American Journal of Epidemiology
Published by Oxford University Press on behalf of the Johns Hopkins Bloomberg School of Public Health 2020. This work is written by (a) US Government employee(s) and is in the public domain in the US.

Vol. 00, No. 00
DOI: 10.1093/aje/kwaa080
Advance Access publication:

Editorial

Editorial: Making the Best Use of Test Kits for COVID-19

Clarice R. Weinberg*

* Correspondence to Dr. Clarice R. Weinberg, Biostatistics and Computational Biology Branch, MD A3-03, National Institute of Environmental Health Sciences, P.O. Box 12233, Research Triangle Park, NC 27709 (e-mail: weinberg@niehs.nih.gov).

Initially submitted May 5, 2020; accepted for publication May 5, 2020.

Expanded molecular testing for severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) is urgently needed to enable identification of infected individuals, tracing and quarantining of their contacts, and clearing of healthy people to return to work. Unfortunately, test kits continue to be in short supply.

An ingenious strategy for screening was developed by a statistician during World War II, when the military needed an efficient way to test recruits for syphilis (1). If an assay is sensitive enough to perform well even when a positive sample is diluted by a factor of k, then specimens from k people can be combined and tested together. Those individuals would then be separately tested only if their pool tested positive. If the pool was negative, the individuals who were included in it would be presumed to be negative. Specimen pooling has been further developed for other applications in epidemiology, such as for retrospective case-control studies (2, 3) and for in silico protection of personal data in meta-analyses (4). However, the original value of Dorfman's idea as a powerful method for efficient screening is often overlooked.

If a condition is rare, this 2-stage approach can markedly improve the efficiency of screening. For example, if 1% of asymptomatic people are infected, pooled testing based on pools of 10 persons at a time would allow 1,000 people to be screened with only approximately 200 kits, which is a 5-fold improvement in efficiency. If part of each original specimen was set aside, those specimens could quickly be used to individually test persons from a positive pool. Because the molecular test for SARS-CoV-2 is based on reverse-transcriptase-polymerase chain reaction, it should work well despite the need to split the original specimens. In fact, the ability of pooled analysis to reliably detect SARS-CoV-2 in a pool comprising 1 positive specimen and up to 31 negative specimens has recently been confirmed empirically (5, 6).

Because the optimal pool size (which can readily be calculated) increases with the rarity of the condition, people should be grouped according to their estimated a priori risk of being infected. Thus, asymptomatic hospital workers and people with whom they live might need to be studied in smaller pools, perhaps of 4 persons, whereas other essential workers with public exposure (e.g., grocery store employees, bus drivers, and restaurant workers) might best be assigned to pools of 6. For people who have been under various levels of community risk and lock-down restrictions, the optimal pool size would be tailored accordingly (e.g., smaller pools for people who live in metropolitan New York, larger for those in many rural counties). The pool size could be revised and adapted to reflect actual positivity rates found in a particular category of people as the program is implemented. For example, the pool size may need to be made smaller for those who have been using public transportation. Symptomatic people should still be individually tested, as should anyone who has spent substantial time with an infected person.

Pooling could enable current lock-down restrictions to be loosened to home plus work for those who are cleared. After clearance, monitoring could be ongoing, with declining resample frequency and increasing pool size until the estimated risk has come down sufficiently; certain categories (e.g., people who live with hospital workers) would undergo more frequent retesting.

Despite the fact that pooled testing is an old idea, it has apparently rarely been implemented for coronavirus disease 19 (COVID-19) (7, 8). It's time to put Dorfman's approach to work in the broader screening context so we can all get back to work without fear.

ACKNOWLEDGMENTS

Author affiliation: Biostatistics and Computational Biology Branch, National Institute of Environmental Health Sciences, Research Triangle Park, North Carolina.

Conflict of interest: none declared.

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