



Public Health
England



Protecting and improving the nation's health

Case-mix adjusted 30-day mortality post systemic anti-cancer therapy rates

Frequently asked questions

Q1. What is a case-mix adjusted rate and why is it useful?

A1. The case-mix adjusted mortality rate is an estimate of a trust's¹ mortality rate. It takes into account the fact that different trusts will see and treat a wide variety of patients depending on the population they serve and whether they provide secondary or tertiary care. By doing so, it estimates a trust's mortality rate for an average group of patients, rather than for its own patient population. In other words, the case-mix adjusted rate is the mortality rate the trust would have if all the trusts treated the same group of patients (i.e. patients in all the trusts included in the analysis combined). This allows for a reasonable comparison to be made between trusts or over time and for the examination of real changes in performance.

Q2. How is 30-day mortality after receiving systemic anti-cancer therapy (SACT) calculated?

A2. The case-mix adjusted mortality rate (CMAR) for each trust is calculated as follows:

$$CMAR = ((\text{Observed Deaths in the trust} / \text{Predicted Deaths in the trust}) * \text{Population rate}) * 100$$

Observed deaths = the sum of the number of patients in each trust who died within 30-days of their latest treatment date.

Predicted deaths = the sum of the predicted probability of death for each patient within the trust.

The predicted probability is calculated from a case-mix adjusted logistic regression model. It takes into account (where these variables are appropriate or available) differences in the age, co-morbidity score, deprivation status, ethnicity, performance status, sex, and stage at diagnosis of patients within each trust. These characteristics are known as the 'independent variables'. The regression model uses all the data to estimate the odds of a 30-day death for each patient. The trust is assigned as a random effect in the model which is a grouping factor for which we are trying to control and which we expect to be influencing the pattern of 30-day mortality. Because the logistic model gives the odds of a 30-day death, this is then converted to a probability. The equation for the odds ratio as derived from the logistic regression model (logodds) and predicted deaths are outlined below:

¹ The adult workbooks were estimated using mortality rates at each NHS trust. The CTYA (children, teenagers and young adults) ALL (acute lymphoblastic leukaemia) workbook was estimated using mortality rates at each Principal Treatment Centre (PTC)

$$\text{Predicted deaths} = \frac{e^{\text{logodds}}}{1 + e^{\text{logodds}}}$$

Where the odds of death ('logodds') are obtained from the logistic regression model as follows:

$$\text{logodds} = \beta_0 + \sum_{i=1}^j \beta_{iX_i} + h_k$$

β_1, \dots, β_j = coefficient(s) on independent variables

x_1, \dots, x_j = independent variables

h = random effect representing the effect of the k^{th} trust

Population rate = this is the mortality rate for all the patients included in the analysis. It is calculated as follows:

Population rate =

Observed deaths within 30 days in the population / Number of patients in the population

Q3. Why were those specific patient characteristics and clinical factors chosen to be adjusted for in the model?

A3. The model adjusts for differences between patients for the following characteristics and clinical factors: age, sex², co-morbidity score³, deprivation status⁴, ethnicity⁵, performance status⁶, and stage at diagnosis⁷. These variables were chosen because they are known to influence 30-day post-SACT mortality and have sufficient completeness. For example, treatment intent was not included as it is highly correlated with stage at diagnosis. The completeness and reliability of stage at diagnosis within the dataset is better than that of treatment intent. It is important to note that due to the absence of any information on factors

² Sex is not adjusted for in sex-specific cancers. Please refer to the specific CMAR workbook and companion brief guidance for further information.

³ The co-morbidity score relates to the Charlson comorbidity score derived using inpatient Hospital Episode Statistics data from 27 to 3 months prior to cancer diagnosis, with the same methodology as described by [Maringe et al.](#)

⁴ Using the income domain of the [Index of Multiple Deprivation \(IMD\)](#). IMD data from 2015 was used for tumours/cancers diagnosed between 2010 and 2013 and IMD data from 2019 was used for tumours diagnosed between 2014 and 2018.

⁵ Grouped into White, non-White and Unknown categories for analysis as there were insufficient numbers in the other ethnic groups for robust analysis.

⁶ Performance status (PS) at start of cycle was used. PS at start of regimen was also included for cases where PS at start of cycle data was missing. Performance status was not used for the CTYA (Children Teenager and Young Adult) acute lymphoblastic leukaemia (ALL) release

This was adjusted for in the regression analysis by categorising as 0, 1, 2+ and Unknown

For further information please see the [ECOG Performance Status page](#)

⁷ Some cancers do not have sufficient staging information available to adjust for stage at diagnosis. For further information please see the [National Cancer Registration Dataset in England, Data Resource Profile](#)

such as patient choice and clinical factors such as liver function tests, the case-mix adjustment may not fully correct for the differences in caseload between trusts.

Q4. Is adjusting for poor performance status and high levels of co-morbidities covering up the possibility of an overuse of SACT in patients with poor performance status and high levels of co-morbidity?

A4. In most instances there is NICE guidance which is relevant, such as only treating patients with PS 0-1 and without other significant medical complications. However, decision-making is complex and there are more factors considered than we are able to adjust for in these analyses. The quarterly Rapid Data Review (RDR) data feed produced by the SACT team provides trusts with details of patients who died within 30-days of SACT, with the aim of supporting routine clinical audit to review the safety and quality of care and address decision making in outlier trusts or services.

Q5. How was 30-day SACT mortality calculated?

A5. We count deaths (for any reason) within 30 days of the date the SACT treatment was last administered. For oral treatments, the 30-day window starts 28 days after the last administration date recorded in SACT, as most oral treatments have a prescription length of 28 days. Please see the [CDF methodology document](#)⁸ for further details. The current method of setting all oral treatments as lasting 28 days is being reviewed for future SACT outputs.

Q6. How is the last SACT treatment obtained and how is the treating trust allocated to each patient?

A6. The last known treatment date in SACT is used – in most cases this is the latest administration date (date of the SACT Drug Administration or the date an oral drug was initially dispensed to the patient). However, if this is missing, then the latest start date of cycle for that patient is taken, and failing that, the latest start date of regimen is used. Only patients who had their last treatment during the time period of interest were included. Therefore, patients still receiving treatment in 2020 were not included in the analysis.

Each patient was allocated to the trust where they received their final treatment, regardless of any prior treatment received at other trusts.

For the CTYA (Children Teenager and Young Adult) acute lymphoblastic leukaemia (ALL) release each patient was allocated to the trust where they received their final treatment, regardless of any prior treatment received at other trusts. This trust was then mapped to its corresponding Principal Treatment Centre (PTC). The trusts and caseloads included for each PTC are shown in the 'List of trusts included' tab in the CTYA ALL workbook.

Q7. We share care with another trust, will these patients appear twice?

A7. No, patients will only be counted under the trust from which they received their latest treatment. This means that, even if trust A has treated a patient many times and that patient is then transferred to trust B where they die within 30 days post-SACT, the patient will not be included within trust A's patient count. This means that for some trusts, the number of

⁸ Appendix links for the CDF methodology document: [Appendix A](#) (oral treatment duration calculations) and [Appendix B](#) (caveats associated with oral treatment duration calculations)

patients treated will be slightly underestimated. We believe the impact of this to be minimal and necessary in order to count patients rather than treatment records.

Q8. How was missing data handled?

A8. Trusts with less than 70% completeness for the following key variables: stage at diagnosis (for cancer sites where staging information was available); performance status; and co-morbidity score were excluded from the analysis. These variables were sourced from the [SACT dataset](#) and the [National Cancer Registration Dataset for England](#).

Trusts that did not meet this threshold across these variables were not considered further in the case-mix adjusted analyses. This exclusion may have introduced some bias but we believe the impact of this to be minimal. We have let trusts know when their low data completeness prevented them from being included in the analysis and these trusts have been listed in the workbook. When trusts met this threshold but still had missing data items, these data were grouped into a 'missing' category for the data modelling.

Q9. How many trusts are included in the workbook?

A9. There are currently 131 trusts in England who submit SACT data to PHE, but not all trusts have been included in the analysis. Trusts were not included if they did not meet the data completeness criteria or if there were no patients treated at the trust for the cancer of interest during the time period selected.

For the CTYA (Children Teenager and Young Adult) acute lymphoblastic leukaemia (ALL) workbook data for 50 trusts were mapped to 17 Principal Treatment Centres (PTCs).

Q10. Why is the report based on patients diagnosed between 2010 and 2018?

A10. In this report, records of SACT, submitted by NHS trusts in England to the SACT dataset are linked to cancer registrations in the [National Cancer Registration Dataset](#). The latest National Cancer Registration data available was to the end of 2018. Cancer registration is a complex process which involves many stages of quality control checks. This process takes time, and therefore the data is not available until approximately 18 months after clinical activity. More recent treatment activity was selected to account for the fact that more recent SACT data was available as compared with the National Cancer Registration data. It is important to note that all patients treated during the period of interest were selected, and not restricted to those who had started treatment during the time period.

Q11. How was the SACT dataset linked to cancer registration data?

A11. Within the analysis system used by the National Cancer Registration and Analysis Service (NCRAS), SACT data is linked at the patient level to the [National Cancer Registration Dataset](#) by NHS number. This is important to note as some patients may have more than one cancer type and in some cases, it may be difficult to identify the treatment data associated to the cancer type. For the purposes of the analysis, and to ensure treatment data was relevant to the cancer site, the following rules were applied when linking SACT data to the cohort of patients identified from the [National Cancer Registration Dataset](#):

1. For those patients with only one cancer diagnosed, all treatment records within the relevant time frame were selected.

2. For those patients with more than one cancer diagnosed, treatment records were selected if they fit the following criteria:
 - a) Within the relevant time frame.
 - b) The first three characters of the primary diagnosis recorded in SACT for that treatment record matched the first three characters of the cancer site identified in the National Cancer Registration Dataset.
3. For those patients with treatment records that did not fall within categories 1 and 2 outlined above, treatment records were selected if they were within the relevant timeframe and fell within 31 days before and a number of days (depending on cancer site) after the diagnosis of interest. The decision to restrict based on the time between treatment and diagnosis is in accordance with the [‘Linking treatment tables – chemotherapy, tumour resections and radiotherapy’ standard operating procedure](#). The timeframes used ensure that treatment given soon after diagnosis is included for those patients where the diagnosis codes recorded in the [National Cancer Registration Dataset](#) are not an exact match to those recorded in SACT. This is particularly relevant for some cancers where coding of the cancer site sometimes differs between data sources.

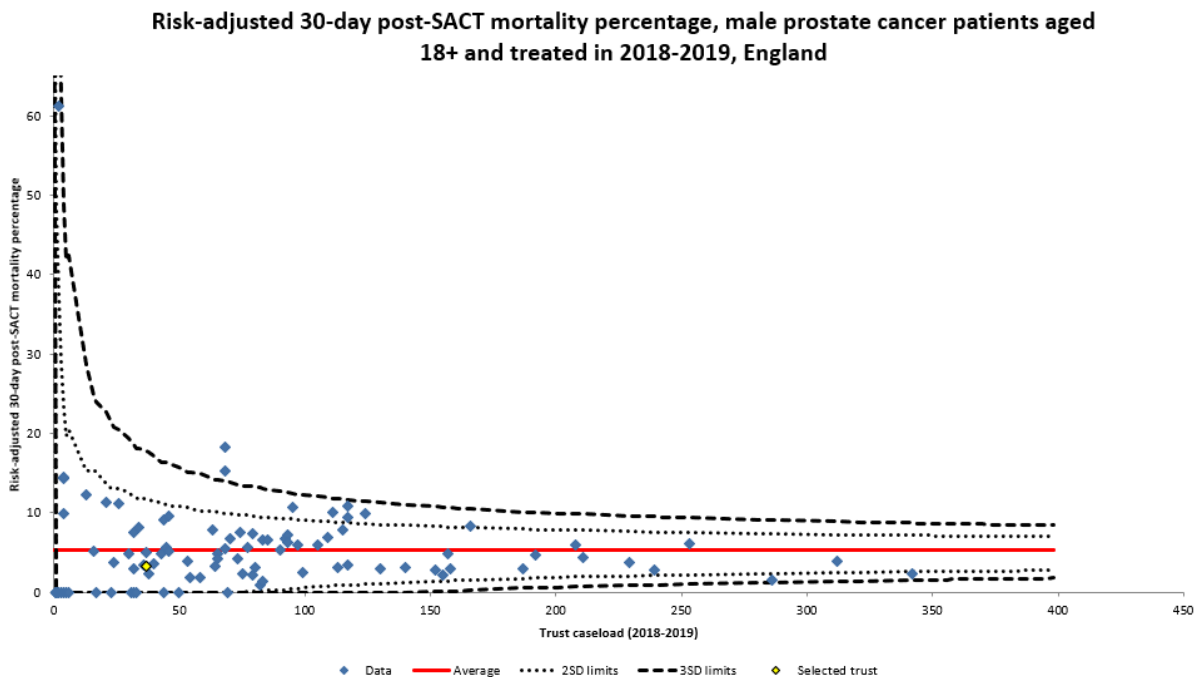
Q12. Where do the dates of death come from?

A12. The dates of death come from the Office for National Statistics via [NHS Digital's Demographics Batch Service Bureau](#).

Q13. How do I interpret the funnel plot?

A13. A funnel plot is a means of visualising 30-day mortality post-SACT rates for all the trusts in England. More information on its uses and interpretation can be found the [PHE Technical Guide](#) and [Tower Hamlets Clinical Commissioning Group Guide](#). A visual example is also provided below for prostate cancer:

Case-mix adjusted 30-day mortality post-SACT



Notes:

Adjusted for Age, Co-morbidity score, Deprivation status, Ethnicity, Performance status and Stage at diagnosis
When the caseload (number of patients) at a trust is fewer than 10 patients, this is unlikely to be statistically robust

- The volume of patients is on the horizontal axis. The more patients treated by your trust, the further to the right your trust will be.
- The 30-day mortality post-SACT is on the vertical axis. The higher the mortality rate at your trust, the further up the graph it will appear.
- The solid red horizontal line shows the average mortality rate post-SACT of all trusts.
- Your trust is indicated by the yellow diamond, other trusts are represented by the blue diamonds.
- The dotted lines represent the ± 2 standard deviations (SDs) (roughly equivalent to 95% confidence intervals); the dashed lines represent the ± 3 standard deviations (SDs) (roughly equivalent to 99.8% confidence intervals).
- Trusts with rates above the upper $+3SD$ are outliers.
- Confidence limits are higher on the left because when a trust treats a smaller number of patients, chance will have a greater impact on the rate, and therefore the confidence intervals will be wider to reflect this.

Q14. What do the confidence intervals mean?

A14. The confidence intervals reflect the distribution of trust mortality post-SACT rates around the national average. The workbook highlights the mortality rates for ± 2 standard deviations (SDs) (roughly equivalent to 95% confidence intervals) and ± 3 standard deviations (SDs) (roughly equivalent to 99.8% confidence intervals). Trusts with rates above the upper, $+3SD$ will be identified as outliers.

- Trusts with rates above the upper, $+3SD$ have a significantly higher than average 30-day mortality post-SACT rate.
- Trusts with rates below the lower, $-3SD$ have a significantly lower than average 30-day mortality post-SACT rate.

- Trusts with rates within the confidence limits have an average 30-day mortality post-SACT rate.

Q15. What is the expected mortality post-SACT rate for these cancer diagnoses?

A15. There is no 'target' mortality post-SACT rate for these treatments. It is acknowledged that many of these drugs have a narrow therapeutic index, and that a certain level of risk needs to be accepted when prescribing these drugs.

Generally, lower rates are better as they reflect that in curative settings, complications are being identified and managed rapidly. In palliative settings they reflect that the clinician is aware when the patient is in the final stages of their disease and discusses with the patient whether other non-SACT treatment options are more appropriate.

However, persistently very low mortality post-SACT or zero mortality post-SACT rates may be indicative of a risk averse approach to prescribing, whereby patients who may potentially have benefitted from SACT are not receiving this treatment. Trusts who have persistently very low mortality post-SACT or zero mortality post-SACT rates may want to consider auditing their clinical practice for this reason.

Q16. Is my trust an outlier?

A16. Trusts that are found to be outliers by having 30-day mortality post-SACT rates that are above the upper, +3SD limit will be informed of this. All trusts are given the opportunity to respond to the SACT team prior to this information being made available to the public, and we particularly encourage responses from outlying trusts.

Q17. Can my trust access the underlying patient data for this report?

A17. You can request the NHS numbers for patients who died at your trust within 30 days of receiving SACT. To request this information please contact the SACT Helpdesk (SACT@phe.gov.uk).

Q18. Who is this data sent to within the trust? Can we nominate members of staff to receive it?

A18. This workbook will be sent to the SACT uploader, lead cancer clinician, the regimen mapper, CEO and medical director for each trust, unless we are informed otherwise. Please let us know if you would like to make changes to the distribution list for your trust.

Q19. How often will we receive this data? Will we receive information for other cancer sites?

A19. Future releases are planned for this work, with some releases planned annually and every two years depending on the cancer site.

Q20. I have the extract of patient data for those patients who died within 30 days post-SACT, but can I request the patient data for the denominator group?

A20. No, only the details of those patients who died within 30 days are available so that it can be used for audit. This is also in accordance with regulations surrounding data minimisation. Any requests for additional patient data should go through the [Office for Data Release](#).

Q21. Please can we have the GMC code for each responsible consultant, so each consultant can review their own data?

A21. No, only the NHS numbers of those patients who died within 30 days are available for this output. GMC code for 30-day mortality is provided as part of a separate data feed called the RDR. Please contact the SACT helpdesk (SACT@phe.gov.uk) for further information about this.

Q22. We think the data which has been submitted for our trust is incorrect – can we correct this?

A22. Unfortunately we cannot accept data re-submission, corrections or re-run the report. The report is a snapshot of the data at the present time. However, if you have identified errors in the data submitted to SACT we recommend that you make changes in your current practice to reduce such errors going forward. Please contact the SACT helpdesk (SACT@phe.gov.uk) for support with this.

Q23. In our trust we treat many older patients with multiple co-morbidities – is the report adjusted to reflect this?

A23. Yes – the report is case-mix adjusted, therefore the influence of these factors should be accounted for in the report. However, the absence of any information on critical factors such as frailty and patient choice as well as clinical factors such as liver function tests, mean that the case-mix adjustment may not fully correct for the differences in caseload between trusts.

Q24. Some of the treatments we use are not harmful to patients at the end of life, for example anti-emetics. Are these treatments included in the report?

A24. Non-harmful, supportive treatments, hormones and non-chemo drugs are excluded from the report. Please refer to the companion brief and workbook guidance for the full list of regimens excluded from the analysis.

Q25. We treat very small numbers of patients for certain disease groups. Will this make a difference?

A25. If you only treat small numbers of patients and one dies within 30 days, your mortality post-SACT rate will be high. However, the funnel plot structure may account for this as the confidence limits will be wider for trusts treating a smaller number of patients.

Q26. Does the report exclude deaths that were within 30 days post-SACT but were from causes unrelated to the patient's cancer?

A26. No, it includes all deaths. This is because cause of death can be misclassified, especially those relating to deaths from cancer treatment, therefore the decision was made to take an inclusive approach to cause of death for this report.

Q27. Why does the data in the workbook differ from our trust monthly SACT submissions for the same period?

A27. The SACT data used in the workbook has been linked to the National Cancer Registration Dataset to provide accurate diagnosis and morphology codes. This may result in a patient being reassigned to a different cancer site, based on the National Cancer

[Registration Dataset](#) or excluded due to an inability to accurately link the patient's cancer site in the two datasets.

Q28. My trust has 'no data' in the workbook, what does this mean?

A28. This means that your trust had no activity data for patients being treated for the cancer site for the time period, who fit the inclusion criteria. Strict criteria were applied to the data for this work and so there are a few reasons why a trust may have no data in the workbook.

Examples of this include:

- c) Patients were still receiving treatment after the period of interest (e.g. in 2020)
- d) Patients were treated with regimens that were excluded from the analysis
- e) Patients received their last treatment at a different trust
- f) We were not able to match the patient's diagnosis in the [National Cancer Registration Dataset](#) to that of the trust and the patient's treatment fell outside of the diagnosis-to-treatment time window

Q29. Which trust mergers are covered in the workbook?

A29. Trusts presented in the analysis have been grouped to reflect any mergers that had taken place up to October 2020. The aim of this work is to highlight areas for improved data submission and clinical governance procedures, for which we have chosen to present the most up to date trust codes at the time the analysis was undertaken. This means that, if two trusts merged in February 2020, the two trusts will appear under their single merged trust name in the workbook, even though treatment activity for 2018-2019 was received for the two trusts individually.

A concrete example of this would be as follows: Aintree University Hospital NHS Foundation Trust (REM) and Royal Liverpool and Broadgreen University Hospitals NHS Trust (RQ6) merged in October 2019 to become Liverpool University Hospitals NHS Foundation Trust (REM). Because this merger was in place by August 2020, figures in the workbook for Liverpool University Hospitals (REM) will represent activity for both Aintree University Hospital (REM) and Royal Liverpool and Broadgreen University Hospitals (RQ6) over the treatment period.

Further information on NHS trust mergers can be found on the [NHS Digital Organisation changes webpage](#).

If you have any other questions, please contact the SACT Helpdesk (SACT@phe.gov.uk)