How a Lung Cancer Screening Program Can Help Reduce Health Disparities

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Pulmonary and Thoracic Medical Oncology
Director, Lung Cancer Screening Program
No Disclosures
Equity Issues with Lung Cancer Screening: Today’s Focus

1. Discuss UI Health’s lung cancer screening program and how it reduces health disparities.

2. Identify components of a successful screening program for minority and underserved populations.

3. Discuss how cancer screening programs can decrease health disparities.
Lung Cancer Stats

Figure 3. Leading Sites of New Cancer Cases and Deaths – 2018 Estimates

<table>
<thead>
<tr>
<th>Male</th>
<th>Female</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Prostate</strong></td>
<td><strong>Breast</strong></td>
</tr>
<tr>
<td>164,690</td>
<td>266,120</td>
</tr>
<tr>
<td><strong>Lung &amp; bronchus</strong></td>
<td><strong>Lung &amp; bronchus</strong></td>
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<tr>
<td>121,680</td>
<td>112,350</td>
</tr>
<tr>
<td>Colon &amp; rectum</td>
<td>Colon &amp; rectum</td>
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<tr>
<td>75,610</td>
<td>64,640</td>
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<tr>
<td>Urinary bladder</td>
<td>Uterine corpus</td>
</tr>
<tr>
<td>62,380</td>
<td>63,230</td>
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<td>Melanoma of the skin</td>
<td>Thyroid</td>
</tr>
<tr>
<td>55,150</td>
<td>40,900</td>
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<tr>
<td>Kidney &amp; renal pelvis</td>
<td>Melanoma of the skin</td>
</tr>
<tr>
<td>42,680</td>
<td>36,120</td>
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<tr>
<td>Non-Hodgkin lymphoma</td>
<td>Non-Hodgkin lymphoma</td>
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<tr>
<td>41,730</td>
<td>32,950</td>
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<tr>
<td>Oral cavity &amp; pharynx</td>
<td>Pancreas</td>
</tr>
<tr>
<td>37,160</td>
<td>26,240</td>
</tr>
<tr>
<td>Leukemia</td>
<td>Leukemia</td>
</tr>
<tr>
<td>39,030</td>
<td>25,270</td>
</tr>
<tr>
<td>Liver &amp; intrahepatic bile duct</td>
<td>Kidney &amp; renal pelvis</td>
</tr>
<tr>
<td>30,610</td>
<td>22,660</td>
</tr>
<tr>
<td><strong>All sites</strong></td>
<td><strong>All sites</strong></td>
</tr>
<tr>
<td>856,370</td>
<td>878,980</td>
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<table>
<thead>
<tr>
<th>Male</th>
<th>Female</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Lung &amp; bronchus</strong></td>
<td><strong>Lung &amp; bronchus</strong></td>
</tr>
<tr>
<td>83,550</td>
<td>70,500</td>
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<tr>
<td>Prostate</td>
<td>Breast</td>
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<td>29,430</td>
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<td>Colon &amp; rectum</td>
<td>Colon &amp; rectum</td>
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<td>27,390</td>
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<td>Pancreas</td>
<td>Pancreas</td>
</tr>
<tr>
<td>23,020</td>
<td>21,310</td>
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<tr>
<td>Liver &amp; intrahepatic bile duct</td>
<td>Ovary</td>
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<td>20,540</td>
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<td>Leukemia</td>
<td>Uterine corpus</td>
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<td>Esophagus</td>
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<td>12,850</td>
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<td>Urinary bladder</td>
<td>Liver &amp; intrahepatic bile duct</td>
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<td>12,520</td>
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<td>Non-Hodgkin lymphoma</td>
<td>Non-Hodgkin lymphoma</td>
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<tr>
<td>11,510</td>
<td>8,400</td>
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<tr>
<td>Kidney &amp; renal pelvis</td>
<td>Brain &amp; other nervous system</td>
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<tr>
<td>10,010</td>
<td>7,340</td>
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<tr>
<td><strong>All sites</strong></td>
<td><strong>All sites</strong></td>
</tr>
<tr>
<td>232,630</td>
<td>286,010</td>
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</tbody>
</table>

Estimates are rounded to the nearest 10, and cases exclude basal cell and squamous cell skin cancers and in situ carcinoma except urinary bladder. Ranking is based on modeled projections and may differ from the most recent observed data.
Lung Cancer Mortality

Estimated Cancer Deaths by Site in the United States, 2015
Lung Cancer Diagnosed by Stage in the U.S.

- Lung and Bronchus Localized: 18%
- Lung and Bronchus Regional: 22%
- Lung and Bronchus Distant: 53%
- Lung and Bronchus Unstaged: 7%
Lung Cancer and Health Disparities
Lung Cancer and Health Disparities

Smoking
- Rates are highest among:
  - **Race/Ethnicity**: American Indians and Alaskan Natives 26.1%, White 19.4%, Black/African Americans 18.3%, Hispanics 18%
  - **Education Status**: no diploma 27.1%, high school 21.7%, some college 20%, college degree 9.1%
  - **Poverty Status**: Below poverty level 26%, at or above poverty level 14%
- Cigarette advertising is targeted at minorities
- Minorities are least likely to be screened for smoking by primary care providers and receive smoking cessation resources

Lung Cancer
- Black/African Americans (AA):
  - AA men have the highest incidence and mortality of lung cancer
  - More likely to smoke longer in years but less cigarettes per day
  - More likely to smoke menthol (more addictive)
  - More likely to be diagnosed at a late stage
Social Determinants of Health
Interplay Between Host, Agent, and Environment

Health Care
Housing
Food
Built Environment
Community
Domestic Violence & Crime
Pollution
Employment
Education
Governance
Economic Stability

Your Zip Code is a better predictor of your health than your Genetic Code
What is Lung Cancer Screening?
National Lung Screening Trial
Chest X-Ray vs. Low-dose CT
Landmark National Lung Screening Trial (NLST) Results Showed Lung Cancer Mortality Benefit - 2011

Results:

• 20% decrease in lung cancer deaths in those who received Low-Dose CT vs. chest x-ray

• 6.7% decrease in all-cause mortality (deaths due to any factor, including lung cancer)

• 1.1% lung cancer detection rate

Population: 91% White, 4.5% African American, 1.8% Hispanic
National Lung Screening Trial
Chest X-Ray vs. Low-dose CT

CHEST X-RAY

VS

LOW-DOSE CT

IMAGE CREDIT: M. PASQUINELLI
Lung Cancer Screening
United States Preventative Services Task Force (USPSTF) Lung Screening Criteria

**Annual Low-Dose CT for those at high risk:**

1. Age 55-80 (age 55 to 77 for Medicare patients)
2. Current smoker or quit within past 15 years
3. Tobacco smoking history of $\geq$30 pack-years*
4. Asymptomatic of lung cancer
5. Able and willing to receive treatment
6. Shared decision making visit (with initial screen)

*30 pack-years = 1 pack of cigarettes per day x 30 years

USPSTF: lung cancer screening: Grade B
What is a Low-Dose CT Scan?

A low-dose CT scan continuously rotates in a spiral motion taking several 3-dimensional x-rays of the lungs:

• Non-invasive: no IVs, injections, or medications
• Painless
• Lie on your back on the table, arms above the head
• No need to change out of regular clothing
• Take 1 deep breath and hold it (~10 seconds)
• Machine is completely open
• Approximately 5 x less radiation compared to regular CT
Number Needed To Screen Lower Than Other Commonly Accepted Cancer Screening Tests

NLST: number needed to screen to prevent one lung cancer death of 320 and 219 to save one life overall.
UI Health’s Lung Cancer Screening Program
Disparities in Chicago

Racial & Ethnic Group Distribution

- Chicago: 2.7 million
- 45% White
- 33% Black

Poverty Distribution

- Downtown Chicago

Lung Cancer Mortality Rates

- Downtown Chicago

U.S. Ave. 15.2%
Lung Cancer Mortality and UI Health’s Service Area

- 24 community areas in the West and South-side of Chicago
- 495 bed hospital, 22 outpatient clinics, and a network of 15 FQHCs (Mile Square)
History of Lung Cancer Screening Program at UI Health

CMS Approves Coverage for Lung Cancer Screening

2013 - 2014
$99 Lung Screening

2/2015

2015 - 2018

Lung Cancer Screening Program Using USPSTF Guidelines:

Age 55-80, smoking history of ≥30 pys, current smokers or quit within the past 15 years

(Grade B Recommendation)

4

750+
Current UI Health’s Lung Cancer Screening Workflow

Provider (MD, APN, PA) Identified patient, meets criteria

Lung Cancer Screening Clinic does Shared Decision Making Visit, Smoking Cessation, Orders Scan

Radiology Completes Screening Questionnaire

LDCT Scan Performed

LungRADS 1 & 2 (Annual LDCT)

Results to Referring Provider who Follows up with Pt

LungRADS 3 (6 month LDCT)

Reviewed in Multidisciplinary Thoracic Tumor Board Conference

Follow up: PET, Biopsy, Surgery, Med or Rad Oncology

LungRADS 4

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2019: Centralized Screening Clinic for Tobacco Related Diseases

- Provider (MD, APN, PA) Identified patient, meets criteria
- Lung Screening Clinic: Shared Decision Making Visit, Tobacco Related Cancer Assessment, Smoking Cessation
- Radiology Completes Screening Questionnaire
- LDCT scan performed and is seen by APN same day for results and counseling
- LungRADS 1 & 2 (Annual LDCT)
- LungRADS 3 (6 month LDCT)
- LungRADS 4
- LDCT screening clinic tracks patients and provides follow up scans, counsels on tobacco related diseases
- Reviewed in Multidisciplinary Thoracic Tumor Board Conference
- Follow up: PET, Biopsy, Surgery, Med or Rad Oncology

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Physician Engagement – A Key to Lung Cancer Screening

1. Get Physicians/APNs/PA/RNs involved early, listen to them
2. Give them the Big Picture
3. Support with Structure and Resources
4. Listen and Communicate
5. Continue to Evolve the Process
6. Keep them Informed of the Process and Outcomes
UI Health
From Patient to Community Engagement
Results of UI Health’s Lung Cancer Screening Program
Outcomes From a Minority-Based Lung Cancer Screening Program vs the National Lung Screening Trial

M. PASQUINELLI, DNP

PASQUINELLI MM, KOVITZ KL, KOSHY M, ET AL. OUTCOMES FROM A MINORITY-BASED LUNG CANCER SCREENING PROGRAM VS THE NATIONAL LUNG SCREENING TRIAL. JAMA Oncol. 2018;4(9):1291-1293
Outcomes From a Minority-Based Lung Cancer Screening Program vs the National Lung Screening Trial

Table 1. Baseline Demographic Factors and Smoking Status of Participants Included in the UIC’s Lung Cancer Screening Program and the LDCT Arm of the National Lung Screening Trial

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>UIC (n = 500)</th>
<th>NLST (n = 26,722)</th>
<th>P Value</th>
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</thead>
<tbody>
<tr>
<td>Age, mean (SD)</td>
<td></td>
<td></td>
<td>&lt; .001</td>
</tr>
<tr>
<td>Male</td>
<td>262 (52.4)</td>
<td>15,770 (59.0)</td>
<td>.01</td>
</tr>
<tr>
<td>Female</td>
<td>238 (47.6)</td>
<td>10,952 (41.0)</td>
<td></td>
</tr>
<tr>
<td>Race</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>White</td>
<td>144 (28.8)</td>
<td>24,289 (90.9)</td>
<td></td>
</tr>
<tr>
<td>African American</td>
<td>348 (69.6)</td>
<td>11,955 (4.5)</td>
<td>&lt; .001</td>
</tr>
<tr>
<td>Asian</td>
<td>7 (1.4)</td>
<td>559 (2.1)</td>
<td></td>
</tr>
<tr>
<td>Other/Other</td>
<td>1 (0.2)</td>
<td>516 (1.9)</td>
<td></td>
</tr>
<tr>
<td>Missing</td>
<td>0</td>
<td>163 (0.6)</td>
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Ethnicity

<table>
<thead>
<tr>
<th>Ethnicity</th>
<th>UIC (n = 500)</th>
<th>NLST (n = 26,722)</th>
<th>P Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hispanic or Latino</td>
<td>53 (10.6)</td>
<td>479 (1.8)</td>
<td>&lt; .001</td>
</tr>
<tr>
<td>Neither Hispanic nor Latino</td>
<td>447 (89.4)</td>
<td>26,079 (97.6)</td>
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</tr>
<tr>
<td>Missing</td>
<td>0</td>
<td>164 (0.6)</td>
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</table>

Smoking status

<table>
<thead>
<tr>
<th>Smoking status</th>
<th>UIC (n = 500)</th>
<th>NLST (n = 26,722)</th>
<th>P Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Current</td>
<td>364 (72.8)</td>
<td>12,860 (48.1)</td>
<td>&lt; .001</td>
</tr>
<tr>
<td>Former</td>
<td>136 (27.2)</td>
<td>13,862 (51.9)</td>
<td></td>
</tr>
</tbody>
</table>

Abbreviations: LDCT, low-dose computed tomography; NLST, National Lung Screening Trial; UIC, University of Illinois at Chicago.

*Table adapted from Aberle et al, adjusted with UIC results and data provided from the NLST data set at the National Cancer Institute.
Outcomes From a Minority-Based Lung Cancer Screening Program vs the National Lung Screening Trial

<table>
<thead>
<tr>
<th>Lung-RADS Classification</th>
<th>UIC, No. (%)</th>
<th>UIC With Cancer, No./No. (%)</th>
<th>NLST, No. (%)</th>
<th>NLST With Cancer, No./No. (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>136 (27.2)</td>
<td>0/136</td>
<td>14,709 (55.6)</td>
<td>15/14,709 (0.1)</td>
</tr>
<tr>
<td>2</td>
<td>241 (48.2)</td>
<td>0/241</td>
<td>8,145 (30.8)</td>
<td>29/8,145 (0.4)</td>
</tr>
<tr>
<td>3</td>
<td>77 (15.4)</td>
<td>0/77</td>
<td>1,667 (6.4)</td>
<td>21/1,697 (1.2)</td>
</tr>
<tr>
<td>3, 4A*</td>
<td>0</td>
<td>0/0</td>
<td>57 (0.4)</td>
<td>0/97</td>
</tr>
<tr>
<td>3, 4A, 4B*</td>
<td>0</td>
<td>0/0</td>
<td>193 (0.7)</td>
<td>22/193 (1.1)</td>
</tr>
<tr>
<td>4A</td>
<td>33 (6.6)</td>
<td>4/33 (12.1)</td>
<td>1,107 (4.2)</td>
<td>78/1,107 (7.0)</td>
</tr>
<tr>
<td>4B</td>
<td>10 (2.0)</td>
<td>6/10 (60.0)</td>
<td>358 (1.4)</td>
<td>124/358 (34.6)</td>
</tr>
<tr>
<td>4X</td>
<td>3 (0.6)</td>
<td>3/3 (100)</td>
<td>149 (0.6)</td>
<td>3/149 (2.0)</td>
</tr>
<tr>
<td><strong>All</strong></td>
<td>500 (100)</td>
<td>13/500 (2.6)</td>
<td>26,455 (100)</td>
<td>292/26,455 (1.1)</td>
</tr>
</tbody>
</table>

Abbreviations: LDCT, low-dose computed tomography; NLST, National Lung Screening Trial; UIC, University of Illinois at Chicago.

* Adapted from Pinsky et al to compare NLST and UIC data.

** Lung-RADS category descriptor: 0 (incomplete scan), 1 (negative: no nodules and definitely benign nodules), 2 (benign-appearing nodules with low likelihood of becoming cancer owing to size or lack of growth), 3 (probably benign and short-term follow-up is suggested), 4 (suspicious; additional diagnostic testing and/or tissue sampling is recommended; subcategories 4A, 4B, and 4X indicate nodules with additional features increasing the degree of suspicion of malignancy). The distributions of Lung-RADS categories were significantly different between UIC and NLST cohorts (P < .001).

d) Percentages may not sum to 100 due to rounding.

* These classifications were consistent with more than 1 Lung-RADS category in the NLST.
Outcomes From a Minority-Based Lung Cancer Screening Program vs the National Lung Screening Trial

1. Consistent with the goal of screening, both cohorts had greater than 50% of lung cancer cases detected at an early (stage I) curable stage (UIC [7 of 13] and NLST [155 of 266]).

2. Screening that is skewed toward the white population could paradoxically increase racial disparities in lung cancer outcomes.

3. These real-world differences are in accordance with a secondary analysis from NLST that showed that reduction in LC mortality was greatest among African American participants.

4. Refining risk-based guidelines would improve the beneficial results of LDCT screening.
Meeting the Goal of Early Detection: Results of UI Health’s Lung Cancer Screening Program (N = 500)

- **Stage Distribution CR - Lung Cancer DX 2014 %**
  - Stage 0: 0.0%
  - Stage I: 14.9%
  - Stage II: 8.5%
  - Stage III: 19.1%
  - Stage IV: 57.4%
  - N/A or UNK: 0.0%

- **Stage Distribution CR - Lung Cancer DX 2015 %**
  - Stage 0: 0.0%
  - Stage I: 4.4%
  - Stage II: 4.4%
  - Stage III: 17.8%
  - Stage IV: 51.1%
  - N/A or UNK: 0.0%

- **Stage Distribution CR - Lung Cancer DX 2016 %**
  - Stage 0: 0.0%
  - Stage I: 5.2%
  - Stage II: 19.8%
  - Stage III: 25.9%
  - Stage IV: 45.7%
  - N/A or UNK: 0.0%
Downstream Revenue

$\$\$

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Background
The National Lung Screening Trial (NLST) showed a 20% decrease in mortality from lung cancer in the patients screened with low-dose CT when compared to chest radiography. The NLST also demonstrated a 22% reduction in mortality from any cause in the LDT group, due to incidental findings such as aneurysms, cardiac disease, etc. As a result of the study, the US Preventative Service Task force grade B recommends annual lung cancer screenings with LDT for patients who meet the following criteria:

- Age 55-74
- 30 pack-year smoking history
- Current smoker or has quit within the past 15 years

The goal of incorporating such screening programs into health systems is to identify cases of lung cancer in early stages of development and thereby reduce mortality. University of Illinois Health System (UHS) implemented a lung cancer screening program following these criteria and this study will evaluate patients screened 2010-2017.

This study will seek to provide an estimate of the downstream revenue of the Lung Cancer Screening Program within UHS. Downstream revenue is defined as revenue captured after a patient uses one hospital service and then subsequently uses others. It is used to evaluate the economic impact of a new procedure or program within a hospital system. Downstream revenue from this program would capture the revenue from screening as well as any required follow-up — this could include additional LDT, chemotherapy, surgical procedures, radiation, etc.

This study is unique in assessing the financial value of a screening program that serves a specific population. Thirty-eight percent of patients within the program receive insurance through Medicaid/Medicare Managed Care and 46% have Medicare as their insurance provider. Approximately 75% of patients screened are Black/African American.

Methods
In performing this analysis, we will first identify all patients included in the screening program. All patients receive an initial LDT to screen for the presence of nodule. Results of the LDT can be classified according to Lung Imaging Reporting and Data System (Lung-RADS). Results are placed in categories: 1, 2, 3, 4A, 4B, and 4C, representing findings that are increasingly suspicious for lung cancer. Based on the category, different follow-up protocols are recommended. 

Compass® was queried using the UMR hit & scan screening data provided by Mary Pasquinelli. A PI-Lung Screening Program Director for the LDT program between FY14 and FY17. Downstream patient activity was queried in Compass® by UMR and by each individual screening data through September 2017. All downstream cases were then filtered using the diagnosis code field to include only those cases related to LDT. Using the filtered downstream cases, ThinkMD® was queried to gather cost and operating margin data.

Results
- The downstream revenue for screened patients in the LDT program resulted in a net revenue of approximately $150,000. This is approximately $770,000 in net revenue.
- There were a total of 24 ineligible screening cases in this time span which accounted for a downstream revenue of approximately $50,000. The Medicare Managed Care payer represented 34% of the payer mix. The Medicare payer represented 19% of the payer mix.
- There were a total of 947 outpatient cases which resulted in an operating margin of $3,468.
- Of the patients screened, 13 patients were diagnosed with cancer. All subsequent diagnostic work and treatment after the initial screening of these patients was billed and the net revenue was $1,157X. This equates to approximately $5,800/patient in downstream revenue of this subset of patients.

Discussion
The downstream revenue attributable to the lung cancer screening program at UHS is approximately $770,000. The overall net revenue for the screening program is approximately $150,000 from 2013-2017. The screening program has detected 36 cancer cases. Of which some early stage cancers. In consideration of the mortality benefit of this program and the higher risk population it serves, further research would evaluate the financial value of its positive downstream revenue of $770,000 demonstrates that a lung cancer screening program is viable in a low socioeconomic environment. As screening program as it continues to expand. It is notable that the LDT used for screening may incidentally detect additional health problems, and this could provide additional downstream revenue attributable to this screening. Further research would evaluate the financial value of this screening program as it continues to expand in coming years. It is notable that the LDT used for screening may incidentally detect additional health problems and this could provide additional downstream revenue attributable to lung cancer screening. This could be an area of further investigation.

References
Screening Can Reduce Health Disparities and Save Lives

BREAST CANCER MORTALITY

PROSTATE CANCER MORTALITY

CERVICAL CANCER MORTALITY

Downtown Chicago

Downtown Chicago

Downtown Chicago
Conclusions

1. Lung cancer screening with low-dose CT scan can be successfully accomplished in minority and underserved communities.

2. High risk communities may benefit most by lung cancer screening and help to reduce health disparities.

Contact Information

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