Lahey Hospital & Medical Center

CT Lung Screening Implementation Challenges: State Based Initiatives

Andrea McKee, MD

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Co-Director Rescue Lung, Rescue Life Program

Co-Chair Massachusetts State Lung Cancer Subcommittee

December 2018

Business

America's Heaviest Smokers Don't Want to Know if They Have Cancer

Screening could save 12,000 lives annually, but fewer than 2 percent of those eligible take advantage of it.

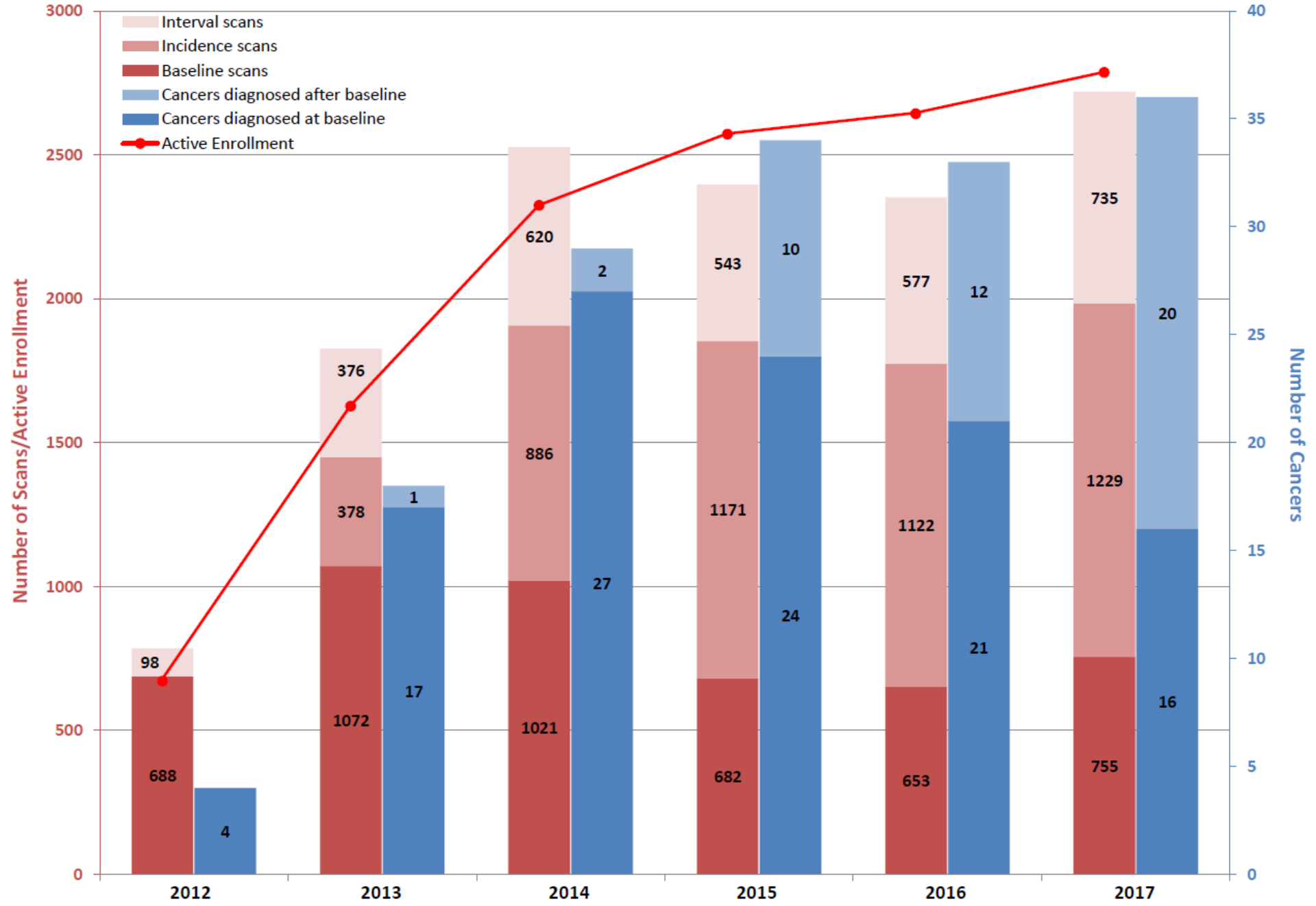
2016 data, 3 years after ACS recommendation and one year after CMS coverage

Mammography -28% in 1987, 11 years after ACS recommendation

Colonoscopy -32% in 1980, 20 years after ACS recommendation

Lung cancer screening Lahey– 65% in 2018, 6 years after NCCN recommendation
65% of eligible population screened – Changed the conversation

CTLS Program Volume, Active Enrollment, and Cancers Diagnosed per Year



HEALTH NEWS ✓ Fact Checked

Why Only 2 Percent of Heavy Smokers Get Lung Cancer Screenings

Why so slow?

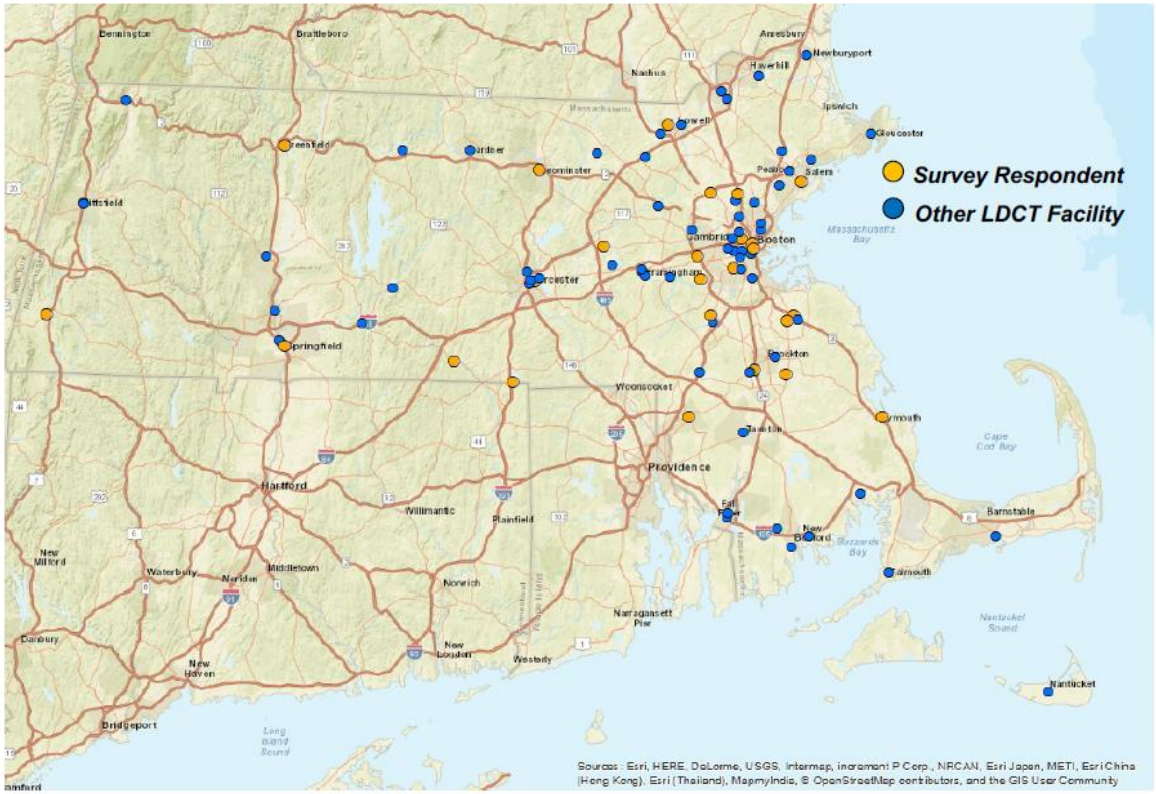
Reimbursement
Stigma
Infrastructure
Misinformation
Terminology
Resources
Training
Silos

Survey

Massachusetts LCS facilities were surveyed to characterize screening practices, assess barriers to screening implementation, and identify needs for information and support. The LCWG then established a LCS learning collaborative to address needs identified in the survey.

Survey Sites

Map of 91 Confirmed LDCT Lung Cancer Screening Facilities in Massachusetts



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Findings: 37 of 119 (31%) ACR accredited screening sites returned the survey.

Specific Findings Massachusetts Lung Cancer Screening Site Survey
62% had multidisciplinary governance group
82% used a decentralized model for shared decision making
Average number screened/month = 65 with 21% of sites screening over 100 and 45% having capacity to screen over 100/month
36% of sites reported <75% of participants received annual follow up LCS exam and 29% didn't know how many had received their follow up
44% reported participants were evaluated by physician team
24% capture whether radiologist recommendation was completed and/or track complications of biopsies

Most screening sites reported operating below capacity.

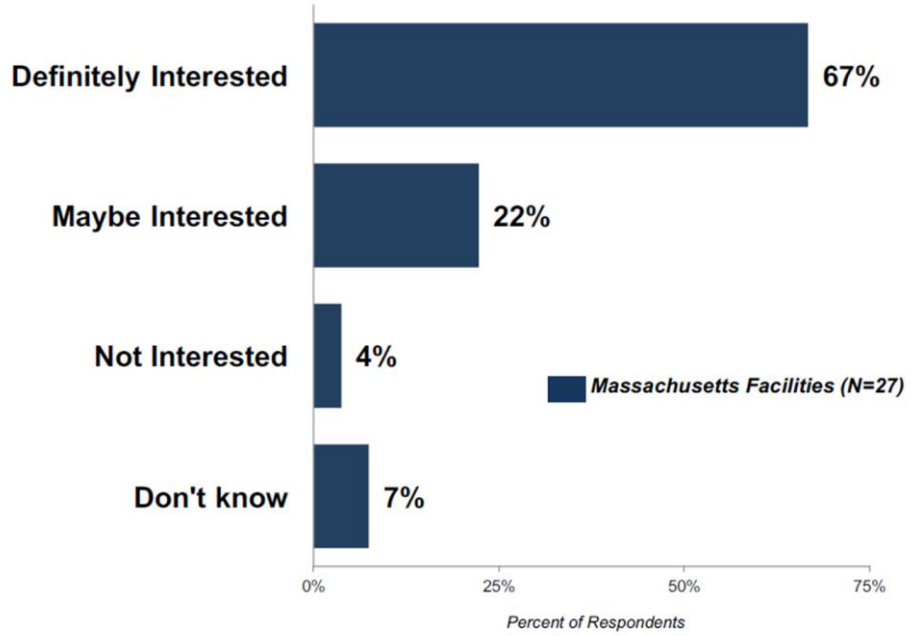
The greatest challenges and barriers to implementation reported were:

- lack of infrastructure and resources
- coordination of follow-up scans
- limited staff for workload
- data tracking
- getting accurate information from providers.

LCS facilities indicated a desire to learn more about data tracking, shared decision making, smoking cessation counseling, and documentation of these efforts.

Gauge Interest

Figure 22
How interested would you and/or other lung cancer screening team members at your facility be in participating in a statewide quality improvement collaborative aimed at assuring patient access to the highest quality LDCT lung screening in Massachusetts?
The collaborative would develop and engage participants in educational activities focused on disseminating best LDCT lung cancer screening practices, and in quality improvement efforts aimed at measuring and comparing progress on quality indicators across all member facilities.



To address desires for information, a statewide learning collaborative was established.

The first collaborative meeting was held March 2018 and focused on needs identified in the survey.

59 people from 28 screening sites attended. Feedback identified topics for two following meetings; fall 2018 and spring 2019.

Dear Lung Cancer Screening Colleague,

We would like to invite you to participate in an exciting new statewide collaborative: The **Massachusetts Learning Collaborative on Lung Cancer Screening (MLCLCS).**

Many thanks to all of you who participated in our recent, Survey of LDCT Lung Cancer Screening Facilities conducted by the Massachusetts Department of Public Health. This Survey has provided critical information on the current practices and needs of lung cancer screening facilities reported in the attached executive summary.

Survey respondents also expressed a strong interest in participating a statewide learning collaborative. In response to this interest, we, as co-chairs of the Lung Cancer Work Group of the Massachusetts Comprehensive Cancer Prevention and Control Network (MCCPCN), have identified resources to support a learning collaborative and are making plans to get it going.

Our Working Group proposes to:

1. Engage representatives from lung cancer screening sites across Massachusetts in establishing and designing the collaborative.
2. Sponsor a kick-off meeting on March 14, 2018 to address key concerns identified in the Survey and to set the agenda and format for future collaboration aimed at quality improvement in: patient tracking, follow-up of abnormal scans, shared decision making, smoking cessation and other priority topics.

Participation in the MLCLCS is open to all who have an interest in improving the quality of the lung cancer screening program at their institution including:

1. Hospital CEOs, CFOs and Clinical Leaders
2. Radiologists, Pulmonologists and Primary Care Providers
3. CT Scan Supervisors, CT Scan Technicians,
4. Patient Navigators, Patient Schedulers, LDCT Program Administrators
5. Nurse Practioners, Physician Assistants

So please encourage as many staff from your LDCT site to register for the Statewide Kick-off Meeting of the Massachusetts Lung Cancer Screening Learning Collaborative on March 14 in Framingham using the following link: http://www.cvent.com/d/htqf9r.

For questions, please contact Andrea McKee, MD at andrea.b.mckee@lahey.org.
Thank you for your commitment in decreasing the burden of Lung Cancer in Massachusetts.

Sincerely,

Andrea McKee, MD
Co-Chair, MCCPCN Lung Cancer Work Group

Roger Luckmann, MD
Co-Chair, MCCPCN Lung Cancer Work Group

Monday Report
The News Source for the Massachusetts Hospital Community
MHA MASSACHUSETTS Health & Hospital ASSOCIATION

02.12.2018 |

Mark Your Calendars: Lung Cancer Collaborative

The Massachusetts Lung Cancer Screening Learning Collaborative is holding a kickoff meeting on Wednesday, March 14, from morning through afternoon at the Sheraton Tara in Framingham. Details and registration information will be available later, but the Collaborative plans to offer CMEs and the event will be free.

This meeting will be an opportunity for hospitals across Massachusetts to send staff members currently involved in a lung cancer screening program or looking to start a lung cancer screening program. The Learning Collaborative is being run through the Massachusetts Department of Public Health. More details to follow, but please have interested staff Save the Date today.

This story originally appeared in the February 12, 2018 edition of Monday Report.

Massachusetts Comprehensive Cancer Prevention & Control Network

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Lung Cancer Learning Collaborative Kick-Off State Meeting
March 14th 2018
Sheraton Tara, Framingham, MA

Agenda

9:30 am – 10:00 am	Registration and Coffee	
10:00 am – 10:05 am	Welcome	**Andrea McKee, MD**, Co-Chair, Lung Cancer WG **Roger Luckmann**, MD Co-Chair
10:05 am- 10:25 am	Opening Presentation: *"Lung Cancer Screening: Decreasing the Burden of Lung Cancer in MA"* • Key Findings from Survey Report	**Andrea McKee, MD**
10:25 am- 10:45 am	Lung Cancer Learning Collaborative: Desired Outcomes and Process	**Anita Christie, RN, MHA, CPHQ**
10:45 am- 11:00 am	Break	
11:00 am - 12:00 pm	Panel: Challenges and Successes in Implementation of Lung Cancer Screening in MA	**Brady McKee, MD** **Carey Thompson, MD** **Kelli Milne, MS** **Victor Pinto-Plata, MD**
12:00 pm - 12:40 pm	Lunch (Networking at Tables)	Key Questions: 1. What is working @ your site? 2. What are your key challenges? 3. What should the Learning collaborative look like?
12:40 pm-1:00 pm	Brief Report out from Lunch Networking	
1:00 pm- 1:30 pm	Tracking and Follow-up	**Shawn Regis, PhD, Patient Navigator, Lahey** **Kaitlyn Kelly, RN, MSN, Patent Navigator, Mt. Auburn Hospital**
1:30 pm- 2:10 pm	Breakout Session (small group discussion of Tracking and Follow-up: Large group report out)	
2:10 pm -2:25 pm	Break	
2:25 pm – 2:55 pm	Engaging Primary Care Providers	**Michael Myers, MD, Compass Medical Group**
2:55 pm – 3:30 pm	Breakout Session (small group discussion of Engaging Primary Care Providers: Large group report out)	
3:30 pm	Wrap-Up, Evaluations, Adjourn - Future Learning Collaborative Topics	**Lung Cancer WG co-chairs**

Reimbursement and Messaging

70498	Ct Angio, Neck Combo, Incl Image Process	$2,586.00	$300.14	$160.27	$1,163.70	$345.16
71010	Chest X-Ray 1 Vw	$150.00	$58.96	$31.48	$67.50	$67.80
71020	Chest X-Ray 2 Vw	$150.00	$58.96	$31.48	$67.50	$67.80
71035	Chest X-Ray Spec Views	$298.00	$58.96	$31.48	$134.10	$67.80
71110	X-Ray Ribs 3 Vw Bilat	$448.00	$93.44	$49.90	$201.60	$107.46
71111	X-Ray Ribs, Chest 4+ Vw	$448.00	$93.44	$49.90	$201.60	$107.46
71250	Ct Scan, Thorax, w/o Contrast	$1,671.00	$130.01	$69.43	$751.95	$149.51
71260	Ct Chest Contrast	$2,586.00	$255.98	$136.69	$1,163.70	$294.38
71275	Ct Angio, Chest, Combo, Incl Image Proc	$2586.00	$300.14	$160.27	$1,163.70	$345.16
72040	X-Ray Exam Neck Spine 3/Or Less	$298.00	$58.96	$31.48	$134.10	$67.80

CTLS Medicare Payment
2016 -$112.49
2017 – $59.84
2018 –$52.56

2018 TC - $189.71
2018 Global - $242.28

Positive, Cancer Detection, Cat S, LR4 Rates

Major Assumptions
1. Net payment screening LDCT = $100
2. Definition of positive exam = Nodule > 6mm
3. Net payment diagnostic followup LDCT = $100

	US	Region
Population	300,000,000	6,500,000
High-Risk Group 1 (55-77y, 30PY, Quit < 15y)	7,000,000	151,667
High-Risk Group 2 (> 50y, >20PY, 1 Rfactor)	2,000,000	43,333
Total Qualified	9,000,000	195,000
Potential Lives Saved with 3 CT Screens	28,125	609

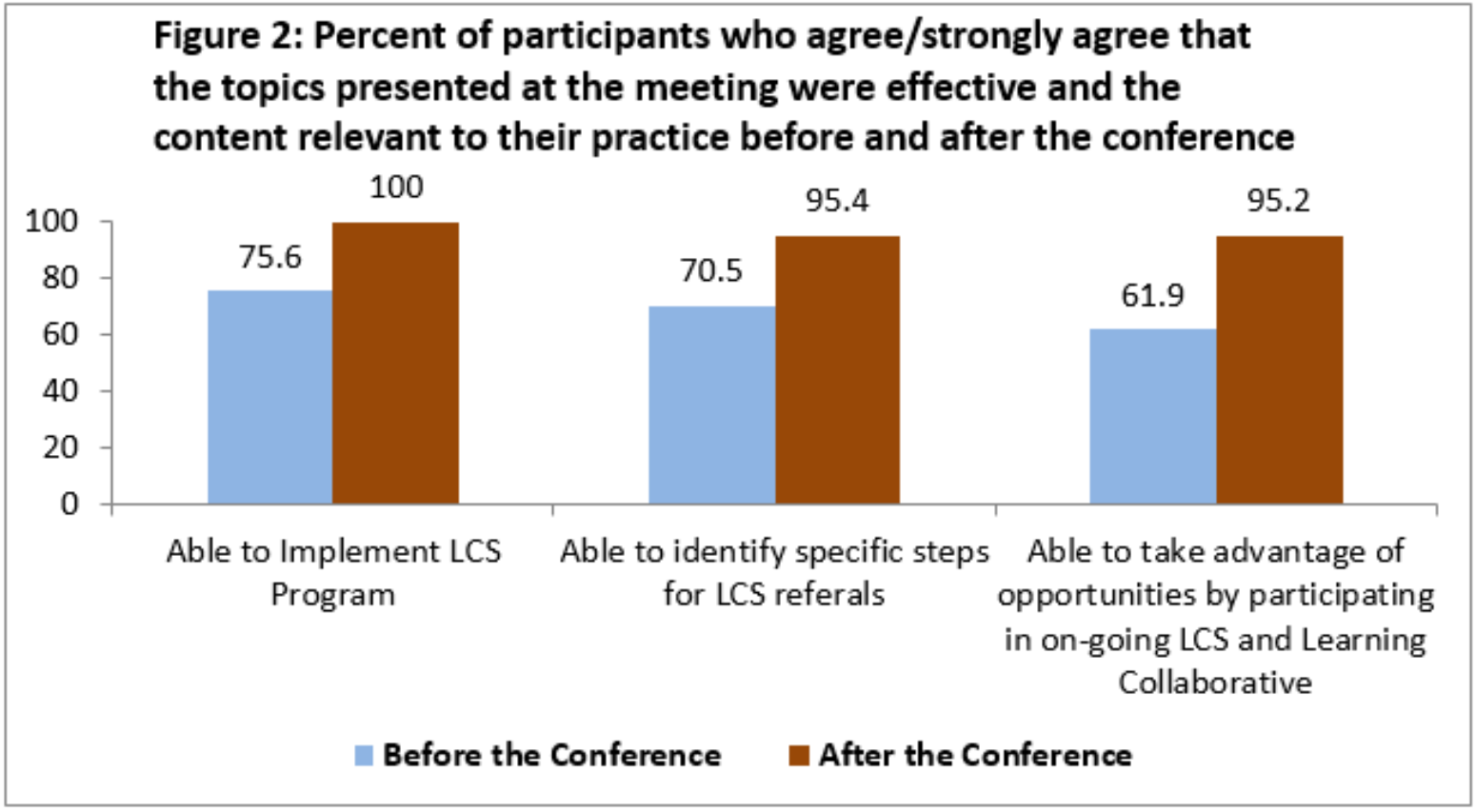
Net Income/Screened Patient Years 0-2	
Year 0	**$291**
Year 1	**$186**
Year 2	**$153**

Based on Lahey Clinical Experience

INPUTS	
LDCT Screening	***$100***
Region Population	***6,500,000***
Pt Compliance	***50%***
LDCT Diagnostic	***$100***
Cancer Treatment	***$15,000***
Percutaneous Bx	***$500***
Bronchoscopy	***$500***
Surgical Bx	***$500***
Chest CT	***$200***
CXR	***$50***
PET-CT	***$1,000***
Incidentals	***$500***
Radiologist	***$300,000***
Program Coordinator	***$100,000***
Radiology Tech(3)	***$150,000***
Retention Rate	***75%***
Uninsured (55-64)	***2%***
T0 (Baseline) Cases	***1,000***
T0 (Baseline) Positive	***13.0%***
T0 (Baseline) CDR	***2.6%***
T0 (Baseline) Category S	***10.2%***
T1 (Incidence) New Cases	***500***
T1 (Incidence) Postive	***6.0%***
T1 (Incidence) CDR	***0.8%***
T1 (Incidence) Category S	***7.0%***
T2+ (Incidence) New Cases	***500***
T2+ (Incidence) Positive	***6.0%***
T2+ (Incidence) CDR	***0.2%***
T2+ (Incidence) Category S	***7.0%***

Lung-RADS 4 Rates	
Overall	**4%**
PET	**50%**
CXR	**5%**
Chest CT	**17%**
Sugery	**5%**
Bronchoscopy	**7%**
Perc Bx	**2%**

Utilization Fraction (Assumes 50% Population Compliance)	Lives Saved and Net Income					
	1 Year			3 Years		
2% (1,950 Screenings/yr)	6	$	568,062	30	$	1,227,746
5% (4,875 Screenings/yr)	15	$	1,420,155	76	$	2,325,880
10% (9,750 Screenings/yr)	30	$	2,840,310	152	$	6,138,731
20% (19,500 Screenings/yr)	61	$	5,680,621	305	$	12,277,462



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LUNG CANCER WORK GROUP/ Sub-group planning call
Wednesday, April 4th, 2018, 8:00-9:00 am
VIRTUAL
CONFERENCE LINE: **1-866-244-8528** access code: **440819**
VIRTUAL MEETING ROOM: http://donahue.adobeconnect.com/lung_cancer_workgroup/

MCCPCN 2017-2021 PLAN – TARGETED LUNG CANCER STRATEGIES

Objective 8: By 2021, increase the percent of currently eligible patients in Massachusetts who have received a screening within the previous year.

Strategy 5: Facilitate the implementation of a statewide lung cancer screening quality improvement collaborative involving interested screening sites.

LUNG CANCER WORK GROUP AREA OF FOCUS/DELIVERABLES

1. By 2018, establish a statewide lung cancer screening learning collaborative of interested lung cancer screening sites.

ANTICIPATED MEETING OUTCOMES

- Review Evaluation Report from Kick-off Meeting
- Identify desired outcome (s) for In-Person Meeting (April 25th)
- Select priority areas for discussion for April 25th meeting
- Develop draft agenda

AGENDA

8:00 am	Welcome	Roger Luckmann/Andrea McKee
8:10 am	Review Evaluation Report from Kick-off meeting - Implications from data from meeting evaluations - Key highlights to present to larger WG	Sub-Work Group members
8:25 am	Planning for In-Person Work Group April meeting • What are 1-2 desired outcomes? • How to facilitate short and long term planning? • Leadership decisions ahead of time? • Draft agenda	Roger/Andrea
8:50 am	Summary of Next Steps	Gail/Co-Chairs
9:00 am	Adjourn	

NEXT MEETING: Wednesday, April 25th, 9- 11 am, American Lung Association, Framingham

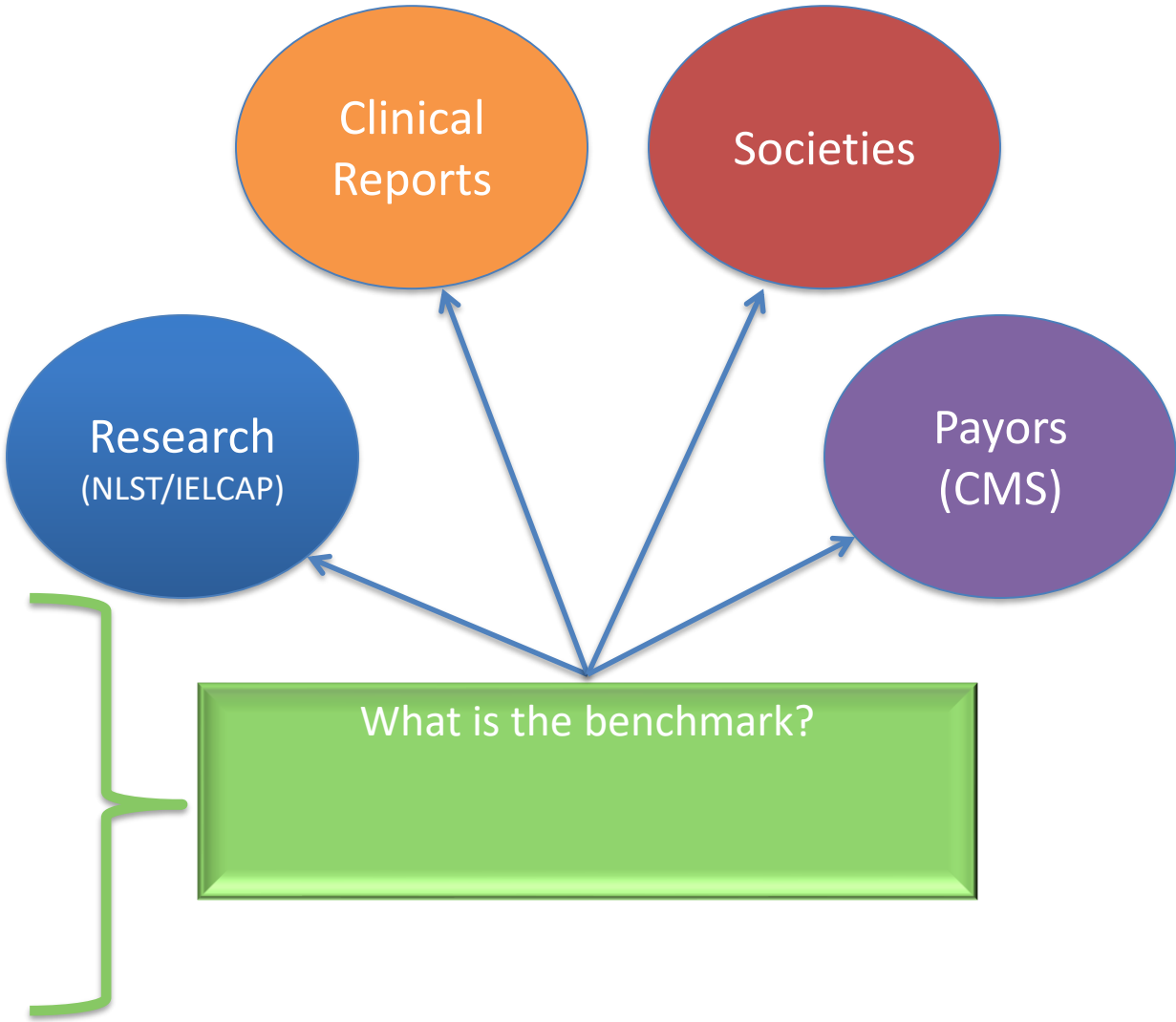
Measures of Success

Program Volume

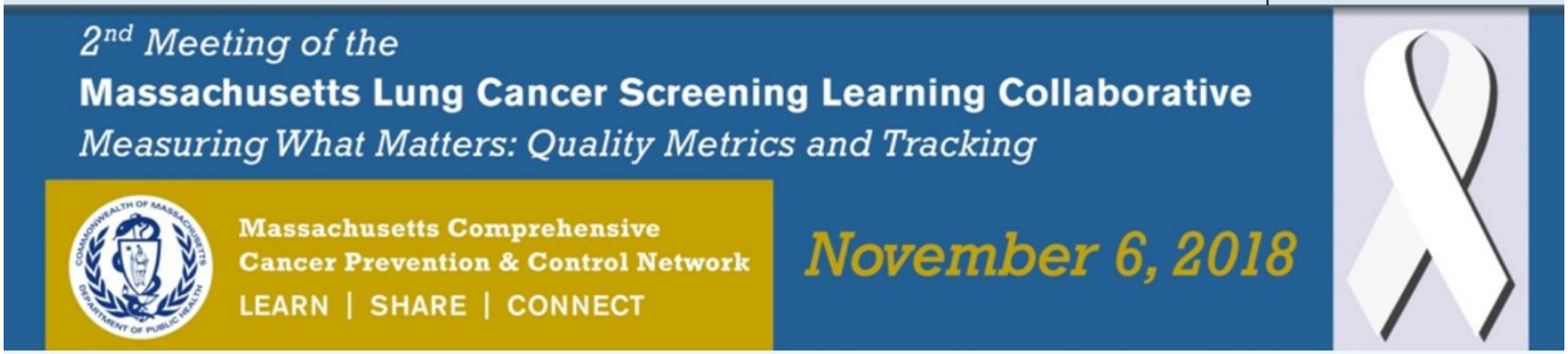
- # referred
- # qualified
- # screened

Exam Results

- ***# positive***
- ***# suspicious***
- ***# cancers***
- ***# false pos/neg***
- ***# S positive***



Already Registered?



2nd Meeting of the Massachusetts Lung Cancer Screening Learning Collaborative

~ Measuring What Matters: Quality Metrics and Tracking ~

To **register, click on the "**Register**" button located in the upper or lower right hand corner of the page.*

Summary

Please join us for the 2nd Meeting of the Massachusetts Lung Cancer Screening Learning Collaborative. This meeting will give you the opportunity to connect, learn and share challenges and best practices with other screening programs in the state.

Click here to download the draft agenda: 2nd Learning Collaborative - Draft Agenda.

Please note: This is an in-person event.

Continuing Medical Education

Massachusetts Comprehensive Cancer Prevention & Control Network

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"Measuring What Matters: Quality Metrics and Tracking"

Massachusetts Lung Cancer Screening Learning Collaborative 2nd State Meeting

November 6, 2018

Sheraton Tara, Framingham, MA

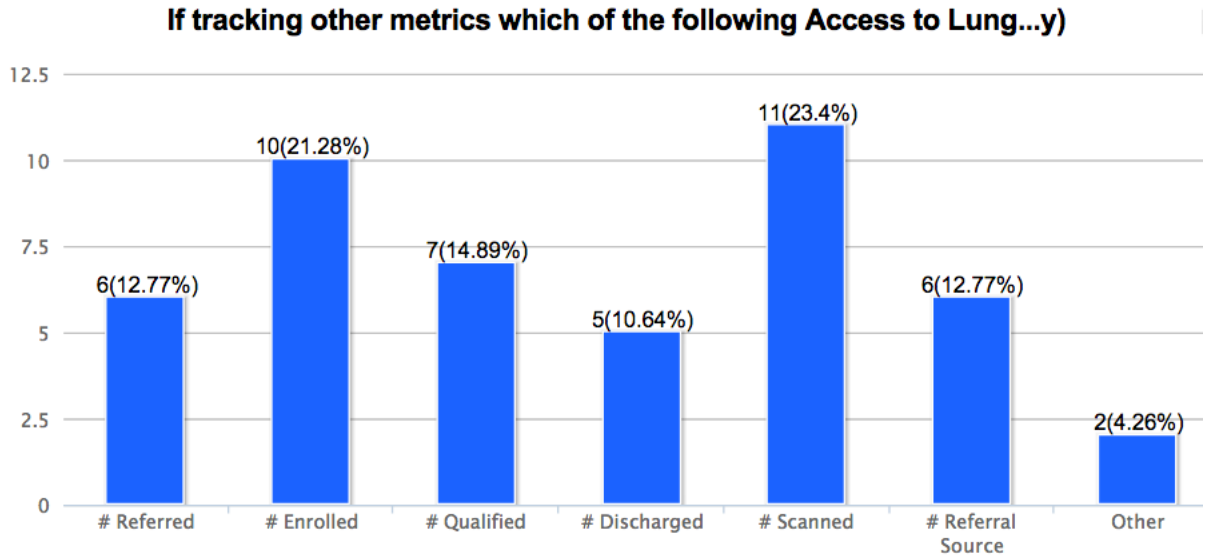
Agenda

9:30 am – 10:00 am	Registration and Coffee	
10:00 am – 10:10 am	Welcome	**Andrea McKee, MD**, Co-Chair, Lung Cancer WG **Carey Thomson**, MD Co-Chair **Michael Meyers, MD,** Co-Chair
10:10-10:20 am	High Quality Lung Cancer Screening: Survivor & Family Perspective	**Andrea Borondy-Kitts (spouse)** **Frank Flahive (survivor)**
10:20 am- 10:30 am	Opening Presentation: *"Quality in Lung Cancer Screening: Why it Matters"*	**Carey Thomson, MD**
10:30 am- 10:50 am	"ACR Metrics: What, why and how"	**Debra Dyer, MD** American College of Radiology
10:50 am- 11:00 am	Break	
11:00 am - 12:00 pm	"Beyond The ACR-IELCAP" - Define what the IELCAP is collecting and why - How it differs from ACR - Who they are collecting from? - Lessons learned	**Claudia Henschke, MD** Mt Sinai Hospital, NY
12:00 pm – 1:00 pm	Lunch (Networking at Tables): 3 groups: 1. Patient Navigators (2 groups) 2. Clinicians 3. Administrators	
1:00 pm- 2:30 pm	Panel Presentation: LCT site representatives: (discuss what they collect, if they collect beyond the ACR & why, what they have learned)	1. **Brady McKee (Lahey)** 2. **Carey Thomson (Mt. Auburn)** 3. **Mike Meyers (Compass Medical)** 4. **Katie Steiling (BMC)** 5. **Debra Dyer, MD (ACR)** 6. **Claudia Henschke, MD (Mt. Sinai)**
2:30- 3:00 pm	Q&A Panel	
3:00-3:15 pm	Closing Remarks	**Andrea, Carey & Mike**
3:15-3:30 pm	Wrap-Up, Evaluations, Adjourn -save the Date for Spring meeting	

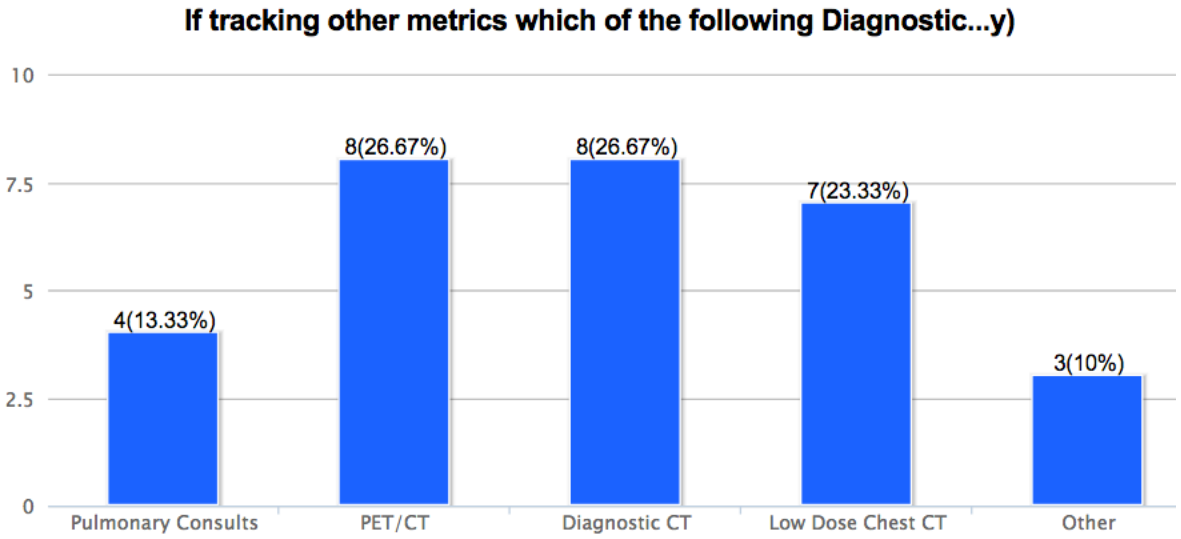
Save the Date, Registration E blasts, and Reminders

Game changing confirmatory evidence from the European NELSON CT lung screening trial was reported at the International Association for the Study of Lung Cancer's(IASLC) 19th World Conference in Toronto on World Lung Day, 9/25/18. The near 16,000 patient study demonstrated a lung cancer specific mortality benefit of **26% in men and up to 60% in women,** yielding one of the greatest mortality benefits ever proven in a randomized trial for any secondary screening intervention. The NELSON trial included younger individuals with fewer pack years than the National Lung Screening Trial (NLST) revealing that screening those at risk for lung cancer will save even more lives than previously believed based on earlier screening publications.

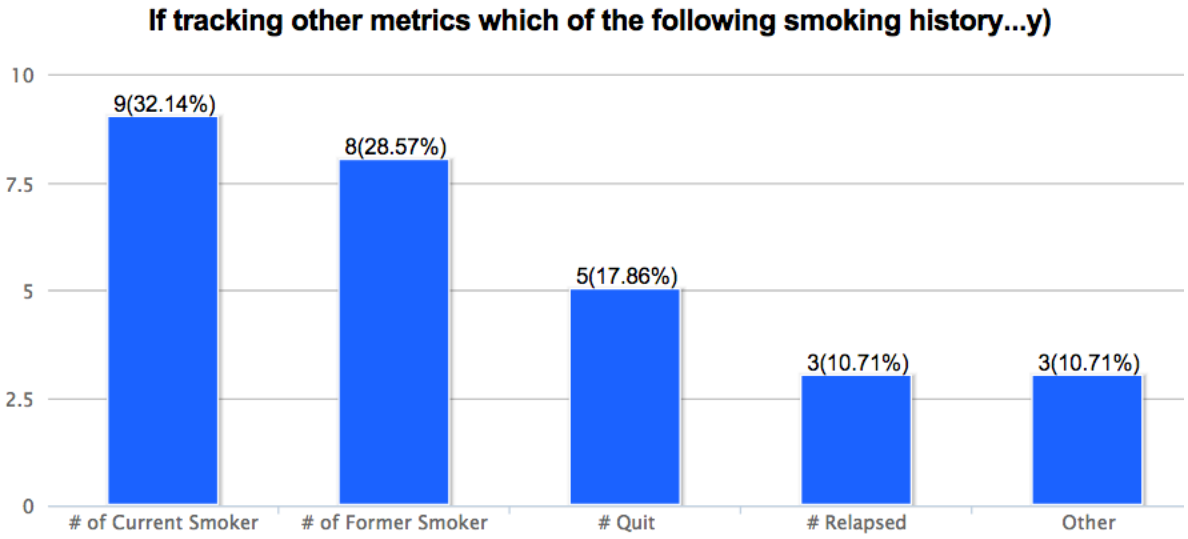
Please join us for the Massachusetts Lung Cancer Screening Learning Collaborative 2nd State Meeting to learn more about recent CT screening progress and better understand what important quality metrics are helpful to monitor safety in CT lung screening programs.



Total Response Count		10
Answer	**Count**	**Percent**
# Referred	6	12.77%
# Enrolled	10	21.28%
# Qualified	7	14.89%
# Discharged	5	10.64%
# Scanned	11	23.40%
# Referral Source	6	12.77%
Other	2	4.26%



Total Response Count		7
Answer	**Count**	**Percent**
Pulmonary Consults	4	13.33%
PET/CT	8	26.67%
Diagnostic CT	8	26.67%
Low Dose Chest CT	7	23.33%
Other	3	10.00%



Total Response Count		9
Answer	**Count**	**Percent**
# of Current Smoker	9	32.14%
# of Former Smoker	8	28.57%
# Quit	5	17.86%
# Relapsed	3	10.71%
Other	3	10.71%

Shared Decision Making

Editorials Exaggerating Radiation Harm and FPR

What is the false positive rate in modern clinical practice CTLS?

98%, 60%, 50%, 23%, 12%, 7%, 2%

Patient Anxiety – Little/No Evidence

“Permission to Smoke” – Little/No Evidence

Overdiagnosis

What is the rate of overdiagnosis in the NLST when using modern reporting and work up algorithms?

70%, 50%, 18%, 3%

Significant Incidental Findings

What is the rate of significant incidental findings in clinical CTLS practice?

70%, 40%, 10%, 6%, 4%,2%

”False” False Positive Rates

What is the False Positive Rate?

"On a population-based level, the FP rate is traditionally defined as the probability of receiving a positive result, given an absence of the disease. In this review, the FP rate will be defined as the number of FPs as a proportion of the total number of screening examinations conducted (i.e. accounting for cases of both the presence and absence of malignant disease). The definition has been modified from the true technical definition as a result of an observed trend, whereby the FP rate is reported in the latter manner by most of the publications concerning mammographic screening." -British Journal of Radiology

What is NOT the False Positive Rate?

"In 1995, Benjamini and Hochberg introduced the concept of the False Discovery Rate (FDR) as a way to allow inference when many tests are being conducted. The FDR is the ratio of the number of false positive results to the number of total positive test results." -Partnership for Assessment and Accreditation of Scientific Practice

	Disease or Condition	No Disease or Condition
Test Positive	A True Positive	B False Positive
Test Negative	C False Negative	D True Negative

- **False positive rate = B / (A + B + C + D)**
- **False discovery rate = B / (A + B)**

Table 2. Results of Three Rounds of Screening.*

Screening Round	Low-Dose CT			
	Total No. Screened	Positive Result	Clinically Significant Abnormality Not Suspicious for Lung Cancer	No or Minor Abnormality
			no. (% of screened)	
T0	26,309	7191 (27.3)	2695 (10.2)	16,423 (62.4)
T1	24,715	6901 (27.9)	1519 (6.1)	16,295 (65.9)
T2	24,102	4054 (16.8)	1408 (5.8)	18,640 (77.3)

Table 3. Diagnostic Follow-up of Positive Screening Results in the Three Screening Rounds.*

Variable	Low-Dose CT			
	T0	T1	T2	Total
				number
Total positive tests	7191 (100.0)	6901 (100.0)	4054 (100.0)	18,146 (100.0)
Lung cancer confirmed	270 (3.8)	168 (2.4)	211 (5.2)	649 (3.6)
Lung cancer not confirmed†	6921 (96.2)	6733 (97.6)	3843 (94.8)	17,497 (96.4)

Baseline

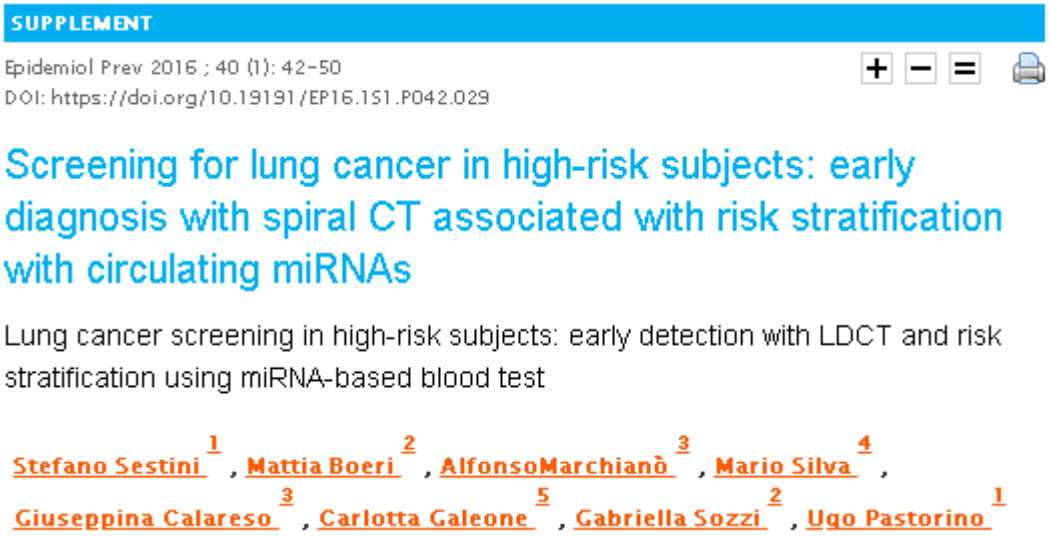
- 26,309 patients screened; 7191 positive exams; 270 confirmed lung cancers
  - False positive rate = (7191 –270) / 26,309 = **26.3%**

Overall

- 75,126 scans performed; 18,146 positive exams; 649 confirmed lung cancers
  - False positive rate = (18,146 – 649) / 75,126 = **23.3%**

False discovery rate

"Across the three rounds, 96.4% of the positive results in the low-dose CT group and 94.5% of those in the radiography group were false positive results. These percentages varied little by round. Of the total number of low-dose CT screening tests in the three rounds, 24.2% were classified as positive and 23.3% had false positive results; of the total number of radiographic screening tests in the three rounds, 6.9% were classified as positive and 6.5% had false positive results."



SUPPLEMENT

Epidemiol Prev 2016 ; 40 (1): 42-50
DOI: https://doi.org/10.19191/EP16.1S1.P042.029

Screening for lung cancer in high-risk subjects: early diagnosis with spiral CT associated with risk stratification with circulating miRNAs

Lung cancer screening in high-risk subjects: early detection with LDCT and risk stratification using miRNA-based blood test

Stefano Sestini [1], Mattia Boeri [2], AlfonsoMarchianò [3], Mario Silva [4], Giuseppina Calareso [3], Carlotta Galeone [5], Gabriella Sozzi [2], Ugo Pastorino [1]

"With the results of the American study National Lung ScreeningTrial (NLST), published in 2011, for the first time a lung cancer-specific mortality reduction by 20% thanks to the use of LDCT compared to RXT, was highlighted. However, a false positive rate of 96.4% was also described with an overdiagnosis that can be up to 78.9% for bronchioalveolar lung cancer."

This is the false discovery rate

American Journal of Respiratory and Critical Care Medicine

Home > All AJRCCM Issues > **Vol. 191, No. 1 | Jan 01, 2015**

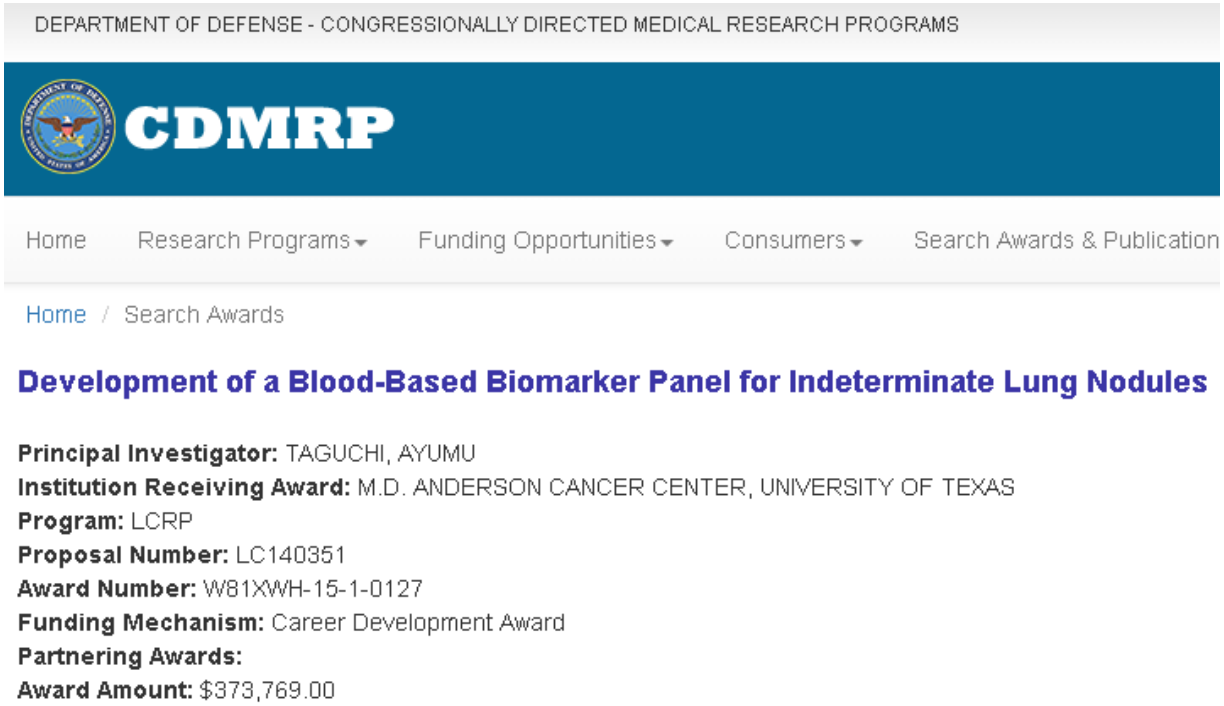
Lung Cancer Screening

Lynn T. Tanoue [1], **Nichole T. Tanner** [2], **Michael K. Gould** [3], and **Gerard A. Silvestri** [2]
+ Author Affiliations
https://doi.org/10.1164/rccm.201410-1777CI **PubMed:** 25369325

Received: October 03, 2014 Accepted: November 02, 2014

"Overall, 39.1% of participants in the NLST LDCT group had at least one positive screening test, with a false positive rate of 96.4% across the three rounds of screening."

This is the false discovery rate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Development of a Blood-Based Biomarker Panel for Indeterminate Lung Nodules

Principal Investigator: TAGUCHI, AYUMU
Institution Receiving Award: M.D. ANDERSON CANCER CENTER, UNIVERSITY OF TEXAS
Program: LCRP
Proposal Number: LC140351
Award Number: W81XWH-15-1-0127
Funding Mechanism: Career Development Award
Partnering Awards:
Award Amount: $373,769.00

"Objective and Rationale: Lung cancer screening with low-dose CT (LDCT) has been shown to reduce mortality by 20%, although there are concerns including high false positivity, cost, and radiation exposure. Of note, the false positive rate of lung cancer screening with LDCT alone was 96.4% in the National Lung Cancer Screening Trial."

This is the false discovery rate

cancernetwork
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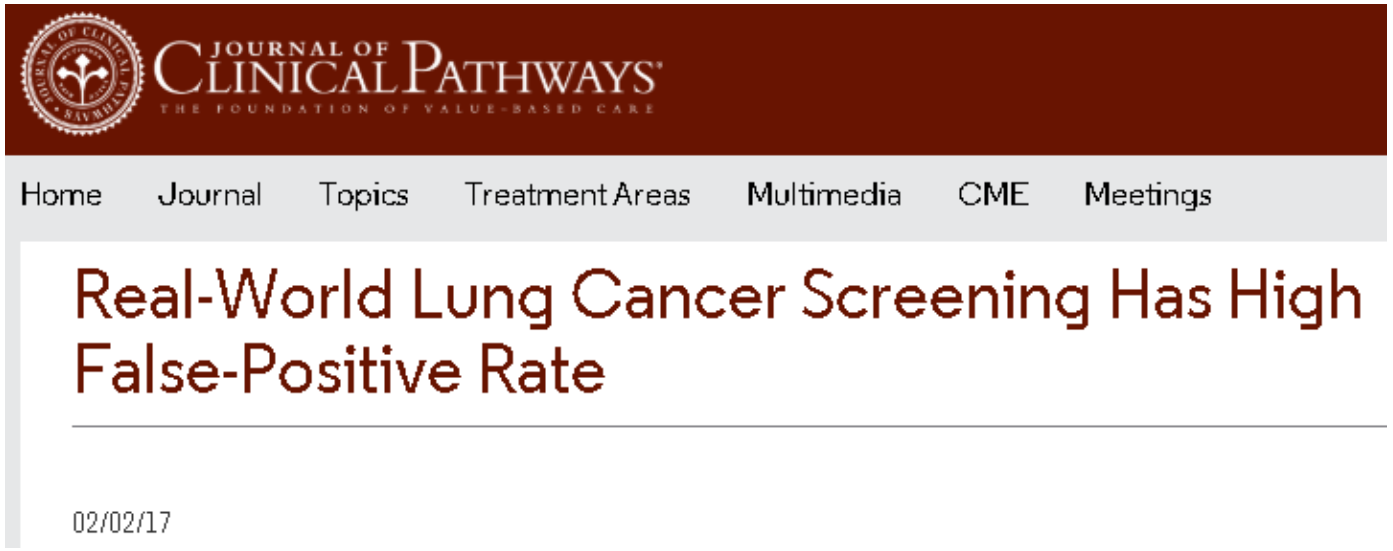
The Time for Low-Dose Computed Tomography Screening Is Now: A Medical Oncologist Perspective

By Benjamin P. Levy, MD and Daniel J. Becker, MD

Nov 15, 2014

"Perhaps one of the most commonly cited critiques of the NLST is the high false-positive rate (96.4%), which led to further diagnostic tests and unnecessary invasive procedures. While some have suggested that this contributes to patient anxiety and worsening quality of life (QOL), a formal analysis demonstrated no statistically significant difference in anxiety or QOL scores between participants with false-positive results and those with normal results."

This is the false discovery rate



"Of the 2106 screened patients, 1257 (59.7%) had nodules, and 1184 (56.2%) required tracking. Only 42 (2.0%) patients required further evaluations that did not result in a lung cancer diagnosis, and only 31 (1.5%) were diagnosed with lung cancer within 330 days. Overall, researchers calculated a false-positive rate of 97.5%. Incidental findings such as emphysema, other pulmonary abnormalities, and coronary artery calcification were observed on the scans of 857 patients (40.7%). Wide variation in processes and patient experiences among the 8 sites was also noted."

This is the false discovery rate

JAMA Internal Medicine | Original Investigation

Implementation of Lung Cancer Screening in the Veterans Health Administration

Linda S. Kinsinger, MD, MPH; Charles Anderson, MD, PhD; Jane Kim, MD, MPH; Martha Larson, BSN, MS; Stephanie H. Chan, MPH; Heather A. King, PhD; Kathryn L. Rice, MD; Christopher G. Slatore, MD, MS; Nichole T. Tanner, MD, MSCR; Kathleen Pittman, BSN, MPH; Robert J. Monte, MBA; Rebecca B. McNeil, PhD; Janet M. Grubber, MSPH; Michael J. Kelley, MD; Dawn Provenzale, MD, MSc; Santanu K. Datta, PhD; Nina S. Sperber, PhD; Lottie K. Barnes, MPH; David H. Abbott, MS; Kellie J. Sims, PhD, MS; Richard L. Whitley, BS; R. Ryanne Wu, MD, MHS; George L. Jackson, PhD, MHA

Patients screened	2106 (85.9)	442 (81.0)	228 (92.3)	213 (82.9)	444 (90.8)	247 (96.9)	135 (76.3)	258 (89.0)	139 (72.8)
Patients with nodular findings on scans[c]	1257 (59.7)	340 (76.9)	70 (30.7)	181 (85.0)	248 (55.9)	153 (61.9)	63 (46.7)	112 (43.4)	90 (64.7)
Patients with nodules to be tracked[d]	1184 (56.2)	323 (73.1)	64 (28.1)	176 (82.6)	225 (50.7)	143 (57.9)	61 (45.2)	108 (41.9)	84 (60.4)
Patients with suspicious findings not confirmed to be lung cancer[e]	42 (2.0)	10 (2.3)	2 (0.9)	2 (0.9)	13 (2.9)	10 (4.0)	0	1 (0.4)	4 (2.9)
Patients with confirmed lung cancer	31 (1.5)	7 (1.6)	4 (1.8)	3 (1.4)	10 (2.3)	0	2 (1.5)	3 (1.2)	2 (1.4)

- 2106 patients screened; 1257 positive* exams; 31 confirmed lung cancers
- False positive* rate = (1257 – 31) / 2106 = **58.2%**
- False suspicious rate = (73 – 31) / 2106 = **2%**

"There was wide variation among sites in the percentage of screening test results that were positive for nodules or possible lung cancer. Overall, 1257 of the 2106 patients (59.7%) screened had a positive test result (site range, 70 of 228 [30.7%] to 181 of 213 [85.0%]) (Table 1), including 1184 patients (56.2%) who had 1 or more nodules needing to be tracked (site range, 64 of 228 [28.1%] to 176 of 213 [82.6%]). Most nodules were small (<5 cm; 710 of 1293 [54.9%]) and solid (1079 of 1293 [83.4%]) (Table 3). A total of 73 patients (3.5% of all patients screened) had findings suspicious for possible lung cancer and underwent further diagnostic evaluation. Lung cancer was confirmed for 31 of those patients (1.5%; site range, 0 of 247 to 10 of 444 [2.3%]) within the 330-day follow-up period; 20 (64.5%) of the cancers were stage I (Table 4). The mean number of days from initial LDCT scan to cancer diagnosis was 137 (range, 5-330 days). The remaining 42 patients (2.0%; site range, 0 of 135 to 10 of 247 [4.0%]) who underwent evaluation were not confirmed to have lung cancer during that time frame. The rate of false-positive test results for lung cancer was 97.5% (1226 of 1257) during the 330-day follow-up period (Table 1)."

false discovery rate

* *"Since only about one-third of nodules identified as needing to be tracked in the LCSDP were 6 mm or greater, the positive rate might decline from nearly 60% to about 20%."*

- **Jan 2017 JAMA Internal Medicine article:**

  - "The rate of false-positive test results for lung cancer was 97.5% (1226 of 1257) during the 330-day follow-up period"

  - "The reason for the overall high rate of initially positive examination results in the VHA sites is not certain but may be owing, in part, to the older age and heavier smoking history of veterans screened."

  - **"Since only about one-third of nodules identified as needing to be tracked in the LCSDP were 6 mm or greater, the positive rate might decline from nearly 60% to about 20%"**

http://jamanetwork.com/journals/jamainternalmedicine/fullarticle/2599437

Editorial

October 2018

Failing Grade for Shared Decision Making for Lung Cancer Screening

Rita F. Redberg, MD, MSc[1,2]

» Author Affiliations | Article Information

JAMA Intern Med. 2018;178(10):1295-1296. doi:10.1001/jamainternmed.2018.3527

"Even in the highest-rated discussions, there was no mention of possible harms from the screening by the physicians, even though these harms include a 98% false-positive rate, which may lead to anxiety; additional testing including imaging or procedures, such as biopsy or lobectomy; and radiation from the LDCT with the small increased risk of cancer. Some evidence suggests that a more-rigorous and -informative SDM discussion about lung cancer screening is occurring in the Veterans Administration system."

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MEDICAL NEWS | PHYSICIAN'S FIRST WATCH

January 31, 2017

Lung Cancer Screening in Real World Has High False-Positive Rate

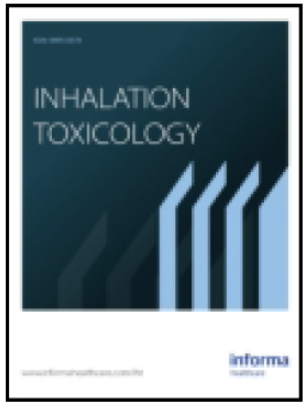
By Kelly Young

Edited by David G. Fairchild, MD, MPH, and Jaye Elizabeth Hefner, MD

"A pair of studies in JAMA Internal Medicine illustrate the difficulties of implementing lung cancer screening.

In the first, eight Veterans Health Administration medical centers identified and screened patients using low-dose computed tomography (LDCT). Over 2100 patients who were eligible for screening based on smoking history and other factors completed LDCT. Overall, 60% had nodules, but just 1.5% had lung cancer diagnosed within 330 days. The researchers calculate a false-positive rate of 97.5%."

This is the false discovery rate



Taylor & Francis
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Inhalation Toxicology

International Forum for Respiratory Research

ISSN: 0895-8378 (Print) 1091-7691 (Online) Journal homepage: http://www.tandfonline.com/loi/iiht20

Screening tests: a review with examples

L. Daniel Maxim, Ron Niebo & Mark J. Utell

Table 5. Reported false positive rates for CT scans for lung cancer.

Reported false positives as %		Remarks	Source
96.4		National Lung Screening Trial Research Team, p. 399 **(Exhibit A again)**	National Lung Screening Trial Research Team (2011)
96.1		Study also reports 90% sensitivity	Swensen et al. (2003)
95.5	**D**	106 false positives among 111 with nodules >0.5 cm	Tiitola et al. (2002)
92.9–96.0		Rates depended on nodule size, p. 260.	Swensen et al. (2005)
86.6–96.4		Rates depend upon assumed nodule size from 5.0 to 9.0 mm	Henschke et al. (2013)
94.6	**E**	Based on 14 detected cancers among 259 patients with abnormal CT scans	McWilliams et al. (2003)
94.1	**F**	From Table 2, 1773 false positives among 1883 nodules detected	Mahadevia et al. (2003)
93	**G**	Based on 8 lung cancers among 114 subjects with nodules >5 mm	Novello et al. (2005)
92.6	**H**	Based on 22 lung cancers among 298 patients with nodules	Pastorino et al. (2003)
92.1	**I**	Based on 22 cancers in 279 with suspicious nodules	Sone et al. (2001)
88.5–97		From Table 3, rate dependent upon risk	Kovalchik et al. (2013)
87.6		Based on 29 malignancies among 233 positive results	Henschke et al. (2002)
75		Percent of patients with non-calcified nodules on CT	Manos (2013)
73.4		Based on 163 benign nodules among 222 evaluated by thin section CT	Li et al. (2004)
>70		Reported value derived from Mayo clinic and ELCAP trials	Patz et al. (2004)
62.1		Based on 18 false positives among 29 subjects; for nodules >10 mm	Diedrerich et al. (2002)
43.75		Based on 36 confirmed lung cancer cases among 64 patients	Nawa et al. (2002)
21–33		Rates depend upon number of tests, p. 509. Of participants with a false-positive CT scan, 7% had an unnecessary invasive procedure and 2% had major surgery for benign disease.	Croswell et al. (2010)
19		p. 119	Gohagan et al. (2004)
7.9		p. 612. Includes multi-stage process with classification of nodules by size and calcification with follow-up.	Pedersen et al. (2009), Saghir et al. (2012)
7.9 M/5.6 F		Sensitivity reported to range between 84.6% W to 90.6% M	Toyoda et al. (2008)
1.7		Sensitivity reported at 94.6%, based on Volume CT scanning	van Klaveren et al. (2009)

D: 95.5% = 106 / 111 ≠ false positive rate

E: 94.6% = (259 – 14) / 259 ≠ false positive rate

F: 94.1% = 1773 / 1883 ≠ false positive rate

G: 93% = (114 – 8) / 114 ≠ false positive rate

H: 92.6% = (298 – 22) / 298 ≠ false positive rate

I: 92.1% = (279 – 22) / 279 ≠ false positive rate

THESE ARE ALL FALSE DISCOVERY RATES

JAMA | US Preventive Services Task Force | EVIDENCE REPORT

Screening for Cervical Cancer With High-Risk Human Papillomavirus Testing

Updated Evidence Report and Systematic Review for the US Preventive Services Task Force

Joy Melnikow, MD, MPH; Jillian T. Henderson, PhD; Brittany U. Burda, DHSc, MPH; Caitlyn A. Senger, MPH; Shauna Durbin, MPH; Meghan S. Weyrich, MPH

Not using false discovery rate when discussing cervical cancer screening

Table 3. Colposcopy Referrals and False-Positive Rates as Harms of hrHPV Screening, Based on Randomized Clinical Trials (Key Question 2)

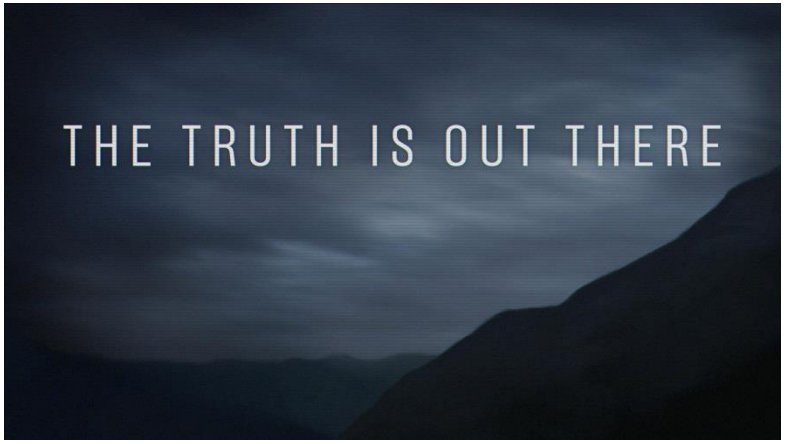
Source	Quality[a]	Screening Round (Planned Follow-up Period, y)[b]	Screening Approach	No./Total (%) Test Positivity[c] Intervention	Test Positivity[c] Control	Colposcopy Referrals[d] Intervention	Colposcopy Referrals[d] Control	False-Positive Rate, No. Screened Positive Without CIN 2+/Total No. Screened Without CIN 2+ (%)[d] Intervention	False-Positive Rate, No. Screened Positive Without CIN 2+/Total No. Screened Without CIN 2+ (%)[d] Control
hrHPV Primary Screening									
NTCC Phase II Ronco et al,[20] 2008 Ronco et al,[14] 2010	Good	1 (3.5)	hrHPV vs conventional cytology	hrHPV+: 1936/24 661 (7.9)	ASCUS+: 825/24 353 (3.4)	1936/24 661 (7.9)	679/25 435 (2.8)	1799/24 428 (7.4)	770/24 038 (3.2)
HPV FOCAL Ogilvie et al,[22] 2010 Cook et al,[19] 2015 Ogilvie et al,[21] 2017 Ogilvie et al,[13]	Fair	1 (1)[c]	hrHPV with LBC triage vs LBC	hrHPV+: 771/9540 (8.1)[d,e]	ASCUS+: 334/9408 (3.5)[d,e]	544/9540 (5.7)[e,g]	290/9408 (3.1)[e,g]	624/9393 (6.6)	244/9318 (2.6)
		2 (4)[c]	Cotesting vs cotesting[f]	hrHPV+: 469/8296 (5.7)	ASCUS+: 513/8078 (6.4)[d,e]	469/9540 (4.9)[e,g]	660/9408 (7.0)[e,g]	421/8248 (5.1)	413/7978 (5.2)
FINNISH Leinonen et al,[23] 2012	Fair	1 (5)	hrHPV with conventional cytology triage vs conventional cytology	hrHPV+: 4971/62 106 (8.0)[h]	ASCUS+: 4506/65 747 (6.9)[h]	796/66 410 (1.2)	755/65 784 (1.1)	4462/61 597 (7.2)	4239/65 480 (6.5)
Compass Canfell et al,[12] 2017	Fair	1 (5)	hrHPV with LBC triage vs LBC[i]	hrHPV+: 277/4000 (6.9)	ASCUS+: 67/995 (6.7)	154/4000 (3.8)	27/995 (2.7)	NR	NR
hrHPV Cotesting With Cytology									
NTCC Phase I Ronco et al,[25] 2006 Ronco et al,[26] 2006 Ronco et al,[14] 2010	Good	1 (3.5)	Cotesting vs conventional cytology	hrHPV+ or ASCUS+: 2830/22 708 (12.5)	ASCUS+: 855/22 466 (3.8)	2470/22 708 (10.9)[j]	738/22 466 (3.3)	2702/22 042 (12.3)	771/21 972 (3.5)
POBASCAM Bulkmans et al,[27] 2004 Rijkaart et al,[28] 2012 Dijkstra et al,[29] 2016	Good	1 (4)	Cotesting vs conventional cytology	hrHPV+ or ASCUS+: 1406/19 999 (7.0)	ASCUS+: 706/20 106 (3.5)	NR	NR	1149/19 742 (5.8)	513/19 913 (2.6)
		2 (5)	Cotesting vs cotesting	hrHPV+ or ASCUS+: 742/19 579 (3.8)	hrHPV+ or ASCUS+: 774/19 731 (3.9)	NR	NR	610/9572 (6.4)	612/9450 (6.5)
Swedescreen Naucler et al,[30] 2008 Elfström et al,[31] 2014	Fair	1 (3)	Cotesting vs conventional cytology	hrHPV+: 433/6257 (6.9) ASCUS+: 146/6257 (6.9)	ASCUS+: 150/6270 (2.4)	NR	NR	NR	72/6192 (1.2)
ARTISTIC Kitchener et al,[32] 2008 Kitchener et al,[33] 2009 Kitchener et al,[34] 2009 Kitchener et al,[35] 2014	Fair	1 (2)	Cotesting vs LBC	hrHPV+ or ASCUS+: 4019/18 386 (21.9)	ASCUS+: 786/6124 (12.8)	1247/18 386 (6.8)	320/6124 (5.2)	3566/17 933 (19.9)	653/5991 (10.9)
		2 (2)	Cotesting vs LBC	hrHPV+ or ASCUS+: 1258/11 862 (10.6)[k]	ASCUS+: 210/3928 (5.3)[k]	284/10 716 (2.7)[k]	74/3514 (2.1)[k]	1178/10 512 (11.2)[k]	176/3832 (4.6)[k]

	False Positive Rate				False Discovery Rate			
Screening Round	NLST	NLST LR	LHMC	MG	NLST	NLST LR	LHMC	MG
T0	26.3%	12.6%	10.6%	~20%	96.2%	92.8%	83.1%	97%
T1	27.2%	5.3%	5.2%	5-10%	97.6%	90.3%	78.2%	95%
T2	15.9%	5.1%	5.0%	5-10%	94.8%	87.2%	84.6%	95%

NLST: National Lung Screening Trial; NLST LR: Pinsky et al NLST conversion;

LHMC: Lahey CTLS program; MG: Mammography (nationwide)

Do you ever hear the false positive rate for mammography quoted as 95%??



"Based on solid evidence, approximately 96% of all positive, low-dose helical computed tomography screening exams do not result in a lung cancer diagnosis. False-positive exams may result in unnecessary invasive diagnostic procedures. Magnitude of Effect: Based on the findings from a large randomized trial, the average false-positive rate per screening round was 23.3%. A total of 0.06% of all false-positive screening results led to a major complication after an invasive procedure performed as diagnostic follow-up to the positive screening result. Over three screening rounds, 1.8% of participants who did not have lung cancer had an invasive procedure following a positive screening result."

- NIH
2 Feb 2018

So What **ARE** the False Positive Rates for CT Lung Screening?

The NEW ENGLAND JOURNAL of MEDICINE

ESTABLISHED IN 1812 AUGUST 4, 2011 VOL. 365 NO. 5

Reduced Lung-Cancer Mortality with Low-Dose Computed Tomographic Screening

The National Lung Screening Trial Research Team*

T0: 26.3%
T1: 27.2%
T2: 15.9%
Overall: 23.3%

Annals of Internal Medicine ORIGINAL RESEARCH

Performance of Lung-RADS in the National Lung Screening Trial

A Retrospective Assessment

Paul F. Pinsky, PhD; David S. Gierada, MD; William Black, MD; Reginald Munden, MD; Hrudaya Nath, MD; Denise Aberle, MD; and Ella Kazerooni, MD

T0: 12.6%
T1: 5.3%
T2: 5.1%
Overall: 7.8%

Original Research

JNCCN The official journal of the NCCN National Comprehensive Cancer Network®

NCCN Guidelines as a Model of Extended Criteria for Lung Cancer Screening

Brady J. McKee, MD; Shawn Regis, PhD; Andrea K. Borondy-Kitts, MS, MPH; Jeffrey A. Hashim, MD; Robert J. French Jr, MD; Christoph Wald, MD, MBA, PhD; and Andrea B. McKee, MD

T0: 10.6%
T1: 5.2%
T2: 5.0%
Overall: 7.6%

Recommendation for all positive (ie suspicious) exams: Pulmonary consultation

	screening uptake	indeterminate test result	positive test result (final result)	lung cancer detection (participants)	positive predictive value positive test result
ROUND 1	7,557 (95.6%)	1,451 (19.2%)	197 (2.6%)	70 (0.9%)	36%
ROUND 2	7,295 (92.3%)	480 (6.6%)	131 (1.8%)	55 (0.8%)	42%
ROUND 3	6,922 (87.6%)	471 (6.8%)	165 (2.4%)	75 (1.1%)	45%
ROUND 4	5,279 (66.8%)	101 (1.9%)	105 (2.0%)	43 (0.8%)	41%
TOTAL	**27,053 (85.6%)**	**2,503 (9.3%)**	**598 (2.2%)**	**243 (0.9%)**	**41%**

Probably Benign

Table 6. CTLS Metrics by Screening Round: CDR, PPV, and SPV

Screening Round	Lung Cancers Detected (CDR)							PPV				SPV			
	Overall		Group 1		Group 2		*P* Value	Overall	Group 1	Group 2	*P* Value	Overall	Group 1	Group 2	*P* Value
T0	66	2.3%	52	2.3%	14	2.0%	.61	16.6%	17.2%	14.3%	.54	37.0%	38.7%	29.6%	.38
T1	28	1.6%	23	1.7%	5	1.2%	.41	21.8%	23.6%	20.0%	.68	43.9%	46.5%	42.9%	.81
T2	11	1.0%	4	0.5%	7	2.7%	.005	15.4%	8.2%	37.5%	.01	29.4%	17.4%	54.5%	.04
≥T3	8	1.2%	6	1.1%	2	1.2%	1	19.5%	19.4%	20.0%	1	32.0%	31.6%	33.3%	1
Total	113	1.7%	85	1.7%	28	1.8%	.84	17.7%	17.6%	18.8%	.76	37.0%	37.3%	37.9%	.93

Abbreviations: CDR, cancer detection rate; CTLS, CT lung screening; PPV, positive predictive value; SPV, suspicious predictive value.

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T1	28	1.6%	23	1.7%	5	1.2%	.41	21.8%	23.6%	20.0%	.68	43.9%	46.5%	42.9%	.81
T2	11	1.0%	4	0.5%	7	2.7%	.005	15.4%	8.2%	37.5%	.01	29.4%	17.4%	54.5%	.04
≥T3	8	1.2%	6	1.1%	2	1.2%	1	19.5%	19.4%	20.0%	1	32.0%	31.6%	33.3%	1
Total	113	1.7%	85	1.7%	28	1.8%	.84	17.7%	17.6%	18.8%	.76	37.0%	37.3%	37.9%	.93

Abbreviations: CDR, cancer detection rate; CTLS, CT lung screening; PPV, positive predictive value; SPV, suspicious predictive value.

Massachusetts Medical Society Website

HTTP://WWW.MASSMED.ORG/CONTINUING-EDUCATION-AND-EVENTS/ONLINE-CME/COURSES/SDM---MOD-2/SHARED-DECISION-MAKING--ESSENTIAL-SKILLS-FOR-PROSTATE,-LUNG---BREAST-CANCER-SCREENING/

Engaging Primary Care Spring 2019

Shared Decision Making

Smoking Cessation

Role of PCP

Establishment of State Learning Collaborative

Screening patients at high risk for lung cancer with low dose CT scans is recommended by the United States Preventive Services Task Force and covered by all insurers since early 2015. However, only 2-4% of the eligible population nationally has received an initial screening.[1,2]

To address the Massachusetts Statewide Cancer Plan's objective to increase the percent of eligible people in Massachusetts receiving a screening within the prior year, the Massachusetts Comprehensive Cancer Prevention and Control Program established a Lung Cancer Work Group (LCWG) to identify and implement strategies to facilitate and accelerate the statewide implementation of lung cancer screening (LCS).

1. Huo J, Shen C, Volk RJ, Shih YC T. Use of CT and chest radiography for lung cancer screening before and after publication of screening guidelines: Intended and unintended uptake. JAMA Intern Med. 2017; 177(3):439-441. doi: 10.1001/jamainternmed.2016.9016.
2. Jemal A, Fedewa SA. Lung cancer screening with low-dose computed tomography in the United States—2010 to 2015 JAMA Oncol. 2017;3(9):1278-1281. doi:10.1001/jamaoncol.2016.6416