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Spirometry for Assessing Work Ability and Impairment: Navigating Scylla and Charybdis

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Firefighting is a safety-sensitive profession where impaired performance can have severe consequences for the firefighter, co-workers, and the public they protect. Firefighting is physically demanding. Firefighters use heavy gear and personal protective equipment like self-contained breathing apparatus, carry heavy loads, climb stairs, and are exposed to thermal stress. One impact of these intense physical demands is that sudden cardiac death accounts for about 50% of firefighters' mortality in the line of duty (1).

To mitigate these risks, fire departments go to great lengths to ensure that firefighters are medically able to take on their challenging tasks. The National Fire Protection Association (NFPA) details extensive medical including respiratory health requirements in its *NFPA 1580 Standard for Emergency Responder Occupational Health and Wellness* (2). Requirements apply to "candidates" who have submitted applications and "members" who are already firefighters. Medical requirements are implemented consistent with the Americans with Disabilities Act, which protects those with disabilities. Candidates must pass a rigorous candidate physical ability test before potentially receiving a conditional job offer. After the job offer, they undergo a candidate medical examination. In the case of the Fire Department of New York (FDNY) medical examination includes spirometry, a stairmill exercise test and other tests. A timed run is also required (3). NFPA 1580 recommends baseline and annual examinations which include spirometry and an ongoing fitness program for members to remain in firefighting (2). Results of medical examinations are reviewed by the fire department physician, who identifies and reports job restrictions for essential job tasks to the department. The

department makes employment decisions based on this report. To protect confidentiality, details of medical test results and diagnoses are not shared without the examinee's consent.

NFPA-1580 specifies that the National Health and Nutrition Examination Survey (NHANES)-III race-specific spirometry reference equation (4) be used to interpret spirometry results. This differs from the American Thoracic Society (ATS) general recommendation in 2023 to use the Global Lung Initiative (GLI)-Global spirometry reference equation (5). GLI-Global was derived by equally weighting spirometry data from four racial/ethnic groups and does not use race/ethnicity as an input variable (6). Because the distribution of forced expiratory volume in 1 second (FEV_1) and forced vital capacity (FVC) values adjusted for age, height, and sex observed in Black populations are lower than those observed in White populations, GLI-Global predicts higher FEV_1 and FVC values (thus lower percent predicted values) for people who are Black and lower values (thus higher percent predicted values) for people who are White than race-specific equations (7). An important motivation for moving to GLI-Global is the concern that the greater percent predicted values generated for people who are Black by race-specific equations obscures the presence of respiratory disease (5). Moving to GLI-Global, which generates lower percent predicted spirometry values for people who are Black, increases the chances that they will fall below the maximum thresholds set to show sufficient impairment for medical interventions like lung transplantation or disability benefits. However, having lower percent predicted values also increases the chances of falling below minimum thresholds set to show the ability to do certain jobs. Conversely,

higher percent predicted values for people who are White are more likely to be above maximum thresholds for impairment and minimum thresholds for work ability (7,8).

Against this background, two research letters provide an important, complementary view of how transitioning from NHANES-III race-specific reference equations to the GLI-Global race-neutral equation may influence firefighter medical qualification (9,10).

Goldfarb and colleagues evaluated a large, well-characterized cohort of 9,224 FDNY candidates and demonstrated that while overall potentially disqualifying values changed modestly, reclassification using the GLI-Global equation disproportionately affected Black candidates with potentially disqualifying values more than tripling from 1.5% to 5.4% at the current threshold of 70% predicted for those without diagnosed respiratory disease (9). The impact on White candidates was much smaller, with 0.3% moving up to qualifying values. Baugh and colleagues analyzed data from nearly 11,000 candidates and incumbents tested by a health screening company providing services to departments nationwide (10). Results for candidates were qualitatively similar to Goldfarb et al., with 5.6% of Black candidates newly falling below the 70% threshold and 1.3% of non-Hispanic White candidates moving above it with a switch from NHANES-III to GLI-Global. The two equations categorized candidates and incumbents more comparably when both were set at less restrictive thresholds of 60% predicted or z-score of -2.5. Strengths of both studies are data drawn from actual candidates and members of fire departments and large sample sizes. An important limitation is that participants' outcomes related to job performance, safety events, and long-term health

outcomes are unknown. Also, both reports note that the ability of spirometry to identify these outcomes is unknown.

What are the implications of these reports for future practice? Without knowing that a change in reference equations would better identify those able to safely engage in firefighting tasks, an important priority going forward is to avoid doing harm. Like Ulysses in *the Odyssey*, we must avoid unnecessarily changing outcomes of firefighting candidates' and members' evaluations to potentially exclude individuals who are physiologically capable of safely performing essential duties on one side or missing those with meaningful impairment on the other. In the specific setting of firefighter evaluation, for purposes of continuity, it would be reasonable to continue using the NHANES-III equation. For a change to GLI-Global, data such as in these reports could be used to set thresholds that maintain continuity to the degree possible in how candidates and members are categorized. Also, it is important that spirometry results near threshold values not be used as sole determinants in making work ability determinations. Extensive additional information such as candidate physical ability tests and timed run results, exercise tests, and other medical tests are already collected for firefighters. Where appropriate, additional pulmonary function tests, chest imaging, etc., can be performed. Fire department physicians can weigh the full range of relevant information, not just spirometry, in making decisions about whether to recommend work restrictions. Ultimately, protecting both workforce fairness and public safety involves moving toward transparent, evidence-based, performance-anchored standards informed by real-world data.

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