Exploring the influence of the online physician service delivery process on patient satisfaction

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A B S T R A C T

The vibrant and rapid advancement of Web 2.0 technologies has made it possible for online health communities to provide convenient platforms that enable patients to consult physicians online. Healthcare services are related to issues of mortality and quality of life for patients, hence studies on online healthcare services and patient satisfaction continue to be fundamentally important as healthcare practices evolve and change. Although many studies have investigated the benefits of the online health community and motivation of participants, there has been scant research on the influence of the online physician service quality with regard to patient satisfaction. This paper is based on service quality model and the customer characteristics theory, as well as the analysis of data from the online health community. It verifies that online physician service delivery processes significantly affect patient satisfaction, specifically with respect to response speed and interaction frequency. Moreover, this paper examines how a patient’s disease risk moderates the relationship between the service delivery process and satisfaction. The empirical results of this paper support all our hypotheses. This paper contributes to online service quality and e-health literature by investigating the effects of the physician service delivery process on patient satisfaction.

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1. Introduction

The Internet is transforming traditional ways of acquiring knowledge on diseases and treatments [46], particularly as people access online health communities. Online health communities have the capacity to create favorable environments in which patients can obtain information [23] and emotional support [40] that is beneficial to the improvement of their health conditions. With the development and application of Web 2.0 technology, online health communities streamline the process of finding health information and knowledge of diseases for patients [6]. Previously, communication between physicians and patients transpired mainly in physical hospital buildings, whereas patients are now able to consult physicians on health issues and the treatment of their illnesses in the online community, anytime and anywhere. The online health community provides unique levels of convenience for patients as they access information on health problems and related treatments swiftly and incurring minimal cost.

This novel platform, where physicians and patients communicate closely with each other, has two primary features that differ significantly from the traditional method of interaction between physicians and patients in actual hospitals [6]. Firstly, by reading the online text descriptions of a patient, a physician can potentially diagnose a patient’s illness without direct observation of the patient’s condition. In an online health community, a patient can choose a physician and create a post describing his/her condition, and pose questions. Based on the information provided by the patient, the physician can provide a diagnosis and subsequent treatment without direct observation of the patient’s condition. Secondly, the interaction between physicians and patients on the Internet lacks face-to-face communication. The development of the online health community observed for this paper has dramatically changed the traditional process of physician service delivery. Therefore, how physicians use this novel platform to deliver high-quality service to satisfy patients has become a significantly important issue.

With increasing consumer demand for high-quality service, service quality and consumer satisfaction have become key issues in management research [37,43,44]. In particular, as health services are related to mortality and fundamental quality of life [4], service quality and interaction between physicians and patients are of greater importance to patients than other kinds of service. However, according to a survey conducted by the China Youth Daily in 2013, 66.8% of participants stated that they neither trusted nor were satisfied with physicians’ professional services [26]. Thus, it follows that improvement of the physicians’ service quality will enhance relationships between physicians and patients.

The uncertainty of outcomes of health services translates to difficulties and uncertainties in their measurement [4]. Moreover, because online health services are intangible, heterogeneous, and inseparable,
it is impossible for researchers to focus solely on the outcomes of those services: it is necessary to study the process of service delivery itself [31].

Although numerous studies have investigated the benefits of the online health community for patients, as well as the e-service quality and interaction between consumers and service providers on the Internet [5,6,40], there is a dearth of research examining the influence of the online physician service delivery process on patient satisfaction. This paper focuses on exploring the effects of the physician service delivery process on patient satisfaction in order to fill this research gap.

In comparison to research on offline service quality, the study of online service quality is still preliminary [1]. Many new attributes have arisen in online services that markedly differ from offline services [11,20,24]. Based on the service quality theory [28,31] and the customer characteristics theory [3,13], this paper explores the effects of physicians’ online service delivery in this online health community from two perspectives: responsiveness and communication. In addition, based on the customer characteristics theory, we also investigate the moderating effects of disease risk on the relationship between physicians’ service delivery and patients’ satisfaction.

The objective of this research is to investigate the effects of the service delivery process on patient satisfaction, using data from an online health community. The main research questions are:

1. Could response speed and interaction frequency affect patient satisfaction?
2. What are the moderating effects of a patient’s disease risk on the relationship between the service delivery process and satisfaction?

This research collected 2112 physicians’ data from the “Good Physician Online” website, one of the biggest online health communities in China. We established an empirical model to test our hypotheses. The empirical results show that both online response speed and interaction frequency positively affect patients’ satisfaction. Furthermore, importantly, our results prove the moderating effects of disease risk on the relationship between service delivery process and patients’ satisfaction. The effects of physicians’ online service delivery processes are more influential to patients with high-risk disease than to patients with low-risk disease.

The contributions of this paper are threefold, as follows. Firstly, this paper contributes to online service research by expanding the service quality theory to encompass e-health research. Secondly, our research further contributes to e-health literature by exploring the effects of physicians’ service delivery process on patient satisfaction. Our study examines physicians’ process of service from two perspectives: response speed and interaction frequency. Our study provides a more customized approach to understanding the delivery process of service quality and interaction between physicians and patients. Lastly, this paper examines the moderating effect of disease risk on the relationship between online physician service delivery processes and patient satisfaction.

The rest of this paper is organized as follows. In Section 2, we review the literature on online health communities, service quality and customer characteristics. Our research model and hypotheses are presented in Section 3. We then describe data sources and the regression in Section 4. Section 5 includes the discussion of our results, the implications of our findings, the limitations of our research, and the implications for further research. Section 6 comprises our concluding comments.

2. Literature review

In this section, we examine literature on online health community, service quality and consumer’s characteristics for a better understanding of the relationship between online physician service process attributes and patient satisfaction.

2.1. Online health community

With the growth of Web 2.0 technologies, many hospitals, healthcare organizations and physicians are involving themselves in online health community utilization. This utilization can promote the interaction between physicians and patients. Moreover, these communities create a convenient platform for patients to obtain health information [40]. Previous online interactions between patients and physicians were mainly through emails and online chat rooms [6]. However, now, patients can participate in an online community where they share information with physicians and other patients [6], and physicians can deliver health services online. Thus, it offers convenience for both physicians and patients.

Extensive studies have investigated the advantages and mechanisms of online health communities. Ba and Wang have studied the effects of motivation mechanisms on participants in an online fitness community [6]. They found that networking activities and support motivated participants to do more exercise. Yan and Tan found that information and emotional support from an online health community could affect the patients’ health conditions [40]. Xiao explored the factors that could impact on patients’ online health information search [39]. Bansal investigated the factors that could affect patients to disclose health information online [7]. Although many studies have investigated the online health communities, literature that has focused on physicians’ service quality and patient satisfaction is sparse. To fill this research gap, we aim to explore the effects of physicians’ online service delivery process on patient satisfaction in this study.

2.2. Service quality and consumer satisfaction

Service quality and consumer satisfaction are indispensable for service providers’ capacity to obtain competitive strengths [9,33,41]. This is especially important in the healthcare industry, because health services relate to issues of high personal importance. Hence, the relationship between service and patient satisfaction is an issue that is of growing importance.

Previous studies on service quality provide findings relating to aspects of the service delivery process that may affect consumer satisfaction. Parasuraman [31] showed that, because services are intangible, heterogeneous, and inseparable, the intentions of the service providers may be significantly different from what the consumer receives. Thus, the process of service delivery can affect consumers’ satisfaction and evaluation regarding service quality, and the evaluation of service quality should focus on the service delivery process. Lehtinen [25] presented the fundamental idea that service quality comes from the interaction between the service provider and the consumer. Their research focused on three dimensions of service, of which interaction quality was considered the most important dimension. Gronroos [19] concluded that there are technical and functional qualities in service quality. The former type of service quality is concerned with what the consumer receives from the service provider, and the latter involves the manner of service delivery.

Service quality is considered as the result of a consumer’s expectations compared to the actual service performance [28,31]. The expectation–confirmation theory is instrumental in explaining consumers’ perceptions of service quality [28,29,45]. According to this theory, researchers have developed the service quality model and a multi-item scale called SERVQUAL to measure the service delivery process [41,42]. This theory is widely used by researchers to investigate service quality [15,20,37].

Research on online services has also received considerable attention and effort. However, since face-to-face services differ from online services in terms of fundamental quality dimensions, the established methods of measuring the offline service delivery process is not suitable for measuring the online service delivery process [16]. Researchers have developed new methods to evaluate the online service delivery.
processes, based on the unique characteristics of the Internet context. However, previous researchers of online services have mainly investigated systems and the quality of the technology used, rather than the providers’ service delivery process and interaction between service providers and consumers [28,12]. For example, studies have investigated the effects of website design on consumer satisfaction, including aspects of website navigation, information presentation, download speed, and system quality. In order to better explore the influence of the online service delivery process, more research is required. This is particularly true for “pure service industries” that involve minimal physical attributes, such as online health services. In this milieu, research should focus on the delivery process, and on interactional attributes that encapsulate the main factors influencing consumer satisfaction.

2.3. Consumer characteristics

Consumers’ characteristics fundamentally affect their perceptions of service quality and satisfaction [3,10]. Previous research has found that consumer differences have moderating effects on levels of satisfaction regarding service quality [10]. Those studies mainly focused on investigating demographic and situational characteristics that are significant in examining moderating effects [13,14,21]. Demographic characteristics refer to a consumer’s age, gender and social and economic status [3]. Situational characteristics mainly include purchase uncertainty, cost, duration of consumer relationship, and purchase importance [38].

Previous studies have mainly focused on the effects of consumer characteristics in the e-commerce context. There is little research examining the moderating effects of patients’ characteristics on the relationship between service and satisfaction. Patient characteristics relate to fitness, disease risk and health conditions. Meanwhile, those characteristics affect the purchase importance of health services. Therefore, patients’ characteristics are significantly different from traditional customers’ characteristics. To fill this research gap, this paper investigates the moderating effects of disease risk on the relationship between the online physician service delivery process and patient satisfaction.

3. Research hypotheses

The main function in the online health communities is to enable a patient to consult a physician online. In an online health community, patients present their health conditions and symptoms to the physician in the form of a text description, following which the physician responds to the patient and provides suggestions according to the patient’s description of the symptoms. The service delivery and interaction between the physician and the patient transpire via the Internet. Based on this function, this paper develops a model to examine the influence of the physician service delivery process on patient satisfaction.

3.1. The impact of physician service delivery on patient satisfaction

Service quality arises in the interaction between customers and service providers. This interactional quality (i.e., how service is delivered) is one of the most important quality dimensions [25]. Parasuraman developed a service quality model to investigate the effects of service quality, which posits two fundamental factors of service delivery process, namely, responsiveness, and communication [31].

Responsiveness involves speed of service, i.e., whether service providers give prompt service to customers [31]. For customers, service speed is important in evaluating online service [16], as it saves consumers’ time and enhances service efficiency [17]. Furthermore, previous researchers [32,34] have found that perceived service quality and satisfaction are significantly affected by service speed.

Service quality perceptions result from a comparison of consumer expectations with actual service performance [28,31]. Similarly, patients also expect the online health community to deliver efficient and high quality service when they consult a physician via this community. According to the expectation–confirmation theory [28,29], when online service process quality perceptions exceed expectations, patient will be satisfied with the physician’s service. Patients are likely to compare service quality in the online health community with traditional face-to-face healthcare. Since physicians can provide a patient with an immediate diagnosis in a face-to-face healthcare situation, patients expect that physicians in the online health community are able to present diagnoses as efficiently as in a face-to-face healthcare interaction. In other words, they expect physicians to respond to patients with immediate speed. Therefore, based on the above discussion, we hypothesize:

Hypothesis 1a. The physician’s speed hypothesis

A physician’s response speed positively affects patient’s satisfaction.

Another important factor of service delivery that impacts customer satisfaction is communication between the customer and service provider [31]. Previous studies have shown that positive patient–physician interaction could enhance patients’ satisfaction with physicians’ services [36]. Patient–physician communication involves information delivery that could assist patients to understand their health conditions and treatment [26,30,39]. Therefore, patients’ satisfaction with physicians’ services could be enhanced by positive communication between patients and physicians, to enable patients to obtain as much information and knowledge as possible from physicians [39].

The frequency of interaction between service providers and customers is one of the most significant factors that can reflect communication quality [18]. Physicians can provide patients with several communications in face-to-face situations. According to the expectation–confirmation theory, patients expect that physicians in the online health community are able to communicate as in an offline situation. Patients are likely to compare service quality in the online health community with traditional face-to-face healthcare. In other words, patients expect several communications with their physicians. Therefore, based on the above discussion, we hypothesize:

Hypothesis 1b. The interaction frequency hypothesis

The interaction frequency between a physician and a patient positively affects the patient’s satisfaction.

3.2. The moderating effects of disease risk on patient satisfaction

There are extensive studies that have investigated the effects of consumer characteristics on satisfaction with service quality [3,27,38]. Individual differences significantly impact levels of satisfaction on service quality [13]. Thus, consumer characteristics moderate the relationship between service quality and satisfaction [3]. Previous research has shown that purchase importance is one of the most important factors to reflect situational characteristics as well as affect satisfaction about service quality [38]. In the online health community, disease risk relates to purchase importance of health service for patients. Therefore, the risk of disease can explain why patients’ satisfaction with physicians’ service varies between patients.

Because of its association with mortality, the risk of disease is related to physical factors (health status and lack of fitness) and physiological factors (distress and anxiety) [35]. Due to the influence of these factors, the effects of physicians’ service quality on patients with different diseases are diverse in significant ways. Patients with high-risk diseases could be more sensitive to attributes of physicians’ services than patients with low-risk diseases. For example, a patient with heart disease needs a faster response and more detailed communication than a patient who has merely caught a cold. Moreover, patients with high-risk diseases experience more pain and distress than patients with low-risk diseases. Therefore, they are eager for higher-quality healthcare services to deal effectively with physical factors.

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In the online health community, the differences in disease risk result in different requirements for individual patients, thereby affecting the patients' perceived service and satisfaction. Patients with high-risk diseases will expect their physicians to communicate faster and in more detail. Compared to those with high-risk diseases, patients with low-risk diseases have fewer service requirements. Therefore, based on the above discussion, we hypothesize:

**Hypothesis 2a.** The response speed/patient satisfaction for high disease risk hypothesis

Response speed will be more influential on satisfaction for patients with high-risk disease than for patients with low-risk disease.

**Hypothesis 2b.** The interaction frequency/patient satisfaction for high disease risk hypothesis

Interaction frequency will be more influential on satisfaction for patients with high-risk disease than for patients with low-risk disease.

**4.1. The research context**

Our research context centers on the “Good Physician Online” website, which is the largest online health community in China. The “Good Physician Online” website was founded in 2006, and is a physician–patient interaction platform in China. Currently, the “Good Physician Online” website has information on 3233 hospitals, and provides health recommendations in 188 specialties. Thus, it represents a very valuable reference site for patients to help inform the physician selection process. Patients in increasing numbers have utilized this website to consult physicians online.

Our study uses the “Good Physician Online” website to test our proposed hypotheses. This online website possesses a number of characteristics that make it particularly suitable for testing our research model, that also distinguish it from traditional healthcare forums. Firstly, the “Good Physician Online” website has become popular with many physicians and patients. It provides abundant data for our research. Secondly, this online health community provides a platform that enables physicians and patients to communicate with each other. Patients can seek physicians for consultation, and receive the physicians’ responses based on their descriptions of their health issues. Therefore, we can examine the effects of the service delivery process.

**4.2. Data and variables**

Data was collected from the “Good Physician Online” website (www.haodf.com). We developed a JAVA program to automatically download web pages containing information on physician responses and to calculate physicians’ mean response speeds and interaction frequencies. In addition, the data was collected from 16 disease categories with 150 physicians from each category. After deletion of invalid data, we finally obtained 2112 physicians’ personal responses.

Fig. 2 shows a sample of a physician responding to patients’ questions on the website. It includes the description of the patient’s condition, physician’s reply, and times of the responses. The data was primarily obtained for 16 specific kinds of disease (the most common diseases in our research context). In addition, the patients’ ratings on online service quality were also based on the 16 kinds of diseases, i.e., coronary heart disease, hepatitis B liver disease, hypertension, hyperlipidemia, insomnia, headache, gastritis, depression, leukemia, cirrhosis, cerebral infarction, nephritis, diabetes, arrhythmia, irregular menstruation, and pancreatitis.

The dependent variable of this research is patient satisfaction. We used the ratio of the number of positive ratings to the number of patients as a proxy for patient average satisfaction rate. In this research context, the website doesn’t provide the magnitude of the rating or the number of negative ratings; it is limited to the number of positive ratings of the physician’s service quality. When patients complete their online health consultation, they have an opportunity to give ratings to the physician’s service, and positive ratings can reflect patients’ satisfaction with that online service. Therefore, the ratio of the number of positive ratings to the number of patients is a useful method to express patients’ average satisfaction rate with regard to a physician’s overall service quality.

The independent variable is the mean response speed and mean interaction frequency. We use response time as a proxy for response speed. The physician’s mean response time refers to the mean time interval between the patient’s asking time and the physician’s response time in all posts. More response time means lower response speed. The unit of response speed is one day. The mean interaction frequency refers to the physician’s mean times of interaction between a physician and patients in all posts. The specific methods to calculate the response speed and frequency are as follows:

\[
    Time = \frac{\sum_{k=1}^{m} \sum_{j=1}^{n_k} (answerTime_{\text{phys}} - askingTime_{\text{pat}})}{n_k}/m
\]

\[
    Frequency = \frac{\sum_{k=1}^{m} (n_k)}{m}
\]

For the first equation, \(n_k\) and \(m\) represent how many times a physician responded to patient \(k\) and how many posts a physician received, respectively. The response time was calculated as follows. First, we calculate the response time in one individual post by averaging that the physician’s answering time minus the patient’s asking time in one post. Next, we calculate the physician’s mean response time by averaging times for all individual posts. For the second equation, we calculated the physician’s interaction frequency by averaging all the response frequencies in one post (we calculated only the number of times of interactions between physicians and patients. If a physician or patient continuously responds to a question several times, we count only one time).

The disease risk mainly refers to the mortality of that disease for patients [22,23]. In this paper, we investigate the moderating effects of disease risk by analyzing data on eight kinds of high-risk diseases and eight kinds of low-risk diseases. Generally, diseases can be divided into two types, i.e., lethal and non-lethal diseases. It follows that we can treat lethal diseases as high-risk diseases and non-lethal diseases as low-risk diseases.

The China Health Statistics Yearbook includes the mortality and relevant data for major lethal diseases, but there is no such relevant data for non-lethal diseases, because non-lethal diseases are common in our lives, and the mortality of those diseases is so small. Nonetheless, there are still significant differences in the mortality between lethal and non-lethal diseases. According to the death rate for city patients...
patients thank physicians by giving digital gifts; similarly, after online consultation, they will give other feedback to the physician: a letter also expresses appreciation of a physician's service quality. Hence, we must control this in our research context, the website provides a useful variable that can reflect physicians' online working ethics and usage of website, i.e., the influence of the online physician service delivery process on patient satisfaction.

4.3. Model estimation

To test our hypotheses on the effectiveness of the physicians' service delivery process, we created the following empirical model. Due to the large variance in independent and dependent variables, the distribution of variables could not be normal. Therefore, the model was adjusted to a linear logarithmic model, as follows:

$$\text{Ratio}_i = a_0 + a_1 \log(\text{time}_i) + a_2 \log(\text{frequency}_i) + a_3 \log(\text{title}_i) + a_4 \log(\text{letter}_i) + a_5 \log(\text{gift}_i) + a_6 \log(\text{contribution}) + a_7 \log(\text{risk}_i) + a_8 \log(\text{risk}_i \log(\text{time}_i)) + a_9 \log(\text{risk}_i \log(\text{frequency}_i)) + u_i$$

where $a_1$ to $a_9$ are the parameters to be estimated, and $u_i$ is the error term associated with observation $i$. The title is the sum of physician ranking and academic title. The variables risk*log(time) and risk*log(frequency) are interaction terms.

4.4. Results

Table 1 presents the descriptive statistics and correlations of our major variables, including physicians' personal information, response speeds, interaction frequencies, and the ratio of the number of positive ratings to the number of patients.
Table 1
Descriptive statistics and correlations (N = 2112).

<table>
<thead>
<tr>
<th></th>
<th>M</th>
<th>SD</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
</tr>
</thead>
<tbody>
<tr>
<td>1Time</td>
<td>3.643</td>
<td>6.012</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2Frequency</td>
<td>1.692</td>
<td>1.372</td>
<td>0.090∗∗</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3Title</td>
<td>5.037</td>
<td>1.761</td>
<td>−0.097∗∗</td>
<td>0.011</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>4Gift</td>
<td>25.99</td>
<td>91.91</td>
<td>0.047∗</td>
<td>−0.019</td>
<td>−0.004</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5Letter</td>
<td>8.391</td>
<td>16.822</td>
<td>0.069∗∗</td>
<td>−0.031</td>
<td>−0.001</td>
<td>0.415∗∗</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6Contribution</td>
<td>704.3</td>
<td>1977</td>
<td>0.082∗∗</td>
<td>−0.018</td>
<td>−0.019</td>
<td>0.498∗∗</td>
<td>0.466∗∗</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7Risk</td>
<td>0.5492</td>
<td>0.4976</td>
<td>−0.008</td>
<td>0.026</td>
<td>−0.097∗∗</td>
<td>0.034</td>
<td>0.000</td>
<td>−0.055∗∗</td>
<td>1</td>
<td></td>
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<tr>
<td>8Ratio</td>
<td>0.431</td>
<td>0.224</td>
<td>−0.004</td>
<td>0.055∗</td>
<td>0.050∗</td>
<td>0.287∗∗</td>
<td>0.319∗∗</td>
<td>0.393∗∗</td>
<td>−0.019</td>
<td>1</td>
</tr>
</tbody>
</table>

*t statistics in parentheses.
∗ p < 0.1.
∗∗ p < 0.05.

Table 2 shows the results of our model estimated by ordinary least squares. We presented our model hierarchically, first showing a model with control variables only, and then introducing our independent variables and interaction terms in Columns 2 and 3. The adjusted R-square and F values were reasonable. No VIF (variance inflation factor) statistics for the variables were greater than 2.0, which indicates the absence of multicollinearity. Moreover, we accounted for heteroskedasticity and reported heteroskedasticity-consistent standard errors in all our models.

The Physician’s Speed Hypothesis (H1a) predicted that a physician’s response speed would affect patient satisfaction. According to Column 2 of Table 2, we found support for this hypothesis, because the coefficient of response time ($a_1 = -0.001, t = -2.260, p < 0.05$) is negative and statistically significant. It means that when response time increases, the average satisfaction rate will decrease. Similarly, if physicians’ response time decreases, the average satisfaction rate will increase. Therefore, the response speed has a positive effect on patient satisfaction.

The Interaction Frequency Hypothesis (H1b) predicted that the frequency of interactions between the physician and the patient will affect the patient’s satisfaction. Column 2 of Table 2 provides support for this hypothesis, because the coefficient of interaction frequency ($a_2 = 0.049, t = 9.656, p < 0.01$) is positive and statistically significant. It means that when interaction frequency increases, the average satisfaction rate will increase. Therefore, the interaction frequency has a positive effect on patient satisfaction.

The Response Speed/Patient Satisfaction for High Disease Risk Hypothesis (H2a) and the Interaction Frequency/Patient Satisfaction for High Disease Risk Hypothesis (H2b) proposed the moderating effects of disease risk on the relationship between the physician’s service delivery process, and patient satisfaction. Column 3 of Table 2 supports our two hypotheses, because the coefficients of the two interaction terms are also significant ($a_8 = -0.074, t = -4.480, p < 0.01; a_9 = 0.038, t = 3.432, p < 0.01$), indicating that disease risk positively moderates the influence of physicians’ service delivery process on patient satisfaction. The effects of response speed and interaction frequency on satisfaction of patients with high-risk diseases are more influential than that of patients with low-risk diseases. The moderating effects are illustrated in Figs. 3 and 4. Fig. 3 shows that the effects of response time on patient satisfaction were found to be significant under both the high-risk disease condition and low-risk disease condition, but the relationship was stronger under the high-risk disease condition. Fig. 4 also suggests that the effects of interaction frequency on patient satisfaction were stronger under the high-risk disease condition.

4.5. Robustness check

In order to check the robustness of our results, we divide total data into two subsamples and run the model again. We have run the analysis for each type of diseases separately (high-risk diseases and low-risk diseases), without disease risk as the moderator. The purpose of this is to validate that the main effects of response time and frequency remain robust without the moderating effects of disease risk. The results of this robustness check are presented in Table 3. They are consistent with the results of the previous model using all data with interaction terms. The response speed and interaction frequency still have significant effects on the patients’ satisfaction.

5. Discussion and implications

5.1. Discussion

In this paper, we investigated the effects of the online service delivery process on patients’ satisfaction with their physicians. We hypothesized
that, in the online health community, when the physician’s response speed is faster and the interaction between the physician and patient is more frequent, the patients who consult physicians online are more likely to be satisfied with the physician’s service. Moreover, we also hypothesized that patients’ disease risk moderates the relationship between the service delivery process and satisfaction. Using physicians’ data collected from a real online health community, we build an empirical model to test our hypotheses. However, in the estimation of our empirical model, there are potential endogeneity issues, such that some unobserved factors could affect independent and dependent variables simultaneously. Endogeneity of variables could lead to biased coefficients in the model. Therefore, in this paper, we attempt to use physicians’ contribution value, title, digital gifts, and ‘thank you’ letters as control variables to address this potential endogeneity issue. Although this approach is limited, it mitigates endogeneity concerns to some degree. The empirical results in the study provide substantial support for all of our hypotheses. The empirical results imply that the physician’s response speed is related to patient satisfaction. The faster a physician responds, the more satisfied a patient is with that physician’s online service quality. This indicates that response speed is fundamental to patient satisfaction. Since healthcare relates to a patient’s mortality and quality of life, patients need rapid service delivery. Moreover, patients may compare online service experiences to offline situations. Therefore, patients expect that physicians can deliver online service as efficiently as in offline situations.

The results relating to the frequency of interaction between physicians and patients imply that this variable is closely related to patient satisfaction. The interaction frequency is indicative of the communication quality and information flow between physicians and patients, which can help patients better understand their diseases. Therefore, frequent interactions could improve patients’ satisfaction about physicians’ online service.

Moreover, we also found that disease risk plays a role in moderating the relationship between the service delivery process and patient satisfaction. One possible explanation is that patients with different health problems require different service approaches. Patients with high-risk diseases are impacted by psychological and physiological factors relating to their health. To cope with these factors, patients with high-risk diseases need higher quality service than patients with low-risk diseases. Therefore, the effects of online service quality on patients with high-risk diseases are more influential than patients with low-risk diseases. For example, people with heart disease need faster responses and more detailed communication than patients who just have a cold.

### 5.2. Theoretical implications

Our results extend findings from online services and e-health literature while also contributing to them in several ways. Firstly, although extensive studies have examined the relationship between online service and customer satisfaction, those studies mainly focused on e-commerce contexts. A key contribution of our research is that we extend the service quality theory to online health community literature. Based on the service quality theory and the customer characteristics theory, our study adds to this research by investigating the effects of physician online service delivery on patient satisfaction. Our study provides theoretical evidence that physicians’ online service delivery process positively impacts degrees of patient satisfaction. Moreover, compared to previous research, this paper uses the more detailed variables, response speed and interaction frequency, to explore the effects of responsiveness and communication on patient satisfaction in service delivery process.

Secondly, this paper also contributes to the online health community literature. Although many studies have investigated the benefits and motivations for utilization of online health communities, there is little research on physicians’ online service quality. From two perspectives – response speed and interaction frequency – this paper explores how physicians deliver health services that satisfy their patients. This research helps us to understand physicians’ online service quality indicators and adds to the e-health service literature.
Thirdly, we investigated the moderating effects of patient disease risk on the relationship between the service delivery process and patient satisfaction. Although previous studies have explored the moderating effects of customer characteristics on the relationship between service quality and degree of customer satisfaction, traditional customer characteristics consist of components that are very different from patients’ characteristics. This paper adds to customer characteristics research by analyzing the role of disease risk in affecting the degree of patient satisfaction on physicians’ service. Our study provides theoretical evidence that disease risk moderates the relationship between physicians’ service delivery and patient satisfaction.

5.3. Practical implications

This paper shows that the online physician service delivery processes will affect patient satisfaction. Our results indicate that online health services’ quality, and thus patients’ satisfaction, can be improved via reduction of physicians’ response speed. Since a health service relates to mortality and significant quality of life issues, patients are more concerned with health service quality than other services. Physicians should, therefore, devote conscientious attention to the process of health service delivery. Physicians who use the online health community to respond to patients can enhance response speed to obtain more positive patient ratings on their health service.

Our results also indicate that the frequency of interaction between physician and patient plays a significant role in enhancing a patient’s satisfaction towards the health service they are accessing. Physicians should enquire about the patient’s condition and provide detailed answers to patients. However, because there is no face-to-face interaction in the online health community, many physicians simply deal with a patient’s questions without genuinely understanding the patient’s condition or answering the patient’s questions. Hence, physicians in online health communities should take considerable measures to improve on this vulnerability to enhance health service quality and communicate with patients with conscientious attention to detail, just as they would in a physical hospital.

Our results also emphasize that in order to enhance patient satisfaction, response speed and frequency of communication should be adapted relative to the seriousness of a patient’s disease. Our results show that patients with high-risk diseases need better health service quality than those with low-risk diseases. This point is very important for physicians in deciding how to respond to patients’ questions. For example, a patient with heart disease may require more details of the dangers faced by heart patients, and more information on treatment options, than a patient with just a cold. Therefore, physicians should bear in mind the moderating role of patient characteristics in the health service delivery process.

5.4. Limitations and future research

Although our research model uses the data from a website to verify our hypotheses, there remain some limitations. Our results are based solely on data collected from the “Good Physician Online” health community, which opens up the possibility that the findings are specific only to this context. Future research must test the validity of our results in other online health communities, in order to enact careful, critical, and appropriate extension and application of our findings to other contexts.

Furthermore, because of differences in patients’ age, gender and living area, mortality or risk of one disease for different patients is diverse. Hence, the moderating effect of risk on the relationship between service delivery process and satisfaction may be correspondingly diverse. However, without data of patients’ personal information, we recognize a lack of an accurate method to measure disease risk for every patient. In addition, there is no way to sort orders of diseases in the high risk and low risk groups, and the moderating effects of diseases in same group may also be different. Therefore, in this paper, we have been unable to explore the specific information of disease risk in the same group. Future research could develop novel approaches to efficiently measure individuals’ disease risk and thus deepen the understanding of the moderating effects of disease risk.

Thirdly, although we use control variables to mitigate our concerns relating to potential endogeneity to some degree, our method may nonetheless be limited by the limitations of our data. Future research can adopt a longitudinal perspective by using panel data, and integrating methods such as fixed effects, instrumental variables, or difference-in-difference approaches to address this endogeneity issue.

Lastly, we did not establish a control for the content of physician responses, which is very important regarding patient satisfaction with physician service quality in terms of outcome and process of service. For future research, we can use text mining techniques to explore the effects of response contents on patients’ satisfaction.

In general, given that limitations are always in existence in all research efforts, we are confident that our methodology has reduced the limitations to negligible levels.

6. Conclusion

Although the delivery processes of online health services are of great significance for patients, there is little research to investigate the effects of the physician’s online service processes on patient satisfaction. To address this research gap, we built and empirically tested a theoretical model to explore the influence of the online physician service delivery process on patient satisfaction, from the two perspectives of physician response speed and interaction frequency between physicians and patients. Moreover, this paper also investigated the moderating effects of disease risk on the relationship between physician service delivery process and patient satisfaction. We developed our research model based on the service quality theory literature, and our empirical results support all our hypotheses.

Besides the theoretical contributions, the findings of this paper also provide plenty of practical implications for both online healthcare communities as well as other online service platforms. Our results indicate that online service providers could augment online service quality and consumer satisfaction by enhancing their response speed and interaction frequency, thereby potentially attracting more consumers.

Meanwhile, platform designers could also adopt certain design approaches to ensure the quality of platform users’ (such as online service providers) online service. Our findings also suggest that those approaches to enhance the consumers’ satisfaction should be adapted with respect to the consumers’ situational characteristics, such as disease risk in our e-health setting, or purchase importance under the e-commerce context.

Overall, by investigating the relationships between the physician service delivery process and patient satisfaction, this paper offers valuable contributions to the online service and e-health research and practice.

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