STATISTICAL SIGNIFICANCE

Fewer tests lead to lower health care costs and quicker diagnoses: Statisticians develop algorithms to efficiently test populations at risk for sexually transmitted diseases (STDs).

Sexual Health

CRISIS: The STD Surveillance Report for the US stated that the number of known chlamydia and gonorrhea cases as 1.7 and 0.6 million, respectively, for 2017. Thousands of more cases were likely but not reported because infected individuals are often asymptomatic. For those identified as infected, antibiotic resistance is making it more difficult to treat. In particular, there is only one remaining treatment option available for gonorrhea that is recommended by the CDC. Outside of chlamydia and gonorrhea, new STDs are becoming more prominent. This includes mycoplasma genitalium (Mgen) which has been characterized as the next "superbug" by news media outlets and has growing resistance to antibiotic treatments. Jonathan Mermin, Director of the CDC's National Center for HIV/AIDS, Viral Hepatitis, STD, and TB Prevention recently said, "We are sliding backward. ... It is evident the systems that identify, treat, and ultimately prevent STDs are strained to near-breaking point."

IDENTIFICATION: Laboratories need timely and cost-effective testing methods to identify infected individuals. For this purpose, laboratories frequently use a statistical algorithm known as *group testing* for assaying high volumes of clinical specimens. Group testing involves amalgamating a set number of specimens, such as urine or swabs, from separate individuals into a "group" that is tested as if it were only one specimen. If a group tests negatively, all individuals within it are declared disease free. Alternatively, if a group tests positively, retests are performed in an algorithmic manner to decode the positive individuals from the negative ones.

ALGORITHMS: Statisticians help laboratories choose the best group testing algorithm based on overall disease prevalence and individual-specific information, such as personal behavior and clinical observations. The goal is to choose an algorithm with a small expected number of tests but with high accuracy to identify the positive/negative individuals.

BENEFITS: In comparison to testing each specimen separately, large reductions in the number of overall tests occur when disease prevalence is small, because group sizes are chosen so that most groups test negatively. Over a recent 5-year period, Iowa's State Hygienic Laboratory reported saving $3 million by using group testing for chlamydia and gonorrhea testing.

APPLICATIONS: Group testing is applied widely in other areas, including:

- Blood donation screening
- Infectious disease detection in animals
- Estimation of virus transmission rates from insects to plants
- Detection of bacteria in food
- Discovery of chemical compounds for new pharmaceuticals
- Verification of computer network security

"Statistics detects STDs" is part of Statistical Significance, a series from the American Statistical Association documenting the contributions of statistics to our country and society. For more in this series, visit https://www.amstat.org/outreach/statsig.cfm. The American Statistical Association is the foremost professional society of statisticians, representing 19,000 scientists in industry, government and academia. This Statistical Significance was produced under the supervision of the ASA Scientific and Public Affairs Advisory Committee. All images are from the CDC's Public Health Image Library and are in the public domain.