Koo et al., supplementary material

Supplementary material for: **Guideline concordance for timely chest imaging after new presentations of dyspnoea or haemoptysis in primary care: a retrospective cohort study**
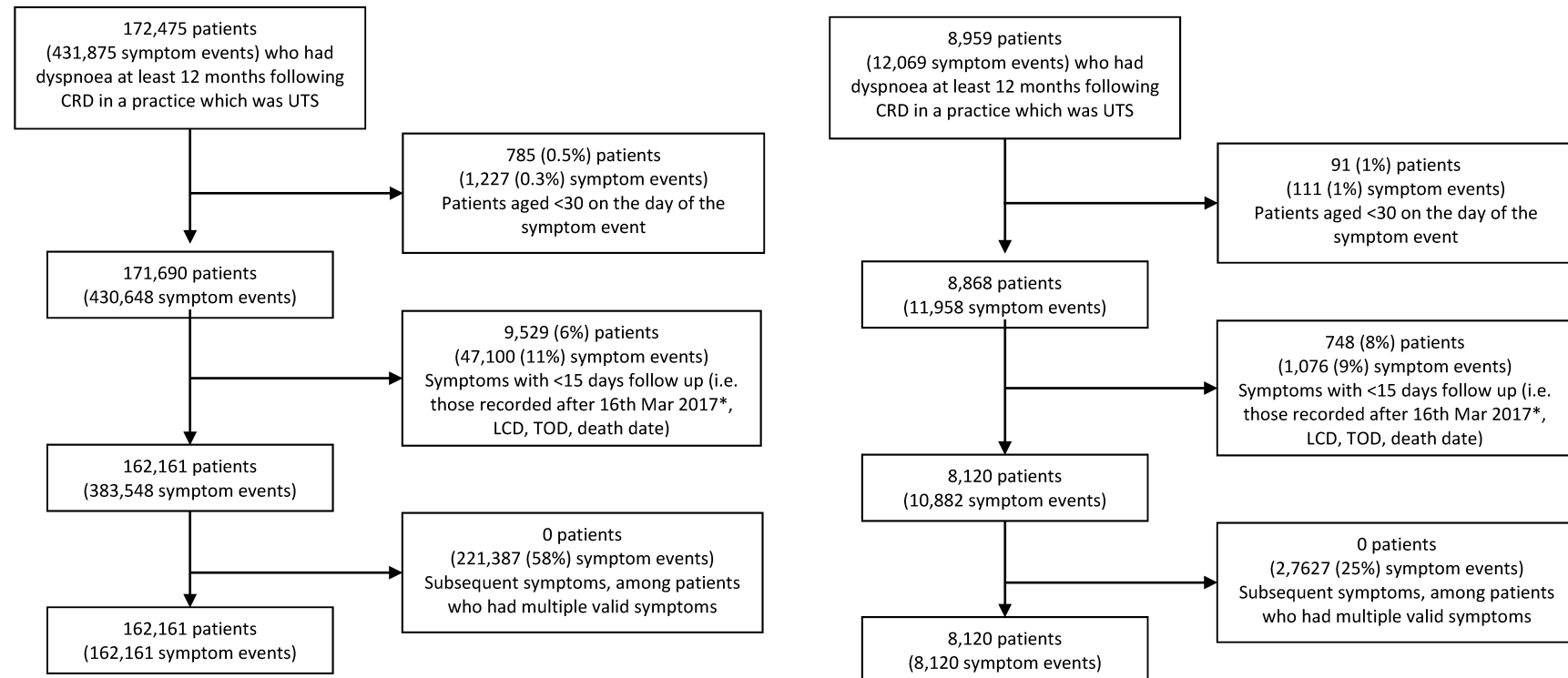
Appendix 1: sample derivation

In CPRD, symptom information is available in clinical files (which are typically used to capture clinical features and details during consultations), and referral files (which are typically used to capture information relating to referrals made from primary care). Symptoms recorded in both types of files were considered to identify all symptom records of interest. The symptom code lists are published as part of the following research article:

Moore SF, Price SJ, Chowienczyk S, Bostock J, Hamilton W (2021) The impact of changing risk thresholds on the number of people in England eligible for urgent investigation for possible cancer: an observational cross-sectional study. *Br J Cancer* 125:1593–7. doi:10.1038/s41416-021-01541-4

Please see the figures A1.1 and A1.2 below for sample derivation.

Supplemental material

BMJ Publishing Group Limited (BMJ) disclaims all liability and responsibility arising from any reliance
placed on this supplemental material which has been supplied by the author(s)

Thorax

Koo et al., supplementary material

Figures A1.1 and A1.2: Sample derivation for dyspnoea (left) and haemoptysis (right)

*Symptoms recorded on or after 16 Mar 2017 were excluded as 31 March 2017 was the last reliable date in our segment of DID data, and we would be unable to confirm outcome status for these individuals

CRD: current registration date

LCD: last collection date (before a practice leaves CPRD)

TOD: transfer out date (when a patient leaves a practice)

UTS: up to standard (CPRD's practice level measure of data quality)

Koo et al., supplementary material

Appendix 2 DID variables used to define the outcome

The three criteria (imaging modality and body region; source of referral; time from symptomatic presentation) used to define a guideline-concordant imaging event are expanded below indicating the variables used to apply the definition.

1. <u>Tests conducted in a relevant part of the body with a relevant modality</u>
   NICIP/SNOMEDCT code lists published previously by Pearson et al 2019 were used to identify lung cancer-specific imaging. The full reference is below:

   Pearson C, Fraser J, Peake M, Valori R, Poirier V, Coupland VH, Hiom S, McPhail S, Moffat J, Lyratzopoulos G, Shelton J (2019) Establishing population-based surveillance of diagnostic timeliness using linked cancer registry and administrative data for patients with colorectal and lung cancer. *Cancer Epidemiol* 61: 111–118, doi:10.1016/j.canep.2019.05.010

2. <u>Tests that were ordered by the GP / from primary care</u>

This was identified using two variables:

DID variable name	Variable description	Included value	Value description
ic_reftype_desc	Referrer type	4	GP direct access
did_patsource_code	Referral source	"GP"	GP [string variable]

3. <u>Tests conducted 0-14 days from symptomatic presentation</u>

The time from presentation to imaging was calculated using two date variables:
   1. Symptom event date [from CPRD]
   2. DID Diagnostic Test Date (variable name: did_date3): the date that test took place. This variable is mandatory to complete for providers.

Koo et al., supplementary material

Appendix 3 Imaging conducted within 4 weeks of symptomatic presentation

The main analysis was repeated with a broader definition of guideline-concordant care, namely lung imaging ordered by primary care that took place within 4 weeks of symptomatic presentation (instead of 2 weeks).

Table A3.1 Receipt of primary care ordered chest imaging within 4 weeks of presentation among the dyspnoea cohort (n=162,161)

DYSPNOEA	Total	Guideline-concordant imaging N (%)	Crude OR (95% CI)	Adjusted OR (95% CI)*	Adjusted OR (95% CI)**
Total	162161	26127 (16%)	-	-	-
Sex			*<0.001*	*<0.001*	*<0.001*
Men	75683	12489 (17%)	Ref	Ref	Ref
Women	86478	13638 (16%)	**0.95 (0.92–0.97)**	**0.94 (0.91–0.96)**	**0.94 (0.91–0.97)**
Age group			*<0.001*	*<0.001*	*<0.001*
30-39 years	9549	1062 (11%)	**0.65 (0.60–0.70)**	**0.55 (0.51–0.59)**	**0.55 (0.51–0.59)**
40-49 years	16602	2561 (15%)	**0.95 (0.90–<1.00)**	**0.86 (0.82–0.91)**	**0.87 (0.82–0.92)**
50-59 years	24772	4000 (16%)	Ref	Ref	Ref
60-69 years	38835	6338 (16%)	1.01 (0.97–1.06)	**1.08 (1.03–1.13)**	**1.08 (1.03–1.13)**
70-79 years	40491	6984 (17%)	**1.08 (1.04–1.13)**	**1.11 (1.07–1.17)**	**1.10 (1.06–1.15)**
80+ years	31912	5182 (16%)	1.01 (0.96–1.05)	**0.92 (0.88–0.97)**	**0.91 (0.87–0.96)**
Ethnicity			*<0.001*	*<0.001*	*<0.001*
White	143728	23527 (16%)	Ref	Ref	Ref
Non-white	7822	1311 (17%)	1.03 (0.97–1.09)	0.96 (0.90–1.02)	0.96 (0.90–1.02)
Missing	10611	1289 (12%)	**0.71 (0.67–0.75)**	**0.67 (0.63–0.71)**	**0.67 (0.63–0.71)**
IMD quintile			*<0.001*	*0.002*	*0.002*
1 (least)	32621	5756 (18%)	Ref	Ref	Ref
2	33848	5469 (16%)	**0.90 (0.86–0.94)**	**0.94 (0.90–0.98)**	**0.94 (0.90–0.98)**
3	33628	5612 (17%)	**0.93 (0.90–0.97)**	0.99 (0.95–1.03)	0.99 (0.95–1.04)
4	31480	4844 (15%)	**0.85 (0.81–0.89)**	**0.95 (0.91–0.99)**	**0.95 (0.91–0.99)**
5 (most)	30514	4431 (15%)	**0.79 (0.76–0.83)**	**0.94 (0.90–0.98)**	**0.94 (0.90–0.98)**
Smoking status			*<0.001*	*<0.001*	*<0.001*
Non-smoker	34576	6653 (19%)	Ref	Ref	Ref
Ex-smoker	69667	10961 (16%)	**0.78 (0.76–0.81)**	**0.94 (0.91–0.98)**	**0.94 (0.91–0.97)**
Current smoker	57559	8460 (15%)	**0.72 (0.70–0.75)**	**0.89 (0.86–0.92)**	**0.88 (0.85–0.92)**
Missing	359	53 (15%)	**0.73 (0.54–0.97)**	**0.64 (0.48–0.87)**	**0.64 (0.47–0.86)**
Morbidities†			*<0.001*	*<0.001*	*<0.001*
No COPD/Asthma or HF	86129	20123 (23%)	Ref	Ref	Ref
HF only	3417	557 (16%)	**0.64 (0.58–0.70)**	**0.58 (0.53–0.64)**	**0.59 (0.53–0.64)**
COPD/Asthma only	70008	5262 (8%)	**0.27 (0.26–0.28)**	**0.25 (0.24–0.26)**	**0.25 (0.24–0.26)**
COPD/Asthma & HF	2607	185 (7%)	**0.25 (0.22–0.29)**	**0.22 (0.19–0.26)**	**0.22 (0.19–0.26)**
Imaging in the 6 weeks prior to presentation			*<0.001*	*<0.001*	*<0.001*
No prior imaging	153538	25654 (17%)	Ref	Ref	Ref
Prior imaging	8623	473 (5%)	**0.29 (0.26–0.32)**	**0.22 (0.20–0.25)**	**0.22 (0.20–0.24)**
Cancer diagnosis in the year following symptomatic presentation			*<0.001*	*<0.001*	*<0.001*
No cancer	158575	25297 (16%)	Ref	-	Ref
Lung cancer	1103	291 (26%)	**1.89 (1.65–2.16)**	-	**2.13 (1.84–2.45)**
Other cancer	2483	539 (22%)	**1.46 (1.33–1.61)**	-	**1.33 (1.21–1.47)**

Joint testing p-values are presented in italics.

COPD = chronic obstructive pulmonary disease; HF = heart failure; IMD = Index of Multiple Deprivation

Koo et al., supplementary material

*adjusted for sex, age, ethnicity, IMD quintile, smoking status, morbidities
**adjusted for sex, age, ethnicity, IMD quintile, smoking status, morbidities, cancer diagnosis
†Recorded in the 78 months to 6 months prior to symptomatic presentation

Table A3.2 Receipt of primary care ordered chest imaging within 4 weeks of presentation among the haemoptysis cohort (n=8,120)

HAEMOPTYSIS	Total	Guideline-concordant imaging N (%)	Crude OR (95% CI)	Adjusted OR (95% CI)*	Adjusted OR (95% CI)**
Total	8120	4234 (52%)			
Sex			*0.020*	*0.001*	*0.001*
Men	4728	2517 (53%)	Ref	Ref	Ref
Women	3392	1717 (51%)	**0.90 (0.82–0.98)**	**0.86 (0.78–0.94)**	**0.86 (0.78–0.94)**
Age group			*<0.001*	*<0.001*	*<0.001*
30-39 years	904	389 (43%)	**0.68 (0.58–0.80)**	**0.64 (0.54–0.76)**	**0.65 (0.55–0.77)**
40-49 years	1218	602 (49%)	0.88 (0.76–1.02)	**0.85 (0.73–<1.00)**	0.86 (0.73–>1.00)
50-59 years	1477	777 (53%)	Ref	Ref	Ref
60-69 years	1768	1029 (58%)	**1.25 (1.09–1.44)**	**1.31 (1.13–1.51)**	**1.30 (1.12–1.50)**
70-79 years	1646	901 (55%)	1.09 (0.95–1.25)	**1.17 (1.01–1.36)**	**1.16 (>1.00–1.35)**
80+ years	1107	536 (48%)	**0.85 (0.72–0.99)**	0.89 (0.75–1.05)	0.87 (0.74–1.03)
Ethnicity			*<0.001*	*<0.001*	*<0.001*
White	6857	3622 (53%)	Ref	Ref	Ref
Non-white	746	388 (52%)	0.97 (0.83–1.13)	1.02 (0.86–1.20)	1.02 (0.87–1.20)
Missing	517	224 (43%)	**0.68 (0.57–0.82)**	**0.66 (0.55–0.80)**	**0.67 (0.55–0.81)**
IMD quintile			*0.518*	*0.217*	*0.248*
1 (least)	1592	829 (52%)	Ref	Ref	Ref
2	1614	829 (51%)	0.97 (0.85–1.12)	0.97 (0.84–1.12)	0.97 (0.84–1.12)
3	1704	895 (53%)	1.02 (0.89–1.17)	1.02 (0.88–1.17)	1.01 (0.88–1.17)
4	1619	825 (51%)	0.96 (0.83–1.10)	0.94 (0.81–1.08)	0.93 (0.81–1.08)
5 (most)	1588	855 (54%)	1.07 (0.93–1.23)	1.10 (0.95–1.28)	1.10 (0.95–1.27)
Smoking status			*0.766*	*0.241*	*0.227*
Non-smoker	1955	1013 (52%)	Ref	Ref	Ref
Ex-smoker	3121	1616 (52%)	1.00 (0.89–1.12)	0.93 (0.82–1.05)	0.92 (0.82–1.05)
Current smoker	3024	1596 (53%)	1.04 (0.93–1.16)	1.03 (0.91–1.16)	1.02 (0.91–1.16)
Missing	20	9 (45%)	0.76 (0.31–1.84)	0.66 (0.27–1.63)	0.67 (0.27–1.64)
Morbidities†			0.246	0.071	0.071
No COPD/Asthma or HF	5596	2947 (53%)	Ref	Ref	Ref
HF only	144	82 (57%)	1.19 (0.85–1.66)	1.08 (0.76–1.53)	1.09 (0.77–1.54)
COPD/Asthma only	2281	1154 (51%)	0.92 (0.83–1.01)	**0.88 (0.79–0.97)**	**0.88 (0.79–0.97)**
COPD/Asthma & HF	99	51 (52%)	0.96 (0.64–1.42)	0.84 (0.56–1.27)	0.85 (0.56–1.28)
Imaging in the 6 weeks prior to presentation			*0.036*	*<0.001*	*<0.001*
No prior imaging	7567	4170 (55%)	Ref	Ref	Ref
Prior imaging	553	64 (12%)	**0.11 (0.08–0.14)**	**0.10 (0.08–0.13)**	**0.10 (0.08–0.13)**
Cancer diagnosis in the year following symptomatic presentation			*0.065*		*0.047*
No cancer	7742	4017 (52%)	Ref		Ref
Lung cancer	253	150 (59%)	**1.35 (1.05–1.74)**		**1.41 (1.07–1.85)**
Other cancer	125	67 (54%)	1.07 (0.75–1.53)		1.08 (0.74–1.57)

Joint testing p-values are presented in italics.
COPD = chronic obstructive pulmonary disease; HF = heart failure; IMD = Index of Multiple Deprivation
*Adjusting for sex, age, ethnicity, IMD quintile, smoking status, morbidities, prior imaging
**Adjusting for sex, age, ethnicity, IMD quintile, smoking status, morbidities, prior imaging, cancer diagnosis
†Recorded in the 78 months to 6 months prior to symptomatic presentation

Koo et al., supplementary material

Appendix 4 Imaging ordered by any source

The main analysis was repeated with a broader definition of guideline-concordant care, namely lung imaging ordered by any source that was conducted within 2 weeks of symptomatic presentation (instead of looking at solely primary care ordered chest imaging).

The Diagnostic Imaging Dataset has two variables that can be used to identify who ordered the imaging (did_patsource_code and ic_reftype_desc). The variable did_patsource_code describes "the type of department or organisation making the referral for imaging activity" while the variable ic_reftype_desc describes the "referrer type description" (see Table A8.1).

There was overlap between these two variables which made it challenging to identify Inpatient vs Outpatient vs Emergency vs GP. Instead, the definition of guideline-concordant care used in the main analysis (which included a condition that did_patsource_code=GP direct access OR ic_reftype_desc=GP) was modified so that all timely chest imaging was included, regardless of source.

Table A4.1 DID variables used to identify source of imaging

DID variable	Categories
did_patsource_code	1 Admitted Patient Care – Inpatient (this healthcare provider)
	2 admitted patient care – Day case (this healthcare provider)
	3 Outpatient (this healthcare provider)
	4 GP direct access
	5 Accident & Emergency department (this healthcare provider)
	6 Other healthcare provider
	7 Other
	99 Unknown
ic_reftype_desc	GP
	Consultant
	Nurse
	Physio
	Other health professional
	Not known

Koo et al., supplementary material

Table A4.2 Receipt of chest imaging (any source) within 2 weeks of presentation among the dyspnoea cohort (n=162,161)

DYSPNOEA	Total	Guideline-concordant imaging N (%)	Crude OR (95% CI)	Adjusted OR (95% CI)*	Adjusted OR (95% CI)**
Total	162161	34154 (21%)			
Sex			*0.001*	*<0.001*	*<0.001*
Men	75683	16214 (21%)	Ref	Ref	Ref
Women	86478	17940 (21%)	**0.96 (0.94–0.98)**	**0.93 (0.91–0.96)**	**0.94 (0.91–0.96)**
Age group			*<0.001*	*<0.001*	*<0.001*
30-39 years	9549	1585 (17%)	**0.81 (0.76–0.87)**	**0.70 (0.66–0.75)**	**0.70 (0.66–0.75)**
40-49 years	16602	3206 (19%)	0.98 (0.93–1.03)	**0.90 (0.85–0.95)**	**0.90 (0.86–0.95)**
50-59 years	24772	4870 (20%)	Ref	Ref	Ref
60-69 years	38835	7705 (20%)	1.01 (0.97–1.05)	**1.07 (1.03–1.12)**	**1.06 (1.02–1.11)**
70-79 years	40491	8967 (22%)	1.16 (1.12–1.21)	**1.18 (1.14–1.23)**	**1.16 (1.12–1.21)**
80+ years	31912	7821 (25%)	1.33 (1.27–1.38)	**1.20 (1.15–1.25)**	**1.18 (1.13–1.23)**
Ethnicity			*<0.001*	*<0.001*	*<0.001*
White	143724	31131 (22%)	Ref	Ref	Ref
Non-white	7823	1714 (22%)	1.01 (0.96–1.07)	0.95 (0.89–1.00)	0.95 (0.90–1.01)
Missing	10614	1309 (12%)	**0.51 (0.48–0.54)**	**0.49 (0.46–0.52)**	**0.50 (0.47–0.53)**
IMD quintile			*<0.001*	*0.001*	*0.001*
1 (least)	32621	7446 (23%)	Ref	Ref	Ref
2	33848	7184 (21%)	**0.91 (0.88–0.94)**	**0.95 (0.91–0.99)**	**0.95 (0.91–0.99)**
3	33628	7386 (22%)	**0.95 (0.92–0.99)**	1.01 (0.97–1.05)	1.01 (0.97–1.05)
4	31480	6319 (20%)	**0.85 (0.82–0.88)**	**0.96 (0.92–0.99)**	**0.96 (0.92–0.99)**
5 (most)	30514	5803 (19%)	**0.79 (0.76–0.83)**	**0.95 (0.91–0.99)**	**0.94 (0.91–0.98)**
Smoking status			*<0.001*	*<0.001*	*<0.001*
Non-smoker	34576	8770 (25%)	Ref	Ref	Ref
Ex-smoker	69667	14175 (20%)	**0.75 (0.73–0.77)**	**0.89 (0.86–0.92)**	**0.88 (0.86–0.91)**
Current smoker	57559	11120 (19%)	**0.70 (0.68–0.73)**	**0.88 (0.85–0.91)**	**0.87 (0.84–0.90)**
Missing	359	89 (25%)	0.97 (0.76–1.23)	0.86 (0.67–1.10)	0.85 (0.66–1.08)
Morbidities†			*<0.001*	*<0.001*	*<0.001*
No COPD/Asthma or HF	86129	25473 (30%)	Ref	Ref	Ref
HF only	3417	1019 (30%)	1.01 (0.94–1.09)	**0.87 (0.80–0.93)**	**0.87 (0.81–0.94)**
COPD/Asthma only	70008	7305 (10%)	**0.28 (0.27–0.29)**	**0.27 (0.26–0.27)**	**0.27 (0.26–0.27)**
COPD/Asthma & HF	2607	357 (14%)	**0.38 (0.34–0.42)**	**0.33 (0.29–0.37)**	**0.33 (0.29–0.37)**
Imaging in the 6 weeks prior to presentation			*<0.001*	*<0.001*	*<0.001*
No prior imaging	153538	33124 (22%)	Ref	Ref	Ref
Prior imaging	8623	1030 (12%)	**0.49 (0.46–0.53)**	**0.39 (0.37–0.42)**	**0.39 (0.36–0.41)**
Cancer diagnosis in the year following symptomatic presentation			*<0.001*	*<0.001*	*<0.001*
No cancer	158575	32886 (21%)	Ref		Ref
Lung cancer	1103	453 (41%)	**2.66 (2.36–3.00)**		**3.02 (2.66–3.43)**
Other cancer	2483	815 (33%)	**1.87 (1.72–2.03)**		**1.68 (1.54–1.84)**

Joint testing p-values are presented in italics.

COPD = chronic obstructive pulmonary disease; HF = heart failure; IMD = Index of Multiple Deprivation

*Adjusting for sex, age, ethnicity, IMD quintile, smoking status, morbidities, prior imaging

**Adjusting for sex, age, ethnicity, IMD quintile, smoking status, morbidities, prior imaging, cancer diagnosis

†Recorded in the 78 months to 6 months prior to symptomatic presentation

Koo et al., supplementary material

Table A4.3 Receipt of chest imaging (any source) within 2 weeks of presentation among the haemoptysis cohort (n=8,120)

HAEMOPTYSIS	Total	Guideline-concordant imaging N (%)	Crude OR (95% CI)	Adjusted OR (95% CI)*	Adjusted OR (95% CI)**
Total	8120	5039 (62%)			
Sex			*0.026*	*0.004*	*0.004*
Men	4728	2982 (63%)	Ref	Ref	Ref
Women	3392	2057 (61%)	**0.90 (0.82–0.99)**	**0.87 (0.79–0.96)**	**0.87 (0.79–0.96)**
Age group			*<0.001*	*<0.001*	*<0.001*
30-39 years	904	463 (51%)	**0.59 (0.50–0.70)**	**0.59 (0.50–0.70)**	**0.60 (0.50–0.71)**
40-49 years	1218	663 (54%)	**0.67 (0.58–0.79)**	**0.66 (0.56–0.77)**	**0.66 (0.57–0.78)**
50-59 years	1477	944 (64%)	Ref	Ref	Ref
60-69 years	1768	1170 (66%)	1.10 (0.96–1.28)	1.09 (0.94–1.27)	1.08 (0.93–1.25)
70-79 years	1646	1096 (67%)	1.13 (0.97–1.30)	1.12 (0.96–1.31)	1.10 (0.94–1.29)
80+ years	1107	703 (64%)	0.98 (0.84–1.16)	0.97 (0.82–1.15)	0.95 (0.80–1.12)
Ethnicity			*<0.001*	*<0.001*	*<0.001*
White	6859	4369 (64%)		Ref	Ref
Non-white	745	437 (59%)	**0.81 (0.69–0.94)**	0.92 (0.79–1.09)	0.93 (0.79–1.10)
Missing	516	233 (45%)	**0.47 (0.39–0.56)**	**0.50 (0.42–0.60)**	**0.51 (0.42–0.61)**
IMD quintile			*0.019*	*0.004*	*0.006*
1 (least)	1592	984 (62%)	Ref	Ref	Ref
2	1614	991 (61%)	0.98 (0.85–1.13)	0.97 (0.84–1.13)	0.97 (0.84–1.13)
3	1704	1079 (63%)	1.07 (0.93–1.23)	1.07 (0.93–1.24)	1.07 (0.92–1.23)
4	1619	957 (59%)	0.89 (0.78–1.03)	0.88 (0.76–1.02)	0.87 (0.75–1.01)
5 (most)	1588	1026 (65%)	1.13 (0.98–1.30)	1.16 (0.99–1.34)	1.14 (0.98–1.33)
Smoking status			*<0.001*	*0.003*	*0.006*
Non-smoker	1955	1130 (58%)	Ref	Ref	Ref
Ex-smoker	3121	1991 (64%)	**1.29 (1.15–1.44)**	**1.14 (>1.00–1.29)**	1.12 (0.99–1.27)
Current smoker	3024	1909 (63%)	**1.25 (1.11–1.40)**	**1.23 (1.09–1.39)**	**1.21 (1.07–1.37)**
Missing	20	9 (45%)	0.60 (0.25–1.45)	0.50 (0.20–1.23)	0.51 (0.20–1.25)
Morbidities†			*0.144*	*0.685*	*0.674*
No COPD/Asthma or HF	5596	3439 (61%)	Ref	Ref	Ref
HF only	144	100 (69%)	1.43 (<1.00–2.04)	1.15 (0.80–1.66)	1.16 (0.80–1.68)
COPD/Asthma only	2281	1435 (63%)	1.06 (0.96–1.18)	0.95 (0.86–1.06)	0.95 (0.86–1.06)
COPD/Asthma & HF	99	65 (66%)	1.20 (0.79–1.82)	0.94 (0.61–1.44)	0.96 (0.62–1.47)
Imaging in the 6 weeks prior to presentation			*<0.001*	*<0.001*	*<0.001*
No prior imaging	7567	4836 (64%)	Ref	Ref	Ref
Prior imaging	553	203 (37%)	**0.33 (0.27–0.39)**	**0.30 (0.25–0.35)**	**0.29 (0.24–0.35)**
Cancer diagnosis in the year following symptomatic presentation			*<0.001*		*<0.001*
No cancer	7742	4757 (61%)	Ref		Ref
Lung cancer	253	195 (77%)	**2.11 (1.57–2.84)**		**1.92 (1.41–2.60)**
Other cancer	125	87 (70%)	1.44 (0.98–2.11)		1.31 (0.88–1.95)

Joint testing p-values are presented in italics.

COPD = chronic obstructive pulmonary disease; HF = heart failure; IMD = Index of Multiple Deprivation

*Adjusting for sex, age, ethnicity, IMD quintile, smoking status, morbidities, prior imaging

**Adjusting for sex, age, ethnicity, IMD quintile, smoking status, morbidities, prior imaging, cancer diagnosis

†Recorded in the 78 months to 6 months prior to symptomatic presentation