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About this submission

This submission was prepared by Dr Stephen Bradley MSc, MRCP, MRGP(2016). Dr Bradley is a Clinical Research Fellow at the University of Leeds and a General Practitioner in a practice which serves a population which is particularly deprived, including patients who are homeless, those with drug and substance misuse disorders, asylum seekers and recent immigrants. This submission is

focused primarily on achieving early lung cancer diagnosis and is informed by Dr Bradley's doctoral research which is supported by Cancer Research UK.

This submission is lengthy due to the complexity of the issues discussed. Given this complexity and because of the importance of lung cancer with respect to improving overall cancer outcomes it may be advisable to take oral evidence specifically on this this topic.

Summary

- Despite being only the third most common cancer in the UK, lung cancer is the leading cause of cancer death
- Lung cancer is an important driver of health inequalities and premature mortality in deprived communities
- The UK has poor lung cancer outcomes compared to similar countries. The reasons are likely to include the 'case-mix' with patients who have more co-morbidities and who are more deprived in the UK, disparities in uptake of optimal treatments and because cancer is diagnosed later in the UK compared to other countries.
- It is possible that part of the reason lung cancer is diagnosed later in the UK is that we have poorer access to radiological investigations in the UK compared to other countries
- Almost 90% of patients who are diagnosed with the earliest stage of lung cancer (stage 1) survive at least one year compared to less than 20% of those who are diagnosed with the latest stage (stage 4).
- Therefore increasing the proportion of patients who are diagnosed when they have early stage lung cancer is vital. The NHS long term plan's aspiration that 75% of cancer patients are diagnosed with early stage disease (stage 1 or 2) by 2028 will be very difficult to achieve for lung cancer since currently 75% of patients are diagnosed with late stage lung cancer (stage 3 or 4).
- Lung cancer is a difficult diagnosis for GPs because most patients have symptoms that are very common in the public at large and patients who are at risk of lung cancer face barriers to seeking help when they have symptoms
- Lung cancer screening for patients who do not have symptoms will not be a 'silver bullet' that will transform lung cancer outcomes. This is because most patients who have lung cancer would not be eligible for lung cancer screening, therefore along with screening we need to continue to focus on improving the diagnosis of lung cancer in patients who have symptoms
- The pandemic has caused significant disruption in how lung cancer is diagnosed, with a sustained dip in numbers of chest x-rays that are performed which has still not recovered to pre-pandemic levels
- The UK depends on chest x-ray to diagnose lung cancer (in patients who have symptoms) more than most similar countries which make greater use of computed tomography (CT). The UK has fewer CT scanners than many similar countries and we face shortages of radiology staff who are needed to perform and interpret CT scans

- Chest x-ray may 'miss' about 20% of lung cancer cases, but the test has the advantages of being cheap and accessible and may currently be our most important tool in identifying lung cancer
- It is not known whether the costs of changing our system so that patients have a CT rather than a chest x-ray as a first line test for lung cancer would lead to significant improvements in survival for patients and whether such improvements would be cost effective compared to other ways health care resources could be used
- By using chest x-ray more extensively in patients who have symptoms we may be able to increase the numbers of patients who are diagnosed with earlier stage (and more treatable) lung cancer. This may be an important short to medium term strategy since increasing our CT capacity will require large and long term investments in staff and infrastructure before coming on-stream

Key Recommendations

- Build on existing initiatives to encourage patients, particularly those from deprived patient groups, to see their GP if they have symptoms and do more to tackle 'fatalistic' perceptions about lung cancer that can discourage patients from seeking help if they have symptoms
- Ensure that there is continued emphasis on diagnosing lung cancer in patients who have symptoms alongside lung cancer screening which is targeted at patients who do not have symptoms
- Consider offering greater access to 'direct access CT' to GPs so they can investigate patients who they are worried might have lung cancer, even if they have had a normal chest x-ray
- Ensure there is a focus on improving access and uptake of chest x-ray, as well as CT, in order to restore lung cancer diagnostic pathways following the disruption of the pandemic
- Invest in a randomised control trial to assess whether the UK should switch from using low dose CT instead of chest x-ray as the first line test for lung cancer
- Encourage GPs to make greater use of chest x-ray in patients who have symptoms that could be caused by lung cancer and expand initiatives which allow patients to request their own chest x-ray if they have symptoms without having to see a GP first

Why does lung cancer warrant particular consideration in the cancer services inquiry?

Lung cancer is the third most common skin cancer in the UK but it is the leading cause of cancer death. In contrast to the substantial improvements in survival in several other cancers, outcomes for lung cancer remain poor. While outcomes for several cancers are poor in the United Kingdom compared to other advanced economies, this disparity is particularly stark for lung cancer. Lung cancer incidence is strongly associated with deprivation and is a key driver of health inequalities. It is

a leading cause of premature mortality (deaths before age 75) in the North of England so it is vital we tackle lung cancer in order to 'level up' health outcomes throughout the UK.

Diagnosing lung cancer earlier is one of the best ways we have to improve lung cancer survival. Lung cancer is diagnosed through radiological investigations (chest x-ray and computed tomography), but access to these investigations has been significantly disrupted by the pandemic.

For these reasons lung cancer warrants particular consideration in the cancer services inquiry. In particular it is important that the inquiry recognises that the improvements we need to see in lung cancer survival is unlikely to be achieved through lung cancer screening in asymptomatic patients alone and that emphasis is also given to improving early diagnosis in patients who have symptoms.

What are the UK's lung cancer outcomes and why do they remain poor compared to other countries?

In England, lung cancer accounts for 13% of all cancers, following only breast and prostate cancer in terms of incidence(1), but is the leading cause of cancer deaths(2). Improvements in early diagnosis and treatment have led to improved outcomes for many cancers, but outcomes remain poor for lung cancer. Since 1971, age-standardised 5-year survivals from breast cancer, prostate cancer and colorectal cancer in England and Wales have increased from 53% to 87%,(3) 37% to 85%(4) and 24% to 59% respectively(5). In contrast, the age-standardised 5-year survival for lung cancer has only increased from 5% to 10%(6).

The International Cancer Benchmarking Partnership (ICBP) has compared the improvements in cancer outcomes across several countries between 1995 and 2014.(7) During this period the UK continued to have the lowest 5 year survival for lung cancer of the countries studied, and the relative improvement in cancer outcomes compared to that achieved by the other countries was disappointing (Table 1 & Figure 1). Of the cancers examined by ICBP, only pancreatic cancer, a much rarer tumour, had poorer outcomes in the UK over this period.

Country	**Lung Cancer 5 Year Survival 1995-99 (95% Confidence Intervals)**	**Lung cancer 5 year survival in 2010-14 (95% Confidence Intervals)**	**Absolute change 1995-99 to 2010-14**
Australia	13.3% (12.9-13.8)	21.4% (20.8-22.0)	8.1
Canada	15.4% (15.1-15.7)	21.7% (21.3-22.2)	6.3
Denmark	8.2% (7.7-8.7)	18.9% (18.1-19.6)	10.7
Republic of Ireland	9.3% (8.5-10.1)	19.8 (18.7-20.9)	10.5
New Zealand	11.5% (10.7-12.4)	15.5% (14.5-16.5)	4.0
Norway	10.8% (10.1-11.6)	20.4% (19.4-21.4)	9.6

United Kingdom	7.2% (7.0-7.3)	14.7 (14.5-15.0)	7.5

Table 1: Lung cancer outcomes 1995-2014(7)

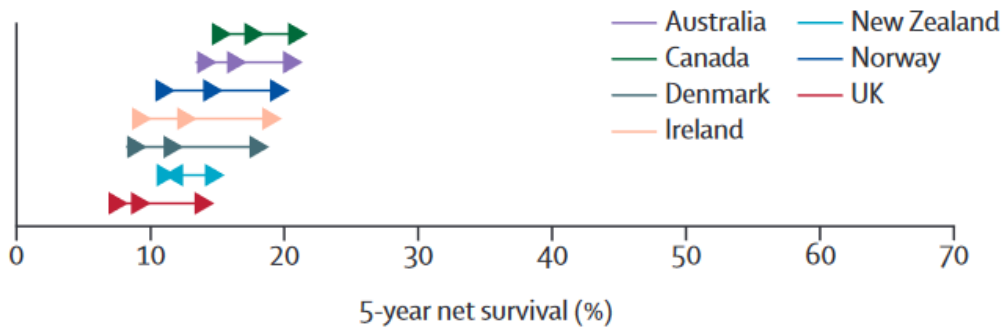

Figure 1: Age-standardised 5-year net survival for lung cancer by country, and period of diagnosis, 1995–2014. Beginning of arrow denotes estimates for 1995–99 and arrow heads from left to right refer to 2000–04, 2005–09, and 2010–14 estimates. Reproduced from Arnold et al.(7)

The reasons for the UK's poor cancer outcomes compared to other countries are likely to be complex and remain debated. Differences in how cancer is registered between countries may account for some of the variation, with the UK's particularly high performance in consistently recording cancer diagnoses possibly exaggerating these disparities, though this is likely to be only a partial explanation.(8)

Other explanations that have been proposed are that the UK has a greater burden of co-morbidities and deprivation than similar countries(9-11), that there is unwarranted geographical and socio-economic variation in access to the best treatments for lung cancer(12, 13) and that more patients are diagnosed with lung cancer at later stages in the UK than elsewhere.(14)

Recommendation: Undertake measures to reduce the burden of co-morbidities particularly amongst deprived populations and address variations in utilisation of optimal treatments

Achieving early diagnosis has long been understood as vital to improve lung cancer outcomes, since 88% of those who are diagnosed at stage 1 (the earliest stage) survive for at least one year after survival compared to only 19% of those who are diagnosed with stage 4 (the latest stage) lung cancer (see Figure 2).(15) Currently almost three quarters of lung cancer cases are diagnosed with late stage disease (stage 3 or 4) in the UK. This means that the aspiration outlined in the NHS Long Term Plan of diagnosing three quarters of cancer cases with early stage disease by 2028 is very ambitious, particularly with respect to lung cancer.(16, 17)

Recommendation: Undertake an ambitious but plausible plan detailing how to increase the proportion of early stage lung cancer diagnoses to support the wider Long Term Plan aspiration that 75% of all cancer diagnoses should be in stage 1 or 2 by 2028

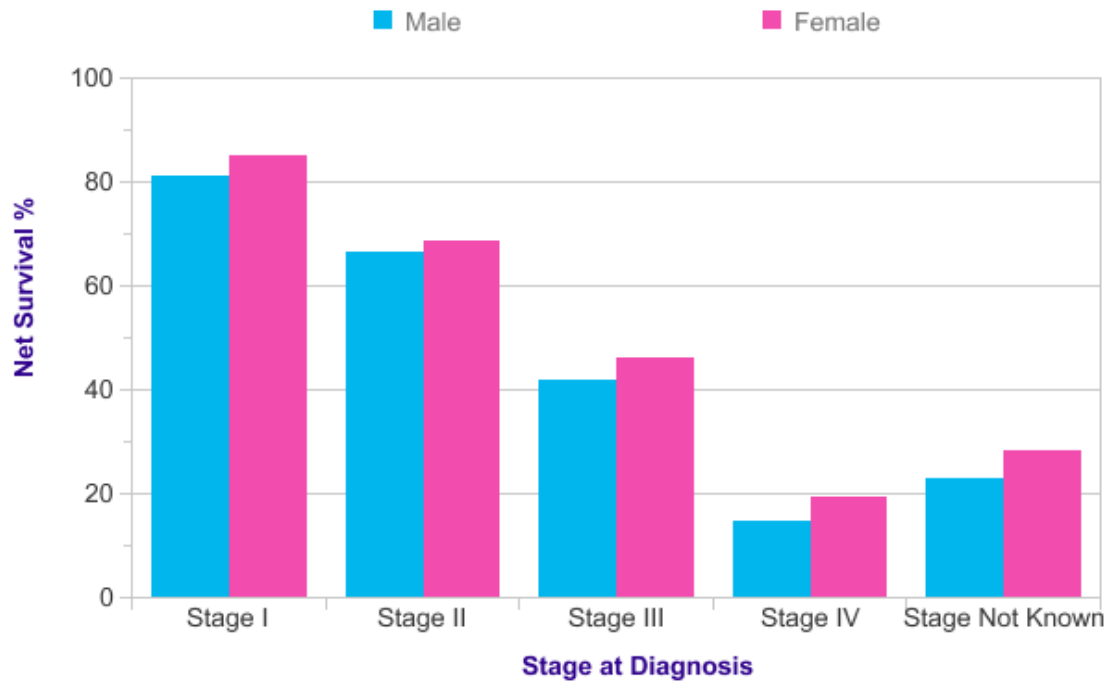

Figure 2: One-year net survival (%) by stage, adults aged 15-99 (Cancer Research UK)(15)

As lung cancer is diagnosed primarily through radiological investigations (chest x-ray and computed tomography) it is likely that access to these investigations could be a factor that explains why lung cancer is diagnosed later in the UK than in other countries, which in turn could help explain why the UK has poor lung cancer survival. Compared to other wealthy countries the UK has many fewer computed tomography (CT) scanners and performs much fewer CT scans (figure 3).(18, 19) Arguably more important than shortages in equipment is our lack of radiologists and other skilled radiology staff.(20) The case for expanding radiology capacity as part of an overhaul in cancer diagnosis has been made by Sir Mike Richards.(21, 22)

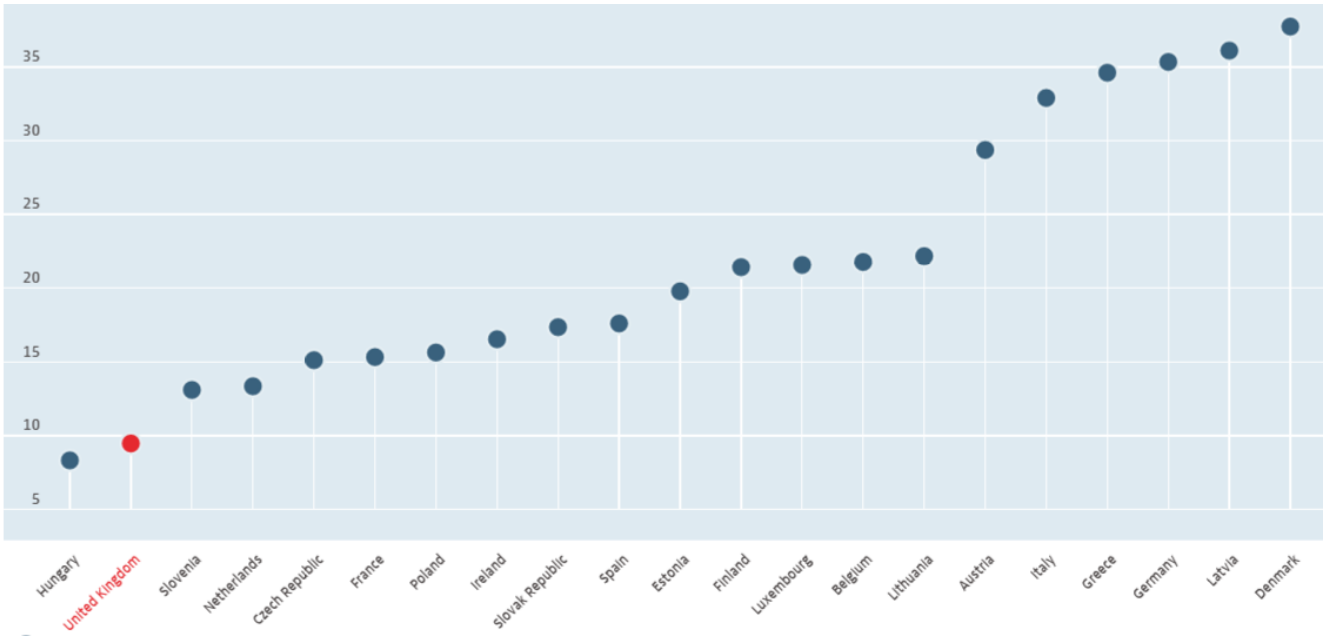

Figure 3: CT Scanners per 1,000,000 people in 2014 (OECD)(18)

The UK consequently relies much more on chest x-ray as a first line investigation for possible lung cancer than most other high income countries. Chest x-ray is less accurate that CT and may 'miss' around a fifth of cancers, leading to some concern that our reliance on chest x-ray may be contributing to delayed diagnosis.(23, 24) The trade-offs that would be involved were the UK to transition to employing CT as a first line test for lung cancer instead of chest x-ray are not straightforward and are considered in greater detail later in this submission (section: *should we replace chest x-ray with computed tomography as the first line test for lung cancer?*).

Recommendation: Prioritise long term investment in radiology capacity including radiology staff as well as equipment and infrastructure.

How is lung cancer currently diagnosed in the UK?

Most patients who have lung cancer see their GP before they are diagnosed.(25-28) Guidelines from the National Institute of Health and Care Excellence (NICE) recommend that GPs arrange a chest x-ray urgently for the important symptoms that are associated with possible lung cancer, with the exception of coughing up blood (haemoptysis) for which a direct referral to hospital specialists is advised. Since patients who have haemoptysis are only a very small minority of patients, chest x-ray is the investigation that is currently recommended for almost all patients who could have symptoms of lung cancer.(29) In some areas GPs have access to urgent CT, however this is very variable and depends upon the policies and initiatives from local NHS Trusts.

It is important to appreciate that chest x-ray may not identify around 20% of lung cancer cases.(23) GPs are advised to give 'safety-netting' advice to patients who have symptoms that do not resolve and GPs do have discretion to refer urgently for hospital assessment for patients who they are concerned could have cancer, even if they don't meet referral criteria. However, the guidance

currently isn't very clear as to what GPs should do when they have some concern that cancer could be present but the chest x-ray result is normal.

A needle in a haystack: why is diagnosing lung cancer difficult?

For GPs lung cancer is a challenging diagnosis because the most common symptoms of lung cancer are also symptoms that are very common in the population in general. This means that the chance of someone who has a lung cancer symptom, actually having lung cancer is very low. For example, about a third of patients who have lung cancer will have had a cough, but because this is such a common symptom the chance of any patient who has a cough having lung cancer is less than half of one percent (Table 2). Cough is a particularly common symptom among smokers so it may easily be overlooked by patients or their GPs as a possible symptom of lung cancer, or patients who might feel it is just a "smokers' cough". It is probably not feasible for GPs to investigate all patients who have very common symptoms like cough.

Coughing up blood (haemoptysis) has traditionally been regarded as *the* 'text-book' symptom for lung cancer, but over the past 20 years it has become less common, such that now less than 5% of patients have this symptom. This is probably because we getting better at diagnosing lung cancer earlier before haemoptysis develops, but this infrequency with which the 'text book' symptom of lung cancer is actually seen makes diagnosing lung cancer very challenging.

NICE use a threshold that those who have a 3% risk of having cancer should be referred urgently for hospital assessment. Of the common lung cancer symptoms only haemoptysis approaches this level of risk (Table 2).

A third of patients diagnosed with lung cancer have attended their GP with symptoms attributable to their cancer three or more times before diagnosis, the highest proportion for any cancer aside from multiple myeloma and cancers of unknown primaries, both of which are much rarer than lung cancer. (30) The challenges in diagnosing lung cancer probably also help explain why a third of lung cancers are diagnosed as a result of an emergency attendance to hospital. Emergency diagnoses are not only a distressing way for patients to obtain a diagnosis of cancer but is a route to diagnosis which is associated with particularly poor outcomes.(31)

It is also important to recognise the barriers that patients who are at the greatest risk of having lung cancer face in going to see their GP when they have symptoms. Such patients tend to feel stigmatised and blamed for their smoking and may be reluctant to seek help for problems that may be attributed to tobacco use.(32) Smokers are less likely to see their GP than non-smokers if they have symptoms that are concerning for lung cancer.(33) Patients who contend with socio-economic deprivation often have 'fatalistic' beliefs about cancer, perceiving that 'it is better not to know' if they have cancer and may have competing priorities which make it difficult for them to seek help.(34) Therefore these patients who are at highest risk of lung cancer need particular encouragement and support to attend along with consistent messaging that the disease isn't necessarily a death sentence and that seeking help early can save lives.

Recommendation: Continue to invest in campaigns that encourage patients who have symptoms to get help and support messaging and research that tackles 'fatalistic' beliefs about lung cancer

Symptom	% of patients with lung cancer who have symptom	% chance that someone with this symptom has lung cancer
Cough	24	0.4
Fatigue	4	0.4
Shortness of breath	16	0.7
Chest Pain	8	0.8
Weight Loss	3	1.1
Loss of appetite	0.6	0.9
Coughing blood (haemoptysis)	4	2.4

Table 2: Common symptoms of lung cancer, highlighting the percentage of patients who have that symptom in the period 2000-17 (Chowiencyk 2020) and the percent chance that someone with that symptom has lung cancer (Hamilton 2009).(35, 36)

Lung cancer screening can help improve survival but is not a 'silver bullet'

Lung cancer often does not cause any symptoms at all until it has advanced into a late and less treatable stage. The rationale for lung cancer screening (sometimes termed 'lung health checks') is for lung cancer to be detected in patients who are at risk of lung cancer, but who do not yet have symptoms, and if they do have lung cancer to catch it at an earlier and hopefully more treatable stage. This screening uses a form of computed tomography which has a low radiation dose (low dose computed tomography or LDCT) screening patients who do not have symptoms with chest x-ray alone has not been shown to reduce lung cancer mortality.(37)

The evidence for lung cancer screening using LDCT comes mainly from two large trials which have shown an approximately 20% reduction in lung cancer mortality.(38, 39) It is important to understand that this reduction is a *relative* reduction in lung cancer deaths between those who were screened and those who were not. It is estimated that this equates to three additional lives saved because of lung cancer screening, per 1000 patients who undergo that screening (Figure 4).

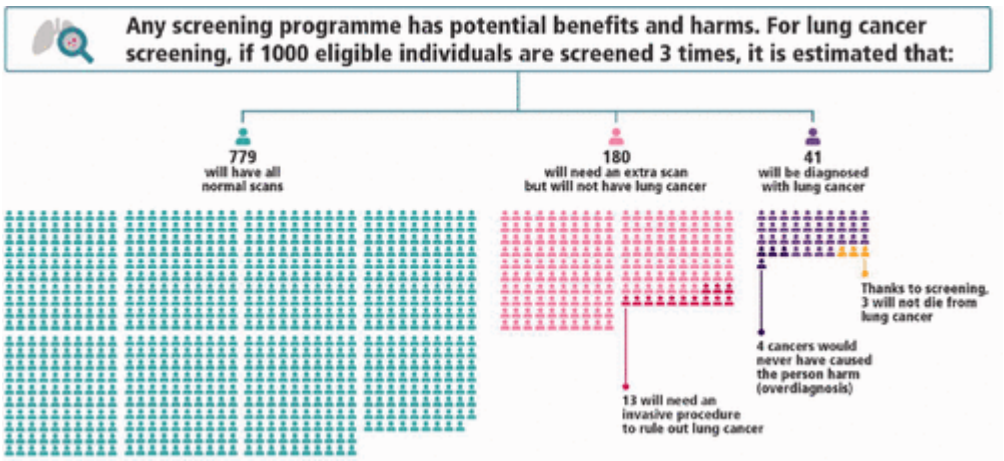

Figure 4: 1000-person tool for lung cancer screening. The tool illustrates estimated outcomes based on in the National Lung Screening Trial (NLST). Reproduced from the International Agency for Research on Cancer.(40)

Lung cancer screening is featured prominently in the NHS Long Term plan and is likely to become an important part of efforts to reduce cancer mortality in England in years to come.(17) However, most lung cancer cases occur in those who *would not be* eligible for lung cancer screening.(41) In addition, not all those who are eligible take up the offer of lung cancer screening- uptake in trials and pilots has been around 30-60%.(39, 42-44) This means that, on its own, lung cancer screening will not be a silver bullet to transform lung cancer outcomes.

It is possible that in the future improvements in the tools that are used to identify patients at risk of lung cancer and/or new blood tests as a way to select patients who should go on to have LDCT screening will allow us to better select the patients who should be screened but in the meantime it is important we continue to improve the ways patients with symptoms are diagnosed rather than relying on lung cancer screening alone.(45-47)

There are other important outstanding questions and issues regarding lung cancer screening, which are detailed more fully in a review paper.(48) Some of these are:

- *Cost effectiveness:* A previous Health Technology Assessment has suggested that lung cancer screening would not be cost-effective at a threshold of £20,000 per Quality Adjusted Life Year (Quality Adjusted Life Year, or QALY is a notional measure of cost for one year of good health).(49) A health economic analysis from a lung cancer screening pilot targeted at an area of particular deprivation has yielded a lower estimate(50) and it is possible that an updated Health Technology Assessment will find that lung cancer screening is cost effective at a £20,000 per QALY threshold.
- *Opportunity cost:* A nation wide roll out of screening will require substantial radiology capacity (CT scanners and radiologists) which may have implications for our ability to promptly carry out other investigations, including urgent investigations for suspected cancer
- *Role of the National Screening Committee (NSC).* Lung cancer screening has not yet been approved by the National Screening Committee (NSC) which is the UK's body which was established to assess screening programmes following controversies around other types of screening. In the meantime screening seems set to emerge as a patchwork of local pilots and initiatives in England rather than a UK wide programme which could mean access to screening is subject to a 'post-code lottery'. Lung cancer screening is not currently being offered routinely in Scotland, Wales and Northern Ireland.

Improving how lung cancer is diagnosed in patients who have symptoms will remain important and must not be neglected, even as lung cancer screening services are rolled out.

Recommendation: Ensure that we continue to improve early diagnosis in patients who have symptoms, in addition to screening patients who are at risk but who do not have symptoms

How has lung cancer diagnosis been disrupted by the coronavirus pandemic?

The pandemic caused precipitous declines in both the numbers of GP requested chest x-rays and the numbers of patients referred urgently to hospital for suspected lung cancer ('two week wait clinics') which have still not recovered fully (Figures 4 & 5). As noted above, chest x-ray is the main method used by GPs to diagnose lung cancer, so in many cases the essential step before the 'two week wait' urgent suspected cancer referral is a chest x-ray.

An as yet unpublished analysis by colleagues in Leeds suggests that lung cancer identified on chest x-rays was the common way lung cancer was diagnosed prior to the pandemic, so this disruption in the number of chest x-rays requested is concerning.(51) The proposal that chest x-ray is utilised more extensively to diagnose lung cancer is considered later in this submission (section: *How can we use chest x-ray more effectively to diagnose lung cancer?*).

It is highly likely that this disruption will have resulted in delays to diagnosis for patients with lung cancer. It remains to be seen if this also resulted in those patients being diagnosed at a later stage and if they had poorer outcomes than those diagnosed before the pandemic, but one study has estimated that the pandemic will have resulted in approximately 1,300 additional lung cancer deaths, a 5% increase over 5 years.(52)

Recommendation: Ensure that utilisation of chest x-ray is restored to pre-pandemic levels

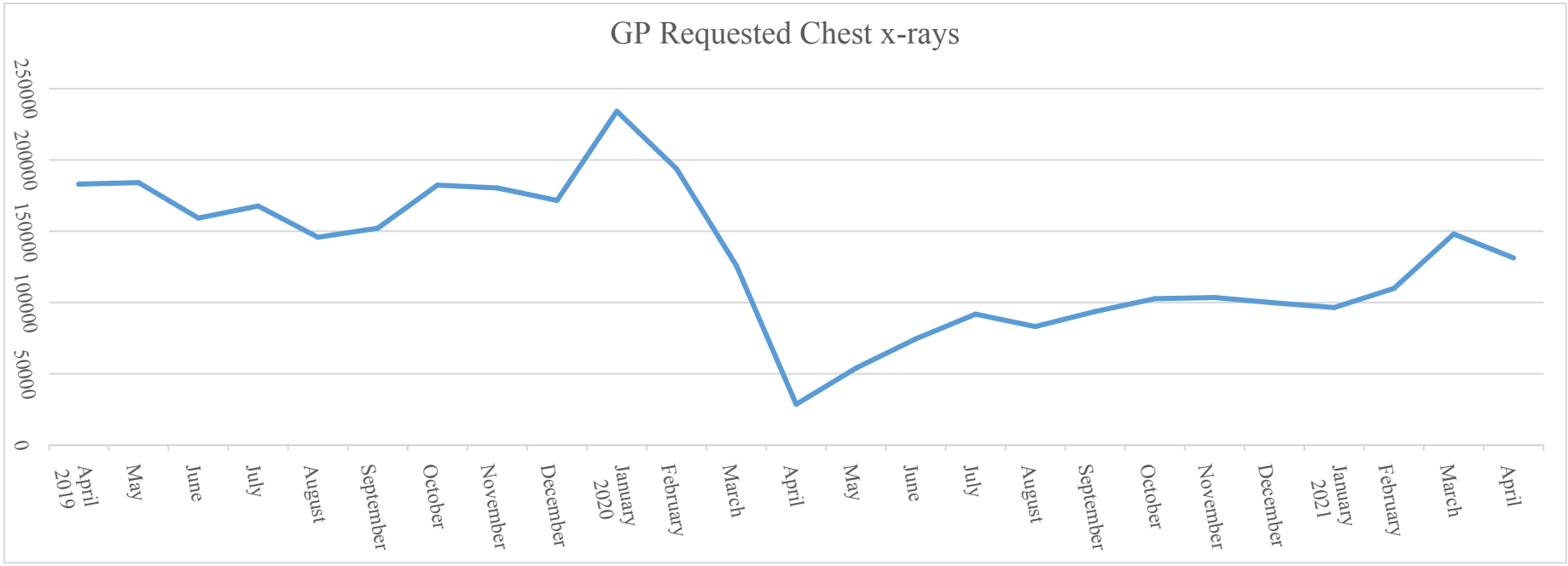

Figure 4: Number of GP requested chest x-rays in England April 2019 to April 2021. The number of chest x-rays in April 2021 has recovered to 131,265 but remains 28% lower than the number performed in April 2019 (183,035)(53, 54).

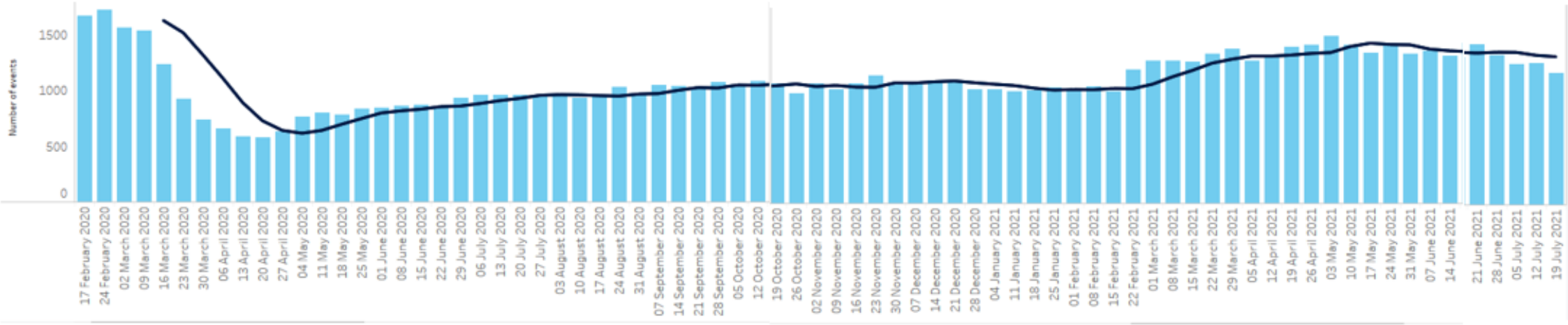

Figure 5: Number of lung cancer urgent referrals (two week wait) from February 2020 to July 2021.(55) Weekly totals indicated by bars and four week rolling average is indicated by black line. The four week rolling average at the start of this period (17th February to 16th March) was 1,622 falling to a low of 638 (6th April to 27th April) and finishing on 1,324 (28th June to 19th July) which was 18% lower than the first four week period in this graph.

Should we replace chest x-ray with computed tomography as the first line test for lung cancer?

Chest x-ray successfully detects only around 80% of lung cancers.(23, 56) There is therefore a great deal of concern that chest x-ray is not accurate enough to detect lung cancer reliably and it has been suggested that the test needs to be phased out in favour of CT.(24, 57) Denmark, a country which has a similar 'gatekeeper' role for GPs as the UK has recently made such a change and low dose computed tomography (LDCT) is now made available to GPs as the first line test for lung cancer.(58) Currently the UK is something of an outlier amongst wealthy countries in the extent to which we rely on chest x-ray for lung cancer detection and the relative lack of access to urgent CT for GPs.

Computed tomography is certainly a more accurate test than chest x-ray and seems certain that if we did switch to using CT instead of chest x-ray we would detect more lung cancers earlier. However there would likely to be other consequences of making such a change and the decision as to whether this would be worth the costs and harms that might result is not at all straightforward. As well as the direct costs of CT, which takes longer to perform for radiologists and requires using equipment of which we have a limited supply, using CT will also result in 'false positive' results and incidental findings being identified which may not have resulted in any harm to patients if they were left undiscovered but which may require additional investigations, appointments and inconvenience and worry for patients.

Symptoms that could represent lung cancer are very common in the population at large. NICE currently recommend patients over age 40, that have had one of these symptoms, such as cough, to have a chest x-ray and we have had undertaken successful campaigns to encourage patients to come forward for testing ('be clear on cancer').(29, 59) We would need a huge investment in equipment and radiologists for these patients to all have a CT instead of a chest x-ray. If we attempted to give all these patients a CT instead of a chest x-ray with our current capacity we would probably delay many other investigations in patients who are likely to have a higher risk of having cancer. Because chest x-ray *does* identify most patients who do have lung cancer, if we performed a CT for all patients who had a normal chest x-ray, we would only find one extra lung cancer case for about every 300 of these extra CT scans we performed.(60)

Chest x-ray is cheap, easy to perform, very accessible to GPs and has a low dose of radiation.(61-63) That means it is well suited to investigating large numbers of patients, including opportunistically investigating those who have a very low risk of having lung cancer but who have symptoms. We have seen increases in the numbers of patients investigated in this way following symptom awareness campaigns. (59) Because only a small proportion of those who are investigated with chest x-ray because of symptoms actually have lung cancer, the ability of the test to 'rule out' lung cancer is actually high. We call this the 'Negative Predictive Value'. Our team has worked that the Negative Predictive Value for chest x-ray is 0.97 (the negative predictive value for a theoretical 'perfect test' would be 1).(64)

We have also found that by taking into account the symptoms that patients had before their chest x-ray we can get a better understanding of how likely someone is to have lung cancer if they have had a normal chest x-ray. We found the only symptom which conferred a risk of having lung cancer that was not detected on chest x-ray that was greater than 1% was coughing up blood (haemoptysis). It is already recommended that patients who are coughing up blood are not just investigated with a chest x-ray, but that they are referred urgently to a suspected cancer clinic, where they would usually be investigated with CT, so this finding supports current practice.(29)

While it seems certain that using CT would correctly identify more cancers than chest x-ray we also do not know whether this would necessarily translate into improved survival for those patients and if it did, whether that improved survival would be cost-effective, compared to other ways in which health care funding could be used. In a study that retrospectively compared patients who were diagnosed correctly by chest x-ray and patients who had cancers that were not identified by chest x-ray we did not find a difference between these groups in terms of survival and stage at diagnosis.(65) But, it is not really possible to answer this question in retrospect because the detectability of the cancer on chest x-ray could itself be linked to cancer stage and survival and therefore distort the results. For example, a bigger tumour might be more likely to be detected on chest x-ray but would also be more likely to be in an advanced stage and have a lower chance of survival.

The only way to work out whether using CT instead of chest x-ray as a first line test would lead to better outcomes for patients and whether it would be cost effective, taking in to account issues such as 'false positive' results and incidental findings, would be through a large randomised controlled trial. While this would be expensive, this is a very important policy issue and the cost of the trial would be justified whatever was discovered: either that using CT instead of chest x-ray is beneficial for patients and cost effective or that we should not switch to CT and instead save the healthcare funding we might have spent on this change for other ways to improve cancer outcomes.

Recommendation: Undertake a randomised controlled trial and health economic analysis to compare chest x-ray with computed tomography as the first line test used by GPs to detect lung cancer in patients who have symptoms

Even though we do not yet investigate all patients with possible lung cancer symptoms with CT, in several localities GPs have been given enabled to request urgent CTs (sometimes known as 'direct access CT') for patients they are particularly worried about. Even if we do not currently have enough radiology capacity to ensure that all patients with possible lung cancer symptoms should get a CT, it seems sensible to take advantage of GPs judgement (sometimes called 'gut instinct') to allow them greater flexibility in requesting CT scans for patients they are particularly worried about.

Recommendation: Support expansion of 'direct access CT' so that GPs have the flexibility to request CT for patients they are particularly worried about, even if they have had a normal chest x-ray and ensure the benefits and costs of these services are properly evaluated

How can we use chest x-ray more effectively to diagnose lung cancer?

Analysis by members of our team suggests that chest x-ray is the investigation which most often leads to lung cancer being diagnosed.(51) In our healthcare system GPs may be the clinicians who have the greatest role in diagnosing lung cancer and most patients see their GP before diagnosis. Although access to CT is limited in the UK, GPs do have good access to chest x-ray and our research suggests that chest x-ray is a useful test for diagnosing lung cancer, particularly in those patients who are not at the highest risk of lung cancer (such as those who are coughing up blood who GPs should refer to suspected cancer clinics urgently for other investigations like CT, even if the chest x-ray is negative).(66)

However, further research by our team which has been accepted for publication in the *British Journal of General Practice,* has demonstrated that there is a great deal of variation in the utilisation of chest x-ray by different general practices.(67) Of the 6,675 General Practices examined, the median rate of investigation with chest x-ray was 34 per 1,000 patients but the numbers of chest x-rays varied a great deal, with the lowest 10% referring for only 17 chest x-rays per 1,000 patients and the highest 10% referring for 51 chest x-rays per 1,000 patients. Surprisingly we also found that when we accounted for differences in factors like smoking rates and age in the populations of these practices this only explained 16% of the variation in the amount chest x-ray was used. This suggests that the reasons for the variation in how often chest x-ray is used are likely to be caused by factors such as different cultures, habits and beliefs of the staff working in General Practices. We can use readily available data (Diagnostic Imaging Dataset) to see which GPs request chest x-ray much less than average and it may well be feasible to encourage General Practices which investigate with chest x-ray infrequently to use the test more often for their patients who have symptoms. We have applied for data from the National Cancer Registry to work out whether patients who attend practices which investigate with chest x-ray more frequently are diagnosed with earlier stage disease. If we find that this is the case then this would be important as it would suggest we should try to increase how often GPs use chest x-ray in patients with symptoms in practices where they use this test infrequently.

Recommendation: If it is confirmed in pending study that patients attending practices which investigate more often with chest x-ray are diagnosed with earlier stage lung cancer then consider using existing data to support practices which use chest x-ray infrequently to investigate patients who have symptoms more often.

The experience of increasing the utilisation of chest x-ray by GPs in Leeds suggests that increasing use of chest x-ray may well be an effective way to achieve earlier stage at diagnosis and survival for patients. Under a local implementation of the 'be clear on cancer' campaign in the city the number of chest x-rays was increased by 80% through a number of measures which included:(68)

- Direct advertising to patients, targeted at areas of socio-economic deprivation and employing methods which ensured wide exposure such as messaging on beer mats in pubs and advertising on buses
- Engagement and education of GPs to encourage them to request chest x-rays in patients who have symptoms

- Establishing a service whereby patients who had symptoms for which NICE recommend a chest x-ray should be arranged could have this investigation organised directly without having to first see a GP(66)

The increase in the number of chest x-rays which resulted was associated with a 9% increase in the proportion of patients who were diagnosed with early stage lung cancer and a 9% decrease in the proportion of those who were diagnosed with late stage cancer along with an improvement in survival. Because the study was an observational study, rather than a trial, it is not possible to definitively say that these improvements were because of the increase in the number of chest x-rays, but it does seem plausible that the campaign did contribute since the improvements in Leeds were greater than those seen in England and Wales overall in the same period.(68) The pending study mentioned above which will link lung cancer outcomes with the amount of times different general practices use chest x-ray will give us a more definitive evidence as to whether increasing the number of chest x-rays requested by GPs might improve survival.

In the meantime we should consider replicating the small number of services which have allowed patients to request their own chest x-rays particularly in view of the difficultly patients currently face in getting appointments to see their GP along with encouraging GPs to arrange investigations or referral for patients with symptoms that could be caused by lung cancer.(66, 69)

Recommendation: Encourage GPs to investigate patients who have symptoms that could be caused by lung cancer with chest x-ray and consider establishing services which allow patients to have a chest x-ray without seeing a GP if they have symptoms

Other areas to consider

This submission has focused on lung cancer diagnosis, particularly from the perspective of primary care in England, though it has attempted to give an overview of several issues pertaining to lung cancer in general. Several of the issues referenced are beyond the core expertise of the author. The cancer services inquiry may wish to benefit from more detailed evidence on some of the following:

- geographic and socio-economic inequalities in diagnosis and treatment of lung cancer
- the behavioural science of what works in encouraging more patients who have symptoms to see their doctor or, for patients who are at risk of cancer, to get involved in screening if they are invited (witnesses may be able to give evidence across all major cancers as well as lung cancer)
- the experience of screening programmes and pilots currently underway in the UK (e.g. lung cancer screening pilots in Manchester and Liverpool and the Yorkshire Lung Cancer Screening Trial)
- radiology workforce issues
- measures that are required to reduce tobacco consumption and smoking cessation services
- the disruption to treatment and diagnosis caused by the coronavirus pandemic and possible consequences this might have for survival
- the situation in Scotland, Wales and Northern Ireland

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