

Online Research @ Cardiff

This is an Open Access document downloaded from ORCA, Cardiff University's institutional repository: <http://orca.cf.ac.uk/126586/>

This is the author's version of a work that was submitted to / accepted for publication.

Citation for final published version:

McCutchan, Grace, Smits, Stephanie, Ironmonger, Lucy, Slyne, Ciaran, Boughey, Amanda, Moffat, Jodie, Thomas, Rebecca, Huws, Dyfed Wyn and Brain, Kate 2020. Evaluation of a national lung cancer symptom awareness campaign in Wales. *British Journal of Cancer* 122 , pp. 491-497. 10.1038/s41416-019-0676-2 file

Publishers page: <http://dx.doi.org/10.1038/s41416-019-0676-2> <<http://dx.doi.org/10.1038/s41416-019-0676-2>>

Please note:

Changes made as a result of publishing processes such as copy-editing, formatting and page numbers may not be reflected in this version. For the definitive version of this publication, please refer to the published source. You are advised to consult the publisher's version if you wish to cite this paper.

This version is being made available in accordance with publisher policies. See <http://orca.cf.ac.uk/policies.html> for usage policies. Copyright and moral rights for publications made available in ORCA are retained by the copyright holders.



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

3 **Authors:**

4 Grace McCutchan^{1*+}, Stephanie Smits^{*1}, Lucy Ironmonger², Ciarán Slyne⁴, Amanda Boughey³, Jodie
5 Moffat², Rebecca Thomas⁵, Dyfed Wyn Huws⁵, Kate Brain⁵.

6 *co-lead authors contributed equally to this work

7 §co-last authors contributed equally to this work

8 +Corresponding author: Dr Grace McCutchan. Email: mcutchanGM@cardiff.ac.uk

9 ¹Cardiff University, School of Medicine, Division of Population Medicine

10 ²Cancer Research UK

11 ³Formerly Cancer Research UK

12 ⁴Cwm Taf Morgannwg University Health Board

13 ⁵Public Health Wales, Welsh Cancer Intelligence and Surveillance Unit

14 **Keywords:** lung cancer, early diagnosis, campaign, intervention, help seeking behaviour

15

16

17

18

19

20

21

22

23

24

25

26

27

28

29

30

31 **This is a pre-print of an article published in The British Journal of Cancer. The final authenticated**
32 **version is available online at: <https://doi.org/10.1038/s41416-019-0676-2>**

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.

23

24

25

26

27

28

29

30

31

32

33

34

35

36

1 **Background**

2 Lung cancer has the highest mortality of all cancer types, accounting for a fifth of all cancer deaths
3 worldwide¹. Lung cancer survival outcomes in the UK are amongst the worst of comparable high-
4 income countries². High incidence and poor long-term survival mean that mortality rates are high³,
5 particularly in areas of high socioeconomic deprivation. Lung cancer incidence rises steeply with
6 increasing deprivation and the survival inequality gap is widening⁴. 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 disease⁵⁻⁷. 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^{6,8}.

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 symptoms⁹⁻¹³. Interventions are therefore required to raise lung
15 cancer symptom awareness and reduce barriers to early presentation to expedite diagnosis¹⁴.
16 However, evidence of the impact of symptom awareness campaigns is limited¹⁵. In 2008, the
17 National Awareness and Early Diagnosis Initiative was formed in England with the aim of improving
18 cancer outcomes through earlier diagnosis¹⁶. 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 stage¹⁷⁻¹⁹. However, to date, there is
22 little evidence regarding the effectiveness of mass-media symptom awareness campaigns¹⁸ that
23 have been adapted and implemented in different geographical settings and demographic contexts.
24

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 shift¹⁸, 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^{9, 20-24}.

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 11th July and 11th 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 Measure²⁵ 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%).

30

31

32

33

34

35

36

37

38

39

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	%
Gender				
Male	438	43.3	475	46.9
Female	573	56.7	538	53.1
Age				
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
Social group (SES)				
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
Area of residence				
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
Children in household				
Yes	323	31.9	344	34
No	688	68.1	669	66

2

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) ($p = 0.33$).

14

15

16

17

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
Symptom recall				
Cough/coughing	27.5%	40.8%	13.3%	<0.001
Persistent/ long lasting/ bad cough	14.2%	15.4%	1.2%	0.26
Shortness of breath/ bad chest/difficulty breathing	29.7%	37.2%	7.5%	<0.001
Coughing up blood/ blood in mouth or mucus	22.5%	18.1%	-4.4%	0.05
Don't know/none	31.4%	19.7%	-11.7%	<0.001
Symptom recognition				
A cough for three weeks or more that does not go away	82.2%	86.6%	4.4%	<0.001
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
Recognition of three-week cough by social group				
ABC1 (most affluent)	80.5%	83.9%	3.4%	0.16
C2DE (most deprived)	86.3%	87.2%	0.9%	0.02
Worry about wasting GP time				
ABC1 (most affluent)	47.9%	46.3%	-1.6%	0.33
C2DE (most deprived)	50.1%	40.1%	-10.0%	<0.001
Total	49.2%	42.8%	-6.4%	<0.001

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).

17
18
19

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
Number of presentations per practice per week in patients over the age of 50 (adjusted*)					
Cough					
Pre-campaign	7.9	7.6	-0.3	-3.1	
Campaign	6.0	7.7	1.7	28.9	<0.001
Post-campaign	8.1	8.3	0.2	2.1	
Urinary Tract Infection					
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	
Neck Pain					
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	
Shoulder Pain					
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	
Knee Pain					
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	
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					
Age group					
0-9	5745	6612	867	15.1	<0.001
10-19	1870	2061	191	10.2	0.002
20-29	2112	2561	449	21.3	<0.001
30-39	2155	2747	592	27.5	<0.001
40-49	3075	3673	598	19.4	<0.001
50-59	4197	5324	1127	26.9	<0.001
60-69	5374	6605	1231	22.9	<0.001
70-79	4676	5900	1224	26.2	<0.001
80+	3050	3678	628	20.6	<0.001
Total aged 50+	17297	21507	4210	24.3	<0.001
Total all ages	32254	39161	6907	21.4	<0.001

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
Urgent suspected lung cancer referrals (total, n)				
Pre-campaign	623	659	3.3	
Campaign	650	642	-1.2	0.82
Post-campaign	581	559	-1.6	
Conversion rate (%)				
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	
GP referred chest X-rays						
Pre-campaign	21714	23092	529.6	549.8	3.8	
Campaign	19107	23585	444.3	548.5	23.4	<0.001
Post-campaign	21368	23409	485.6	544.4	12.1	
All chest x-rays						
Pre-campaign	77763	79787	1896.7	1899.7	0.2	
Campaign	73690	79686	1713.7	1853.2	8.1	<0.001
Post-campaign	77556	80912	1762.6	1881.7	6.8	
GP referred chest CT scans						
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	
All Chest CT scans						
Pre-campaign	5207	6040	127	143.8	13.2	
Campaign	5244	5775	122	134.3	10.1	<0.001
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).

16

17

18

19

20

21

22

23

24

25

26

27

28

29

30

31

32

33

34

35

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
Number of new lung cancer cases				
Non-small cell lung cancer				
Pre-campaign	324	326	2	4
Campaign	348	372	24	0.34
Post-campaign	342	318	-24	5
Small-cell lung cancer				
Pre-campaign	51	47	-4	6
Campaign	53	40	-13	0.38
Post-campaign	42	39	-3	7
Total				
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
Stage of new lung cancer cases number and proportion of cases with known stage*				
Early (stage I and II)				
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
Late (stage III and IV)				
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
Stage unknown				
Pre-campaign	3	10		16
Campaign ⁵	6	9		17
Post-campaign	7	9		
Number and proportion of new lung cancer cases diagnosed by source of referral				
Following A&E attendance or emergency admission				
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
Referral from GP				
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
Referral from a consultant (other than in an A&E department)				
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
Referral from a consultant (from inpatients)				
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
Other source				
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
Not recorded				
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 ⁵Statistical 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^{17,18}.
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 education¹⁹ 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^{17,18}. 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 referrals¹⁹.

11 The methodological limitations associated with the evaluation of cancer awareness campaigns may
12 also explain these findings¹⁶. 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.

33

34

35

36

37

38

39

40

41

1

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
7 requests to the corresponding author.

8 **Conflict of Interest:** The authors declare no conflict of interest.

9 **Funding:** The pre-campaign testing and elements of the evaluation were funded by the Early
10 Diagnosis team at Cancer Research UK. Public Health England funded the development of the assets
11 used in the campaign. NHS Wales funded the Welsh campaign and evaluation. Dr Grace McCutchan
12 is supported by Health and Care Research Wales as part of the Wales Cancer Research Centre (Grant
13 reference no: CA05). Dr Stephanie Smits is supported by a Health and Care Research Wales
14 Fellowship.

15 **Authors’ contributions:** AB contributed to the development of the campaign. KB, JM, LI, GM and SS
16 contributed to the development of the campaign and campaign evaluation from an advisory
17 capacity. DH, RT, LI, CS analysed the data. GM and SS prepared the manuscript. All authors were
18 involved in the development of the manuscript. All authors read and approved the final version.

19 **Acknowledgements:** We would like to thank the members of the Welsh Lung Cancer Initiative
20 Virtual Reference group (Jane Hanson, John Watkins, Gareth Collier, Clare Bath, Karen Gully, Carol
21 Owen and Richard Neal) for their input into the development and implementation of the campaign.
22 Thanks to Sian Howell who coordinated campaign delivery and Sara Roberts who supported
23 campaign implementation. We would also like to thank Beaufort Research and the Welsh Cancer
24 and Intelligence Unit, who collected the data, and Katie Connor of Cancer Research UK who
25 supported analysis of the survey data.

26 Supplementary information is available at the British Journal of Cancer’s website

27 **References**

28 1. Bray F, Ferlay J , Soerjomataram I, Siegel R, Torre L, Jemal A. GLOBOCAN estimates of incidence
29 and mortality worldwide for 36 cancers in 185 countries. *CA Cancer J Clin* 2018, **68**(6), 394-424,
30 <https://doi.org/10.3322/caac.21492>

31 2. Allemani C, Matsuda T, Di Carlo V, Harewood R, Matz M Nksic M et al. Global surveillance of
32 trends in cancer survival 2000–14 (CONCORD-3): analysis of individual records for 37513025 patients
33 diagnosed with one of 18 cancers from 322 population-based registries in 71 countries. *Lancet* 2018,
34 **391**, 1023–75, [doi:10.1016/S0140-6736\(17\)33326-3](https://doi.org/10.1016/S0140-6736(17)33326-3)

35 3. Cancer Research UK. Lung cancer statistics [website]. Available at:
36 [https://www.cancerresearchuk.org/health-professional/cancer-statistics/statistics-by-cancer-](https://www.cancerresearchuk.org/health-professional/cancer-statistics/statistics-by-cancer-type/lung-cancer)
37 [type/lung-cancer](https://www.cancerresearchuk.org/health-professional/cancer-statistics/statistics-by-cancer-type/lung-cancer). Accessed 19.07.2019

38 4. Welsh Cancer Intelligence and Surveillance Unit. Cancer statistics. Available at:
39 <http://www.wcisu.wales.nhs.uk/home>. Accessed 19.07.2019

- 1 5. Barrett J, Hamilton W. Pathways to the diagnosis of lung cancer in the UK: a cohort study. *BMC*
2 *Fam Pract* 2008, **9**, 31, doi: [10.1186/1471-2296-9-31](https://doi.org/10.1186/1471-2296-9-31)
- 3 6. Walters S, Maringe C, Coleman MP, Peake MD, Butler J, Young N, et al. Lung cancer survival and
4 stage at diagnosis in Australia, Canada, Denmark, Norway, Sweden and the UK: a population-based
5 study, 2004–2007. *Thorax* 2013, **68**(6), 551-64
- 6 7. Tørring ML, Frydenberg M, Hansen RP, Olesen F, Vedsted P. Evidence of increasing mortality with
7 longer diagnostic intervals for five common cancers: A cohort study in primary care. *Eur J Cancer*
8 2013, **49**(9), 2187-98
- 9 8. National Cancer Registration and Analysis Service. Chemotherapy, Radiotherapy and Tumour
10 Resections in England [Internet]. Available at: <https://www.cancerdata.nhs.uk/treatments>. Accessed
11 19.07.2019
- 12 9. Simon AE, Juszczak D, Smyth N, Power E, Hiom S, Peake MD, et al. Knowledge of lung cancer
13 symptoms and risk factors in the UK: development of a measure and results from a population-
14 based survey. *Thorax* 2012, **67**(5), 426-32
- 15 10. Quaife SL, Forbes LJJ, Ramirez AJ, Brain KE, Donnelly C, Simon AE, et al. Recognition of cancer
16 warning signs and anticipated delay in help-seeking in a population sample of adults in the UK. *Br J*
17 *Cancer* 2014, **110**(1), 12-8
- 18 11. Crane M, Scott N, O'Hara BJ, Aranda S, Lafontaine M, Stacey I, et al. Knowledge of the signs and
19 symptoms and risk factors of lung cancer in Australia: mixed methods study. *BMC Public Health*
20 2016, **16**, 508
- 21 12. McLachlan S, Mansell G, Sanders T, Yardley S, van der Windt D, Brindle L, et al. Symptom
22 perceptions and help-seeking behaviour prior to lung and colorectal cancer diagnoses: a qualitative
23 study. *Fam Pract* 2015, **32**(5), 568-77
- 24 13. McCutchan G, Hiscock J, Hood K, Murchie P, Neal R, Newton G et al. Engaging high-risk groups in
25 early lung cancer diagnosis: a qualitative study of symptom presentation and intervention
26 preferences among the UK's most deprived communities. *BMJ Open* 2019, **9**, e025902, doi:
27 [10.1136/bmjopen-2018-025902](https://doi.org/10.1136/bmjopen-2018-025902)
- 28 14. Weller M, Peake M, Field J. Presentation of lung cancer in primary care. *Primary Care Resp Med*
29 2019, **29**(21), doi.org/10.1038/s41533-019-0133-y
- 30 15. Austoker J, Bankhead C, Forbes LJJ, Atkins L, Martin F, Robb K, et al. Interventions to promote
31 cancer awareness and early presentation: systematic review. *Br J Cancer* 2009, **101**(Suppl 2), S31-S9
- 32 16. Richards MA. The National Awareness and Early Diagnosis Initiative in England: assembling the
33 evidence. *Br J Cancer* 2009, **101**(Suppl 2), S1-S4.
- 34 17. Public Health England: National Cancer Registration and Analysis Service. 2018. Be Clear on
35 Cancer: Regional and national lung cancer awareness campaigns 2011 to 2014. Final evaluation
36 results. Report available via:
37 [http://www.ncin.org.uk/cancer_type_and_topic_specific_work/topic_specific_work/be_clear_on_c](http://www.ncin.org.uk/cancer_type_and_topic_specific_work/topic_specific_work/be_clear_on_cancer/)
38 [ancer/](http://www.ncin.org.uk/cancer_type_and_topic_specific_work/topic_specific_work/be_clear_on_cancer/)
- 39 18. Ironmonger L, Ohuma E, Ormiston-Smith N, Gildea C, Thomson CS, Peake MD. An evaluation of
40 the impact of large-scale interventions to raise public awareness of a lung cancer symptom. *Br J*
41 *Cancer* 2014, **112**, 207

- 1 19. Kennedy MPT, Cheyne L, Darby M, Plant P, Milton R, Robson JM, et al. Lung cancer stage-shift
2 following a symptom awareness campaign. *Thorax* 2018, **0**, 1–9, doi:10.1136/thoraxjnl-2018-211842
- 3 20. Hamilton W, Peters T, Round A, Sharp D. What are the clinical features of lung cancer before the
4 diagnosis is made? A population based case-control study. *Thorax* 2005, **60**(12), 1059-65
- 5 21. Hamilton W. The CAPER studies: five case-control studies aimed at identifying and quantifying
6 the risk of cancer in symptomatic primary care patients. *Br J Cancer* 2009, **101**, S80
- 7 22. Lövgren M, Leveälähti H, Tishelman C, Runesdotter S, Hamberg K, Koyi H. Time spans from first
8 symptom to treatment in patients with lung cancer – The influence of symptoms and demographic
9 characteristics. *Acta Oncologica* 2008, **47**(3), 397-405
- 10 23. Kvale PA. Chronic Cough Due to Lung Tumors: ACCP Evidence-Based Clinical Practice Guidelines.
11 *Chest* 2006, **129**, 147S-53.
- 12 24. Shim J, Brindle L, Simon M, George S. A systematic review of symptomatic diagnosis of lung
13 cancer. *Fam Pract* 2014, **31**(2), 137-48.
- 14 25. Stubbings S, Robb K, Waller J, Ramirez A, Austoker J, Macleod U, et al. Development of a
15 measurement tool to assess public awareness of cancer. *Br J Cancer*, 2009, 101, S13-S7
- 16
- 17