Institution: The University of Manchester

Unit of Assessment: 1 (Clinical Medicine)

Title of case study: Manchester's Lung Health Checks: community-based screening boosts early lung cancer detection and leads to national screening pilots

Period when the underpinning research was undertaken: June 2016 – December 2020

Details of staff conducting the underpinning research from the submitting unit:

Name(s):	Role(s) (e.g. job title):	Period(s) employed by submitting HEI:
Philip Crosbie	Clinical Senior Lecturer Honorary Senior Lecturer	2017 – present 2015 – 2017
Richard Booton	Honorary Clinical Chair Honorary Senior Lecturer	2019 – present 2015 – 2019

Period when the claimed impact occurred: 1 June 2016 – 31 December 2020

Is this case study continued from a case study submitted in 2014? N

1. Summary of the impact

Manchester's Lung Health Checks (LHC) used a community-based approach to address the unmet need for lung cancer early detection. University of Manchester (UoM) researchers took lung cancer screening directly into socio-economically disadvantaged communities using mobile computerised tomography (CT) scanners in supermarket car parks. In a pilot study (2,541 attendees), 75% were from the most deprived quintile. 80% of lung cancers detected were early stage compared to fewer than 20% using conventional referral routes. UoM research has led to incorporation of community LHCs into the NHS Long Term Plan with investment of GBP70,000,000 and a national LHC roll out at 10 country-wide locations, representing a screening population of approximately 60,000 more people.

2. Underpinning research

Lung cancer is the most common cause of cancer-related death in the world. 75% of patients are diagnosed with advanced disease where treatments are ineffective and median survival <1 year. There is currently no national lung cancer screening programme in the UK. Screening those at risk with low dose CT (LDCT) scans reduces lung cancer-specific mortality by between 20-26%. Current smoking and low socio-economic status are associated with increased lung cancer risk but lower screening/research uptake. Those at greatest risk are therefore under-represented in research trials and least likely to access screening services (all data in this paragraph evidenced in [3]).

UoM research addressed how, by taking lung cancer diagnostics into the greatest at-risk communities, patient lives could be saved and NHS costs reduced.

UoM researchers developed the Manchester Lung Health Check (LHC) pathway to address the unmet need of lung cancer early detection in deprived populations, a priority area for screening implementation. The holistic approach was community-based and offered a convenient 'one-stop-shop' service, including targeted LDCT screening to those at high risk with immediate access to a scan in a mobile CT scanning unit. It also included additional strategies for disease prevention (smoking cessation, cardiovascular risk assessment) and screened for earlier detection of chronic obstructive pulmonary disease (COPD) to address other common causes of premature death and co-morbidity.

The Manchester LHC was piloted in 3 highly deprived areas of Manchester between June 2016 and January 2018 (funded by Macmillan Cancer Support). Ever smokers, age 55-74

registered with 14 participating GP practices, were invited to attend an LHC, based at local supermarket car parks near their homes, with two rounds of annual LDCT screening offered to those at high risk. Key outcomes include:

- 2,541 ever smokers attended an LHC. 75% were from the most socio-economically deprived quintile for England.
- 56% (n=1,429) were eligible for two rounds of annual LDCT-screening.
- Lung cancer
  - 4.3% (n=61) were diagnosed with lung cancer equivalent to **one person for every 23 people screened** [1, 2].
  - 80% of screen-detected tumours were early stage (stages 1 and 2) and 90% offered potentially curative treatment.
  - Discovered that by initiating a risk-based screening programme for lung cancer, co-morbidities were also detected, many of which were manageable [3].
- Co-morbidities
  - LHCs detected a high rate of previously undiagnosed COPD [4] and 34% of attendees were at high risk of cardiovascular disease but were not receiving primary prevention as per national guidelines [5].
  - There was a 10% smoking quit rate at 12-months, with no evidence of a 'licence to smoke' [6].
  - Qualitative research led by UoM underlined the importance of the community location especially in 'current smokers' and those who are most deprived.

UoM research demonstrated that the **Manchester LHC model engages individuals at risk from highly deprived communities and transforms outcomes from lung cancer** by detecting early stage disease. It also provides an important opportunity to address other common causes of premature death and co-morbidity in this population, thereby helping to reduce health inequality.

3. References to the research

1. **Crosbie PA**, Balata H, Evison M, et al. Second round results from the Manchester 'Lung Health Check' community-based targeted lung cancer screening pilot. *Thorax*. 2019;74(7):700-704. DOI: 10.1136/thoraxjnl-2018-212547
2. **Crosbie PA**, Balata H, Evison M, et al. Implementing lung cancer screening: baseline results from a community-based 'Lung Health Check' pilot in deprived areas of Manchester. *Thorax*. 2019;74(4):405-409. DOI: 10.1136/thoraxjnl-2017-211377
3. Lebrett MB, Balata H, Evison M, Colligan D, Duerden R, Elton P, Greaves M, Howells J, Irion K, Karunaratne D, Lyons J, Mellor S, Myerscough A, Newton T, Sharman A, Smith E, Taylor B, Taylor S, Walsham A, Whittaker J, Barber PV, Tonge J, Robbins HA, **Booton R**, **Crosbie PA**. Analysis of lung cancer risk model (PLCOM2012 and LLPv2) performance in a community-based lung cancer screening programme. *Thorax*. 2020 Aug;75(8):661-668. DOI: 10.1136/thoraxjnl-2020-214626
4. Balata H, Harvey J, Barber PV, Colligan D, Duerden R, Elton P, Evison M, Greaves M, Howells J, Irion K, Karunaratne D, Mellor S, Newton T, Sawyer R, Sharman A, Smith E, Taylor B, Taylor S, Tonge J, Walsham A, Whittaker J, Vestbo J, **Booton R**, **Crosbie PA**. Spirometry performed as part of the Manchester community-based lung cancer screening programme detects a high prevalence of airflow obstruction in individuals without a prior diagnosis of COPD. *Thorax.* 2020 Aug;75(8):655-660. DOI: 10.1136/thoraxjnl-2019-213584
5. Balata H, Blandin Knight S, Barber P, Colligan D, Crosbie EJ, Duerden R, Elton P, Evison M, Greaves M, Howells J, Irion K, Karunaratne D, Kirwan M, Macnab A, Mellor S, Miller C, Newton T, Novasio J, Sawyer R, Sharman A, Slevin K, Smith E, Taylor B, Taylor S, Tonge J, Walsham A, Waplington S, Whittaker J, Booton R, **Crosbie PA**. Targeted lung cancer screening selects individuals at high risk of

cardiovascular disease. *Lung Cancer.* 2018 Oct;124:148-153. DOI: 10.1016/j.lungcan.2018.08.006

6. Balata H, Traverse-Healy L, Blandin-Knight S, Armitage C, Barber P, Colligan D, Elton P, Kirwan M, Lyons J, McWilliams L, Novasio J, Sharman A, Slevin K, Taylor S, Tonge J, Waplington S, Yorke J, Evison M, Booton R, **Crosbie PA**. Attending community-based lung cancer screening influences smoking behaviour in deprived populations. *Lung Cancer*. 2020 Jan;139:41-46 DOI: 10.1016/j.lungcan.2019.10.025

4. Details of the impact

Pathways to impact

Community engagement: 'Hard-to-reach' at risk residents in some of Manchester's most deprived areas were engaged through community initiatives, including:

- Macmillan bus roadshows
- participation by local media (61 events)
- recruitment of community champions
- wide-reaching poster campaign in GP and community centres, libraries and pharmacies

Publicity of initial findings via BBC Breakfast (>6,000,000 views), national newspapers (e.g. Independent, Daily Mail) and radio interviews.

Reach and significance of the impact

Transformation of lung cancer outcomes:

Manchester: Early stage lung cancer is potentially curable. Late stage disease is not curable: survival is around six months. Across Greater Manchester during the LHC trial, 18% of non-screening detected lung cancers were stage 1 compared to 65% in the trial; 48% were stage 4 compared to 13% in the trial. Macmillan Cancer Improvement Partnerships reported, "*Almost 8 out of 10 cancers were early stage and only 1 in 10 had advanced lung cancer (stage 4). Potentially curative treatment was offered to 9 out every 10 people with lung cancer*" [A]. Manchester City Council's Director of Public Health said, "*The Lung Health Checks are a game-changer for outcomes in Manchester…This pilot has engaged the most affected communities and offered new hope to many local people*" [Bi]. Manchester Health and Care Commissioning (MHCC) subsequently announced an LHC expansion across North Manchester in September 2017, saying of the pilot, *"we have developed a risk-stratified screening model that can detect lung cancer and other conditions earlier and can have an immediate impact on saving lives. We are very pleased… to take this forward and enable thousands more people in North Manchester to benefit*" [Bii].

Wider NHS: In November 2017, NHS England's Chief Executive announced a roll-out of mobile lung cancer screening [Biii]. The NHS Long Term Plan (January 2019) confirmed, *"we will extend the lung health checks that have already produced strong results...starting in parts of the country with the lowest lung cancer survival rates. This will identify more cancers quickly, pick up a range of other health conditions...and help reduce inequalities in cancer outcomes*" [C]. In February 2019, 10 new LHC projects were announced across England: NHS England's National Cancer Director said, *"These new projects will save lives… but it will also mean thousands of patients will avoid life changing treatments"* [Biv]. An independent review of adult screening in England (2019) endorsed community locations for screening in general stating, "*Services in other locations (e.g. close to people's work) should be explored*" [D].

The first LHC pilot scheme in London (August 2018 to April 2019) offered screening either at hospital or at a mobile scanning unit (following Manchester's model of supermarket lung screening). It was conducted in West London areas with the lowest one year survival and highest smoking rates; 29 of 1,145 participants (2.5%) were diagnosed with lung cancer, one with non-Hodgkin lymphoma and one with breast cancer. 58.6% of cancers were stage 1 [E].

Europe: In 2020, the European Society of Radiology and European Respiratory Society's joint statement paper on lung cancer screening stated, *"Europe's health systems need to adapt to allow citizens to benefit from organised pathways, rather than unsupervised initiatives, to allow early diagnosis of lung cancer and reduce the mortality rate"* [F]. It cited Crosbie's research [2] and other European trials.

Australia: In a report in November 2020, the Australian Government's cancer control programme recommended the creation of a national lung cancer screening programme including mobile screening. It stated, "*there is international recognition of both the effectiveness and feasibility of lung cancer screening*" and cited the Manchester LHC as an international example of implementation [Gi]. Lung Foundation Australia's CEO stated, "*This report will bring hope to thousands of Australians and lead to early detection of lung cancer which is critical to optimal treatment*" [Gii].

Cost effectiveness of healthcare intervention delivery for NHS: Analysis of LHC showed cost effectiveness ratio of GBP10,069/QALY (quality-adjusted life year) [H]. UK's National Institute for Health and Care Excellence's threshold for recommending treatments is usually GBP20,000 to GBP30,000/QALY Treatments above this threshold are usually deemed not cost-effective and are not funded. The cost effectiveness of the LHC is important in confirming its economic viability.

Positive participant feedback: Testimonials from patients recruited to LHC were positive. A patient diagnosed with stage one lung cancer said: "*I'd rather know now than in a few months or years when it will be too late. I honestly feel this Lung Health Check has saved my life*" [Ii]. Another patient, given the all clear but having previously lost their partner to lung cancer said, "*It's an opportunity for people to save their lives*" [Iii].

Leveraged funding to expand and develop pilot:

Manchester: The success of LHC led to MHCC providing GBP4,000,000 to roll out the service in North Manchester [Bii].

Yorkshire: Yorkshire Lung Screening Trial built on the Manchester pilot by addressing issues including optimal selection criteria for screening in the community and the population impact of screening. (Crosbie Co-PI, Booton Co-I, GBP5,200,000 funded by Yorkshire Cancer Research) [J].

National 10 site pilots: Announced with GBP70,000,000 NHS funding [Biv].

5. Sources to corroborate the impact

A. MacMillan Cancer Improvement Partnership report on 'Manchester's Lung Health Check Pilot' August 2016 – ***showing the successes of the LHC.***

B. News Articles from Cancer Research UK, MHCC and NHS England:

   i. 'Lung cancer early diagnosis rates soar during UK-first CT Community Scanner Pilot in Manchester by UHSM (University Hospital of South Manchester NHS Foundation Trust)' CRUK Lung Centre News 16 March 2017 – ***including quote from Manchester City Council's Director of Public Health calling the health checks a "game-changer".***

   ii. 'North Manchester Pilot is Quadrupling Lung Cancer Early Diagnosis Rates', MHCC, 4 October 2017 - ***confirming GBP4,000,000 NHS funding to roll out lung health check pilot in Manchester and including quotes from Manchester Health and Care Commissioning Chief Accountable Officer and Manchester City Council's Director of Public Health***.

   iii. 'NHS England action to save lives by catching more cancers early', NHS England, 21 November 2017 - ***announcing scaling up of Manchester scanner scheme.***

iv. 'NHS to rollout lung cancer scanning trucks across the country', NHS England, 8 February 2019 - ***confirmation of GBP70,000,000 funding for 10 national pilot sites.***

C. NHS Long Term Plan, published January 2019 https://bit.ly/3p5XtVF - p58 3.56; and insert p61- ***confirmation of intent to extend the lung checks that have produced strong results in Manchester.***

D. The Independent Review of Adult Screening Programmes in England – published October 2019 https://bit.ly/3k5q89Q - ***confirmed that LHC will be rolled out nationally if successful; and endorsed community screening locations.***

E. Baseline Results of the West London Lung Cancer Screening pilot study; Bartlett E, Kemp S, Ridge CA et al. Lung Cancer Oct 2020 148, 12-19 DOI:10.1016/j.lungcan.2020.07.027- ***Trial using UoM's supermarket mobile scanning model confirms targeted screening is effective in detecting early-stage lung cancer. Cites UoM reference 2.***

F. ESR/ERS statement paper on lung cancer screening Kauczor HU, Baird AM, Blum TG, et al. *Eur Radiol*. 2020;30(6):3277-3294. DOI:10.1007/s00330-020-06727-7- ***European experts call for organised pathways including national level approval of implementation of nationwide, population based LDCT lung cancer screening. Cites UoM reference 2.***

G. Lung Cancer Screening Enquiry in Australia initiated August 2019:

i. Report on the Lung Cancer Screening Enquiry by Cancer Australia on behalf of the Australian Government. Released 30 November 2020 – ***Manchester LHC included as an international example of an implemented screening programme***.

ii. News article from Lung Foundation Australia 'A welcome step toward lung cancer screening' 1 December 2020 – ***reporting on Cancer Australia's recommendation to create a national lung cancer screening programme.***

H. The cost-effectiveness of the Manchester 'lung health checks', a community-based lung cancer low-dose CT screening pilot. Hinde S, Crilly T, Balata H, et al. Lung Cancer. 2018;126:119-124. DOI:10.1016/j.lungcan.2018.10.029 - ***demonstrates LHC model is cost effective.***

I. Patient feedback – ***positive patient feedback on their experiences of LHC:***

i. British Lung Foundation. Taskforce for lung health personal perspective- story from a lung health check patient, 12 November 2018.

ii. BBC News article with LHC patient stories, 14 November 2016.

J. Protocol for Yorkshire Lung Screening Trial: bmjopen.bmj.com/content/bmjopen/10/9/e037075.full.pdf - ***cites UoM references 1 & 2.***