Disease Screening in the 21st Century: Is it Viable and What are the Tools?

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Synopsis
There is a general misunderstanding in the populace, and even among many knowledgeable physicians, about the validity of screening asymptomatic individuals for disease. The lay media and marketing forces have projected screening as inevitably positive, however, the success of screening depends on a complex interplay of factors. This presentation focuses on some of the pitfalls of screening and why technologies fail to succeed in a screening role. It will consider the prospects for magnetic resonance as a screening technology, evaluate advances in biology and technology that may enhance the likelihood of success, and chart a path for evaluating MR screening.

"Screening" is the systematic testing of asymptomatic individuals with respect to some target disease. The purpose of screening is to prevent, interrupt, or delay the development of advanced disease in the subset of screened individuals who have a pre-clinical form of the target disease.

Given this definition, there are two pre-conditions for screening to be effective: 1. screening must promote diagnosis at an earlier point in time; and 2. treatment for earlier disease must be more effective or less harmful than treatment for later disease (this is the part often forgotten by screening advocates). In addition, if screening is to be considered for the general population, there must be a favorable balance between the benefits of screening and the costs and harm to patients (largely through false negative and false positive diagnoses) of conducting the screening.

Screening is more likely to be effective under certain conditions. These include: the test being non-invasive with few and innocuous side effects, highly sensitive and specific, inexpensive, and generally available; the target disease being highly prevalent and causing severe morbidity/mortality; the target disease having a long pre-clinical phase; and available treatment for the target disease that is effective against the early stages of the condition.

The foregoing provides the reader with a sense of the complexity inherent in attempting to divine the value of a technology as a screening test. Evaluating a technology that has shown some promise in this regard is just as exacting. This because case series and cohort studies (often called "observational" studies) demonstrating that a technology performs well for such intermediate endpoints as finding smaller and earlier stage tumors are incapable of determining the only truly important question with regards to screening technologies: Does screening with the technology reduce mortality (the death rate) due to the target disease. With regard to this question, only randomized clinical trials (RCTs) are capable of producing convincing evidence, because only RCTs overcome important "lead-time", "length", and "overdiagnosis" biases that inevitably bedevil observational studies and make their results appear more positive than is really the case.

The presentation will specifically consider magnetic resonance (MR) as a screening technology in the context of the pre-conditions for success detailed above. It will consider advances in biology and technology that may eventually facilitate making MR screening a societally cost-effective option in an increasingly "value-conscious" policy-making milieu. Finally, the presenter will attempt to chart a path for evaluating MR as a screening technology.