

## National Electrocardiography Screening for Competitive Athletes: Feasible in the United States?

Sudden death in young persons, associated with participation in competitive athletics, has generated considerable visibility and concern in both the general public and medical community (1–7). Such deaths, particularly when associated with unsuspected cardiovascular disease, have become a prominent public health debate focused on strategies to prevent these catastrophes (8–11). Two primary prevention initiatives have evolved in an effort to create a safer athletic environment: preparticipation screening in athlete populations to identify the culprit diseases (3, 5, 12–17), and eligibility and disqualification standards to prohibit athletes identified with cardiovascular abnormalities from engaging in competitive sports to reduce their risk (2, 4).

The efficacy of the preparticipation screening process has been scrutinized (8, 9). Substantial contributions from investigators in Italy have energized this dialogue, reporting that the routine addition of 12-lead electrocardiography (ECG) to systematic screening of competitive sports participants reliably identified potentially fatal cardiac diseases, such as hypertrophic cardiomyopathy (12, 15).

In Italy, for the past 27 years, a mandatory national program has been used to screen all competitive athletes with a medical history, physical examination, and 12-lead ECG and disqualify those identified with various cardiovascular diseases (3, 12, 15). This program attracted heightened visibility, with an observational study from the Veneto, Italy, that reported a substantially reduced incidence of cardiovascular disease–related sudden death associated with the implementation of the national screening program (12).

In this issue, 2 groups from respected U.S. centers offer much-needed data relevant to screening with ECG, an area impaired by a paucity of evidence. In a study of 510 collegiate student–athletes, Baggish and colleagues (18) report that screening with ECG enhanced sensitivity and negative predictive accuracy (compared with history and physical examination alone) for detection of cardiovascular abnormalities; however, this strategy was also associated with a high rate of false-positive results. In a detailed economic analysis, Wheeler and coworkers (19) present a construct supporting the cost-efficacy of ECG in screening athletes for cardiovascular disease.

Although mass ECG screening has its proponents (8) (largely in Europe [3]), it is useful to dissect this issue without bias from all perspectives by focusing on resources, implementation, and societal influences relevant to translating the Italian model to the very different U.S. health care system. Screening of general populations for diseases responsible for sudden death in athletes (7) is a far more

complex venture than it might seem initially. Excessively simplistic conclusions about screening are reminiscent of the allegory in which 6 blind men come in contact with different parts of an elephant and each is convinced that their interpretation is correct without realizing that they are describing only one part of the animal, and none of them is completely accurate.

### MANDATED SCREENING

Considerable confusion about screening with ECG persists, and it is important to first frame what has become a complex debate. Italian preparticipation screening with ECG is a federally subsidized program required of all athletes (aged 12 to 35 years) and anchored in Italian law (2, 3, 12, 15)—which is much different from the United States, in which history and physical examination screening without additional testing is customary practice (5, 13, 14). A multitude of factors reinforce the impracticality of creating such a massive and expensive governmental program within the U.S. medical system, confined to only athletes and administered long-term.

First, the U.S. population is 300 million, with an athlete population of an estimated 15 million—who largely participate in high school and college sports programs—easily exceeding that in Italy (about 6 million athletes). An ambitious screening program limited to young persons who choose organized sports would probably be regarded as exclusionary and discriminatory because most sudden deaths due to genetic heart disease occur in nonathletes. Therefore, any systematic program with ECG screening would probably require the participation of all children in the United States (there are 75 million persons younger than 18 years).

Second, although sudden deaths of young athletes are tragic, these are uncommon events in the United States—fewer than 100 annually (7) or 1 in 220 000 participants (20), with a low event rate no different from that in the Veneto region of Italy over the past 11 years (11).

Third, as noted (18), inclusion of ECGs may lead to screening with low specificity and positive predictive value, as well as a high rate of false-positive ECG results (10% to 20% [5, 9, 16, 21, 22] and 17% [18]) requiring extensive noninvasive testing that would unavoidably promote inappropriate disqualifications, unnecessary anxiety, and possibly chaos in a national program (5). False-negative ECG results may also occur, particularly in young athletes with hypertrophic cardiomyopathy or congenital coronary artery anomalies (5, 22, 23).

Fourth, although it is impossible to assign a monetary value to the life of a young athlete and despite the interesting data from Wheeler and coworkers (19) and the rel-

atively low mortality rate (7, 11), cost-efficacy considerations will inevitably persist in this dialogue. The American Heart Association's panel estimated that the initial annual cost of a national screening program would be about \$2 billion (5).

Fifth, certain societal, cultural, and legal considerations may limit acceptance of mandatory screening, including the inevitable perception by some that disqualification from sports represents an infringement on individual liberty and the freedom to assume personal risks, even for sudden death. Also deserving of consideration is the potential exposure to legal liability for examining physicians who (under the Italian model) are responsible for establishing diagnosis and enforcing disqualification. Such circumstances would inevitably lead to federal lawsuits disputing disqualification decisions, with U.S. physicians positioned as defendants.

Finally, and perhaps most important, is the matter of resources and logistics. It is underappreciated that the Italian program is workable largely because of the availability of a dedicated cadre of primary care sports medicine physicians (without in-hospital postgraduate training) who have formal responsibilities that are confined to evaluating athletes for sports eligibility. Such physician resources simply do not exist in the United States (or probably any other country), and consequently, a nationwide screening program would create substantial additional burden to an already overworked and overcommitted physician workforce.

## INDIVIDUAL SCREENING INITIATIVES

Although the American Heart Association's consensus panel (5) does not endorse mandatory ECG screening for all competitive athletes, it does not discourage less ambitious screening initiatives in individual high schools, colleges, and local communities, as reported by Baggish and colleagues (18) for the intercollegiate athletic program at Harvard University. Some programs in universities (16, 17), certain professional sports in the United States (for example, basketball and football [24, 25]), and some European Olympic teams (6) have selectively undertaken routine ECG screening. Of course, many of the aforementioned obstacles to mass screening nationally are also relevant to regional or local initiatives, not the least of which are false-positive test results and the challenge of recruiting long-term financial and manpower commitments.

## CONCLUSION

Prevention of sudden death due largely to congenital and genetic cardiovascular diseases in young, trained athletes has become a highly visible and controversial public health and societal issue, albeit a deceptively complex one involving diverse clinical practice disciplines. However, convincing solutions continue to be elusive. The attraction of the Italian screening model is perhaps understandable, given that ECG is a relatively simple and inexpensive test

that the medical community is comfortable in performing. However, on closer inspection, when even such an apparently "simple" test is applied to large, healthy populations, important limitations become obvious, temporizing initial enthusiasm with prudent restraint. At this time, the aforementioned obstacles probably prohibit the creation of a mandatory, systematic preparticipation screening program with ECGs confined to young persons in competitive sports in the United States.

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#### DISCLOSURE OF CONFLICTS OF INTEREST

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