
D10-acute simple appendicitis	severe pain in the lower right side of the stomach, not getting better all the time, possibly appendicitis	(Would you have surgery for appendicitis? Where would you have it done?) No surgery ?	0.4
		Township health centre?*	0.55
		County hospital ?	0.65

STROBE Statement—Checklist of items that should be included in reports of ***cross-sectional studies***

	Item No	Recommendation	Page No
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract	P1 Line 1-3
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found	P2-P3
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	P7 140-150
Objectives	3	State specific objectives, including any prespecified hypotheses	P8 151-153
Methods			
Study design	4	Present key elements of study design early in the paper	P8157-158
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	P12 234-245
Participants	6	(*a*) Give the eligibility criteria, and the sources and methods of selection of participants	P12 240-245
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	P13 247-260
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	P9-P11
Bias	9	Describe any efforts to address potential sources of bias	P13
Study size	10	Explain how the study size was arrived at	P12
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	P11 222-230
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding	P13 264-268
		(*b*) Describe any methods used to examine subgroups and interactions	P11
		(*c*) Explain how missing data were addressed	P12-243
		(*d*) If applicable, describe analytical methods taking account of sampling strategy	P12
		(*e*) Describe any sensitivity analyses	
Results			
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	P13-271
		(b) Give reasons for non-participation at each stage	P12-243
		(c) Consider use of a flow diagram	
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	P13-P14
		(b) Indicate number of participants with missing data for each variable of interest	P12-243

Outcome data	15*	Report numbers of outcome events or summary measures	P16-297
Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	P14-282
		(*b*) Report category boundaries when continuous variables were categorized	P11
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	P16-297
Discussion			
Key results	18	Summarise key results with reference to study objectives	P17-317
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	P21-404
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	P18-P19
Generalisability	21	Discuss the generalisability (external validity) of the study results	P20-372
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	P23-438

*Give information separately for exposed and unexposed groups.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at www.strobe-statement.org.

BMJ Open

Residents' Willingness towards First-contact with Primary Health Care under Uncertainty in Healthcare: A Cross-sectional Study in Rural China

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Residents' Willingness towards First-contact with Primary Health Care under Uncertainty in Healthcare: A Cross-sectional Study in Rural China

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Abstract

Objective

To estimate Chinese rural residents' willingness degree of initially contacting Primary Health Care (PHC) under uncertainty in healthcare, and to explore its influencing factors.

Setting

This study collected primary data from rural residents in Dangyang, Hubei Province in China.

Participants

The study investigated 782 residents, and 701 finished the survey. The response rate was 89.64%. A further 27 residents failed the internal consistency test, so the effective sample size was 674.

Design

In this cross-sectional study, residents' willingness was reflected by the Threshold of Disease Severity for PHC (TDSP), the individual maximal disease scope for considering PHC based on residents' decision-making framework. TDSP was measured through scenario tests. Univariate analysis and unordered multiple logistic regression were used to explore the influencing factors of three-level TDSP: low, general, and high.

Results

Only 28.2% of respondents had high TDSP and high willingness towards PHC. Compared to general TDSP, respondents who were younger than 40 (OR 7.344, 95% CI 2.463 to 21.894), rich (OR 1.913, 95% CI 1.083 to 3.379), highly risk-averse (OR

1.958, 95% CI 1.016 to 3.774), had substitute medical decision-maker (OR value of parent/child was 2.738, 95% CI 1.386 to 5.411), and had no visits to PHC in the last 6 months (OR 2.098, 95% CI 1.316 to 3.346) tended to have low TDSP and low willingness towards PHC. Compared to general TDSP, no factors were found to significantly influence respondents' high TDSP.

Conclusions

TDSP can be a good indicator of residents' willingness. TDSP results demonstrate rural residents' generally low willingness towards first-contact with PHC that some residents refuse to consider PHC even for mild diseases. This study provides practical significance for elaborating the underutilization of PHC from resident decision-making and offers advice to policy-makers and researchers for future modifications.

Strengths and limitations of this study

- To the best of our knowledge, this study is the first nationwide study to analyze Chinese rural residents' willingness towards first-contact with PHC with their medical decision-making under uncertainty considered.
- The measurement method in this study is innovative by taking the disease spectrum and patients' decision-making framework simultaneously into account.
- The measurement of this study is mainly single item of scenario tests, and results might be biased due to the limited number of scenarios.
- Though the topic and methodology may be widely applicable, the criteria for the level of willingness to seek primary care in this article are set according to Chinese guidelines.

Introduction

Uncertainty in healthcare, which signals an unknown probability of risk, pertains to nearly every health-related activity such as whether a patient has a particular disease and how that condition will evolve[1]. Uncertainty can trigger cognitive and affective responses in patients including increased risk perception and increased judgmental bias, which may bring about defensive decision-making and behavior[2,3]. Moreover,

residents' reactions to uncertainty can be further extended with the increasing freedom of choice of doctors, which has been emphasized by many countries and regions for promoting institutional competition and patients' satisfaction[4-7]. Residents can freely determine their healthcare providers according to their estimations, even though governments have encouraged them to first visit primary health care (PHC), the gatekeeper of the national health system, for initial diagnosis and referral suggestions. As a result, residents always subjectively bypass PHC and contact high-level hospitals first even for minor diseases[8]. In Korea, about 15% of outpatient visits that were eligible for primary institutions chose high-level hospitals[9]. Under the Japanese free-access healthcare system, undertaking the gatekeeping function of PHC was also a challenge[6]. The underuse of PHC can be more serious in China, especially in rural areas. There is inevitably an increased burden on patients, a waste of limited healthcare resources, and inequities among patients when everyone wants to directly get access to high-level hospitals.

In rural China, a tiered healthcare delivery system geographically consisting of county hospitals, township health centers (THC), and village clinics (PHC includes village clinics and THC) has been extensively promoted to provide a full range of health services to local residents[10-12]. Those medical institutions have different responsibilities. PHC institutions are expected to provide preventative and initial care for residents, as well as treatment of common diseases, whereas county hospitals are responsible for intractable diseases and emergency issues[13]. Residents' first-contact with PHC is the key to ensuring the fulfillment of the tiered healthcare delivery system

and residents' sequential medical appointments. However, there were 4.25 billion visits of PHC institutions in 2021, accounting for 50.12% of all medical visits, 3.95% lower than the proportion in 2017[14]. Many rural residents only consider county hospitals or above for first-contact regardless of their actual disease situation even if PHC is well capable after years of improving quality and enlarging service scope[15-18]. It is evident that only strengthening PHC in directing patient flow and enhancing the tiered healthcare delivery system is insufficient. The prominent problem is that residents have the freedom to make medical choices, but their considerations and subjective demands for healthcare under uncertainty may not overlap perfectly with the government's ideal expectation[13].

Therefore, it is necessary to understand residents' decision-making process in China. According to Andersen's behavioral model, residents identify their health demands first before utilizing health services, which means they primarily make subjective judgments about the disease condition and its severity[19]. Then residents compare the perceived disease severity with the perceived capacity of PHC, a stable perception of PHC's ability to treat diseases. Residents may be willing to visit PHC first only when they perceive that PHC is capable of treating their diseases, which is the prerequisite decision-making process for generating willingness towards PHC, though residents may still ultimately go to other institutions weighing up situational factors under the freedom of choice of doctors[13].

This study invents a new method to reflect residents' willingness towards PHC based

on their decision-making framework. Due to inadequate medical knowledge and avoidance responses caused by uncertainty in healthcare, residents' perceptions of disease severity often deviate from their objective disease severity, and the degree of deviation varies with personal characteristics[1]. Assuming that a resident is exposed to a spectrum of diseases of different severity, there exists an approximate severity of objective diseases that in the resident's mind is so serious that the maximum capacity of PHC exactly cannot handle. We call this objective and abstract upper limit of severity the Threshold of Disease Severity for Primary Health Care (TDSP), and we measure this by what we call standardized disease severity. Therefore, TDSP can represent the objective and maximal disease scope for individual resident to consider PHC. More importantly, it is a reflection of residents' degree of willingness towards first-contact with PHC.

Although previous studies have noticed the importance of residents' first-contact with PHC, few studies have noticed the possible impact of the spectrum of diseases and different disease severity on residents' willingness towards PHC[20,21]. Moreover, despite the continuous focus on patients' underuse of PHC and patients' low willingness towards first-contact with PHC, the problem has not been ameliorated[14-18]. This study primarily summarizes residents' decision-making process of medical choices under uncertainty, and attempts to essentially elaborate the gap between residents' current status of PHC utilization and policy expectations in order to provide references for improving willingness towards PHC from the perspective of residents[22]. Therefore, this study applied a theoretical framework and standardized

tools to measure TDSP among rural residents through scenario tests. Our study has two objectives: (1) to describe rural residents' willingness towards PHC under uncertainty through their corresponding TDSP level; (2) to explore the influencing factors of TDSP to make future recommendations.

Materials and Methods

Principle of TDSP

TDSP is generated based on two factors: residents' perceived disease severity and perceived capacity of PHC (Figure 1). In Figure 1, the horizontal and vertical axes both represent standardized disease severity with values from 0-1. The capacity of PHC can be understood as the maximum severity of the disease that can be treated by PHC, so the vertical axis connects the disease severity with the capacity of PHC. The curve that depicts the trend of residents' perceived disease severity as disease severity increases is L1. The resident's perceived capacity of PHC is L2, and the horizontal coordinate of the intersection P of L2 and L1 is TDSP. Each resident has a unique L1, L2, and TDSP.

TDSP with an interval between 0-1 is the antecedent factor for generating willingness towards PHC. Only when the objective disease severity is lower than the TDSP will the resident include PHC as an alternative plan. The higher the TDSP, the more likely the resident is to consider first-contact with PHC when the disease is relatively serious, and the higher the willingness degree towards PHC. For example, an individual with a TDSP value of 0.4 will consider PHC if the disease scope is between 0-0.4 severity, and her willingness to attend PHC first is higher than those with a TDSP of 0.3 or 0.2.

Standardized tool for TDSP

This study applied a standardized disease severity framework already developed based on the incidence of common diseases, clinical pathways, and government guidelines[23,24]. The principle is to equate the standardized disease severity with the difficulty of treating the disease and to roughly grade it through standard treatment combinations including examinations, operations, and the performing institutions. The increasing complexity of treatment combinations is indicative of the increasing standardized disease severity addressed. As for a patient's single consultation, the treatment combinations are categorized into 9 situations from the mildest small outpatient clinic (0.1), general outpatient clinic (0.2), to the extremely severe Acute and Critical Care (0.9) (see Annex 1). A single situation represents a range of disease severity (±0.05), not a specific degree, and the disease severity can be specially adjusted for treatment complexity and duration. The most complex situation within the capacity of PHC is minor inpatient surgery (0.6) according to government guidelines, which means that PHC is capable of treating diseases of 0-0.55 severity when the critical value (0.6) is removed to be conservative.

Measurement of TDSP

To estimate patients' perception of disease severity and plot L1, scenario tests were conducted among respondents based on 10 diseases including common cold (D1), gastritis (D2), gastroenteritis (D3), urticaria (D4), otitis media (D5), furuncle (D6), hemorrhoids (D7), fracture (D8), coronary heart disease(D9), acute simple appendicitis (D10). The 10 typical diseases were selected based on clinicians' recommendations

according to situation categorizations and prevalence among residents. Specific treatment complexity was taken into account to differentiate disease severity. In scenario tests, residents were assumed to suffer from the given symptoms of each of the 10 diseases and were asked to choose their intended treatment with reasonable interpretations. For example, they wanted to get a transfusion or only take medicine to cure colds (Annex 2 for details). To draw L1, a horizontal coordinate from 0.1 to 0.55 was established according to 10 diseases with 0.05 being the interval, and the vertical coordinate was the perceived disease severity of the 10 diseases in line with individual resident's choice. For example, a cold normally required a small outpatient medication prescription with a severity of 0.1, but the resident believed that the cold required an X-ray with a perceived severity of 0.4, so the point (0.1, 0.4) was one of the 10 bases for fitting curve the resident's L1. For each individual, a total of 10 points were generated to simulate L1.

As for curve fitting, L1 was fitted respectively based on four basic functions: linear, logarithmic, exponential, and power functions, yielding four functional expressions for individual L1. The four functions can mainly cover the possible directions and shapes of L1. Then the fitting results were screened according to the following criteria: (1) the function with outliers was excluded; (2) $R^2 \geqslant 0.7$, and the function with the largest R^2 was selected; (3) when (1) and (2) were not met, the case was separately checked and analyzed to adjust the fitting function.

To estimate resident's perception of the capacity of PHC and plot L2 for each individual,

residents were asked to choose the most complex treatment combinations they would like to utilize in PHC, which demonstrated the maximum standardized disease severity they might want to be treated by PHC. Moreover, to measure residents' perceived capacity of PHC accurately, for each treatment combination they chose, residents could express their intention of three levels: strong, medium, and weak (Table 1).

Table 1 Estimation of residents' perceived capacity of PHC

Situation Categorization	Treatment combinations utilization	Attitude	Standardized disease severity
Standard Outpatient Clinic	Willing to do minor examinations + general outpatient treatment + medication in PHC	weak	0.25
		medium	0.3
		High	0.35
Outpatient Surgery	Willing to do minor examinations + minor operations + outpatient medication in PHC	weak	0.35
		medium	0.4
		High	0.45
Inpatient Internal Medicine	Willing to accept inpatient monitoring, care and treatment services in PHC	weak	0.45
		medium	0.5
		High	0.55
Minor inpatient surgery	Willing to accept minor surgery + inpatient monitoring, care and treatment services in PHC	weak	0.55
		medium	0.6
		High	0.65

*Investigators would help participants to tell the connotations and differences between treatment combinations.

TDSP was divided into three levels: low TDSP (0-0.3), general TDSP (0.3-0.55), and high TDSP (>0.55) because the willingness degree reflected by TDSP intervals can be more accurate and practical than specific values. According to government guidelines for PHC construction, the cut-off value of 0.3 (standard outpatient clinic) represents the lower limit of the capacity of PHC. Residents who had such minor diseases and refused to consider visiting PHC were classified as having low TDSP and low willingness. The cut-off value of 0.55 (minor inpatient surgery) represents the upper limit of the capacity of PHC. Residents who had diseases more serious than 0.55 and still considered visiting

PHC were classified as having high TDSP and high willingness. While residents who scored 0.3-0.55 had low but reasonable willingness towards PHC because different PHC institutions accessed routinely by residents were inconsistent in capacity.

Research setting and data sources

We conducted a cross-sectional study in Dangyang, a typical rural area in Hubei Province in central China, with a rural population of 331,349 and a gross domestic product per capita higher than the national average[25]. We used the stratified sampling method to randomly select 3 villages from each of the 10 townships in Dangyang. The household survey was conducted in each selected village. Respondents were investigated through face-to-face questionnaire interviews by uniformly trained investigators. Inclusion criteria: (1) >18 years of age; (2) permanent residents of the area (living in Dangyang for ≥ 6 months); (3) voluntary participation in the study. Exclusion criteria: presence of cognitive impairment. A total of 782 residents were investigated and 701 residents finished the survey, so the response rate was 89.64%. Moreover, twenty-seven respondents did not pass the internal consistency test, so the effective sample size for this study was 674.

Questionnaire design and variables

The questionnaire was self-designed based on government guidelines, previous literature, and expert consultations. We conducted a pilot study to verify the consistency between TDSP and residents' self-assessed willingness towards PHC and to test the reliability and validity of the questionnaire. The final version of the questionnaire

contained three sections: fundamental personal characteristics, scenario tests, and estimation of residents' perceived capacity of PHC. Fundamental personal characteristics identified as independent variables were mainly from three aspects: (1) sociodemographic characteristics including gender, age, education, marital status, employment, economic status and chronic disease status; (2) health-seeking objective factors including county hospital acquaintance and substitute medical decision-maker; (3) health-seeking subjective factors including expected price to cure colds, watching health video frequency, attitudes towards the tiered healthcare delivery system, level of risk aversion, and experience of visiting PHC in the last 6 months. The dependent variable was the three-level TDSP.

Patient and public involvement

Patients were not involved in the design and conduct of this research. Residents participated in the pilot study and interviews to ensure the final version of the questionnaire. We also involved experts in health economics and clinicians in the design of this research and survey tool.

Statistical analysis

The software SPSS 26.0 was used to create a database and analyze data with a double check to ensure the quality. Sample descriptions were listed to depict the fundamental characteristics of respondents. Univariate analysis was performed using the Chi-square test and variance analysis. The unordered multiple logistic regression method was used to analyze the predictors of three-level TDSP.

Results

Description of TDSP and willingness degree

TDSP distribution is shown in Figure 2. Among 674 valid respondents, the mean of TDSP was roughly 0.434±0.179, with an upper quartile of 0.285 and a lower quartile of 0.559. The two frequency peaks of TDSP occurred in the intervals of 0.15-0.2 and 0.5-0.55, and the percentage of TDSP below 0.2 and 0.55 was 19.0% and 71.8% respectively. Generally, the overall level of TDSP was relatively low. Only 190 (28.2%) respondents had a high TDSP more than 0.55, and there were 176 (26.1%) respondents who had low willingness towards first-contact with PHC with TDSP less than 0.3.

Baseline characteristics and univariate analysis of TDSP level

Table 2 presents the baseline characteristics of respondents and the results of univariate analysis of their TDSP level. Among 674 respondents, elders over 60 years of age accounted for 49.9%. Moreover, respondents under 40 tended to have a higher possibility of low TDSP. As for economics, rich respondents were more likely to have low TDSP, while average and poor respondents tended to occupy a higher proportion of general and high TDSP. When faced with consultation choice, the vast majority of respondents made decisions by themselves. Respondents who had not visited PHC in the last 6 months accounted for 68.5%. Respondents had a strong level of risk aversion accounting for 15.9%, and they were more likely to have low TDSP. In addition, results showed that there were no statistically ($p>0.05$) significant differences for gender, chronic diseases, expected price to cure colds, and attitudes towards the tiered healthcare delivery system.

296 Table 2 Respondents' baseline characteristics and univariate analysis of TDSP level

Characteristic	N (%)	TDSP level			χ2	P
		Low (%)	General (%)	High (%)		
Sex					5.174	0.075
Female	328(48.7)	98(55.7)	146(47.4)	84(44.2)		
Male	346(51.3)	78(44.3)	162(52.6)	106(55.8)		
Age					29.154	<0.001
<40	77(11.4)	37(21)	23(7.5)	170(8.9)		
40-59	261(38.7)	63(35.8)	125(40.6)	73(38.4)		
60-74	270(40.1)	69(39.1)	121(39.3)	80(42.2)		
>=75	66(9.8)	7(4)	39(12.7)	20(10.5)		
Education					25.283	<0.001
Primary school	263(39)	42(23.9)	140(45.5)	81(42.6)		
Junior school	245(36.4)	77(43.8)	101(32.8)	67(35.3)		
Senior school	129(19.1)	42(23.9)	55(17.9)	32(16.8)		
College and above	37(5.5)	15(8.5)	12(3.9)	10(5.3)		
Marital status					10.138	0.038
Married	620(92)	157(89.2)	287(93.2)	176(92.6)		
Unmarried	22(3.3)	12(6.8)	5(1.6)	5(2.6)		
Divorced or widowed	32(4.7)	7(4)	16(5.2)	9(4.7)		
Employment					21.594	0.001*
Farming or workers	381(56.5)	82(46.6)	190(61.7)	109(57.4)		
Individual business, work in enterprises	143(21.2)	48(27.3)	54(17.5)	41(21.6)		
Retirement	136(20.2)	36(20.5)	61(19.8)	39(20.5)		
Others	14(2.1)	10(5.7)	3(1)	1(0.5)		
Economics					13.778	0.008
Rich	101(15)	38(21.6)	33(10.7)	30(15.8)		
Average	483(71.7)	120(68.2)	224(72.7)	139(73.2)		
Poor	90(13.4)	18(10.2)	51(16.6)	21(11.1)		
Chronic diseases					6.017	0.198
0	340(50.4)	102(58)	144(46.8)	94(49.5)		
1 or 2	277(41.1)	60(34.1)	136(44.2)	81(42.6)		
More than 2	57(8.5)	14(8)	28(9.1)	15(7.9)		
County hospital acquaintance					6.515	0.038
Yes	122(18.1)	43(24.4)	50(16.2)	29(15.3)		
No	552(81.9)	133(75.6)	258(83.8)	161(84.7)		
Substitute medical decision maker					11.199	0.024
No (Oneself)	541(80.3)	128(72.7)	253(82.1)	160(84.2)		
Partner	70(10.4)	22(12.5)	29(9.4)	19(10)		
Parent/child	63(9.3)	26(14.8)	26(8.4)	11(5.8)		
Expected price for outpatient					15.291	0.018
50 yuan	286(42.4)	63(48.1)	148(39.5)	75(42.4)		

100 yuan	246(36.5)	80(29.2)	90(40)	76(36.5)		
300 yuan	103(15.3)	25(16.9)	52(13.7)	26(15.3)		
500 yuan	39(5.8)	8(5.8)	18(6.8)	13(5.8)		
Watching health video					10.048	0.04
Always	104(15.4)	34(11.4)	35(18.4)	35(15.4)		
Occasionally	227(33.7)	65(34.1)	105(30)	57(33.7)		
Rarely	343(50.9)	77(54.5)	168(51.6)	98(50.9)		
Attitudes towards tiered healthcare system					6.448	0.168
Agree	588(87.2)	145(89.3)	275(88.4)	168(87.2)		
Disagree	50(7.4)	18(5.5)	17(7.9)	15(7.4)		
Indifferent	36(5.3)	13(5.2)	16(3.7)	7(5.3)		
Level of risk aversion					13.43	0.009
Strong	107(15.9)	42(13)	40(13.2)	25(15.9)		
Middle	413(61.3)	104(62.7)	193(61.1)	116(61.3)		
Low	154(22.8)	30(24.4))	75(25.8)	49(22.8)		
Experience of visiting PHC in the last 6 months					12.582	0.002
Yes	212(31.4)	37(36.4)	112(33.2)	63(31.5)		
No	462(68.6)	139(63.6)	196(66.8)	127(68.5)		

* cases where the expected value is less than 5, corrected with Fisher's exact test

Predictors of TDSP level of First-contact with PHC

Table 3 presents the results of the multiple unordered logistic regression model and identifies the predictors of TDSP level. Compared with respondents with general TDSP, factors including age, economics, medical decision maker, level of risk aversion, and experience of visiting PHC in the last 6 months significantly ($P<0.05$) contributed to low TDSP of respondents. Respondents aged under 40, 40-60, and 60-75 were respectively 7.34, 2.51, and 4.18 times more likely to have a low TDSP compared to respondents aged 75 and over. Compared with respondents who just finished primary school, those who completed junior school had significantly lower TDSP. Moreover, rich respondents were 1.91 times more likely to have low TDSP than respondents of average economic level. Respondents who were strongly risk-averse were 1.96 times more likely to have a low TDSP than those who were low risk-averse. While

respondents with no experience of visiting PHC in the last 6 months were twice as likely to have a low TDSP as those who had such experience. However, compared with respondents with general TDSP, we found no factors that could significantly contribute to high TDSP.

Table 3 Predictors of TDSP level in the multiple unordered logistic regression model

Characteristic	Low TDSP				High TDSP			
	β	OR	95% CI	P	β	OR	95% CI	P
Age (*>=75)								
<40	1.994	7.344	2.463-21.894	<0.001	0.233	1.262	0.486-3.274	0.633
40-59	0.919	2.508	0.978-6.429	0.056	0.002	1.002	0.516-1.947	0.995
60-74	1.430	4.181	1.680-10.405	0.002	0.266	1.304	0.692-2.458	0.411
Education (*Primary school)								
junior school	0.913	2.491	1.501-4.136	<0.001	0.112	1.053	1.053-0.361	0.924
Senior school	0.553	1.739	0.923-3.273	0.087	-0.089	0.915	0.512-1.635	0.764
College and above	0.319	1.376	0.484-3.914	0.550	0.052	1.119	0.716-1.747	0.621
Economics (*Average)								
Rich	0.649	1.913	1.083-3.379	0.025	0.420	1.521	0.867-2.670	0.144
Poor	-0.201	0.818	0.441-1.517	0.524	-0.453	0.636	0.363-1.114	0.114
Substitute medical decision maker (*oneself)								
Parent/child	1.007	2.738	1.386-5.411	0.004	-0.387	0.679	0.316-1.460	0.322
Partner	0.709	2.032	1.071-3.856	0.030	0.135	1.145	0.613-2.139	0.672
Level of risk aversion (*Low)								
Strong	0.672	1.958	1.016-3.774	0.045	-0.09	0.914	0.482-1.731	0.782
Middle	0.135	1.144	0.683-1.917	0.609	-0.130	0.878	0.567-1.360	0.560
Experience of visiting PHC in the last 6 months (*Yes)								
No	0.741	2.098	1.316-3.346	0.002	0.138	1.148	0.773-1.705	0.494

*** indicates the reference group**

Discussion and conclusions

Discussion

Respondents' overall TDSP was relatively low indicating their willingness to seek primary care was deficient. More than 70% of respondents did not have a high TDSP. The general overestimation of disease severity and the underestimation of PHC capacity

together manifest as low TDSP, which explains residents' preferences and habitual visits to larger hospitals first even for treating mild diseases[26,27]. Although no research directly proved the results, previous research corroborated the findings of this study. Research stated that patients' health condition and disease perception could influence their willingness to seek primary care and that patients' willingness to first visit PHC was insufficient and even continuously decreasing[13,28-30]. Under the freedom of choice of doctors without strict stipulations about referral or triage of patients, the advocacy of the tiered healthcare delivery system cannot effectively guide patients' decision-making process. Residents' lack of awareness of PHC capacity results in the distrust of PHC, which has been regarded as the most immediate reason for residents to skip PHC[31,32]. In addition, residents' misconceptions about disease severity under uncertainty are perhaps also essential and fundamental reasons for them bypassing PHC.

Low TDSP level is the focus of this study. Compared with respondents with general TDSP, age, education, economics, substitute medical decision-maker, level of risk aversion, and experience for visiting PHC significantly influenced low TDSP. Respondents older than 75 years old with common diseases were more willing to go to PHC first. As people age, they become more tolerant of diseases, and PHC can be more convenient for them in terms of their visit frequency, distance, and medical costs. However, these advantages are not similarly attractive to young residents. As for economics, rich respondents' probability of low TDSP was more than twice that of poor respondents. Rich respondents were inclined to consider PHC only when undergoing a

really minor disease. Research also proved that better economic condition was positively correlated with residents' willingness towards high-level hospitals[33]. Higher income represents insensitivity to healthcare costs and high demand for quality health resources which can simplify the decision-making process directed to high-level hospitals[34]. Moreover, high risk-averse respondents were more likely to have low TDSP. Residents' aversive reactions to uncertainty and its unknown risk can lead to an increased focus on their disease severity and a careful decision-making process[27,35]. Patients would rather choose high-level hospitals to bear high financial costs than take the little risk of medical delay, which is to "pay for the peace of mind". We also found that respondents who had no visits to PHC in the last 6 months tended to have low TDSP. Personal experience may modify residents' understanding of PHC institutions and mitigate their perceived risk of seeking primary care. However, this study found no significant relationship between individual chronic disease condition and their TDSP level. The Chinese government has dedicated itself to constructing PHC for managing chronic diseases sustainably, which has also been regarded as an opportunity to develop the gatekeeping function of PHC[36,37]. By the goal, a previous study found that rural residents with chronic diseases had stronger acceptance of the tiered healthcare system and were less likely to skip PHC[38]. As for our findings, chances are that the management of chronic diseases has not been fully underlined in study areas.

Results also suggested that 28.2% of respondents had high TDSP, which meant they continuously considered PHC first when their disease was relatively severe. The high willingness towards PHC is beneficial to residents' sequential and effective utilization

of medical resources according to the advocacy of the tiered healthcare delivery system. However, compared with respondents with general TDSP, we did not find factors that could significantly influence high TDSP. Possibly, residents' high TDSP is mainly due to individual estimates of disease severity rather than other factors. However, residents with high TDSP might underestimate severe diseases and have the risk of delaying treatment in PHC, even though PHC brings convenience and good health accessibility to them[12]. Special attention needs to be paid to providing serious patients with appropriate referrals to high-level hospitals.

Rural residents' average low willingness towards first-contact with PHC reflects the dilemma of "matching supply and demand" between residents and the government. The conflict lies in the fact that the government makes plans based on the population's probability of disease and group objective health needs, while the individual resident moves based on her subjective judgment and perceived health demand[39]. Under the freedom of choice of doctors residents are responsible for determining their healthcare providers, but their perception of disease severity is inherently biased and difficult to match with the treatment combinations they truly deserve. Moreover, the category of PHC in rural areas depends on the geographical location, rather than the disease varieties, indicating that PHC may remain ambiguous in its quality and service scope to residents[40]. In this way, residents' preference for high-level hospitals can arise due to risk aversion and insufficient confidence towards PHC[41,42].

To modify rural residents' willingness towards PHC in an attempt to promote health

equity and the efficient use of health resources, we make the following recommendations. Firstly, the example of the UK's well-established gatekeeping mechanism provides meaningful references[43]. The establishment of a disease triage mechanism with both professionalism and accessibility is a feasible solution, and web-based intelligent healthcare consultation can be an effective form of triage[44,45]. Video and graphic information can eliminate the restriction of time and space, and the consultation suggestions given by intelligence can help control residents' uncertainty. By narrowing down the gap between residents' perceived health demands and their objective health needs, it can guide residents to make rational medical decisions and accordingly increase their willingness towards first-contact with PHC, so that the tiered healthcare delivery system can be facilitated efficiently[46]. Secondly, what residents think and perceive plays an intrinsic role in leading their rational decision-making. Promoting the scientific knowledge of common diseases and the accurate cognition of PHC among rural residents can probably relieve their psychological stress about common diseases and motivate them to contact PHC first for minor diseases. Thirdly, empowering general practitioners by promoting basic clinical skills and in-depth doctor-patient communication may improve patients' experience of visiting PHC and make residents trust PHC more[47]. A good experience at PHC may change residents' impressions and shift the previous habitual visits to high-level hospitals.

Limitations

This study also has several limitations. First, the connotation of disease severity is ambiguous, so in most previous studies, disease severity has been referred to by

descriptive ratings. Although the methodology is not yet perfect, this paper has attempted to quantify the concept of disease severity and tried to optimize it by integrating actual treatment situations, clinical experts' opinions, and government guidelines. Second, only 10 diseases were selected for scenario tests in this study. Each disease severity was represented by one disease, which was susceptible to be impacted by patients' preference for a certain disease. Third, this study estimated the capacity of PHC according to its achievable treatment combinations from government guidelines, but the guidelines may not be objective and comprehensive enough, which may also give rise to some deviation.

Conclusions

TDSP can be a good indicator of residents' willingness towards first-contact with PHC under uncertainty and freedom of choice in healthcare based on residents' decision-making process. Residents' overall TDSP was relatively low with low willingness towards PHC, and a small percentage of residents had high TDSP with high willingness to visit PHC. Age, education, economics, substitute medical decision-maker, level of risk aversion, and experience of visiting PHC in the last 6 months were the predictors of low TDSP level. Those results may intervene in future improvement for modifying residents' medical decisions and rationally promoting their willingness towards PHC.

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Footnotes:

Contributors: FS and WR contributed equally to this paper, so they were both the first authors. ZY received the grant. FS, WR and ZY were involved in conceptualization and methodology. All authors collected the data together. WC, FS and WR analyzed the data. FS and WR wrote the main manuscript text. ZY and WC supervised and commented on the manuscript. All the authors have read and agreed to the final version of the manuscript. ZY is responsible for the overall content as a guarantor.

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Competing interests: None declared.

Patient and public involvement: Patients and/or the public were involved in the design, or conduct, or reporting, or dissemination plans of this research. Refer to the Methods section for further details.

Provenance and peer review: Not commissioned; externally peer reviewed.

Data availability statement

Data are available upon reasonable request. Data are available upon request. To obtain data, please email the corresponding author.

Ethics statements

Patient consent for publication

Not required.

Ethics approval

This study involves human participants. The study was approved by the Ethics Committee of Tongji Medical College of Huazhong University of Science and Technology. The ethics number was IORG0003571. All the respondents were voluntary to be interviewed and signed the informed consent form.

References:

1. Arrow KJ. Uncertainty and the welfare economics of medical care. 1963. J *Health Polit Policy Law*. 2001;26:851-83. 10.1215/03616878-26-5-851

2. Han PK, Klein WM, Arora NK. Varieties of uncertainty in health care: a conceptual taxonomy. *Med Decis Making*. 2011;31:828-38. 10.1177/0272989x1139 3976

3. Zhang Y, Tang WX, Sun XW, et al.. [Studying on the influence of residents' seeing a doctor freely on the integration of health service system in China]. *The Chinese Health Service Management*. 2014;31:678-680

4. Simões J, Augusto GF, Fronteira I. Introduction of freedom of choice for hospital outpatient care in Portugal: Implications and results of the 2016 reform. *Health Policy*. 2017;121:1203-1207. 10.1016/j.healthpol.2017.09.010

5. Yoon KJ, Oh YH, Lee SH, et al.. [Issues and Improving Strategies on Korea Healthcare Delivery System]. *Korea Institute for Health and Social Affairs*; Sejong, Korea: 2014

6. Aoki T, Yamamoto Y, Ikenoue T, et al.. Effect of Patient Experience on Bypassing a Primary Care Gatekeeper: a Multicenter Prospective Cohort Study in Japan. *J Gen Intern Med*. 2018;33:722-728. 10.1007/s11606-017-4245-1

7. Hillen MA, Gutheil CM, Strout TD, et al.. Tolerance of uncertainty: Conceptual analysis, integrative model, and implications for healthcare. *Soc Sci Med.* 2017;180:62-75. 10.1016/j.socscimed.2017.03.024

8. Zhang Y. [Research on the evaluation and mechanism of the multi-institutional readmission service integration in rural China: township-county hospitals]. Wuhan: Huazhong University of Science and Technology

9. Kim AM, Cho S, Kim HJ, et al.. Primary Care Patients' Preference for Hospitals over Clinics in Korea. *Int J Environ Res Public Health*. 2018;15:1119. 10.3390/ijerph15061119

10. Bull State Council People's Repub China. [State Council's guiding opinions on promoting the construction of the tiered healthcare delivery system]. 2015;27:27-31 http://www.gov.cn/zhengce/content/2015-09/11/content_10158.htm

11. Eggleston K, Ling L, Qingyue M, et al.. Health service delivery in China: a literature review. *Health Econ*. 2008; 17:149-165. 10.1002/hec.1306

12. Wang X, Yang H, Duan Z, et al.. Spatial accessibility of primary health care in China: A case study in Sichuan Province. *Soc Sci Med*. 2018;209:14-24. 10.1016/j.socscimed.2018.05.023

13. Zhao X, Xiao J, Chen H, et al.. Patient preferences and attitudes towards first choice medical services in Shenzhen, China: a cross-sectional study. *Brit Med J Open*.

2022;12(5):e057280. 10.1136/bmjopen-2021-057280

14. National Health Commission of the People's Republic of China. [China health statistics yearbook]. 2021; https://www.yearbookchina.com/navibooklist-n-3020013080-1.html

15. Yang J, Siri JG, Remais JV, et al.. The Tsinghua-Lancet Commission on Healthy Cities in China: unlocking the power of cities for a healthy China. *Lancet*. 2018;391:2140-2184. 10.1016/S0140-6736(18)30486-0

16. World Health Organization. The world health report 2008: primary health care now more than ever: introduction and overview. Geneva, 2008. https://apps.who. int/iris/handle/10665/69863

17. Bull State Council People's Repub China. [State Council guidance on the promotion and development of medical consortium]. 2017; 13:14–8. http://www.gov.cn/gongbao/content/2017/content_5191699.htm

18. Li X, Lu J, Hu S, et al.. The primary health-care system in China. *Lancet*. 2017;390:2584-2594. 10.1016/S0140-6736(17)33109-4

19. Andersen R, Newman JF. Societal and individual determinants of medical care utilization in the United States. *Milbank Mem Fund Q Health Soc*. 1973;51:95-124

20. Song H, Zuo X, Cui C, et al.. The willingness of patients to make the first visit to primary care institutions and its influencing factors in Beijing medical alliances: a comparative study of Beijing's medical resource-rich and scarce regions. *BioMed Central Health Serv Res*. 2019;19:361. 10.1186/s12913-019-4184-0

21. Li X, Zhang L, Li Z, et al.. Patient Choice and Willingness Toward Gatekeepers as

First-Contact Medical Institutions in Chinese Tiered Healthcare Delivery System: A Cross-Sectional Study. *Front Public Health.* 2021;9:665282. 10.3389/fpubh.2021.665282

22. Liu C, Qiu L, Wang H. Willingness rate of the first visit to primary healthcare services and the associated factors in China: a meta-analysis. *Aust J Prim Health*. 2022;28:459-468. 10.1071/PY21296

23. Zhang Y, Wang C, Lu S, et al.. [Governance Logic of Hierarchical Medica al System and The Effect of Cognitive Bias of Rural Residents]. *Chinese Journal of Health Policy*, 2022,15:24-30

24. National Health Commission of the People's Republic of China. [Notice on the issuance of three service capacity standards including the service capacity standards for township health centres]. Published 2022. http://www.nhc.gov.cn/jws/s7874/202207/03f2e43540384209b67cce25a6cd9ae2.shtml

25. Wang C, Lu S, Zhang Y. Drivers of high-cost persistence in rural China: A population-based retrospective study. *Front Public Health*. 2022;10:988664. 10.3389/fpubh.2022.988664

26. Xiao Y, Qiu QM, Huang YX, et al.. Patients gather in large hospitals: the current situation of Chinese hospitals and the direction of medical reform. *Postgrad Med J*. 2022;98:e43. 10.1136/postgradmedj-2021-140147

27. Mishel M, Braden C. Finding meaning: antecedents of uncertainty in illness. *Nursing Research*, 1988, 37(2):98-103

28. Kang L. [Determinants of residents' health seeking willingness in rural areas of

China]. *Chinese Rural Health Service Administration.* 2020,40:319-323

29. Tang J, Liu YN, Liao Y, et al.. [Analysis of the choice and influencing factors of the first visit hospitals for 6619 urban and rural residents in Liaoning Province]. *Chinese Hospitals*, 2021,25:24-27

30. Teng L, Li Y. Analysis on the willingness and influencing factors of choosing primary healthcare institutions among patients with chronic conditions in China: a cross-sectional study. *Brit Med J Open*. 2022;12:e054783. 10.1136/bmjopen- 2021-054783

31. Zhang L, Cheng G, Song S, et al.. Efficiency performance of China's health care delivery system. *Int J Health Plann Manage*. 2017;32:254-263. 10.1002/hpm.2425

32. Li J, Wang P, Kong X, et al.. Patient satisfaction between primary care providers and hospitals: a cross-sectional survey in Jilin province, China. *Int J Qual Health Care*. 2016;28:346-354. 10.1093/intqhc/mzw038

33. Liu Y, Kong Q, Yuan S, et al.. Factors influencing choice of health system access level in China: A systematic review. *PLoS One*. 2018;13:e0201887. 10.1371/journal.pone.0201887

34. Zeng Y, Wan Y, Yuan Z, et al.. Healthcare-Seeking Behavior among Chinese Older Adults: Patterns and Predictive Factors. *Int J Environ Res Public Health.* 2021;18:2969. 10.3390/ijerph18062969

35. Li H, Xu H. [Can medical insurance policies promote the realization of hierarchical medical treatment: An Empirical Analysis Based on Medical Demand Behavior]. *Comparative Economic&Social Systems*, 2018:28-35.

562 36. Beaglehole R, Epping-Jordan J, Patel V, et al.. Improving the prevention and
563 management of chronic disease in low-income and middle-income countries: a priority
564 for primary health care. *Lancet.* 2008;372:940-949. 10.1016/S0140- 6736(08)61404-X
565 37. Sun X, Meng H, Ye Z, et al.. Factors associated with the choice of primary care
566 facilities for initial treatment among rural and urban residents in Southwestern China.
567 *PLoS One*. 2019;14:e0211984. 10.1371/journal.pone. 0211984
568 38. Sun H, Miao CX, Jiang JX, et al.. [Residents' approval and influencing factors of
569 hierarchical diagnosis and treatment system, Xuzhou]. *Modern Preventive Medicine.*
570 2019;46:3548-3551+3569.
571 39. Coube M, Nikoloski Z, Mrejen M, et al.. Inequalities in unmet need for health care
572 services and medications in Brazil: a decomposition analysis. *Lancet Reg Health Am*.
573 2023;19:100426. 10.1016/j.lana.2022.100426
574 40. Wang Y, Wu X, Yin M, et al.. Patient capability: Justice and grassroots healthcare
575 delivery in China. *Dev World Bioeth.* 2022;22:170-178. 10.1111/dewb. 12328
576 41. Jia HN, Chen RH, Teng BJ, et al.. [Analysis on the Medicine Purchase Decision-
577 making Process of Rural Residents' Self-medication from the Perspective of Behavioral
578 Economics]. *Chinese Health Economics.* 2021,40:21-23.
579 42. Gao QF. [Medical-care-seeking behavior and concentration]. *Health Economics*
580 *Research.* 2007;228:36-37.
581 43. Wheat HC, Barnes RK, Byng R. Practices used for recommending sickness
582 certification by general practitioners: a conversation analytic study of UK primary care
583 consultations. *Soc Sci Med.* 2015;126:48-58. 10.1016/j.socscimed.2014.12.006

584 44. Cao B, Huang W, Chao N, et al.. Patient Activeness During Online Medical
585 Consultation in China: Multilevel Analysis. *J Med Internet Res*. 2022;24:e35557.
586 10.2196/35557
587 45. He C, Zhou Q, Chen W, et al.. Using an Internet-Based Hospital to Address
588 Maldistribution of Health Care Resources in Rural Areas of Guangdong Province,
589 China: Retrospective and Descriptive Study. *JMIR Med Inform*. 2018;6:e51.
590 10.2196/medinform.9495
591 46. Rodriguez Santana I, Mason A, Gutacker N, et al.. Need, demand, supply in health
592 care: working definitions, and their implications for defining access. *Health Econ*
593 *Policy Law*. 2023;18:1-13. 10.1017/S1744133121000293
594 47. Guo A, Wang P. The Current State of Doctors' Communication Skills in Mainland
595 China from the Perspective of Doctors' Self-evaluation and Patients' Evaluation: A
596 Cross-Sectional Study. *Patient Educ Couns*. 2021;104:1674-1680.10.1016/j.pec.2020.
597 12.013

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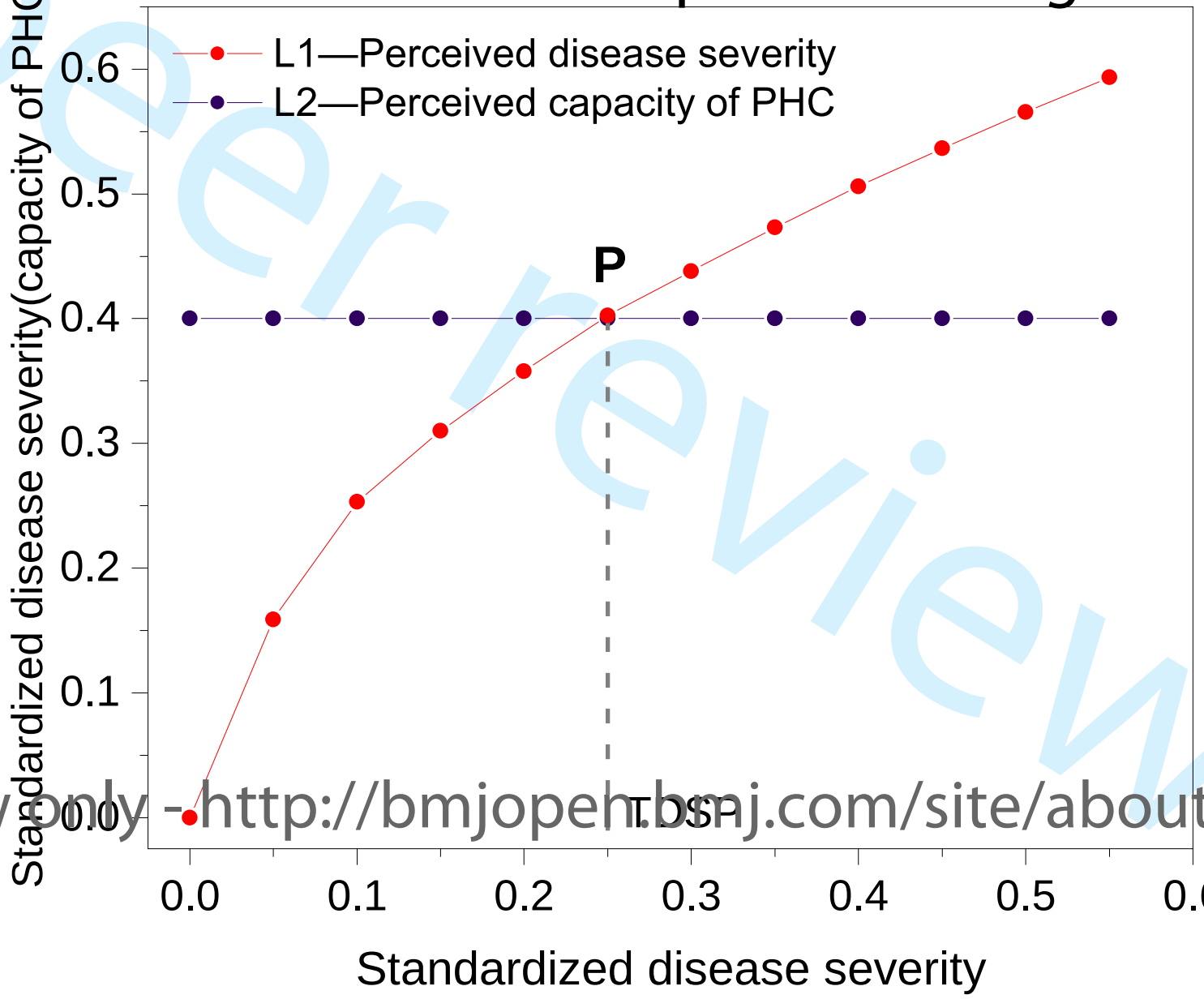
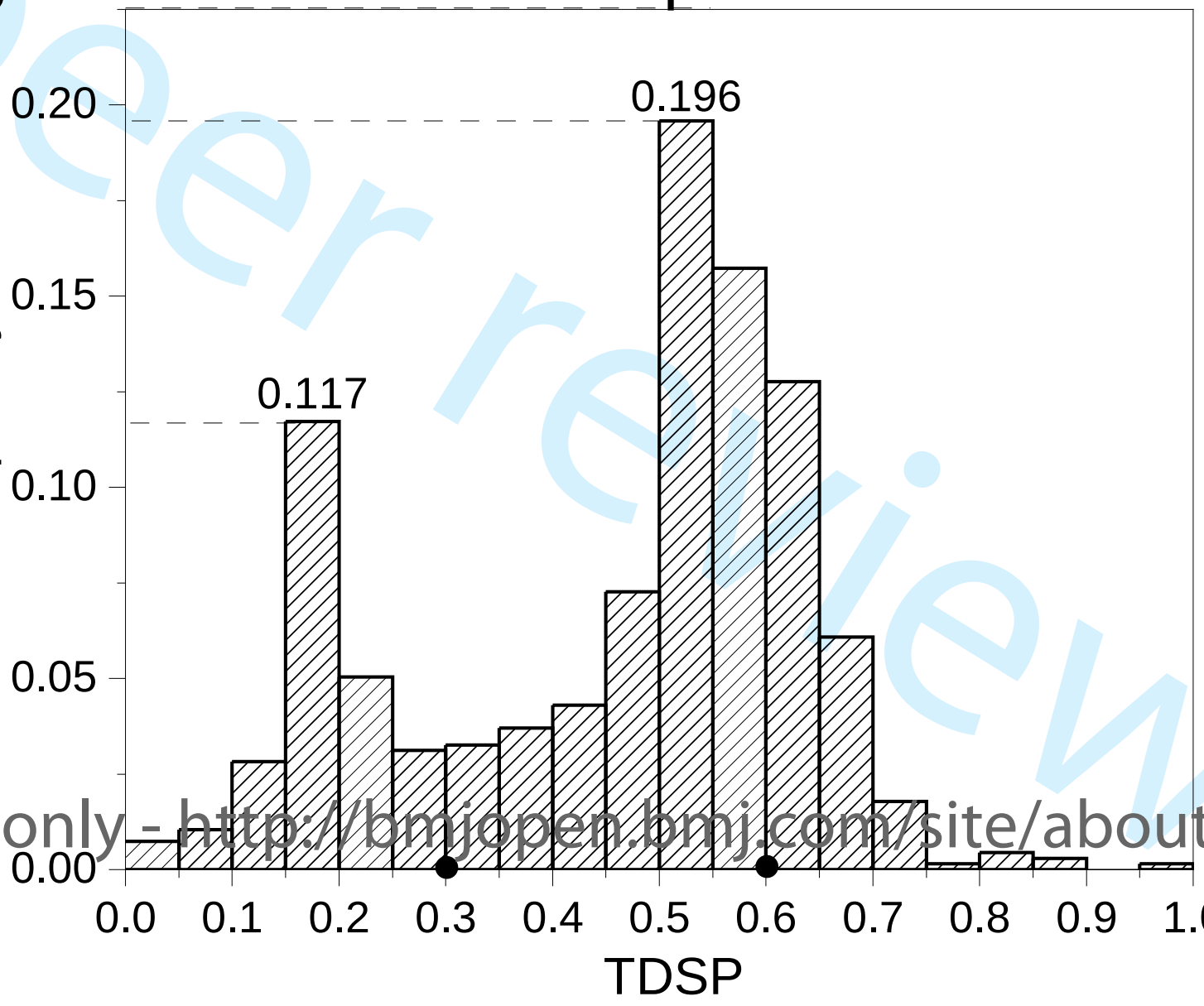
599 Figure 1 TDSP schematic diagram

600 Figure 2 TDSP distribution diagram

601

TDSP schematic diagram





Annex 1

Situation Categorization	Treatment combinations	Typical diseases	Standardized disease severity (±0.05)	Level of medical institution
ISmall Outpatient Clinic	Outpatient prescribed medication	Common cold; indigestion; gastritis	0.1 (0.05-0.15)	Village clinics
IIGeneral Outpatient Clinic	General outpatient treatment + outpatient prescribed medication	Acute gastroenteritis	0.2 (0.15-0.25)	Village clinics
	Minor examination + outpatient prescribed medication	Urticaria		Weak THC
IIIStandard Outpatient Clinic	Minor examination + general outpatient treatment + outpatient prescribed medication	Otitis media; urinary tract infections;	0.3 (0.25-0.35)	Weak THC
IVOutpatient Surgery	Minor examinations + minor operations + outpatient prescribed medication	Excision of body surface masses (boils, haemorrhoids); fracture repositioning and fixation	0.4 (0.35-0.45)	General THC
V Inpatient Internal Medicine	Inpatient monitoring, care and treatment services	Hospitalisation for progressive chronic disease (coronary heart disease); hospitalisation for pneumonia	0.5 (0.45-0.55)	Central THC
VI Minor surgery inpatient/ suspected high risk diagnosis	minor surgery + inpatient monitoring, care, treatment services	appendicitis	0.6 (0.55-0.65)	Central THC
	Suspected high risk: major examination + outpatient prescribed medication + general outpatient treatment operations	Gastroscopy for suspected gastrointestinal high-risk disease		Community Hospitals/ Quality THC
VII Major internal medicine admission	Major examination + inpatient monitoring, care, treatment services	Stroke attack, Progressive cirrhosis of the liver	0.7 (0.65-0.75)	County Hospitals
VIII Major surgery admissions	Major surgery + inpatient monitoring, care,	Major lobectomy of the lungs Liver and kidney transplantation	0.8 (0.75-0.85)	Tertiary Hospitals

	treatment services + major investigations			
IX Acute and Critical Care	Critical care resuscitation and monitoring	Acute heart attack stenting; haemorrhage and shock; respiratory failure	0.9 (0.85-0.95)	Grade IIIA hospital

Annex 2

Number	Scenario symptoms	Prediagnosis judgment	Score
D1-common cold	It's been three days since I had a sore throat, runny nose, sneezing, coughing and lack of energy, and it's still not getting better.	Take your own medication without going to the doctor?	0.05
		Do you go to the doctor? *	0.1
		Is it necessary to see a doctor at a county hospital?	0.6
		Do you need a blood test?	0.2
		Do you need a transfusion?	0.3
		Do you need a X-ray to check for pneumonia?	0.4
D2-gastritis	In the last ten days, I have felt uncomfortable stomach, often bloating, stomachache, hiccups and bad appetite.	Take your own medication without going to the doctor?	0.05
		Do you need to see a doctor and take some medicine? *	0.15
		Is it necessary to see a doctor at a county hospital?	0.6
		Is it necessary to have a gastroscopy now that I can have a full check-up for stomach disorders?	0.65
D3-gastroenteritis	I had diarrhea five times a day, and my stomach was very painful. I didn't feel well all day.	Take your own medication without going to the doctor?	0.05
		Do you go to the doctor?	0.1
		Is it necessary to see a doctor at a county hospital?	0.6
		Do you need a blood test?	0.2
		Do you need a transfusion?	0.3
		Do you need a stool test?	0.4
		Is a colonoscopy necessary now to see if there are any other serious diseases of the intestines?	0.65
D4-urticaria	Basically every day I get an itch and I scratch it and I break out in a rash and it goes away on its own.	Take your own medication without seeing a doctor?	0.05
		Do I need to see a doctor to see what's going on and get some medication? *	0.25
		Do I need to see a dermatologist or a general internist?	0.6
		Do I need to have a blood test?	0.3
		Do I need to test for allergens to see what I am allergic to?	0.65
D5-otitis media	In the last week, there was pain and tinnitus in the ears, and pus flowing out of the ears.	Use your own medication without seeing a doctor?	0.05
		Do you need a doctor to look at your ears and deal with the pus? *	0.3
		Is it necessary to have an ear, nose and throat specialist or is a general practitioner of internal and external medicine sufficient?	0.6

D6-furuncle	A hard bump on the neck, the size of a fingernail, but painful, growing larger and larger. It has been there for a week.	Use your own medicine without going to the doctor?	0.05
		Do you need to see a doctor?	0.1
		Do you need a doctor to cut you open and drain the pus? *	0.35
		Is it necessary to go to a doctor at a county hospital to do this?	0.6
		Do I need to have the contents examined to see if it is benign or malignant after the incision?	0.65
D7-hemorrhoids	The bowel movements have been painful and bloody in the last week.	Take your own medication without seeing a doctor?	0.05
		Do you need to see a doctor to get checked out and take minor opeartions when necessary? *	0.4
		Is it necessary to see a doctor at a county hospital?	0.6
		Do I need a proctoscopy to rule out rectal cancer?	0.65
D8-fracture	I fell off my bike and my hand fell to the ground. It was very sore and swollen, and I couldn't move it. I've had half a day off.	Buy your own medicine without going to the doctor?	0.05
		Do you want to go to the hospital to have a X-ray taken for possible surgery? *	0.45
		Is it necessary to have a CT so that you can see it better?	0.55
		Is it necessary to go to the doctor at the county hospital to see the X-ray for diagnosis?	0.6
D9-coronary heart disease	Twice in the last month I have had angina with chest tightness, dizziness and profuse sweating, relieved after half an hour.	Take your own medication without seeing a doctor?	0.05
		Do I need to see a doctor for an ECG inpatient monitoring?*	0.5
		Is it necessary to see a doctor at a county hospital?	0.6
		Do I need more accurate heart tests? For example, cardiac magnetic resonance imaging, coronary CT	0.65
D10-acute simple appendicitis	severe pain in the lower right side of the stomach, not getting better all the time, possibly appendicitis	(Would you have surgery for appendicitis? Where would you have it done?) No surgery ?	0.4
		Township health centre?*	0.55
		County hospital ?	0.65

STROBE Statement—Checklist of items that should be included in reports of ***cross-sectional studies***

	Item No	Recommendation	Page No
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract	P1 Line 1-3
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found	P2-P3
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	P7 142-152
Objectives	3	State specific objectives, including any prespecified hypotheses	P8 153-155
Methods			
Study design	4	Present key elements of study design early in the paper	P8 158-159
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	P12 236-247
Participants	6	(*a*) Give the eligibility criteria, and the sources and methods of selection of participants	P12 240-244
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	P13 249-262
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	P9-P11
Bias	9	Describe any efforts to address potential sources of bias	P13
Study size	10	Explain how the study size was arrived at	P12
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	P11 226-234
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding	P13 268-273
		(*b*) Describe any methods used to examine subgroups and interactions	P11
		(*c*) Explain how missing data were addressed	P12-247
		(*d*) If applicable, describe analytical methods taking account of sampling strategy	P12
		(*e*) Describe any sensitivity analyses	
Results			
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	P14-275
		(b) Give reasons for non-participation at each stage	P12-247
		(c) Consider use of a flow diagram	
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	P14-P16

		(b) Indicate number of participants with missing data for each variable of interest	P12-247
Outcome data	15*	Report numbers of outcome events or summary measures	P16-298
Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	P14-283
		(*b*) Report category boundaries when continuous variables were categorized	P11-P12
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	P16-298
Discussion			
Key results	18	Summarise key results with reference to study objectives	P17-318
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	P21-405
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	P18-P19
Generalisability	21	Discuss the generalisability (external validity) of the study results	P18-322
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	P23-439

*Give information separately for exposed and unexposed groups.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at www.strobe-statement.org.