Electrocardiogram testing during athletic preparticipation physical examinations

O'Connor DP, Knoblauch MA

Record Status
This is a critical abstract of an economic evaluation that meets the criteria for inclusion on NHS EED. Each abstract contains a brief summary of the methods, the results and conclusions followed by a detailed critical assessment on the reliability of the study and the conclusions drawn.

CRD summary
This study examined the cost-effectiveness of electrocardiogram screening compared with conventional mass screening during examinations before athletic participation to detect underlying cardiac abnormalities and reduce the incidence of sudden cardiac death in high-school athletes. The authors concluded that mass electrocardiogram screening was very expensive and that testing only those at high risk of cardiac abnormalities improved its cost-effectiveness. The study had some methodological limitations and caution is required when assessing the validity of the authors' conclusions.

Type of economic evaluation
Cost-effectiveness analysis

Study objective
The objective was to examine the cost-effectiveness of electrocardiogram (ECG) screening during examinations before athletic participation to detect underlying cardiac abnormalities and reduce the incidence of sudden cardiac death in high-school athletes.

Interventions
The intervention of resting 12-lead electrocardiographic screening during high-school pre-participation physical examinations was compared with conventional mass pre-participation examinations alone (consisting of a thorough medical history with a dynamic cardiac evaluation as recommended by the American Heart Association).

Location/setting
USA/primary care.

Methods
Analytical approach:
The analysis was based on a simulation model. The authors did not explicitly report which perspective was adopted in the study.

Effectiveness data:
The clinical data were estimated using two approaches. The PubMed database was searched to identify data on sensitivity and specificity of screening, which were the key inputs for the model. Other epidemiological inputs were based on a selection of relevant studies. For example, the population data for male and female participation in public high-school athletics were from the National Federation of High School Associations 2006 to 2007 rates, while the ethnic participation was based on US Census Bureau School Enrollment statistics.

Monetary benefit and utility valuations:
Not considered.

Measure of benefit:
Life-years and cases of cardiac abnormalities were the summary benefit measures.

Cost data:
The economic analysis included the costs of screening (ECG and onsite history plus physical examination) and the costs of follow-up cardiology examination (office visit and echocardiogram) for all athletes with positive ECG findings. The quantities of resources used were assumed on the basis of the screening strategy. The costs were estimated using
Medicare reimbursement rates. All costs were in US dollars ($).

Analysis of uncertainty:
Not investigated.

Results
For a population of 1,835,727 athletes, the total costs of including ECG in pre-participation examinations were $126,392,333, with 3,524 additional true-positive cases, 288,686 additional false-positive cases, and 112,677 life-years gained.

In comparison with conventional mass screening, the incremental cost per life-year gained with ECG screening was $2,693 in the overall population ($286 in Black males, $879 in White males, $1,470 in Black females, and $6,359 in White females). The incremental cost per case identified with ECG screening was $100,827 in the overall population ($10,663 in Black males, $33,294 in White males, $55,023 in Black females, and $241,089 in White females).

Authors’ conclusions
The authors concluded that mass ECG screening during examinations before athletic participation was very expensive due to the low positive predictive value and high follow-up costs. Testing only those athletes at high risk of cardiac abnormalities (males, especially African American) improved the cost-effectiveness of screening.

CRD commentary
Interventions:
The rationale for the selection of the comparators was clear, as the ECG was added to the conventional screening strategy, which was based on the 12-item American Heart Association cardiovascular history and physical examination.

Effectiveness/benefits:
Some of the clinical evidence came from a literature review, but its methods and conduct were not reported. More detailed information on the design and other key characteristics of the studies found in the literature would have been helpful in judging the validity of the clinical inputs. High variability was found in accuracy for the ECG, but uncertainty in this parameter was not considered. Both benefit measures were appropriate for measuring the impact of the disease on patient health. A measure incorporating the impact of the interventions on quality of life would have been interesting, as acknowledged by the authors.

Costs:
The authors did not explicitly report the perspective of the study, but the use of Medicare reimbursement rates suggested the adoption of a third-party payer’s perspective. The unit costs were reported for key items, allowing replication of the analysis in other settings. The price year was not clearly reported, but appears to have been 2009. The data sources were clearly stated. The cost estimates were specific to the study setting and no statistical analysis of the variability of these costs was carried out.

Analysis and results:
The results were not presented extensively; the costs and benefits associated with the comparator were not clearly reported. Incremental cost-effectiveness ratios were appropriately calculated to synthesise the economic and clinical outcomes of the two screening strategies. The authors did not carry out a sensitivity analysis to consider the uncertainty. They acknowledged some limitations of their analysis and these mainly related to the use of data from multiple sources and the high variability in these findings. The time horizon was not clearly reported, but appears to have been the individuals’ lifetime. It was unclear whether a discount rate was applied to the costs and benefits and this would have been necessary for a lifetime horizon. The authors’ conclusions focused on the strong budget impact of using ECG in the whole high-school population, but the intervention appears to have been a cost-effective strategy. The results cannot be easily transferred to other settings, as no sensitivity analysis was conducted.

Concluding remarks:
The study had some methodological limitations and the uncertainty was not investigated. Caution is required when assessing the validity of the authors’ conclusions.
Since this abstract was published the author has asked us to point out the following:

The primary purpose of the paper was to estimate the effectiveness of ECG use during athletic PPEs and the main finding was that large-scale ECG screening is likely to be inefficient because of the expected high rate of false positive tests in that population, requiring further clinical testing (and risks and expenses) in persons that are perfectly healthy. ECG should not be used in isolation for screening, but should be combined with other screening methods and used primarily in high-risk populations rather than indiscriminately for all student athletes. The cost analyses were secondary to the primary purpose of the research and were used only to provide tangible examples and were not intended to inform policy or practice. Therefore the paper was not a cost-effectiveness analysis in the strict sense of the word and this explains many of the criticisms made in the economic sections of the abstract.

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