

Topics in Group Testing With Multiple Infections

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SUMMARY: Group testing, dating back to the early 1940s, was first proposed to screen for syphilis among US inductees during World War II (Dorfman, 1943). Since then, the benefits of reducing testing costs by employing group testing have been demonstrated in many areas, such as drug discovery, genetics, and infectious disease testing. Traditionally, statistical research in group testing has largely been motivated by applications involving a single infection. With the recent development of multiplex assays that can diagnose multiple infections simultaneously, generalizing the existing group testing literature to incorporate multiple infections is a natural and necessary next step. Motivated by it, this dissertation consists of three research projects that extend the usefulness of group testing to multiple infections. In Chapter 2 and Chapter 3, we propose two different testing algorithms to accommodate the use of multiplex assays. Compared to the two-stage hierarchical group testing algorithms currently employed by the Infertility Prevention Project (IPP) in Iowa, our algorithms are proven to confer significant cost savings. In Chapter 4, we propose a semi-parametric framework to estimate individual-level marginal probability of infections from multiple infections group testing data. The performance of our testing algorithms and estimation framework is evaluated through numerical study, simulation, and an application of our algorithms on chlamydia and gonorrhea data collected by four states in Federal HHS Region X and Nebraska as part of the IPP.