# Rapid Cancer Registration Dataset: data at 7th January (CAS2301)

The National Cancer Registration and Analysis Service (NCRAS) has developed an algorithmically generated Rapid Cancer Registration Dataset (RCRD) using the standard administrative datasets which flow rapidly into NHS Digital (NHSD) and are incorporated into the Cancer Analysis System (CAS) of NCRAS. The data takes the form of a series of significant events that occur to each patient as they proceed through the diagnostic and then therapeutic parts of the cancer pathway, and is available at approximately 4-5 months behind real time. The RCRD is shallower and narrower than the full NCRAS cancer registration dataset; it should be used and interpreted with reference to the caveats outlined within this document.

## Main findings

This document outlines the main features of the data to be aware of when interpreting the Rapid Cancer Registration Dataset:

- Across all cancers types included approximately 11.5% of cases are missing and 6.1% of cases are included erroneously or with incorrect cancer type or diagnosis date (when compared to 'Gold Standard' registration data for 2018 data).
- These figures vary strongly with cancer site. Broadly, more common cancers (particularly breast and prostate cancer) perform best and less common cancers (particularly bone and soft tissue and cancers of unknown primary) perform worst.
- Non-melanoma skin cancer (ICD-10 C44) tumours are excluded from the majority of data shown (Figure 3 onwards). Carcinoma of the cervic (ICD-10 D06) is excluded from all data presented.
- There are more missing tumours in those aged over 70 compared to younger age groups.
- Other factors that reduce data completeness include the patient's route to diagnosis, mortality within 30 days or diagnosis, and the presence of multiple cancers.
- Usable data is available approximately 4-5 months after diagnosis or other clinical activity occurs.
- Data on cancer stage group at diagnosis is available for a number of common tumour types, although completeness is lower than that for the Gold Standard registration data. Where data is available it generally agrees with the Gold Standard stage group in 80-90% of tumours.

The dataset includes Rapid Cancer Registrations from January 2018 to the most recently available data (at the date specified in the title to this document), plus additional event data for the same period.

## Contents



## Summary


A need to make rapidly available 'proxy cancer registrations' (and associated clinical activity) for the COVID-19 period has been identified to support the public health response by NHS Digital (PHE) and other agencies, and service reorganisation by the NHS. These proxy registrations are called Rapid Registrations in contrast to the more formal detailed registration process that are used in non-clinical cancer research and the National Statistics (https://www.gov.uk/government/statistics/cancer-registration-statistics-england-2018-final-release).

The National Cancer Registration and Analysis Service (NCRAS) has developed a Rapid Cancer Registration Dataset (RCRD) using all standard administrative datasets which flow rapidly into PHE and are incorporated into the Cancer Analysis System (CAS) of NCRAS.

This document describes the dataset structure, creation methodology, and data quality caveats (due to the rapid automated creation process without additional data curation) behind this dataset.

These data structures and methodologies are expected to evolve over the course of the public health response to COVID-19. The data is updated monthly and is referred to by the monthly CAS snapshot upon which it is based, e.g. CAS2009 refers to the CAS snapshot from September 2020. This document is considered a 'living document' and strictly applies only to the snapshot of CAS identified in the title.


## Methodology

### Proxy registration events (Rapid Registrations)

Datasets available to PHE were surveyed for how many months in arrears that they arrive within NCRAS and are loaded in a usable format for analysis. From these datasets a selection of event types were defined similarly to those typically used for cancer pathway analysis pursued by NCRAS.

The data takes the form of a series of significant events that occur to each patient as they proceed through the diagnostic and then therapeutic parts of the cancer pathway. These events include chemotherapy cycles, radiotherapy episodes and major cancer surgery as well as events based on the Cancer Waiting Times (CWT) and Cancer Outcomes and Services Dataset (COSD) datasets. These event types are numbered in the range 1-23 in the dataset.

Some events hypothesised to be indicative of a cancer diagnosis were defined including 'Diagnosis reported in COSD' (event 51) and 'CWT estimated diagnosis date' (event 52). These are numbered in the range 50-57 in the dataset - see Appendix 1 for a full list.

The indicative events for diagnosis were explored as candidate Rapid Registration events. These candidate rapid registration events were judged as matching against a Gold Standard Registration event if it met the following two conditions:

- The difference in diagnosis dates for each event was 90 days or less.
- Both registrations fell into the same broad tumour group (as defined in Appendix 3).

Using these matching criteria False Positive errors and False Negative errors are defined as:

- **False Positive Error (FPE)**: A rapid registration event has been created which does not match against a Gold Standard Registration in the comparison period.
- **False Negative Error (FNE)**: There exists a Gold Standard Registration event for which no rapid registration event can be matched.

Additional filtering was applied to the candidate events and eventually event 101 was defined to minimise both false positive and false negative errors and is recommended for use by researchers as the best candidate for a rapid cancer registration. Appendix 4 briefly examines some of the alternatives examined in the development of this event definition.

## Data structures

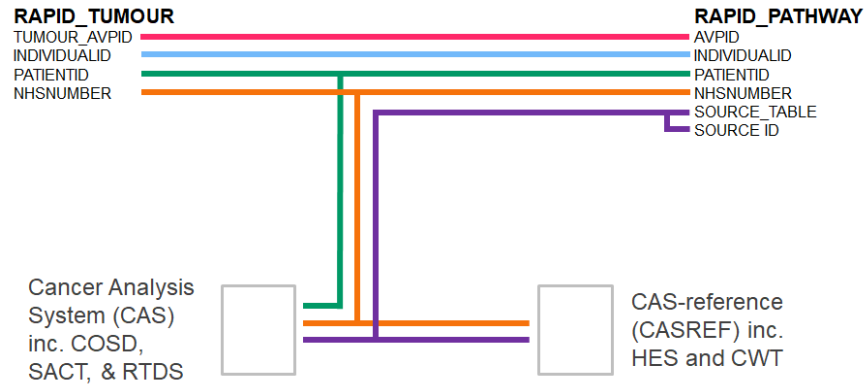
The rapid registration dataset consists of two tables:

**AT_RAPID_PATHWAY**: This is an event-based dataset with a number of types of event of interest defined based on the rapidly available datasets, see Appendix 1 for event definitions and properties. These are numbered in the range 1-23 for general purpose events, 50-57 for events that are candidates for combining into a rapid registration, and 101 for the final rapid registration event.

**AT_RAPID_TUMOUR**: This is a tumour level dataset that holds tumour and patient level data for each of the tumours defined by a rapid registration. The structure and contents of this table are presented in Appendix 3.

The rapid registration pathway and tumour table can be linked together as shown in Figure 1, and also to other datasets that are timely enough via NHSnumber.

Figure 1: Linkage diagram for the Rapid Cancer Registration Dataset



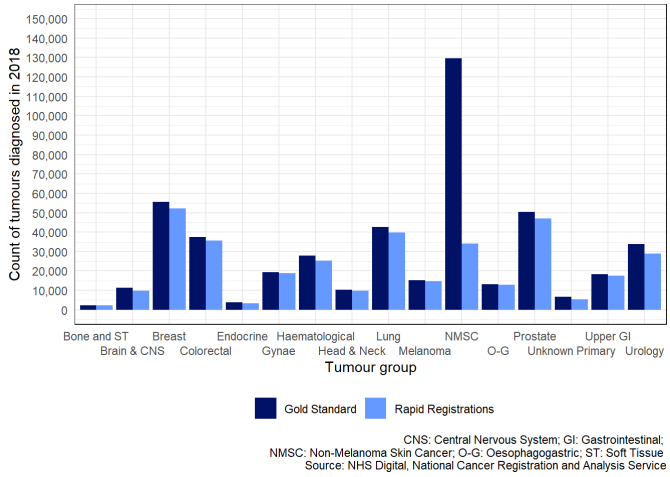

# Data Quality

## How do the number of Rapid Registrations compare with Gold Standard Registrations?

To illustrate the strengths and weaknesses of the Rapid Registrations compared to the gold standard process, registrations for tumours diagnosed during 2018 are compared in Figure 2.

For most tumour groups the counts of Rapid Registrations are significantly lower than those of standard registrations. The COSD system does not attempt to record basal cell carcinoma non-melanoma skin cancers (but they are recorded by hospital pathology systems, and thereby registered), explaining the discrepancy there. There is only one group where this situation is reversed - bone and soft tissue - for which a precise morphology is required to properly record the diagnosis. These cancers are being preferentially coded to bone and soft tissue in COSD (as the COSD standard necessitates simpler site-based coding, and this is the best choice under the circumstances) and re-coded during the gold standard registration process where more sophisticated combination of site and morphological coding is possible.

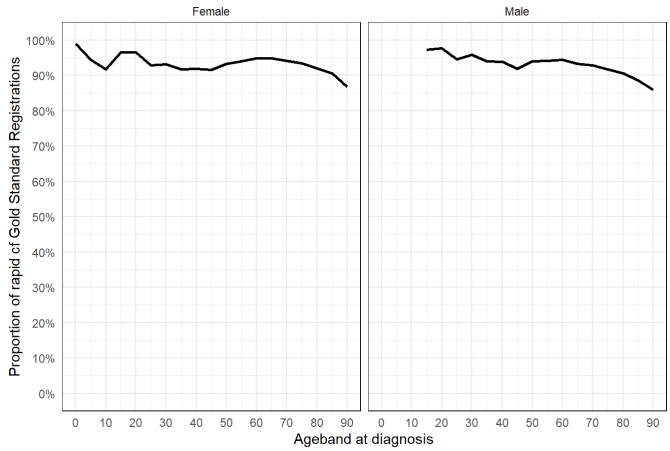
Figure 2: The number of cancer registrations by registration and tumour type, England, 2018




CNS: Central Nervous System; GI: Gastrointestinal;
NMSC: Non-Melanoma Skin Cancer; O-G: Oesophagogastric; ST: Soft Tissue
Source: NHS Digital, National Cancer Registration and Analysis Service

Figure 3 shows the age dependence of the ratio between Gold Standard and Rapid Registrations, Non-Melanoma Skin Cancer is excluded. The proportion of diagnoses is consistently high for both males and females until the age of 70 is reached, where it declines. This is explored further in Figure 5 below.

Figure 3: The proportion of cancer registrations by sex, age and registration type, England, 2018 (all tumour types combined)




Source: NHS Digital, National Cancer Registration and Analysis Service

## Comparing the matching quality of Rapid Registrations

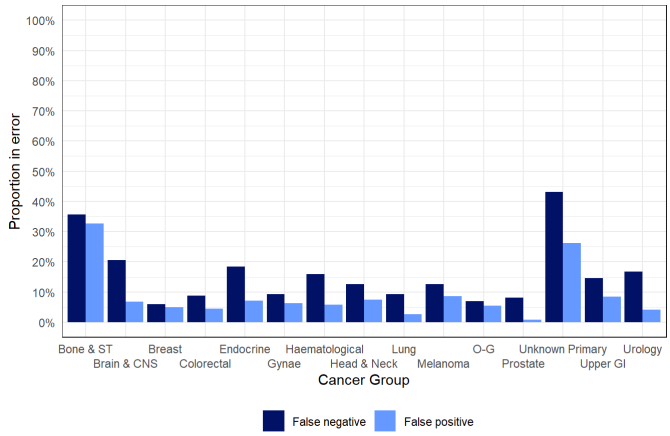
The quality of the Rapid Registrations was judged by comparing them against the gold-standard cancer registrations in the period April 2018 to September 2018. This period was chosen as available gold standard registration data was only finalised to December 2018 and a matching period of 90 days was allowed (restricting comparison to the middle six months of the twelve-month period).

Figure 4 shows the proportions of false positive and false negative events, by broad cancer type (excluding non-melanoma skin cancer), measured in the cas2301 snapshot (the tumour groups are defined in Appendix 3). A more detailed tabulation is available by tumour group and tumour site in Appendix 5.

In most tumour groups, there are more tumours missed by the rapid registrations process (false negatives) than there are falsely identified as tumours (false positives).

For breast and prostate, very few incorrect proxy registrations are made. Breast, colorectal, lung, oesophagogastric (O-G) and prostate cancers are also least likely to be missing from the proxy dataset, whereas for cancers of unknown primary, and bone and soft tissue tumours more than 25% of cancers are missed. Bone and soft tissue tumours are not frequently diagnosed. These tumours often require multiple pathology reports to correctly diagnose a patient and the Rapid Registrations dataset has not attempted to reconcile differences in the reported diagnoses.

### Figure 4: Types of error by tumour group

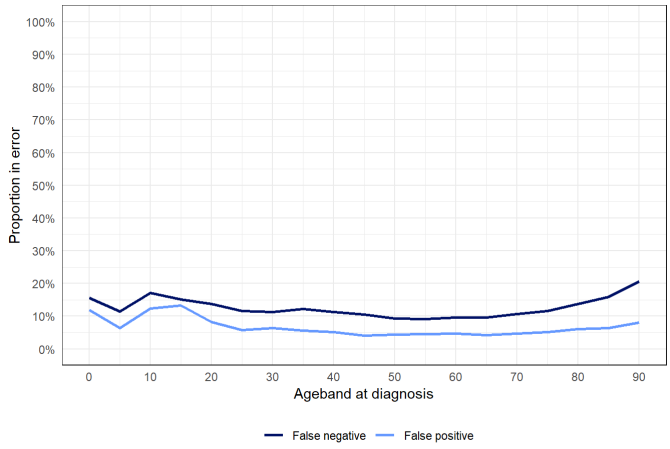



CNS: Central Nervous System; GI: Gastrointestinal; O-G: Oesophagogastric; ST: Soft Tissue
Source: NHS Digital, National Cancer Registration and Analysis Service

The proportion of false positive errors is fairly stable across all ages (Figure 5); the proportion of false negative errors slowly declines until age 70 when it increases significantly. The age dependence was investigated and the age-dependence of the basis of diagnosis was found to be at least partially responsible for this - see Appendix 6 for details.

The proportion of false positive cases is less sensitive to the age of the patient.

### Figure 5: False negative and false positive errors by age band at diagnosis




Source: NHS Digital, National Cancer Registration and Analysis Service

The charts in Figure 6 (below) examine these patterns by tumour group. Please note that age groups for each tumour group must have a denominator of 25 patients or more or they are suppressed for reasons of statistical power.

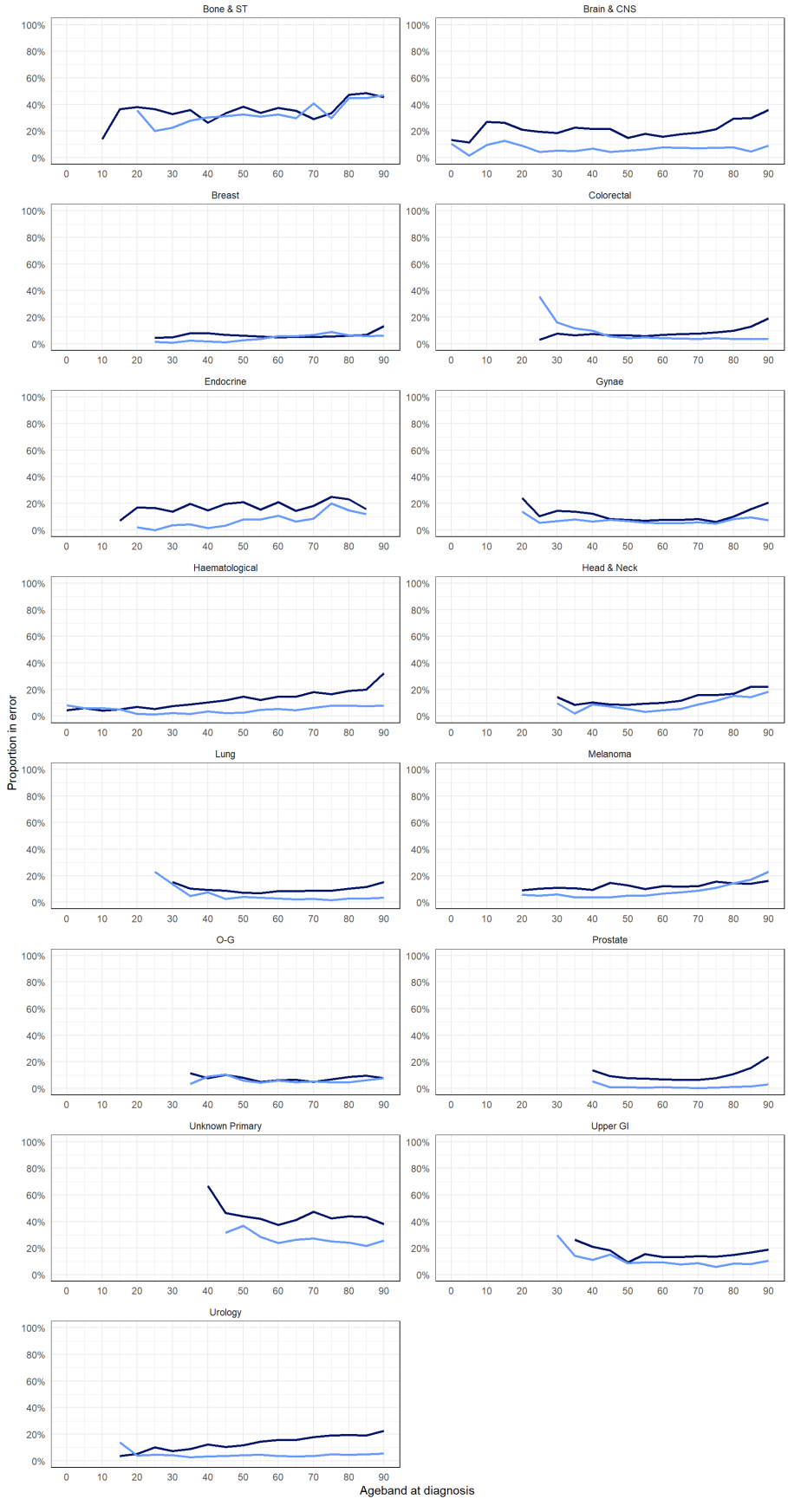
The patterns of false negative and false positive vary significantly by tumour group. Most groups have a higher proportion of false negatives than false positives at each age.

The proportion of false positives does not exhibit a trend by age for most tumour groups; the proportion rises with increasing age in the bone and soft tissue, head and neck groups and melanoma group and conversely falls with increasing age in the colorectal and unknown groups.

The proportion of false negatives rises with increasing age for all tumour groups except bone and soft tissue and endocrine. The most pronounced increases occur in the brain and central nervous system, colorectal, gynaecological, haematological, prostate, upper gastro-intestinal and unknown primary tumour groups.

The levels of both types of error are highest in tumour groups which are less likely to have solid-tissue pathology (haematological) or where survival rates are typically low. Conversely, the levels of error are lowest for tumour groups for which survival rates are typically higher.

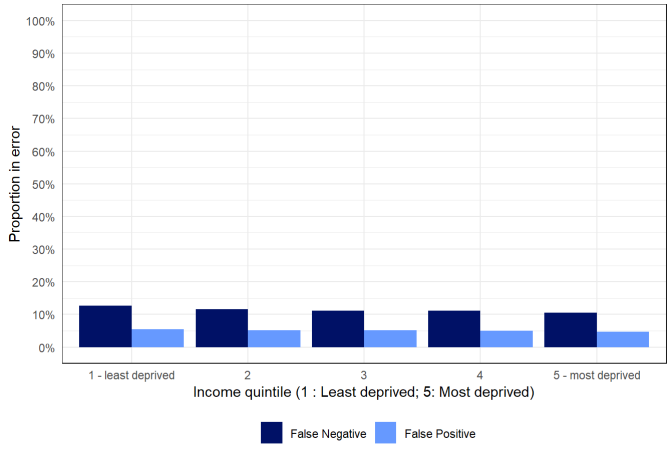
Figure 6: False negative and false positive errors by age band at diagnosis and tumour group




CNS: Central Nervous System; GI: Gastrointestinal; O-G: Oesophagogastric; ST: Soft Tissue
Source: NHS Digital, National Cancer Registration and Analysis Service

The variation of the false positive and false negative errors with Income deprivation quintile is shown in figure 6. While there is an overall trend visible this is likely to be due to confounding due to the variation with tumour type shown above and the known association of the incidence of many cancer types with income deprivation.

Figure 6: False negative and false positive errors by income deprivation quintile

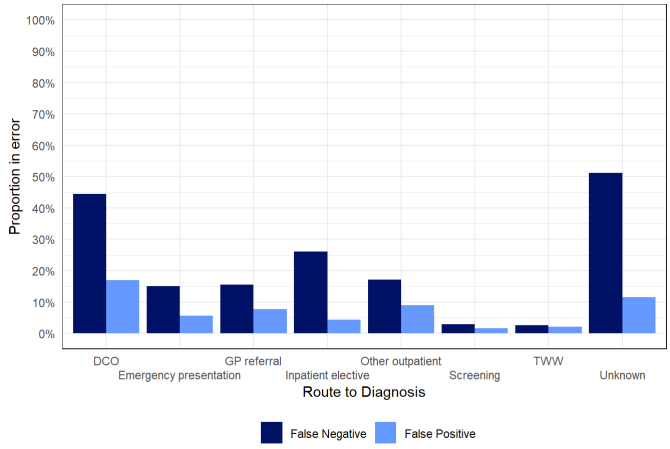



Source: NHS Digital, National Cancer Registration and Analysis Service

Figure 7 shows the variation of false negative and false positive errors with route to diagnosis. For false positives there is moderate variation with the lowest error rate being those cases identified through cancer screening or a two week wait referral. (These tumours are those that are likely to be captured in both the COSD dataset and the screening/Cancer Waiting Times datasets so the lower error rate is understandable.)

Most routes to diagnosis have a substantially higher false negative rate than the overall average. 'Two Week Wait' (TWW) and screening routes have a substantially lower false negative rate (and make up between them 45% of the total cohort).

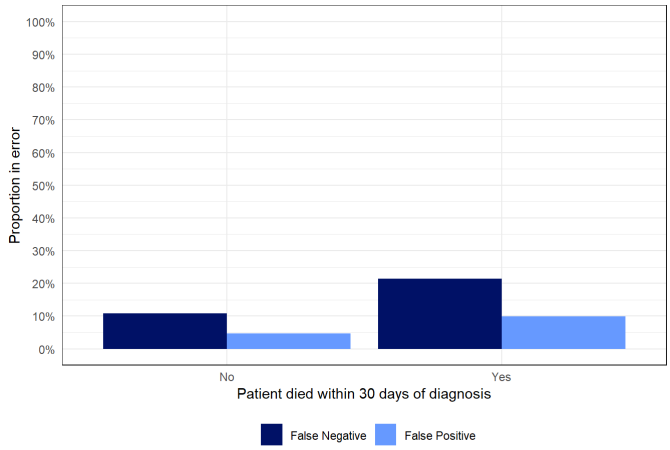
Figure 7: False negative and false positive errors by route to diagnosis




Source: NHS Digital, National Cancer Registration and Analysis Service

Figure 8 below shows the variation of false negative and false positive errors with whether or not the patient died within 30 days of diagnosis. The false negative error rate varies substantially between patients who die in the 30 days post-diagnosis compared to those who did, meaning that patients who die within 30 days are more likely to be missing from the dataset.

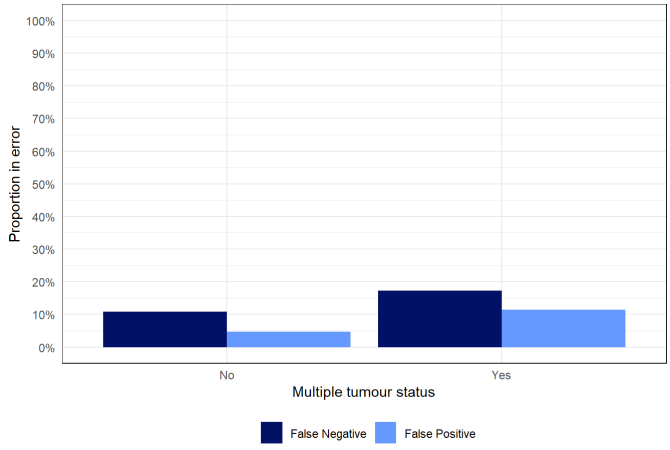
Figure 8: False negative and false positive errors by 30-day mortality




Source: NHS Digital, National Cancer Registration and Analysis Service

Figure 9 below shows the variation of false negative and false positive errors with the multiple tumour status of the patient, i.e. whether or not the patient had been diagnosed with more than one type of tumour in the period January 2018 onward. The false positive error rate varies substantially between patients with multiple tumour types and those that don't, meaning that these patients with multiple tumours are more likely to have incorrect tumour types or diagnosis dates recorded.

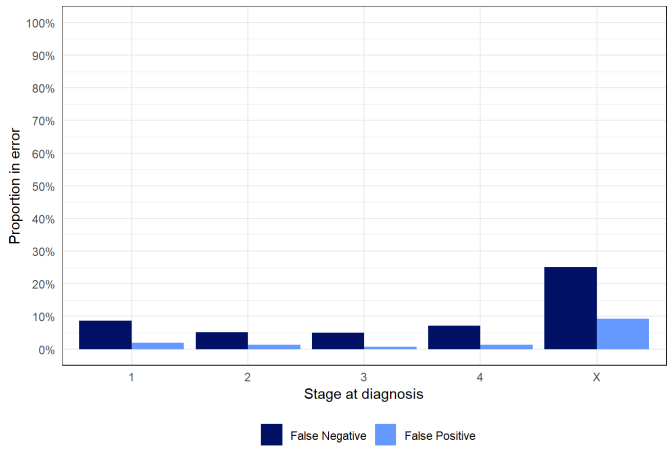
Figure 9: False negative and false positive errors by multiple tumour status




Source: NHS Digital, National Cancer Registration and Analysis Service

Figure 9b below shows the variation of false negative and false positive errors with the stage at diagnosis.

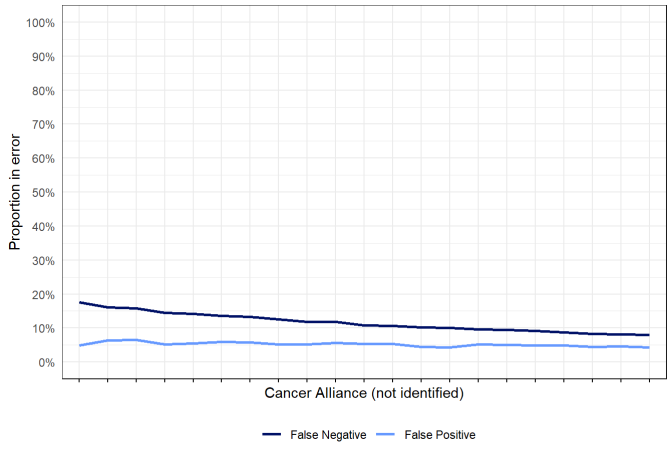
Figure 9b: False negative and false positive errors by stage




Source: NHS Digital, National Cancer Registration and Analysis Service

Figure 10 below shows the variation of false negative and false positive errors with the cancer alliance of residence of the patient at the time of diagnosis. The false negative error rate varies more in absolute terms than the false positive rate and may be driven by trust level variation (see figures 11 and 12 below).

Figure 10: False negative and false positive errors by Cancer Alliance




Source: NHS Digital, National Cancer Registration and Analysis Service

Figures 11 and 12 below show the variation of false negative and false positive errors with the trust that diagnosed the tumour. Figure 11 shows the error proportion and figure 12 the numerator (count) of the errors. Trusts shown are limited to NHS secondary care trusts with a denominator of at least 50 patients over the assessment period. Both figures are ordered in descending order of the false negative statistic - but note that the order is not the same in each figure.

There is substantial variation in both false positive and false negative rates and counts. Some large trusts have several hundred or up to 1000 cases (over the six-month period under assessment).

Figure 11: False negative and false positive errors (proportion) by hospital trust

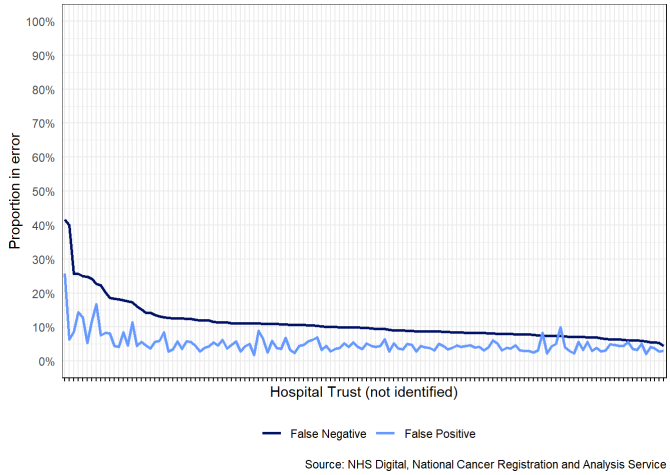
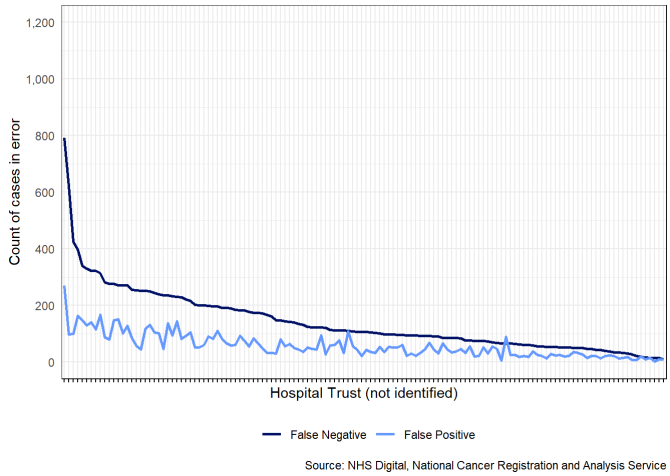



Figure 12: False negative and false positive errors (count) by hospital trust



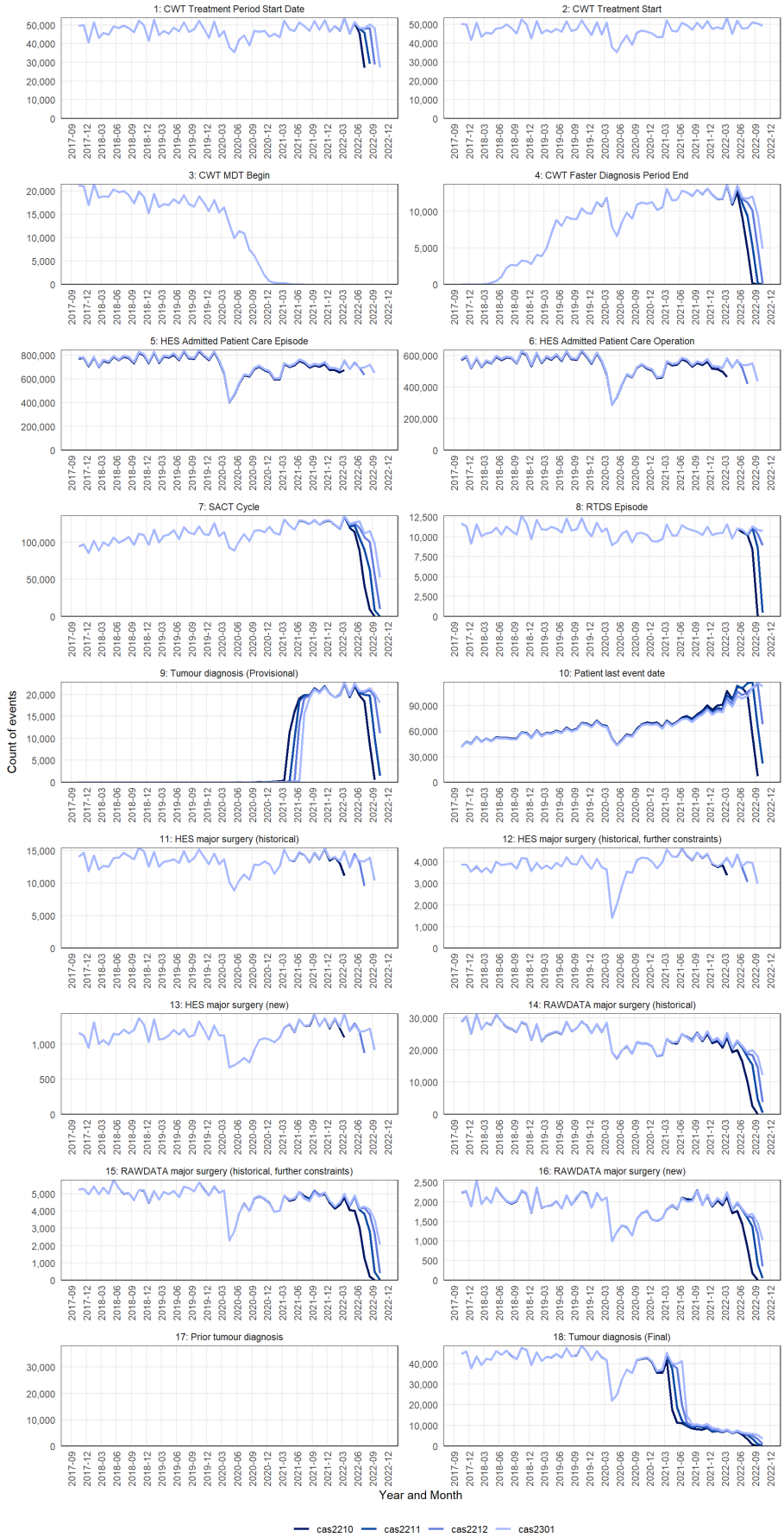

## Counts of events over time

This section examines the population of events by chronological time and when they appear in successive analytical snapshots in the CAS. Figure 13 shows that most data items in the Rapid Registrations dataset are stable with respect to the snapshot month.

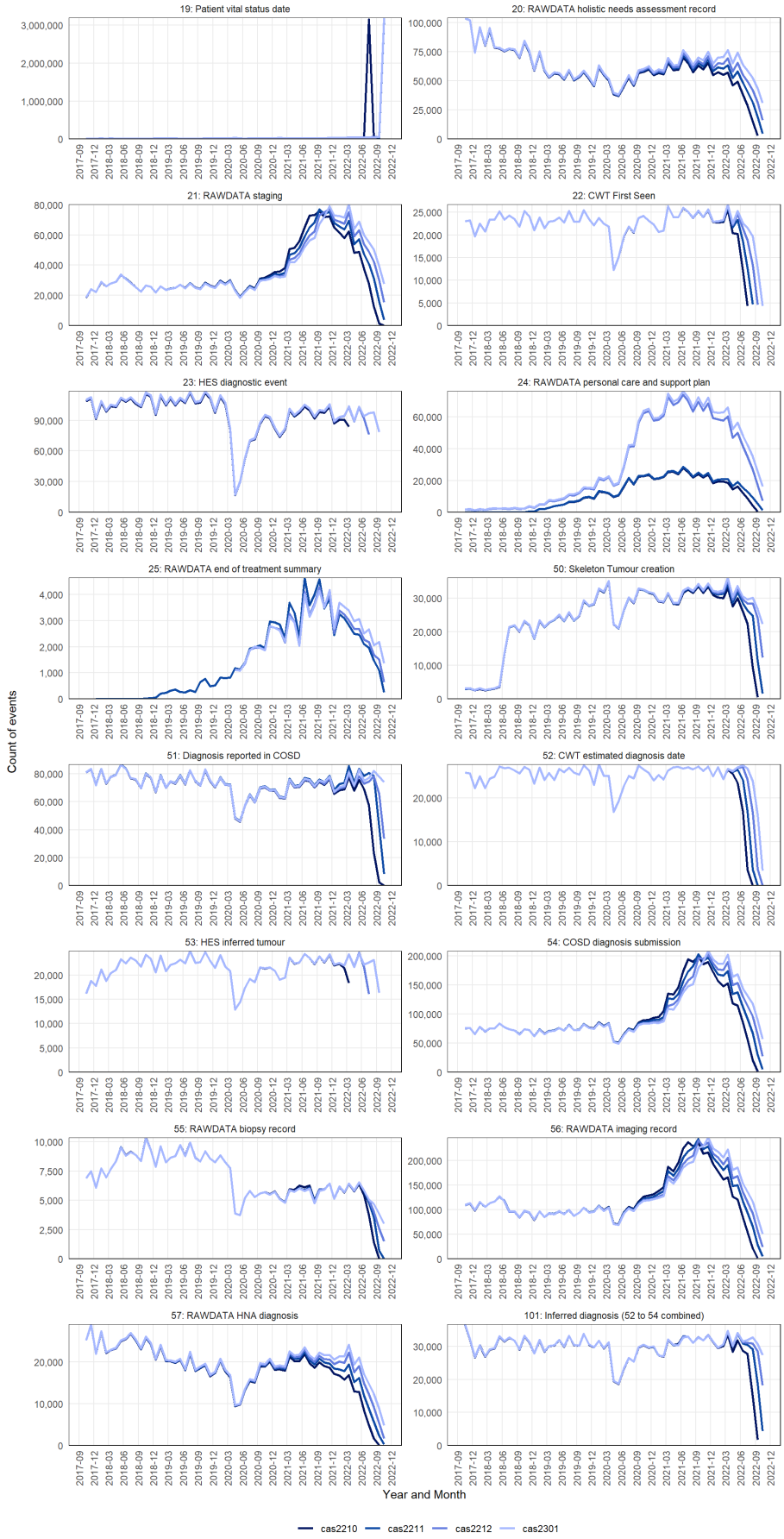
Specific comments about the events shown below are:

- Cancer Waiting Times data (events 1-4) are received based on the treatment start date, this explains the fact that for event 2 all lines lie exactly on top of each other. Other CWT events accumulate over successive snapshots where these events precede the first treatment start event.
- An issue with HES data resulting in lower than expected completeness port 2020-04-01 was resolved in cas2102, showing as increased event counts in events 5,6, 11, 12, 13 and 23.
- The definition of event 17 only includes tumour diagnoses prior to 2018, lack of data in the chart below is expected.
- Definitions of staging events may change between snapshots, this might explain higher or lower counts in one snapshot compared to others.
- The vital status shown in the event 19 is typically only assessed each January or the completion of registering each diagnosis year, explaining the large peaks in the graph.
- The raw data used to populate events 21, 54, and 56 is subject to ongoing deduplication, this explains lower counts in earlier time periods for later snapshots.
- Between snapshots there is generally an increase in the Event 101-103 (Inferred diagnoses) counts, particularly for recent months as additional COSD data is submitted. However, for some earlier months there is a small decrease in these event counts. This is because the algorithm to define Events 101-103 excludes potential diagnoses where the patient has a confirmed diagnosis for the same tumour group which was more than 90 days before the potential diagnosis, to avoid double-counting the same diagnosis. These exclusions can change between snapshots due to the processing of gold standard cancer registration data, which leads to an increase in confirmed previous diagnoses. However the magnitude of this effect has been measured to be <1% of all cases in any given month.

Figure 13: Population of data items to CAS snapshot




Source: NHS Digital, National Cancer Registration and Analysis Service




Source: NHS Digital, National Cancer Registration and Analysis Service

## Estimated completeness of Rapid Registrations and secondary datasets

Detailed linked rapid cancer registration, CWT, SACT and RTDS data is available at approximately a four-month lag from real time. Linked HES and raw COSD data is available at approximately 4-5 months behind real time.

Table 2 below shows data usability and completeness for Rapid Registrations and the constituent datasets. The "latest usable" column shows the 'hard limit' on data that is considered fit for analytical purposes (90% completeness), even in months prior to this though data is not necessarily considered complete and the completeness is displayed below. This should be taken into account in any use of the rapid registration data and the secondary datasets.

For the Rapid Tumour data completeness is expressed as the proportion of CCG of residence which show a cancer incidence within the normally expected range (see Table 3 below). For other datasets except CWT completeness is computed as a percentage of the number of data providers who have supplied data over those who are expected to do so.

Data completeness within the Cancer Waiting Times dataset varies at patient level with event type. Figures for the Treatment Start Date and Treatment Period Start Date are given below. Completeness of other CWT events can be estimated by inspecting Figure 13 (events 1-4).

Table 2: Rapid registration and dataset usability/completeness in cas2301

| Data source | Latest usable | February 2022 | March 2022 | April 2022 | May 2022 | June 2022 | July 2022 | August 2022 | September 2022 | October 2022 |
|---|---|---|---|---|---|---|---|---|---|---|
| Rapid Tumours (COSD) | September 2022 | Complete | Complete | 97% | Complete | Complete | 97% | 97% | 91% | • |
| HES | August 2022 | Complete | Complete | Complete | Complete | Complete | Complete | Complete | • | • |
| SACT | June 2022 | 98% | 98% | 97% | 95% | 95% | • | • | • | • |
| RTDS | September 2022 | 96% | 96% | 94% | 92% | 96% | 94% | 96% | 94% | • |
| CWT (TSD) | October 2022 | Complete | Complete | Complete | Complete | Complete | Complete | Complete | Complete | Complete |
| CWT (TPSD) | September 2022 | Complete | Complete | Complete | Complete | Complete | Complete | Complete | 98% | • |

*Note:*
COSD = Cancer Outcomes and Services Dataset
TSD = Treatment Start Date
TPSD = Treatment Period Start Date

Table 3: Number of outlier CCGs in COSD dataset in cas2301

The table below shows the number of CCGs (using the April 2020 boundaries) which have 3-sigma outlier counts per month (either high or low) compared to the expectation of the fraction of the total number of new cancer registrations in England. This can be used to judge to what extent there is large scale missing data in COSD (and therefore in the Rapid Registrations in any particular month.)

| Year and month | Outlier: High | Outlier: Low | In expected range | Total received |
|---|---|---|---|---|
| 2020-01 | 0 | 1 | 134 | 135 |
| 2020-02 | 1 | 0 | 134 | 135 |
| 2020-03 | 0 | 1 | 134 | 135 |
| 2020-04 | 4 | 7 | 124 | 135 |
| 2020-05 | 4 | 2 | 129 | 135 |
| 2020-06 | 1 | 3 | 131 | 135 |
| 2020-07 | 1 | 0 | 134 | 135 |
| 2020-08 | 1 | 4 | 130 | 135 |
| 2020-09 | 1 | 0 | 134 | 135 |
| 2020-10 | 0 | 4 | 131 | 135 |
| 2020-11 | 0 | 1 | 134 | 135 |
| 2020-12 | 1 | 1 | 133 | 135 |
| 2021-01 | 0 | 0 | 135 | 135 |
| 2021-02 | 1 | 2 | 132 | 135 |
| 2021-03 | 2 | 2 | 131 | 135 |
| 2021-04 | 2 | 0 | 133 | 135 |
| 2021-05 | 0 | 1 | 134 | 135 |
| 2021-06 | 0 | 1 | 134 | 135 |
| 2021-07 | 0 | 1 | 134 | 135 |
| 2021-08 | 0 | 1 | 134 | 135 |
| 2021-09 | 2 | 3 | 130 | 135 |
| 2021-10 | 1 | 2 | 132 | 135 |
| 2021-11 | 0 | 1 | 134 | 135 |
| 2021-12 | 0 | 1 | 134 | 135 |
| 2022-01 | 2 | 4 | 129 | 135 |
| 2022-02 | 0 | 2 | 133 | 135 |
| 2022-03 | 0 | 3 | 132 | 135 |
| 2022-04 | 0 | 4 | 131 | 135 |
| 2022-05 | 1 | 1 | 133 | 135 |
| 2022-06 | 1 | 1 | 133 | 135 |
| 2022-07 | 2 | 2 | 131 | 135 |
| 2022-08 | 1 | 3 | 131 | 135 |
| 2022-09 | 1 | 11 | 123 | 135 |
| 2022-10 | 8 | 12 | 115 | 135 |
| 2022-11 | 36 | 39 | 56 | 131 |

# Staging data in the Rapid Registrations dataset

## TNM stage group 1-4

The size and extent of a cancer is commonly described using the 'TNM' system (https://www.uicc.org/resources/tnm) for "Tumour", "Node", and "Metastases". This is often abbreviated to a number between 1 (typically a localised tumour with limited spread) to 4 (typically a tumour that has invaded or spread to distant organs). The stage at diagnosis is very strongly associated with patient outcomes.

In the current version of the Rapid Registrations dataset partial staging data is provided for a number of different cancer sites (ICD-10 codes can be found in the labels for tables 5a-k). This has been benchmarked against the gold standard cancer registry data for cas2301.

Table 4 shows the count and proportion of cases by TNM stage group for both the Rapid Registrations and the Gold Standard Registrations, for calendar year 2018. For example 32% of breast cancers are TNM stage group 1 in the Rapid Registrations, but 38% in the Gold Standard Registrations. Compared to the Gold Standard Registrations in 2018, the Rapid Registrations under report breast cancers diagnosed at stages 1 or 2; colorectal cancers diagnosed at stage 4 are under reported and prostate cancers have under reported stages 1 and 4. In all three tumour groups, there are more tumours allocated to the unknown or unstageable category. Lung cancers in the RCRD most accurately match the Gold Standard Registrations and exhibits a broadly similar stage profile from both measures.

Table 4: Summary proportions of stage at diagnosis for the Rapid Registrations and Gold Standard Registrations

| Broad Cancer Group | Stage Group | Count (Rapid) | Percentage (Rapid) | Count (Gold Standard) | Percentage (Gold Standard) |
|---|---|---|---|---|---|
| Bladder | 1 | 2320 | 24.2% | 2868 | 29.9% |
| Bladder | 2 | 1799 | 18.7% | 1879 | 19.6% |
| Bladder | 3 | 559 | 5.8% | 885 | 9.2% |
| Bladder | 4 | 258 | 2.7% | 659 | 6.9% |
| Bladder | U | 4666 | 48.6% | 3311 | 34.5% |
| Breast | 1 | 14042 | 31.8% | 16580 | 37.5% |
| Breast | 2 | 13241 | 30.0% | 16734 | 37.9% |
| Breast | 3 | 3234 | 7.3% | 3688 | 8.3% |
| Breast | 4 | 1181 | 2.7% | 1974 | 4.5% |
| Breast | U | 12483 | 28.3% | 5205 | 11.8% |
| Colorectum | 1 | 4920 | 15.0% | 5507 | 16.8% |
| Colorectum | 2 | 7036 | 21.4% | 7725 | 23.5% |
| Colorectum | 3 | 8240 | 25.1% | 9310 | 28.4% |
| Colorectum | 4 | 5114 | 15.6% | 7476 | 22.8% |
| Colorectum | U | 7528 | 22.9% | 2820 | 8.6% |
| Kidney | 1 | 2381 | 28.8% | 3348 | 40.5% |
| Kidney | 2 | 447 | 5.4% | 558 | 6.8% |
| Kidney | 3 | 1370 | 16.6% | 1660 | 20.1% |
| Kidney | 4 | 686 | 8.3% | 1581 | 19.1% |
| Kidney | U | 3376 | 40.9% | 1113 | 13.5% |
| Lung | 1 | 6173 | 17.1% | 6646 | 18.4% |
| Lung | 2 | 2588 | 7.2% | 2694 | 7.5% |
| Lung | 3 | 7305 | 20.2% | 7617 | 21.1% |
| Lung | 4 | 14922 | 41.3% | 17213 | 47.7% |
| Lung | U | 5123 | 14.2% | 1941 | 5.4% |
| Lymphoma | 1 | 909 | 7.4% | 1755 | 14.3% |
| Lymphoma | 2 | 951 | 7.8% | 1623 | 13.3% |
| Lymphoma | 3 | 1200 | 9.8% | 2001 | 16.4% |
| Lymphoma | 4 | 2656 | 21.7% | 4946 | 40.4% |
| Lymphoma | U | 6514 | 53.3% | 1905 | 15.6% |
| Melanoma | 1 | 6338 | 48.1% | 8265 | 62.7% |
| Melanoma | 2 | 2389 | 18.1% | 2653 | 20.1% |
| Melanoma | 3 | 442 | 3.4% | 1034 | 7.8% |
| Melanoma | 4 | 202 | 1.5% | 350 | 2.7% |
| Melanoma | U | 3818 | 28.9% | 887 | 6.7% |
| Oesophagus | 1 | 291 | 3.5% | 449 | 5.4% |
| Oesophagus | 2 | 1503 | 18.0% | 971 | 11.6% |
| Oesophagus | 3 | 1784 | 21.4% | 2156 | 25.8% |
| Oesophagus | 4 | 2555 | 30.6% | 3251 | 38.9% |
| Oesophagus | U | 2214 | 26.5% | 1520 | 18.2% |
| Ovary | 1 | 1152 | 22.6% | 1481 | 29.0% |
| Ovary | 2 | 234 | 4.6% | 279 | 5.5% |
| Ovary | 3 | 1182 | 23.1% | 1632 | 31.9% |
| Ovary | 4 | 692 | 13.5% | 1051 | 20.6% |
| Ovary | U | 1848 | 36.2% | 665 | 13.0% |

| Broad Cancer Group | Stage Group | Count (Rapid) | Percentage (Rapid) | Count (Gold Standard) | Percentage (Gold Standard) |
|---|---|---|---|---|---|
| Pancreas | 1 | 359 | 4.5% | 669 | 8.3% |
| Pancreas | 2 | 617 | 7.7% | 804 | 10.0% |
| Pancreas | 3 | 749 | 9.3% | 1039 | 12.9% |
| Pancreas | 4 | 2037 | 25.4% | 4126 | 51.4% |
| Pancreas | U | 4262 | 53.1% | 1386 | 17.3% |
| Prostate | 1 | 11620 | 25.0% | 16271 | 35.1% |
| Prostate | 2 | 5534 | 11.9% | 6570 | 14.2% |
| Prostate | 3 | 10400 | 22.4% | 11686 | 25.2% |
| Prostate | 4 | 5630 | 12.1% | 8104 | 17.5% |
| Prostate | U | 13219 | 28.5% | 3772 | 8.1% |
| Stomach | 1 | 317 | 8.3% | 334 | 8.7% |
| Stomach | 2 | 358 | 9.3% | 452 | 11.8% |
| Stomach | 3 | 608 | 15.8% | 679 | 17.7% |
| Stomach | 4 | 1100 | 28.7% | 1620 | 42.2% |
| Stomach | U | 1456 | 37.9% | 754 | 19.6% |
| Uterus | 1 | 4644 | 58.1% | 5416 | 67.7% |
| Uterus | 2 | 513 | 6.4% | 544 | 6.8% |
| Uterus | 3 | 732 | 9.2% | 823 | 10.3% |
| Uterus | 4 | 504 | 6.3% | 559 | 7.0% |
| Uterus | U | 1605 | 20.1% | 656 | 8.2% |

In Tables 5a-m below, the distribution of the stage allocations between the Rapid Registrations and the Gold Standard Registrations are examined.

The figures indicate the proportion of agreement at the 1-digit TNM stage group level, where the stage is known in the Rapid Registrations dataset. Stages 1-4 in the Rapid Registrations dataset agree with the gold standard stage variable for a high proportion.

For example, when examining the subset of Rapid Registrations breast tumours that are identified as TNM stage 1 (32%), approximately 89% of these are found to be TNM stage group 1 in the gold standard registration data, with another 11% distributed across TNM stages 2-4 and the unknown or unstageable groups.

For many but not all (e.g., late stage breast cancer), roughly 85% or more of staged cases in the Rapid Registrations table have the same stage grouping as the equivalent tumour in the standard registration data - this can be seen in the table below by inspecting the figures where the stage metrics for the Rapid Registrations and Gold Standard Registrations are the same.

Where the stage is labelled as unknown or unstageable in the rapid pathway dataset it is known for at least 70% of those cases in the gold standard data.

## Tables 5a-m: Stage comparison between Rapid Registrations and Gold Standard Registrations by cancer site

a. bladder (ICD-10 C67)

| | Stage Group (Rapid) | | | | |
|---|---|---|---|---|---|
| **Stage Group (Gold Standard)** | **1** | **2** | **3** | **4** | **Unknown** |
| 1 | 84.9% | 4.2% | 7.9% | 5.4% | 16.4% |
| 2 | 3.8% | 71.7% | 15.7% | 5.8% | 8.5% |
| 3 | 2.6% | 10.9% | 64.9% | 4.7% | 5.4% |
| 4 | 1.2% | 4.9% | 5.5% | 79.1% | 6.6% |
| U | 7.4% | 8.3% | 5.9% | 5.0% | 63.1% |

b. breast (ICD-10 C50)

| | Stage Group (Rapid) | | | | |
|---|---|---|---|---|---|
| **Stage Group (Gold Standard)** | **1** | **2** | **3** | **4** | **Unknown** |
| 1 | 89.1% | 4.9% | 1.5% | 3.3% | 26.7% |
| 2 | 6.5% | 88.6% | 10.9% | 14.4% | 28.6% |
| 3 | 0.5% | 2.7% | 80.3% | 5.5% | 4.8% |
| 4 | 0.2% | 0.9% | 2.9% | 72.0% | 7.1% |
| U | 3.7% | 3.0% | 4.3% | 4.8% | 32.8% |

c. colorectum (ICD-10 C18-C20)

| | Stage Group (Rapid) | | | | |
|---|---|---|---|---|---|
| **Stage Group (Gold Standard)** | **1** | **2** | **3** | **4** | **Unknown** |
| 1 | 84.9% | 2.1% | 1.8% | 0.7% | 13.3% |
| 2 | 5.7% | 85.6% | 5.5% | 1.2% | 12.0% |
| 3 | 6.6% | 7.5% | 85.1% | 4.4% | 16.2% |
| 4 | 0.9% | 2.8% | 5.8% | 92.7% | 26.8% |
| U | 1.9% | 2.0% | 1.8% | 1.0% | 31.8% |

d. kidney (ICD-10 C64)

| | Stage Group (Rapid) | | | | |
|---|---|---|---|---|---|
| **Stage Group (Gold Standard)** | **1** | **2** | **3** | **4** | **Unknown** |
| 1 | 91.2% | 6.7% | 3.1% | 1.7% | 32.3% |
| 2 | 0.5% | 78.3% | 1.0% | 0.7% | 5.2% |
| 3 | 1.7% | 6.7% | 85.7% | 3.9% | 11.5% |
| 4 | 0.5% | 3.4% | 6.0% | 92.4% | 24.9% |
| U | 6.1% | 4.9% | 4.2% | 1.2% | 26.1% |

e. lung (ICD-10 C33-C34)

| | Stage Group (Rapid) | | | | |
|---|---|---|---|---|---|
| **Stage Group (Gold Standard)** | **1** | **2** | **3** | **4** | **Unknown** |
| 1 | 93.7% | 6.6% | 1.1% | 0.4% | 10.7% |
| 2 | 2.7% | 84.5% | 1.8% | 0.3% | 3.1% |
| 3 | 1.7% | 4.8% | 90.7% | 1.3% | 11.1% |
| 4 | 1.2% | 3.1% | 5.5% | 97.5% | 41.2% |
| U | 0.8% | 1.0% | 0.9% | 0.4% | 33.8% |

f. melanoma (ICD-10 C43)

| | Stage Group (Rapid) | | | | |
|---|---|---|---|---|---|
| **Stage Group (Gold Standard)** | **1** | **2** | **3** | **4** | **Unknown** |
| 1 | 94.2% | 1.8% | 5.9% | 8.9% | 57.8% |
| 2 | 2.1% | 79.0% | 9.0% | 17.8% | 14.5% |
| 3 | 2.0% | 11.7% | 78.3% | 15.3% | 6.6% |
| 4 | 0.2% | 1.6% | 2.5% | 46.5% | 5.2% |
| U | 1.5% | 5.9% | 4.3% | 11.4% | 15.9% |

g. oesophagus (ICD-10 C15)

| | Stage Group (Rapid) | | | | |
|---|---|---|---|---|---|
| **Stage Group (Gold Standard)** | **1** | **2** | **3** | **4** | **Unknown** |
| 1 | 80.8% | 5.1% | 0.5% | 0.2% | 5.6% |
| 2 | 7.9% | 49.5% | 3.5% | 1.0% | 5.2% |
| 3 | 2.1% | 35.1% | 68.7% | 6.3% | 10.7% |
| 4 | 1.0% | 5.3% | 21.7% | 83.4% | 29.3% |
| U | 8.2% | 5.1% | 5.5% | 9.1% | 49.2% |

h. ovary (ICD-10 C56-C57)

| | Stage Group (Rapid) | | | | |
|---|---|---|---|---|---|
| **Stage Group (Gold Standard)** | **1** | **2** | **3** | **4** | **Unknown** |
| 1 | 97.3% | 7.3% | 0.9% | 0.3% | 17.9% |
| 2 | 0.4% | 88.0% | 0.5% | NA | 3.4% |
| 3 | 0.8% | 2.6% | 91.5% | 11.1% | 24.8% |
| 4 | 0.3% | 0.4% | 4.4% | 84.4% | 22.2% |
| U | 1.2% | 1.7% | 2.6% | 4.2% | 31.8% |

i. prostate (ICD-10 C61)

| | Stage Group (Rapid) | | | | |
|---|---|---|---|---|---|
| **Stage Group (Gold Standard)** | **1** | **2** | **3** | **4** | **Unknown** |
| 1 | 86.3% | 9.6% | 4.2% | 1.3% | 39.3% |
| 2 | 6.7% | 83.0% | 2.5% | 0.9% | 6.7% |
| 3 | 4.3% | 4.2% | 86.7% | 2.7% | 13.6% |
| 4 | 0.8% | 0.8% | 4.0% | 93.2% | 17.5% |
| U | 1.9% | 2.4% | 2.6% | 2.0% | 22.9% |

j. stomach (ICD-10 C16)

| | Stage Group (Rapid) | | | | |
|---|---|---|---|---|---|
| **Stage Group (Gold Standard)** | **1** | **2** | **3** | **4** | **Unknown** |
| 1 | 67.5% | 4.7% | 0.7% | 0.1% | 6.7% |
| 2 | 19.2% | 66.5% | 10.2% | 0.8% | 5.6% |
| 3 | 6.0% | 18.2% | 69.7% | 3.1% | 9.4% |
| 4 | 1.9% | 6.4% | 15.5% | 94.0% | 31.8% |
| U | 5.4% | 4.2% | 3.9% | 2.0% | 46.4% |

k. uterus (ICD-10 C54-C55)

| | Stage Group (Rapid) | | | | |
|---|---|---|---|---|---|
| **Stage Group (Gold Standard)** | **1** | **2** | **3** | **4** | **Unknown** |
| 1 | 97.6% | 10.9% | 5.7% | 7.3% | 46.6% |
| 2 | 0.6% | 83.6% | 1.2% | 2.2% | 4.2% |
| 3 | 0.5% | 2.1% | 87.8% | 6.5% | 7.0% |
| 4 | 0.2% | 1.8% | 2.3% | 77.4% | 8.3% |
| U | 1.1% | 1.6% | 2.9% | 6.5% | 33.8% |

l. pancreas (ICD-10 C25)

| | Stage Group (Rapid) | | | | |
|---|---|---|---|---|---|
| **Stage Group (Gold Standard)** | **1** | **2** | **3** | **4** | **Unknown** |
| 1 | 73.5% | 3.6% | 0.9% | 0.3% | 8.7% |
| 2 | 14.8% | 75.4% | 2.4% | 0.5% | 6.0% |
| 3 | 4.7% | 12.0% | 88.7% | 0.6% | 6.4% |
| 4 | 3.3% | 6.0% | 6.1% | 97.6% | 47.9% |
| U | 3.6% | 3.1% | 1.9% | 0.9% | 31.0% |

m. lymphoma (ICD-10 C81-C86, C88)

| | Stage Group (Rapid) | | | | |
|---|---|---|---|---|---|
| **Stage Group (Gold Standard)** | **1** | **2** | **3** | **4** | **Unknown** |
| 1 | 90.4% | 1.3% | 0.5% | 0.5% | 13.8% |
| 2 | 0.9% | 93.3% | 1.2% | 0.5% | 10.7% |
| 3 | 0.4% | 1.3% | 90.2% | 1.5% | 13.2% |
| 4 | 5.8% | 2.6% | 7.0% | 93.1% | 35.5% |
| U | 2.4% | 1.6% | 1.0% | 4.4% | 26.7% |

## “Early” vs “Late” stage

Below in table 6 we repeat the above tabulations but now grouping Rapid and Gold Standard cancers into “Early” (TNM stage group 1 & 2) or “Late” (TNM stage group 3 & 4) categories. We see that 62% of breast cancers are identified as “Early” stage in the Rapid Registrations dataset compared to 76% in the Gold Standard Registration data due to the higher proportion of “Unknown” stage tumours (28% vs 10% respectively).

As with the more detailed stage data, there is a high degree of concordance between the gold standard and rapid registration stage fields if a known stage can be identified.

Table 6: Summary proportions of “Early” vs “Late” stage for Rapid Registrations and Gold Standard Registrations

| Broad Cancer Group | Stage Group | Count (Rapid) | Percentage (Rapid) | Count (Gold Standard) | Percentage (Gold Standard) |
|---|---|---|---|---|---|
| Bladder | Early | 4119 | 42.9% | 4747 | 49.4% |
| Bladder | Late | 817 | 8.5% | 1544 | 16.1% |
| Bladder | Unknown | 4666 | 48.6% | 3311 | 34.5% |
| Breast | Early | 27283 | 61.8% | 33314 | 75.4% |
| Breast | Late | 4415 | 10.0% | 5662 | 12.8% |
| Breast | Unknown | 12483 | 28.3% | 5205 | 11.8% |
| Colorectum | Early | 11956 | 36.4% | 13232 | 40.3% |
| Colorectum | Late | 13354 | 40.7% | 16786 | 51.1% |
| Colorectum | Unknown | 7528 | 22.9% | 2820 | 8.6% |
| Kidney | Early | 2828 | 34.2% | 3906 | 47.3% |
| Kidney | Late | 2056 | 24.9% | 3241 | 39.2% |
| Kidney | Unknown | 3376 | 40.9% | 1113 | 13.5% |
| Lung | Early | 8761 | 24.3% | 9340 | 25.9% |
| Lung | Late | 22227 | 61.6% | 24830 | 68.8% |
| Lung | Unknown | 5123 | 14.2% | 1941 | 5.4% |
| Lymphoma | Early | 1860 | 15.2% | 3378 | 27.6% |

| Broad Cancer Group | Stage Group | Count (Rapid) | Percentage (Rapid) | Count (Gold Standard) | Percentage (Gold Standard) |
|---|---|---|---|---|---|
| Lymphoma | Late | 3856 | 31.5% | 6947 | 56.8% |
| Lymphoma | Unknown | 6514 | 53.3% | 1905 | 15.6% |
| Melanoma | Early | 8727 | 66.2% | 10918 | 82.8% |
| Melanoma | Late | 644 | 4.9% | 1384 | 10.5% |
| Melanoma | Unknown | 3818 | 28.9% | 887 | 6.7% |
| Oesophagus | Early | 1794 | 21.5% | 1420 | 17.0% |
| Oesophagus | Late | 4339 | 52.0% | 5407 | 64.8% |
| Oesophagus | Unknown | 2214 | 26.5% | 1520 | 18.2% |
| Ovary | Early | 1386 | 27.1% | 1760 | 34.5% |
| Ovary | Late | 1874 | 36.7% | 2683 | 52.5% |
| Ovary | Unknown | 1848 | 36.2% | 665 | 13.0% |
| Pancreas | Early | 976 | 12.2% | 1473 | 18.4% |
| Pancreas | Late | 2786 | 34.7% | 5165 | 64.4% |
| Pancreas | Unknown | 4262 | 53.1% | 1386 | 17.3% |
| Prostate | Early | 17154 | 37.0% | 22841 | 49.2% |
| Prostate | Late | 16030 | 34.5% | 19790 | 42.6% |
| Prostate | Unknown | 13219 | 28.5% | 3772 | 8.1% |
| Stomach | Early | 675 | 17.6% | 786 | 20.5% |
| Stomach | Late | 1708 | 44.5% | 2299 | 59.9% |
| Stomach | Unknown | 1456 | 37.9% | 754 | 19.6% |
| Uterus | Early | 5157 | 64.5% | 5960 | 74.5% |
| Uterus | Late | 1236 | 15.5% | 1382 | 17.3% |
| Uterus | Unknown | 1605 | 20.1% | 656 | 8.2% |

In Table 7a-m below the distribution of the stage allocation between the Rapid Registrations and the Gold Standard Registrations are examined, aggregated into Early and Late stage.

## Tables 7a-m: “Early” vs “late” stage comparison between Rapid Registrations and Gold Standard Registrations

a. bladder (ICD-10 C67)

| | Stage Category (Rapid) | | |
|---|---|---|---|
| **Stage Category (Gold Standard)** | **Early** | **Late** | **Unknown** |
| Early | 83.1% | 19.7% | 24.9% |
| Late | 9.1% | 74.7% | 12.0% |
| Unknown | 7.8% | 5.6% | 63.1% |

b. breast (ICD-10 C50)

| | Stage Category (Rapid) | | |
|---|---|---|---|
| **Stage Category (Gold Standard)** | **Early** | **Late** | **Unknown** |
| Early | 94.5% | 13.9% | 55.3% |
| Late | 2.1% | 81.7% | 11.9% |
| Unknown | 3.4% | 4.4% | 32.8% |

c. colorectum (ICD-10 C18-C20)

| | Stage Category (Rapid) | | |
|---|---|---|---|
| **Stage Category (Gold Standard)** | **Early** | **Late** | **Unknown** |
| Early | 88.9% | 5.2% | 25.3% |
| Late | 9.1% | 93.3% | 42.9% |
| Unknown | 1.9% | 1.5% | 31.8% |

d. kidney (ICD-10 C64)

| | Stage Category (Rapid) | | |
|---|---|---|---|
| **Stage Category (Gold Standard)** | **Early** | **Late** | **Unknown** |
| Early | 90.7% | 3.6% | 37.6% |
| Late | 3.4% | 93.2% | 36.3% |
| Unknown | 5.9% | 3.2% | 26.1% |

e. lung (ICD-10 C33-C34)

| | Stage Category (Rapid) | | |
|---|---|---|---|
| **Stage Category (Gold Standard)** | **Early** | **Late** | **Unknown** |
| Early | 94.8% | 1.5% | 13.8% |
| Late | 4.4% | 97.9% | 52.4% |
| Unknown | 0.8% | 0.6% | 33.8% |

f. melanoma (ICD-10 C43)

| | Stage Category (Rapid) | | |
|---|---|---|---|
| **Stage Category (Gold Standard)** | **Early** | **Late** | **Unknown** |
| Early | 92.1% | 18.6% | 72.3% |
| Late | 5.2% | 74.8% | 11.8% |
| Unknown | 2.7% | 6.5% | 15.9% |

g. Oesophagus (ICD-10 C15)

| | Stage Category (Rapid) | | |
|---|---|---|---|
| **Stage Category (Gold Standard)** | **Early** | **Late** | **Unknown** |
| Early | 60.1% | 2.4% | 10.8% |
| Late | 34.3% | 90.0% | 40.0% |
| Unknown | 5.6% | 7.6% | 49.2% |

h. ovary (ICD-10 C56-C57)

| | Stage Category (Rapid) | | |
|---|---|---|---|
| **Stage Category (Gold Standard)** | **Early** | **Late** | **Unknown** |
| Early | 97.3% | 1.0% | 21.2% |
| Late | 1.4% | 95.8% | 47.0% |
| Unknown | 1.3% | 3.2% | 31.8% |

i. prostate (ICD-10 C61)

| | Stage Category (Rapid) | | |
|---|---|---|---|
| **Stage Category (Gold Standard)** | **Early** | **Late** | **Unknown** |
| Early | 92.9% | 5.1% | 46.0% |
| Late | 5.0% | 92.5% | 31.0% |
| Unknown | 2.1% | 2.4% | 22.9% |

j. stomach (ICD-10 C16)

| | Stage Category (Rapid) | | |
|---|---|---|---|
| **Stage Category (Gold Standard)** | **Early** | **Late** | **Unknown** |
| Early | 78.5% | 4.4% | 12.4% |
| Late | 16.7% | 92.9% | 41.2% |
| Unknown | 4.7% | 2.7% | 46.4% |

k. uterus (ICD-10 C54-C55)

| | Stage Category (Rapid) | | |
|---|---|---|---|
| **Stage Category (Gold Standard)** | **Early** | **Late** | **Unknown** |
| Early | 97.8% | 8.0% | 50.8% |
| Late | 1.0% | 87.6% | 15.3% |
| Unknown | 1.1% | 4.4% | 33.8% |

l. pancreas (ICD-10 C25)

| | Stage Category (Rapid) | | |
|---|---|---|---|
| **Stage Category (Gold Standard)** | **Early** | **Late** | **Unknown** |
| Early | 82.4% | 1.5% | 14.7% |
| Late | 14.3% | 97.3% | 54.3% |
| Unknown | 3.3% | 1.1% | 31.0% |

m. lymphoma (ICD-10 C81-C86, C88)

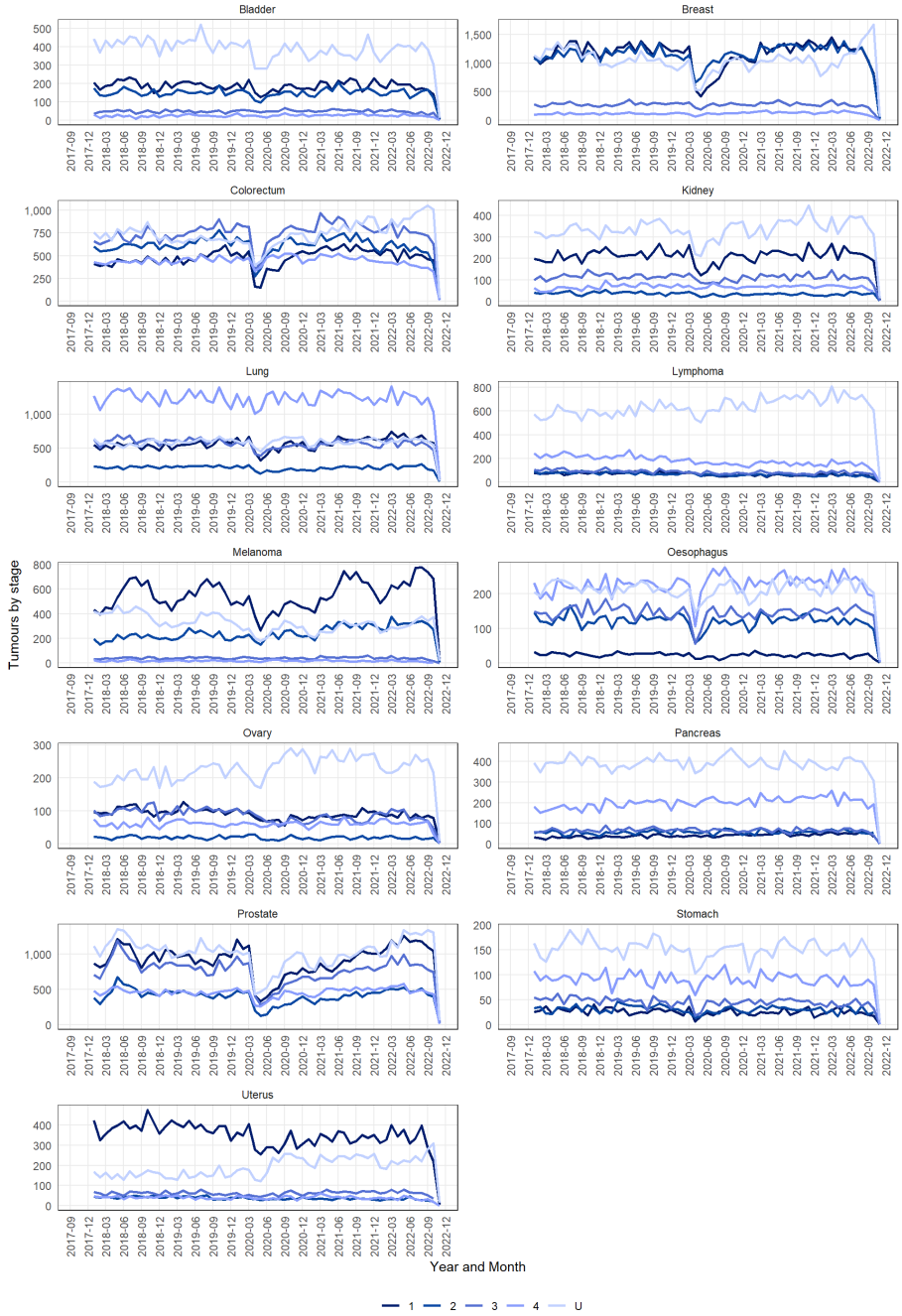
| | Stage Category (Rapid) | | |
|---|---|---|---|
| **Stage Category (Gold Standard)** | **Early** | **Late** | **Unknown** |
| Early | 93.0% | 1.3% | 24.6% |

| | Stage Category (Rapid) | | |
|---|---|---|---|
| **Stage Category (Gold Standard)** | **Early** | **Late** | **Unknown** |
| Late | 5.1% | 95.4% | 48.7% |
| Unknown | 2.0% | 3.3% | 26.7% |

## Stage trends over time

Figure 13 shows the monthly variation of the incidence count by stage at diagnosis for a number of common cancers. Allowing for variation in the number of working days in each month (which affects the overall number of tumours diagnosed per month) and for statistical fluctuation there is little evidence of any stage shift in the period displayed. The feature around May 2018 in the prostate cancer trends can be ascribed to the so called 'Turnbull-Fry effect' (https://www.ndrs.nhs.uk/examining-the-fry-and-turnbull-effect-on-prostate-cancer-incidence-in-england/).

Figure 13: Stage trends over time

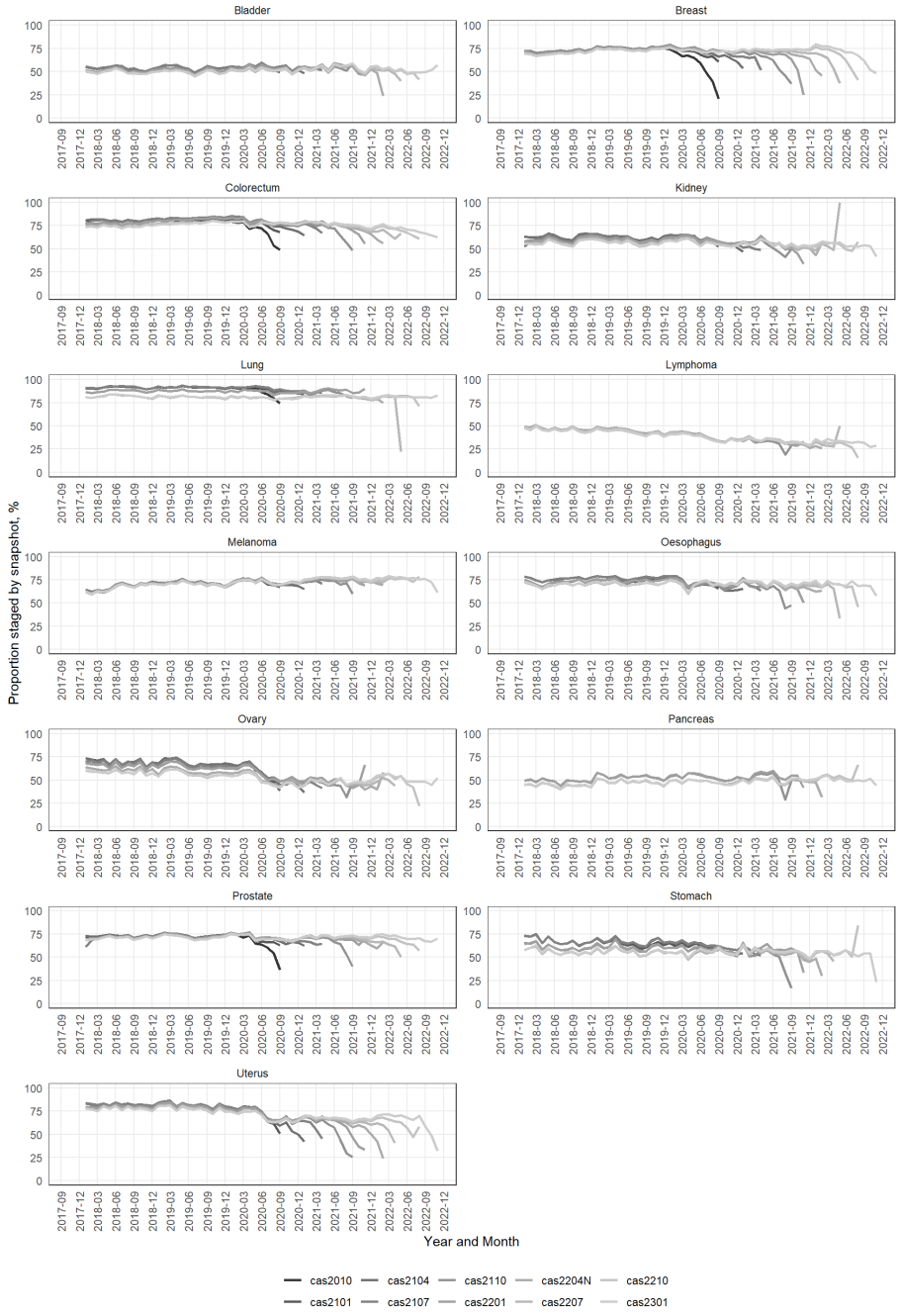



Source: NHS Digital, National Cancer Registration and Analysis Service

## Stage completeness by snapshot

Figure 14 shows the completeness of stage by tumour type for one snapshot per quarter. Stage completeness continues to increase and lags behind the incidence completeness due to staging activity happening up to several months after diagnosis.

Figure 14: Stage completeness by snapshot

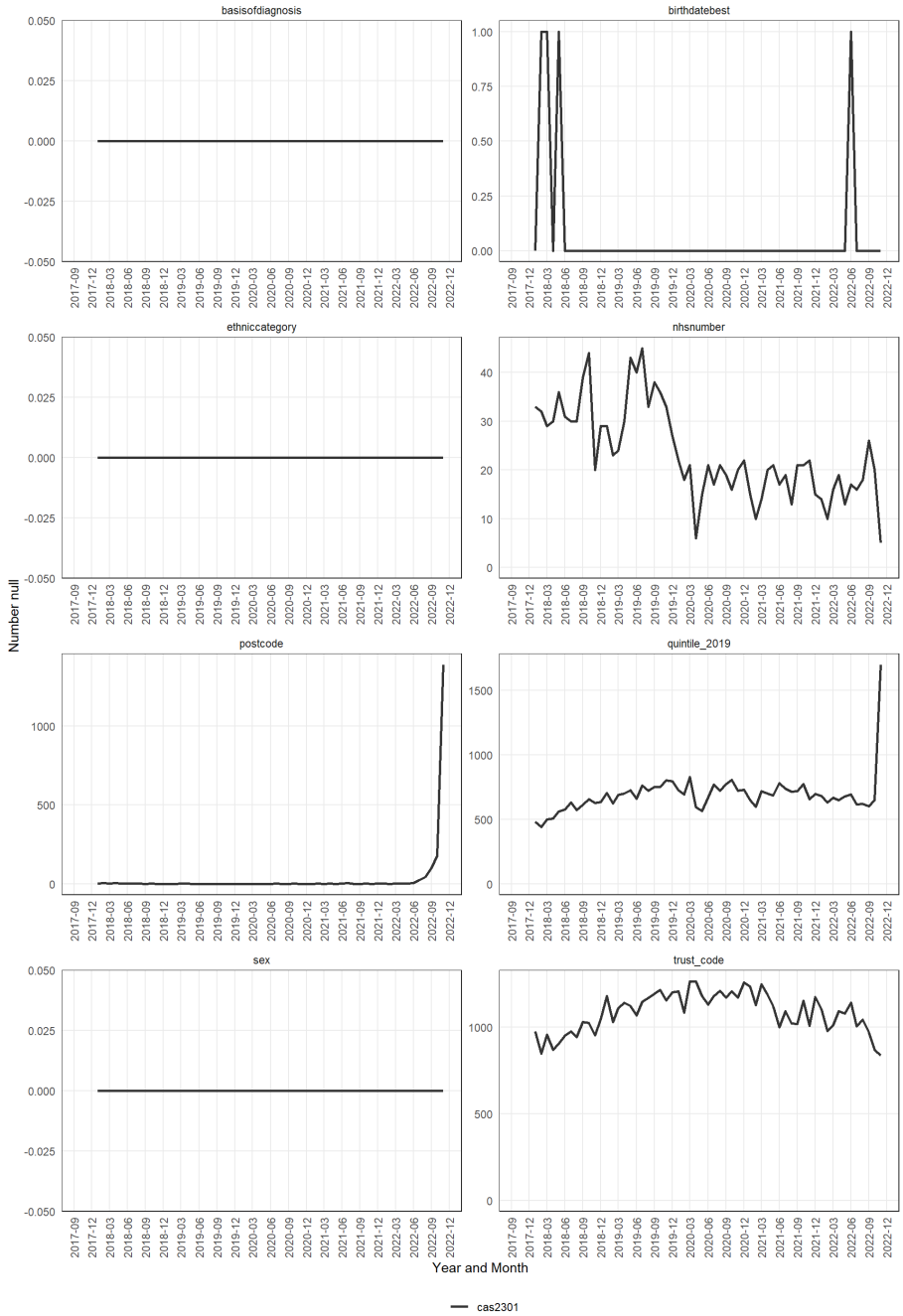



Source: NHS Digital, National Cancer Registration and Analysis Service

## Counts of missing data

Figure 15 shows the count of tumours per month where the indicated data item is missing. Larger counts in the most recent months are to be expected.

Figure 15: Counts of missing data

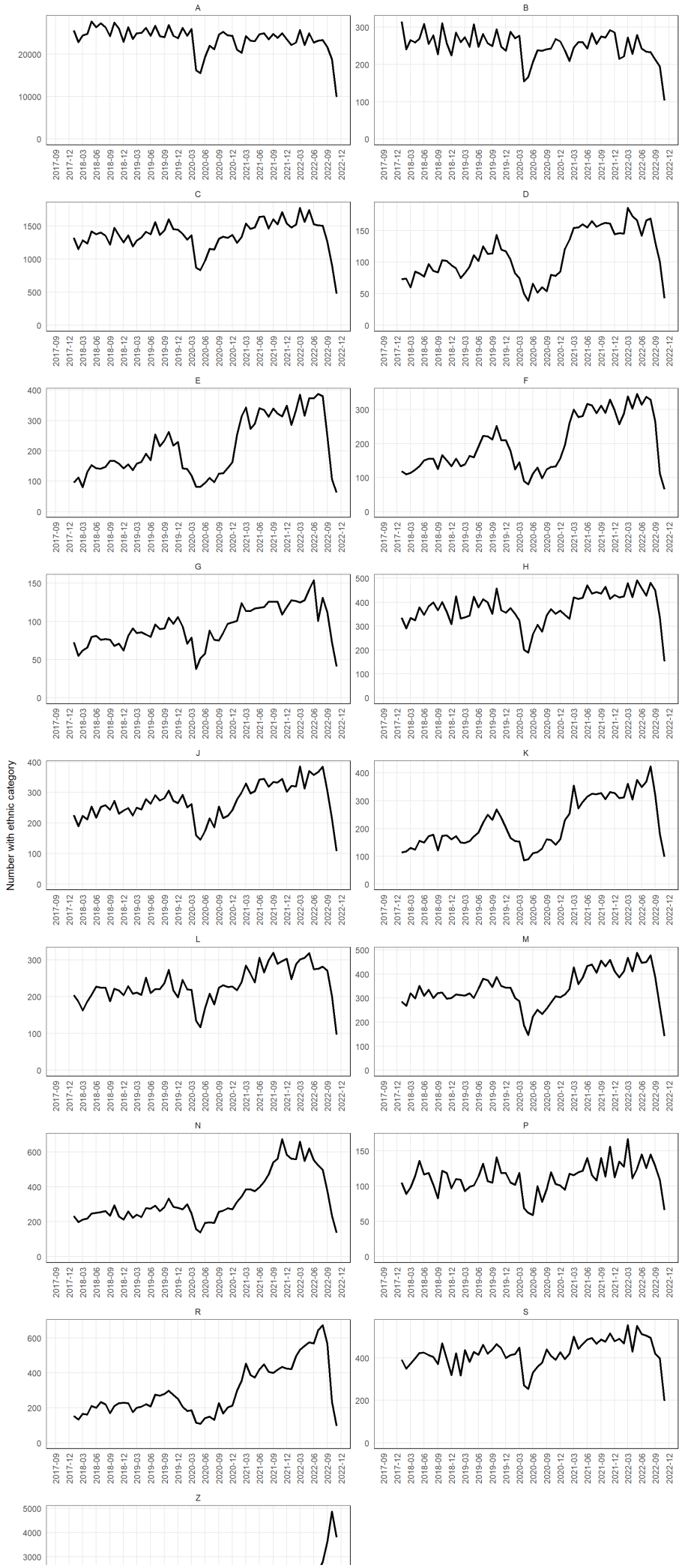



Source: NHS Digital, National Cancer Registration and Analysis Service

## Ethnicity completeness

Figure 16 shows the count of tumours per month where the indicated data item is missing. Larger counts in the most recent months are to be expected.

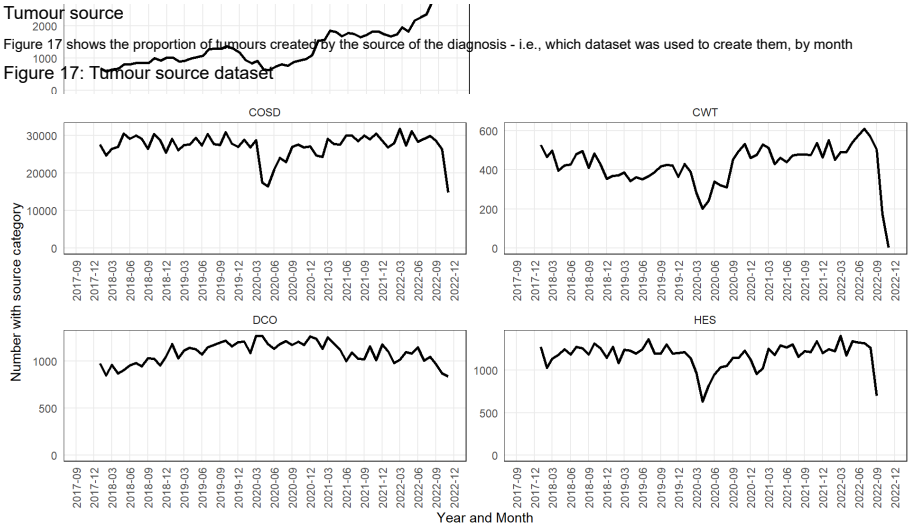
Figure 16: Ethnicity completeness


A
B
C
D
E
F
G
H
J
K
L
M
N
P
R
S
Z
Number with ethnic category

## Tumour source

Figure 17 shows the proportion of tumours created by the source of the diagnosis - i.e., which dataset was used to create them, by month

Figure 17: Tumour source dataset

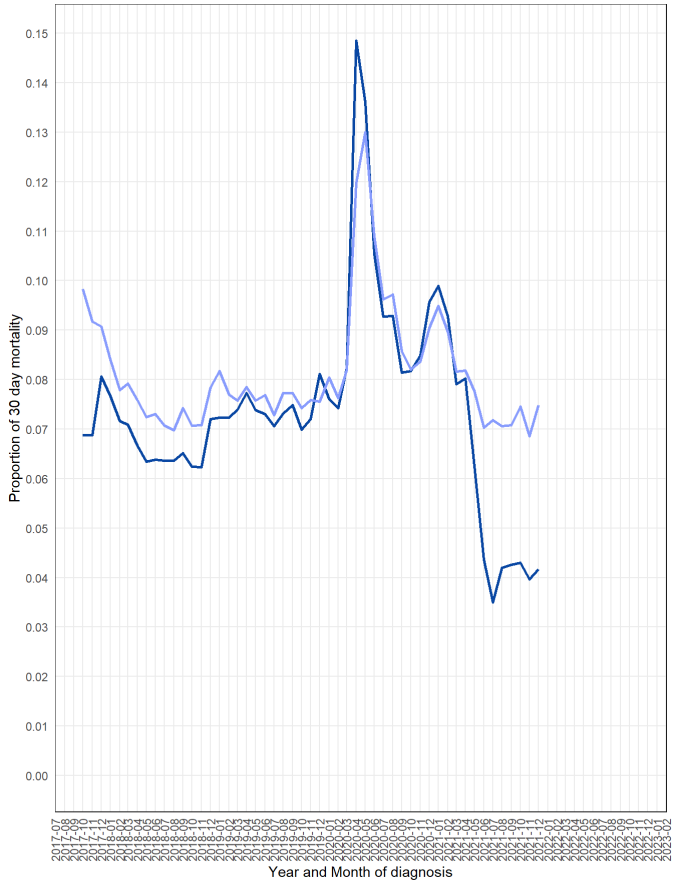



Source: NHS Digital, National Cancer Registration and Analysis Service

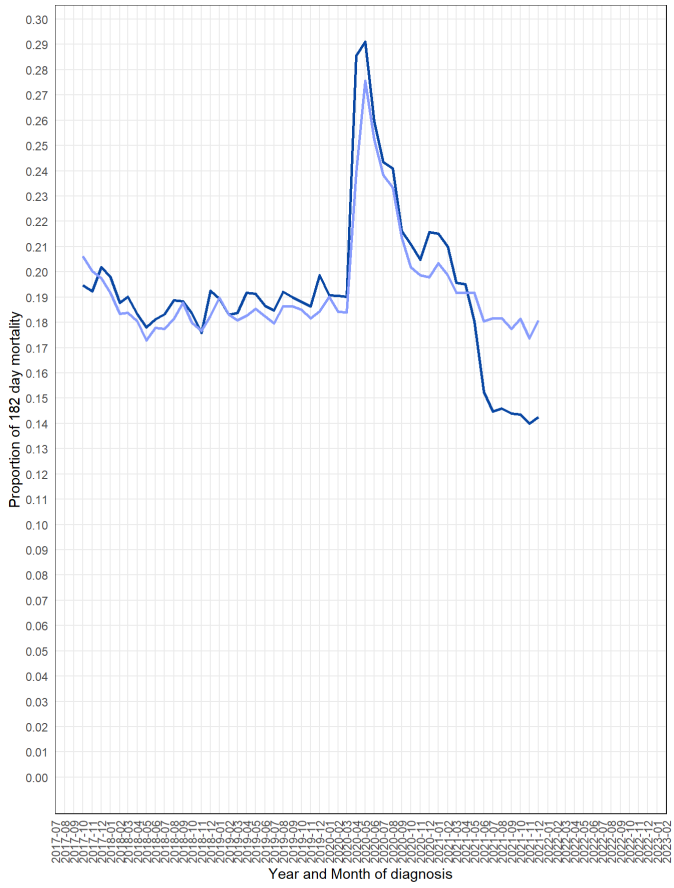
## Mortality proportion by month

Figure 19 shows the mortality proportions by month mortality within 30 and 182 days in the RCRD compared to the NCRD, for all cancers included in RCRD excl C44 and D06.

Figure 19: Monthly mortality proportions at 30 and 182 days,




Source: NHS Digital, National Cancer Registration and Analysis Service




Source: NHS Digital, National Cancer Registration and Analysis Service

## Appendix 1 - List of pathway events

Table A1: AT_RAPID_PATHWAY: event list

| EVENT_TYPE | EVENT_DESC | EVENT_PROPERTY_1 | EVENT_PROPERTY_2 | EVENT_PROPERTY_3 | EVENT_DATE | Linkage |
|---|---|---|---|---|---|---|
| 1 | CWT Treatment Period Start Date | CWT First Treatment Flag | CWT SITE_ICD10 | CWT Cancer Treatment Event Type | Treat period start | NHSNUMBER |
| 2 | CWT Treatment Start | CWT Treatment Modality | CWT Cancer Treatment Event type | | Treatment start date | NHSNUMBER |
| 3 | CWT MDT Begin | CWT MDT Cancer Care Plan discussed indicator | | | MDT date | NHSNUMBER |
| 4 | CWT Faster Diagnosis Period End | (null) | Faster Diagnosis Period site | | Faster Diagnosis Period end date | NHSNUMBER |
| 5 | HES Admitted Patient Care Episode | Treatment speciality | All ICD-10 codes (for episode) | All OPCS-4 codes (for episode) | Episode Start date - Episode end date | NHSNUMBER |
| 6 | HES Admitted Patient Care Operation | OPCS codes (for date) in POS order | ICD-10 codes (for episode) | | Operation date | NHSNUMBER |
| 7 | SACT Cycle | Benchmark group | Cycle number | Treatment intent | Cycle start date | PATIENTID |
| 8 | RTDS Episode | Radiotherapy intent | ICD-10 diagnosis code | | Episode treatment start date | PATIENTID |
| 9 | Tumour diagnosis (Provisional) | Statusofregistration | ICD-10 diagnosis code | Stage_best | Diagnosisdatebest | PATIENTID |
| 10 | Patient last event date | Vitalstatus | | | Dateofvitalstatus1 (start of range) | PATIENTID |
| 11 | HES major surgery (historical) | OPCS-4 code | ICD-10 diagnosis code | Further notes/constraints | Operation date | NHSNUMBER |
| 12 | HES major surgery (historical, further constraints) | OPCS-4 code | ICD-10 diagnosis code | Further notes/constraints | Operation date | NHSNUMBER |
| 13 | HES major surgery (new) | OPCS-4 code | ICD-10 diagnosis code | Further notes/constraints | Operation date | NHSNUMBER |
| 14 | RAWDATA major surgery (historical) | OPCS-4 code | ICD-10 diagnosis code | Further notes/constraints | Operation date | PATIENTID |
| 15 | RAWDATA major surgery (historical, further constraints) | OPCS-4 code | ICD-10 diagnosis code | Further notes/constraints | Operation date | PATIENTID |
| 16 | RAWDATA major surgery (new) | OPCS-4 code | ICD-10 diagnosis code | Further notes/constraints | Operation date | PATIENTID |
| 17 | Prior tumour diagnosis | Statusofregistration | ICD-10 diagnosis code | Stage_best | Diagnosisdatebest | PATIENTID |
| 18 | Tumour diagnosis (Final) | Statusofregistration | ICD-10 diagnosis code | Stage_best | Diagnosisdatebest | PATIENTID |
| 19 | Patient vital status date | Vitalstatus | ICD-10 Underlying cause of death | | Vitalstatusdate | PATIENTID |
| 20 | RAWDATA holistic needs assessment record | HNA point of pathway : HNA offered : HNA staff role | Primary diagnosis | Laterality | Date of HNA | PATIENTID |
| 21 | RAWDATA staging | Inferred best stage | ICD-10 diagnosis code | T/N/M components | Collected stage date | PATIENTID |
| 22 | CWT First Seen | Source of referral | Categorisation of TWW, screening and consultant upgrade cases, where relevant | Suspected cancer referral type | Date first seen | NHSNUMBER |
| 23 | HES diagnostic event | OPCS-4 code | Description | BX/LD | Operation date | NHSNUMBER |
| 24 | RAWDATA personal care and support plan | PCSP point of pathway : PCSP offered : PCSP staff role | Primary diagnosis | Laterality | PCSP date | PATIENTID |
| 25 | RAWDATA end of treatment summary | eots_date | Primary diagnosis | Laterality | | PATIENTID |
| 50 | Skeleton Tumour creation | E_base_record type (COSD = England, CANISC = Wales) | ICD-10 diagnosis code | | Diagnosisdate | PATIENTID |

| EVENT_TYPE | EVENT_DESC | EVENT_PROPERTY_1 | EVENT_PROPERTY_2 | EVENT_PROPERTY_3 | EVENT_DATE | Linkage |
|---|---|---|---|---|---|---|
| 51 | Diagnosis reported in COSD | Number of times reported | ICD-10 diagnosis code | E_base_record type | Diagnosisdate | NHSNUMBER |
| 52 | CWT estimated diagnosis date | CWT First Treatment Flag | CWT recorded primary diagnosis (ICD) | CWT Cancer Treatment Event Type | Adjusted treat period start | NHSNUMBER |
| 53 | HES inferred tumour | HES cancer group | ICD-10 diagnosis code | | Episode start date | NHSNUMBER |
| 54 | COSD diagnosis submission | E_base_record primary diagnoses | ICD-10 diagnosis code (submission) | | Diagnosis date (submission) | PATIENTID |
| 55 | RAWDATA biopsy record | Laterality | ICD-10 diagnosis code | | Collected date/authorised date | PATIENTID |
| 56 | RAWDATA imaging record | Laterality | ICD-10 diagnosis code | Procedure_date - diagdate | Diagdate | PATIENTID |
| 57 | RAWDATA HNA diagnosis | Laterality | Primary diagnosis (ICD-10) | | Diagdate | PATIENTID |
| 101 | Inferred diagnosis (54 only) | Event_property_1 | ICD-10 diagnosis code | Cancer group | First recorded date | PATIENTID |

*: https://www.datadictionary.nhs.uk/data_dictionary/attributes/p/prev/primary_cancer_site_for_cancer_faster_diagnosis_pathway_de.asp?shownav=0 (https://www.datadictionary.nhs.uk/data_dictionary/attributes/p/prev/primary_cancer_site_for_cancer_faster_diagnosis_pathway_de.asp?shownav=0)

**: https://www.datadictionary.nhs.uk/data_dictionary/attributes/h/ho/holistic_needs_assessment_point_of_pathway_for_cancer_de.asp?shownav=0 (https://www.datadictionary.nhs.uk/data_dictionary/attributes/h/ho/holistic_needs_assessment_point_of_pathway_for_cancer_de.asp?shownav=0)

## Appendix 2 - List of Rapid Registration fields available

Table A2: AT_RAPID_TUMOUR: field list

| COLUMN_NAME | DATA_TYPE | Notes |
|---|---|---|
| INDIVIDUALID | NUMBER(11,0) | Matches AT_RAPID_PATHWAY for each event with event_type=101 |
| PATIENTID | NUMBER(19,0) | Matches AT_RAPID_PATHWAY for each event with event_type=101 |
| NHSNUMBER | VARCHAR2(12 BYTE) | Matches AT_RAPID_PATHWAY for each event with event_type=101 |
| TUMOUR_AVPID | NUMBER | Matches AT_RAPID_PATHWAY for each event with event_type=101 |
| DIAGNOSISDATE | DATE | Matches AT_RAPID_PATHWAY for each event with event_type=101 |
| TUMOUR_SITE | VARCHAR2(255 BYTE) | Matches AT_RAPID_PATHWAY for each event with event_type=101 (event_property_2) |
| BIRTHDATEBEST | DATE | Taken from Encore |
| SEX | VARCHAR2(255 BYTE) | Taken from Encore |
| POSTCODE | VARCHAR2(255 BYTE) | Taken from Encore |
| SURNAME | VARCHAR2(64 BYTE) | Taken from Encore |
| FORENAME | VARCHAR2(64 BYTE) | Taken from Encore |
| STAGE | VARCHAR2(255 BYTE) | Defined for selected cancer sites |
| ETHNICITY | VARCHAR2(255 BYTE) | Taken from Encore |
| FINAL_ROUTE | VARCHAR2(22 BYTE) | Final Route to Diagosis using an adapted version of the standard NCRAS methodology |
| QUINTILE_2019 | VARCHAR2(26 BYTE) | Index of Multiple Deprivation quintile defined using the standard NCRAS methodology |
| CHRL_TOT_27_03 | NUMBER | Charlson score defined using the standard NCRAS methodology |
| TUMOUR_MORPHOLOGY | VARCHAR2(255 BYTE) | Tumour morphology as recorded in the COSD system |
| TUMOUR_PERFORMANCESTATUS | VARCHAR2(4 BYTE) | Patient performance status at time of diagnosis |
| BASISOFDIAGNOSIS | VARCHAR2(260 CHAR) | The basis of diagnosis (e.g. clinical; pathological; etc.) |
| LSOA11 | VARCHAR2(27 BYTE) | LSOA of residence at time of diagnosis |
| SOURCE | VARCHAR2(7 BYTE) | The dataset used as the primary source for the RCRD registration |
| SOURCE_ID | VARCHAR2(64 BYTE) | The unique ID of the record used as the primary source for the RCRD registration |

## Appendix 3 - Cancer groups used for matching

Table A3: Rapid Registration ICD-10 tumour inclusion list

| ICD | CANCER_GROUP | SCOPE | ICD | CANCER_GROUP | SCOPE |
|---|---|---|---|---|---|
| C00 | Head & Neck | DQ & CD | C54 | Gynae | DQ & CD |
| C01 | Head & Neck | DQ & CD | C55 | Gynae | DQ & CD |
| C02 | Head & Neck | DQ & CD | C56 | Gynae | DQ & CD |
| C03 | Head & Neck | DQ & CD | C57 | Gynae | DQ & CD |
| C04 | Head & Neck | DQ & CD | C58 | Gynae | DQ & CD |
| C05 | Head & Neck | DQ & CD | C59 | Other | DQ & CD |
| C06 | Head & Neck | DQ & CD | C60 | Urology | DQ & CD |
| C07 | Head & Neck | DQ & CD | C61 | Prostate | DQ & CD |
| C08 | Head & Neck | DQ & CD | C62 | Urology | DQ & CD |
| C09 | Head & Neck | DQ & CD | C63 | Urology | DQ & CD |
| C10 | Head & Neck | DQ & CD | C64 | Urology | DQ & CD |
| C11 | Head & Neck | DQ & CD | C65 | Urology | DQ & CD |
| C12 | Head & Neck | DQ & CD | C66 | Urology | DQ & CD |
| C13 | Head & Neck | DQ & CD | C67 | Urology | DQ & CD |
| C14 | Head & Neck | DQ & CD | C68 | Urology | DQ & CD |
| C15 | O-G | DQ & CD | C69 | Brain & CNS | DQ & CD |
| C16 | O-G | DQ & CD | C70 | Brain & CNS | DQ & CD |
| C17 | Upper GI | DQ & CD | C71 | Brain & CNS | DQ & CD |
| C18 | Colorectal | DQ & CD | C72 | Brain & CNS | DQ & CD |
| C19 | Colorectal | DQ & CD | C73 | Endocrine | DQ & CD |
| C20 | Colorectal | DQ & CD | C74 | Endocrine | DQ & CD |
| C21 | Colorectal | DQ & CD | C75 | Endocrine | DQ & CD |
| C22 | Upper GI | DQ & CD | C76 | Unknown Primary | DQ & CD |
| C23 | Upper GI | DQ & CD | C77 | Unknown Primary | DQ & CD |
| C24 | Upper GI | DQ & CD | C78 | Unknown Primary | DQ & CD |
| C25 | Upper GI | DQ & CD | C79 | Unknown Primary | DQ & CD |
| C26 | Upper GI | DQ & CD | C80 | Unknown Primary | DQ & CD |
| C27 | Other | DQ & CD | C81 | Haematological | DQ & CD |
| C28 | Other | DQ & CD | C82 | Haematological | DQ & CD |
| C29 | Other | DQ & CD | C83 | Haematological | DQ & CD |
| C30 | Head & Neck | DQ & CD | C84 | Haematological | DQ & CD |
| C31 | Head & Neck | DQ & CD | C85 | Haematological | DQ & CD |
| C32 | Head & Neck | DQ & CD | C86 | Haematological | DQ & CD |
| C33 | Lung | DQ & CD | C87 | Haematological | DQ & CD |
| C34 | Lung | DQ & CD | C88 | Haematological | DQ & CD |
| C35 | Other | DQ & CD | C89 | Haematological | DQ & CD |
| C36 | Other | DQ & CD | C90 | Haematological | DQ & CD |
| C37 | Other | DQ & CD | C91 | Haematological | DQ & CD |
| C38 | Lung | DQ & CD | C92 | Haematological | DQ & CD |
| C39 | Lung | DQ & CD | C93 | Haematological | DQ & CD |
| C40 | Bone & ST | DQ & CD | C94 | Haematological | DQ & CD |
| C41 | Bone & ST | DQ & CD | C95 | Haematological | DQ & CD |
| C42 | Other | DQ & CD | C96 | Haematological | DQ & CD |
| C43 | Melanoma | DQ & CD | C97 | Unknown Primary | DQ & CD |
| C44 | NMSC | • | D05 | Breast | DQ |
| C45 | Lung | DQ & CD | D06 | Gynae | • |
| C46 | Bone & ST | DQ & CD | D09 | Urology | DQ |
| C47 | Brain & CNS | DQ & CD | D32 | Brain & CNS | DQ |
| C48 | Gynae | DQ & CD | D33 | Brain & CNS | DQ |
| C49 | Bone & ST | DQ & CD | D35 | Brain & CNS | DQ |
| C50 | Breast | DQ & CD | D41 | Urology | DQ |
| C51 | Gynae | DQ & CD | D42 | Brain & CNS | DQ |
| C52 | Gynae | DQ & CD | D43 | Brain & CNS | DQ |
| C53 | Gynae | DQ & CD | D44 | Brain & CNS | DQ |

Scope: DQ = ‘Included in this data quality document’; CD = ‘Included in cancerdata.nhs.uk/covid-19/rcrd dashboard’

## Appendix 4 - Alternative defining events

Several options were considered as to the defining events for the Rapid Registrations. Both standalone datasets, subsets of standalone datasets, and combined datasets were explored and their FNE and FPE figures quantified. A subset of these alternatives are presented below as a demonstration of the process but the majority of this exploratory work is out of scope for this document.

Candidates for diagnosis events from the three main datasets that are rapidly available and have nominally full coverage of cancer patients are shown below (SACT and RTDS were also examined but data is not presented). Of the three, the CWT data has the best FPE but the FNE is substantially higher than the COSD dataset. HES produced the worst results in both measures. A filtering process was applied to the standalone COSD data to remove apparently new diagnoses that were actually recurrences of prior tumours. This improved the FPE at a cost of increasing the FNE. We continue to test whether this process can be further refined to improve the combined FPE and FNE figures, and monitor changes in the underlying datasets that might also give new opportunities to do so.

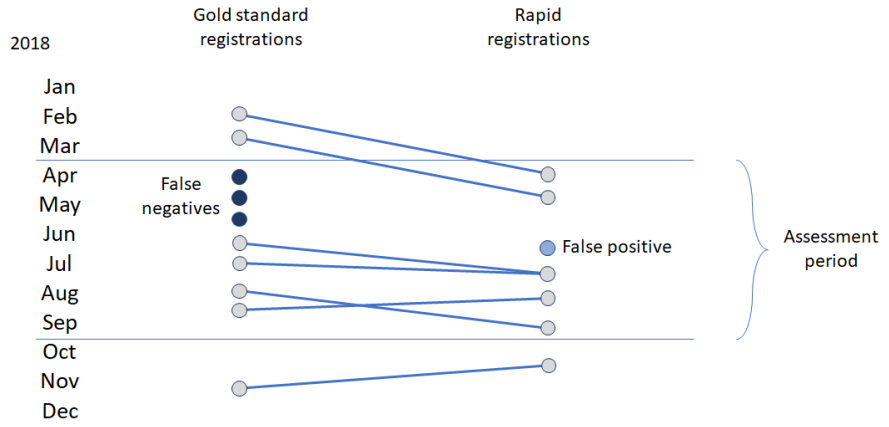
Table A4: Rapid Cancer Registrations: alternative defining events

| Event | FPE | FNE |
|---|---|---|
| Event 52 - standalone CWT | 7.6% | 28.3% |
| Event 53 - standalone HES | 13.2% | 38.9% |
| Event 54 - standalone COSD | 8.1% | 15.8% |
| Event 101 (up to cas2106) - filtered COSD | 5.2% | 17.7% |
| Event 101 (cas2107) - filtered combined COSD/CWT | 5.6% | 16.4% |
| Event 101 (cas2108) - filtered combined COSD/CWT | 5.1% | 16.5% |
| Event 101 (cas2109) - filtered combined COSD/CWT | 5.1% | 16.6% |
| Event 101 (cas2110) - filtered combined COSD/CWT/HES | 5.1% | 14.7% |
| Event 101 (cas2111) - filtered combined COSD/CWT/HES | 6.2% | 13.4% |
| Event 101 (cas2112 to cas2202) - filtered combined COSD/CWT/HES and Death Certificates Only | 5.3% | 13.4% |
| Event 101 (cas2203 to cas2204) - filtered combined COSD/CWT/HES and Death Certificates Only | 6.3% | 12.2% |
| Event 101 (cas2205) - filtered combined COSD/CWT/HES and Death Certificates Only | 6.1% | 12.3% |
| Event 101 (cas2206) - filtered combined COSD/CWT/HES and Death Certificates Only | 5.6% | 12.5% |
| Event 101 (cas2207) - filtered combined COSD/CWT/HES and Death Certificates Only | 6.0% | 11.8% |
| Event 101 (cas2208 to cas2210) - filtered combined COSD/CWT/HES and Death Certificates Only | 6.0% | 11.6% |
| Event 101 (cas2211 to cas2212) - filtered combined COSD/CWT/HES and Death Certificates Only | 6.1% | 11.5% |

## Appendix 5 - Counts and error tabulations

Figure A1 shows an example for a very small dataset of how counts and error proportions are derived. This dataset has 10 Gold Standard Registrations and 7 Rapid Registrations overall (both indicated by the dots in the figure, with time running vertically over the course of 2018 and Gold Standard vs Rapid Registrations divided horizontally). Successful linkages between Gold Standard and Rapid Registrations are indicated by blue lines. False negatives and false positives are indicated. Only tumours in the 6-month assessment period are included in the tabulations below, although these can link to tumours outside the period as shown, and many-to-one linkages are also allowed. The false negative rate is therefore 3 in 7 and the false positive rate 1 in 6 below.

Figure A1: Illustration of counts and errors tabulation




Tables A5 and A6 below tabulate counts of Gold Standard and Rapid Registrations together with the numbers of false positive and false negative errors. When considering comparisons between figures the nature of the linkage and relationships displayed in the diagram above should be kept in mind.

Table A5: Counts and errors tabulation by cancer group

| Cancer group | Gold Standard (GS) Registrations | Rapid Registrations | Difference | Percentage Rapid/GS | FPE | FNE |
|---|---|---|---|---|---|---|
| Brain & CNS | 5583 | 5123 | 460 | 91.8% | 691 | 1148 |
| Breast | 28920 | 27190 | 1730 | 94.0% | 1497 | 1744 |
| Colorectal | 18957 | 17856 | 1101 | 94.2% | 915 | 1672 |
| Endocrine | 1899 | 1680 | 219 | 88.5% | 195 | 351 |
| Gynae | 9766 | 9445 | 321 | 96.7% | 700 | 904 |
| Haematological | 13910 | 12524 | 1386 | 90.0% | 804 | 2211 |
| Head & Neck | 5276 | 4933 | 343 | 93.5% | 390 | 664 |

| Cancer group | Gold Standard (GS) Registrations | Rapid Registrations | Difference | Percentage Rapid/GS | FPE | FNE |
|---|---|---|---|---|---|---|
| Lung | 21648 | 20137 | 1511 | 93.0% | 624 | 2022 |
| Melanoma | 8245 | 7694 | 551 | 93.3% | 689 | 1043 |
| O-G | 6617 | 6483 | 134 | 98.0% | 374 | 466 |
| Prostate | 27040 | 25241 | 1799 | 93.3% | 314 | 2219 |
| Bone & Soft Tissue | 1138 | 1091 | 47 | 95.9% | 367 | 405 |
| Unknown Primary | 3421 | 2662 | 759 | 77.8% | 716 | 1477 |
| Upper GI | 9226 | 8766 | 460 | 95.0% | 831 | 1344 |
| Urology | 16982 | 14763 | 2219 | 86.9% | 918 | 2839 |

Table A6: Counts and errors tabulation by cancer site

| Cancer site | Gold Standard (GS) Registrations | Rapid Registrations | Difference | Percentage Rapid/GS | FPE | FNE |
|---|---|---|---|---|---|---|
| C00 | 109 | 150 | -41 | 137.6% | 65 | 23 |
| C01 | 645 | 470 | 175 | 72.9% | 13 | 59 |
| C02 | 604 | 618 | -14 | 102.3% | 17 | 85 |
| C03 | 233 | 108 | 125 | 46.4% | 4 | 64 |
| C04 | 253 | 240 | 13 | 94.9% | 10 | 30 |
| C05 | 214 | 188 | 26 | 87.9% | 8 | 31 |
| C06 | 270 | 287 | -17 | 106.3% | 20 | 48 |
| C07 | 236 | 284 | -48 | 120.3% | 99 | 50 |
| C08 | 82 | 91 | -9 | 111.0% | 16 | 13 |
| C09 | 913 | 775 | 138 | 84.9% | 13 | 59 |
| C10 | 150 | 233 | -83 | 155.3% | 11 | 28 |
| C11 | 110 | 109 | 1 | 99.1% | 6 | 11 |
| C12 | 155 | 98 | 57 | 63.2% | 1 | 10 |
| C13 | 142 | 129 | 13 | 90.8% | 11 | 21 |
| C14 | 25 | 64 | -39 | 256.0% | 15 | 13 |
| C15 | 3996 | 4322 | -326 | 108.2% | 126 | 217 |
| C16 | 2621 | 2161 | 460 | 82.4% | 248 | 249 |
| C17 | 809 | 716 | 93 | 88.5% | 152 | 230 |
| C18 | 12425 | 11764 | 661 | 94.7% | 667 | 1224 |
| C19 | 994 | 954 | 40 | 96.0% | 45 | 90 |
| C20 | 4894 | 4494 | 400 | 91.8% | 114 | 320 |
| C21 | 644 | 644 | 0 | 100.0% | 89 | 38 |
| C22 | 2636 | 2540 | 96 | 96.4% | 265 | 425 |
| C23 | 472 | 475 | -3 | 100.6% | 30 | 55 |
| C24 | 641 | 525 | 116 | 81.9% | 28 | 84 |
| C25 | 4517 | 4201 | 316 | 93.0% | 138 | 477 |
| C26 | 151 | 309 | -158 | 204.6% | 218 | 73 |
| C30 | 162 | 155 | 7 | 95.7% | 25 | 26 |
| C31 | 92 | 64 | 28 | 69.6% | 5 | 25 |
| C32 | 881 | 870 | 11 | 98.8% | 51 | 68 |
| C33 | 13 | 12 | 1 | 92.3% | 1 | 3 |
| C34 | 20192 | 18766 | 1426 | 92.9% | 550 | 1841 |
| C37 | 167 | 86 | 81 | 51.5% | 11 | 56 |
| C38 | 72 | 356 | -284 | 494.4% | 47 | 21 |
| C39 | NA | 13 | NA | NA% | 4 | NA |
| C40 | 119 | 106 | 13 | 89.1% | 11 | 25 |
| C41 | 116 | 144 | -28 | 124.1% | 78 | 45 |
| C43 | 8245 | 7694 | 551 | 93.3% | 689 | 1043 |
| C45 | 1204 | 904 | 300 | 75.1% | 11 | 101 |
| C46 | 68 | 43 | 25 | 63.2% | 3 | 25 |
| C47 | 26 | 14 | 12 | 53.8% | 6 | 20 |
| C48 | 285 | 453 | -168 | 158.9% | 141 | 72 |
| C49 | 835 | 798 | 37 | 95.6% | 275 | 310 |
| C50 | 25096 | 24264 | 832 | 96.7% | 1342 | 1422 |
| C51 | 640 | 596 | 44 | 93.1% | 56 | 77 |

| Cancer site | Gold Standard (GS) Registrations | Rapid Registrations | Difference | Percentage Rapid/GS | FPE | FNE |
|---|---|---|---|---|---|---|
| C52 | 94 | 109 | -15 | 116.0% | 16 | 11 |
| C53 | 1317 | 1325 | -8 | 100.6% | 53 | 76 |
| C54 | 4095 | 3727 | 368 | 91.0% | 111 | 177 |
| C55 | 72 | 325 | -253 | 451.4% | 22 | 15 |
| C56 | 2984 | 2571 | 413 | 86.2% | 245 | 438 |
| C57 | 269 | 313 | -44 | 116.4% | 37 | 37 |
| C58 | 10 | 26 | -16 | 260.0% | 19 | 1 |
| C60 | 303 | 292 | 11 | 96.4% | 41 | 50 |
| C61 | 27040 | 25241 | 1799 | 93.3% | 314 | 2219 |
| C62 | 1053 | 1073 | -20 | 101.9% | 86 | 70 |
| C63 | 31 | 18 | 13 | 58.1% | 7 | 24 |
| C64 | 4843 | 4391 | 452 | 90.7% | 278 | 732 |
| C65 | 413 | 323 | 90 | 78.2% | 23 | 82 |
| C66 | 357 | 259 | 98 | 72.5% | 13 | 116 |
| C67 | 4471 | 5048 | -577 | 112.9% | 140 | 668 |
| C68 | 95 | 57 | 38 | 60.0% | 6 | 39 |
| C69 | 370 | 328 | 42 | 88.6% | 35 | 63 |
| C70 | 20 | 45 | -25 | 225.0% | 4 | 1 |
| C71 | 2260 | 2114 | 146 | 93.5% | 134 | 190 |
| C72 | 78 | 89 | -11 | 114.1% | 35 | 16 |
| C73 | 1725 | 1514 | 211 | 87.8% | 109 | 269 |
| C74 | 116 | 116 | 0 | 100.0% | 49 | 46 |
| C75 | 58 | 50 | 8 | 86.2% | 37 | 36 |
| C76 | 94 | 225 | -131 | 239.4% | 122 | 53 |
| C77 | 272 | 130 | 142 | 47.8% | 63 | 125 |
| C78 | 597 | 57 | 540 | 9.5% | 25 | 324 |
| C79 | 230 | 129 | 101 | 56.1% | 53 | 120 |
| C80 | 2228 | 2121 | 107 | 95.2% | 453 | 855 |
| C81 | 893 | 879 | 14 | 98.4% | 17 | 59 |
| C82 | 1207 | 1047 | 160 | 86.7% | 15 | 141 |
| C83 | 3147 | 2711 | 436 | 86.1% | 36 | 329 |
| C84 | 392 | 235 | 157 | 59.9% | 15 | 121 |
| C85 | 1372 | 1006 | 366 | 73.3% | 64 | 308 |
| C86 | NA | 102 | NA | NA% | 2 | NA |
| C88 | 209 | 357 | -148 | 170.8% | 14 | 54 |
| C90 | 2534 | 2202 | 332 | 86.9% | 69 | 418 |
| C91 | 2258 | 1900 | 358 | 84.1% | 82 | 463 |
| C92 | 1759 | 1648 | 111 | 93.7% | 307 | 267 |
| C93 | 23 | 190 | -167 | 826.1% | 27 | 1 |
| C94 | 27 | 80 | -53 | 296.3% | 65 | 12 |
| C95 | 50 | 68 | -18 | 136.0% | 12 | 13 |
| C96 | 39 | 99 | -60 | 253.8% | 79 | 25 |
| D05 | 3824 | 2926 | 898 | 76.5% | 155 | 322 |
| D09 | 4909 | 1278 | 3631 | 26.0% | 262 | 912 |
| D32 | 1395 | 1044 | 351 | 74.8% | 92 | 423 |
| D33 | 447 | 605 | -158 | 135.3% | 117 | 165 |
| D35 | 463 | 547 | -84 | 118.1% | 188 | 111 |
| D41 | 507 | 2024 | -1517 | 399.2% | 62 | 146 |
| D42 | 142 | 16 | 126 | 11.3% | 4 | 27 |
| D43 | 265 | 265 | 0 | 100.0% | 54 | 66 |
| D44 | 117 | 56 | 61 | 47.9% | 22 | 66 |

## Appendix 6 - False negative errors and basis of diagnosis

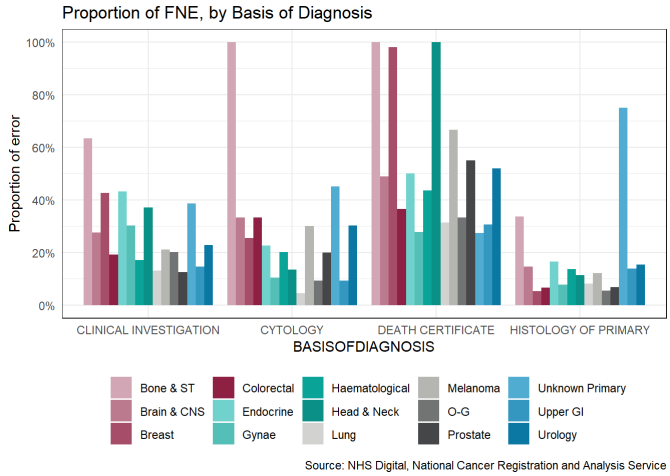
This appendix explores the reason for the overall age-dependence of the false negative error rate.

The most common methods of confirming a diagnosis (histology and cytology) account for the lowest proportion of false negatives (Figure A2). Where diagnosis comes from specific tumour markers, the Rapid Registrations are much more likely to “miss” the significant event or events. Patients diagnosed clinically (from imaging, consultation by a doctor but without a pathological sample being taken) are also more likely to be “missed” in the Rapid Registrations dataset.

Those patients for whom a diagnosis method cannot be determined (unknown) or died before they could be offered cancer treatment (death certificate), are most likely to be “missed” in the Rapid Registrations dataset. As Figure A3 indicates though, these account for a small proportion of those falsely omitted from the Rapid Registrations.

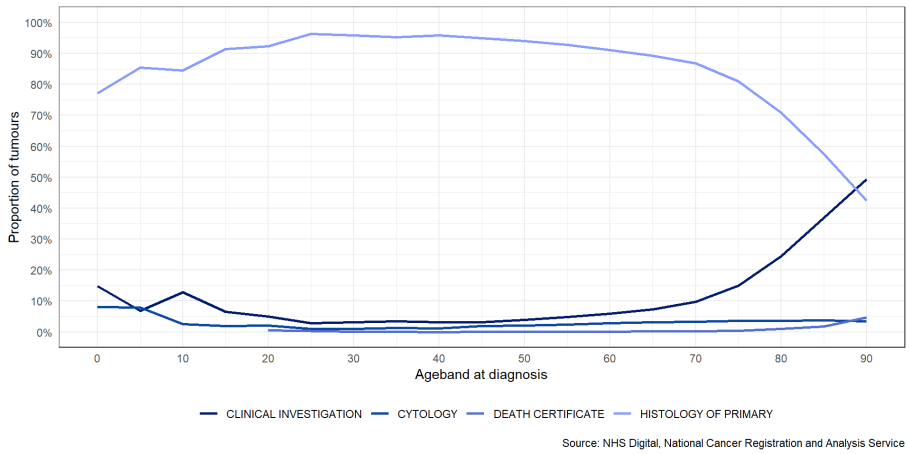
The marked reduction in the proportion of patients having their diagnosis confirmed from a pathological specimen (histology or cytology) explains the increase often observed at older ages in Figure A3, from the age of around 70, reflecting fewer patients having an invasive procedure performed on them as age increases. This is likely to be the reason behind the increasing false negative proportions by age observed overall and in most tumour groups (Figures 5 and 6).

Figure A2: The proportion of false negative Rapid Registrations by tumour group and basis of diagnosis, England, 2018




Source: NHS Digital, National Cancer Registration and Analysis Service

Figure A3: The proportion of false negative Rapid Registrations by method of diagnosis, England, 2018 (all tumour types combined)

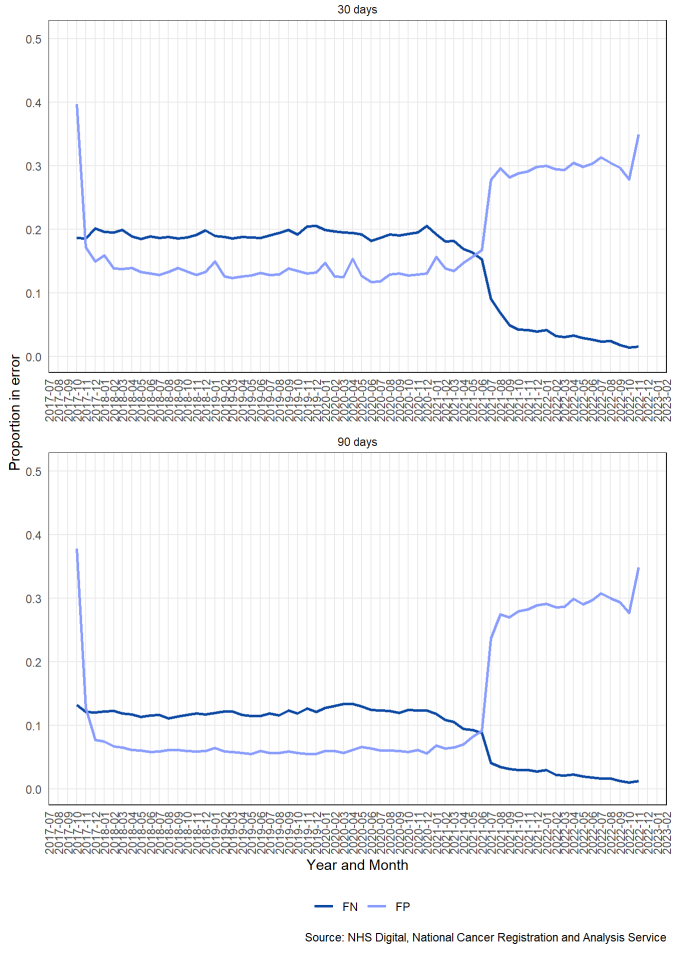



Source: NHS Digital, National Cancer Registration and Analysis Service

## Appendix 7 - False positive and false negative proportion by month

Figure 18 shows the False Negative and False Positive error proportions by month for the broader matching criteria and a matching period of 90 and 30 days.

Figure A4: Monthly False Positive and False Negative proportions




Source: NHS Digital, National Cancer Registration and Analysis Service

## Appendix 8 - Sensitivity testing of matching criteria

In this section, the sensitivity of the Rapid Registrations dataset is illustrated for different matching criteria.

As expected, the stricter the criteria about the timing of events, more errors (both false negative and false positive) are observed. Not including a match specification on tumour type (the second line of table 1) improves both matching criteria and demonstrates that approximately 40% of false positive tumours have a cancer diagnosis of some sort when the necessity of matching by tumour group is removed.

Table A7: Proportions of false positive and negative errors under alternative matching criteria

| Tumour matching | Match within N days | False Negative % | False Positive % |
|---|---|---|---|
| Broader | 90 | 11.5% | 6.1% |
| Broader | 60 | 13.2% | 7.7% |
| Broader | 30 | 18.7% | 13.4% |
| Broader | 14 | 29.8% | 25.1% |
| Broader | 7 | 46.4% | 42.9% |
| Broader | 0 | 82.0% | 80.7% |
| Narrow | 90 | 19.4% | 13.9% |
| None | 90 | 10.0% | 4.6% |