



Economic Considerations in Lung Cancer Screening

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Agenda

- Role of Economic Evaluation in Lung Cancer Screening
- Types of Economic Evaluations in Lung Cancer Screening
- Findings of Economic Evaluations in Lung Cancer Screening
- Key Uncertainties
- Future Directions

Role of Economic Evaluation

- ‘Comparison of alternative options in terms of costs and consequences’¹
- Medical decision-making, heuristics, and bias²
- Finite resources for lung cancer screening
 - Technology, personnel, centers
- Economic evaluation methods...
 - Can synthesize data from multiple sources
 - Make assumptions explicit
 - Quantify the decision parameters
 - Allow systematic evaluation of uncertainty

Cost-Effectiveness Analysis (CEA)

- ‘Compares the relative value of different interventions in creating better health and/or longer life’¹
- Measure of effectiveness is typically life years or quality-adjusted life years¹
 - Life Years (LY)=Years of survival
 - Quality-Adjusted Life Years (QALYs)=Duration and quality of survival expressed in a single metric
- Willingness to pay threshold
 - Cost per QALY gained is compared vs. a standard threshold to assess level of value¹
 - Typically \$100,000 per QALY gained, but a range of \$50,000-\$200,000/QALY is often explored²

¹Gold et al., *Cost-Effectiveness in Health & Medicine*, 1996; ²Neumann, *NEJM*, 2015

Budget Impact Analysis (BIA)

- ‘Evaluation of the expected changes in the expenditure of a health care system after the adoption of a new intervention’¹
- Compares a scenario with coverage of the new intervention vs. a scenario without coverage of the new intervention¹
- Results are typically presented as total budget impact to the health care system and per-member per-month budget impact
- Finite resources → Implementing high-value medical technologies and strategies will lead to an increased budget unless costs are offset elsewhere

National Lung Screening Trial (NLST) CEA

The NEW ENGLAND JOURNAL of MEDICINE

ORIGINAL ARTICLE

Cost-Effectiveness of CT Screening in the National Lung Screening Trial

William C. Black, M.D., Ilana F. Gareen, Ph.D., Samir S. Soneji, Ph.D.,
JoRean D. Sicks, M.S., Emmett B. Keeler, Ph.D., Denise R. Aberle, M.D.,
Arash Naeim, M.D., Timothy R. Church, Ph.D., Gerard A. Silvestri, M.D.,
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for the National Lung Screening Trial Research Team*

NLST CEA: Methods

- Objective: To assess the cost-effectiveness of lung cancer screening with low-dose CT (vs. no screening) as performed in the NLST.
- Screening in 55-74 with ≥ 30 smoking pack years & current smoker or quit in the past 15 years
- Analysis takes a U.S. societal perspective over a lifetime horizon
- Evaluation limited to 3 annual screening rounds (from NLST)

NLST CEA: Primary Results

Strategy	Life Years	QALYs	Total Cost	Cost Per Life Year	Cost Per QALY
Low-Dose CT	14.7386	10.9692	\$3,074	-	-
No Screening	14.7071	10.9491	\$1,443	-	-
Difference	0.0315	0.0201	\$1,631	\$51,778	\$81,144

- \$1,631 increase in cost with screening
- 7 day gain in QALYs with screening
- \$81,144 per QALY gained generally considered a 'moderate' level of value

NLST CEA: Sensitivity Analysis Results

- The cost per QALY gained approached or exceeded \$100,000 when:
 - Future health care costs were included
 - When costs for the screening examination, follow-up, or surgery were increased
 - When the pessimistic expectations of survival with stage IA non–small cell lung cancer were assumed
 - When small reductions in quality of life related to positive screening results and a diagnosis of stage IA lung cancer were included

NLST CEA: Sub-Group Results

Table 4. Incremental Costs According to Subgroups.

Characteristic	No. of Participants	Incremental Costs	Incremental QALYs	Cost per QALY
		U.S. \$	QALY	U.S. \$
Sex				
Male	31,446	1,683	0.0115	147,000
Female	21,856	1,557	0.0340	46,000
Age at entry				
55–59 yr	22,773	1,541	0.0101	152,000
60–64 yr	16,333	1,520	0.0320	48,000
65–69 yr	9,504	1,900	0.0351	54,000
70–74 yr	4,685	1,905	0.0163	117,000
Smoking status				
Former	27,643	1,661	0.0027	615,000
Current	25,659	1,601	0.0369	43,000
Risk of lung cancer				
First quintile	10,660	1,453	0.0086	169,000
Second quintile	10,661	1,454	0.0118	123,000
Third quintile	10,660	1,651	0.0061	269,000
Fourth quintile	10,661	1,672	0.0515	32,000
Fifth quintile	10,660	1,851	0.0354	52,000

NLST CEA: Key Points

- Overall, the NLST approach to LDCT lung cancer screening is a moderately cost-effective alternative to no screening
- Cost-effectiveness varied greatly by gender, age, smoking status, and lung cancer risk level
- Results are limited to 3 annual screening rounds, do not reflect Lung-RADS management, and do not consider the potential impacts of smoking cessation
- Based on outcomes at academic centers involved in the NLST

Medicare BIA

Health Care Delivery

Original Contribution

Projected Clinical, Resource Use, and Fiscal Impacts of Implementing Low-Dose Computed Tomography Lung Cancer Screening in Medicare

By Joshua A. Roth, PhD, MHA, Sean D. Sullivan, PhD, Bernardo H.L. Goulart, MD, MS, Arliene Ravelo, MPH, Joanna C. Sanderson, PharmD, MS, and Scott D. Ramsey, MD, PhD

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Medicare BIA: Methods

- Objective: To project the 5-year clinical, resource, and budget impacts of implementing LDCT lung cancer screening in Medicare
- Screening in 55-77 with ≥ 30 smoking pack years & current smoker or quit in the past 15 years
 - Estimated 9m Americans are eligible \rightarrow 6m are Medicare beneficiaries
- Analysis takes a Medicare perspective over a 5-year horizon
- Analysis assumes gradual uptake of LDCT screening over the model time horizon
 - 15% of eligible screened in 2015 to 63% in 2019

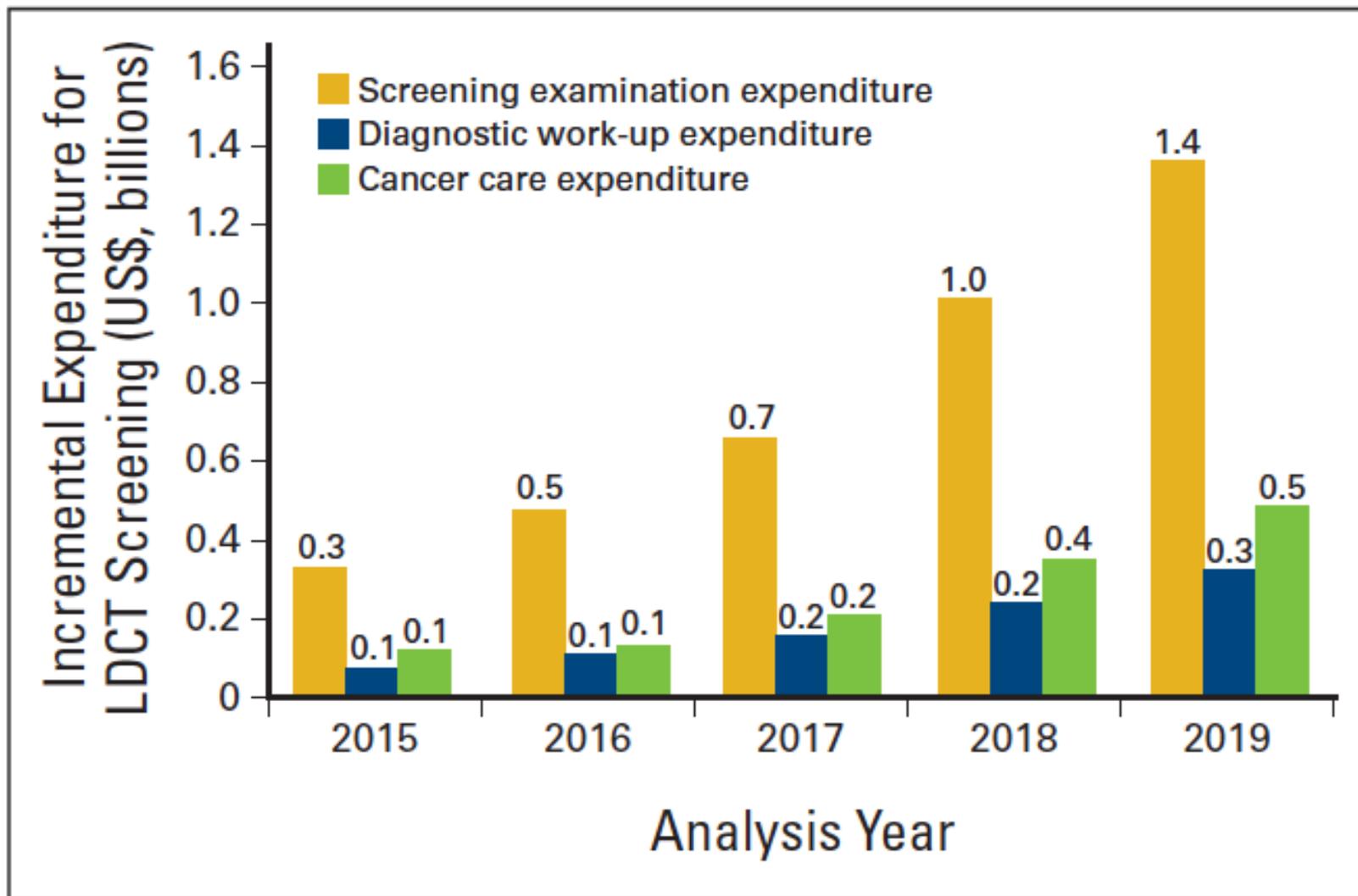
Medicare BIA: Primary Results

Strategy	Screening Cost	Diagnostic Cost	Cancer Care Cost	Total Cost	Per-Enrollee Per-Month Cost
Low-Dose CT	\$4.3 B	\$1.3 B	\$18.3 B	\$24.0 B	-
No Screening	\$0.0 B	\$0.3 B	\$16.9 B	\$17.2 B	-
Difference	\$4.3 B	\$1.0 B	\$1.5 B	\$6.8 B	\$2.22

B=Billion

- Results are reported for the Medicare program
- \$6.8 billion increase in Medicare budget expected over 5 years by covering LDCT screening
- \$2.22 per-enrollee per-month budget impact over 5 years

Medicare BIA: Drivers of Expenditure



Medicare BIA: Key Points

- Over a 5-year period, LDCT lung cancer screening in Medicare is expected to result in:
 - More lung cancers detected (+55,000)
 - More lung cancers detected at Stage I/II (+17%)
 - Increased total expenditure (\$6.8 billion)
- Average annual screening + diagnostic expenditure (\$1.06 billion) similar to breast cancer screening in Medicare (\$1.08 billion)¹
- Medicare and healthcare systems should plan for:
 - Increased demand for LDCT imaging and associated health professionals
 - Treatment capacity for more early-stage lung cancer cases
 - Increased expenditure, particularly for screening exams

¹Gross et al, JAMA Intern Med, 2013

Key Uncertainties & Future Directions

Clinical Review & Education

From The JAMA Network

Computed Tomography Screening for Lung Cancer A High-Value Proposition?

Joshua A. Roth, PhD, MHA; Scott D. Ramsey, MD, PhD

JAMA January 5, 2016 Volume 315, Number 1

Remaining Uncertainties in Economic Evaluation of Lung Cancer Screening

- Screening performance in community practice vs. academic centers in the NLST
 - False-positives → Diagnostic imaging → Invasive Procedures
- Impacts of improved screening management protocols
 - Lung-RADS: False-positive result rate reduced from 26.6% to 12.8%¹
 - Potential budget savings of about \$300m in Medicare over 3 years²
- Smoking cessation impacts of screening
 - Reduced smoking → Clinical impacts → Economic Impacts
 - Unintended consequences of negative results on smoking cessation³
- Long-term adherence to screening guidelines

Future Directions for Economic Evaluation

- Economic evaluation based on 'real world' outcomes from community practice (vs. clinical trials)
- Evaluation of short-term (2-5 year) LDCT screening demand vs. existing center, scanner, and medical professional supply
- Cost-effectiveness and budget impact implications of new lung cancer screening strategies and technologies
- Value of information analysis to identify high-value lung cancer screening research questions for future studies

Conclusions

- The NLST approach to annual LDCT lung cancer screening is expected to be cost-effective vs. no screening
- The 5-year budget impact of lung cancer screening coverage in Medicare is expected to be substantial
- Most economic evaluations to date have used outcomes from the NLST, but 'real world' evaluations are important too
- Lung cancer screening technologies, strategies, and shared decision making processes are rapidly evolving, and these changes can alter the economic impacts of screening

Thanks!

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