Do Physicians' Online Activities Impact Outpatient Visits? An Examination of Online Health Communities

Completed Research Paper

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Abstract

The medical service on online health communities (OHCs) has created an additional touch point whereby physicians can interact with patients and extends physicians' service from hospitals to the online environment. As the supplement and improvement of physicians' diagnosis and treatment services, online consultation services can make full use of physicians' spare time. Despite heated debates about the pros and cons of the online services to the traditional services in the hospitals, little empirical work has been conducted to examine it. We seek to understand and measure the impacts of physicians' various activities online on their outpatient visits in the hospitals. By collecting a panel dataset from an OHC and a hospital in China, we find that participation in the OHCs leads to an increase in outpatient visits. We provide insights for physicians about how to increase patient visits in the emerging era of the Internet medical.

Keywords: Online health communities, the Internet medical, online medical services, outpatient visits, online and offline

Introduction

With the implementation of a series of policies, the application of the Internet in medical continues to grow. As an important Internet medical[1] platform, online health communities (OHCs) can meet people's growing concern for health and provide a channel for people to seek healthcare knowledge and discuss health experiences (Zhang et al. 2017). OHCs are becoming valuable platforms for physicians to provide services which are the important supplement of diagnosis and treatment services in the hospitals in their spare time (Shi 2016), such as ehealth forum, Sermo and Haodf. The market size for the Internet medical services approached 32.5 billion in 2017, with approximately 0.25 billion Internet medical users (Li 2018).

Although OHCs have developed quickly in recent years, there are still a large number of physicians and hospitals stay on the sidelines, and even disapprove. The primary concerns of hospital managers are that a) high-intensity work on OHCs may lower physicians' productivity in the hospitals as "one's energy is limited", and b) online medical services providing may exacerbate patients' difficult to access medical services in the hospitals (Wang 2014). Adding an online channel to traditional channel might bring potential channel conflict and result in one channel cannibalizing sales from the other

[1] As the integration of traditional healthcare services and IT, Internet medical is expected to fundamentally restructure the current healthcare ecosystem by leveraging rich digital information and advanced artificial intelligence technologies, and address the challenges (difficulty of access and high costs) of medical services in China.

(Montoya-Weiss et al. 2003). In China, the medical resource is insufficient and physicians also need to conduct scientific research after intense work (Sohu News 2016). Advocates argue that these third-party platforms with services based on fragment time help physicians build their brands, improve their reputation and popularity, which help attract more patients to the hospitals (Wang 2018). The provision of online services helps reach new consumers, and the potential spillover effects may result in increased purchases and decreased cost (Ward 2001). Consumers' motives in online and offline channels are often different and the multi-channel strategy is useful to match respective consumers (Kollmann et al. 2012). The combination of online and offline can improve the continuity of medical service and physician-patient interaction efficiency in the hospitals (Luan 2018).

Although the question on the benefits and drawbacks of services on OHCs to services in the hospitals engenders considerable debates among policy makers, medical organizations and physicians, little empirical work has been done to investigate it. With the rapid development of the OHCs, empirical research is needed to explore the influences of the participation in online platforms on the service demands in the hospitals. Especially, we aim to address the fundamental question about the channel effect in healthcare: *How do the physicians' activities on OHCs influence their medical service demands in the hospitals?*

Despite the strategy of using OHCs to overcome distance and time barriers has been brought up for many years (Time weekly 2016). The adoption rate of OHCs remains low in the hospitals (fewer than 50%), especially in these medium or low-rank ones. Furthermore, many managers do not hold well for the influences of OHCs on their hospitals (Wang 2014). Therefore, it is necessary to provide healthcare decision makers with a clear picture of the influences of OHCs participation on traditional hospitals.

Research background and hypotheses development

The trust-transfer theory in healthcare

The trust-transfer theory refers to a cognitive process in which a person's trust in an entity can be derived from his trust in a related entity (Stewart 2003). According to previous studies on trust transfer among entities, perceived similarity and perceived entitativity are two representative factors used in capturing the relationships between source and target (Stewart 2006; Wang et al. 2014). Perceived similarity, often referred to as perceived fit or consistency in other studies, means the extent to which users perceive that the source and target share certain internal features, thereby driving them to form similar perceptions regarding these parties (Wang et al. 2013; Yang et al. 2014). Meanwhile, perceived entitativity, also known as a business tie or perceived integration, refers to the extent to which users believe that the source and target share certain external cues, that is, the source and target may be considered as one group (Song et al. 2009; Wang et al. 2013). Therefore, given the internal and external relationships, the perceptions of users toward the target can be transferred from the experience of the source.

Some studies have examined the trust transfer process in the cross-channel context. For example, Lee et al. (2007) found that customers' trust in an offline bank significantly influenced four perceptions regarding its online banking counterpart (flow, structural assurance, perceived web satisfaction, and perceived extent of future use). By examining the formation of initial trust in mobile brokerage services, Lin et al. (2011) found that investors' trust in online brokerage services had a significant effect on their trust in the mobile divisions. Similarly, Lu et al. (2011) found that users' trust in online payment had a positive effect on their trust in mobile payment belonging to the same brand.

Trust can influence usage behavior (Liébana-Cabanillas et al. 2014) and is an important condition of a successful commercial transaction (Sharma and Lijuan 2014). Given the context of the present study, many factors need to be considered for deciding to go to hospitals for face-to-face services, such as time, cost and effort. Therefore, trust built online may promote patients to visit physicians in the hospitals.

The medical service continuity

Based on prior studies, the continuity of medical service can be explained from different perspectives (Freeman et al. 2003; Haggerty et al. 2003; Saultz 2003). For the service providers, the continuity of medical service includes a) information continuity. Relative information can be effectively transferred and shared; b) time continuity. The whole treatment process is complete; c) interpersonal relation continuity. A service provider and a service receiver need to keep understanding each other and building trust. For the service receivers, it includes a) feeling continuity. The feeling for the whole service process is coordinated and uninterrupted; b) geography continuity. The provision of medical service is not influenced by patients' geographic location.

Information technology could be used to support medical service coordination and continuity (Cipriano et al. 2013). Patients often face gaps in the information after they leave hospitals (Koru et al. 2016). The Internet helps strengthen the interconnection and intercommunication of various information systems to achieve the continuity of medical services (Liu 2018). Although the online services cannot fully meet the patients' needs as it cannot provide treatments (Wang 2017), the online services connect physicians and patients in advance, and supplement the services in the hospitals effectively (Wang 2017) by providing daily consultation and follow-up consultation. For example, since Yanda hospital in Hebei province in China has established a cooperative relationship with chunyuyisheng in 2017, the average daily number of new patients increases by 200, and patient satisfaction also increases significantly (Sohu News 2017).

Research concerning the different purchasing stages is multifarious and offers different conceptualizations of the underlying process. While some authors propose a three-stage model (Steinfield et al. 2002), consisting of a pre-purchase stage, a purchase stage, a post-purchase stage. Consider the pre-purchase stage, including information seeking and consultation, service information can be compared more easily through online channels (Gupta et al. 2004). Consider the purchase stage, the notion of risk perceptions affecting consumers' decision making is well grounded in research, with the introduction of an online channel, the occurring risks changed (Taylor 1974). The post-purchase stage is following the purchase stage and does not need decision-making. Online channel experience helps patients know physician and reduce perceived risk.

Physicians' online actions with offline impacts

While previous research has studied the relationships between online and offline channels (Brynjolfsson et al. 2003; Zentner et al. 2013), cross-channel relationships between digital and physical products (Danaher et al. 2010; Deleersnyder et al. 2002), and the impact of multichannel marketing campaigns on within- and cross-channel sales (Dinner et al. 2014; Neslin et al. 2014), and suggests that the good brands can spread across channels and the Internet has a distinct influence on offline sales (Ward 2001), little is known about the channel effect in healthcare.

This paper extends a prior work that examined the channel effect on OHCs (Wu and Lu 2017). However, they did not use real offline data to measure offline service demands, which may lead to biased results. Our study extends this stream of research by studying the impact of online service providing and offline service demands by collecting data from an OHC and a hospital in China.

Unlike other goods or services, such as books and restaurants, when it comes to medical services, the stakes are high, for both physicians and patients. In the last decades, the asymmetric information in healthcare leads to a great waste of social resources and is also an important cause of current tension between physicians and patients (Liang et al. 2017). The emergence of OHCs introduces a completely different type of information channel: a) the mandatory individual information disclosure on OHCs brings more transparency to the public. Consumers typically face uncertainties before purchases, so they often seek information from the Internet (Chevalier and Mayzlin 2006). Patients search physician information via the Internet frequently (Gorrindo and Groves 2008); b) communications between physicians and peers, feedbacks from peers are important reference for evaluation of physician quality; c) direct interaction with a physician helps the patient acquire targeted advice or treatments. Although online services help patients to some extent, services online and offline are not homogeneous (Wu and

Lu 2017). Based on the medical service continuity, we believe there is a complementary relationship between online service and offline service. Specifically, we hypothesize a positive relationship between online participation and offline service demands. By distinguishing different activities of physicians on OHCs, we develop these following hypotheses:

H1: Physicians who provide individual information on OHCs will have more demands in the hospitals.

H2: Physicians who provide online services on OHCs will have more demands in the hospitals.

Institutional Knowledge

An OHC-Haodf

One of the major data sources we use to understand the offline impacts of online actions is Haodf (www.haodf.com). Haodf is a major physician-patient interaction platform that provides diverse services in China. Its prominence is a clear reason that Haodf was chosen for this study. Haodf was launched in 2006 and currently is the biggest and most professional OHC in China. More than 582 thousand physicians' information is presented and more than 200 thousand physicians actively work on Haodf. Three main services are provided for physicians to serve patients: written (text-photo) consultation, telephone consultation, and outpatient registration service. The multiple services providing is another reason for choosing Haodf. Via the Haodf site, patients can choose from services according to their needs. There are more than 3 million non-repeat site visitors and nearly 300 thousand patients seek help every day. In 2016, Haodf established an Internet hospital—Yin Chuan intelligent internet hospital in Ningxia Hui Autonomous Region, and promote the development of Internet medical. Moreover, this platform provides comprehensive information about each physician, including authenticated individual information and patients' feedbacks, which is important for this study.

A hospital

We also collect data from one of the top-tier comprehensive hospitals in China. It has more than 7,000 workers with around 1,000 physicians. Haodf is the main platform for physicians from this hospital to provide consultation services online and few of physicians from this hospital have participated in other OHCs, which is helpful for us to get reliable results.

Methodology

Data collection

We combined data from Haodf and the hospital. On Haodf, a physician's activities include individual information providing, online services providing and others. Based on different activities of physicians on Haodf, we can empirically examine the offline impacts of different online actions.

From Haodf, We collected data on activities for each physician who worked in the hospital. We also collected each physician's individual information, including medical title, gender, education, returnee and department. Moreover, we obtained patients' feedbacks for each physician; From the hospital, we collected each physician's outpatient records with sources (make appointment in the hospital or via internet platforms). As a physician's online actions are more likely to have significant effects on patients with online medical information seeking/consultation experiences, and these patients are more likely to make appointments via the internet platforms (Wu and Lu 2017), therefore, we only included these outpatient records with appointments made via internet platforms.

We developed a program to crawl data on Haodf. In order to examine the outcomes of participation in OHCs, we follow the physician activities on Haodf from March to August 2018. We collected data for each physician on Haodf on a monthly basis (on the first day of each month). Finally, a panel dataset with 6 waves that include 672 physicians are included. From the hospital, we collected daily outpatient records for each physician from March to August 2018. We matched physicians from Haodf and the hospital by their names and departments.

Measurement

Table 1 shows the description and measurement of variables included in this paper. Figure 1 shows an example of a physician's homepage on Haodf and Figure 2 shows two physicians with a comparison for whether physician works online.

Table 1. Variable Descriptions

Variables	Definition
Dependent variables	
$OffP_{it}$	The number of offline patients for physician *i* at time *t* in the hospital.
Independent variables	
H_{it}	Whether physician *i* provides individual information at time *t* on the site.
W_{it}	Whether physician *i* provides written consultation service at time *t* on the site.
T_{it}	Whether physician *i* provides telephone consultation service at time *t* on the site.
O_{it}	Whether physician *i* provides outpatient registration service at time *t* on the site.
Control variables	
$Mtitle1_{it}/Mtitle2_{it}$	Physicians' medical skill that are evaluated by the government. Considering the proportion for physicians with different medical titles, two dummy variables are used to. *Mtitle1* with value 1 represents the chief and associate chief physician. *Mtitle2* with value 1 represents the attending physicians and others.
$Etitle1_{it}$	Dummy variable. Some physicians also work in universities and have teachers' positions. *Etitle1* with value 1 represents physician *i* is a professor or associate professor.
$Gender_i$	Dummy variable with value 1 represents male.
$Education_i$	Dummy variable with value 1 represents doctor degree.
$Returnee_i$	Dummy variable with value 1 represents physician *i* gains his graduate degree abroad.
$department_i$	Dummy variable with value 1 represents physician *i* works in a surgery department
$Recommendation_{it}$	A comprehensive indicator calculated by the site and is used to measure the medical skill, hospital level and popularity among patients on the site for physician *i* at time *t*.
P_{it}	The average price of all online services for physician *i* at time *t* on the site.

Figure 1. A Screenshot of a Physician's Homepage on Haodf

Figure 2. A comparison of physicians without and with individual information providing

The dependent variable in our model is the number of outpatient visits for physician *i* in the hospital at *t* ($OffP_{it}$). Based on the physicians' activities on Haodf, we include four independent variables—individual information providing and three kinds of online services providing. For the physician's individual information providing, we measure whether physician *i* provides his information on the site at *t*, that is, whether physician *i* open his homepage and manage it at *t* on Haodf (H_{it}); For the physician's online service providing, we measure whether physician *i* provides written consultation service (W_{it}), telephone consultation service (T_{it}), or outpatient registration service (O_{it}) at *t* on Haodf.

Control variables are introduced in the models, including medical title, gender, education, returnee, service price. Tasks in different departments have vastly different levels of complexity and interdependence which exert different physicians' behaviors and performance (Allen et al. 2003), therefore, the department that the physician works in is also controlled.

Estimation model

To address the possible endogeneity issue, we apply the panel data model to identify the influences of physicians' participation on OHCs on their outpatient visits in the hospitals. We use the following equation as the main econometric estimation model:

$$OffP_{it} = \beta_0 + \beta_1 IV_{it} + \beta_2 Time_i + \varphi X_{it} + \theta_t + \alpha_i + \varepsilon_{it}$$

Let i=1,…,N index physicians and t=1,…,M index time. β are coefficients to be estimated. *Time* is used to control the effect of time. θ_t is time-fixed effects, α_i is used to control all static factors related to each project. *IV* represent the independent variables in our study and *X* are control variables. Our study design of choosing different appropriate control groups for each online action additionally reduces the sample heterogeneity making the conditional common trend assumption more plausible.

Results

The panel data model is used to get empirical results (see Table 2 and 3). The results based on the mixed, random and fixed effect model are consistent and prove that there are significant offline impacts of online actions on OHCs. Results in Table 2 show that the number of outpatient visits of a physician is higher when the physician provides individual information (IV_H: β=0.286, p<0.01) and written consultation service (IV_W: β=0.305, p<0.01). Results in Table 3 suggest that physicians have higher outpatient visits when they provide telephone consultation service (IV_T: β=0.435, p<0.001) and outpatient registration service (IV_O: β=0.550, p<0.01) on Haodf. Hypotheses 1 and 2 are supported.

Table 2. Results for individual information and written consultation service providing

Variables		H_{it}			W_{it}		
		Mixed	Random	Fixed	Mixed	Random	Fixed

Control variables							
MTitle1	1.326^{***} (0.291)	1.358^{***} (0.229)	0.332^{***} (0.053)		1.908^{***} (0.366)	0.330^{***} (0.053)	
MTitle2	1.039 (0.287)	1.001^{***} (0.226)	0.974^{***} (0.212)		1.405^{***} (0.356)	1.002^{***} (0.214)	
Etitle1	0.255 (0.108)	0.278^{**} (0.094)	0.277^{**} (0.083)		0.284^{*} (0.127)	0.304^{***} (0.083)	
Gender	0.003 (0.086)	-0.021 (0.069)	0.008 (0.062)		-0.011 (0.078)	-0.006 (0.063)	
Education	0.017 (0.106)	-0.086 (0.087)	0.014 (0.076)		0.035 (0.107)	-0.013 (0.076)	
Returnee	-0.076 (0.103)	-0.031 (0.086)	-0.093 (0.076)		-0.051 (0.104)	-0.088 (0.077)	
Department	-0.475 (0.067)	-0.546^{***} (0.054)	-0.525^{***} (0.049)		-0.625^{***} (0.073)	-0.517^{***} (0.050)	
Recommendation	0.329^{*} (0.167)	-0.087 (0.186)	0.159 (0.123)		-0.027 (0.185)	0.155 (0.131)	
Time		1.292^{***} (0.077)	1.291^{***} (0.077)		1.276^{***} (0.134)	1.381^{***} (0.060)	
Dependent variable							
IV		0.286^{**} (0.100)	0.293^{**} (0.096)	0.285^{**} (0.100)	0.305^{*} (0.135)	0.225^{**} (0.094)	0.302^{**} (0.105)
Physician fixed effect				Yes			Yes
Time fixed effect				Yes			Yes
R-squared	0.096	0.4715	0.4819	0.4716	0.5511	0.4769	0.5012

Notes: ***p<0.001, **p<0.01, *p<0.05. Robust S.E. are in brackets.

Table 3. Results for telephone consultation and outpatient registration providing

Variables		T_{it}			O_{it}		
		Mixed	Random	Fixed	Mixed	Random	Fixed
Control variables							
$MTitle1_{it}$	1.326^{***} (0.291)	0.282^{**} (0.093)	0.336^{***} (0.053)		0.457^{***} (0.092)	0.294^{***} (0.052)	
$MTitle2_{it}$	1.039 (0.287)	1.418^{***} (0.132)	1.004^{***} (0.215)		--	1.038^{***} (0.214)	
$Etitle1_{it}$	0.255 (0.108)	0.412^{***} (0.336)	0.307^{***} (0.083)		-0.257^{*} (0.159)	0.241^{**} (0.083)	
$Gender_{it}$	0.003 (0.086)	0.049 (0.080)	-0.007 (0.063)		0.025 (0.103)	0.006 (0.063)	
$Education_{it}$	0.017 (0.106)	-0.073 (0.112)	-0.010 (0.076)		0.203^{*} (0.120)	0.028 (0.078)	
$Returnee_{it}$	-0.076 (0.103)	-0.021 (0.111)	-0.088 (0.077)		0.073 (0.146)	-0.091 (0.077)	
$Department_{it}$	-0.475 (0.067)	-0.479^{***} (0.075)	-0.530^{***} (0.050)		-0.538^{***} (0.092)	-0.511^{***} (0.049)	
$Recommendation_{it}$	0.329^{*} (0.167)	0.062 (0.219)	0.118 (0.132)		1.094^{***} (0.272)	0.178 (0.131)	
Time		1.148^{***} (0.132)	1.405^{***} (0.053)		1.043^{***} (0.221)	1.434^{***} (0.052)	1.003^{***} (0.201)
Dependent variable							
IV		0.435^{***} (0.133)	0.195^{**} (0.070)	0.400^{***} (0.113)	0.550^{**} (0.214)	0.133^{*} (0.114)	0.430^{**} (0.198)
Physician fixed effect				Yes			Yes
Time fixed effect				Yes			Yes
R-squared	0.096	0.5540	0.4769	0.5320	0.5524	0.4746	0.5520

Notes: ***p<0.001, **p<0.01, *p<0.05. Robust S.E. are in brackets.

Conclusion

In this study, we investigate the offline impacts of online action, as measured by different activities in OHCs. Our study fills an important gap in the literature by providing a understanding of the impacts of online platform participation on offline performance. We address the endogeneity concerns posted by self-selected behaviors by adopting a panel data model and establishing a robust quantitative relationship between online actions and offline performance, and all the hypotheses are supported.

Our research has the following contributions. First, our research serves as the first attempt to empirically examine the offline impacts of a physician's activities online and contributes to the emerging literature on OHCs. OHCs have become extremely popular in recent years, however, existing studies on OHCs mainly focus on exploring user behavior online (Cao et al. 2017; Guo et al. 2017; Wu and Lu 2018), and few studies have investigated the influences of physicians' participation in OHCs on their outpatient visits in the hospitals. Our research has obtained a panel dataset directly from a large OHC platform and a hospital, and discovered the cross-channel effects in healthcare.

Second, our study contributes to the literature on channel effects in healthcare. Prior studies mainly focus on channel effects in the product or other service fields (Bakos 1997; Bansal et al. 2010). Few studies have focused on service field, especially the healthcare field. Based on the differences in medical services on online and offline channels, our results have proved that there are complementary effects between online and offline services in healthcare. Services on OHCs are a complementary resource for patients.

Practically, first, we provide practical insights to physicians and hospitals in the era of Internet medical. Our findings regarding the significant positive impacts of online actions in OHCs on outpatient visits in the hospitals suggest that hospitals can improve their outpatient visits by encouraging their physicians to work on OHCs. By joining the Internet, the information asymmetry between physicians and patients can be reduced greatly. The medical service continuity (consultation, treatment, follow-up service) could be promoted and patients' experience can be improved. Internet helps increase the radiation radius and siphon capacity of the hospitals. In addition, hospitals can also establish their own OHCs as part of their service offering. Second, our findings have direct implications for the managers of OHCs. Operators of platforms could actively establish cooperative relationships with hospital managers: introduce more types of services, encourage physicians to serve more patients online, and attract more hospitals to join in OHCs. Third, our study has practical implications for policy makers. Our results provide a reference for policy makers to guide and standardize policies in healthcare to promote the development of Internet medical, such as policies on Internet hospital and multi-site practices.

Although this research has highlighted several notable findings and contributions, we acknowledge some limitations. First, although Haodf is the main platform for physicians to serve patients online in China, some physicians may also work on other OHCs and we did not obtain physicians' activities on other OHCs. Second, we cannot match patients online and offline as their information is hidden for privacy. Whether an outpatient has searched or communicated with physicians on OHCs is unknown. Therefore, even we only include these outpatients with appointments via the Internet, we are still not sure these outpatients have been influenced by OHCs. Third, we cannot exclude the case that there may exist the induced behaviors for physicians who participate in OHCs to induce patients to go to their hospitals, which may lead to bias results. Fourth, we only obtained data from an OHC and a hospital, and the results need to be carefully considered. Future research could consider the above questions in their work.

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