The Effect of Online Reviews on Physician Demand: A Structural Model of Patient Choice

Introduction. Consumers in the healthcare market typically face uncertainty regarding the doctor’s quality, and may rely on imperfect signals to infer quality measures such as accuracy of diagnosis, bedside manner, and operational factors such as service time, waiting time, and appointment availability. By enabling large-scale distribution of information from countless other consumers, those consumer review websites can help resolve information asymmetries among a much broader peer group than has been traditionally possible. This paper provides empirical evidence on the impact of patient-generated reviews on demand in the outpatient healthcare market. We integrate and extend the advances in online marketing and healthcare operations literature, taking a step toward a more detailed understanding of patients’ choice behavior in the healthcare online markets and how it can help doctors improve the demand of outpatient care through operational strategies. The key challenges of this paper are to integrate the various sources of social media (both textual and numeric information), and leverage the aggregated level demand data into a consumer choice model. With the rapid growth and popularity of user-generated content (UGC) on the web, a new area of research has emerged that applies text mining techniques to product reviews. We have seen more and more papers in the information systems and marketing literature incorporate text information into the consumer choice models; however, limited research has looked at mining professional service reviews with operational factors and choice models in mind, and limited research in empirical operations management has utilized the information from text mining. One potential difficulty in mining doctor service reviews is deriving the operations based service features, namely, waiting time and service time. Compared to product reviews, the features for doctor service reviews have a more diverse format, due to service intangibility. Our goal here is to fill this gap by proposing a patient choice model that allows for doctors to be differentiated along multiple dimensions, contains richer distributions of taste parameters, and incorporates operational factors derived from online user-generated information.
Summary and Conclusion. In this paper, we estimate a structural consumer choice model based on a unique data set consisting of actual appointment booking data of doctors in the United States, their demographics, service characteristics, and multiple aspects of review text. We quantify the economic value of different operational and review based service characteristics of doctors, taking into consideration the two sources of consumer heterogeneity introduced by the different healthcare specialties and different doctor characteristics. Using techniques from text mining and sentiment analysis, we further derive the service characteristics that are implicitly imbedded in the text reviews. Finally, based on the estimates, we conduct multiple counterfactual experiments and propose different ways to increase potential market demand for doctors.

Our estimation results provide us with critical insights regarding how patients make outpatient doctor choices when exposed to various sources of information. We extract the seven most frequently mentioned service features from text mining of reviews, and then proceed with our BLP-type choice model. We derive the causal impact of overall ratings, as well as its interaction effects with consumer income. We then study the effects of various operational factors, namely, location flexibility, displayed appointment book slots, waiting time, and service time. Finally, we supplement our estimation with counterfactual experiments on: (i) rating change, (ii) displayed service duration change, (iii) location flexibility change, (iv) disclosure of reviewer identity, and (v) word limitation of reviews.

Our work takes an initial step toward understanding how patients choose their doctors based on online review information. However, our study still has several limitations, some of which might serve as fruitful areas for future research. First, to better understand the antecedents of consumers’ decisions, future work can look not only at transaction data but also into consumers’ browsing history and learning behavior. Our current model assumes consumers engage in optimal utility maximizing behavior; however, in reality, especially in a service industry, consumers might be involved in intention based search. For example, outpatient care appointment websites have very different browsing sequences: on some websites,
users view a doctor’s rating first and then his available appointments; on other websites, users view the appointments first and then rating. These different sequences might lead to different intention based search behaviors. By leveraging such types of browsing histories, we can build models that explicitly consider the fact that some users are utility optimizers and others simply engage in satisficing behavior. The differences in choice sequence can guide these online platforms to offer a better display service that increases consumer surplus. Furthermore, by incorporating more individual-level demographics, one could extend our techniques to infer expected utility gains at a more personalized level. This step would potentially improve the evaluation process by comparing our results with the traditional collaborative filtering or content-based algorithms.

Our model has a limited structure with regard to competition, preventing us from studying the impact of entry/exit decisions of doctors in different regions. Future work can relax this constraint. In our model, we focus on the consumer or demand side choice, but we did not explicitly model the doctor or supply side decision, that is, a doctor’s utility maximization model, and how doctor’s operational strategies can impact the ratings. Taking the doctor’s utility maximization problem into account can better capture the competition among different doctors. In this setting, we can see a dynamic structural model would be a promising direction for future work, with a focus on the supply side decisions. In our choice structure, we have not taken into account the impact of the exact time of slots, which could be an important factor for consumer choices. For example, some working professionals might only be available after 6pm on weekdays. Considering time based bundles in consumer choice might improve the prediction power of our model. Notwithstanding all these limitations, we believe our paper can pave the way for more research in this increasingly important domain.