Conspicuous by Its Absence:
Diagnostic Expert Testing under Uncertainty

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Few issues in the healthcare market are more salient than the provision of diagnostic tests: an estimated 30% of medical-testing decisions are deemed inappropriate, which may entail either over- or under-provision. All too frequently, the public attention has centered around over-provision. By comparison, under-provision of diagnostic testing has been little recognized by the mass media, but is more frequently reported in the medical literature than over-provision (Zhi et al. 2013).

Motivated by the phenomenon of under-testing in the healthcare market, our paper develops an analytical lens for understanding its drivers. Specifically, we examine a physician’s diagnostic decision under both information asymmetry and diagnostic uncertainty. Consider the physician-patient encounter in a physician’s office. A patient consults with a physician about the nature of a medical problem, which may be either positive (sick) or negative (healthy). During a consultation, the physician collects and synthesizes patient history, and acquires a private signal—a “hunch”—indicative of the nature of the problem. A more competent physician is able to generate a more accurate signal of the patient’s condition. The physician does not always perform a diagnostic test, which imposes monetary and other burdens on the patient. Although a high-ability physician may enjoy various reputational benefits, her competence level may not be immediately obvious to others. However, the physician can possibly manage perceptions about her diagnostic ability by making certain diagnostic-testing decisions. Anticipating such observational learning, the physician has an opportunity to choose a diagnostic pathway (i.e., the process to reach the eventual diagnosis, which may or may not involve diagnostic testing) to influence the perception of her diagnostic ability.

In the healthcare settings, a considerable uncertainty is associated with physicians’ diagnostic accuracy. Furthermore, the difference in the skill levels across experts may not be transparent to patients (Gawande 2004). Indeed, information asymmetry plays a pivotal role in the expert’s decision-making process. The information asymmetry manifests itself in two different aspects:
the patient does not know about the diagnostic ability of the physician ex ante, which is the physician’s private information; and (2) the patient cannot observe the physician’s private signal, which the physician cannot credibly communicate to the patient.

We consider a client, whose state as assigned by nature is either positive or negative, visits a diagnostic expert to learn about her state. The expert, who can be of either high or low type, receives an informative signal of the client’s state. A high-type expert receives a more informative signal of the client’s state than a low-type one does. The expert’s type information and private signal are both unobservable to the client. The expert cares about both the client’s utility and her own reputational payoff. The expert offers a diagnosis that may be either based only on her private signal or on a diagnostic test that perfectly reveals the client’s state. The belief about the expert’s diagnostic ability or type is updated based on the diagnostic pathway the expert chooses. We model the expert’s sequential decision-making process and characterize the perfect Bayesian equilibrium; clients have prior beliefs about the type of the expert (either high or low), which are updated using the Bayes rule after observing the expert’s testing decisions. We look for separating equilibria in which the two types of experts have externally different pathways leading to the eventual diagnosis.

In this paper, we formulate a diagnostic expert’s pathway-selection problem when the clients observe these decisions and form beliefs about the expert’s skill level accordingly. We show a high-type diagnostic expert may use her diagnostic pathway to credibly inform clients of her skill level. We find that, due to information asymmetry, the high-type expert’s optimal diagnostic pathway may entail not performing the test even when the test generates a positive surplus to the clients. Furthermore, we show this type of under-testing pattern is the unique pattern allowing the high-type expert to credibly signal her type.

We have established the existence of the separating equilibrium depends on the magnitude of reputational payoff in a non-monotonic fashion: for separation between different types of experts to occur, the reputational payoff can be neither too low nor too high. The desire to be viewed as being of high ability leads to under-testing only when the expert’s reputational payoff is intermediate. Furthermore, we show under-testing may undermine the quality of service to such an extent that a low-type expert can effectively provide better services to clients than a high-type expert, particularly when the cost of the diagnostic test is sufficiently low.

We generally think of monetary incentives (e.g., fee-for-service in the healthcare service setting) as presenting a source of misalignment between an expert’s and her client’s interests. Our research provides a more balanced view: receiving additional payments for performing the diagnostic test
may induce a behavior-modification effect in experts. Specifically, although a low-type expert may be more likely to perform unnecessary diagnostic tests, a high-type expert, because of this financial incentive, may be more likely to act in the best interests of her clients, with a lower tendency to under-test. On the other hand, we also show that in some cases, providing a stronger financial incentive for performing the test may lead to more salient under-testing by the high-type expert.

Our paper represents an initial attempt to formalize the linkage between information asymmetry about expert type and the diagnostic pathway. We contribute to the service operations management literature, which focuses on the phenomenon of over-provision by diagnostic experts and identifies important drivers such as insurance structure (Dai et al. 2017), unverifiable service requirement (Debo et al. 2008), and conflicts of interest (Paç and Veeraraghavan 2015). In contrast to this stream of literature, our paper was motivated by under-provision, which is an equally important aspect in many service industries (particularly healthcare) but has not been formally modeled in this literature. Our paper also contributes to the literature on diagnostic process, including recent work by Ayvacı et al. (2016) and Deo et al. (2016). A crucial assumption separating our paper from this emerging literature is that in our model, the expert’s diagnostic accuracy is unobservable to the clients ex ante. This setting presents a compelling venue for investigating how the expert may use the diagnostic process to influence the clients’ perception of the expert’s skill level.

References


