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Lung Cancer Screening: A Cost-Effective Public Health Imperative

See also Frank, p. 1276; Weissman and Howard, p. 1290; Mulshine, p. 1294; and Markowitz et al., p. 1296.

Lung and bronchus cancer cause the most deaths of all cancers and account for about one quarter of US cancer deaths. The five-year survival rate (portion of people still living five years after their initial diagnosis) for lung and bronchus cancer is only 18.6%[1]; however, 88% of those with screen-detected stage I cancer are alive 10 years after diagnosis.[2] Screenings that increase early detection of lung and bronchus cancer will decrease mortality, which makes low-dose computerized tomography (CT) screening a public health imperative.

Traditionally, physician-based medicine focused on treating conditions, whereas public health focused on preventing or controlling disease. Today, the distinction is blurred; physician quality assessments often include metrics on the portion of their patients who receive guideline-based screening. However, the dismal uptake of low-dose CT screening through physician-focused efforts suggests that the public health community needs to champion low-dose CT screening and embrace its cost-effectiveness.

ESTABLISHED BENEFITS OF SCREENING

In this issue of *AJPH*, Markowitz et al. (p. 1296) offers additional evidence that lung and bronchus cancer is detectable at early stages with low-dose CT. Low-dose CT screening is recommended by the US Preventive Services Task Force, and its effectiveness in reducing mortality among high-risk populations has been established by randomized controlled trials, cohort studies, and actuarial studies. Low-dose CT screening can also identify other modifiable conditions associated with smoking—specifically, chronic obstructive pulmonary disease and coronary artery disease.[3] The scan is not invasive or painful, and research shows that the few false-positive results are rarely harmful.[4]

Markowitz et al.'s article extends the well-established benefits of low-dose CT screening to an occupational hazard cohort; the context is worksite-screening efforts. The authors have provided important evidence that (1) worksite programs' health promotion of low-dose CT screening is effective, especially for union-supported health programs; (2) low-dose CT screening programs in rural areas can be effective; and (3) the practical program's results are similar to those of randomized controlled trials. Worksite health initiatives are not new,[5] but this demonstration that worksite-related low-dose CT screening can be effective is important, because the usual medical settings have been frustratingly slow to adopt low-dose CT screening.

OVERCOMING ACCESS BARRIERS

In an effort to remove cost barriers, health insurance policies usually are required to cover screenings recommended by the US Preventive Services Task Force for individuals deemed to be at elevated risk based on age, gender, and other characteristics. Covered screenings include mammograms; cervical, colorectal, and prostate cancer screening; and sexually transmitted infection screening. Medicare and commercial insurance cover low-dose CT for adults aged 55 to 80 who have an elevated risk for lung cancer, but individuals can face access barriers through lack of awareness or excessively narrow at-risk criteria.

Markowitz et al.'s findings support widening the criteria for defining the at-risk population that should be provided low-dose chest CT screening, particularly the smoking "time since quitting" criteria—30.3% of lung cancer detected in Markowitz et al.'s study occurred in individuals who had quit smoking at least 15 years earlier, which would have excluded them from screening based on National Lung Screening Trial criteria. Widening these criteria will increase the population eligible for insurance-covered screening.

Lung cancer deaths could become a "disease of the poor" through lack of screening

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awareness; people with higher socioeconomic status (SES) are more likely to access screenings and have their lung cancer detected early and cured. Lower SES is associated with increased likelihood of smoking and lung cancer and lower access to preventive medical care, including screening. Fortunately, Markowitz et al.'s study of a largely rural blue-collar cohort shows that the SES barrier can be overcome for low-dose CT screening. Additionally, if low-dose CT screening were promoted by public health campaigns, more people would become aware of its existence and whether they may fall into a high-risk category; individuals of all SES levels would be more able to advocate for themselves and request this test.

IMPROVED TECHNOLOGY AND MARKET AVAILABILITY

Although history is not a focus of their article, Markowitz et al. capture an amazing transition in the progress of low-dose CT screening technology. The first patients enrolled in 2000, not long after the groundbreaking 1999 *Lancet* publication (https://doi.org/10.1016/S0140-6736(99)06093-6) indicating early detection of lung cancer through CT scans. At the beginning of the nuclear worker program, CT scans were conducted on single-slice CT scanners, and later scans used 16-slice machines; in 2018, 64- and 128-slice machines are commonplace.

Technology advances and increased market penetration coincided with lower costs for imaging: in 2007, the Medicare fee for a CT scan of the thorax without contrast (CPT 71250) was $189.54; by 2018, that fee had declined to $165.96.[6] Future advances in imaging analytics may further reduce cost and make low-dose CT screening even more cost-effective.

COST-EFFECTIVENESS OF SCREENING

Numerous studies have reported the cost-effectiveness of low-dose CT screening. The particular factors used can vary dramatically by study but generally consider the following.

- Cost of the intervention: some screenings (e.g., neonatal genetic testing) may be done once, but for lung cancer, the screening is annual for many years.
- Cost of follow-up, including cancer treatment, relative to the status quo.
- Effects relative to the status quo, including life extension and avoided treatments: commonly, effects are measured in quality-adjusted life-years, a simple ratio that purports to quantify patients' subjective views of outcomes, although we believe that this measure oversimplifies multidimensional values.
- Time value of money: discounting future spending to the value of current dollars (present value calculation) is commonly done, but many analyses ignore intractable medical inflation.

Despite considerable differences in modeling techniques, assumptions, standards, and national settings,[7] virtually all recent studies conclude that low-dose CT screening is cost-effective.

In our experience, cost-benefit and cost-effectiveness studies typically overemphasize clinical details of an intervention but often lack necessary rigor regarding costs. Even when studies are conducted in real-world settings, such as in nuclear weapons workers, it is often difficult to integrate such information directly into cost analyses. For example, when the study started, CT scanners were brought to individual worksites on flatbed trucks (an expensive proposition), because low-dose CT technology was not widely available in rural areas; the cost-effectiveness of this study would have greatly improved over time as they transitioned participants to newly established local screening facilities.

Because of the limitations of observational and randomized studies, high-quality population-based cost-benefit and cost-effectiveness studies of screening combine data from multiple sources, including real-world data, prices from a relevant payer, and outcomes from observational or randomized trials. Modeling outcomes over long durations is mandatory, because society cannot wait to observe outcomes over decades before acting to address lung cancer. All recent cost studies of low-dose CT screening combine data from multiple sources, and despite different inputs, all come to the same basic conclusion: low-dose CT screening is highly cost-effective.

WIDENING THE ELIGIBLE POPULATION

Studies such as Markowitz et al.'s indicate that low-dose CT screening for at-risk populations can be successful in promoting early diagnosis; furthermore, the yield rate of early-stage cancers supports cost-effectiveness. This study adds to the body of evidence supporting low-dose CT screening as a public health imperative. Ignoring or limiting access to a test that can reduce morbidity and mortality at a reasonable cost is directly antithetical to the aims of public health and to the field of medicine. As stated by Hippocrates (*Epidemics, Book I, Section II;* http://classics.mit.edu/Hippocrates/epidemics.1.i.html): "have two special objects in view with regard to disease, namely, to do good or to do no harm." Low-dose CT screening achieves both. AJPH

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