NLCA
National Lung Cancer Audit

NATCAN
National Cancer Audit Collaborating Centre

National Lung Cancer Audit State of the Nation Report: Methodology Supplement

An audit of care received by people diagnosed with lung cancer between 1 January 2024 to 31 December 2024 in England and Wales.

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HQIP Healthcare Quality Improvement Partnership

The National Cancer Audit Collaborating Centre (NATCAN) is commissioned by the Healthcare Quality Improvement Partnership (HQIP) and funded by NHS England and the Welsh Government as part of the National Clinical Audit and Patient Outcomes Programme (NCAPOP). NATCAN delivers national audits in bowel, breast (primary and metastatic), kidney, lung, non-Hodgkin lymphoma, oesophago-gastric, ovarian, pancreatic and prostate cancers.

NDRS NATIONAL DISEASE REGISTRATION SERVICE

GIG CYMRU NHS WALES Rhwydwaith Canser Cymru Wales Cancer Network

This work uses data that has been provided by patients and collected by the NHS as part of their care and support. For patients diagnosed in England, the data is collated, maintained and quality assured by the National Disease Registration Service (NDRS), which is part of NHS England. Access to the data was facilitated by the NHS England Data Access Request Service.
NHS Wales is implementing a new cancer informatics system. As a result, the quality and completeness of data from Wales is likely to have been impacted due to implementation of this new system across multiple NHS organisations (Health Boards), which has resulted in data being supplied by both old and new systems. Additionally, and reflecting the uncertainty of data quality, the data submitted to the audit may not have undergone routine clinical validation prior to submission to the Wales Cancer Network (WCN), Public Health Wales.

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Contents

1. Introduction

This document describes the methods used to produce the indicators that are included in the 2026 State of the Nation (SotN) Report for the National Audit of Lung Cancer (NLCA) and its data tables and online dashboard. The document provides information on sources of data, criteria for patient inclusion, and how the statistics on data completeness, patient characteristics and performance indicators were derived and reported.

2. Sources of Data

The NLCA uses information from routine national health care datasets in England and Wales. These national datasets contain details on the diagnosis, management, treatment, and outcome of care for every patient who was newly diagnosed with cancer in the NHS in England and Wales.

For England, the audit received information from the National Disease Registration Service (NDRS) at a tumour level. Extracts of data on patients diagnosed with lung cancer were provided from the "Gold standard" National Cancer Registration Data (NCRD) and the Rapid Cancer Registration Data (RCRD) for England. This rapid data set provides a reduced set of cancer data compared to the NCRD but it is available more quickly. The information held in these datasets is compiled from a variety of sources including: the Cancer Outcomes and Services Dataset (COSD), Hospital Episode Statistics admitted patient care (HES APC) records, the Systemic Anti-Cancer Therapy dataset (SACT), the Radiotherapy Dataset (RTDS), and data submitted by pathology laboratories. Appendix 1 provides more detail on the data sources listed below and the information they contain.

For this annual report, the NLCA used data from the Rapid Cancer Registration Dataset (RCRD). This dataset is compiled mainly from COSD records. While it is made available more quickly than the full NCRD data, the speed of production means that the range of data items is limited and several standard Registration data items are unavailable. It also does not have complete coverage of all patients diagnosed with lung cancer in England during the reporting period. The audit also received datasets linked at patient level to the RCRD, including information from the COSD (linked at tumour level), as well as HES APC, HES Outpatients data (HES OP), SACT, and RTDS (all linked at patient level).

The English data received by the National Cancer Audit Collaborating Centre (NATCAN) included data on patients registered with cancer up to April 2025. Data were used for people with lung cancer diagnosed upto 31st December 2024 for the main report. For information on the timeliness of NCRD and RCRD, please see the NATCAN website.

As with cancer registries in other countries, cancer registrations in England can take up to 5 years after the end of a given calendar year to reach approximately 100% completeness and stability. NDRS uses an active system of gathering information on cancer diagnoses from multiple sources across the patient pathway. Completeness varies by tumour type because different patient pathways provide different opportunities for data flows into NDRS. The 'Gold standard' cancer registration dataset that is used in cancer statistics bulletins and available for analysis outside of NDRS contains over 98% of all the people that will eventually be found by the registration process, and the completeness for a calendar year of data increases over time. More information about the cancer registration process can be found here

For Wales, the audit was provided with a patient-level information by the Welsh Cancer Network (WCN) for people diagnosed with lung cancer between 1 January 2024 and 31 December 2024. Welsh cancer registration data is captured through a national system, Cancer Information System for Wales (CaNISC) and the new Welsh Clinical Portal called the Clinical Dataset Form (CDF). The audit also received datasets that linked to these registration records. Records on inpatient and day case activity was supplied from the Patient Episode Database for Wales (PEDW), and information on systemic anti-cancer therapy and radiotherapy were supplied from the Welsh-versions of SACT and RTDS, respectively. Data on death registrations was supplied from the Office for National Statistics (ONS) for both English and Welsh patients. Data for England and Wales were managed and analysed separately.

3. Inclusion and Exclusion Criteria

The data submitted by NDRS and WCN was reviewed and processed to ensure the audit analysis contained only eligible participants. Tables 3.1 and 3.2 explains the process of defining the cohort used in the audit.

People were included for analysis within the SotN Report if they met the following inclusion and not the exclusion criteria:

Table 3.1: Audit Inclusion Criteria	
Inclusion Criteria	**Details**
Type of cancer	Lung cancer ICD-10 code C34
Adults	Age at diagnosis is 18 years or above
Valid Diagnosis Date	1/1/2024 to 31/12/2024

Table 3.2: Audit Exclusion Criteria	
Exclusion Criteria	**Details**
Type of cancer	Mesothelioma (ICD-10 codes C450; C451; C457 or tumour morphology codes (9050/3,9051/3,9052/3,9053/3)
Reported by death certificate only	**For English data:** Using RCRD: final_route = DCO (Death Certificate Only) **For Welsh data:** Basis of diagnosis = DCO (Death Certificate Only)
Diagnosed and treated outside of an NHS organisation in England or Wales.	**For English data:** Organisation of diagnosis was not an English NHS trust (code starting with "R") No record of pathway event via trust_code in England* & No record of org_code_of_drug_provider in England* in SACT & No record of orgcodeprovider in England* in RTDS **For Welsh data:** Organisation of diagnosis was not a Welsh health board (code starting with "7")

4. Key Data Items

Details of the variables and datasets used to compile the data completeness are shown below in Table 4.1

Table 4.1: Data Completeness Variables				
Data Item	**Source**			
	England		**Wales**	
	Data field	**Dataset**	**Data field**	**Dataset**
Age at diagnosis	Derived from birthmonth and birthyear	RCRD	ageatdiagnosis	CANISC, CDF
Socio-economic status	Index of multiple deprivation from quintile_2019	RCRD	deprivationquintile	CANISC, CDF
Ethnicity	ethniccategory	RCRD	ethnicity_description	CDF only
Stage at Diagnosis	stage	RCRD	StageGroupFinalPreTreatment	CANISC, CDF
Performance status	tumour_performancestatus	RCRD	performancestatus	CANISC, CDF
Basis of diagnosis	basisofdiagnosis	RCRD	basisofdiagnosis	CANISC, CDF
Morphology	tumour_morphology	RCRD	morphology morphologydiagnosis	CANISC CDF
Seen by Lung Cancer Nurse Specialist at diagnosis	clinicalnursespecialist	COSD	specialistnurseseen	CANISC, CDF
Smoking status	smokingstatus	COSD	smokingstatus	CDF only

Details of the variables and datasets used to compile the patient characteristics are shown below in Table 4.2.

Table 4.2: Patient Characteristics Variables				
Data Item	**Source**			
	England		**Wales**	
	Data field	**Dataset**	**Data field**	**Dataset**
Age at diagnosis	Derived from birthmonth and birthyear	RCRD	ageatdiagnosis	CANISC, CDF
Gender	gender	RCRD	gender	CANISC, CDF
Smoking status	smokingstatus	COSD	Smokingstatus	CDF
Type of lung cancer	Derived from morphology codes from data field tumour_morphology	RCRD	Derived from morphology description + codes	CANISC, CDF
Performance status	tumour_performancestatus	RCRD	performancestatus	CANISC, CDF
Stage at Diagnosis	stage	RCRD	StageGroupFinalPreTreatment	CANISC, CDF

5. Indicator Definitions

The audit uses key indicators to monitor progress against its healthcare improvement goals. These indicators align with national guidelines and standards. The definitions of the indicators included in the SotN report and how they were derived from data for England and Wales are described below.

Some indicators are limited to subgroups of patients, being defined in relation to performance status and stage of the disease. These two factors are important determinants of whether particular treatments are suitable for individual patients.

5.1 Performance Indicator 1: Proportion of people with lung cancer who are diagnosed with stage 1-2 disease

Table 5.1: Proportion of people with lung cancer who are diagnosed with stage 1-2 disease

	England	**Wales**
Dates of diagnosis / treatment:	1/1/2024-31/12/2024	1/1/2024-31/12/2024
Numerator: Number of people with stage 1-2 lung cancer	RCRD: Stage variable	CANISC / CDF: Stage variable
Denominator: All people with lung cancer with data on stage recorded	RCRD: No of patients in cohort	CANISC / CDF: No of patients in cohort
Construction notes	N/A	N/A
Country reporting:	England and Wales separate	
Organisational Reporting level:	NHS Trust	Health board & hospital
Subgroup Reporting:	None	
Risk adjusted:	No	No
Outlier reporting:	No	No

5.2 Performance Indicator 2: Proportion of people with lung cancer diagnosed after an emergency admission

This process indicator provides information on the proportion of patients diagnosed after an emergency presentation. This indicator complements the work of the NHS England's Lung Health Checks initiative, part of the NHS Long Term Plan to improve early diagnosis and survival for those diagnosed with cancer. It also relates to NICE 2019 Quality Standards: increasing the proportion of patients encouraged to seek medical advice if experiencing symptoms (statement 1).

Table 5.2: Proportion of people with lung cancer diagnosed after an emergency admission		
	England	**Wales**
Dates of diagnosis / treatment:	1/1/2024-31/12/2024	1/1/2024-31/12/2024
Numerator: Number of people with lung cancer who were diagnosed via an emergency route	RCRD final_route "Emergency presentation"	CANISC / CDF: source_of_referral codes equivalent to emergency presentation
Denominator: All people with a diagnosis of lung cancer and known route to diagnosis	RCRD final_route not "Unknown"	CANISC / CDF: source_of_referral not "unknown"
Construction notes	Risk adjusted values produced using multiple imputation to deal with missing values	Risk adjusted values produced using multiple imputation to deal with missing values
Country reporting:	England and Wales separate	
Organisational Reporting level:	NHS Trust	Health board & hospital
Subgroup Reporting:	None	
Risk adjusted: *Yes*	Age, sex, comorbidity, stage, performance status, tumour type,	Age, sex, comorbidity, stage, performance status, tumour type, audit-year
Outlier reporting:	No	No

5.3 Performance Indicator 3: Proportion of people with lung cancer with a pathological diagnosis (PS 0-1)

This process indicator provides information on early diagnosis which supports a key ambition of the NHS Long term Plan. It also relates to NICE Quality Standard statement 5 and statement 6.

Table 5.3: Proportion of people with lung cancer with a pathological diagnosis (PS 0-1)		
	England	**Wales**
Dates of diagnosis / treatment:	1/1/2024-31/12/2024	1/1/2024-31/12/2024
Numerator: Number of people with lung cancer with a valid pathological diagnosis (PS 0-1)	RCRD tumour_morphology coded as SCLC (80413, 80423, 80433, 80453) carcinoid (82403) or NSCLC (other code excl. mesothelioma)	CANISC / CDF: tumour morphology description or code for SCLC, carcinoid or NSCLC
Denominator: All people with lung cancer and PS 0-1	RCRD : cohort restricted to people with performance status 0-1	CANISC / CDF : cohort restricted to people with performance status 0-1
Construction notes	N/A	N/A
Country reporting:	England and Wales separate	
Organisational Reporting level:	NHS Trust	Health board & hospital
Subgroup Reporting:	People with performance status 0-1	
Risk adjusted:	No	No
Outlier reporting:	No	No

5.4 Performance Indicator 4: Proportion of people who had contact with a Lung Cancer Nurse Specialist (LCNS) around the time of diagnosis

This process indicator provides information on the proportion of patients who are seen by a lung cancer nurse specialist (LCNS) and reflects NICE 2019 Quality Standard statement 3.

Table 5.4: Proportion of people who had contact with a Lung Cancer Nurse Specialist (LCNS) around the time of diagnosis

	England	Wales
Dates of diagnosis / treatment:	1/1/2024-31/12/2024	1/1/2024-31/12/2024
Numerator: Number of people with lung cancer with a record of contact with a LCNS	COSD (CR2050 codes Y1, Y3, Y4, Y5)	CANISC / CDF: specialistnurseseen codes for "Yes"
Denominator: All people with a diagnosis of lung cancer and data not missing on whether a LCNS was seen.	COSD (CR2050 codes NN, NI, Y1, Y3, Y4, Y5)	CANISC / CDF: specialistnurseseen not "unknown"
Construction notes	N/A	N/A
Country reporting:	England and Wales separate	
Organisational Reporting level:	NHS Trust	Health board & hospital
Subgroup Reporting:	None	
Risk adjusted:	No	No
Outlier reporting:	No	No

5.5 Performance Indicator 5: Proportion of people with NSCLC who had curative treatment

This indicator is stratified into people with stage 1-2 NSCLC and stage 3A NSCLC and restricted to people with performance status 0-2.

For people with stage 1-2 NSCLC, this process indicator provides information on the proportion of people who receive treatment with curative intent. This reflects NICE guideline recommendations for people with NSCLC undergoing resection surgery and adjuvant therapy. It is also related to NICE 2019 Quality Standards: increasing the proportion of people encouraged to seek medical advice if experiencing symptoms (statement 1) and ensuring that people suitable for curative treatment have their stage and lung function established (statement 4 and statement 5)

For people with stage 3A NSCLC, this process indicator provides information on the proportion of people who receive treatment with curative intent. This will reflect NICE guideline recommendations for people with NSCLC undergoing resection surgery and adjuvant therapy. It is also related to two NICE 2019 Quality Standards: increasing the proportion of people encouraged to seek medical advice if experiencing symptoms (statement 1) and ensuring that people suitable for curative treatment have their stage and lung function established (statement 4).

Table 5.5: Proportion of people with NSCLC who had curative treatment		
	England	**Wales**
Dates of diagnosis / treatment:	1/1/2024-31/12/2024	1/1/2024-31/12/2024
Numerator: Number of people with lung cancer who receive curative resection surgery or radical radiotherapy among the subgroups reported	RCRD linked with RTDS (RT with curative intent) and HES APC (surgery). Surgery codes: E391, E398, E399, E461, E463, E468, E541, E542, E543, E544, E545, E548, E549, E552, E554, E558, E559, T013, T018	CANISC / CDF : Records with evidence of surgical resection or radical radiotherapy
Denominator: All people with a diagnosis of lung cancer among the two subgroups reported	RCRD : Restricted to performance status 0-2 and NSCLC stage 1-3A	CANISC / CDF : Restricted to performance status 0-2 and NSCLC stage 1-3A
Construction notes	Risk adjusted values produced using multiple imputation to deal with missing values	Risk adjusted values produced using multiple imputation to deal with missing values
Country reporting:	England and Wales separate	
Organisational Reporting level:	NHS Trust	Health board & hospital
Subgroup Reporting:	Stratified into 1) Stage 1-2 NSCLC 2) Stage 3A NSCLC	
Risk adjusted: Yes	age, sex, comorbidity, stage, performance status, tumour type	age, sex, comorbidity, stage, performance status, tumour type, audit-year
Outlier reporting:	No	No

5.6 Performance Indicator 6: Proportion of people with NSCLC who had surgery

This process indicator provides information on the proportion of people with NSCLC undergoing surgery. This reflects NICE guideline recommendations for people with NSCLC who are well enough and for whom treatment with curative intent is suitable to be offered lobectomy. It is also related to NICE 2019 Quality Standards statement 5: treatment with curative intent.

Table 5.6: Proportion of people with NSCLC who had surgery		
	England	**Wales**
Dates of diagnosis / treatment:	1/1/2024-31/12/2024	1/1/2024-31/12/2024
Numerator: Number of people with NSCLC who received surgery	RCRD linked with HES APC (surgery) Surgery codes: E391, E398, E399, E461, E463, E468, E541, E542, E543, E544, E545, E548, E549, E552, E554, E558, E559, T013, T018	CANISC / CDF : Records with evidence of surgical resection in description or codes (eg, OPCS code E54, etc)
Denominator: All people with a diagnosis of NSCLC	RCRD: No of patients in cohort with NSCLC tumour type	CANISC / CDF: No of patients in cohort with NSCLC tumour type
Construction notes	Risk adjusted values produced using multiple imputation to deal with missing values	Risk adjusted values produced using multiple imputation to deal with missing values
Country reporting:	England and Wales separate	
Organisational Reporting level:	NHS Trust	Health board & hospital
Subgroup Reporting:	People with tumour type NSCLC	

Risk adjusted: Yes	age, sex, comorbidity, stage, performance status, tumour type	age, sex, comorbidity, stage, performance status, tumour type, audit-year
Outlier reporting:	No	No

5.7 Performance Indicator 7: Proportion of people with NSCLC (stages 3B-4, PS 0–1) who received systematic anti-cancer therapy

This process indicator provides information on the proportion of people who receive treatment who had systemic anticancer therapy. This reflects NICE guideline recommendations for people with stage 3B or 4 NSCLC and eligible PS to be offered systemic therapy.

Table 5.7: Proportion of people with NSCLC (stages 3B-4, PS 0–1) who received systematic anti-cancer therapy

	England	**Wales**
Dates of diagnosis / treatment:	1/1/2024-31/10/2024	1/1/2024-31/12/2024
Numerator: Number of people with NSCLC who received SACT	RCRD linked with SACT record and HES APC record in which SACT delivered	CANISC / CDF: evidence of SACT delivered in registration record, PEDW or SACT record
Denominator: All people with a diagnosis of NSCLC (Stage3B-4; PS 0-1)	RCRD: cohort restricted to people with NSCLC (Stage3B-4; PS 0-1)	CANISC / CDF: cohort restricted to people with NSCLC (Stage3B-4; PS 0-1)
Construction notes	OPCS codes indicating SACT in HES records (X70, X71, X72, X73, X74) Risk adjusted values produced using multiple imputation to deal with missing values	OPCS codes indicating SACT in PEDW records (X70, X71, X72, X73, X74) Risk adjusted values produced using multiple imputation to deal with missing values
Country reporting:	England and Wales separate	
Organisational Reporting level:	NHS Trust	Health board & hospital
Subgroup Reporting:	NSCLC; Stage3B-4; Performance status 0-1	
Risk adjusted: Yes	age, sex, comorbidity, stage, performance status, tumour type	age, sex, comorbidity, stage, performance status, tumour type, audit-year
Outlier reporting:	No	No

5.8 Performance Indicator 8: Proportion of people with SCLC who received systematic anti-cancer therapy

This process indicator provides information on the proportion of SCLC patients receiving chemotherapy. This reflects NICE guideline recommendations to offer platinum-based combination chemotherapy to people with extensive stage disease SCLC if they are fit enough.

Table 5.8: Proportion of people with SCLC who received systematic anti-cancer therapy		
	England	**Wales**
Dates of diagnosis / treatment:	1/1/2024-31/10/2024	1/1/2024-31/12/2024
Numerator: Number of people with SCLC who received SACT	RCRD linked with SACT record and HES APC record in which SACT delivered	CANISC / CDF: evidence of SACT delivered in registration record, PEDW or SACT record
Denominator: All people with a diagnosis of SCLC	RCRD: cohort restricted to people with SCLC	CANISC / CDF: cohort restricted to people with SCLC
Construction notes	OPCS codes indicating SACT in HES records (X70, X71, X72, X73, X74) Risk adjusted values produced using multiple imputation to deal with missing values	OPCS codes indicating SACT in PEDW records (X70, X71, X72, X73, X74) Risk adjusted values produced using multiple imputation to deal with missing values
Country reporting:	England and Wales separate	
Organisational Reporting level:	NHS Trust	Health board & hospital
Subgroup Reporting:	SCLC	
Risk adjusted: Yes	age, sex, comorbidity, stage, performance status	age, sex, comorbidity, stage, performance status, audit-year
Outlier reporting:	No	No

5.9 Performance Indicator 9: Waiting Times from referral to Treatment

These process indicators provide information on compliance with the National Optimal Lung Cancer Pathway, which sets timeframes for each stage of the care pathway, enabling treatment for NSCLC patients to start within 49 days of lung cancer being suspected, and within 14 days of diagnosis for SCLC.

Table 5.9a: Time from referral to treatment NSCLC		
	England	**Wales**
Dates of diagnosis / treatment:	*1/1/2024-31/12/2024*	*1/1/2024-31/12/2024*
Numerator:	*N/A*	*N/A*
Denominator: People with NSCLC who receive treatment	RCRD linked to HES APC, SACT, RTDS and Cancer Waiting Times	CANISC / CDF registration record
Construction notes	*Median time from referral to treatment*	
Country reporting:	England and Wales separate	
Organisational Reporting level:	NHS Trust	Health board & hospital
Subgroup Reporting:	People with Stage 1-2 NSCLC receiving surgery People with Stage 1-2 NSCLC receiving radiotherapy People with Stage 3B-4 receiving systemic anti-cancer therapy (SACT)	
Risk adjusted: *No*	N/A	N/A
Outlier reporting:	No	No

Table 5.9b: Time from diagnosis to treatment SCLC		
	England	**Wales**
Dates of diagnosis / treatment:	*1/1/2024-31/12/2024*	*1/1/2024-31/12/2024*
Numerator:	*N/A*	*N/A*

Denominator: People with SCLC who receive treatment with SACT	RCRD linked with SACT and Cancer Waiting Times	CANISC / CDF registration record
Construction notes	*Median time from diagnosis to treatment with Interquartile range*	
Country reporting:	England and Wales separate	
Organisational Reporting level:	NHS Trust	Health board & hospital
Subgroup Reporting:	People with SCLC receiving systemic anti-cancer therapy (SACT)	
Risk adjusted: *No*	N/A	N/A
Outlier reporting:	No	No

5.10 Performance Indicator 10: Survival

The one year survival indicator describes the number of diagnosed patients who are still alive one year after their diagnosis. This will monitor medium-term survival rates for patients with lung cancer and monitor progress towards the UK Lung Cancer Coalition goal of raising 5-year survival to 25% by 2025.

Table 5.10a: One year survival		
	England	**Wales**
Dates of diagnosis / treatment:	1/1/2024-30/06/2024	1/1/2024-31/12/2024
Numerator: Number of people with lung cancer alive at one year post diagnosis	ONS mortality data supplied within Rapid Cancer Registration Dataset (pathway events)	CANISC / CDF linked to ONS Death Registration dataset
Denominator: All people with lung cancer	RCRD: whole cohort	CANISC / CDF: whole cohort
Construction notes	Risk adjusted values produced using multiple imputation to deal with missing values	Risk adjusted values produced using multiple imputation to deal with missing values
Country reporting:	England and Wales separate	
Organisational Reporting level:	NHS Trust	Health board & hospital
Subgroup Reporting:	None	
Risk adjusted: Yes	age, sex, comorbidity, stage, performance status, tumour type	age, sex, comorbidity, stage, performance status, tumour type, audit-year
Outlier reporting:	Yes	Yes

Table 5.10b: 90 days survival after surgical resection for NSCLC		
	England	**Wales**
Dates of diagnosis / treatment:	1/1/2024-31/12/2024	1/1/2024-31/12/2024
Numerator: Number of people with NSCLC who received surgery who survived to 90 days	ONS mortality data within Rapid Cancer Registration Dataset (pathway events)	CANISC / CDF linked to ONS Death Registration dataset
Denominator:	RCRD: No of patients in cohort with NSCLC tumour type	CANISC / CDF: No of patients in cohort with NSCLC tumour type

All people with NSCLC who received curative surgery		
Construction notes	Risk adjusted values produced using multiple imputation to deal with missing values	Risk adjusted values produced using multiple imputation to deal with missing values
Country reporting:	England and Wales separate	
Organisational Reporting level:	NHS Trust	Health board & hospital
Subgroup Reporting:	Only people with NSCLC who had resection surgery	
Risk adjusted: Yes	age, sex, comorbidity, stage, performance status, tumour type	age, sex, comorbidity, stage, performance status, tumour type, audit-year
Outlier reporting:	No	No

6. NHS organisations

For patients in England, the audit presents organisation-level findings by the NHS trust. Patients are allocated to the NHS trust where they were first seen. For most patients, this will be the trust of diagnosis, but for patients referred to a surgical hub whose final diagnosis is post-surgery, the trust first seen and trust of diagnosis will differ. The RCRD only contains the trust of diagnosis. The Cancer Waiting Times dataset contains data on trust first seen but not for all patients. If both are available, trust first seen is used; otherwise, the patients are allocated to the trust of diagnosis.

For patients in Wales, the audit presents organisation-level findings by Health Board and the NHS hospital. Patients are allocated to the NHS hospital (and Health Board) where they were diagnosed. In the data available for Welsh patients, the hospital where a patient was first seen corresponded to the place of diagnosis.

7. Statistical Analysis

All statistical analyses were conducted using *Stata version 17.*

In the SotN report, information about categorical data items are reported as percentages (%), while waiting times are summarised using the median and interquartile range. Results are typically provided as an overall figure and broken down by the appropriate NHS organisation (see NHS organisations section). Note that, within tables in the SotN Report, the total percentage may not equal 100% due to rounding.

Funnel plots are used to graphically display the variation in indicator values across NHS organisations (English NHS trusts and Welsh hospitals). A funnel plot shows the indicator value for each NHS organisation on the vertical axis and the total number of patients used to calculate the indicator value on the horizontal axis. The 'target' is specified as the average rate across all NHS organisations.

The funnel plots generated for the performance indicators use control limits to define the range within which an indicator value might be expected to fall if it only differed from the target value because of random variation. Differences correspond to two standard deviations (inner limits) and three standard deviations (outer limits) from the target value. The control limits become progressively narrower as the volume of data on which an indicator value is based becomes larger. This reflects the increased levels of uncertainty around an organisation's result when the organisation treated fewer patients.

7.1 Suppression

- Data quality and completeness results have not been supressed.
- Organisations with indicator denominator values less than 10 have been suppressed.

7.2 Risk-adjustment of indicators

The tables of performance indicators state whether risk adjustment has been performed.

Multivariable logistic regression was performed to risk adjust the performance indicators whose value was expressed as a percentage. The regression model was used to estimate the probability of a patient having an event; to produce the expected number of events at an organisation, the individual probabilities of the patients treated at that organisation were summed. The adjusted indicator value for an organisation was then calculated using indirect standardisation: the observed number of events divided by the expected number, multiplied by the overall national average.

Table 7.1 below provides details on the datasets and variables used to compile the variable used for risk adjustment

Table 7: Risk Adjustment Variables	
Data Item	**Source**
Age at diagnosis	England: age (RCRD) categorised into 10 year groups Wales: age (Cohort data), modelled as continuous variable to improve coefficient estimation due to smaller sample size
Gender	Male or female
Charlson comorbidity index	The CCI is a commonly used scoring system for medical comorbidities, consisting of a grouped score calculated based on the absence (0) and presence (≥1) of 14 pre-specified medical conditions (Appendix 2). The CCI was calculated using information on secondary diagnoses (ICD-10 codes) recorded in HES APC (England) / PEDW (Wales) within the 12-month period prior to a patient's diagnosis. For the purpose of analysis, the CCI is grouped into four categories: • **0** none of the 14 pre-specified comorbidities. • **1** only 1 of the 14 pre-specified comorbidities. • **2** 2 of the 14 pre-specified comorbidities • **3+** 3 or more of the 14 pre-specified comorbidities
Lung cancer type	• SCLC • Carcinoid • NSLC (known histology) • NSLC (unknown histology)
Disease stage	Grouped into five categories or the values available if the indicator is restricted to a subset • 1 • 2 • 3A • 3B

	• 4
Performance status	Categorised from 0-4, or based on the values available if the indicator is restricted to a subset
Audit Year	England: N/A Wales: The regression models were fitted to a number of years to increase the precision of the coefficient estimates for the explanatory variables.

7.3 Handling of missing data

For the risk-adjustment, missing values were imputed using multiple imputation by chained equations to create an estimated value to ensure all included people contributed to the statistical models.

8. Outlier Process

The outlier process can be found in the separate audit outlier policy.

Appendix 1: Routine data sources

Overview of the data sources used for the SotN Report.

Country	Data source	Content
England	Core NDRS data sets 1. Rapid Registration 2. Pathway	Data on all aspects of the cancer registration including information from hospital pathology systems. The Rapid Cancer Registration Data (RCRD) is a reduced set of data items on cancer registrations compared to the "Gold standard" National Cancer Registration Data (NCRD), but it available for analysis more rapidly than the NCRD, which has a lag of over two years
England	COSD	Cancer Outcomes and Services dataset (COSD) items, are submitted routinely by service providers via multidisciplinary team (MDT) electronic data collection systems to the National Cancer Data Repository (NCDR) on a monthly basis.
England	SACT	Systemic Anti-Cancer Therapy (SACT) data contains information on chemotherapy dates, regimen(s) and dose(s).
England	RTDS	Radiotherapy dataset (RTDS) contains information on radiotherapy treatment including dates, prescription region and dose.
England	HES	Hospital Episode Statistics (HES) is the administrative database of all NHS hospital admissions in England; records were supplied by NHS Digital to NCRAS.
England	PCPD	Primary Care Prescription Database (PCPD) contains information on the use of endocrine therapy.
Wales	CaNISC	Cancer Network Information System Cymru (Canisc) contains data on all aspects of the cancer registration including investigations. (OLD SYSTEM)
Wales	CDF	Clinical Dataset Form (CDF) contains data on all aspects of the cancer registration including investigations (NEW SYSTEM)
Wales	PEDW	Patient Episode Database for Wales (PEDW) is the administrative database of all NHS hospital admissions in Wales.
Wales	RTH	Radiotherapy data (RTH) contains information on radiotherapy treatment.
England & Wales	ONS	Office for National Statistics (ONS) death data including date of death and cause of death.

Appendix 2: Charlson Comorbidity Index

Reference:

Armitage JN, van der Meulen JH. Identifying co-morbidity in surgical patients using administrative data with the Royal College of Surgeons Charlson Score. Br J Surg 2010;97:772-81. doi https://doi.org/10.1002/bjs.6930

Pre-specified conditions included in the assignment of Charlson Comorbidity Index (CCI).

CCI Conditions
Myocardial infarction
Dementia
Diabetes mellitus
Metastatic solid tumour
Congestive cardiac failure
Chronic pulmonary disease
Hemiplegia or paraplegia
AIDS/HIV infection
Peripheral vascular disease
Rheumatological disease
Renal disease
Cerebrovascular disease
Liver disease
Any malignancy

Note: AIDS/HIV diagnoses cannot be identified in HES APC data because of legal requirements for NHS trusts to remove patient identifiers from legally restricted records, including those containing diagnoses of HIV/AIDS. These diagnoses are also not found in linked PEDW data.