Factors Affecting Consultation Volume in an Online Healthcare Community: Evidence from Online Data in China

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Abstract: Under the background of sharing economy, online healthcare has been developing rapidly to ease the pressure of offline medical care. The interaction between doctors and patients is the key element of the sustainable development of online healthcare communities. To explore the influence of doctors' online word-of-mouth, online vitality and consulting service price on consultation volume, we build a multiple regression model taking consultation volume as the dependent variable, online word-of-mouth and online vitality and consulting service price as independent variables. By analyzing the data of 37,977 doctors collected from the online healthcare community, we find that doctors' online word-of-mouth and online vitality have significant positive impacts on consultation volume. Our results also show that there is an inverted U-shaped relationship between consulting service price and consultation volume, and online word-of-mouth has a greater impact on consultation volume than any other factors. Finally, we put forward suggestions for doctors in online healthcare communities.

Keywords: online healthcare communities, consultation volume, online word-of-mouth, vitality

1. INTRODUCTION

The *Tracking Universal Health Coverage: 2017 Global Monitoring Report*, released in December 2017 by the World Bank and the World Health Organization, shows that at least half of the world's population does not have access to basic health services, and the main reason for this situation is that the uneven distribution of medical resources [1]. In China, as the demand for medical services continues to grow, the problem of inadequate medical services caused by insufficient medical resources and imbalanced resource allocation is more obvious. According to the statistical bulletin issued by the National Health Commission of the PRC in 2017, the tertiary hospitals and the primary and ungraded hospitals accounted for 7.7% and 65.1% of the total hospitals respectively, but the number of medical treatments each accounted for 49.8% and 12.8% of the total respectively [2]. Medical resources and medical needs are seriously asymmetrical in the structure. In order to optimize the allocation of medical resources, improve the utilization rate of medical resources, and solve the problem of inadequate medical services, the Chinese government advocates the implementation of sharing medical resources.

Online healthcare communities (OHCs) have two main advantages compared with the traditional medical model. For one thing, it provides patients easier access to medical knowledge and information [3] as well as online emotional support [4], which can effectively reduce the cost of patient care and improve the doctor-patient relationship. For another thing, it can help doctors make full use of their spare time to serve patients across institutional restrictions and barriers caused by space in medical resources. OHC will play an increasingly important role in optimizing the medical treatment process, rationally allocating medical resources, and promoting medical system reform.

According to the monitoring data of the online medical industry by the E-Commerce Research Center of

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China, by December 2017, the online medical market in China had reached 32.5 billion yuan, and is expected to rise to 90 billion yuan in 2020. However, how to attract more patients to consult doctors online is always an urgent problem for the development of OHC. Studies in the field of e-commerce show that there is an important relationship between the price of online products or services, online word-of-mouth and their sales. At the same time, relevant research in the field of online marketing shows that the vitality of corporate accounts or other subject accounts on Weibo has important influences on the consumers' or fans' brand perception and behavioral decision-making [5]. Based on these works, the paper mainly analyzes the relationship between the doctor's online word-of-mouth, vitality, consulting service price and consultation volume, and provides advice for improving doctors' online consultation, so as to alleviate offline medical pressure and realize the sustainable development of OHC.

2. THEORETICAL BACKGROUND AND HYPOTHESIS

2.1 Online healthcare communities and the information asymmetry theory

OHC, as a communication platform for patients and doctors, can not only provide medical information [3] and emotional support [4] for patients but help patients know information about doctors, including doctors' personal experience, service information and patients' evaluation. At the same time, OHC will help doctors accumulate case experience, improve doctor-patient relationship, build personal brand and increase personal income.

However, in process of selecting a doctor to consult in OHC, the patient has limited information to judge a doctor. Akerlof used the information asymmetry theory in the commodity market for the first time in 1970. He pointed out that information asymmetry means that the information owned by the two parties is not equal, and the seller of the product has more information about the quality of the product than the buyer does [6]. In OHC, doctors, as professionals, know more about the disease diagnosis and treatment knowledge than patients do. Meanwhile, patients can only vaguely judge the doctors' service quality based on the online information [7]. Therefore, doctors are in a dominant position in OHC with asymmetric information, and patients are in a disadvantaged position. In order to protect their own interests, patients will make decisions based on various online information as much as possible, such as evaluation of doctors by other patients, the price of the consultation service, doctors' online articles and the 24-hour reply rates.

Hence, the paper explores the impacts of three main factors on consultation volume that doctors receive in OHC. Figure 1 shows the conceptual model of the study.
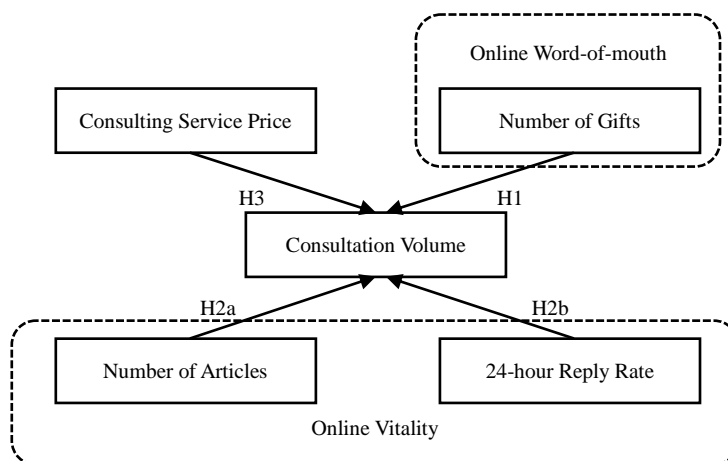

Figure 1.   Conceptual model

2.2 Online word-of-mouth and consultation volume

Online or electronic word-of-mouth has been defined as "any positive or negative statement made by potential, actual, or former customers about a product or company, which is made available to a multitude of people and institutions via the Internet" [8]. It has been proved that online word-of-mouth plays an important role in consumers' purchasing behaviors. At the same time, because of the characteristics of network communication, the influence of online word-of-mouth is broader than that of traditional word-of-mouth [9]. Chevalier et al. proved that online word-of-mouth has a significant impact on consumer behavior through their research on Amazon.com and Barnesandnoble.com book reviews [10]. Measurement and analysis of online word-of-mouth for product or services can provide important decision support for businesses and consumers [11].

In OHC, after consulting a doctor, the patient can evaluate the doctor's service. If the patient feel satisfactory, he will vote for the doctor. The voting method includes sharing the experience of visiting the doctor, writing a thank-you letter and giving a gift. Because the patient needs to pay for the gift, which more accurately indicates the patient's recognition of the doctor, so we use the number of gifts doctors received to indicate doctors' online word-of-mouth. Research in the field of e-commerce has found that the quality of online word-of-mouth has an important impact on consumers' purchasing intentions [12] and product sales [10]. Therefore, we speculate that the online word-of-mouth of doctors' online consulting service has a certain impact on the consultation volume obtained by doctors, and put forward the following hypothesis:

H1: The number of gifts doctors received is positively related to the consultation volume in online healthcare communities.

2.3 Online vitality and consultation volume

In OHC, the number of articles and 24-hour reply rate represent online vitality of doctors. The more articles published and the higher 24-hour reply rate indicates the higher online vitality of doctors. In the field of online marketing, research on microblog marketing shows that online vitality of corporate accounts or opinion leaders in groups has significant impacts on consumers' brand perception, preference and decision-making [5, 13], higher online vitality will attract more fans and improve the effectiveness of online marketing. Therefore, we speculate that doctors as professional medical personnel and providers of online medical consultation services, their online vitality has impacts on consultation volume. Based on this, we put forward the following hypothesis:

H2a: The number of articles is positively related to the consultation volume in online healthcare communities;

H2b: The 24-hour reply rate is positively related to the consultation volume in online healthcare communities.

2.4 Consulting service price and consultation volume

In an asymmetrical information environment, consumers usually measure the quality of products according to their prices [14]. OHC have obvious information asymmetry characteristics, and price may have a certain impact on patients' decision-making services. There are two types of price in consulting service: telephone consultation price and text consultation price. Since the number of telephone consultation accounts for less than 1% of the total consultation volume, and most doctors have not provided telephone consultation services, this paper adopts the price of text consultation as the price of the doctors' consulting service. According to theoretical research on price, consumers usually think that the products or services with higher price have higher quality when making purchasing decisions [15]. When it comes to personal health or safety, consumers are less sensitive to the price and pay more attention to the quality of products or services. However, once the price of a product or service exceeds consumers' consumption ability, consumers' demand will decrease [16]. Therefore, we

think that the relationship between consulting service price and consulting volume is inverted U-shaped, and put forward the following hypothesis:

H3: There is an inverted U-shaped relationship between the consulting service price and the consulting volume in online healthcare communities.

3. METHODOLOGY

3.1 Data

Our data is from Haodaifu (www.haodf.com), established in 2006. It has many functions such as text consultation, telephone consultation, appointment referral, remote clinic, post-discipline management, family doctor service, etc. It is a representative OHC with the largest number of doctors and preferable quality in China.

By using our web crawler program, we obtained information of 158,218 doctors in December 2017. Because many doctors only provide appointment services, the data of them lack 24-hour reply rate, consulting service price and other information. By deleting samples with missing values, we finally retained and adopted the complete information of 37,977 doctors. The information of each doctor includes consultation volume, the number of gifts, the number of articles, 24-hour reply rate, and consulting service price.

3.2 Variables and models

The independent variables in this study included the number of gifts, the number of articles, 24-hour reply rate, and consulting service price. The number of gifts (NG) is the patient's appreciation to the doctor after the consultation, which represents the doctor's online word-of-mouth. The number of online articles (NA) reflects doctors' vitality and the contribution to OHC. The 24-hour reply rate (RR) refers to the possibility of a doctor responding to a patient's problems within 24 hours which represents the timeliness of the doctor's response to the question. The number of articles and 24-hour reply rate reflect the online vitality of doctors. Consulting service price (CSP) refers to the price set by the doctor for consultation service. Consultation volume (CV) is set as a dependent variable, representing the total number of times of online counseling service provided by a doctor. Table 1 describes the variables used in this article in detail.

According to the research hypothesis, we established the following multiple regression models.

$$\text{Model 1: } CV_1 = \beta_0 + \beta_1 NG + \beta_2 NA + \beta_3 RR + \beta_4 CSP + \varepsilon \tag{1}$$

$$\text{Model 2: } CV_2 = \beta_0' + \beta_1' NG + \beta_2' NA + \beta_3' RR + \beta_4' CSP + \beta_5' CSP^2 + \varepsilon' \tag{2}$$

There are two equations to prove the inverted U-shaped relationship between the consulting service price and the consulting volume. β_i and β_i' (i=0,1,2,3,4,5) represent the regression parameter to be estimated, ε and ε' represent the error term.

4. RESULTS

4.1 Descriptive statistics and correlations

Table 1 shows the result of descriptive statistics and correlation analysis of variables in our study. The minimum value of the number of articles is zero, while the maximum value is70640. They are significantly different from the average value of 16.43. The results of correlation analysis show that the number of gifts, the number of articles, 24-hour reply rate and consulting service price are all significantly correlated with consultation volume. At the same time, the correlation between the independent variables is low, and there is no multicollinearity, which indicates that the model can obtain stable parameter estimation.

Table 1. Describe statistics and correlation analysis results

Variables	Min	Max	Mean	S.D.	1	2	3	4	5
Dependent Variables									
CV	1	69387	910.86	2048.592	1				
Independent Variables									
NG	0	6751	63.34	186.880	0.679^{***}	1			
NA	0	70640	16.43	369.450	0.064^{***}	0.041^{***}	1		
RR	0	100	67.90	36.936	0.118^{***}	0.120^{***}	0.010	1	
CSP	6	1000	42.69	54.761	0.277^{***}	0.335^{***}	0.016^{**}	0.091^{***}	1

Notes: $^{*}p < 0.05$, $^{**}p < 0.01$, $^{***}p < 0.001$.

4.2 Regression analysis

Table 2 shows the regression results of the models, the adjusted R square of model 2 is 0.469, and the model fitting degree is good, indicating certain explanatory ability. There is a significant positive correlation between NG and CV (B=7.105, p<0.001), indicating that online word-of-mouth has a significant positive influence on the consultation volume, and patients tend to choose doctors with better reputation for consultation. There is also a significant positive correlation between NA and CV (B=0.203, p<0.001), indicating that doctors can improve their popularity and get more consultations by publishing medical-related articles on the website actively. There is also a significant positive correlation between RR and CV (B=1.798, p<0.001). Therefore, Doctors should timely reply to patients' consultation questions online, actively publish medical articles, and strive to improve their online vitality, which can attract more patients. As can be seen above, the research hypothesis H1, H2a, and H2b are all proved.

Table 2. Regression results

Variables	Model 1			Model 2		
	B	Std. Error	Beta	B	Std. Error	Beta
（Constant）	236.775^{***}	16.767		168.535^{***}	17.562	
NG	7.183^{***}	0.044	0.655^{***}	7.105^{***}	0.044	0.648^{***}
NA	0.203^{***}	0.021	0.037^{***}	0.203^{***}	0.021	0.037^{***}
RR	1.908^{***}	0.210	0.034^{***}	1.798^{***}	0.209	0.032^{***}
CSP	2.019^{***}	0.149	0.054^{***}	4.804^{***}	0.264	0.128^{***}
CSP^2				-0.008^{***}	0.001	-0.087^{***}
N	37977			37977		
Adjusted R^2	0.466			0.469		
Sig.	0.000			0.000		

Notes: $^{***}p < 0.001$.

In addition, it can be concluded from the results that there exists an inverted u-shaped relationship between CSP and CV (B1=4.804, B2=-0.008, p<0.001). As is shown in figure 2, the curve reaches the peak when the consulting price is about 300 yuan through CSP*= -b1 / (2B2). When the consulting service price is less than 300 yuan, there is a positive correlation between the price and the consulting quantity; when the consulting price is higher than 300 yuan, there is a negative correlation between them. Hypothesis H3 is also proved. At the same time, according to the standardized regression coefficient, the number of gifts which indicates doctors' online word-of-mouth in this research has the biggest impact on the consultation volume, followed by consultation service price. The number of articles and 24-hour reply rate (doctors' vitality) have relatively smaller influence on consultation volume. We can see that in OHC with asymmetric information, the third-party evaluation

information is relatively objective. For patients making decisions, the most important information is the online word-of-mouth of a doctor, followed by the price of the consultation service. While, the vitality factors such as number of doctors' articles and 24-hour reply rate are not that important, but they are also positively correlated with consultation volume.
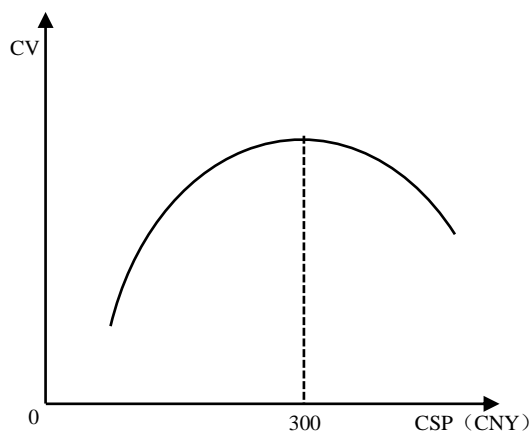

Figure 2. The inverted u-shaped curve between CV and CSP

4.3 Robustness check

To verify the robustness of our research model, we divided the data into two groups based on whether the doctors had senior professional titles. The first group included 22,894 doctors with senior professional titles, including chief physician and deputy chief physician. The second group included 15083 doctors with non-senior professional titles, including attending physicians and resident physicians. Table 3 shows the results of robustness check. Both in the senior professional title group and the non-senior professional title group, the number of gifts, the number of articles and 24-hour reply rate have significant positive effects on consultation volume. Meanwhile, there are inverted U-shaped relationships between consulting service price and consultation volume in both groups. The consistency between the test results and the main results by using the total combined sample proves the robustness of our model. In addition, by comparing the normalized coefficients of the two sets, we can see that in the group of non-senior doctors, the number of doctors' articles and the consulting service price have greater impacts on consultation volume. It shows that publishing more articles and setting reasonable consulting price will forgive these non-senior doctors for their lack of professional titles.

Table 3. Robustness check results

Variables	Senior doctors			Non-senior doctors		
	B	Std. Error	Beta	B	Std. Error	Beta
（Constant）	201.363[***]	26.181		133.374[***]	19.893	
NG	7.465[***]	0.055	0.679[***]	4.960[***]	0.077	0.466[***]
NA	0.179[***]	0.024	0.035[***]	5.511[***]	0.256	0.148[***]
RR	2.800[***]	0.315	0.042[***]	0.562[*]	0.228	0.017[*]
CSP	3.427[***]	0.344	0.091[***]	6.739[***]	0.478	0.167[***]
CSP^2	-0.006[***]	0.001	-0.070[***]	-0.013[***]	0.002	-0.092[***]
N	22894			15083		
Adjusted R^2	0.498			0.303		
Sig.	0.000			0.000		

Notes：[*] $p < 0.05$, [**] $p < 0.01$, [***] $p < 0.001$.

5. DISCUSSION

Regarding the relationship between online word-of-mouth and consultation volume, our results show that as the most representative indicator of doctors' reputation in OHC, the number of gifts has a significant positive influence on the consultation volume. The more gifts doctors receive, the greater likelihood they can attract more patients to counsel. This is because the information in OHC is asymmetric. When making decisions, patients will not only refer to the personal information of doctors, but also pay attention to the online word-of-mouth of doctors. Therefore, in order to obtain more consultation volume, doctors should pay attention to service quality and service attitude when providing consultation service so as to obtain more gifts and high praise from patients to shape good online reputation.

In terms of doctors' online vitality, the results show that the more articles doctors publish on the website, the higher 24-hour reply rate, the more patients' consultation they could attract. Before consulting a doctor, patients usually learn about their expertise by searching for medical information or articles about their illness. By publishing articles, doctors can increase the chance of presenting themselves before patients, show their professional ability to patients, and gain the trust of patients. In addition, between the time when a patient asks a doctor for advice and receives a response, there is a time gap. In our results, the positive correlation between 24-hour reply rate and consultation volume indicate that the patients who need to consult hope to receive the doctor's reply as soon as possible, and they tend to choose the doctors with a higher 24-hour reply rate. Therefore, doctors should increase their online time as much as possible and give timely replies to patients.

The relation between consulting service price and consultation volume is not a simple linear, but an inverted u-shaped unexpectedly. In OHC, most patients do not know much about medical professional information, and the consulting service price becomes an important factor which influences their choice of doctors. When making purchase decisions, people subconsciously think that higher prices is related to higher-quality products or service. Moreover, faced with their own health problems, patients are willing to accept higher prices for better medical services. Nevertheless, when the consulting service price is so high, that exceeds the price acceptance range of patients, they will consider choosing another doctor or channel. However, after paying higher consulting fees, patients will be less likely to give extra gifts [17], indirectly affecting consultation volume through doctors' online word-of-mouth. Therefore, under the condition of this inverted u-shaped relationship, we need to find an optimal balance point. The research results show that the curve which shows the relationship between the price and consultation volume reaches the peak when the consulting service price is about 300 CNY. When the consulting service price is less than 300 CNY, the consultation volume will increase with the increase of price. When the consulting service price is higher than 300 CNY, the consultation volume will decrease with the increase of price. Finally, results of the senior title group and the non-senior title group show differences in robustness tests. Online reputation plays a greater role in consultation volume of doctors with senior professional title. Although non-senior professional title medical staff do not excel in terms of professional title, they can have a greater positive effect on consultation volume through efforts to improve the vitality and set reasonable consulting price.

6. CONCLUSIONS

OHC can ease the pressure of offline medical resources well, but there is little research on how to attract patients to consult doctors online. In this paper, we analyzed the relationship between doctors' online word-of-mouth, online vitality, consulting service price and consultation volume with the multiple regression model. Our results show that in OHC, the doctor's online word-of-mouth and online vitality have significant positive impacts on consultation volume, and there is an inverted u-shaped relation between consulting service price and consultation volume. It reaches the peak when the consulting service price is about 300 CNY.

Especially, online word-of-mouth has the greatest influence on consultation volume. This paper enriches the theoretical researches on online word-of-mouth and price from the perspective of online medical service, and provides some suggestions for doctors in OHC.

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