Index of Suspicion: Predicting Cancer from National Population-Based Prescribing Data

Josephine French\textsuperscript{1,2}, Katherine Henson\textsuperscript{2}, Cong Chen\textsuperscript{1,2}, Brian Shand\textsuperscript{1,2}, Sally Vernon\textsuperscript{2}, Joshua Pencheon\textsuperscript{2}, Patrick Ferris\textsuperscript{1,2}, Meena Rafiq\textsuperscript{3}, David Howe\textsuperscript{1,2}, Georgios Lyratzopoulos\textsuperscript{2,3}, Jem Rashbass\textsuperscript{1,2}.

1. Health Data Insight CIC
3. University College London

This work was funded by a Cancer Research UK Pioneer Award.
Question:

Can we find patterns in prescribing prior to cancer diagnosis?
Overview

• Lung and colorectal cancer.
• Existing work.
• Linked national prescriptions data in England.
• What does prescribing in England tell us?
• Discussion and next steps.
Can We Find Patterns in Prescribing Prior to Cancer Diagnosis?

Lung: antibiotics, COPD drugs, opioids.
Colorectal: Haemorrhoid drugs, laxatives/anti-diarrhoeals, PPIs, opioids, penicillins, iron.

L. Guldbrandt, H. Møller, E. Jakobsen, P. Vedsted: General practice consultations, diagnostic investigations, and prescriptions in the year preceding a lung cancer diagnosis.
P. Hansen, P. Hjertholm, P. Vedsted: Increased diagnostic activity in general practice during the year preceding colorectal cancer diagnosis.
A. Pottegård, J. Hallas: New use of prescription drugs prior to a cancer diagnosis.
Symptoms of Lung and Colorectal Cancer

### Symptoms of Lung Cancer
- Persistent **cough**.
- **Coughing** up blood.
- Persistent **chest infections**.
- **Breathlessness**.
- Ache or pain in **chest** or shoulder.
- Tiredness.
- Loss of appetite or weight loss.

### Symptoms of Colorectal Cancer
- Change in **bowel** habit.
- Blood in stools or bleeding from rectum.
- **Abdominal pain**, discomfort, or bloating.
- Lump or swelling in back passage or abdomen.
- Feeling of straining even after emptying **bowels**.
- Tiredness/breathlessness caused by **anaemia**.
- Vomiting.
- Weight loss.

---

[https://www.nhs.uk/conditions/lung-cancer/symptoms/](https://www.nhs.uk/conditions/lung-cancer/symptoms/)

[https://www.nhs.uk/conditions/bowel-cancer/symptoms/](https://www.nhs.uk/conditions/bowel-cancer/symptoms/)
The Data

920 million prescriptions

38 million patients with a prescription

2.3 million cancer patients alive in April 2015

11 months (April 2015-February 2016)

2.0 million with at least one prescription

Amoxicillin 250mg capsule (Presentation) → Broad-spectrum penicillins (Subparagraph) → Infections (Chapter)
The Cohorts

• First: Quick look at all patients with a first cancer diagnosed in March 2016 (excl. non-melanoma skin cancer).

• Focus: Patients diagnosed with a first cancer of lung or colorectal cancer in 2016.

• Pathway start date between January and March 2016.

• Prescriptions in the nine months prior to pathway start.

• Matched patients receiving prescriptions to controls on age and calendar months of prescribing.
The Cohorts

• 7,235 lung cancer patients, of which 6,770 received at least one prescription in the nine-month period.

• 6,664 colorectal cancer patients, of which 5,869 received at least one prescription in the nine-month period.

• Matched to 67,700 and 58,690 controls respectively.
Methodology

• Overall prescribing: Patients receiving prescriptions and mean prescriptions per person.

• Breakdown by chapter and subparagraph of the British National Formulary.

• Highest drugs by percentage increase in patients prescribed the drug in month -1 compared to month -9 for drugs prescribed to at least 1% of the cohort at month -9.
Numbers of Patients Receiving Prescriptions Prior to a First Cancer Diagnosis in March 2016 (N=26,200)
For Our Cohorts of Interest?

Mean Prescriptions per Person Prior to Lung (N=7,235) and Colorectal (N=6,664) Cancer Diagnoses

<table>
<thead>
<tr>
<th>Month Prior to Pathway Start</th>
<th>Mean Prescriptions per Person</th>
</tr>
</thead>
<tbody>
<tr>
<td>-9</td>
<td>4</td>
</tr>
<tr>
<td>-8</td>
<td>4</td>
</tr>
<tr>
<td>-7</td>
<td>4</td>
</tr>
<tr>
<td>-6</td>
<td>4</td>
</tr>
<tr>
<td>-5</td>
<td>4</td>
</tr>
<tr>
<td>-4</td>
<td>4</td>
</tr>
<tr>
<td>-3</td>
<td>4</td>
</tr>
<tr>
<td>-2</td>
<td>4</td>
</tr>
<tr>
<td>-1</td>
<td>4</td>
</tr>
</tbody>
</table>

24% 

17%

Patients Receiving a Prescription Prior to Lung (N=7,235) and Colorectal (N=6,664) Cancer Diagnoses

<table>
<thead>
<tr>
<th>Month Prior to Pathway Start</th>
<th>Proportion Receiving Prescriptions</th>
</tr>
</thead>
<tbody>
<tr>
<td>-9</td>
<td>0.75</td>
</tr>
<tr>
<td>-8</td>
<td>0.75</td>
</tr>
<tr>
<td>-7</td>
<td>0.75</td>
</tr>
<tr>
<td>-6</td>
<td>0.75</td>
</tr>
<tr>
<td>-5</td>
<td>0.75</td>
</tr>
<tr>
<td>-4</td>
<td>0.75</td>
</tr>
<tr>
<td>-3</td>
<td>0.75</td>
</tr>
<tr>
<td>-2</td>
<td>0.75</td>
</tr>
<tr>
<td>-1</td>
<td>0.75</td>
</tr>
</tbody>
</table>

14% 

13%
Comparison with Controls

Mean Prescriptions per Person Receiving Prescriptions Prior to Lung (N=6,770) Cancer Diagnosis

Mean Prescriptions per Person Receiving Prescriptions Prior to Colorectal (N=5,869) Cancer Diagnosis
Highest Increases by Chapter Prior to Lung Cancer Diagnosis (n=7,235)

**BNF Chapter**
- Infections 132%
- Appliances 52%
- Musculoskeletal & Joint Diseases 39%
- Dressings 31%
- Endocrine System 30%
Highest Increases by Chapter Prior to Colorectal Cancer Diagnosis (n=6,664)

BNF Chapter
- Gastro-Intestinal System 42%
- Infections 41%
- Nutrition And Blood 34%
- Appliances 23%
- Obstetrics,Gynaecology+Urinary Tract Disorders 18%
Prescribing by Chapter Prior to Lung (N=6,770)
Cancer Diagnosis

Highest Patient-Control Ratios:
03: Respiratory System  2.8
05: Infections  2.0
04: Central Nervous System  1.5
09: Nutrition And Blood  1.4
01: Gastro-Intestinal System  1.3

Lowest Patient-Control Ratios:
19: Other Drugs And Preparations  0.5
14: Immunological Products & Vaccines  0.7
Prescribing by Chapter Prior to Colorectal (N=5,869) Cancer Diagnosis

Highest Patient-Control Ratios:
None.

Lowest Patient-Control Ratios:
19: Other Drugs And Preparations  0.5
23: Stoma Appliances  0.6
15: Anaesthesia  0.7
04: Central Nervous System  0.9
13: Skin  0.9
Drugs with the Highest Prescribing Increases Prior to Colorectal Cancer Diagnosis (N=6,664)

- Osmotic Laxatives 122%
- Broad-Spectrum Penicillins 70%
- Oral Iron 63%
- Stimulant Laxatives 56%
- H2-Receptor Antagonists 40%
Discussion

• Findings are consistent with the Danish studies. We see overall prescribing increases and specific increases of antibiotics and corticosteroids for lung cancer, as well as laxatives, penicillins, and iron for colorectal cancer.

• Consistent with clinical knowledge.

• Further work: Machine learning. Investigate predictive values of (combinations of) drugs.
Conclusions

• Prescribing increased in the months prior to a first cancer diagnosis or pathway start.

• Site-specific prescribing increases can be seen to occur within specific BNF chapters and drug groups.

• Increases validate findings from previous studies in Denmark and clinical understanding.
Any Questions?

Thank you for listening.

Data for this study is based on patient-level information collected by the NHS, as part of the care and support of cancer patients. The data is collated, maintained and quality assured by the National Cancer Registration and Analysis Service, which is part of Public Health England (PHE).

josephine.french@phe.gov.uk