The Increasing Risk Of Occupational Cancer

Home House
30 April 2013
Never underestimate the risk of occupational cancer

Lesley Rushton
MRC-HPA Centre for Environment and Health
Aims

• Establish baseline risk
• Identification of major risk factors
  • Carcinogens (42)
  • Cancer sites (23)
  • Industries and occupations (60+)
• Support decisions on priority actions for risk reduction
• Facilitate planning for future needs
• Identify knowledge gaps
What did we estimate?

• **Current Burden of Occupational Cancer:**
  - Estimate size of current burden based on past exposures at work
  - Estimation carried out for all substances and circumstances (e.g. work as a painter or welder) in the workplace defined by International Agency for Research on Cancer (IARC) as:
    - **definite** (group 1) human carcinogen
    - **probable** (group 2A) human carcinogen

• **Prediction of Future Burden of Occupational Cancer**
  - Estimate size of future burden based on current and past exposures
  - Demonstrate effect of measures to reduce exposure
How did we measure burden?

- **Measured burden using:**
  - **Attributable Fraction:** proportion of cases attributable to exposure
    - Needs risk of the cancer from exposure to the carcinogen
    - Needs the population exposed to the carcinogen
  - **Attributable Deaths**
  - **Attributable Cancer Registrations** (Newly occurring cancers)

- **Used data from:**
  - Published literature on occupational risks
  - National data sources
    - Carcinogen exposure database (CAREX)
    - Labour Force Survey (LFS)
    - Employment data
## Attributable fraction

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<th>Attributable Fraction (%)</th>
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## Attributable fraction, deaths

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## Major occupational carcinogens

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<th>Shift work</th>
<th>Mineral oils</th>
<th>Solar radiation</th>
<th>Silica</th>
<th>Diesel Engine Exhaust</th>
<th>Polycyclic Aromatic Hydrocarbons (Tars)</th>
<th>Painters</th>
<th>Dioxins</th>
<th>Environmental Tobacco Smoke</th>
<th>Radon</th>
<th>Welders</th>
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Lung cancer by carcinogen/occupation

- Arsenic
- Asbestos
- Beryllium
- Cadmium
- Chromium VI
- Cobalt
- Diesel engine exhaust
- Environ. Tobacco Smoke
- Inorganic lead
- Ionising radiation
- Mineral oils
- Nickel
- PAHs (coal tars/pitches)
- Painters
- Radon
- Silica
- Steel foundry workers
- Strong inorganic-acid mists
- TCDD (Dioxins)
- Tin miners
- Welders

AF
### Major industry sectors

<table>
<thead>
<tr>
<th>Industry Sector</th>
<th>Asbestos</th>
<th>Shift work</th>
<th>Mineral oils</th>
<th>Solar radiation</th>
<th>Silica</th>
<th>DEE</th>
<th>PAHs (Tars)</th>
<th>Painters</th>
<th>Dioxins</th>
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<td><strong>Total Registrations</strong></td>
<td>4,216</td>
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<td>437</td>
<td>316</td>
<td>284</td>
<td>13,598</td>
</tr>
</tbody>
</table>
Cancer Registrations Attributable to Work in the Construction Industry - Men

- Arsenic
- Asbestos
- Chromium
- Cobalt
- Diesel
- ETS
- Formaldehyde
- Lead
- Painters
- PAH
- PAH - coal tars and pitches
- Radon
- Silica
- Solar Radiation
- Tetrachloroethylene
- Wood dust

Number of Registrations

Legend:
- Construction, inc painters and decorators; road surfacers, roadmen, roofers & glazers, paviours
- Other Sectors
Predicting Future Burden

- Attributable Fractions and Attributable Numbers of deaths and cancer registrations estimated for a series of forecast years, e.g. 2010, 2020 … 2060
- Changing balance between past and future exposure
- Method provides a tool for comparing ‘doing nothing’ with various interventions
- Methods applied to top 14 carcinogens/occupations identified as accounting for 85.7% of total current (2004) cancer registrations
Change in future exposure: Intervention Scenarios

Baseline scenario - based on pattern of past exposure, but no future change in exposed numbers or exposure levels

Interventions - can test:

• Introduction of a range of possible exposure standards or reduction of a current exposure limit
• Improved compliance to an existing exposure standard
• Planned intervention such as engineering controls or introduction of personal protective equipment
• Timing of introduction (2010, 2020 etc)
• Compliance levels e.g. according to workplace size (self-employed, 1-49, 50-249, 250+ employees)

Compare predicted numbers from baseline ‘no change’ with interventions
Example of silica

Silica: current limit 0.1 mg/m$^3$, 33% compliance

- Reduce exposure limit in all workplaces to:
  - 0.05 mg/m$^3$ in 2010
  - 0.025 mg/m$^3$ in 2010

- Improve compliance from 33% to 90% in all workplaces

- Do both for all workplaces

- Successively enforce a new limit and improve compliance in workplaces of different sizes
Reduce exposure standard and then improve compliance

<table>
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<tr>
<th>Test scenarios</th>
<th>Lung cancers from respirable crystalline silica</th>
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<td><strong>Base-line: exposure limit 0.1mg/m³, compliance 33%</strong></td>
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<td>Exposure limit 0.05mg/m³, compliance 33%</td>
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</tr>
<tr>
<td>Exposure limit 0.025mg/m³, compliance 33%</td>
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<td>Exposure limit 0.05mg/m³, compliance 90%</td>
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<tr>
<td>Exposure limit 0.025mg/m³, compliance 90%</td>
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</table>
Reduce exposure standard and then improve compliance

A) Attributable registrations

- Baseline: exposure limit 0.1mg/m³ maintained, compliance 33%
- Exposure limit 0.05mg/m³ from 2010, compliance 33%
- Exposure limit 0.025mg/m³ from 2010, compliance 33%
- Exposure limit 0.1mg/m³ maintained, compliance 90%
- Exposure limit 0.05mg/m³ from 2010, compliance 90%
- Exposure limit 0.025mg/m³ from 2010, compliance 90%

B) Attributable Fractions

- Baseline: exposure limit 0.1mg/m³ maintained, compliance 33%
- Exposure limit 0.05mg/m³ from 2010, compliance 33%
- Exposure limit 0.025mg/m³ from 2010, compliance 33%
- Exposure limit 0.1mg/m³ maintained, compliance 90%
- Exposure limit 0.05mg/m³ from 2010, compliance 90%
- Exposure limit 0.025mg/m³ from 2010, compliance 90%
## Test improvement in compliance by workplace size

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<td>Exposure limit 0.05mg/m³, compliance 33%</td>
<td>0.80</td>
</tr>
<tr>
<td>Exposure limit 0.05mg/m³, change compliance by workplace size/self employed</td>
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<tr>
<td>90% 250+; 33% &lt;250, self employed</td>
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<tr>
<td>90% 50+; 33% &lt;50, self employed</td>
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<tr>
<td>90% all sizes employed; 33% self employed</td>
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<td>90% all workplaces</td>
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</table>
Summary of Future Burden Results

- 14 agents account for 85.7% current occupation attributable cancer giving 12,000 cancers in 2010.
- Will rise to nearly 13,000 by 2060 given current trends in employment and exposure levels.
- No impact seen until 2030 because of general increase in cancers due to aging population.
- With modest intervention over 2,000 cancers can be avoided by 2060 (including 376 lung, 928 breast cancers, 432 NMSC).
- With stronger interventions nearly 8,500 can be avoided by 2060 (including 1,732 lung, 3,062 breast and 3,287 NMSC).
- Methods enables effective interventions to be identified.
- Need to monitor exposure levels in future to assess whether interventions have been successful.
Prevention

• Our study has showed that workplace cancers are a concern
• The current occupational cancer burden is mostly caused by a small number of agents
• Without any additional actions burden in the future will stay approximately the same
• Important to take preventive action to protect future generations of workers
• Exposures have been decreasing steadily over time
• Focused effort could ensure the occupational cancer burden becomes much less:
  - Small and medium sized companies, self employed workers
  - Dusts, fibres, fumes, gases through inhalation e.g. asbestos, silica, wood dust, diesel exhaust, welding fumes
  - Solar radiation – encourage use of sunscreens and appropriate clothing
  - Shift (night) work
Publications

• Current burden results
  • Overview Paper: Br J Cancer 2010, 102: 1428-1437
  • Supplement (13 papers) of current burden detailed results
    » Br J Cancer 2012;107(S1):S1-S108
    » 23 technical reports available at http://www.hse.gov.uk/cancer/

• Future burden
  • Methodology paper: Am J Epidem 2011, 173, 1069-1077+ technical report on HSE website
  • Future burden results: Cancer Prevention Research, 2012, online
Thank you
liability for occupational cancer

Nick Pargeter
Partner
BLM London

30th April 2013
duty of care & knowledge

- **Stokes v. Guest Keen and Nettlefold** [1968] 1 WLR 1776
- **Thompson v. Smiths Shiprepairers** [1984] QB 405

The test is the conduct of the reasonable and prudent employer, taking positive thought for the safety of his workers in light of what he knows or ought to know. The employer must keep up to date, but the standard of what is or is not negligent will be influenced by practice in the industry as a whole.
forseeable risk of personal injury

- *Page v. Smith* [1996] 1 AC 155 - the defendant need not have foreseen the risk of the specific disease

- *Margereson and Hancock v. J.W. Roberts Ltd* [1996] PIQR P358 - defendant will be liable in a mesothelioma claim where the exposure to asbestos was sufficient to give rise to a forseeable risk of respiratory illness

> “It matters not that at the relevant time the diseases understood to be caused by exposure to asbestos did not include mesothelioma.”
the test for causation

“The basic rule of causation in tort is the “but for” rule which requires that the claimant must show that, but for the defendant's breach of duty, he would probably not have suffered the injury complained of.”

this test is not perfect:

“This broad test of balance of probabilities means that in some cases a defendant will be held liable for damage which he did not, in fact, cause. Equally there will be cases where the defendant escapes liability, notwithstanding that he has caused the damage, because the claimant is unable to discharge the burden of proving causation.”
developments in the “but for” test

there are three primary developments/changes to the test relevant in work-related cancer claims.

- Material contribution test
- The place of epidemiology in the “but for” test – doubling of risk
- The *Fairchild* exception
material contribution test and cancer

The key issue is whether it can be said that the tortious and non-tortious agents acted together (ie. both contributed to the cancer) or whether it can only be said that the two agents each contributed to the risk.

Novartis Grimsby Ltd v. John Cookson [2007] EWCA Civ 1261
doubling of risk and the place of epidemiology

- *Shortell v. BICAL Construction Ltd*,
- *Amaca Pty Ltd & others v. Ellis* [2010] HCA 5
- *Novartis Grimsby Ltd v. John Cookson* [2007] EWCA

epidemiology and the assessment of risk
the mesothelioma exception

- *Fairchild v. Glenhaven Funeral Services Ltd* [2002] UKHL 22:

  “Unusual features of the disease led the House of Lords to create a special rule governing the attribution of causation to those responsible for exposing victims to asbestos dust. ..

  when a victim contracts mesothelioma each person who has, in breach of duty, been responsible for exposing the victim to asbestos dust and thus creating a “material increase in risk” of ....the disease will be held to be jointly and severally liable for causing the disease.”
Which test for non-mesothelioma cancers?

- **Agent** – proved to be a carcinogen?

- **Exposure** – was a particular carcinogen (rather than any other) causative?

- **Defendant** – if more than one employer is responsible for the same type of exposure to the carcinogen – which is liable?
agent – proved to be a carcinogen?

- **Ministry of Defence v. Wood [2011] EWCA Civ 792.**
  
  “it’s not always necessary to have scientific proof by epidemiological study before one can reach a sensible conclusion that a particular agent has caused a certain effect”

- **A. Bradford-Hill, ‘The Environment and Disease: Association or Causation?’ Proceedings of the Royal Society of Medicine, 58 (1965) 295).**

- **Phurnacite Litigation  [2012] EWHC 2936 (QB)**
  
  Not proved that the substances to which the employees were exposed made a material contribution to the development of their bladder cancer
exposure – was a particular carcinogen (rather than any other) causative?

divisible v indivisible disease – key to which test to apply here

- Shortell v BICAL Construction Ltd
- Lord Phillips – obiter in Sienkiewicz
- Atomic Veterans
- Phurnacite Litigation [2012] EWHC 2936 (QB)
Dr Rudd “in any individual case where a lung cancer has developed, both exposures will on the balance of probabilities have contributed materially to the carcinogenic process which resulted in the development of the cancer”

Swift J the claimants with lung cancer claims were exposed to carcinogens both from occupational exposure at the Phurnacite plant, and from smoking. It was not possible to say which factor or factors caused or contributed to the cancer.

**the appropriate approach here was the doubling of risk test:**

(i) causation in cancer must be assessed by risk; and thus

(ii) epidemiological evidence – or doubling the risk of the non-tortious factor - must be the basis for assessing causation.
if more than one employer is responsible for the same type of exposure which is liable?

- Identical situation to Fairchild?
- Would the courts be willing to increase *Fairchild’s* reach?
- *Barker v. Corus* [2006] UKHL 20 divisibility of liability
- Compensation Act 2006
- *EL Trigger Litigation* [2012] UKSC 14
Conclusion

- Case law on causation doesn’t fit the indivisible nature of cancers – and the Supreme Court has “work in progress”
- There is political sensitivity around occupational cancers – The Government does intervene when the judiciary’s solution is not politically acceptable
- But there is a balance – a system where contribution to risk establishes liability would not be tenable
Occupational Cancer
Risk management techniques

Home House
30 April 2013

Gordon C Wishart
Professor of Cancer Surgery
Anglia Ruskin University, Cambridge.

Medical Director, HealthScreen UK
Occupational cancer burden

• 14 agents account for 85.7% of occupational cancers (12,000 in 2010)
• 8% of all cancer deaths due to occupational exposure
• >20% of lung cancer deaths in men due to occupational exposure
• Shift work increases the risk of breast cancer
• Not all carcinogens have been evaluated
Reducing occupational cancer deaths

• Minimise exposure to carcinogenic agents
• Improve compliance with existing exposure standards
• Cancer awareness & education
• Early detection programmes
# Reducing occupational cancer

<table>
<thead>
<tr>
<th>Modest intervention</th>
<th>LUNG</th>
<th>BREAST</th>
<th>NMSC</th>
<th>TOTAL</th>
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<tr>
<td></td>
<td>376</td>
<td>928</td>
<td>432</td>
<td>2000</td>
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<tr>
<td>Stronger intervention</td>
<td>1732</td>
<td>3062</td>
<td>3287</td>
<td>8500</td>
</tr>
</tbody>
</table>
Breast cancer risk factors

- Reproductive factors
- Lifestyle (alcohol & obesity)
- Family history and genetic (68 SNPs)
- Environmental & occupational
  - Shift work
  - Radiation
  - Chemicals
    (organochlorines)
Breast cancer & shift work

- One third of female shift workers now work at night
- Exposure to light at night alters circadian rhythms, altering genes in cancer pathways
- Shift work declared a Type 2A carcinogen in 2007
- Research studies on flight personnel and nurses
Breast cancer & shift work

• Based on 6 studies and excluding flight personnel
• Meta-relative risk for female night workers of 1.56 (95% CI 1.36-1.68)

• UK breast cancer risk 1:8 or 12.5%
• Shift work risk = 12.5% x 1.56 = 19.5%
• Responsible for 4.5% of all breast cancers
Breast cancer & flight personnel

- Uncertainty about causation (radiation or shift work)
- Meta-relative risk for flight personnel of 1.44 (95% CI 1.26-1.65)
- UK breast cancer risk 1:8 or 12.5%
- Flight personnel risk = 12.5% x 1.44 = 18%
Managing breast cancer risk at work

- Evaluation of individual breast cancer risk in current or prospective employees
- Avoidance of night shift work in higher risk women
- Education and breast awareness
- Early detection programmes
Managing breast cancer risk at work

• Evaluation of individual breast cancer risk in current or prospective employees
• Avoidance of night shift work in higher risk women
• Education and breast awareness
• Early detection programmes
Tyrer-Cuzick Risk Assessment Model

- Age
- Height & weight
- Age at menarche, first live birth, age at menopause
- Presence of atypia or LCIS on biopsy
- Family history (with or without cancer)
- HRT use

Does not include alcohol

Tyrer J, Duffy SW, Cuzick J
Managing breast cancer risk at work

- Evaluation of individual breast cancer risk in current or prospective employees
- Avoidance of night shift work in higher risk women
- Education and breast awareness
- Early detection programmes
Avoidance of night shift work in higher risk women

If moderate or high risk with Tyrer-Cuzick risk assessment consider:

- Informing existing employees of the additional risk of breast cancer and advising new employees that they may be taking on an unnecessary risk as night shift personnel.
- Asking employee to sign waiver saying they understand and accept the additional risk.
- The employee for alternative role.
Managing breast cancer risk at work

- Evaluation of individual breast cancer risk in current or prospective employees
- Avoidance of night shift work in higher risk women
- Education and breast awareness
- Early detection programmes
Education and breast awareness

• Education about signs and symptoms of breast cancer
• Advice on self-examination
• Advice on breast screening
• Use of presentations, leaflets and web-based information
• Aim is to improve chances of early detection with better survival & less breast cancer deaths
BreastCheck

• Online risk assessment using T-C
• 20-minute consultation with specialist nurse
• Discussion of personal breast cancer risk
• Discussion of risk reduction strategies
• Tuition in breast self-examination
• Clinical breast examination
• Personal risk-stratified breast screening program
Screening mammography

NHS
3 yearly from 50-70 years of age (47-73)

PRIVATE
Age 40-49  Annual screening for higher risk
Age 50-70  Screening mammogram every two years
Lung cancer

• 41,428 new cases diagnosed in UK (2009)
• 34,859 deaths in UK (2010)

• Lifetime risk in men: 1 in 14
• Lifetime risk in women: 1 in 19
Lung cancer

• Most common malignancy among men in most countries
• Rapidly increasing in women
• 90% of cases linked to smoking in developed countries.
• Accounts for 23.4% of male and 17.9% of female cancer deaths (2005)
Lung cancer

- Symptoms often do not arise until lung cancer is quite advanced
- <20% have operable disease
- Only 3-5% have early stage curable disease
- No national lung cancer screening programme
Reducing occupational lung cancer

- Minimise exposure to carcinogenic agents
- Improve compliance with existing exposure standards
- Cancer awareness & education ×
  - Stop smoking
  - Avoid ETS
- Early detection programmes ✓
Reduce Risk via lifestyle changes

Lung Cancer Risk

Smoking Cessation
Oncimmune’s *EarlyCDT-Lung* test

3. So What Else is There for Early Detection?

Autoantibodies are detectable up to 5 years before a tumor is visible. Oncimmune’s *EarlyCDT-Lung* is a simple blood test measuring a panel of autoantibodies that has the potential for the early detection of lung cancer even prior to detection by imaging as well as through late stage.

- **Autoantibodies are detectable up to 5 years before a tumor is visible.**
- **Detectable by CT**
- **Clearly Visible by CT**
- **Clinically Apparent Physical Symptoms Present**
- **Death**

<table>
<thead>
<tr>
<th>Stage</th>
<th>Key Event</th>
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<tbody>
<tr>
<td>0 mm</td>
<td>AUTOANTIBODY DETECTABLE</td>
</tr>
<tr>
<td>2 mm</td>
<td>Detectable by CT</td>
</tr>
<tr>
<td>8 mm</td>
<td>Clearly Visible by CT</td>
</tr>
<tr>
<td>40 mm</td>
<td>Clinically Apparent Physical Symptoms Present</td>
</tr>
<tr>
<td>100 mm</td>
<td>Death</td>
</tr>
</tbody>
</table>
CT¹

- 7x more false positives thus cost-ineffective
- Lower sensitivity c.f. EarlyCDT-Lung of 41%
- Lower PPV (1 in 36) thus increased number of anxious patients
- Lower specificity (50%) and accuracy (50%)
- Harmful Radiation Exposure
- Costly for Patient

EarlyCDT-Lung²,³,⁴

- Increased cost effectiveness due to 7x fewer false positives
- Increased adjusted sensitivity (c.f. CT) of 82%
- 7x better PPV (1 in 5.1) thus fewer anxious patients
- Higher specificity (93%) and accuracy (91%)
- Non-invasive & no radiation risk
- Covered by Medicare and Private Health Insurance
LUNG CANCER SCREENING TRIAL

APRIL 16, 2012

Recent reports of a pilot lung cancer screening programme across Scotland were reported by the media with much excitement, and understandably so.

Scotland has one of the highest rates of lung cancer in the world, and tobacco smoking causes the majority of cases. With early diagnosis patients have a 60 per cent chance of survival, but where the cancer is well advanced at diagnosis the survival rate drops to just one per cent. Currently, early detection rates are poor – 85 per cent of patients remain undiagnosed until the disease has reached an advanced stage and fewer than 9% of patients are still alive five years after diagnosis.

The pilot project is part of the Scottish Government’s Detect Cancer Early programme, which aims to increase the early detection of cancer by 25 per cent, enabling patients to be treated when their general health is better and when less aggressive treatment may be required. Screening will involve those considered at high risk for developing lung cancer – people who have smoked at least 20 a day for more than 20 years. Half of the 10,000 people recruited will get a blood test which will identify antibodies in the blood that are produced by the immune system when lung cancer is present.
LungCheck

- On-line risk assessment based on lifestyle and family history
- Symptom score
- Blood sample (10 minute appointment)
- Results letter within 2-3 weeks
- Recall as per personalised risk assessment
Skin cancer awareness 1
risk factors

• Fair skin that has freckles, burns easily, and does not tan easily
• A history of repeated episodes of sunburn and blistering, especially in childhood and adolescence
• Close family members who have developed melanoma
• Dysplastic nevus syndrome (unusual moles)
• An immune system that is compromised by illness or medication
Skin cancer awareness 2
what to look for

Changes to look for—the ABCD rule

A symmetry: The two halves of your mole do not look the same
B border: The edges of your mole are irregular, blurred, or jagged
C colour: The colour of your mole is uneven, with more than one shade
D diameter: Your mole is wider than 6mm in diameter
Occupational skin cancer risk reduction

• Avoid the sun at its hottest (11 a.m. to 3 p.m.)
• Wear protective clothes when outside
• Use sunscreen with sun protection factor (SPF) >15
• Reapply SPF after swimming and every two hours when outside
• Avoid use of sun beds and sun lamps
• Check your skin regularly including feet, toes, and soles
• Seek clinical opinion for skin lesions that appear or change in appearance
SkinCheck

- Education about risk factors
- Education about risk reduction
- Complete skin examination
- Digital image capture
- Tuition in what to look for
- Results letter
Early cancer detection programmes (EDPs)

- BreastCheck
- LungCheck
- SkinCheck
- ProstateCheck
- BowelCheck (2013)
Early cancer detection programmes (EDPs)

• Awareness & education
• Online risk assessment & symptom scores
• Risk-stratified EDPs
• Ongoing referral if screening test abnormal
• Based on innovative but validated technology
• Supported by KOLs in UK
Early cancer detection programmes (EDPs)

- BreastCheck
- LungCheck
- SkinCheck
- ProstateCheck
- BowelCheck (2013)