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1 **Title:** Evaluation of a national lung cancer symptom awareness campaign in Wales

2 **Running title:** Before- and after- campaign evaluation of a lung cancer campaign

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1 **Abstract**

2 **Background**

3 Lung cancer is the leading cause of cancer mortality in Wales. We conducted a before- and after-  
4 study to evaluate the impact of a four-week mass media campaign on awareness, presentation  
5 behaviour and lung cancer outcomes.

6 **Methods**

7 Population-representative samples were surveyed for cough symptom recall/recognition and worry  
8 about wasting doctors' time pre-campaign (June 2016; n=1,001) and post-campaign (September  
9 2016; n=1,013). GP cough symptom visits, urgent suspected cancer (USC) referrals, GP-ordered  
10 radiology, new lung cancer diagnoses and stage at diagnosis were compared using routine data  
11 during the campaign (July-August 2016) and corresponding control (July-August 2015) periods.

12 **Results**

13 Increased cough symptom recall ( $p < 0.001$ ), recognition ( $p < 0.001$ ) and decreased worry ( $p < 0.001$ )  
14 were observed. GP visits for cough increased by 29% in the target 50+ age-group during the  
15 campaign ( $p < 0.001$ ) and GP-ordered chest X-rays increased by 23% ( $p < 0.001$ ). There was no  
16 statistically significant change in USC referrals ( $p = 0.82$ ), new ( $p = 0.70$ ) or early stage ( $p = 0.27$ )  
17 diagnoses, or in routes to diagnosis.

18 **Conclusion**

19 Symptom awareness, presentation and GP-ordered chest x-rays increased during the campaign, but  
20 did not translate into increased USC referrals or clinical outcomes changes. Short campaign duration  
21 and follow up, and the small number of new lung cancer cases observed may have hampered  
22 detection effects.

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## 1 **Background**

2 Lung cancer has the highest mortality of all cancer types, accounting for a fifth of all cancer deaths  
3 worldwide<sup>1</sup>. Lung cancer survival outcomes in the UK are amongst the worst of comparable high-  
4 income countries<sup>2</sup>. High incidence and poor long-term survival mean that mortality rates are high<sup>3</sup>,  
5 particularly in areas of high socioeconomic deprivation. Lung cancer incidence rises steeply with  
6 increasing deprivation and the survival inequality gap is widening<sup>4</sup>. Delayed symptomatic  
7 presentation to a primary care physician and delays within and across primary and secondary care  
8 contribute to diagnosis of lung cancer in the later stages of disease<sup>5-7</sup>. The possibility of curative  
9 treatment decreases with later-stage disease diagnosis; in the UK, less than a fifth of patients are  
10 eligible for surgical resection, in turn influencing outcomes<sup>6,8</sup>.

11 In the absence of routine lung cancer screening, early lung cancer diagnosis relies on prompt patient  
12 presentation and GP referral with symptoms indicative of lung cancer. Low public awareness of lung  
13 cancer symptoms is one possible barrier to prompt symptomatic presentation, contributing to  
14 normalisation and delay in reporting symptoms<sup>9-13</sup>. Interventions are therefore required to raise lung  
15 cancer symptom awareness and reduce barriers to early presentation to expedite diagnosis<sup>14</sup>.  
16 However, evidence of the impact of symptom awareness campaigns is limited<sup>15</sup>. In 2008, the  
17 National Awareness and Early Diagnosis Initiative was formed in England with the aim of improving  
18 cancer outcomes through earlier diagnosis<sup>16</sup>. Consequently, a national programme of cancer  
19 awareness activity was developed, including a focus on lung cancer, and there were also pockets of  
20 local activity. Evaluations of these interventions have suggested that these activities might have  
21 increased the number of lung cancers diagnosed at an earlier stage<sup>17-19</sup>. However, to date, there is  
22 little evidence regarding the effectiveness of mass-media symptom awareness campaigns<sup>18</sup> that  
23 have been adapted and implemented in different geographical settings and demographic contexts.  
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25 In response to poor lung cancer outcomes in Wales, and with evidence from the English Be Clear on  
26 Cancer (BCOC) campaign suggesting stage shift<sup>18</sup>, the Welsh BCOC mass-media campaign was  
27 launched in 2016. The campaign was designed to increase public awareness of cough as a symptom  
28 of cancer and encourage adults over 50 years of age, especially among lower socioeconomic groups,  
29 to visit their GP if they had cough symptoms for three weeks or more. Cough is the most common  
30 presenting lung cancer symptom, and with reported low public awareness of cough as a cancer  
31 symptom, persistent cough was selected as the primary target symptom for the campaign<sup>9, 20-24</sup>.

32 To evaluate the impact of the Welsh BCOC campaign, we conducted a quasi-experimental study with  
33 a before- and after- design, utilising survey responses and routinely collected data. Population based  
34 survey data to assess lung cancer symptom awareness and worry about wasting GP time as a  
35 perceived barrier to medical help seeking were compared one month before the campaign (pre  
36 campaign period; June 2016) to one month after the campaign (post-campaign period; September  
37 2016). Routine data including symptomatic presentations, primary care referrals, diagnostic testing  
38 and cancer diagnoses were compared in the campaign time period (July-August 2016) to the  
39 equivalent time period in 2015 (control period).

## 40 **Methods**

41 The STROBE statement (strengthening the reporting of observational studies in epidemiology)  
42 guided reporting (Supplementary File 1).

### 43 *Intervention*

44 To inform the campaign, six focus groups (four groups of current or former smokers, two groups of  
45 never smokers, total n=48 participants) were undertaken in Wales during August 2015 to gauge  
46 audience receptiveness to existing lung cancer campaign materials from England, Scotland and

1 Northern Ireland, who had already run national public awareness campaigns. Following minor  
2 adaptations from the English campaign, the Welsh lung cancer awareness campaign was launched in  
3 2016 with the strapline “*If you’ve had a cough for three weeks or more, tell your doctor*” in both  
4 Welsh and English (Supplementary Files 2-5; [https://www.cancerresearchuk.org/health-  
5 professional/awareness-and-prevention/be-clear-on-cancer/lung-cancer-awareness-campaign-  
6 wales](https://www.cancerresearchuk.org/health-professional/awareness-and-prevention/be-clear-on-cancer/lung-cancer-awareness-campaign-wales)).

7 Campaign messages were disseminated between 11<sup>th</sup> July and 11<sup>th</sup> August 2016 on television (S4C  
8 and ITV), online, bus and radio adverts, and on posters in pharmacies and on buses. The TV advert  
9 was intentionally crafted to appeal to older adults and people from lower socioeconomic (C2DE)  
10 groups. Where possible, campaign elements were targeted to reach more deprived groups (i.e.  
11 television scheduling, locations for advertising). Primary care engagement in advance of the  
12 campaign included circulating health care professional briefing materials with details of the  
13 campaign to health boards and primary care networks ([https://www.cancerresearchuk.org/health-  
14 professional/awareness-and-prevention/be-clear-on-cancer/lung-cancer-awareness-campaign-  
15 wales#BCOC\\_Lung\\_Wales\\_Essential0](https://www.cancerresearchuk.org/health-professional/awareness-and-prevention/be-clear-on-cancer/lung-cancer-awareness-campaign-wales#BCOC_Lung_Wales_Essential0)). The first national BCOC respiratory campaign ran in England  
16 during the same time period as the Welsh lung BCOC campaign (July-October 2016). This also  
17 included three week cough messaging utilised in previous English lung cancer campaigns, which was  
18 promoted via a range of channels including digital television with reach into Wales. This alignment of  
19 campaign timing aimed to increase the dissemination of the three week cough message in Wales.  
20 English BCOC lung cancer campaigns that had run prior to 2016 had also utilised media channels that  
21 had reached into Wales, providing opportunity for Welsh audiences to have heard the three week  
22 cough message in advance of the dedicated Welsh national activity.

## 23 **Participants and procedures**

### 24 *Survey data*

25 Pre-campaign (June 2016) and post-campaign (September 2016) population samples were surveyed  
26 by Beaufort Research, a market research company. Survey questions were informed by the Cancer  
27 Awareness Measure<sup>25</sup> and previous campaign evaluation tracking in England, and were included as  
28 part of an omnibus survey carried out with a representative sample of the Welsh population (aged  
29 16+) using face-to-face interviews.

30 Survey questions included gender, age, social group, number of children in the household and area  
31 of residence (Cardiff and South East Wales, Mid/West Wales, North Wales, Valleys and West/South  
32 Wales). Each respondent was allocated to ‘ABC1’ or ‘C2DE’ based on their responses to a range of  
33 profiling questions for social group, with ABC1 reflecting less deprived, and C2DE reflecting more  
34 deprived groups. Lung symptom awareness was measured using recall (“*There are many warning  
35 signs and symptoms of lung cancer. Please name as many as you are aware of*”) and prompted  
36 recognition questions (“*I’m now going to list some symptoms that may or may not be warning signs  
37 for lung cancer. For each one, can you tell me the extent to which you think it is a warning sign for  
38 lung cancer?*”). For the recognition question, the symptoms listed were: *a cough for three weeks or  
39 more that does not go away, breathlessness, coughing up blood, a persistent pain in your chest or  
40 shoulder, losing weight for no obvious reason and a cough that got worse or changes*. Response  
41 options were: *definitely a warning sign, probably a warning sign, probably not a warning sign,  
42 definitely not a warning sign* and *don’t know*. Responses were dichotomised as definitely a warning  
43 sign/probably a warning sign versus Definitely not a warning sign/probably not a warning sign. ‘Don’t  
44 know’ responses were not included in the regression analysis. To align with the focus of the  
45 campaign, data are reported for recognition/recall of cough symptom.

1 Worry about wasting the doctor’s time was measured using the question “I’m going to read you a  
2 statement that is sometimes made about lung cancer. Can you please tell me how much you agree or  
3 disagree with it – that is whether you strongly agree, agree, disagree or strongly disagree. If I had a  
4 cough, I would be worried about wasting the GP/doctor’s time”. Response options were  
5 dichotomised as strongly agree/agree versus strongly disagree/disagree.

#### 6 *Routine data*

7 Relevant routine data were sourced for pre-campaign (May and June), campaign (July and August)  
8 and post-campaign (September and October) periods in 2016, and the same periods in 2015. For the  
9 main comparison, the campaign period (July and August 2016) was compared to the comparable  
10 time period in the previous year (control period; July and August 2015). Health care and clinical  
11 outcomes included:

12 *i. Primary care presentations.* Anonymised counts of visits to GP practices for the cough symptom  
13 were identified using defined Read codes extracted from the Securely Anonymised Information  
14 Linkage (SAIL) databank. Counts were extracted for any patient registered with a GP practice in  
15 Wales using GP data within SAIL for all time points. The number of visits per practice/per week for  
16 the target cough symptom and control symptoms including neck pain, knee pain, shoulder pain and  
17 urinary tract infections in people aged 50 years and older was calculated for all time points.

18 *ii. Urgent suspected cancer (USC) referrals.* USC referrals (patients with suspected lung cancer who  
19 are urgently referred from primary care to a specialist, and who are confirmed as urgent by the  
20 specialist) were received from the Welsh Government both at all-Wales and local health board  
21 (hospital) level. Conversion rates were calculated using the USC referral data received from Welsh  
22 Government. To calculate the conversion rate (the proportion of urgent referrals that resulted in a  
23 lung cancer diagnosis), the number of lung cancers diagnosed as a result of an urgent suspected  
24 cancer referral was divided by the number of USC referrals.

25 *iii. Radiology requests.* The number of chest x-rays and chest CT scans carried out in each month  
26 (including tests with or without abdomen) was extracted for each health board from their systems.  
27 The aggregated data for Wales was used to calculate a count for all time points split by GP-referred  
28 and ‘all-referred’ tests. GP-referred tests were adjusted for working days because most GP surgeries  
29 are open Monday-Friday, while ‘all-referred’ tests could include referrals from other pathways that  
30 can occur on weekends.

31 *iv. Number of new lung cancers diagnosed, stage, source of referral.* Lung cancer (ICD10 codes C33-  
32 C34) incidence data for non-small cell and small cell were extracted from the Cancer Network  
33 Information System Cymru (CaNISC) electronic patient records, and split by month and year. Non-  
34 small cell lung cancer cases included histological, cytological or clinical diagnoses. The number of  
35 lung cancer cases diagnosed for the 2016 time points was compared to the number of cases  
36 diagnosed in the corresponding time periods in 2015. Staging data for small cell and non-small cell  
37 lung cancers were combined and grouped into early stage (stages I and II) and late stage (III and IV).  
38 The proportion of early and late stage cancers for known stages were calculated. The source of  
39 referral was extracted for patients diagnosed with lung cancer for the 2016 and 2015 time periods.  
40 Numbers and percentages of patients diagnosed with lung cancer following emergency attendance,  
41 accident and emergency admission, GP referral, and consultant referral were identified from the  
42 CaNISC records. Diagnosis following referral after emergency attendance and accident and  
43 emergency admission were combined to ‘emergency department referral’.

1 v. *First treatment received and performance status*. The number of lung cancer cases in each  
2 treatment category were extracted for the 2016 time periods and the corresponding time periods in  
3 2015. The proportion of all lung cancer cases by treatment group was compared across the 2015 and  
4 2016 time points. Performance status data for all lung cancer cases diagnosed in the corresponding  
5 2015 and 2016 time periods was extracted, according to the following categories: 0 (able to carry  
6 out normal activity without restriction), 1 (restricted in physically strenuous activity but ambulatory  
7 and able to carry out light work), 2 (ambulatory and capable of all self-care but unable to carry out  
8 any work up to about >50% of waking hours), 3 (capable of only limited self-care, confined to bed or  
9 chair >50% of waking hours), 4 (completely disabled, cannot carry out any self-care, totally confined  
10 to bed or chair), and unknown. Proportions of lung cancer cases by performance status category  
11 were compared across the 2015 control time period and 2016 campaign period.

## 12 **Statistical analysis**

13 Multivariable logistic regression was used to investigate pre- to post- campaign differences in cough  
14 recall/recognition and worry about wasting the GP's time, adjusting for demographic differences  
15 between survey samples. Survey data were weighted by age group within gender within Local  
16 Authority grouping, to be representative of the Welsh population. Interaction terms were used to  
17 test differences between social groups in awareness over time.

18 For the main comparison of the campaign period (July-August 2016) and the equivalent control  
19 period in the previous year (July-August 2015), changes in clinical outcomes were assessed using the  
20 two-sample test of proportions or the likelihood ratio tests for counts. The number of days was  
21 adjusted due to differences in the number of GP working days in each time period. The significance  
22 level was set at  $p < 0.001$  to adjust for multiple testing.

## 23 **Results**

### 24 *Survey sample characteristics*

25 Sample characteristics are presented in Table 1. The pre-campaign (n=1,011) and post-campaign  
26 samples (n=1,013) were primarily female (pre-campaign 56.7%; post-campaign 53.1%), from the less  
27 affluent social group C2DE (pre-campaign 54.6%; post-campaign 53.8%), aged 45 years or over (pre-  
28 campaign 59.4%; post-campaign 60.7%) and resident in Cardiff/South East Wales (pre-campaign  
29 26.2%; post-campaign 26.5%).

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1 **Table 1. Demographic characteristics of survey sample pre- and post-campaign**

	Pre-campaign (June 2016; n=1011)		Post-campaign (Sept 2016; n=1013)	
	N	%	N	%
<b>Gender</b>				
Male	438	43.3	475	46.9
Female	573	56.7	538	53.1
<b>Age</b>				
16-24	127	12.6	89	8.8
25-34	154	15.2	168	16.6
35-44	130	12.9	141	13.9
45-54	174	17.2	153	15.1
55-64	138	13.7	157	15.5
65 and over	288	28.5	305	30.1
<b>Social group (SES)</b>				
AB (most affluent)	144	14.2	176	17.4
C1	315	31.2	291	28.7
C2	194	19.2	188	18.6
DE (most deprived)	358	35.4	356	35.2
<b>Area of residence</b>				
Cardiff/South East Wales	265	26.2	268	26.5
Mid/West Wales	162	16.0	166	16.4
North Wales	208	20.6	230	22.7
Valleys	174	17.2	181	17.9
West/South Wales	202	20.0	168	16.6
<b>Children in household</b>				
Yes	323	31.9	344	34
No	688	68.1	669	66

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3 *Cough symptom awareness and worry about wasting the doctor's time*

4 As shown in Table 2, there was a statistically significant 13.3% increase in recall ( $p < 0.001$ ) and 4.4%  
 5 increase in recognition ( $p < 0.001$ ) of the cough symptom pre- to post-campaign. There was a  
 6 statistically significant 7.5% increase in recall of shortness of breath ( $p < 0.001$ ) and 11.7% reduction  
 7 in the number of people who could not recall any symptoms of lung cancer ( $p < 0.001$ ) pre-to-post  
 8 campaign. The relationship between social group and recognition of the cough symptom was not  
 9 significant ( $p = 0.370$  for the interaction term).

10 There was a statistically significant 6.4% reduction in worry about wasting the GP's time pre- to post-  
 11 campaign ( $p < 0.001$ ). There was a statistically significant 10% decline in worry about wasting GP time  
 12 for C2DE (the most deprived group) pre- to post-campaign ( $p = 0.001$ ), but a non-statistically  
 13 significant 1.6% decline for ABC1 (the more affluent group) ( $p = 0.33$ ).

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1 **Table 2. Public awareness and barriers to help seeking pre- and post-campaign survey results**

Survey question	Pre-campaign (June 2016; n=1011)	Post-campaign (Sept 2016; n=1013)	% change	p-value
<b>Symptom recall</b>				
Cough/coughing	27.5%	40.8%	<b>13.3%</b>	<b>&lt;0.001</b>
Persistent/ long lasting/ bad cough	14.2%	15.4%	1.2%	0.26
Shortness of breath/ bad chest/difficulty breathing	29.7%	37.2%	<b>7.5%</b>	<b>&lt;0.001</b>
Coughing up blood/ blood in mouth or mucus	22.5%	18.1%	-4.4%	0.05
Don't know/none	31.4%	19.7%	<b>-11.7%</b>	<b>&lt;0.001</b>
<b>Symptom recognition</b>				
A cough for three weeks or more that does not go away	82.2%	86.6%	<b>4.4%</b>	<b>&lt;0.001</b>
Breathlessness	83.6%	85.9%	2.3%	0.39
Coughing up blood	95.5%	93.3%	-2.2%	0.02
A persistent pain in your chest or shoulder	68.9%	67.2%	-1.7%	0.18
Losing weight for no obvious reason	78.5%	74.7%	-3.8%	0.02
A cough that has got worse or changes	87.1%	88.9%	1.8%	0.32
<b>Recognition of three-week cough by social group</b>				
ABC1 (most affluent)	80.5%	83.9%	3.4%	0.16
C2DE (most deprived)	86.3%	87.2%	0.9%	0.02
<b>Worry about wasting GP time</b>				
ABC1 (most affluent)	47.9%	46.3%	-1.6%	0.33
C2DE (most deprived)	50.1%	40.1%	<b>-10.0%</b>	<b>&lt;0.001</b>
Total	49.2%	42.8%	<b>-6.4%</b>	<b>&lt;0.001</b>

2 Results in bold indicate a statistically significant change between 2015 and 2016

3 *GP presentations*

4 The number of GP visits for cough symptoms increased significantly between the control and  
5 campaign period in all age groups apart from 10-19 year olds (Table 3). The total number of people  
6 of all ages presenting to their GP with a cough during the 2016 campaign period increased  
7 significantly by 21.4% (p<0.001) compared to the corresponding control period in 2015. In the target  
8 age group of people aged 50 years and over, there was a statistically significant 24.3% increase  
9 (p<0.001) in the number of visits to a GP for cough during 2016 compared to the equivalent 2015  
10 control period.

11 Among the target over 50s age group, the number of presentations with a cough increased from 6.0  
12 per GP practice per week during 2015 to 7.7 per GP practice per week during the campaign period in  
13 2016, equivalent to a statistically significant increase of 28.9% (p<0.001). In the same time period,  
14 there was no significant increase in the number of GP presentations among the over 50 age group  
15 for each of the four control symptoms of urinary tract infection (p=0.77), neck pain (p=0.26),  
16 shoulder pain (p=0.23) or knee pain (p=0.37) (Table 3).

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1 **Table 3. Number of cough presentations adjusted weekly rate of GP presentations for cough and**  
 2 **four control symptoms in patients aged 50 years and cough presentations by age group**

	2015; n	2016; n	Change (n)	% change	P-value
<b>Number of presentations per practice per week in patients over the age of 50 (adjusted*)</b>					
<b>Cough</b>					
Pre-campaign	7.9	7.6	-0.3	-3.1	
Campaign	6.0	7.7	1.7	<b>28.9</b>	<b>&lt;0.001</b>
Post-campaign	8.1	8.3	0.2	2.1	
<b>Urinary Tract Infection</b>					
Pre-campaign	1.0	1.0	0.0	1.1	
Campaign	1.0	1.1	0.1	4.5	0.77
Post-campaign	1.1	1.1	0.1	6.3	
<b>Neck Pain</b>					
Pre-campaign	1.0	1.1	0.1	3.0	
Campaign	1.0	1.0	0.0	0.7	0.26
Post-campaign	1.1	1.1	0.0	-2.2	
<b>Shoulder Pain</b>					
Pre-campaign	0.1	0.1	0.0	5.9	
Campaign	0.1	0.1	0.0	14.7	0.23
Post-campaign	0.1	0.1	0.0	0.8	
<b>Knee Pain</b>					
Pre-campaign	3.2	3.2	0.0	2.1	
Campaign	2.9	3.1	0.2	5.1	0.37
Post-campaign	2.9	3.0	0.1	1.7	
<b>Number of presentations for cough symptom during the campaign period (July and August 2016) and corresponding time period in the previous year (July-August 2015) by age group</b>					
<b>Age group</b>					
0-9	5745	6612	867	<b>15.1</b>	<b>&lt;0.001</b>
10-19	1870	2061	191	10.2	0.002
20-29	2112	2561	449	<b>21.3</b>	<b>&lt;0.001</b>
30-39	2155	2747	592	<b>27.5</b>	<b>&lt;0.001</b>
40-49	3075	3673	598	<b>19.4</b>	<b>&lt;0.001</b>
50-59	4197	5324	1127	<b>26.9</b>	<b>&lt;0.001</b>
60-69	5374	6605	1231	<b>22.9</b>	<b>&lt;0.001</b>
70-79	4676	5900	1224	<b>26.2</b>	<b>&lt;0.001</b>
80+	3050	3678	628	<b>20.6</b>	<b>&lt;0.001</b>
<b>Total aged 50+</b>	17297	21507	4210	<b>24.3</b>	<b>&lt;0.001</b>
<b>Total all ages</b>	32254	39161	6907	<b>21.4</b>	<b>&lt;0.001</b>

3 \*adjusted for working days. Results in bold indicate a statistically significant change between 2015 and 2016

4  
 5 *Urgent suspected cancer referrals and conversion rate*

6  
 7 There was a non-significant 1.2% reduction (p=0.82) in the total number of USC referrals for  
 8 suspected lung cancer, and a non-significant 1.4% reduction (p=0.56) in the number of USC referrals  
 9 resulting in a lung cancer diagnosis (conversion rate) between the 2016 campaign period and the  
 10 equivalent time period in 2015 (Table 4).

11

1 **Table 4. Urgent suspected lung cancer referrals and conversion rate**

	2015	2016	% change (adjusted*)	P-value
<b>Urgent suspected lung cancer referrals (total, n)</b>				
Pre-campaign	623	659	3.3	
Campaign	650	642	-1.2	0.82
Post-campaign	581	559	-1.6	
<b>Conversion rate (%)</b>				
Pre-campaign	24.2%	24.9%	0.6	
Campaign	25.1%	23.7%	-1.4%	0.56
Post-campaign	22.9%	23.1%	0.2%	

10 \*adjusted for working days.

11 *Radiology requests*

12 A statistically significant increase of 23.4% in GP-referred chest x-rays (p<0.001), and 8.1% increase  
 13 in chest x-rays from all referral sources (p<0.001) was reported in the 2016 campaign period  
 14 compared to the equivalent time period in 2015 (Table 5)

15 There was a non-statistically significant 9.6% increase in GP-referred chest CT scans in the 2016  
 16 campaign period compared to the equivalent time period in 2015 (p=0.06). There was a statistically  
 17 significant 10.1% increase in the number of chest CT scans from all referral sources (p<0.001) in the  
 18 2016 campaign period compared to the equivalent time period in 2015 (Table 5).

19 **Table 5. Number of chest x-rays and chest CT scans conducted**

	Number of tests (n)		Tests per day (adjusted*)			P-value
	2015	2016	2015	2016	% change	
<b>GP referred chest X-rays</b>						
Pre-campaign	21714	23092	529.6	549.8	3.8	
Campaign	19107	23585	444.3	548.5	<b>23.4</b>	<b>&lt;0.001</b>
Post-campaign	21368	23409	485.6	544.4	12.1	
<b>All chest x-rays</b>						
Pre-campaign	77763	79787	1896.7	1899.7	0.2	
Campaign	73690	79686	1713.7	1853.2	<b>8.1</b>	<b>&lt;0.001</b>
Post-campaign	77556	80912	1762.6	1881.7	6.8	
<b>GP referred chest CT scans</b>						
Pre-campaign	746	843	18.2	20.1	10.3	
Campaign	780	855	18.1	19.9	9.6	0.0628
Post-campaign	678	791	15.4	18.4	19.4	
<b>All Chest CT scans</b>						
Pre-campaign	5207	6040	127	143.8	13.2	
Campaign	5244	5775	122	134.3	<b>10.1</b>	<b>&lt;0.001</b>
Post-campaign	5390	5871	122.5	136.5	11.5	

32 \*adjusted for working days. Results in bold indicate a statistically significant change between 2015 and 2016

33 *Number and stage of new lung cancers diagnosed*

34 There were no statistically significant changes in the number of new diagnoses of non-small cell lung  
 35 cancer (p=0.34), small cell lung cancer (p=0.38) or the total number of new lung cancer diagnoses  
 36 (p=0.70) in the 2016 campaign period compared to the equivalent time period in 2015 (Table 6).

1 There were no statistically significant differences in staging data. There was a non-statistically  
2 significant 3.5% increase in the total number of early stage (I and II) cases of lung cancer cases  
3 ( $p=0.27$ ) and a 3.5% non-significant decrease in the total number of late stage (III and IV) cases of  
4 lung cancer ( $p=0.27$ ) in the 2016 campaign period compared to the equivalent time period in 2015  
5 (Table 6).

6 *Referral source of number of lung cancers diagnosed*

7 There were no statistically significant changes in the number of new lung cancer diagnoses from all  
8 referral sources. There was a non-statistically significant increase in the proportion of new lung  
9 cancer diagnoses after referral through emergency department (6.3% increase;  $p=0.04$ ), referral  
10 through from an inpatient consultant (1.8% increase;  $p=0.22$ ) and referral from other sources (2.4%  
11 increase;  $p=0.02$ ) during the 2016 campaign to the equivalent time period in 2015 (Table 6).

12 There was a non-statistically significant decrease in the proportion of new lung cancer diagnoses  
13 after referral through from a non-accident and emergency department consultant (7.2% decrease;  
14  $p=0.02$ ), and referral from the GP (3.3% decrease;  $p=0.35$ ) during the 2016 campaign period to the  
15 equivalent time period in 2015 (Table 6).

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1 **Table 6. Number and stage of lung cancer patients, with diagnosis by source of referral**

	2015 Number of cases (%)	2016 Number of cases (%)	n Change	p- 2 value
<b>Number of new lung cancer cases</b>				
<b>Non-small cell lung cancer</b>				
Pre-campaign	324	326	2	4
Campaign	348	372	24	0.34
Post-campaign	342	318	-24	5
<b>Small-cell lung cancer</b>				
Pre-campaign	51	47	-4	6
Campaign	53	40	-13	0.38
Post-campaign	42	39	-3	7
<b>Total</b>				
Pre-campaign	375	373	-2	8
Campaign	401	412	11	0.70
Post-campaign	384	357	-27	9
	2015 Number of cases (%)	2016 Number of cases (%)	% Change	p- 10 value
<b>Stage of new lung cancer cases number and proportion of cases with known stage*</b>				
<b>Early (stage I and II)</b>				
Pre-campaign	95 (25.5%)	85 (23.4%)	-2.1%	12
Campaign	98 (24.8%)	114 (28.3%)	3.5%	0.27
Post-campaign	114 (30.2%)	94 (27.0%)	-3.2%	13
<b>Late (stage III and IV)</b>				
Pre-campaign	277 (74.5%)	278 (76.6%)	2.1%	14
Campaign	297 (75.1%)	289 (71.7%)	-3.5%	0.27
Post-campaign	263 (69.8%)	254 (73.0%)	3.2%	15
<b>Stage unknown</b>				
Pre-campaign	3	10		16
Campaign <sup>5</sup>	6	9		17
Post-campaign	7	9		
<b>Number and proportion of new lung cancer cases diagnosed by source of referral</b>				
<b>Following A&amp;E attendance or emergency admission</b>				
Pre-campaign	102 (27.2%)	111 (29.8%)	2.6%	19
Campaign	89 (22.2%)	117 (28.5%)	6.3%	0.04
Post-campaign	103 (26.8%)	108 (30.3%)	3.4%	20
<b>Referral from GP</b>				
Pre-campaign	176 (46.9%)	184 (49.3%)	2.4%	21
Campaign	180 (44.9%)	171 (41.6%)	-3.3%	0.35
Post-campaign	154 (40.1%)	146 (40.9%)	0.8%	22
<b>Referral from a consultant (other than in an A&amp;E department)</b>				
Pre-campaign	73 (19.5%)	57 (15.3%)	-4.2%	23
Campaign	112 (27.9%)	85 (20.7%)	-7.2%	0.02
Post-campaign	103 (26.8%)	77 (21.6%)	-5.3%	24
<b>Referral from a consultant (from inpatients)</b>				
Pre-campaign	13 (3.5%)	9 (2.4%)	-1.1%	25
Campaign	16 (4.0%)	24 (5.8%)	1.8%	0.23
Post-campaign	11 (2.9%)	16 (4.5%)	1.6%	26
<b>Other source</b>				
Pre-campaign	11 (2.9%)	12 (3.2%)	0.3%	27
Campaign	4 (1.0%)	14 (3.4%)	2.4%	0.02
Post-campaign	13 (3.4%)	10 (2.8%)	-0.6%	28
<b>Not recorded</b>				
Pre-campaign	0 (0%)	0 (0%)	0%	29
Campaign	0 (0%)	1 (0.2%)	0.2%	30
Post-campaign	0 (0%)	0 (0%)	0%	31

\*Small-cell and non-

small cell lung cancer cases combined; %'s presented as proportions of the total known cases <sup>5</sup>Statistical testing not conducted due to very small numbers

1 *First treatment received and performance status of lung cancers diagnosed*

2 For all forms of treatment including surgical resection, there was no statistically significant  
3 difference during the 2016 campaign period to the equivalent time period in 2015 (Supplementary  
4 File 6). There were no statistically significant changes in all performance status categories for new  
5 lung cancer patients during the 2016 campaign to the equivalent time period in 2015  
6 (Supplementary File 7).

7 **Discussion**

8 We evaluated the impact of the first nationwide mass-media lung cancer symptom awareness  
9 campaign to be conducted in Wales. The campaign was successful in raising public awareness of  
10 cough as a symptom of lung cancer and in reducing barriers to symptomatic presentation. A greater  
11 reduction in worry about wasting GP time was observed after the campaign, especially among  
12 socioeconomically deprived groups. Behavioural changes were observed during the campaign, with  
13 an increase in the number of patients presenting to their GP with a cough symptom for the target  
14 over 50s target group. Although GP-ordered chest x-rays increased during the campaign, this did not  
15 extend to USC referrals or the number and stage distribution of new lung cancer diagnoses.

16 The first national BCOC lung cancer campaign in England, involving a four-week regional pilot in the  
17 central TV region in 2011 and eight-week national mass media campaign in 2012, reported increased  
18 symptom awareness, primary care cough symptom presentations and GP requested chest x-rays<sup>17,18</sup>.  
19 A subsequent community-based lung cancer awareness campaign run over an extended period of  
20 time, combining public awareness activities with open-access walk-in chest x-ray for those with  
21 symptoms that could indicate lung cancer and GP education<sup>19</sup> also reported improved lung cancer  
22 outcomes including a highly significant stage shift and higher treatment rates. We found a significant  
23 increase in the number of GP presentations with a cough symptom and GP-ordered chest X-ray  
24 requests. However, when comparing the campaign time period in 2015 to the pre- and post-  
25 campaign time period data for 2015 (Tables 3 and 5), the reported number of cough symptom  
26 presentations and GP-ordered chest X-rays are substantially lower. The lower number of cough  
27 presentations and radiology requests in the 2015 campaign period may either be lower by chance  
28 (thus artificially inflating our findings), or reflect the time of year when the 2016 campaign was run  
29 (July-August) outside of flu season.

30 We found no impact of the Welsh BCOC campaign on USC referrals or other clinical outcomes. Our  
31 findings likely reflect the need for higher-intensity briefings for health-professionals with  
32 information about campaign activities and symptoms for referral. Further, it is possible that despite  
33 the increase in cough presentations, system and access barriers from primary care to secondary care  
34 in Wales may have led to no increase in the proportion of lung cancer cases diagnosed through the  
35 GP referral route, reflecting the need for service re-design.

36 The current campaign was designed to target adults over the age of 50, particularly from C2DE  
37 audiences. However, public-facing materials did not display age-related risk information to maintain  
38 simple campaign messaging. Campaign developers selected actors for the campaign materials to  
39 implicitly reinforce age. It is possible that without explicit advice on age-related risk, younger and  
40 lower risk individuals presented to primary care with symptoms, impacting USC referrals. We report  
41 the largest reduction in worry about wasting GP time as a psychosocial barrier to help seeking in the  
42 target deprived group. Our findings may reflect successful strategic targeting of campaign messages  
43 to areas of high socioeconomic deprivation in Wales to modify salient barriers to help seeking.

1 Low campaign dose and intensity limited the impact of the Welsh BCOC campaign on health care  
2 activity and clinical outcomes. Additionally, possible contamination from previous English Be Clear  
3 on Cancer lung campaigns into Wales (principally via digital channels) may have potentially diluted  
4 the effect of the Welsh Be Clear on Cancer campaign because people in Wales may have previously  
5 been exposed to campaign messaging. Due to funding constraints, the dedicated Welsh campaign  
6 materials were delivered through fewer outlets and with lower intensity, and the duration of the  
7 campaign was half the dose of the first eight-week English BCOC campaign<sup>17,18</sup>. Longer campaign  
8 duration, together with a more comprehensive and multi-faceted mode of delivery, may lead to  
9 larger effects, for example the 5-year community based Leeds lung cancer campaign reported an  
10 increase of 80% in chest X-ray referrals<sup>19</sup>.

11 The methodological limitations associated with the evaluation of cancer awareness campaigns may  
12 also explain these findings<sup>16</sup>. Small numbers of new cases during the campaign and comparison  
13 periods hampered effect detection for new/early stage lung cancer diagnoses. Due to funding  
14 limitations and the time-sensitive nature of the project, it is possible that the follow-up period  
15 restricted the capture of changes to clinical outcomes, and is a limitation of the evaluation. A long  
16 follow up period is required to account for the time lag between campaign implementation and  
17 radiology/suspected cancer referral, and to collect clinical data for patients presenting with  
18 symptoms during the campaign who were subsequently diagnosed with lung cancer. Further, data  
19 were obtained from two sources, including Omnibus surveys and routinely collected data records.  
20 Variation in data collection time points precluded direct comparison of data at each time point.  
21 Future campaign evaluations could assess the possible negative effects of the campaign, such as  
22 increased health anxiety.

23 Promisingly, our findings show that a mass-media cough campaign can increase symptom  
24 awareness, symptomatic presentation and, potentially, GP-ordered diagnostic testing. We found  
25 evidence of reach and reduced barriers to help seeking in socioeconomically deprived groups.

## 26 **Conclusion**

27 Increased public awareness, cough symptom presentation and GP-ordered diagnostic testing did not  
28 translate into increased USC referrals, new lung cancer diagnoses or stage shift following a national  
29 mass-media lung cancer awareness campaign in Wales. This reflected limitations of campaign  
30 delivery and methodological issues associated with its evaluation. Earlier diagnosis might be  
31 achieved by more intensive, sustained and targeted campaigns, by improving GP diagnostic and  
32 referral systems, and through secondary care pathway redesign.

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2 **Ethical approval and consent to participate:** The survey was conducted as part of an omnibus survey  
3 conducted by Beaufort’s Research; therefore, ethical approval was not obtained for the omnibus.  
4 Beaufort Research operate to standard codes of conduct.

5 **Consent for publication:** Not applicable

6 **Data availability:** Requests for data-sharing will be considered by the senior authors. Please submit  
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8 **Conflict of Interest:** The authors declare no conflict of interest.

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