

**Investigating the service characteristics for
specialists treating chronically ill patients
with heterogeneous utilities**

Balaraman Rajan, Tolga Tezcan, Abraham Seidmann

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Medical specialists treating chronic conditions typically face a very heterogeneous set of patients. Such heterogeneity arises because of difference in patients' medical conditions as well as the travel burden each of them faces when trying to reach the clinic. In a healthcare setting, the interaction between the specialist and the patient, or more technically the consultation time, is crucial to formulate the treatment plan. Even though a specialist might be able to cover all possible clinical aspects in a short consultation, if the specialist sees patients too fast, patients might not be satisfied with the specialist's effort [1-2].

Medical specialists, just like a service provider in almost all settings, face a trade-off: While a customer would like more time with the server, spending more time with each customer reduces the number of customers that can be served in a given time, and the slower service rate delays other customers waiting to be served. It is well known that longer waiting times reduce customer satisfaction, and more so if the waiting time is significant when compared to the actual service time. But it is only common in medical settings that patients have to wait for hours for only a few minutes of interaction.

This paper is motivated by our long-term study of the service requirements of chronically ill patients who must visit their providers periodically to manage their condition. We investigate the impact of patient heterogeneity on the strategic behavior of medical specialists in terms of their operating decisions. In addressing this problem, we expand current results in queuing theory related to the service speed-quality trade-offs for both revenue-maximizing and welfare-maximizing servers in the context of customers with a general and heterogeneous utility function.

We consider a single specialist (monopolist) in a region serving a patient base. The specialist chooses his service rate and the price he charges each patient to maximize his revenue. In response to these choices, patients decide to seek service based on their expected net utility. Each patient's utility comprises a reward from seeking treatment, waiting costs, quality costs, and payments. Patients keep joining the queue as long as their expected net utility is positive. An equilibrium is reached when no more patients have an incentive to seek treatment or obtain a positive net utility.

We find that as the relative travel burden increases for the patients, it also has a negative effect on the productivity of the specialist and his expected income. Comparing the optimal service characteristics of revenue-maximizing and welfare-maximizing specialists we see that the former will overall serve a smaller patient population, will have shorter waiting times, and will operate at a lower utilization. Also, in order to maintain quality of service, it is optimal for both kinds of specialists to accelerate the service rate at a slower pace relative to the increase in the expected patient workload.

One way to reduce the travel burden for patients is by means of remote medicine or telemedicine. Telemedicine is the use of electronic communication to improve patient health. Telemedicine can take a number of forms. There can be asynchronous information exchange, such as, when the provider is remote from the facility, as with medical diagnostics and radiology. Telemedicine can be peer-to-peer consultation (for instance, via a video-conferencing facility, as with telestroke) or it can involve direct communication between the physician and the patient.

The direct virtual communication with a specialist holds a good deal of promise, as it can offer specialist access and timely treatment to those located far from a medical practitioner or facility. In this paper, we focus on consultations related to chronic conditions, which often are required

multiple times a year to manage the underlying disease. Without these periodic visits the medical condition deteriorates. By incorporating a factor for clinical feasibility and efficiency into our analysis, we extend the basic model that we use to study the quality-speed trade-off to include the case when patients also have the option to seek treatment via telemedicine.

We prove that with the introduction of telemedicine the revenue-maximizing service rate moves closer to the socially optimal one. In addition, we establish a relatively simple necessary condition to identify when telemedicine is economically feasible. While the enhanced access to specialist care increases the overall social welfare, we explain why some patients, unexpectedly, will be even worse-off with the introduction of this technology. Our results also indicate that telemedicine benefits the specialist physicians as they enjoy higher productivity and higher revenue.

Our analytical results lead to some important policy implications for facilitating the further deployment of telemedicine in the care of chronically ill patients and to remove some of the administrative barriers for its implementation. We show that specialist physicians and patients will both benefit from telemedicine - even without any subsidies - so long as the specialists are reimbursed for telemedicine visits, even if the new (uniform) fees per face-to-face or remote visit are lower than the current fees for face-to-face office visits.

References

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