DISSERTATION PROPOSAL

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# Essays on the Interface of Health Care and Operations Management: Human Judgement, Quality and Technology

For decades, the importance of applying theories and techniques in operations management to healthcare has been recognized by many researchers and practitioners. But due to the highly human-centered characteristic and the high risk involved in healthcare, these well-established theories need to be further studied before they are "borrowed" from manufacturing or other service sectors. In response to this need, and motivated by real applications on the interface of health care and operations management, this thesis studies two important aspects of healthcare operations: (1) discretion in task completion due to human judgment and its impact on quality: we analyze a quality-based scheduling problem and a quality-centric service system respectively in the first two essays; (2) healthcare technology adoption and its link to traditional operations management strategies such as inventory theory, which is the proposed work in the third essay.

The first component of my thesis focuses on analyzing and solving a class of quality optimization scheduling problems. In many domains, such as news reporting, health care, intelligence gathering, new product research and development, the quality obtained by performing a given task will increase with how long it is executed, and the overall quality of the process depends on how effectively time and resources are allocated to various tasks. The ability to vary task durations provides another dimension of managerial flexibility, which is different from traditional purely time-based (make-span or weighted tardiness) scheduling. We formulate the quality optimization scheduling problem and prove its NP-completeness. We develop and empirically evaluate a hybrid solution procedure which integrates two components: (1) a linear programming solver for optimally setting the activity durations of a set of temporally related activities, and (2) a widely used artificial intelligence search procedure — precedence constraint posting — for resolving resource conflicts and establishing resource feasibility. The results show there exists a potential synergy between objectives of maintaining temporal flexibility and maximizing quality, which implies many existing techniques in building up flexible schedules can be adopted to solve this new problem.

The second component of my thesis focuses on the design and analysis of health care service centers in a strategic queueing setting, where customers have autonomy to decide whether to use the service center or not, based on their expectation of diagnostic accuracy and the

waiting time. Different from traditional work, in these service centers, diagnostic accuracy is a key performance measure in addition to customer waiting time. Furthermore, since longer service typically entails higher accuracy but also more congestion, the manager must decide on the optimal service depth to guide a diagnostic process between an agent and customer. Building a model on two elements — a single service queueing system and a sequential testing process, we establish structural properties of the optimal solution. The results not only confirm the previous findings in the literature: why increasing skill level may actually increase congestion; but also generate new insights such as why it may not be optimal for the manager to expand the demand in certain circumstances, and the role of the co-payment in maximizing the potential of the service center.

The third component of my thesis focuses on using an inventory analogy to model and analyze a healthcare technology adoption problem. The care management industry is moving to focus increasingly on better management of health risks and chronic conditions. In this context, one idea for improving health and reducing the economic burden is to efficiently track patients' conditions and to apply timely, cost-effective interventions in order to prevent costly and serious complications. As an emerging practice, remote monitoring technology provides opportunities of continuous monitoring patients' health conditions. Can these technological advances provide a more cost-effective way to manage the care of patients with chronic illnesses? How does it compare to other approaches? Who should pay for remote health care monitoring devices and services? Aiming to answer these questions, I propose to value the remote monitoring technology by making an analogy to traditional inventory control models and explore the potential of applying existing results in operations management to solve new problems in health care domain.