Update on Lung Health Checks and Lung Cancer Screening

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Consultant Respiratory Physician
Leeds Teaching Hospitals
Objectives

• Benefits and Harms of Lung Cancer Screening
• NHS England Targeted Lung Health Check Programme
• NSC position on Lung Cancer Screening
• Impact on Primary Care
Sir Muir Gray (1944 - )

@muirgray

“All screening programmes do harm. Some do good as well and, of these, some do more good than harm at reasonable cost”
Lung Cancer Staging System (TNM8)

<table>
<thead>
<tr>
<th>Proposed</th>
<th>Events / N</th>
<th>MST</th>
<th>24 Month</th>
<th>60 Month</th>
</tr>
</thead>
<tbody>
<tr>
<td>IA1</td>
<td>68 / 781</td>
<td>NR</td>
<td>97%</td>
<td>92%</td>
</tr>
<tr>
<td>IA2</td>
<td>505 / 3105</td>
<td>NR</td>
<td>94%</td>
<td>83%</td>
</tr>
<tr>
<td>IA3</td>
<td>546 / 2417</td>
<td>NR</td>
<td>90%</td>
<td>77%</td>
</tr>
<tr>
<td>IB</td>
<td>560 / 1928</td>
<td>NR</td>
<td>87%</td>
<td>68%</td>
</tr>
<tr>
<td>IIA</td>
<td>215 / 585</td>
<td>NR</td>
<td>79%</td>
<td>60%</td>
</tr>
<tr>
<td>IIB</td>
<td>605 / 1453</td>
<td>66.0</td>
<td>72%</td>
<td>53%</td>
</tr>
<tr>
<td>IIIA</td>
<td>2052 / 3200</td>
<td>29.3</td>
<td>55%</td>
<td>36%</td>
</tr>
<tr>
<td>IIIB</td>
<td>1551 / 2140</td>
<td>19.0</td>
<td>44%</td>
<td>26%</td>
</tr>
<tr>
<td>IIIC</td>
<td>831 / 986</td>
<td>12.6</td>
<td>24%</td>
<td>13%</td>
</tr>
<tr>
<td>IVA</td>
<td>336 / 484</td>
<td>11.5</td>
<td>23%</td>
<td>10%</td>
</tr>
<tr>
<td>IVB</td>
<td>328 / 398</td>
<td>6.0</td>
<td>10%</td>
<td>0%</td>
</tr>
</tbody>
</table>
Screening

• Good
  – Improved survival or reduced deaths?

• Harm

• Cost
Screening biases with Gwyneth Paltrow
Lead time effect with Gwyneth Paltrow

- Miss GP
- Jan 1996 – starts to develop lung cancer
- Jan 1998 – has CT screening – cancer found and surgically removed
- Oct 2000 – presents with headaches – CT shows recurrence of cancer in brain
- Jan 2001 – dies

- Miss GP
- Jan 1996 – starts to develop lung cancer
- Oct 2000 – presents with headaches – CT shows brain metastases from lung cancer
- Jan 2001 - dies
Lead time effect

Carcinogenesis → Diagnosis → Death

Lead time

Carcinogenesis → Diagnosis → Death

Lead time → Prolonged life
Overdiagnosis with Gwyneth Paltrow

• Miss GP
• CT screen May 1998
• Ground glass nodule
• Right upper lobectomy July 1998 – T1N0M0 Bronchoalveolar Cell Carcinoma
• May 2018 – alive and well

• Miss GP
• Didn’t enter CT screening programme
• May 2018 – alive and well
Screening

• Good
  – Improved survival or reduced deaths?

• Harm

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

The National Lung Screening Trial Research Team*
B  Death from Lung Cancer

Cumulative No. of Lung-Cancer Deaths

Years since Randomization

- Chest radiography
- Low-dose CT

National Lung Screening Trial. NEJM 2011;365:395-409
Effects of volume CT lung cancer screening

Mortality results of the NELSON randomised-controlled population-based screening trial

Harry J. de Koning, MD PhD

PI NELSON
Professor & Deputy Head
Department of Public Health
Erasmus MC, University Medical Center Rotterdam, the Netherlands
Cumulative lung cancer deaths (Men only)

Control arm: 214 lung cancer deaths

Screen arm: 157 lung cancer deaths
Screening

• Good
  – Improved survival or reduced deaths?

• Harm

• Cost
Benefit of UK screening programme maybe higher because

- Benefit is compared to CXR screening
- Screening stopped after 2 years (6yr f/u)
- Increased incidence in UK (2-3% vs 1% in NLST)

Source: Canadian Task Force on Preventive Health Care
## False positives vs Cervical Screening

### Pap Smear (Cervix)

<table>
<thead>
<tr>
<th>#</th>
<th>Result</th>
<th>Action</th>
<th>Probability</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Negative</td>
<td>Routine screening</td>
<td>75%</td>
</tr>
<tr>
<td>2</td>
<td>Negative with some changes</td>
<td>Routine screening</td>
<td>73%</td>
</tr>
<tr>
<td>3</td>
<td>Unclear</td>
<td>Re-test 3-6 months</td>
<td>25%</td>
</tr>
<tr>
<td>3D</td>
<td>Dysplasia</td>
<td>Re-test 3-6 months</td>
<td>25%</td>
</tr>
<tr>
<td>4</td>
<td>Highly suspicious</td>
<td>Biopsy</td>
<td>1%</td>
</tr>
<tr>
<td>6</td>
<td>Likely cancer</td>
<td>Surgery</td>
<td>1%</td>
</tr>
</tbody>
</table>

### NLST

<table>
<thead>
<tr>
<th>Result</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Negative</td>
<td>Routine screening</td>
</tr>
<tr>
<td>Positive (Non-calcified nodule ≥4mm)</td>
<td>Further work-up</td>
</tr>
</tbody>
</table>

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National Lung Screening Trial. NEJM 2011;365:395-409
## False positives vs Cervical Screening

### Pap Smear (Cervix)

<table>
<thead>
<tr>
<th>Case</th>
<th>Description</th>
<th>Follow-up Action</th>
<th>Positive</th>
<th>Indeterminate</th>
<th>Negative</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Negative</td>
<td>Routine screening</td>
<td>≈75%</td>
<td></td>
<td>≈83%</td>
</tr>
<tr>
<td>2</td>
<td>Negative with some changes</td>
<td>Routine screening</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Unclear</td>
<td>Re-test 3-6 months</td>
<td>≈25%</td>
<td></td>
<td>≈13%</td>
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<td>Dysplasia</td>
<td>Re-test 3-6 months</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Highly suspicious</td>
<td>Biopsy</td>
<td>≈1%</td>
<td></td>
<td>≈5%*</td>
</tr>
<tr>
<td>6</td>
<td>Likely cancer</td>
<td>Surgery</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Manchester Pilot

<table>
<thead>
<tr>
<th>Positive</th>
<th>Indeterminate</th>
<th>Negative</th>
</tr>
</thead>
<tbody>
<tr>
<td>MDT referral</td>
<td>Repeat CT 3 months then routine screening</td>
<td>Routine screening</td>
</tr>
</tbody>
</table>

* Of which 52% had lung cancer
• Hospital anxiety and depression score and Cancer Worry Score were measured in control (non-screened) and intervention group at baseline, 2 weeks, and up to 2 years.

• Cancer distress was higher in participants with positive results at 2 weeks but not at longer follow-up.
Source: Canadian Task Force on Preventive Health Care
Initial follow-up of NLST cohort

• Overdiagnosis rate was 18% - i.e. 1 in 6 screen-detected cancers did not appear in CXR arm over 6 years

Figure 1. Cumulative Numbers of Lung Cancers and of Deaths from Lung Cancer.

National Lung Screening Trial. NEJM 2011;365:395-409
Longer follow-up of NLST cohort

- Overdiagnosis rate reduced from 18% (at 6 years) to 3% at 11 years

Black et al. JTO 2019 *epub ahead of print*
Source: Canadian Task Force on Preventive Health Care
Source: Canadian Task Force on Preventive Health Care
## Major complications after screening

<table>
<thead>
<tr>
<th>Numbers of patients (Rates per 1000 people screened)</th>
<th>Surgery</th>
<th>Other invasive test</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Major complication</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cancer</td>
<td>71 (2.7)</td>
<td>2 (0.1)</td>
<td>73 (2.7)</td>
</tr>
<tr>
<td>No cancer</td>
<td>9 (0.3)</td>
<td>2 (0.1)</td>
<td>11 (0.4)</td>
</tr>
<tr>
<td>Total</td>
<td>80 (3.0)</td>
<td>4 (0.1)</td>
<td>84 (3.1)</td>
</tr>
<tr>
<td><strong>Death</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cancer</td>
<td>5 (0.2)</td>
<td>5 (0.2)</td>
<td>10 (0.4)</td>
</tr>
<tr>
<td>No cancer</td>
<td>2 (0.1)</td>
<td>4 (0.1)</td>
<td>6 (0.2)</td>
</tr>
<tr>
<td>Total</td>
<td>7 (0.3)</td>
<td>9 (0.3)</td>
<td>16 (0.6)</td>
</tr>
</tbody>
</table>

National Lung Screening Trial. NEJM 2011;365:395-409
Benign resection

• Almost all major complications are post-surgical

• Benign resection rates
  – 21% in NLST
  – 10.3% in UKLS
  – 2.1% in Manchester pilot
Screening

• Good
  – Improved survival or reduced deaths? ✔

• Harm
  – Are present, and must be discussed with participants
  – Far lower than originally reported ✔
  – Can be reduced further by minimising benign resection

• Cost ❓
National Targeted Lung Health Check Programme

- 14 sites chosen (highest mortality for lung cancer)
- Lung Health Checks (risk assessment for lung cancer, spirometry)
- Estimate 50% response rate and ≈ 50% eligibility
- Variable size, but largest project (Newcastle and Gateshead) anticipating over 9,000 scans in 1 year
### National Targeted Lung Health Check Programme

**First phase (2019 to 2023)**

<table>
<thead>
<tr>
<th>Category</th>
<th>Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of participants</td>
<td>600,000</td>
</tr>
<tr>
<td>Ever smoked</td>
<td>54%</td>
</tr>
<tr>
<td>Lung Health Checks</td>
<td>150,000 (50%)</td>
</tr>
<tr>
<td>Initial CT scans</td>
<td>81,000 (56%)</td>
</tr>
<tr>
<td>Clinical Investigations</td>
<td>5,000 (5.9%)</td>
</tr>
<tr>
<td>Indeterminate results</td>
<td>11,500 (14.2%)</td>
</tr>
<tr>
<td>24 month follow up CT scan</td>
<td>67,000 (82.5%)</td>
</tr>
</tbody>
</table>
UK National Screening Committee

• HTA review in 2017 suggested non-significant impact on lung cancer mortality from 4 RCTs
• Screening would not be cost-effectiveness at a £20,000 threshold, but maybe at £30,000
• Future work to update clinical and cost-effectiveness estimates with NELSON data (currently submitted to NEJM)

• No evidence of benefit at “population level”- trials ongoing but won’t report for years.
Involvement/Impact on Primary Care

- Invitation process
- Management of incidental findings
- Undiagnosed COPD
  - $\text{FEV}_1/\text{FVC} < 70\%$, $\text{FEV}_1 < 80\%$ predicted, COPD defining symptoms
  - 221 of 2791 scans to date $\approx 8\%$
MOT FOR YOUR LUNGS
People aged 55 to 80 in Leeds are being offered a new FREE LUNG HEALTH CHECK

The checks take place in mobile vans in convenient community locations like supermarket car parks, so you won’t have to travel to hospital.

They are run by specially trained nurses, who can find out how well your lungs are working. If needed, you’ll get care and treatment to help breathe new life into your lungs.

The checks are for people aged 55 to 80, who are current or former smokers. You are invited whether you feel fine or not, and whether or not you have any lung problems.

Having a check even if you don’t have symptoms is really important. It might pick up things you didn’t even know were there. Catching disease earlier means it’s much easier to treat.

Margaret, Halton

BENEFITS OF THE LUNG HEALTH CHECK
✓ Totally FREE
✓ LOCAL and easy to get to, your check takes place in a community setting close to your home.
✓ TALK through your questions over tea or coffee.
✓ Find out about having a lung scan.
✓ No judgements on smoking.

We started smoking young, back then everyone was smoking around you. It was the norm. It’s good to know people won’t get a hard time at the Lung Health Checks

Jenny, Woodlesford

LOOKING AFTER YOUR LUNGS
HOW THE NHS CAN HELP

Your lungs work hard every minute of your life. As you get older it’s worth checking them out.

The lung health check can spot problems early, often before you notice anything, when treatment could be simpler and more successful.

YOUR LUNGS COULD BE EASIER TO FIX THAN YOU THINK

You have two lungs, made up of five sections called lobes. Each lobe is made up of thousands of tiny grape-like sacs, called alveoli.

If there is a problem in one bit of the lung, early treatment can focus just on the bit that is affected.

RIGHT LUNG

LEFT LUNG

Dr Bill Jones

Reminder Letter v2.1 3rd Jan 2019 (SAO No. 233403)
Summary

• Main impetus behind roll-out of Targeted Lung Health Checks has come from NHS England
• Clinical Expert Group has produced standard protocol, QA, incidental findings document
• Projects are nervous about implications for radiology services, and overall volumes of patients to be seen
• Implications for primary care
  – Involvement in invitation process
  – Management of incidental findings (COPD, radiological findings)