Diagnostic Accuracy in Congested Environments

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We investigate decision-making and judgments in the context of diagnostic services. As an example, consider a triage nurse who orders diagnostic tests and makes diagnoses for patients. Accumulating information by running additional tests on a patient is likely to improve the diagnosis, and diagnostic accuracy affects the value of the service provided. However, additional tests take time and thus increase congestion in the system. The service provider (i.e., the nurse) thus needs to weigh the benefit of running an additional test against the cost of delaying the provision of services to others.

For systems without congestion, diagnostic accuracy has been well-explored in the literature on sequential hypothesis testing, both theoretically and empirically. This paper investigates the effect of congestion on diagnostic accuracy. We conduct controlled laboratory experiments to test the predictions of a formal sequential testing model that captures the key trade-off between accuracy and congestion in the context described above.

Participants in our experiments assume the role of a nurse facing a population of patients that are one of two types (*sick* or *healthy*, with a known base rate). The system moves in "time blocks", at the beginning of which either a new patient arrives or a test results come back (at known rates). At any point, the nurse can run a new test, wait for a pending test, or make a diagnosis and proceed to the next patient. Diagnostic tests are not perfect, and may produce false positives with known probability. Correct diagnoses are rewarded, and incorrect diagnoses are penalized.

To test our main hypotheses, the experimental design varies *congestion*. With congestion, the decision maker incurs a cost for every patient that is in the system at the end of a time block. Without congestion, the decision maker incurs the same cost only for the patient currently "in service".

We make several observations. Subjects capture only 75% of optimal performance (rewards from correct diagnoses, minus costs from incorrect diagnoses, minus congestion costs – expressed in per time unit terms). Generally, we observe a large number of diagnoses that are made without running any diagnostic test, as well as a significant number of diagnoses that go against test results - subjects diagnose a patient as *healthy* after receiving a positive test, even though the test shifts evidence towards the patient being *sick*. As predicted, nurses run fewer tests per patient in a system with congestion. However, and somewhat surprisingly, diagnostic accuracy decreases only marginally.