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Service provision, pricing, and patient satisfaction in online health communities

Wu Hong, Lu Naiji*

School of Medicine and Health Management, Tongji Medical College, Huazhong University of Science and Technology, Wuhan, China

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ABSTRACT

Background The emergence of online health communities (OHCs) broadens and diversifies channels for patient-doctor interaction. In recent times, patient satisfaction has gained new attention within the context of OHCs where unique patterns are provided: a variety of services with unique attributes are available in OHCs for patients and doctors have the options of providing and pricing for different services. OHCs are given high hopes on improving medical efficiency and patient satisfaction. Knowing how these patterns in OHCs affect patient satisfaction is crucial for the development of OHCs and medical practices.

Methods: An empirical research is conducted to examine the effects of provision and pricing of online services on patient satisfaction by analyzing data from 2309 doctors in a Chinese OHC.

Results: The results from this study provided empirical support, suggesting that service quantity positively influenced patient satisfaction. A non-linear correlation between service price and satisfaction was explored and results suggested an inverted U-shaped relationship. At the low price level, service price led to an increase in patient satisfaction, whereas the high price level (over 330 CNY/US$49) could have just the opposite effect. Importantly, we found that price difference between a doctor's different services significantly decreased patient satisfaction. A mediating effect was tested in post-hoc analyses, and results revealed that the impact of price difference on patient satisfaction was partially mediated by flexibility of service selection, and the mediating effect accounted for 28.6% of the total effect.

Conclusions: Our results indicate that patient satisfaction can be improved by effectively providing and pricing services in OHCs. Specifically, doctors can offer different type services and charge within a reasonable range.

1. Introduction

The development of economics and the growth of health awareness have promoted demands for high-quality medical care which is related to the life quality of patients. Despite being of universal importance, the healthcare industry is facing medical resource shortage and improper utilization, and increasingly intensified doctor-patient conflict problems. The improvement of patient satisfaction is key to reducing doctor-patient conflicts, enhancing trust [1], and eventually increasing health care utilization [2,3]. How to increase patient satisfaction has become the major concern of governments and medical organizations [4].

Providing a new channel for patients to seek health information [5], emotional support [6] and OHCs has been the focus of widely used all over the world. With the development of the Internet, service patterns of OHCs have changed drastically. Traditional service patterns (i.e. question & answer) only provide online consultation. With the advance of IT technology, multiple methods such as voice call, video call and online-upload electronic files now assist doctors to diagnose and treat diseases [7]. As service patterns change, service prices follow. Most online services that were used to be free now all charge a premium.

OHCs encourage doctors to make full use of their fragmented time to serve patients and use these services to achieve their goals more efficiently. Doctors get a higher reputation in OHCs can also bring benefits for their hospitals, such as patient flow improved which helps them with career advancement and is necessary in China. Comparing with hospitals, there are two different advantages for doctors in OHCs. First, doctors in OHCs have more options to choose service provision at their convenience than those in physical hospitals. Second, doctors have the pricing power for online services. The free choices of the

Abbreviations: OHC (s), online health community (s); OWTS, online written treatment service; OTTS, online telephone treatment service; OOCAS, offline outpatient care appointment service; OLS, ordinary least squares; 2SLS, two-stage least squares

* Corresponding author at: Huazhong University of Science and Technology, Tongji Medical College, School of Medicine and Health Management, 13 Hangkong road, Qiaokou District, Wuhan, Hubei province, China.

E-mail address: naiji.lu@foxmail.com (N. Lu).

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provision and pricing do not exist in physical hospitals. OHCs also benefit patients in many ways. Patients can search for health information and medical treatment to help them recover more effectively. Moreover, OHCs help patients by decreasing transaction cost brought by geographic restrictions and time limitation.

With these advantages and conveniences, OHCs are given high hopes on improving patient satisfaction. The relationship between pricing and satisfaction has been widely studied in product fields [8]; however, there remind some gaps in knowledge in service field, especially in healthcare. Product/service quality[1] and monetary sacrifice should be incorporated into forming price and are fundamental to understanding the formation of consumer satisfaction [9]. Moreover, prior studies rarely investigate the impact of price difference of one seller's different products/services on consumer satisfaction. On one hand, medical service is often continuous and long-term, especially for chronic diseases. Patients often need to buy services repeatedly with the progress of disease. On the other hand, different services have their unique attributes, which could meet patients' different demands. The price difference may affect the flexibility of service selection for patients and influence their satisfaction. The purpose of this study is to empirically investigate the effects of service provision, pricing and price difference on patient satisfaction. The specific research questions addressed in this paper are:

Q1. How the provision and pricing of online services affect patient satisfaction in OHCs?

Q2. How price difference of one doctor's different services influence patient satisfaction in OHCs, and its possible mechanism?

The rest of this paper is organized as follows. In Section 2, we review relevant literatures on OHCs, multiple channel strategy, price-satisfaction and related theories, equity theory, then follow with our research hypotheses in Section 3. In Section 4, we describe the research context, data collection and variable measurement. We discuss our results, conclusions and implications in Section 5, 6 and 7.

2. Theoretical background

2.1. Multiple channel strategy

A review of the channel effect literature shows that OHCs that use multiple channels tend to be more successful [10]. The multiple channels adopted by sellers can influence the options available for transacting with consumers. Multiple channels interacting with consumers lead to enhanced efficiencies, accompanied with lower perceived risks and enhanced trust [11]. Combinations of channels can be used to target different kinds of consumers and offer different type services cost-effectively [12].

2.2. Price-satisfaction and related theories

In the marketing field, customer perceived quality and price are the main factors that influence customer satisfaction [2,13]. As perceived quality is more objective, decisions should be made mainly based on price [14]. Comparing with product industries, services have unique features: intangibility, inseparability, perishability and heterogeneity. With complex pricing structures in services, price in service marketing usually is more difficult to evaluate than tangible products [15], especially for health care.

2.2.1. Price as signal of quality

Consumers are often unable to make clear quality comparisons among sellers, one solution is to follow market signals of quality. Consumers often use price as a signal of product/service quality when facing uncertainty before making decisions [16–18], especially for one with high dispersion in quality. Consumers are willing to pay higher prices for sellers who are able to reduce their perceived risk and induce trust. Evidence shows that a big price-cut sometimes does not help preserve consumers, but may drive some potential consumers away since they may perceive the price-cut as a signal of poor quality [19]. From the economic perspective, price conveys both demand- and supply-related quality information. A higher price may reflect either high demands for high-quality or high-cost products/services [20]. As a signal of quality, higher price presents higher quality [21], which results in higher satisfaction [14].

2.2.2. Transaction-cost economics theory

Based on transaction-cost economics theory [22], price is an indicator of the sacrifice made and affects satisfaction [23]. Customers have to pay costs for buying products/services [24] and they measure the cost before making decisions. Consumers select sellers in part to minimize transaction cost and uncertainty. Cost plays a vital role for consumers in deciding from whom to get the products/services. In most circumstances, higher cost decrease demand and increase switching [25]. Moreover, when the cost is high for buying the product/service, consumers are unwilling to pay time or money to evaluate or thank the seller.

2.3. Equity theory in social exchange

Equity theory [26] describes the psychology of people in social exchange relationships. They weigh up the ratios of their inputs and outcomes from the exchange and compare with others/referents. In an exchange relationship, when the ratios of perceived inputs and outcomes are psychologically inconsistent with the ratios of referents, consumers may feel inequitable and reduce inequity by decreasing inputs or leaving the exchange relationship. Equity theory is widely used in group decision and distribution of benefits research, and can be applied to a number of exchange situations and explain the consumer-seller relationships [27]. Consumers who feel being treated unfairly may take subsequent psychology or behaviors, such as dissatisfaction.

2.4. Online health communities

A number of OHCs have been developed by medical organizations and providers in recent years, making it easier for patients to find health information [28]. Such online communities are virtual forums for patients to discuss their health concerns, share information about treatments, and communicate with doctors. Most OHCs are characterized by two main functions: information search and social support [29]. Researchers have started to investigate the economic value [30] and social value [31]. Numerous studies have discussed the benefits of OHCs for patients. However, these studies mainly focus on information obtained and social support. Also, they study mostly patient's perspectives and their patient behaviors [32]. Great efforts need to be made to understand OHCs from doctors' perspectives and behaviors.

Online communities in China have emerged in recent years. China's large population generates a variety of unique needs for medical services, exhibiting unique behaviors in OHCs. OHCs in China help a great many patients by providing several services without the restriction of region. Different services have their unique attributes and help patients make accurate selections that suit their needs. These attributes reflects in length, timeliness and channels of services. This new interaction between doctors and patients is attracting an increasing amount of attention within psychological and health care researches, and calls for investigation of whether OHCs can improve patient satisfaction to alleviate doctor-patient conflicts.

[1] In this paper, service quality in service field corresponds to product quality in product field; service process quality in service field corresponds to service quality in product field.

3. Hypotheses development

3.1. Service provision and patient satisfaction

Like multiple channels, multiple services can be also used to target different kinds of consumers. Multiple services give patients more information about doctors, thus reducing their uncertainty and sense of risk, enhancing their trust in doctors and eventually increasing service utilizations. Moreover, different services have their unique attributes such as discontinuous (continuous) delivery process of online written (telephone) treatment service. Patients can make choices on different services according to their preference and needs, especially for these patients who need long-term treatment and repeated purchases. Different services more effectively meet patients' different demands, helping improve their satisfaction. Thus we hypothesize that patients have higher satisfaction for doctors who offer more services. Formally stated,

H1. The doctor who provides more services has higher patient satisfaction in OHCs.

3.2. Service price and patient satisfaction

By systematically reviewing literatures about the relationship between price and customer satisfaction in the area of services, researchers do not obtain consistent results: positive effect [2,14], negative effect [33] and no effect [34,35].

The double effects of price on satisfaction can explain the paradox results. For a positive perspective, price in service field is treated as an important signal of quality. At a higher price, consumers judge this product/service to be of greater quality [36], and satisfaction is an external indicator of quality [37]. When consumers purchase intangible services with expensive fees, low purchase frequency and complex decision-making processes, the use of price as an indicator of quality is stronger [37], such as the case of medical care. Maynes (1985) argues that most markets are informationally imperfect, there are extensive price dispersions even the quality is constant [38]. Medical care is a high-credence service, associated with a higher degree of uncertainty. Lacking professional knowledge, patient have difficulty in judging service quality [39]. Thus, price becomes their main criteria. Patients would like to pay higher prices for getting high quality services which induce higher satisfaction.

For a negative perspective, based on transaction-cost economics theory, price is an indicator of sacrifice made [23] and affects satisfaction negatively [37]. Consumers measure their sacrifice before making decisions. Consumer has a reference price that he/she considers reasonable and acceptable [40]. They accept prices within their price range but reject prices outside this range. When the price of online services is too high (e.g., price is far above registration fee in physical hospitals or the average price for all doctors in OHCs), patients will feel unreasonable which may decrease their satisfaction [41,42]. Pedraja Iglesias et al. (2004) argue that when the product/service has a high purchase price and high perceived risk, sacrifice has greater weight [35].

Based on our arguments above on positive and negative effects, we think linear functions would not reflect the real relationship between price and satisfaction. Both signal of service quality and sacrifice should be incorporated into forming price and are fundamental to understanding the formation of satisfaction [9]. If not controlled, the two opposite signs on satisfaction can create different direction or non-significant relationships. Campo et al. (2009) investigate the relationship between perceived quality and price, and find the medium prices are those that obtain the highest levels of satisfaction [9]. Therefore, we propose a reverted U-shaped (Fig. 1) relationship between price and satisfaction, leading us to the following hypothesis:

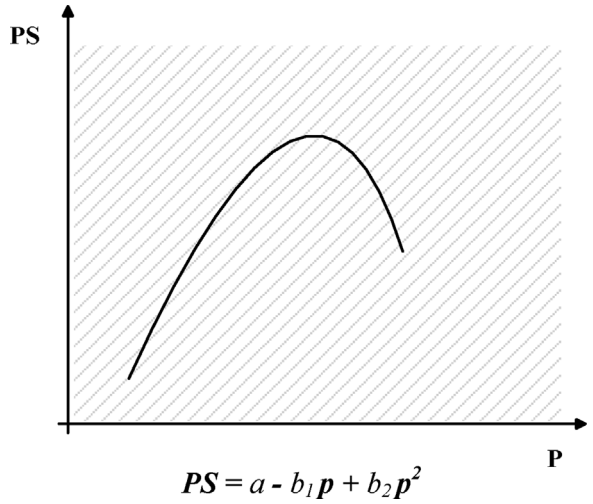

Fig. 1. Reverted U-shaped relationship between price and satisfaction.

H2. There exists a reverted U-shaped relationship between price and patient satisfaction in OHCs.

3.3. Price difference and patient satisfaction

On one hand, equity theory [26] can serve as a theoretical basis for the relationship between price difference and satisfaction response. Unfavorable price difference is perceived as being unfair [43,44], especially when consumers are not clear about the reasons for price differences [42]. Unfavorable deviations in price lead to perceptions of unfairness and consequently dissatisfaction [41].

On the other hand, price difference decreases the flexibility of service selection. Existing studies have shown that switching costs play a crucial role in customer choice by making it costly for customers to change service providers [3]. However, the price difference examined in the prior studies was the difference in prices between different sellers [3]. Based on the same logic, we think the price difference of one seller's different products/services also impacts the switching costs for changing from one service to another, and may decrease consumer satisfaction. Different services have their unique attributes and aim to meet patients' different needs. When there exists a larger price difference between different services, patients cannot transfer services flexibly based on their needs and situations, especially for those with serious diseases and low income. For example, a patient who uses the written treatment service at the first time may think his/her disease is not serious. So he/she is not anxious to get doctor's reply. However, he/she hopes doctor reply quickly as the disease developing and wants to choose telephone treatment service. If the price difference between written and telephone treatment service is big, he/she may be dissatisfied to make the switch. Thus we hypothesize that the larger price difference is associated with lower patient satisfaction.

H3. Price difference between different services that the doctor provides negatively influences patient satisfaction.

4. Methods

In this section, we describe our research context, online services, data collection, and present the variables and models.

4.1. The research context

There are many OHCs that provide multiple paid services in China. We study our research questions based on Haodf.com (Haodf means "good doctor" in Chinese; www.haodf.com), which is regarded as the

Fig. 2. Doctor's homepage.

biggest and most professional OHC in China. More than 400 thousand doctors' information is presented on Haodf.com, and more than 70 thousand doctors actively work on the website. Haodf.com is the largest doctor-patient interaction platform in China and helps a great many patients by providing several services: online written treatment (OWTS), online telephone treatment (OTTS), online video treatment and offline outpatient care appointment service (OOCAS). Via the Haodf.com website, patients can choose from services according to their needs. Moreover, this platform has a formal and comprehensive review mechanism, which is important for this study.

4.2. Online services in haodf.com

These online services in Haodf.com have different charges. OWTS was initially free for the first three times, but is no longer free since the mid-2016. OTTS is always pay-for-fee, regardless of how many times you use the service. Online video treatment is not generally used by doctors and patients, so we do not include online video treatment service in this paper. OOCAS is free and patients can make an appointment online and see a doctor at physical hospital.

OWTS has unique attributes, as do OTTS and OOCAS. For OWTS, it takes a longer time for patients to contact doctors because doctors are not always available. It means that every time patients contact doctors, they need to wait until doctors visit the website. In other words, the interaction is discontinuous. The advantage is that when patients consult a doctor online, they can upload "check results" and pictures of the affected part/s of the body, which can help the doctor to treat more accurately. As the service is discontinuous, doctors can ask patients to upload electronic materials based on doctors' need to help them diagnose. The interaction for OTTS is continuous. Doctors and patients can constantly interact with each other within a period of time (between 10–15 minutes). The disadvantage is that patients cannot upload any electronic materials to the doctor during this service. For OOCAS, patients can receive face-to-face treatment from doctors in the hospital.

OWTS and OTTS are delivered online. OOCAS is received offline, as the service is actually received in physical hospitals. We include OWTS, OTTS and OOCAS in our analyses.

4.3. Service price analysis

We collected data from Haodf.com every month from 7, 2016 to 4, 2017. We found that doctors in Haodf.com rarely change their price, so panel data analysis is not suitable in our study. Because there may exist a positive reverse effect of satisfaction on price, we collect data from two time points, denoted 0 and 1, and use data collected at time $t = 0$ for independent and at time $t = 1$ for dependent variables. Moreover, as doctors don't change their price often, which it is helpful for us to eliminate the reverse relationship between patient satisfaction and price.

4.4. Sample and data collection

In order to eliminate different behaviors caused by different diseases [45], we choose doctors who only treat one kind of disease and focus on diabetes for three reasons. First, there are more than one hundred million diabetes in China, ranked high in the world [46], which has caused the serious concerns to both government and academics. Second, OHCs help patients with diabetes to gain disease information and offer doctors' advices, boosting patients' daily health management. Third, diabetic patients need long-term tracking and treatment, which cause patients to contact doctors constantly. High prevalence, OHCs frequently used and repeated purchases, three characteristics contribute to research the impacts of multiple service and pricing on satisfaction.

We developed a crawler to automatically download doctor information from Haodf.com. The data collection method is that we

Fig. 3. Service selection page of doctor A and B.

collected all the doctors who mainly treat diabetes on March 12, 2017. The whole process lasted for two days and was repeated on April 12, 2017. We included in our analyses the doctors who were seen at both collection times, yielding a sample of 2309 doctors. For each doctor in our dataset, we collected his/her doctor service, patient feedback and some other relevant information (e.g. hospital information).

Services in our model include OWTS, OTTS and OOCAS, along with the services doctors provide and their prices. The feedbacks posted by patients in OHCs can be divided into two dimensions: patients' evaluation of the doctor (i.e. grade the doctor) and gratitude expressing action (i.e. buy digital gifts or write digital thank-you letters). In addition, some other information is collected as well. We collect information on doctor's title, hospital level and city where the hospital is located. Fig. 2 shows an example of doctor's homepage and Fig. 3 shows an example of two doctors' online service selection pages.

4.5. Variables and models

4.5.1. Patient satisfaction (PS)

There are four different ways on Haodf.com for patients to express their opinions for the services received. If patients are satisfied with the doctor's services, they may vote for that doctor. The total number of votes for each doctor forms an indicator named "recommendation" for each doctor (*Rec*). Patients may also rate their doctors by giving 1–5 stars, with 5 being the best (*SS*). This variable is measured by average score from the patient review data in each doctor. In addition, patients may buy digital gifts or write digital thank-you letters for the doctor to express their gratitude. More description is shown Table 1.

We use these four variables in our model to measure patient satisfaction. For the first two variables, we include them directly in our model (*Rec* and *SS*). As doctors may easily receive more digital gifts and thank-you letters if they see more patients, we need to account for the effect of the number of patients. By collecting doctors' information twice (t-1 and t), we use the variation of digital gifts/thank-you letters and the variation of the number of patients to normalize these two variables (*ADG*, *ADTyL*):

$$ADG_t = \frac{Totaldigitalgifts_t - Totaldigitalgifts_{t-1}}{(Totalpatients_t - Totalpatients_{t-1} + 1)}$$

$$ADTyL_t = \frac{Totaldigitalthank\text{-}you\ letters_t - Totaldigitalthank\text{-}you\ letters_{t-1}}{(Totalpatients_t - Totalpatients_{t-1} + 1)}$$

4.5.2. Service provision and pricing

The total services include OWTS, OTTS and OOCAS. Doctors can choose from any of these services based on their convenience. We count the total number of services that the doctor offers (*SQ*) as a service provision variable. As OOCAS is free, we calculate for each doctor the average price (*AP*) based on other two online services. We take the absolute value of the price difference (*PD*) between OWTS and OTTS and created this variable based on the following formula.

$$PD = |Price_{OWTS} - Price_{OTTS}|$$

4.5.3. Control variables

We use service process quality, doctor title, hospital level and city where hospital is located as covariates in the model. Although service quality is hard to measure in healthcare, we can introduce service process quality to control the impact of process quality on satisfaction. Patient's experience during the service receiving process also plays an important role in deciding their satisfaction. The response speed (*RS*) is used to measure service process quality. In China, doctors have a medical title and an academic title. The medical title has several types: chief doctor, associate chief doctor, attending doctor, and resident doctor. Since the number of resident doctor is very small, we combine it with the attending doctor category and use two dummy variables: *Mtitle1* and *Mtitle2* to measure doctors' medical titles. For the academic title, there are, we use two dummy variables, *Atitle1* and *Atitle2,* to measure doctors' academic ranks, professor/researcher, associate professor/researcher and lecturer. We collect hospital level information, which is also evaluated and issued by government health departments. Hospital levels are level A, B or C, with A being the best quality, which are coded by two dummy variables. Detailed definition of these dummy variables are as follows:

Table 1
Variables description.

Variables		Explanation	Type
Dependent Variables			
Patient Satisfaction (PS)	Recommendation (*Rec*)	The total number of votes for each doctor from patients	Interval
	Service star (*SS*)	The average score from the patient review data in each doctor	Ordinal
	Average digital gift (*ADG*)	The ratio of the variation of digital gifts and the variation of the number of patients	Interval
	Average digital thank-you letter (*ADTyL*)	The ratio of the variation of thank-you letters and the variation of the number of patients	Interval
Independent Variables			
Service Provision	Service quantity (*SQ*)	The total number of services that the doctor offers	Interval
Service Pricing	Average price (AP)	The average price of each doctor based on two kinds of online services	Interval
	Average price square (AP^2)		Interval
	Price difference (*PD*)	The absolute value of the price difference between OWTS and OTTS	Interval
Instrument Variables			
	GDP (*GDP*)	GDP of the city that doctor works	Interval
	Registration fee of outpatient service in physical hospital (*RFOS*)	The registration fee of outpatient service in physical hospital	Interval
Mediating Variable			
	Flexibility of service selection (*FSS*)	The proportion of different services used by patients for each doctor	Interval
Control Variables			
Service Process Quality	Respond speed (*RS*)	The respond speed of doctor for OWTS	Interval
	Doctor's medical title (*Mtitle1*, *Mtitle2*)	The medical title has several types: chief doctor, associate chief doctor, attending doctor, and resident doctor, which is evaluated and issued by government health departments	Dummy
	Doctor's academic title (*Atitle1*, *Atitle2*)	Doctors who also work in universities have academic ranks: professor/researcher, associate professor/researcher and lecturer	Dummy
	Hospital level (*Level1*, *Level2*)	Hospital level is evaluated and issued by government health departments. Hospital levels are level A, B or C, with A being the best quality	Dummy

$$Mtitle1 = \begin{cases} =1, \text{chief doctor} \\ =0, \text{others} \end{cases}, \quad Mtitle2 = \begin{cases} =1, \text{associate chief doctor} \\ =0, \text{others} \end{cases}$$

$$Atitle1 = \begin{cases} =1, \text{professor/researcher} \\ =0, \text{others} \end{cases},$$

$$Atitle2 = \begin{cases} =1, \text{associate professor/researcher} \\ =0, \text{others} \end{cases}$$

$$Level1 = \begin{cases} =1, \text{hospital level is A} \\ =0, \text{others} \end{cases}, \quad Level2 = \begin{cases} =1, \text{hospital level is B} \\ =0, \text{others} \end{cases}$$

Our empirical models are as follows:

$$PS_{jt} = f(\beta'_{1j}X_{t-1} + \beta'_{2j}SQ_{t-1} + \beta'_{3j}AP_{t-1} + \beta'_{4j}AP^2{}_{t-1} + \varepsilon'_j), \quad j \in J(1,2,3,4)$$

$$PS_{jt} = f(\beta''_{1j}X_{t-1} + \beta''_{2j}SQ_{t-1} + \beta''_{3j}AP_{t-1} + \beta''_{4j}AP^2{}_{t-1} + \beta''_{5j}PD_{t-1} + \varepsilon''_j), \quad j \in J(1,2,3,4)$$

where $f(\bullet)$ is the link function. All the βs are the parameters we want to estimate. All the ε s are the error term. X is control variables. j ∈ J(1, 2, 3, 4) shows four types of patient satisfaction, including *Rec*, *SS*, *ADG* and *ADTyL*.

5. Results

We used ordinary least squares (OLS) model to estimate the empirical results for *Rec*, *ADG* and *ADTyL*. For *SS*, we used ordered probit model to analyze. All our empirical models were done by STATA.

5.1. Descriptive statistic and correlations

Descriptive statistics and correlations for the key variables used in the analysis are presented in Table 2. The mean value (maximum value) for average price and price difference are 54.38 CNY (479.5 CNY) and 38.34 CNY (421.0 CNY). Comparing with the maximum value, the mean value is much lower. The results show that service quantity, average price and price difference are correlated with satisfaction. Also, the correlations between the independent variables and control variables are low, which helps yield stable results.

5.2. Empirical results

Empirical results are shown in Table 3. These variables explain approximately 26.5–39.5 percent of the variance in patient satisfaction. The resulting low R^2 could have two causes. First, service quality has not been introduced. Although doctor title and hospital level can reflect service quality partly, and we also have controlled service process quality, there still are many omitted factors can impact service quality of doctors and finally influence patient satisfaction. Second, each doctor has individual and behavioral variables that may impact his/her patient satisfaction which this paper does not consider. Such as bedside manner, cause a patient to evaluate satisfaction levels to two doctors with same service quality differently.

As OOCAS is free, the average price is calculated based on the two kinds of online services: OWTS and OTTS. We find that service quantity positively impacts patient satisfaction for all the four dependent variables: *Rec* (β = 0.125, p < 0.001), *SS* (β = 0.362, p < 0.001), *ADG* (β = 6.500, p < 0.001) and *ADTyL* (β = 5.198, p < 0.001). Based on our above hypothesis, we include price and its quadratic term in the empirical model. We find that there are significant reverted U-shaped relationships between service price and patient satisfaction: *Rec* (β = 0.004, β2 = −7.35E-06, p < 0.001), *SS* (β = 0.013, β2 = − 2.68E − 05, p < 0.001), *ADG* (β = 0.214, β2 = − 0.0004, p < 0.001) and *ADTyL* (β = 0.156, β2 = 0.0004, p < 0.001). Our H1 and H2 are both supported.

We then calculate the price difference between OWTS and OTTS for each doctor and include this variable into our model. From the results shown in Table 4, we find that doctors with a larger price difference have lower patient satisfaction. The impact is significant for *SS* (β = − 0.007, p < 0.001), *ADG* (β = − 0.081, p < 0.001) and *ADTyL* (β = − 0.043, p < 0.001). However, it is not significant for *Rec*. Thus, our hypothesis 3 is mostly supported.

5.3. Robustness check

In order to check the robustness of our results, we divided total data according to the different service types. The subsamples are (a) doctors who only provide one kind of online services, (b) doctors who only provide two online services, and (c) doctors who provide all three services. As the service quantity is constant for all the three subsamples,

Table 2
Description and correlation.

Variables	Min.	Max.	Mean	S.D.	1	2	3	4	5	6	7	8	9	10	11	12	13
DV																	
1. *Rec*	0	5.0	4.012	0.38													
2. *SS*	1	5	3.00	1.00	0.52**												
3. *ADG*	0	84.24	23.16	16.59	0.64**	0.67**											
4. *ADTyL*	0	70.45	18.76	11.48	0.69**	0.65**	0.92**										
IV																	
5. *SQ*	0	3	1.32	0.90	0.37**	0.43**	0.54**	0.50**									
6. *AP*	4.00CNY (US$0.6)	479.50CNY (US$70)	54.38	50.64	0.41**	0.32**	0.40**	0.49**	0.36**								
7. *PD*	0	421.00CNY (US$62)	38.34	46.01	−0.21**	−0.05*	−0.11**	−0.18**	0.12**	0.58**							
CV																	
8. *Mtitle1*	0	1	0.37	0.48	0.11*	0.06**	0.09**	0.14**	0.00	0.18**	0.11**						
9. *Mtitle2*	0	1	0.35	0.47	0.02	0.06**	0.01	0.00	0.06**	0.01	−0.00	−0.56**					
10. *Atitle1*	0	1	0.21	0.40	0.17**	0.06**	0.13**	0.17**	0.01	0.20**	0.13**	0.64**	−0.36**				
11. *Atitle2*	0	1	0.18	0.38	0.14**	0.08**	0.11**	0.11**	0.09**	0.05	−0.02	−0.12**	0.39**	−0.24**			
12. *Level1*	0	1	0.80	0.40	0.02	0.00	0.02	0.02	0.02	0.02	−0.01	−0.02	0.03*	0.15**	0.02		
13. *Level2*	0	1	0.09	0.29	−0.01	−0.00	−0.02	−0.02	−0.02	−0.06*	−0.01	−0.02	−0.08**	−0.05**	−0.05**	−0.64**	
14. *RS*	0.00	1.00	0.83	0.19	0.30**	0.26**	0.36**	0.41**	0.15**	0.26**	0.11**	0.03*	0.00	0.04**	0.02	0.00	−0.00

Notes: standard errors are in parentheses. *significant at 10%; **significant at 5%.

we no longer include it in the model. The results are presented in Table 5. Estimation results on control variables are not reported for space consideration. For doctors who only provide one kind of online services, we do not include price difference in our model. From Table 5, we find that there are still significant and positive relationships between service price and patient satisfaction. For doctors who only provide two online services, the results are consistent with the main results by using the total combined sample. For doctors who provide all three services, the results are also consistent with those previous models using the total sample. Thus, our results seem quite robust.

5.4. Post-hoc analyses

5.4.1. Endogeneity of price

There may exist a positive reverse effect of satisfaction on price. The existence of such endogeneity would bias our results. To address this potential problem, we use a two-stage least squares (2SLS) method to study the impact of price on satisfaction. Doctors may price their online services based on levels of the local economy and service fee in physical hospitals. We use two exogenous variables—GDP of the city and registration fee of outpatient service in physical hospital (*RFOS*) as the instrumental variables of price. *GDP* and *RFOS* are collected from the National Bureau of Statistics and Haodf.com website. GDP measures the consumption level of a city. Doctor who works in a city with a high consumption level tends to price their services high. Registration fee of outpatient service in physical hospital gives a reference for doctors to price their online services. An example for *RFOS* in Haodf.com is shown in Fig. 4. *GDP* and *RFOS* may influence the service pricing of doctors, however, they are less likely to impact patient satisfaction online directly.

We model the relationship of average price with the instrumental variables controlling for the control variables to account for the aforementioned reverse causality as:

$$AP\text{-}IV_t = \beta'''_1 X_{t-1} + \beta'''_2 GDP_{t-1} + \beta'''_3 RFOS_{t-1} + \varepsilon'''$$

We use the 2SLS for the endogenous regressor. The first stage results are shown in Table 6. From Table 6, we can see that *GDP* and *RFOS* explain the variability of service price well.

There are two concerns that need to be solved. The first is overidentification of the instruments. We use test of overidentifying restrictions to check the over-identification problem. The null hypothesis is that all instruments are exogenous. The results are shown in Table 7, supporting the exogeneity of our instruments. The second concern is weak instruments. The Shea's partial R-squared results in Table 7 show that there is no weak instrument problem.

Results based on 2SLS are shown in Table 8. We can find that the results in Table 8 is consistent with our main results in Table 3.

5.4.2. The mediating effect of flexibility of service selection

Based on hypothesis 3, we investigate potential mediating effect of flexibility of service selection on the relationship between price difference and patient satisfaction in this section.

We calculate the proportion of different services used by patients for each doctor. The interaction information between a doctor and all his/her patients is listed in the doctor's homepage (see Fig. 5). By crawling the first two pages for each doctor, we obtain information and calculate the degree of the flexibility of service selection (*FSS*) for each doctor by using the following method:

$$FSS_i = -\left| \frac{No.\ OWTS_i}{No.\ OWTS_i + No.\ OTTS_i} - 0.5 \right|$$

where *i* represents each doctor, No . OWTSi (No . OTTSi) represents how many OWTS (OTTS) treatment service that patients buy from doctor *i*. We use percentage of sales for one service among all services to measure the flexibility of service selection. When the ratio equals 0.5, it

Table 3
Empirical model results.

Variables	*Rec*		*SS*		*ADG*		*ADTyL*	
(Constant)	3.562*** (0.06)	3.570*** (0.06)	−0.662*** (0.242)	−0.634*** (0.24)	−2.232 (2.968)	−1.735 (2.912)	−5.168*** (1.923)	−4.864** (1.891)
Mtitle1	−0.048 (0.031)	−0.071** (0.031)	0.232* (0.124)	0.151 (0.124)	−1.749 (1.525)	−3.196** (1.510)	−0.605 (0.988)	−1.491 (0.981)
Mtitle2	−0.033 (0.028)	−0.046* (0.027)	0.283** (0.111)	0.234** (0.110)	−0.935 (1.359)	−1.792 (1.339)	−0.462 (0.880)	−0.988 (0.869)
Atitle1	0.165*** (0.030)	0.160*** (0.030)	0.193 (0.120)	0.175 (0.119)	5.816*** (1.475)	5.503*** (1.448)	4.825*** (0.956)	4.633*** (0.940)
Atitle1	0.117*** (0.025)	0.116*** (0.024)	0.141 (0.099)	0.137 (0.098)	3.41*** (1.216)	3.334*** (1.193)	2.607*** (0.788)	2.56*** (0.775)
Level1	0.001 (0.031)	0.011 (0.031)	−0.012 (0.126)	0.023 (0.125)	−0.821 (1.549)	−0.204 (1.522)	−0.807 (1.004)	−0.429 (0.989)
Level2	0.013 (0.043)	0.021 (0.042)	0.219 (0.172)	0.246 (0.170)	0.720 (2.106)	1.201 (2.067)	0.518 (1.365)	0.813 (1.342)
RS	0.294*** (0.035)	0.292*** (0.035)	0.956*** (0.141)	0.95*** (0.139)	17.127*** (1.723)	17.014*** (1.691)	13.351*** (1.117)	13.281*** (1.098)
SQ	**0.154***** (0.024)	**0.125***** (0.025)	**0.467***** (0.098)	**0.362***** (0.100)	**8.346***** (1.205)	**6.500***** (1.211)	**6.329***** (0.781)	**5.198***** (0.786)
AP	**0.002***** (0.000)	**0.004***** (0.000)	**0.006***** (0.001)	**0.013***** (0.002)	**0.091***** (0.010)	**0.214***** (0.020)	**0.080***** (0.006)	**0.156***** (0.013)
AP^2		**-7.35E-06***** (0.000)		**-2.68E-05***** (0.000)		**0.0004***** (0.000)		**0.0004***** (0.000)
N	1252	1252	1252	1252	1252	1252	1252	1252
Adjusted R^2	0.268	0.284	0.165	0.180	0.268	0.296	0.374	0.395
F change sig.	42.575***	28.368***	23.484***	23.324***	42.681***	49.384***	68.949***	43.997***

Notes: standard errors are in parentheses. *significant at 10%; **significant at 5%; ***significant at 1%. Results of key variables are shown in bold.

means a higher flexibility of service selection. We subtract 0.5 from the ratio, take its absolute value, and then multiply by −1. Larger values of *FSS* imply means higher flexibility of service selection. By including *FSS* in the model, our empirical model is:

$$PS_{jt} = f(\beta'''_{1j}X_{t-1} + \beta'''_{2j}SQ_{t-1} + \beta'''_{3j}AP_{t-1} + \beta'''_{4j}AP^2{}_{t-1} + \beta'''_{5j}PD_{t-1} + \beta'''_{6j}FSS_t + \varepsilon''' j)$$
$$, j \in J(1,2,3,4)$$

Estimation results are shown in Table 9. Column 1 and 2 present the relationship between price difference and the flexibility of service selection. Price difference negatively impacts the flexibility of service selection ($p < 0.01$). Larger price difference decreases the flexibility of service selection. Comparing the adjusted R^2 in column 1, the adjusted R^2 in column 2 is much higher. Variability in flexibility of service selection is well explained by price difference. Column 3–10 in Table 9 show the results with the flexibility of service selection. We see that for all the four satisfaction variables (*Rec*:β = 0.148, p < 0.001, *SS*:β = 0.638, p < 0.001, *ADG*:β = 4.511, p < 0.01, *ADTyL*:β = 3.064, p < 0.01), higher flexibility of service selection leads to higher patient satisfaction. Because the direct path from the price difference to satisfaction in the mediating model is less strong than the path in the constrained model, flexibility of service selection is a partial mediator. Our results prove that the relationship between price difference and patient satisfaction is partially mediated by the flexibility of service selection, and the mediating effect account for about 28.6% of the total effect (take *SS* as an example: the mediating effect is 28.6% = (0.007–0.005)/0.007*100%).

6. Discussion and implications

6.1. Result analysis

Our empirical results support most of the hypotheses. Shown in Fig. 6 are the path diagrams for the different relationships. For the impact of service quantity on satisfaction, our results show that satisfaction can be improved by providing multiple services. Each service has its unique characteristics (as introduced before), so providing multi-choices can meet different needs of patients and improve their satisfaction.

Based on the main and post-hoc analyses, our results for the role of service price in affecting satisfaction are interesting. The observed asymmetric reverted U-shaped is quite different from those in reported by prior studies. First, both quality and price are important impact

Table 4
Empirical results with price difference.

Variables	*Rec*	*SS*	*ADG*	*ADTyL*
(Constant)	3.580*** (0.060)	−0.398* (0.238)	1.118 (2.890)	−3.331* (1.888)
Mtitle1	−0.072** (0.031)	0.121 (0.122)	−3.553** (1.484)	−1.683* (0.969)
Mtitle2	−0.046* (0.027)	0.228** (0.108)	−1.866 (1.315)	−1.028 (0.859)
Atitle1	0.160*** (0.030)	0.180 (0.117)	5.565*** (1.422)	4.666*** (0.929)
Atitle1	0.114*** (0.024)	0.102 (0.097)	2.907** (1.173)	2.331*** (0.766)
Level1	0.011 (0.031)	0.025 (0.123)	−0.176 (1.495)	−0.414 (0.977)
Level2	0.022 (0.042)	0.270* (0.167)	1.487 (2.031)	0.966 (1.326)
RS	0.29*** (0.035)	0.903*** (0.137)	16.444*** (1.663)	12.975*** (1.086)
SQ	**0.121***** (0.025)	**0.256**** (0.099)	**5.217***** (1.204)	**4.508***** (0.786)
AP	**0.004***** (0.000)	**0.019**** (0.002)	**0.287***** (0.022)	**0.195***** (0.015)
AP^2	**-7.70E-06***** (0.000)	**-3.53E-05***** (0.000)	**−0.001***** (0.000)	**0.0003***** (0.000)
PD	0.0001 (0.000)	**−0.007***** (0.001)	**−0.081***** (0.012)	**−0.043***** (0.008)
N	1252	1252	1252	1252
Adjusted R^2	0.284	0.209	0.321	0.410

Notes: standard errors are in parentheses. *significant at 10%; **significant at 5%; ***significant at 1%. Results of key variables are shown in bold.

Table 5
Robustness check results.

Variables	*Rec*	*SS*		*ADG*		*ADTyL*	
For doctors who only provide one kind of online services							
OWTS P			**0.013***** (−0.001)		**0.327***** (0.037)		**0.202***** (0.023)
OWTS P^2			**-4.134E-5***** (4.185E-6)		**−0.001***** (0.000)		**−0.001***** (0.000)
OTTS P	**0.001***** (0.000)	**−0.001**** (0.000)		**0.032***** (0.012)		**0.040***** (0.008)	
OTTS P^2	-4.15E-07 (0.000)	**4.185E-6***** (0.032)		1.005E-5 (0.000)		-8.13E-06 (0.000)	
N	299	299	758	299	758	299	758
Adjusted R^2	0.303	0.646	0.106	0.189	0.296	0.286	0.339
For doctors who only provide two kinds of online services							
AP	**0.004***** (0.001)	**0.020***** (0.002)		**0.328***** (0.026)		**0.216***** (0.016)	
AP^2	**-6.61E-06***** (0.000)	**-3.35E-05***** (0.000)		**−0.001***** (0.000)		**0.000***** (0.000)	
PD	0.0001 (0.000)	**−0.008***** (0.001)		**−0.099***** (0.014)		**−0.054***** (0.009)	
N	1009	1009		1009		1009	
Adjusted R^2	0.194	0.177		0.249		0.328	
For doctors who provide all three kinds of services							
AP	**0.004***** (0.001)	**0.014***** (0.004)		**0.165***** (0.046)		**0.128***** (0.033)	
AP^2	**-9.01E-06***** (0.000)	**-3.15E-05***** (0.000)		**0.000***** (0.000)		**0.000**** (0.000)	
PD	0.0001 (0.000)	**−0.005**** (0.002)		**−0.050**** (0.024)		**−0.027*** (0.017)	
N	243	243		243		243	
Adjusted R^2	0.248	0.108		0.224		0.272	

Notes: standard errors are in parentheses. *significant at 10%; **significant at 5%; ***significant at 1%. Estimation results on control variables are not reported in this table. For *Rec*, there are no doctors who only provide written treatment service. Results of key variables are shown in bold.

factors of satisfaction [2,13]. Evaluation of quality is difficult, as patients often lack professional medical knowledge. Thus, price becomes the main factor that they can use to gauge service quality. Medical services are related to patients' quality of life and they prefer to keep seeking reassurance by paying more. With increasing price, patients feel that they can get higher-quality services and have higher satisfaction. A higher price may reflect either high demands for products/services with high quality or the high product/service cost associated with high quality [20]. Doctors with higher service quality could increase their service price to achieve balance between supply and demand. In addition, Doctors with higher service quality often have many works in physical hospitals and only have less time to work in the OHCs, so higher price can decrease the demand and improve efficiency and efficacy. Second, patients evaluate their cost before making choices. If the price of online service is too high, they may feel unfair and have lower satisfaction based on transaction-cost economics. Third, when patients already pay high cost for service, they may be unwilling to pay any time (i.e. grade the doctor or write digital thank-you letters) or money (i.e. buy digital gifts) to evaluate or thank doctors. By using four variables to measure satisfaction, our results support our hypothesis. Average price and patient satisfaction follow a reverted U-shaped relationship, with the peak value at about 330 CNY. When the price is lower than 330 CNY, higher price reflects higher quality and brings higher satisfaction. When the price reaches this threshold, higher price makes patients feel unreasonable, decreasing their satisfaction.

We find that price difference negatively impacts patient satisfaction, which is in line with the existing literatures [41]. Different services have unique attributes, such as ease of access to electronic files following the doctors' requests in OWTS and continuous engagement in OTTS. Although multiple services can increase satisfaction by giving more choices to patients, the larger price difference between these services increases switching cost, which in return decreases the flexibility of service selection. We examine the mediating effect of flexibility of service selection in post-hoc analyses, and find that price difference indirectly impacts patient satisfaction by influencing the flexibility of service selection. When price difference is large, conversion cost is high for patients, so patients cannot easily transfer among different services. Thus, as flexibility of service selection decreases, so

Table 6
First stage results.

Variables	Model 1	Model 2
(Constant)	3.206*** (0.083)	3.206*** (0.082)
Mtitle1	0.674*** (0.071)	0.652*** (0.067)
Mtitle2	0.552*** (0.064)	0.512*** (0.060)
Atitle1	0.269*** (0.069)	0.166** (0.064)
Atitle1	0.146* (0.058)	0.066 (0.054)
Level1	−0.120* (0.073)	−0.098 (0.068)
Level2	−0.175* (0.100)	−0.160* (0.093)
RFOS		**−0.016***** (0.002)
GDP		**0.137***** (0.017)
N	1252	1252
Adjusted R^2	0.155	0.265
F change sig.	39.205***	94.388***

Notes: standard errors are in parentheses. *significant at 10%; **significant at 5%; ***significant at 1%. Results of key variables are shown in bold.

Fig. 4. Registration fee of outpatient service in physical hospital for doctor A.

Table 7
Results for instruments test.

	Rec	*SS*	*ADG*	*ADTyL*
Over-identification test	Score chi2(1) = 0.1045 (p = 0.7464)	Score chi2(1) = 0.0034 (p = 0.9535)	Score chi2(1) = 2.948 (p = 0.8859)	Score chi2(1) = 0.0509 (p = 0.8213)
Weak instruments test	Shea's partial R^2 = 0.0776 F = 53.1675 Prob > F = 0.0000 53.1675 > 11.59	Shea's partial R^2 = 0.0776 F = 53.1675 Prob > F = 0.0000 53.1675 > 11.59	Shea's partial R^2 = 0.0776 F = 53.1675 Prob > F = 0.0000 53.1675 > 11.59	Shea's partial R^2 = 0.0776 F = 53.1675 Prob > F = 0.0000 53.1675 > 11.59

Table 8
Results with instruments.

Variables	*Rec*	*SS*	*ADG*	*ADTyL*
(Constant)	5.210*** (0.002)	−1.210* (0.030)	0.452 (0.002)	−2.578* (1.110)
Mtitle1	−0.073** (0.005)	0.152 (0.089)	−3.242** (1.524)	−1.785* (0.967)
Mtitle2	−0.045* (0.022)	0.157** (0.100)	−1.639 (1.253)	−1.002 (0.841)
Atitle1	0.160*** (0.030)	0.414 (0.137)	5.665*** (1.421)	4.565*** (0.920)
Atitle1	0.112*** (0.013)	0.098 (0.095)	2.870* (1.089)	2.052*** (0.750)
Level1	0.011 (0.050)	0.024 (0.021)	−0.167 (1.212)	−0.242 (0.220)
Level2	0.021 (0.002)	0.260* (0.100)	1.495 (1.521)	0.841 (1.300)
RS	0.25** (0.007)	0.587** (0.104)	12.035** (1.425)	10.458** (1.005)
SQ	**0.119***** (0.024)	**0.255**** (0.098)	**5.012***** (1.119)	**4.448***** (0.768)
AP-IV	**0.004***** (0.000)	**0.018**** (0.002)	**0.278***** (0.020)	**0.186***** (0.014)
AP-IV^2	**-7.68E-06***** (0.000)	**-3.41E-05***** (0.000)	**−0.001***** (0.000)	**0.0003***** (0.000)
PD	0.0001 (0.000)	**−0.006***** (0.001)	**−0.078***** (0.010)	**−0.033***** (0.007)
N	1252	1252	1252	1252
Adjusted R^2	0.272	0.200	0.319	0.401

Notes: standard errors are in parentheses. *significant at 10%; **significant at 5%; ***significant at 1%. Results of key variables are shown in bold.

Fig. 5. Interaction content between doctor and patient.

does satisfaction.

6.2. Implications and limitations

This paper studies the impact of the provision and pricing of online services on patient satisfaction by researching an OHC in China. Our study contributes to knowledge in several key ways. First, this study enriches the multiple channel strategy research in the context of OHCs. We study whether satisfaction could be improved by providing multiple services which is rarely researched in prior marketing literatures. In OHCs, doctors provide several services which, although having similar functions, cannot be replaced each other because of their unique attributes. Our results show that patient satisfaction can be increased by providing multiple services which can meet patients' different needs.

Second, this study contributes to price-satisfaction related theories in healthcare. Despite some studies indicate that price significantly impacts consumer satisfaction, limited knowledge about the healthcare field, especially within the OHCs context. Prior literatures in product and other service industries have shown that price plays an important role in affecting consumer satisfaction [47,48]. And such relationships are often linear. Our study is among the first to use real data to empirically examine the role of price in OHCs, which is a universally

Table 9
Post-hoc analyses for the flexibility of service selection.

Variables	*FSS*		*Rec*		*SS*		*ADG*		*ADTyL*	
(Constant)	0.362*** (0.020)	0.361*** (0.020)	3.58*** (0.060)	3.639*** (0.064)	−0.398* (0.238)	−0.655*** (0.251)	1.118 (0.890)	2.935 (0.060)	−3.331* (0.888)	−2.097 (0.998)
Mtitle1	−0.002 (0.017)	−0.001 (0.017)	−0.072** (0.031)	−0.072** (0.031)	0.121 (0.122)	0.122 (0.122)	−3.553** (0.484)	−3.558** (0.483)	−1.683* (0.969)	−1.687* (0.968)
Mtitle2	0.009 (0.015)	0.009 (0.015)	−0.046* (0.027)	−0.045* (0.027)	0.228** (0.108)	0.222** (0.108)	−1.866 (0.315)	−1.823 (0.314)	−1.028 (0.859)	−0.999 (0.858)
Atitle1	−0.038** (0.016)	−0.038*** (0.016)	0.160*** (0.030)	0.154*** (0.030)	0.180 (0.117)	0.205* (0.117)	5.565*** (0.422)	5.391*** (0.424)	4.666*** (0.929)	4.548*** (0.930)
Atitle1	−0.042*** (0.013)	−0.040*** (0.013)	0.114*** (0.024)	0.109*** (0.024)	0.102 (0.097)	0.126 (0.097)	2.907** (0.173)	2.733** (0.176)	2.331*** (0.766)	2.213*** (0.768)
Level1	0.030* (0.017)	0.030* (0.017)	0.011 (0.031)	0.016 (0.031)	0.025 (0.123)	0.006 (0.123)	−0.176 (0.495)	−0.038 (0.496)	−0.414 (0.977)	−0.320 (0.977)
Level2	0.041* (0.023)	0.040* (0.023)	0.022 (0.042)	0.028 (0.042)	0.270* (0.167)	0.244 (0.167)	1.487 (0.031)	1.671 (0.032)	0.966 (0.326)	1.091 (0.327)
RS	−0.02 (0.019)	−0.018 (0.019)	0.29*** (0.035)	0.288***(0.035)	0.903*** (0.137)	0.913*** (0.137)	16.444*** (1.663)	16.371*** (1.662)	12.975*** (1.086)	12.926*** (1.085)
SQ			**0.121***** (0.025)	**0.118***** (0.025)	**0.256**** (0.099)	**0.270***** (0.099)	**5.217***** (0.204)	**5.117***** (0.204)	**4.508***** (0.786)	**4.440***** (0.787)
AP	−0.00023 (0.021)	−0.00043* (0.00024)	**0.004***** (0.000)	**0.004***** (0.046)	**0.019**** (0.002)	**0.018*****(0.184)	**0.287***** (0.022)	**0.028***** (0.234)	**0.195***** (0.015)	**0.019***** (0.459)
AP^2	-2.55E-07 (0.000)	1.01E-08 (0.000)	**-7.70E-06***** (0.000)	**-7.75E-06**** (0.000)	**-3.53E-05***** (0.000)	**-3.51E-05***** (0.000)	**−0.001***** (0.000)	**−0.001***** (0.000)	**0.0003***** (0.000)	**0.000***** (0.000)
PD		**−0.0024**** (0.0013)	0.0001 (0.000)	−0.00025 (0.024)	**-0.007***** (0.001)	**−0.005***** (0.097)	**−0.080***** (0.012)	**−0.061***** (0.175)	**−0.043***** (0.008)	**−0.032***** (0.767)
FSS				**0.148***** (0.052)		**0.638***** (0.206)		**4.511**** (2.509)		**3.064**** (1.639)
N	1252	1252	1252	1252	1252	1252	1252	1252	1252	1252
Adjusted R^2	0.022	0.124	0.284	0.288	0.209	0.215	0.321	0.322	0.410	0.411
F change sig.	3.591***	33.450**	64.847***	9.147***	26.467***	9.579***	46.427***	3.232**	67.745***	3.497**

Notes: standard errors are in parentheses. *significant at 10%; **significant at 5%; ***significant at 1%. FSS presents the flexibility of service selection. Results of key variables are shown in bold.

beneficial sector. The research context gives us the opportunity to study the effects of online services' price on patient satisfaction, and our results show that there is an asymmetric reverted U-shaped relationship.

Third, this study contributes equity theory by measuring "price difference for different services for each individual" rather than "price difference for different individuals", and take price difference as an important impact factor of satisfaction. Existing studies rarely take price difference into consideration when researching the impact of price on satisfaction. And the price difference is calculated based on price of different sellers in prior studies. One possible reason is that they rarely study multiple services which have different price in one model. Moreover, by hypothesizing larger price difference decreases flexibility of service selection, we test the influencing mechanism by introducing flexibility of service selection in our model and investigate its mediating effect on the relationship between price difference and satisfaction. Our results show price difference impacts patient satisfaction directly and as well as indirectly through partial mediation by flexibility of service selection.

Fourth, in contrast to the traditional research methods employed in existing studies on satisfaction, this study relies on customers' voluntarily provided reviews to analyze the contribution of service provision and pricing to patient satisfaction. The use of this method allowed us to obtain high volumes of patient rating of 2309 doctors, something that cannot easily be achieved using traditional data-collection methods such as surveys.

The paper also has significant practical contributions. The results of this study can help doctors understand what aspects should be given more attention in order to improve their satisfaction and competitiveness. Based on this research, the researcher recommends improving competitiveness and patient satisfaction healthcare industries through providing more choices and setting the right pricing strategies. With the development of new technologies, improvement of our living standards and more attention being paid onto health, the demand for medical care is increasing. Patients need different services to meet their individual demands. Our study suggests that doctors can choose to provide multiple services which is helpful to increase patient satisfaction. Pricing strategies is to keep the price within reasonable bounds and small price difference. Doctors can foster trust and increase satisfaction by providing services with better quality and charging a relatively higher price. However, large price difference decreases patient satisfaction either directly or indirectly through partially mediated by the decrease in flexibility of service selection. Thus, a small price difference is suggested.

The analysis and estimation of patient satisfaction are crucial for the different participants in healthcare—both hospital managers and website managers—in planning their commercial strategies. The influence of price on the formation of satisfaction is more complex in service than product areas. Knowing how the antecedents of patient satisfaction contribute to the formation of this term is essential, since such knowledge enables the participants in healthcare to configure prices that obtain between levels of satisfaction.

This paper has several future directions. First, as it is hard to get service quality which impacts both price and patient satisfaction, this study cannot handle the problem of missing variables. Even we try to use instruments method for endogenous problem, it is still need a more complex approach such as panel data analysis which is not suitable in this study (see previous section) to research dynamic causal relationships. Second, we only studied one particular disease. Third, we only studied one service context, which, although improving the internal validity, it may reduce the generalizability of our findings. Our future research should validate the results in other service contexts. Fourth, we do not have information at patient level which also has impact on their satisfaction. Future studies can control patients' information, such as patients' socio-demographic characteristics. Fifth, we only study the price of online service, future studies can also include the price of offline service. Sixth, future studies can develop in-depth understanding to

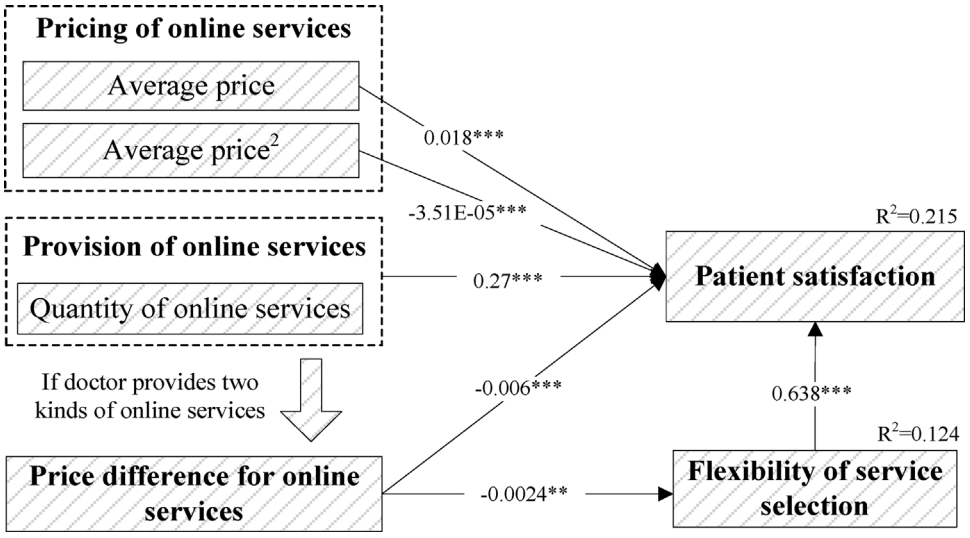

Fig. 6. Research results (take service star as example).
Notes: *significant at 10%; **significant at 5%; ***significant at 1%. Average price^2 and R^2 present quadratic term of average price and the adjusted R^2.

explore the relationship between provision, pricing and satisfaction within different doctor groups. We believe our current findings demonstrate a strong relationship between online service provision, pricing and patient satisfaction.

7. Conclusions

Although researchers believe service price is of great importance for satisfaction, there is little evidence on the effects of online service price in healthcare. To address this research gap, we built and empirically tested a theoretical model to explore the influence of online service provision and pricing on patient satisfaction. This study considers price as both signals of service quality and indicators of sacrifice. Our empirical evidence shows a non-linear correlation between online service price and patient satisfaction to lend some support for the two-sign effect that price exercises on satisfaction, positive (quality) and negative (sacrifice). Furthermore, this paper also investigated the impact of price difference on patient satisfaction and observed an interesting mediation effect by flexibility of service selection. This paper contributes to the price and satisfaction literatures by studying them in the healthcare field and also contributes to the OHC literatures. This paper also provides plenty of suggestions to doctors who work in OHCs.

Conflicts of interest

All authors confirm that we have no conflicts of interest

Summary point

What was already known.

1. Existing studies indicating that multiple channel strategies tend to be more successful, limited knowledge about the healthcare.
2. By using linear functions, researchers do not obtain consistent results about the relationship between price and customer satisfaction.
3. Price difference is measured by the difference in prices between different sellers, and impacts customer satisfaction negatively.

What this study has added.

1. Our study enriches the multiple channel strategy research in the context of OHCs and the results show that patient satisfaction can be increased by providing multiple services which can meet patients' different needs.
2. Our study is among the first to use real data to empirically examine non-linear relationship between service price and patient satisfaction in healthcare, especially in OHCs.
3. Our study contributes equity theory by measuring "price difference for different services for each individual" rather than "price difference for different individuals", and take price difference as an important impact factor of patient satisfaction in OHCs.
4. We test the influencing mechanism of price difference by introducing flexibility of service selection in our model and investigate its mediating effect on the relationship between price difference and satisfaction.

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