

# Ovarian Cancer Audit Feasibility Pilot

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Short-term mortality in ovarian, fallopian tube and primary peritoneal carcinomas across England

## About the NDRS

The National Disease Registration Service (NDRS) is part of NHS Digital (NHSD). Its purpose is to collect high-quality, timely data on cancer, rare diseases and congenital anomalies to monitor changes in the health of the population.

The NDRS includes:

- the National Cancer Registration and Analysis Service (NCRAS) and
- the National Congenital Anomaly and Rare Disease Registration Service (NCARDRS)

Healthcare professionals, researchers and policy makers use data to better understand population health and disease. The data is provided by patients and collected by the NHS as part of their care and support. The NDRS uses the data to help:

- understand cancer, rare diseases, and congenital anomalies
- improve diagnosis
- plan NHS services
- improve treatment
- evaluate policy
- improve genetic counselling



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Improving lives with data and technology – NHS Digital support NHS staff at work, help people get the best care, and use the nation's health data to drive research and transform services.



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# Ovarian Cancer Audit Feasibility Pilot

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Data for this report is based on patient and tumour-level information collected by the NHS, as part of the care and support of cancer patients. The data is collated, maintained and quality assured by the National Cancer Registration and Analysis Service, which is part of NHS Digital.

## Executive summary

Ovarian cancer is the leading cause of cancer gynaecological death for women in the UK. Studies have found that a disproportionately high percentage of ovarian cancer patients die within the first year following their diagnosis. This report investigates factors associated with mortality in the first year after diagnosis of ovary, fallopian tube and primary peritoneal carcinomas and examines to what extent geographical variation occurs at a Cancer Alliance level.

Data from the National Cancer Registration dataset were used to identify women diagnosed with ovary, fallopian tube and primary peritoneal carcinomas in England between 2013 and 2018. To examine how mortality rates changed over the first year after diagnosis, patients were assigned into 4 groups: patients who died within 0 to 2 months, 2 to 6 months, 6 to 12 months, or patients who did not die within 12 months following diagnosis. Crude mortality rates were calculated to examine the distribution of patient demographics and tumour characteristics across these short-term mortality groups. Factors investigated include tumour site, tumour morphology, basis of diagnosis, stage at diagnosis, route to diagnosis, age at diagnosis, deprivation quintile, ethnicity, comorbidity, performance status, treatment, whether the trust at diagnosis housed a specialist gynaecological cancer centre and GP to population ratio. Factors were assessed for statistically significant differences in mortality via chi-squared tests. Mixed effects logistic regression models were fitted to estimate the association of statistically significant factors with short-term mortality in ovarian cancer patients. To examine geographical variation, crude and case-mix adjusted mortality rates for each Cancer Alliance were calculated.

Results from these analyses show that the short-term mortality rate for ovarian, tubal and primary peritoneal cancer patients remains high. 14% died within 2 months of diagnosis, and 30% died within the first year. This compares to an analysis by the NCIN of 2006-2008 cases, published in 2013, which showed a 15% 2 month and 31% 12 month mortality rate. However, the 2013 analysis included cases of borderline tumours with an excellent long term prognosis and excluded primary peritoneal cancer which has a relatively high short-term mortality rate, suggesting a modest overall improvement in short-term mortality rates from ovarian cancer in England over the last decade.

Mixed effect logistic regression models show that mortality rates were impacted by a number of factors. The greatest variation in patient mortality across different patient demographics and tumour characteristics was seen for women who died within 2 months following their diagnosis. Mortality rates were significantly higher for older women, women who were diagnosed at a later or unknown stage of disease, had an unknown morphology, were diagnosed following an emergency presentation or non-urgent route, women who had a greater burden of comorbidities and women who had a more deprived socioeconomic status. There was also a strong trend observed of higher short-term mortality rates in patients diagnosed in a trust that did not house a specialist gynaecological cancer centre compared to trusts that did. This trend remained significant for patients that died within 2 to 6 months of diagnosis. Crude and case-mix adjusted results indicated that some variation in short-term mortality may exist at a Cancer Alliance level, but that much of this variation is likely due to different patient case-mix or that while variation still exists at a more local level, this has evened out by the time data is analysed

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at Alliance level.

The results from this report suggest a need for earlier diagnosis via increasing symptom awareness and timely general practitioner referral, for women of all backgrounds, to aid in reducing ovarian cancer mortality within the first year of diagnosis.

## Background

The Ovarian Cancer Audit Feasibility Pilot (OCAFP) is a collaboration between the gynaecological oncology clinical community, the charity sector and NHS Digital. It aims to undertake meaningful analyses of routinely collected data for the purpose of improving treatment and outcomes for women diagnosed with ovarian cancer in England. The OCAFP is jointly funded by the British Gynaecological Cancer Society, Target Ovarian Cancer and Ovarian Cancer Action, and is being delivered by analysts at the National Disease Registration Service (NDRS), part of NHS Digital. The pilot originally ran for 2 years from 2019 and has been extended for an additional year. The pilot will publish a range of data outputs on ovarian cancer, including a final report on the audit and its findings, bringing all the analysis into one place. The outputs can be found on the [project webpage](#).

The first publication from the OCAFP was the Disease Profile in England report, which describes incidence, mortality, stage and survival for ovary, fallopian tube and primary peritoneal carcinomas diagnosed in England.<sup>1</sup> This report found that 32% of ovarian cancer patients do not survive 1-year after their diagnosis and that there was variation in ovarian cancer patient survival across England, with age-standardised 1-year net survival for the 19 Cancer Alliances varying between 62.9% and 75.2%.

Previous work by The National Cancer Intelligence Network (NCIN) investigated short-term mortality of ovarian cancer patients diagnosed in 2006 to 2008 and 2008 to 2010.<sup>2,3</sup> The analysis covering 2006 to 2008 found that 31% of ovarian cancer patients died within 1 year following diagnosis, and that almost half (49%) of these patients died within the first 2 months following their diagnosis.<sup>2</sup> This cohort only included patients diagnosed with ICD10 C56 and C57 (and includes borderline tumours). *Barclay et al*, (2016) extended this analysis to include ICD10 C48 and excluded borderline tumours to investigate factors associated with mortality via a multivariate Poisson model.<sup>3</sup> They found that 36% of ovarian cancer patients died within 1 year following diagnosis and of these 32% died within the first month following diagnosis. They also found that many factors impacted ovarian cancer patient mortality, finding considerable differences by age, route to diagnosis, stage, morphology, basis of diagnosis and treatment, with smaller differences by comorbidity and deprivation.<sup>3</sup>

This report builds on these analyses, to explore additional factors associated with short-term mortality in patients diagnosed with ovary, fallopian tube and primary peritoneal carcinomas in England and covers more recent years. This report has also been extended to include patients diagnosed with neoplasms of uncertain or unknown behaviour of female genital organs (ICD-10 D39.1) and a geographical breakdown to investigate to what extent variation in short-term mortality occurs between Cancer Alliances.

## Methods

There were 40,521 women diagnosed with ovary, fallopian tube and primary peritoneal carcinomas, hereinafter referred to as 'ovarian cancer', in England between 2013 and 2018 extracted from the National Cancer Registration dataset. Due to data quality reasons, 128 cases were excluded from the analysis (missing NHS numbers, n=32; embarked patients (patient stopped being registered in England and Wales for primary care on a specified date, such as in the case of moving outside of England), missing vital status date or known issue with the vital status, n=96). 187 cases were also excluded as their cancer registrations had an unknown basis of diagnosis. There were also 2 cases with a death certificate only record which were removed from the cohort. Cases with borderline malignancies (n=6,639) were excluded from the cohort as these cases do not exhibit short-term mortality, with a 12 month net survival rate of almost 100%.<sup>1</sup> The first ovarian cancer diagnosis in the study period for each patient was selected (excluding borderlines), leaving a final cohort of 33,442 ovarian cancer patients in the analysis.

The first section of this report describes the distribution of mortality by patient demographics and tumour characteristics. Variables investigated include: tumour site, tumour morphology, basis of diagnosis, stage at diagnosis, route to diagnosis, age at diagnosis, deprivation quintile, ethnicity, comorbidity, performance status, treatment, whether the trust at diagnosis housed a specialist gynaecological cancer centre and General Practitioner (GP) to population ratio. To examine how mortality rates changed over the first year after diagnosis, patients were assigned into 4 groups:

- Patients who died within the first 2 months after diagnosis, defined as 0-60 days (n=4,548)
- Patients who survived more than 2 months after diagnosis but died within 6 months of diagnosis, defined as 61-180 days (n=2,815)
- Patients who survived more than 6 months after diagnosis but died within the first year of diagnosis, defined as 181-365 days (n=2,756)
- Patients who survived longer than one year following diagnosis, defined as over 365 days (n=23,323)

Analysis considered crude mortality rates, defined as the percentage of ovarian cancer patients who died within 2 months, 2 to 6 or 6 to 12 months following their diagnosis, or survived longer than 1 year, divided by the number of patients included in the cohort. This is presented in figures 3-16, with descriptive data available in Appendix 2, Table 1. Figures 3-16 also present the percentage of patients diagnosed in the total cohort at the top of each stacked bar.

The second section of this report investigates the association of factors with short-term mortality via unadjusted (crude) and adjusted mortality rates. To further examine mortality in each of the 3 short-term mortality intervals, the data were split into 3 cohorts each excluding patients that had died prior to the short-term mortality interval being investigated:

- To investigate patients who died within the first 2 months after diagnosis the total cohort was used (n=33,442)

- Patients who were alive at day 61 were included in the cohort to investigate patients who died within 2 to 6 months (n=28,894)
- Patients who were alive at day 181 were included in the cohort to investigate patients who died within 6 to 12 months following diagnosis (n=26,079)

Chi-squared tests were performed to ascertain whether there was a statistically significant difference in mortality rates for each of the short-term mortality time periods by patient demographics and tumour characteristics (Appendix 2, Table 2).

Unadjusted mortality rates were calculated as the percentage of patients that died within the short-term mortality interval divided by the number of patients in each cohort. Rates were presented with 95% confidence intervals calculated using the Wilson score method (Appendices 3-5).<sup>4</sup> Two mixed effects logistic regression models were fitted for each short-term mortality group to allow comparisons according to differing levels of covariate adjustment. The first model (minimally adjusted model) adjusted for age at diagnosis, tumour morphology, stage at diagnosis, deprivation quintile, ethnicity and comorbidity. To account for additional hospital level variation, trust at diagnosis was also included as a random effect. For diagnosis to 2 months only, basis of diagnosis was also included to adjust for lead time bias. The second model (maximally adjusted) additionally adjusted for route to diagnosis and whether the trust at diagnosis housed a specialist gynaecological cancer centre. The results were presented as odds ratios in Appendices 3-5. Only results for the maximally adjusted models are discussed throughout the report, but findings from the minimally adjusted models are presented in Appendices 3-5. Appendix 9 displays results from a sensitivity analysis investigating performance status at diagnosis and ovarian cancer patient short-term mortality between 0 and 2 months from diagnosis.

The final section of this report explores geographical variation in ovarian cancer patient mortality across England. This was assessed via crude and case-mix adjusted mortality rates at a Cancer Alliance level. Case-mix adjusted rates were derived from the predicted mortality rates from the mixed effects logistic regression models in section 2 of the report. The models have controlled for available confounding variables which may help to explain some of the differences seen between Alliances. The case-mix adjusted rates provide an estimate of a Cancer Alliance's mortality rate if all Alliances had the same sample of patients, presenting in the same way, allowing for comparisons to be made across Alliances. The results are presented as funnel plots in figures 17-22 and in tables in Appendices 6-8.

Please see Appendix 1 for a more detailed description of the cohort definition, definition of variables included in the analysis and statistical methodology.

For readers within the NHS, supporting tables for crude counts and rates of mortality at NHS trust level are also available on CancerStats2.

## Mortality distribution in ovarian cancer patients

Of the 33,442 ovarian cancer patients included in the cohort, 10,119 (30.3%) died within the first year following their diagnosis. Figure 1 shows that mortality rates gradually declined as the number of days from diagnosis increased.

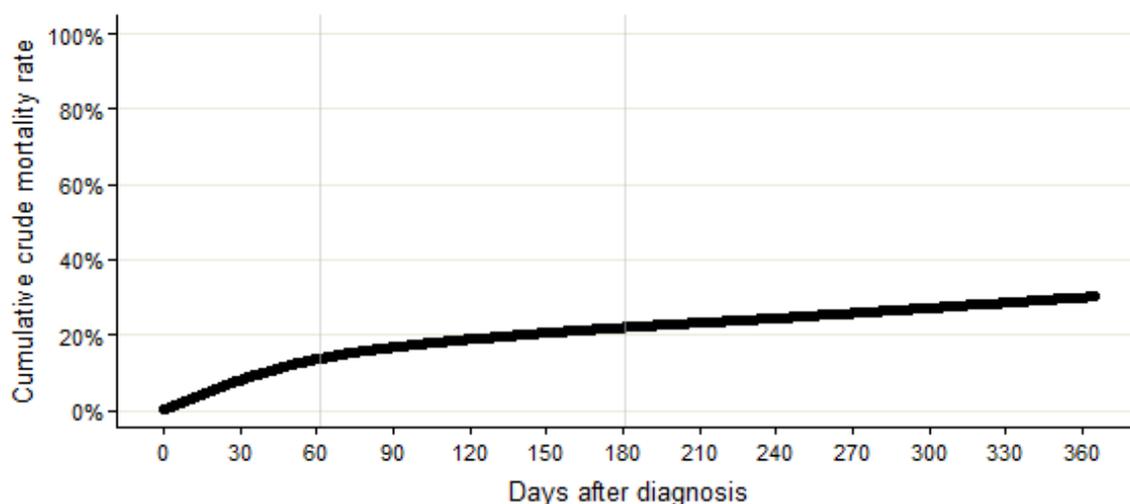


Figure 1: Cumulative crude mortality in the first year after diagnosis with ovary, fallopian tube or primary peritoneal carcinomas, England 2013-2018

13.6% of patients diagnosed with ovarian cancer died within the first 2 months following their diagnosis, compared to 8.4% that died within 2 to 6 months following diagnosis, and 8.2% that died within 6 to 12 months following an ovarian cancer diagnosis (Figure 2).

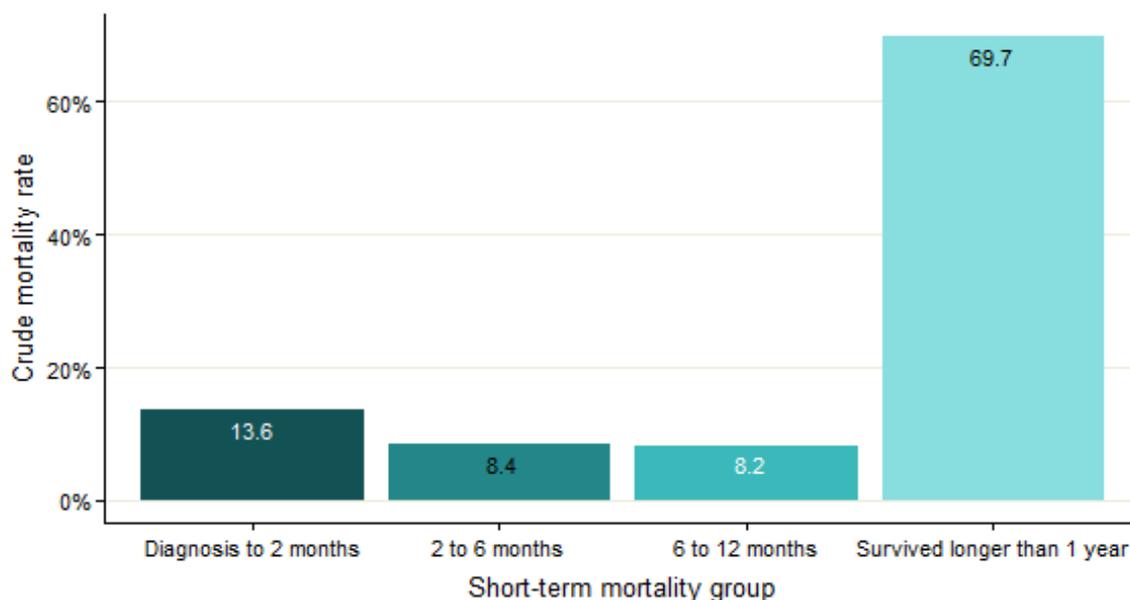


Figure 2: Short-term mortality in patients diagnosed with ovary, fallopian tube or primary peritoneal carcinomas, England 2013-2018

An average of 5,574 women were diagnosed with ovarian cancer per year in England between 2013 and 2018, excluding cases of borderline malignancy. The average number of women

diagnosed with ovarian cancer that died within their first year after diagnosis was 1,687 per year, with an average of 758 per year dying within the first 2 months after their diagnosis.

## Mortality variation by tumour site

ICD-10 (International Classification of Diseases, Tenth Revision) codes are used to classify diagnoses. For neoplasms, ICD-10 codes indicate the site of origin and type of malignant tumour. The majority (83.8%) of women included in the cohort were diagnosed with ICD-10 C56 (malignant neoplasm of ovary). All tumour sites (defined by ICD-10 code) show a similar pattern in short-term mortality, with the highest percentage of patients with short-term mortality dying within 2 months following their diagnosis. The proportion of patients that died within the first 2 months was greatest for those diagnosed with tumours of a C48 (malignant neoplasm of retroperitoneum and peritoneum) site, at 15.0% (Figure 3).

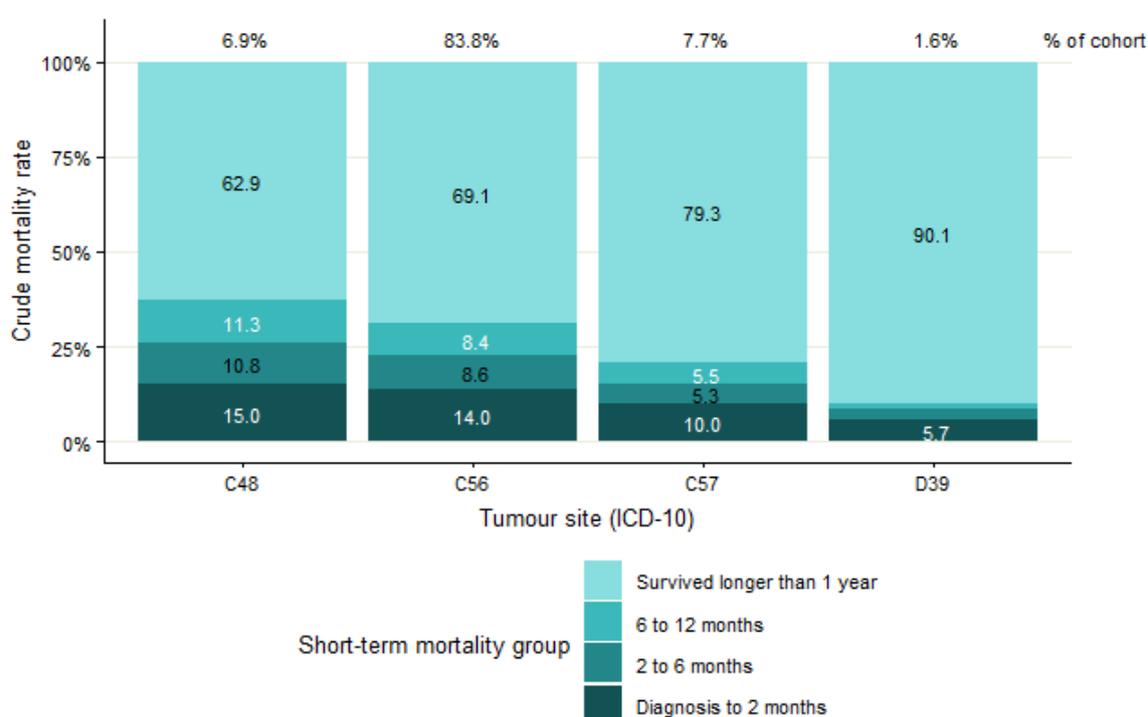


Figure 3: Short-term mortality in patients diagnosed with ovary, fallopian tube or primary peritoneal carcinomas by tumour ICD-10 site, England 2013-2018

## Mortality variation by tumour morphology

Figure 4 displays variation in patient mortality by tumour morphology. Tumour morphology is the histological type of cancer, determined by assessment from tissue biopsies, including the use of immunohistochemical analysis. Tumour morphology can impact the type of treatment and outcomes for a patient. This report uses the tumour morphology groups as defined in the OCAFP Disease Profile in England report and Get Data Out.<sup>1,5</sup>

The majority of patients identified in our cohort were diagnosed with tumours of serous carcinoma morphology (51.0%). Mortality within 2 months following diagnosis was greatest for patients diagnosed with 'miscellaneous and unspecified' or 'non-specific site' morphologies at 51.3% and 37.5% respectively. These are patients who were likely too unwell to complete the

full diagnostic process. Patients who were diagnosed with a 'sex cord-stromal and germ cell' morphology saw the lowest short-term mortality rates with only 0.9% of patients dying within the first 2 months following their diagnosis. Patients diagnosed with an 'endometrioid carcinoma' or 'clear cell carcinoma' morphology also had low mortality in the first 2 months after diagnosis at 1.3% and 3.0% respectively. Patients with 'mucinous carcinoma' or 'serous carcinoma' morphologies experienced higher mortality rates with 3.5% and 7.1% of patients dying within the first 2 months following diagnosis.

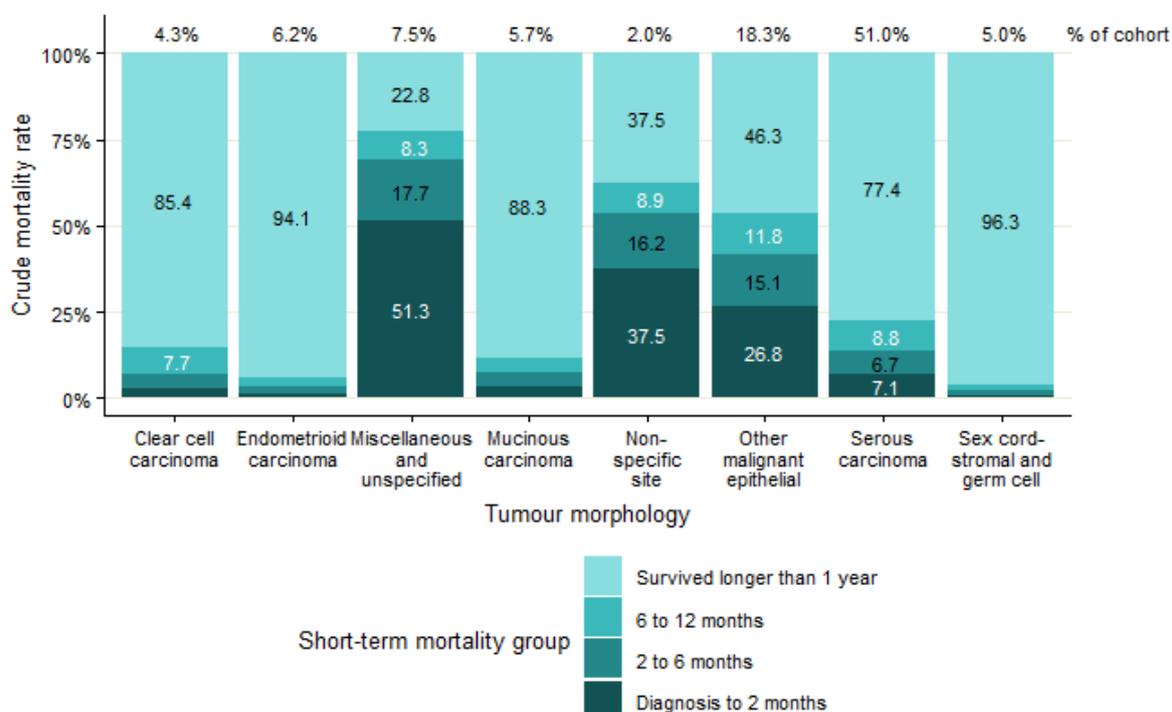


Figure 4: Short-term mortality in patients diagnosed with ovary, fallopian tube or primary peritoneal carcinomas by tumour morphology group, England 2013-2018

## Mortality variation by basis of diagnosis

Tumours can be diagnosed in a number of ways including clinically, histologically or via cytology methods. Clinical diagnoses are made on the basis of medical signs and reported symptoms, sometimes including investigations such as diagnostic imaging, endoscopy or tumour markers. Histological diagnoses involve microscopic examination of tissue whereas cytology diagnoses involve microscopic examination of cells from fluid (ascites or pleural effusion) or fine needle aspiration sampling of solid tumour. Basis of diagnosis can give an indication of the validity of the diagnosis. Identifying the histology of a malignancy by microscopic examination is generally accepted as the most accurate method of diagnosis, however this cannot always be performed, for example if a patient is very unwell at the time of diagnosis. Patients with an unknown basis of diagnosis or those diagnosed via death certificate only, were not included in these analyses.

83.3% of patients in the cohort were diagnosed via histology compared to only 9.4% of patients having been diagnosed clinically or 7.3% by cytology. Differences in short-term mortality were most pronounced for deaths within 2 months following diagnosis. For example, 54.9% of women who were diagnosed clinically died within 2 months following diagnosis, compared to only 7.0% of patients who were diagnosed by histological investigation (Figure 5).

## Short-term mortality in ovarian, fallopian tube and primary peritoneal carcinomas across England

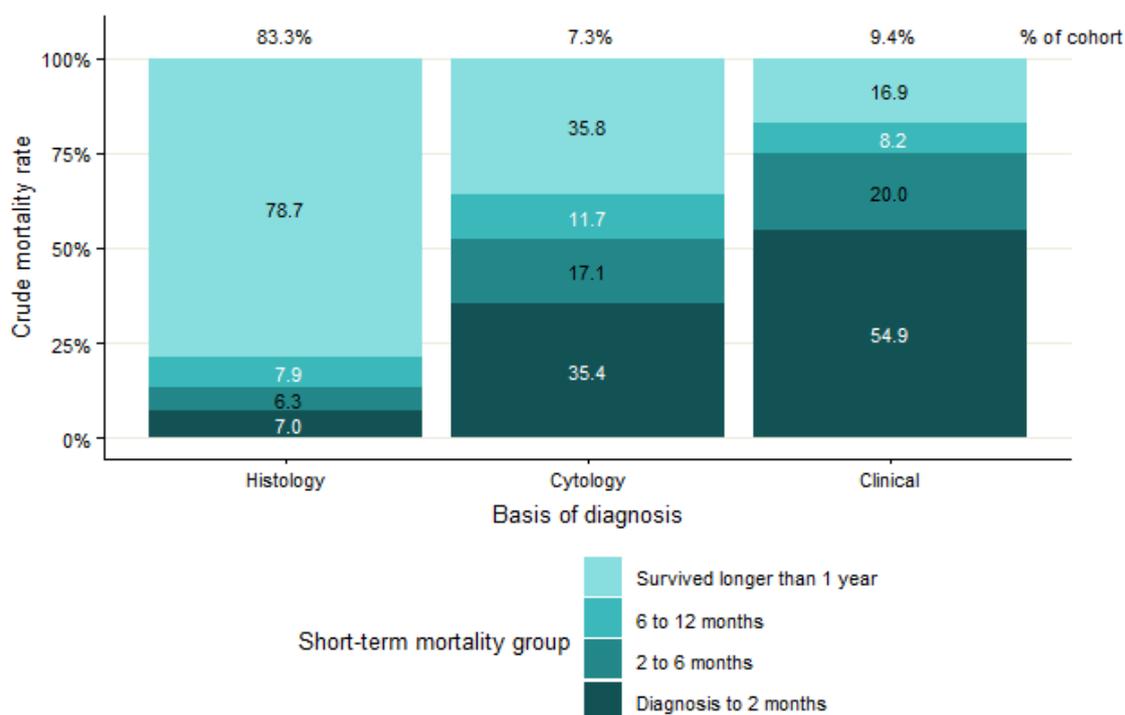


Figure 5: Short-term mortality in patients diagnosed with ovary, fallopian tube or primary peritoneal carcinomas by basis of diagnosis, England 2013-2018

## Mortality variation by stage at diagnosis

Tumour stage describes the size and severity of a patient's tumour, including how far a cancer has spread. Diagnosing ovarian cancer in its early stage is one of the most important factors affecting good cancer outcomes.<sup>6</sup> In this report, stage at diagnosis was defined by the cancer registry, which generally uses FIGO (International Federation of Gynecology and Obstetrics) for ovarian cancers. Please see Appendix 1 for a more detailed definition of stage at diagnosis.

Patients with a lower stage at diagnosis showed lower rates of short-term mortality, with only 0.8% of patients diagnosed at stage 1 having died within the first 2 months following diagnosis, compared to 21.0% of patients diagnosed at stage 4 (Figure 6). All ovarian cancers should be staged by the Multidisciplinary Team (MDT), however if a patient is too unwell at diagnosis, due to comorbidities or advanced disease, it may not be possible to perform the necessary investigations in order to capture accurate stage data. This explains why a large number of patients with an unknown stage at diagnosis die within 2 months (30.6%).

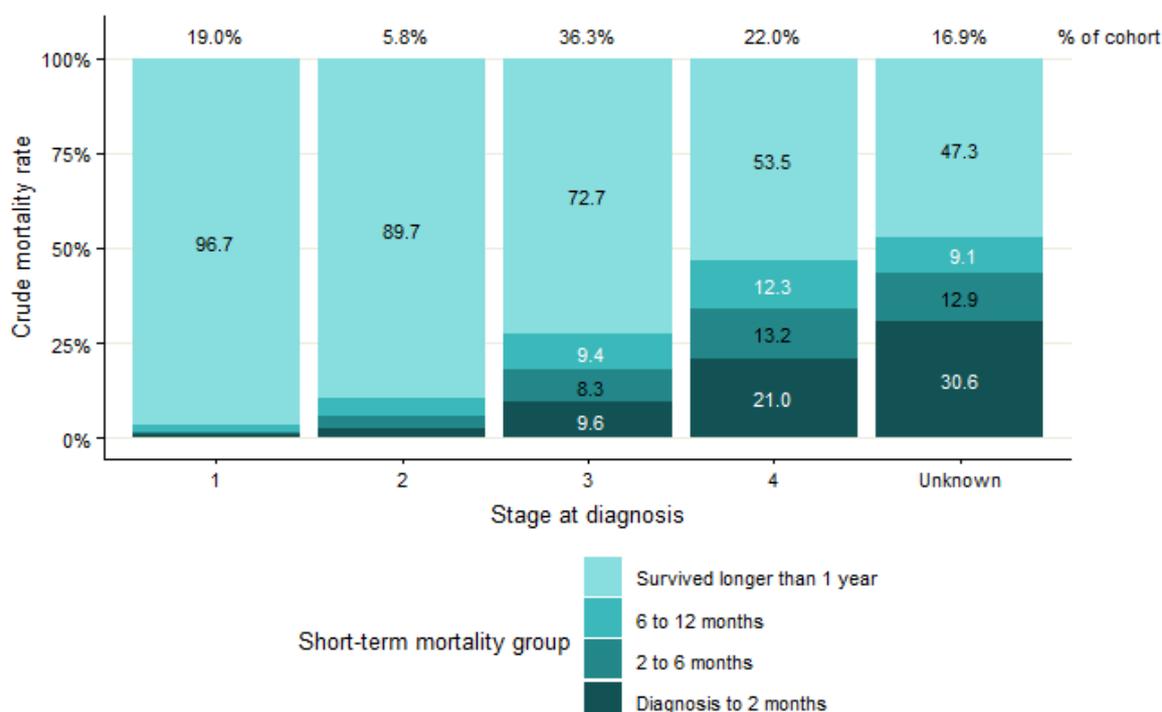


Figure 6: Short-term mortality in patients diagnosed with ovary, fallopian tube or primary peritoneal carcinomas by stage at diagnosis, England 2013-2018

## Mortality variation by route to diagnosis

Patients can be diagnosed late with advanced disease and a poor performance status due to delays in presenting for medical care, delays in primary care, delays between primary and secondary care or delays in secondary care.<sup>7,8</sup> A route to diagnosis describes the pathway a patient took, and the interactions made through the healthcare system, before receiving a cancer diagnosis.<sup>8</sup> In this report, routes to diagnosis were defined as emergency presentation, Two Week Wait, non-urgent or unknown route. The Two Week Wait referral system, whereby a GP urgently refers a patient to be seen within 2 weeks by a specialist, was set up in 2000 with the aim of achieving faster diagnosis for patients with suspected cancer. An emergency presentation includes diagnosis via any emergency service such as A&E admission or attendance, emergency GP Referral, emergency transfer or emergency consultant outpatient referral. Patients diagnosed by an emergency presentation generally have poor prognosis as their symptoms and stage of disease are more severe at the point that they engage with the healthcare system.<sup>9</sup> 36.5% of patients in the cohort were diagnosed via the Two Week Wait route, 30.0% of patients were diagnosed via an emergency presentation, 31.2% were diagnosed via a non-urgent route and 2.3% of patients had an unknown route. 'Non-urgent' route includes patients that were diagnosed via GP Referral (20.2% of the patients in the cohort), Other Outpatient (9.6%) or Inpatient Elective (1.4%). More detailed descriptions of these routes to diagnosis can be found in Appendix 1.

Figure 7 shows notable differences in mortality by route to diagnosis. Across all 3 short-term mortality timeframes, mortality rates were highest in ovarian cancer patients who were diagnosed via an emergency presentation, with 30.8% having died within 2 months from diagnosis, 13.2% within 2 to 6 months and 9.8% within 6 to 12 months. Women that were

diagnosed via the Two Week Wait referral system showed the lowest mortality rates for patients that died within 2 months (4.6%) and 2 to 6 months (5.9%) from diagnosis. Patients diagnosed via a non-urgent GP Referral generally had higher mortality as these patients may experience longer delays in diagnosis, allowing the disease more time to progress, leading to poorer survival.

Ovarian cancer patients with an unknown route to diagnosis show high mortality rates within 2 months from diagnosis (12.3%). An unknown route is assigned when there is no useful information found for the patient in the Hospital Episode Statistics (HES) data 6 months prior to diagnosis, or the Cancer Waiting Time (CWT) dataset. This could include patients who have received diagnosis or treatment in private hospitals. Other reports have found that patients with an unknown route to diagnosis have similar survival to other non-emergency routes.<sup>8</sup> However, patients in this cohort with 'non-urgent' routes show much lower mortality rates within 2 months from diagnosis compared to patients diagnosed with an unknown route (7.6%).

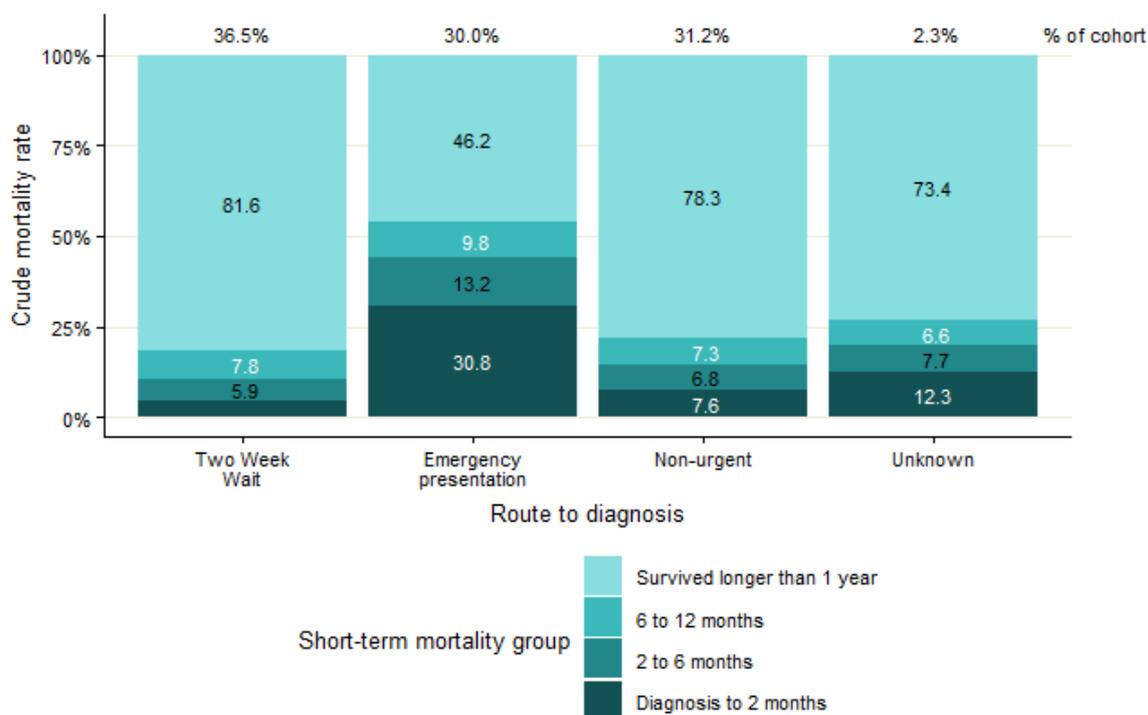


Figure 7: Short-term mortality in patients diagnosed with ovary, fallopian tube or primary peritoneal carcinomas by route to diagnosis, England 2013-2018

## Mortality variation by patient age at diagnosis

Figure 8 shows that short-term mortality was higher in patients who were of an older age at the point of diagnosis. Older patients are more likely to have more severe and more numerous comorbidities as well as a poorer performance status than younger patients, and therefore will be less likely to receive treatment with curative intent. 34.8% of patients aged 80 years and over died within 2 months following their diagnosis, compared to only 0.7% of patients aged 0-29 years. 95.6% of patients aged 0-29 years survived longer than 1 year.

## Short-term mortality in ovarian, fallopian tube and primary peritoneal carcinomas across England

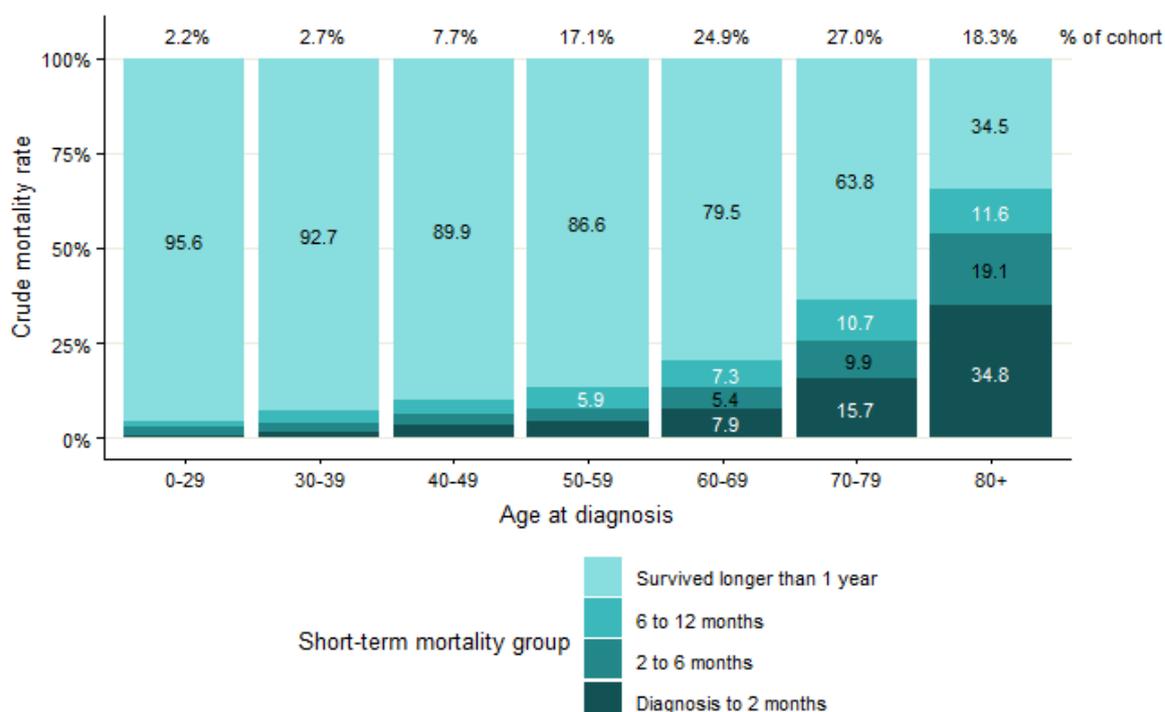


Figure 8: Short-term mortality in patients diagnosed with ovary, fallopian tube or primary peritoneal carcinomas by age at diagnosis, England 2013-2018

## Mortality variation by deprivation

Socioeconomic differences in ovarian cancer patient mortality may be due to differences in tumour morphology, patient knowledge around symptoms, access to a GP, or differences in treatment.<sup>10</sup> The Index of Multiple Deprivation (IMD) measures relative levels of deprivation in small geographical areas, to which all persons within that area are assigned the same deprivation level. The IMD takes into account many factors relating to low socioeconomic status including employment, education, skills and training, disability, crime, barriers to housing and services, living environment and income. Patients were assigned into ordered quintiles, based on their postcode at diagnosis, where 5 is the least deprived and 1 is the most deprived.

16.3% of women were living in the most deprived areas at the time of diagnosis compared to 21.8% of women living in the least deprived areas at the time of diagnosis. Figure 9 shows that the proportion of women who died within 2 months following diagnosis was slightly higher for those living in areas of greater deprivation than among women in areas of lower deprivation. 12.0% of ovarian cancer patients that were resident in the least deprived quintile died within 2 months following diagnosis, compared to 16.2% within the most deprived quintile.

Short-term mortality in ovarian, fallopian tube and primary peritoneal carcinomas across England

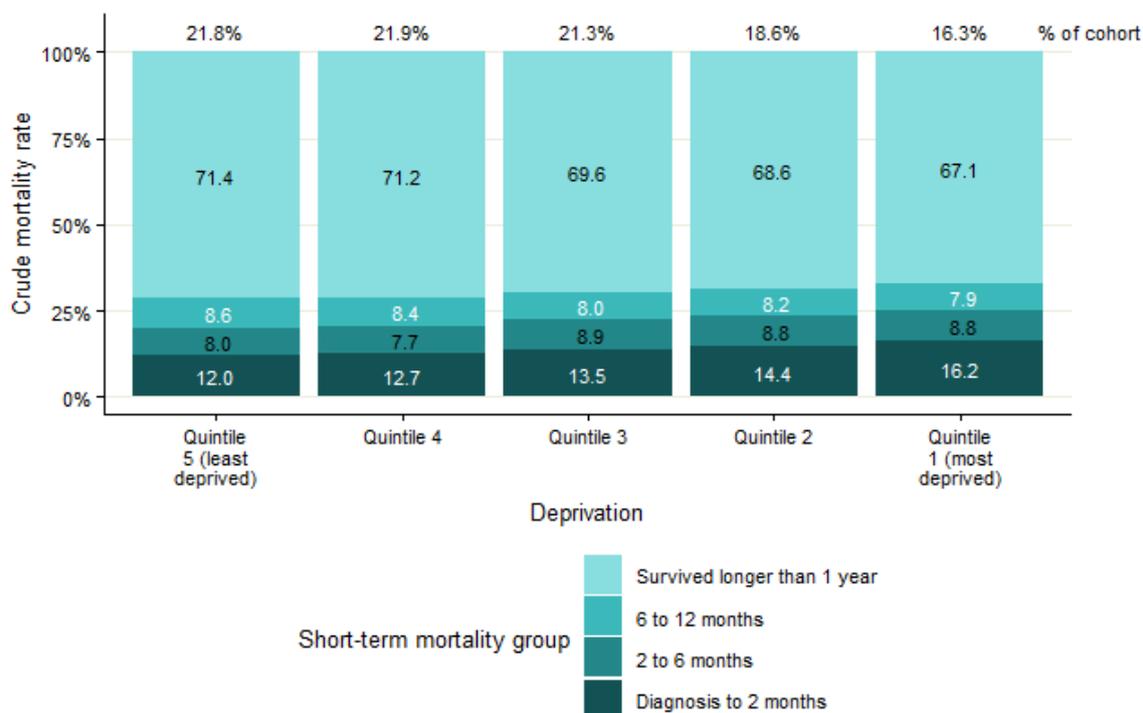


Figure 9: Short-term mortality in patients diagnosed with ovary, fallopian tube or primary peritoneal carcinomas by deprivation, England 2013-2018

## Mortality variation by ethnicity

Figure 10 displays that some variation in ovarian cancer patient mortality exists by ethnicity. 88.5% of patients in the cohort were of white ethnicity. 13.5% of white female patients died within 2 months following diagnosis. All other ethnicities had lower mortality rates within the same time period, particularly Asian women at 6.9%. Patients with an unknown ethnicity had the highest short-term mortality rates with 24.1% of patients dying within the first 2 months following diagnosis. Given the low number of patients recorded with non-white ethnicities in the cohort, it is possible that many patients with an unknown ethnicity are women of mixed or non-white ethnicities and that these ethnicities may have mortality rates much higher than presented in Figure 10.

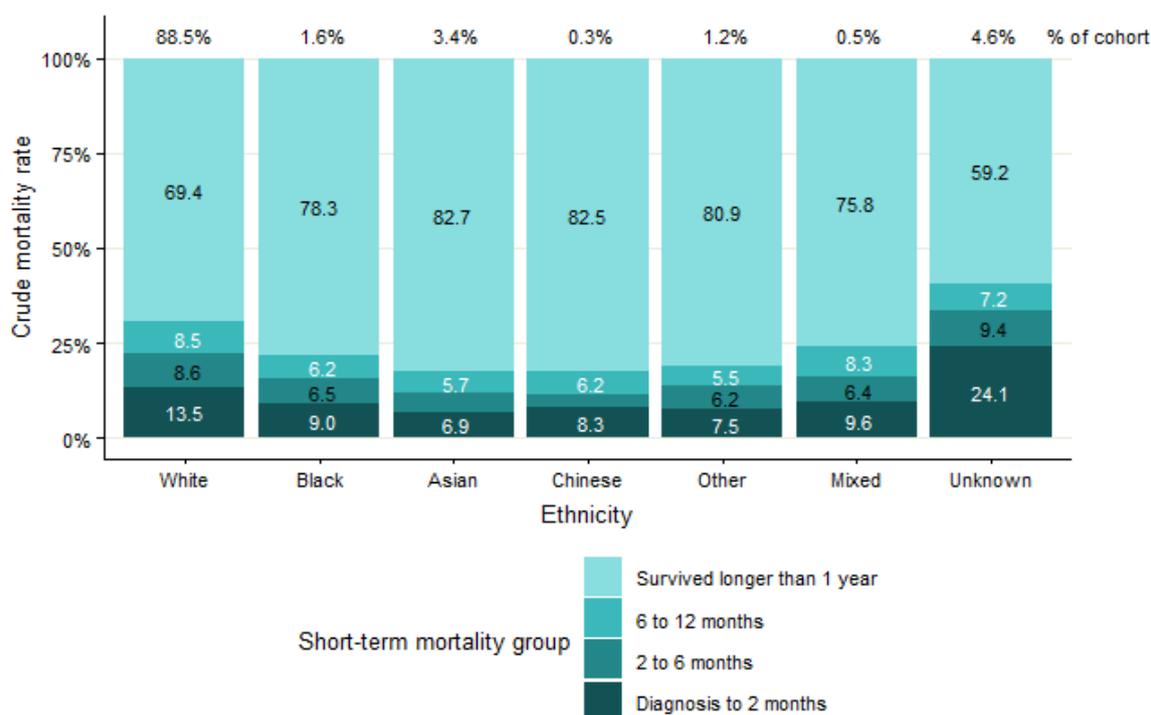


Figure 10: Short-term mortality in patients diagnosed with ovary, fallopian tube or primary peritoneal carcinomas by ethnicity, England 2013-2018

## Mortality variation by comorbidity

Comorbidities and cancer are more likely with an ageing population and may mean patients have fewer options for treatment.<sup>11</sup> Patients with severe comorbidities may be too unwell to receive curative treatment and therefore show poorer survival. To investigate differences in short-term mortality by comorbidity in this report the Charlson comorbidity index was used. This index describes the burden of pre-specified comorbid conditions within patients, and was developed to predict one-year mortality in hospital patients.<sup>12</sup> Comorbidities included in the index, and scores for each condition are listed in Appendix 11. Comorbidity scores were assigned to tumours based on the number and burden of comorbidities recorded within the HES admitted patient care dataset or cancer registry data, occurring between 3 and 27 months prior to the cancer diagnosis of interest. Higher scores are indicative of a greater burden of comorbid disease. A Charlson comorbidity index score of 0 indicates that a patient did not have any other cancers or any of the comorbidities listed in Appendix 11 recorded in the cancer registry or HES admitted patient care dataset within the time period specified. This means that patients with comorbid conditions not considered in Appendix 11 or only documented within an outpatient or primary care setting will have a score of 0. A score of 1 indicates that a patient did have a comorbidity recorded within the specified time period, and a score of 2 or higher indicates that a patient has multiple or a single severe comorbidity recorded within the time period. Where a patient could not be linked to HES, a Charlson score was assigned as 'not recorded'. Please see Appendix 1 for more details about how Charlson comorbidity has been defined in this report.

84.3% of patients in the cohort did not have any record in HES admitted patient care or cancer registry data of pre-specified comorbidity between 3 and 27 months prior to the cancer

diagnosis of interest. 8.1% of patients in the cohort had a comorbidity index score of 1 and 2.8% of patients had a comorbidity score of more than 2. The high proportion of patients with no recorded comorbidity indicates that inpatient HES is not a sensitive process for capturing comorbidity in this cohort and likely markedly underreports it. Figure 11 shows that short-term mortality was greater in patients with higher burdens of comorbidity. For example, 11.9% of ovarian cancer patients with no recorded comorbidities, died within 2 months following their diagnosis. Conversely, 34.9% of ovarian cancer patients with a comorbidity score of more than 2, died within 2 months following their ovarian cancer diagnosis.



Figure 11: Short-term mortality in patients diagnosed with ovary, fallopian tube or primary peritoneal carcinomas by Charlson comorbidity, England 2013-2018

## Mortality variation by WHO performance status

Performance status is a measure of a patient’s ability to undertake daily living activities. This is captured as a score between 0 and 4, where 4 indicates complete disability and total confinement to a bed or chair. Performance status is known to be an important factor in ovarian cancer survival and may explain why a patient did not receive treatment or a histological diagnosis. In this cohort, 63.4% of patients did not have their performance status recorded at diagnosis. Figure 12 shows that of those patients that did have a performance status recorded at diagnosis, patients with higher values (i.e. less physical function) had higher rates of short-term mortality. 2.4% of patients with a performance status of 0 died within 2 months following diagnosis, compared to 62.7% of patients with a performance status of 4.



Figure 12: Short-term mortality in patients diagnosed with ovary, fallopian tube or primary peritoneal carcinomas by performance status, England 2013-2018

## Mortality variation by treatment

Based on the type of treatment and the order in which treatment was received, each patient was assigned to one of the following treatment categories following the method outlined in the OCAFP Geographic variation in ovarian, fallopian tube and primary peritoneal cancer treatment in England report:<sup>1</sup>

1. No surgery or chemotherapy
2. Primary surgery with adjuvant chemotherapy (i.e. surgery followed by chemotherapy)
3. Neoadjuvant chemotherapy with interval debulking surgery (i.e. chemotherapy followed by surgery)
4. Chemotherapy but no surgery
5. Primary surgery but no chemotherapy

The OCAFP treatment report found that women with stage 4, or unknown stage of disease at time of diagnosis, and tumours with a miscellaneous and unspecified morphology were much less likely to receive any treatment. Women with comorbidities were less likely to receive surgery, and older women were more likely to have no treatment or only chemotherapy.<sup>1</sup>

In this report 20.3% of patients in the cohort did not have any treatment recorded between 1 month prior and 9 months following diagnosis. Figure 13 shows that most patients that did not receive any surgery or chemotherapy treatment died within 2 months following diagnosis (56.9%). This could have been because patients presented with advanced disease, high burden

## Short-term mortality in ovarian, fallopian tube and primary peritoneal carcinomas across England

of comorbidity or poor performance status, limiting treatment options. Very few patients that died within 2 months from diagnosis received both chemotherapy and surgery (0.3%).

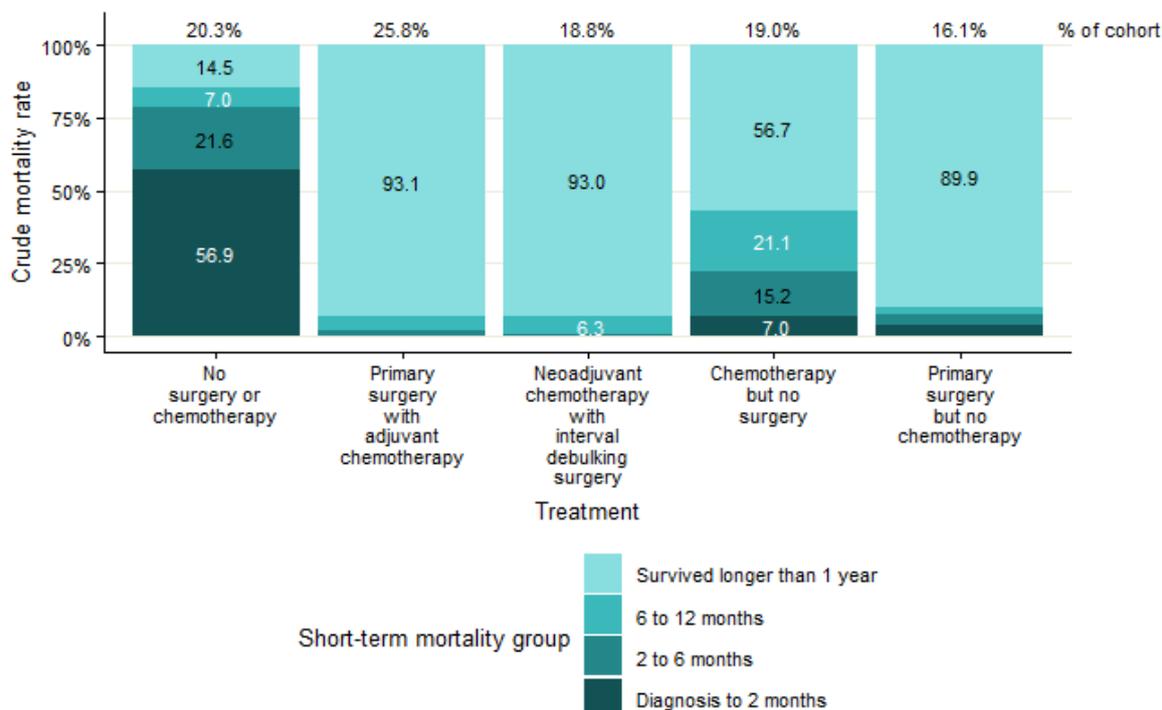


Figure 13: Short-term mortality in patients diagnosed with ovary, fallopian tube or primary peritoneal carcinomas by treatment, England 2013-2018

## Mortality variation by cancer centre

Cancer Units provide diagnostic services for their local populations and refer cases of suspected or confirmed ovarian cancer to their local specialist gynaecological cancer centre. Cancer centres house specialist gynaecological oncology MDTs and provide diagnostic and treatment services for patients referred from local Cancer Units. In 2021 there were 40 specialist gynaecological cancer centres in England. 55.8% of patients in this cohort were diagnosed at a trust that housed a cancer centre in 2021. Figure 14 shows that 18.0% of patients diagnosed at a trust that did not house a cancer centre died within the first 2 months following diagnosis, compared to only 10.1% of patients that were diagnosed at a trust that had a cancer centre.

Short-term mortality in ovarian, fallopian tube and primary peritoneal carcinomas across England

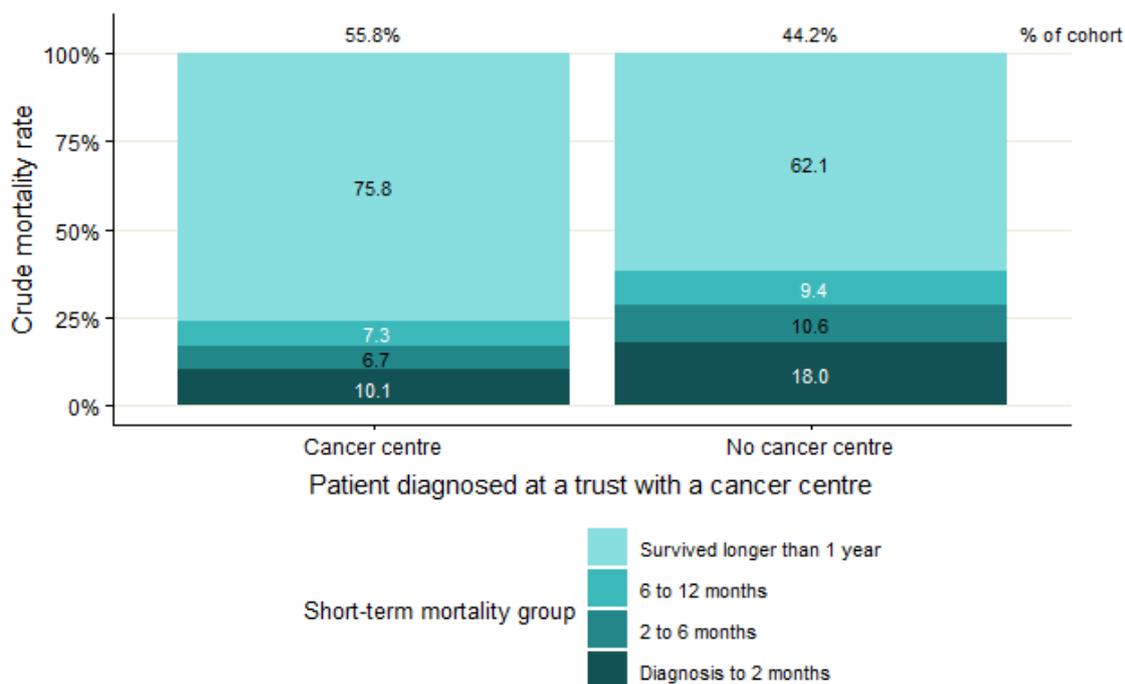


Figure 14: Short-term mortality in patients diagnosed with ovary, fallopian tube or primary peritoneal carcinomas by whether the trust at diagnosis has a cancer centre, England 2013-2018

Figure 15 displays the percentage of patients in the cohort by route to diagnosis and availability of a specialist gynaecological cancer centre at the trust of diagnosis. There were more emergency presentations among ovarian cancer patients who are diagnosed at a trust without a cancer centre than those who were diagnosed at a trust with a cancer centre, at 57.5% compared to 48.3% respectively. This figure is only based upon ovarian cancer patients who died within 1 year of diagnosis.

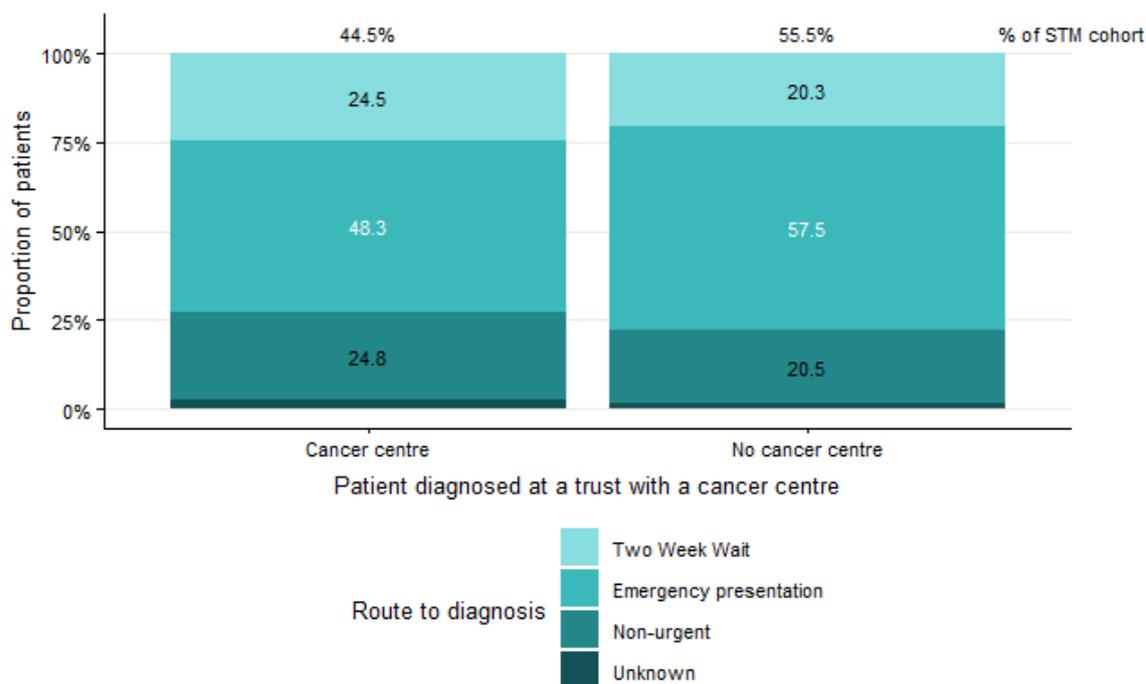


Figure 15: Proportion of short-term mortality ovary, fallopian tube or primary peritoneal carcinoma patients by route to diagnosis and whether the trust at diagnosis has a cancer centre, England 2013-2018

## Mortality variation by GP to population ratio

The ratio of GPs to the local general population could impact on the time to patient referral and diagnosis, and thereby prognosis. The mean number of GPs per Clinical Commissioning Group (CCG) during 2018 was 189 (min=39, max=927). The GP to population ratio was calculated as the number of registered GPs per 10,000 population in a CCG in 2018. A lower GP to population ratio indicates that there were fewer GPs per 10,000 population in the CCG. The average GP to population ratio across the 195 CCGs was 6.6, with values ranging from 3.5 to 10.8. The GP to population ratios were split into tertiles for analysis; low=3.53-5.94, medium=5.95-7.09, high=7.10-10.84. Figure 16 shows that 13.8% of patients that died within 2 months from diagnosis lived in a CCG that had a low GP to population ratio per 10,000, compared to 13.5% of patients that lived in a CCG that had a high GP to population ratio per 10,000. When looking at urgent referrals, *Mendonca et al* (2018) found that there was no association with the number of patients registered with a GP, or a GP practice location (rural vs urban), but that there was some variation in urgent referrals by practice characteristics such as age of GPs.<sup>13</sup>

Short-term mortality in ovarian, fallopian tube and primary peritoneal carcinomas across England

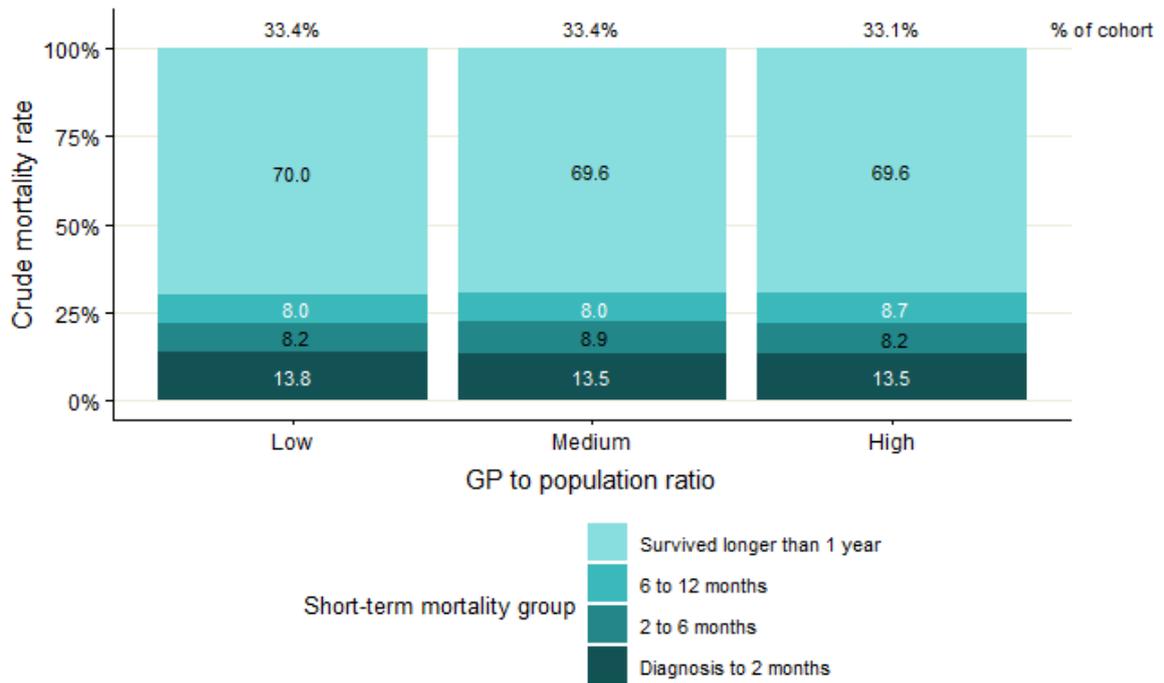


Figure 16: Short-term mortality in patients diagnosed with ovary, fallopian tube or primary peritoneal carcinomas by GP to population ratio, England 2013-2018

## Adjusted mortality rates

P-values from chi-squared tests found mortality was significantly different ( $p \leq 0.001$ ) across all 3 short-term mortality time periods by the following factors: tumour site, tumour morphology, stage at diagnosis, basis of diagnosis, route to diagnosis, treatment, patient age at diagnosis, ethnicity, comorbidity, WHO performance status and whether the trust at diagnosis housed a specialist gynaecological cancer centre (Appendix 2, Table 2). Short-term mortality was significantly different by IMD quintile only for patients who died within 2 months ( $p \leq 0.001$ ), or 2 to 6 months ( $p = 0.004$ ) following a diagnosis. GP to population ratio was not significantly associated with short-term mortality.

Factors that were found to have a significant difference in mortality were considered for inclusion in the mixed effects logistic regression models to estimate the association of factors within each of the short-term mortality time periods. *A priori* knowledge and model fit also led factor selection. The multivariable analysis model adjusted for the following covariates: age at diagnosis, tumour morphology, stage at diagnosis, deprivation quintile, ethnicity, comorbidity, route to diagnosis and whether the trust at diagnosis housed a specialist gynaecological cancer centre. For diagnosis to 2 months only, basis of diagnosis was also included to adjust for lead time bias, whereby patients who received a histological diagnosis will likely be those who lived long enough to receive a tissue biopsy (up to 2 weeks may elapse between an initial clinical and subsequent histological diagnosis). Trust at diagnosis was also included as a random effect accounting for patients clustered within hospital trusts.

Tumour site was not included in the models as *a priori* knowledge suggested tumour morphology was a better measure of tumour type. Due to the high percentage of missing performance status data, this covariate was not included in the logistic regression models. A sensitivity analysis is available in Appendix 9 which investigates the association between performance status at diagnosis and ovarian cancer patient short-term mortality between 0 and 2 months from diagnosis. Treatment was also not adjusted for in the models based on *a priori* knowledge that many patients who exhibit short-term mortality will not receive any treatment. Treatment would also act as a mediator in many relationships with other covariates and may therefore bias the estimates of the models if it was included.

Results from the maximally adjusted and the minimally adjusted models (without route to diagnosis and whether the trust at diagnosis housed a cancer centre) are displayed in Appendices 3-5.

Adjusted mortality rates from the mixed effects logistic regression models show that mortality was consistently higher across all short-term mortality groups for patients diagnosed with 'miscellaneous and unspecified', 'mucinous carcinoma', 'non-specific site' and 'other malignant epithelial' morphologies compared to tumours of a 'serous carcinoma' morphology. Odds ratios for these groups, relative to 'serous carcinoma', ranged between 1.7 (95% CI 1.3-2.2) in patients with 'mucinous carcinoma' morphology and 3.0 (95% CI 2.5-3.5) in patients with 'miscellaneous and unspecified' morphology for those that died within 2 months of diagnosis. Patients with a 'clear cell carcinoma' morphology also showed significantly higher odds of dying

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within 2 to 6 months (OR 1.9 95% CI 1.4-2.6) or 6 to 12 months (OR 2.6 95% CI 2.1-3.2) compared to patients with 'serous carcinoma' morphologies. Across all 3 short-term mortality groups, women with a 'sex cord-stromal and germ cell' morphologies showed the lowest odds of mortality compared to 'serous carcinomas'.

Adjusted odds ratios from the maximally adjusted model investigating mortality between 0 and 2 months from diagnosis show that patients diagnosed clinically (OR 2.4 95% CI 2.1-2.8) or by cytology (OR 2.2 95% CI 1.9-2.4) are significantly more likely to die within 2 months from diagnosis than patients diagnosed via histological examination.

Adjusted mortality rates also show the odds of short-term mortality were significantly higher in women whose cancer was more advanced at diagnosis. Patients diagnosed at stage 4 showed the highest risk of mortality compared to patients diagnosed at stages 1-3 or an unknown stage (0 to 2 months: OR 10.2 95% CI 7.6-13.7, 2 to 6 months: OR 16.8 95% CI 12.3-22.9, 6 to 12 months: OR 10.8 95% CI 8.6-13.7). Patients with an unknown stage at diagnosis also had a higher risk of mortality than patients diagnosed within stages 1-3 (0 to 2 months: OR 9.5 95% CI 7.1-13.7, 2 to 6 months: OR 11.6 95% CI 8.5-15.9, 6 to 12 months: OR 7.3 95% CI 5.8-9.4).

Patients diagnosed via an emergency presentation had the highest likelihood of mortality across all short-term mortality time periods compared to patients diagnosed via a Two Week Wait route (0 to 2 months: OR 4.3 95% CI 3.9-4.8, 2 to 6 months: OR 2.4 95% CI 2.1-2.6, 6 to 12 months: OR 1.7 95% CI 1.6-1.9). Patients diagnosed via a non-urgent route also showed significantly higher odds of mortality during 0 to 2 months (OR 1.5 95% CI 1.3-1.7) and 2 to 6 months (OR 1.2 95% CI 1.1-1.4) than patients diagnosed via a Two Week Wait route.

Short-term mortality was significantly higher in patients who were of an older age at the point of diagnosis across all short-term mortality groups following adjustment for confounding variables. Odds of death were highest for patients aged 80 years and over at diagnosis when compared to patients aged 70-79 years (0 to 2 months: OR 1.4 95% CI 1.3-1.6, 2 to 6 months: OR 2.3 95% CI 2.1-2.6, 6 to 12 months: OR 1.7 95% CI 1.5-1.9). All younger age groups had a significantly lower odds of short-term mortality when compared to patients aged 70-79 years.

Logistic regression models showed that mortality risk increased with a more deprived deprivation quintile. Patients within the most deprived quintile had a 50% higher risk of mortality within 0-2 months from diagnosis and 40% higher risk of mortality within 2 to 6 months from diagnosis when compared to patients in the least deprived quintile (0 to 2 months: OR 1.5 95% CI 1.4-1.8, 2 to 6 months: OR 1.4 95% CI 1.2-1.6). The differences in mortality rates by deprivation quintile were not significant for patients that died within 6 to 12 months.

After controlling for confounding variables, minimal variation in ovarian cancer patient short-term mortality remained across ethnicity groups, though patients of an unknown ethnicity still had significantly higher odds of mortality within 2 months following diagnosis compared to patients of white ethnicity (OR 1.5 95% CI 1.3-1.8). Patients that died within 0 to 2 (OR 0.7 95% CI 0.5-0.9) or 2 to 6 months (OR 0.7 95% CI 0.5-0.9) had significantly lower odds of mortality if they were of Asian ethnicity compared to patients of white ethnicity.

## Short-term mortality in ovarian, fallopian tube and primary peritoneal carcinomas across England

Logistic regression models showed that patients with a recorded comorbidity (Charlson score of 1, 2 or >2), or a Charlson score not recorded, showed higher odds of mortality compared to patients with a Charlson score of 0. Across all short-term mortality periods, patients with a Charlson comorbidity score of more than 2 showed significantly higher odds of mortality than patients with a Charlson score of 0 (0 to 2 months: OR 1.6 95% CI 1.3-1.9, 2 to 6 months: OR 1.8 95% CI 1.4-2.2, 6 to 12 months: OR 1.5 95% CI 1.2-1.9).

Multivariable models that adjusted for confounding factors found that patients diagnosed in a trust that did not have a specialist gynaecological cancer centre had significantly higher odds of short-term mortality only between 2 and 6 months following diagnosis than patients who were diagnosed in a trust that did have a cancer centre (OR 1.2 95% CI 1.1-1.4).

## Mortality by Cancer Alliance

Mortality rates by Cancer Alliance at diagnosis (using the 19 Alliances as defined for England in 2018) were found to be significantly different across all short-term mortality time periods ( $p \leq 0.001$ ) (Appendix 2, Table 2). To estimate the magnitude of variation in short-term mortality between the Alliances, crude and adjusted mortality rates were presented in funnel plots in Figures 17-22 (also tabulated in Appendices 6-8).<sup>14</sup>

Each point on the funnel plot represents a Cancer Alliance. The number of ovarian cancer patients diagnosed in the Cancer Alliance between 2013 and 2018 is shown on the horizontal axis, and the crude or adjusted mortality rate is shown on the vertical axis. The average mortality rate for ovarian cancer patients in England between 2013 and 2018 is indicated by the red horizontal line. A Cancer Alliance with a mortality rate above this average line suggests that patients in this Cancer Alliance have a higher mortality rate than expected for the size of the Alliance, and vice versa for points below the line. The 2 pairs of dashed lines on the funnel plot indicate the bounds of statistical confidence around the average. The inner lines represent 2 standard deviations (SD) from the population average and the outer set represents 3 SDs, being approximately equivalent to 95.0% and 99.7% confidence intervals respectively. Observations outside of these lines had a confidence interval that did not include the average mortality rate for the cohort and may therefore indicate a systematic deviation in clinical practice that warrants further investigation. However, some random variation in short-term mortality is expected between Alliances such that some points will sit outside the dashed lines through chance alone. This should be taken into consideration when interpreting funnel plots (for example, five out of every 100 observations are likely to lie outside the 2 SD funnel). Please see Appendix 1 for a more detailed methodological description.

## Mortality by Alliance within 2 months from diagnosis

The average crude mortality rate for ovarian cancer patients in the first 2 months following diagnosis across England was 13.3%. Figure 17 shows that some variation did exist between Cancer Alliances. 4 Cancer Alliances fell 2 SDs below the population average, indicating that patients diagnosed within these Alliances have a significantly lower mortality rate within the first 2 months following diagnosis. 3 Cancer Alliances fell 2 SDs above the population average, indicating that patients diagnosed within these Alliances have a significantly higher mortality rate within the first 2 months following diagnosis. The adjusted average mortality rate for ovarian cancer patients in the first 2 months following diagnosis was 13.5%. Figure 18 shows that after adjustment for the covariates of interest (basis of diagnosis, age at diagnosis, tumour morphology, stage at diagnosis, route to diagnosis, deprivation quintile, ethnicity, comorbidity, whether the trust at diagnosis housed a specialist gynaecological cancer centre and trust at diagnosis as a random effect), some geographical variation remained although it was reduced. There were no Cancer Alliances that had an adjusted mortality rate outside of 2 standard deviations. Due to the reduced variation we can conclude that some of the geographical variation can be partly explained by the factors adjusted for in the model.

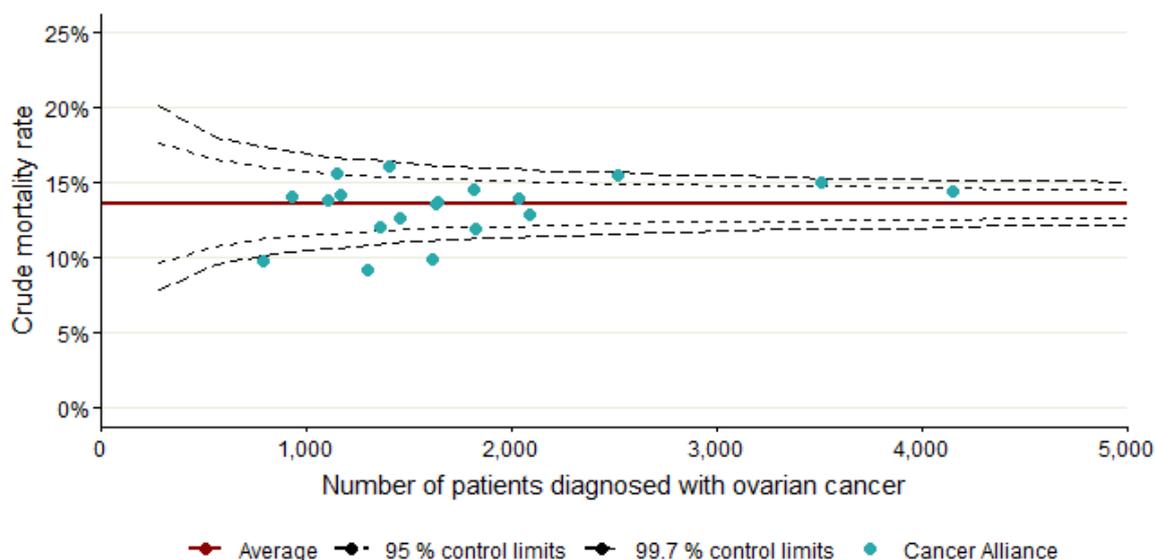


Figure 17: Crude short-term mortality rate within 2 months of an ovarian cancer diagnosis by Cancer Alliance, England 2013-2018

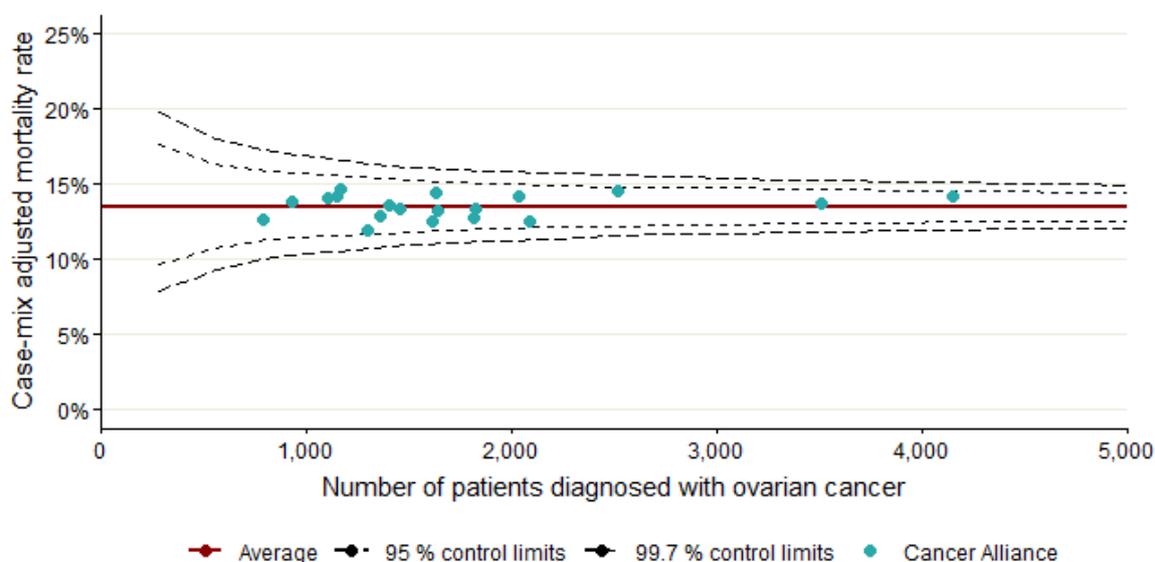


Figure 18: Case-mix adjusted short-term mortality rate within 2 months of an ovarian cancer diagnosis by Cancer Alliance, England 2013-2018

## Mortality by Alliance within 2 to 6 months from diagnosis

The crude average mortality rate for ovarian cancer patients who survived longer than 2 months but died within 6 months following diagnosis was 9.4% and the case-mix adjusted average mortality rate was 9.6%. Crude mortality rates in Figure 19 show that there were 4 Cancer Alliances that fell 2 SDs below the population average and 3 Alliances that were 2 SDs above the population average. Figure 20 shows that controlling for the covariates of interest reduced variation between Alliances such that none had significantly different rates to the average.

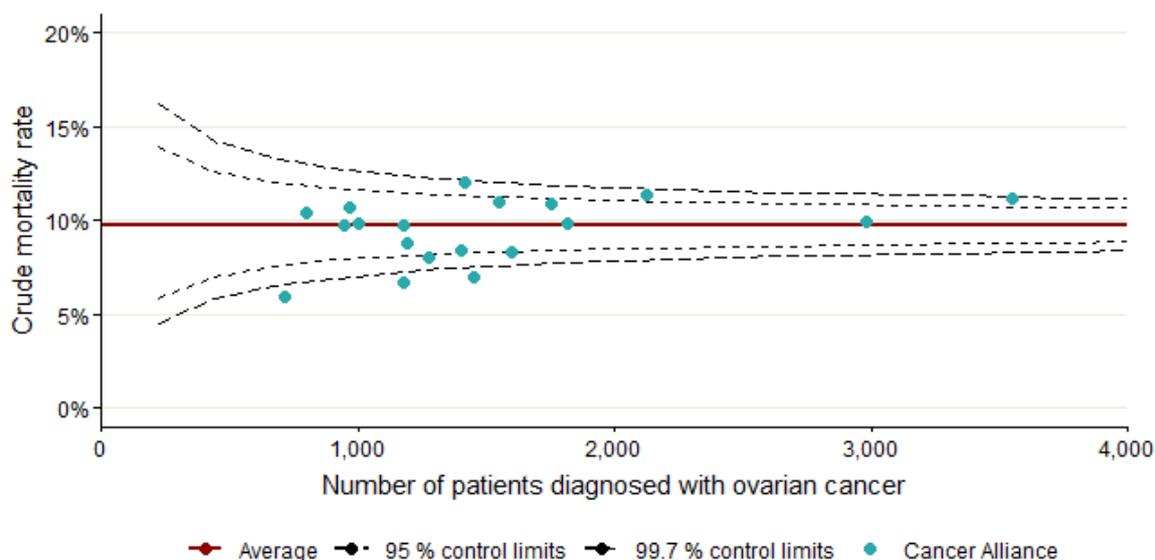


Figure 19: Crude short-term mortality rate within 2 to 6 months of an ovarian cancer diagnosis by Cancer Alliance, England 2013-2018

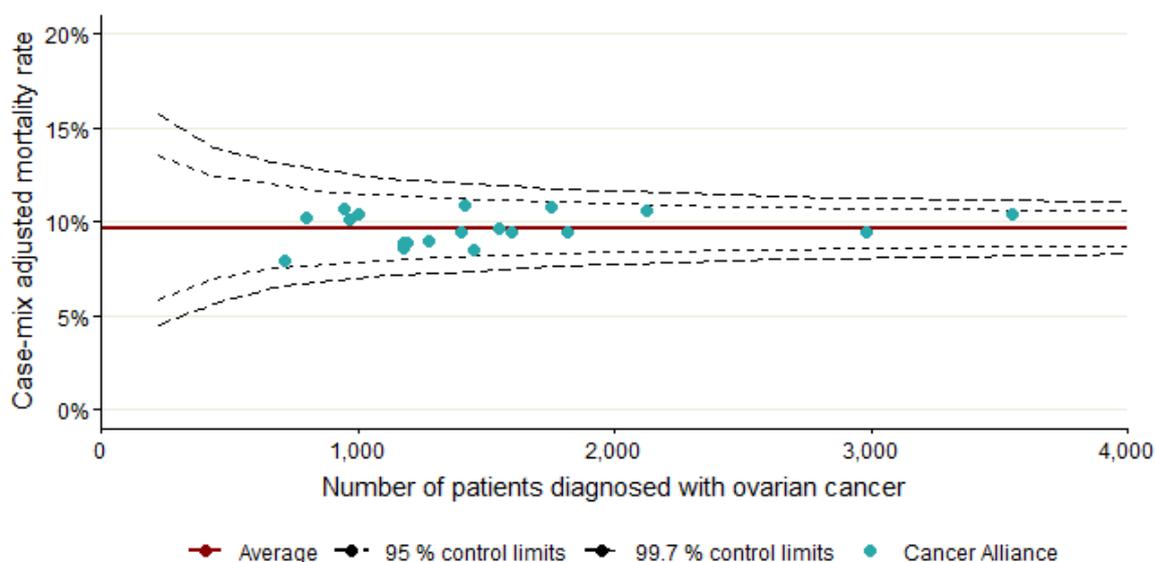


Figure 20: Case-mix adjusted short-term mortality rate within 2 to 6 months of an ovarian cancer diagnosis by Cancer Alliance, England 2013-2018

## Mortality by Alliance within 6 to 12 months from diagnosis

Both the crude and case-mix adjusted average mortality rate for ovarian cancer patients who survived longer than 6 months but died within 12 months following diagnosis was 10.5%. Figure 21, displaying crude mortality rates for the period 6 to 12 months following diagnosis, shows that there were 4 Cancer Alliances that had a mortality rate below 2 SDs of the cohort average. There are also 3 Alliances with a mortality rate 2 SDs above the average. After case-mix adjustment (Figure 22) some variation remains with one Alliance falling above 2 standard deviations from the average. All other Alliances had mortality rates inside of 2 standard

deviations from the average suggesting that most of the differences in short-term mortality between Alliances was due to confounding factors that have been adjusted for.

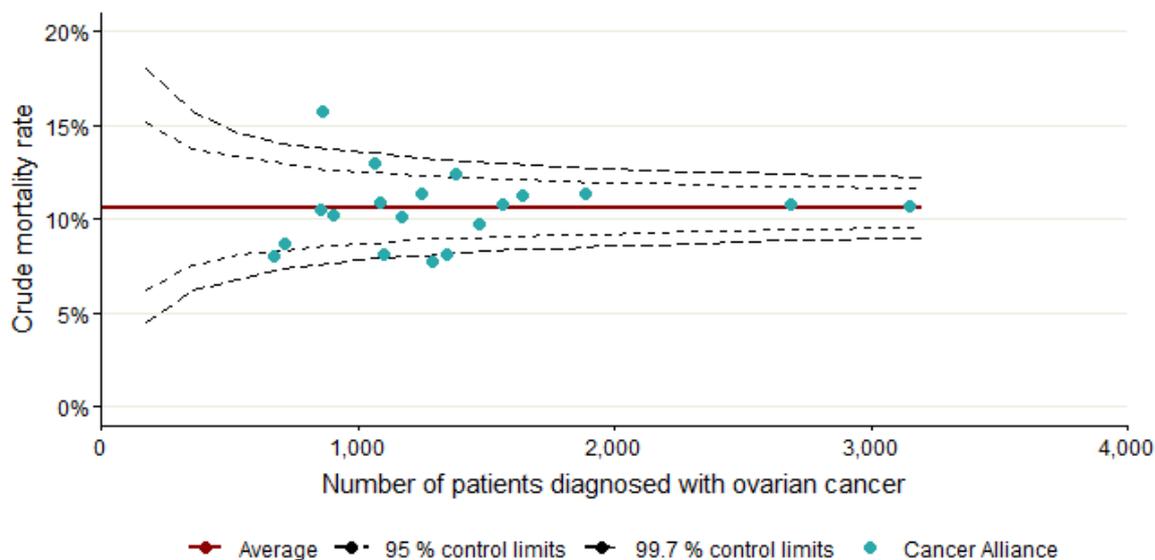


Figure 21: Crude short-term mortality rate within 6 to 12 months of an ovarian cancer diagnosis by Cancer Alliance, England 2013-2018

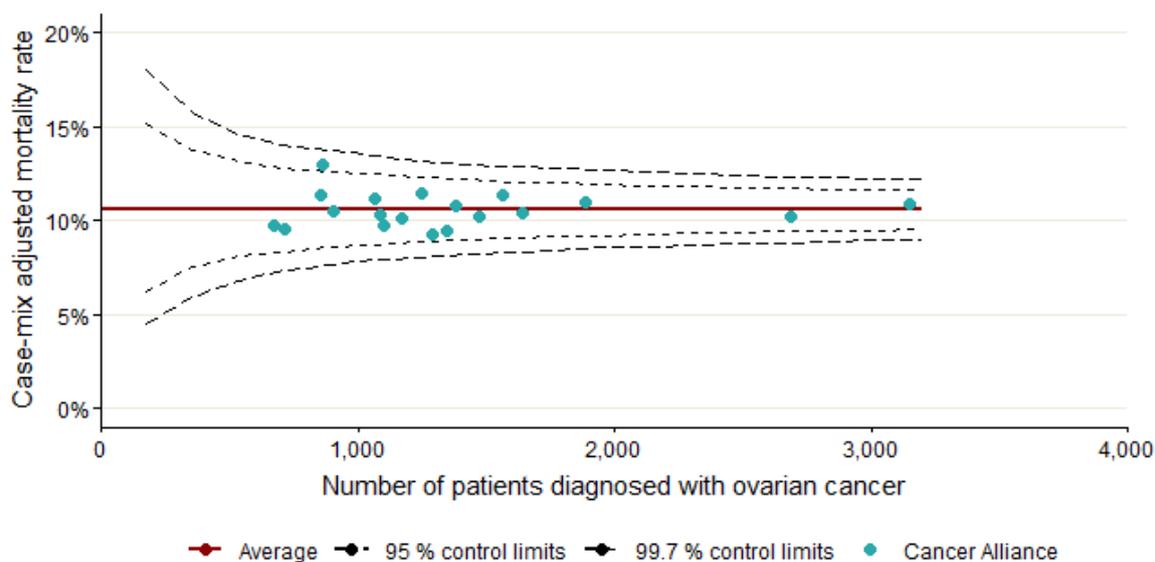


Figure 22: Case-mix adjusted short-term mortality rate within 6 to 12 months of an ovarian cancer diagnosis by Cancer Alliance, England 2013-2018

## Conclusion

Short-term mortality rates for ovarian cancer patients across the first year after diagnosis remain high, particularly within the first 2 months. Mortality rates within 1 year of diagnosis from this report (30.3%) are similar to the previous NCIN report covering 2006 to 2008 (31%).<sup>2</sup> However, the cohort in this report does exclude borderline tumours, which have a very low mortality rate, and includes primary peritoneal cancers, which have a high rate of short-term mortality, suggesting that outcomes of mortality within 1 year of diagnosis may have improved more than the 0.7% difference reported. Mortality rates within 1 year of diagnosis have also improved slightly from the NCIN report covering 2008 to 2010, which had a closer matching cohort definition to this report and found that 36% of patients died within 1 year following diagnosis.<sup>3</sup>

Mixed effects logistic regression models examined factors that were associated with ovarian cancer patient mortality across the first year after diagnosis. Most variation in mortality rates between women of different tumour characteristics and patient demographics was found to exist in the shortest time period investigated; diagnosis to 2 months.

Analysis identified patients about which little is known, due to missing data, who have a consistently higher risk of dying within the first year following diagnosis. The poor data quality may be due to their short survival times or poor performance status making diagnostic investigations inadvisable, meaning there is no pathological confirmation of their diagnosis, no staging data and no morphology data for their tumour. These poor outcomes are reflected in the OCAFP Treatment report, where the same cohort are also the least likely to receive effective anticancer treatments including chemotherapy and surgery.<sup>1</sup> Additionally, mixed effects logistic regression models found that patients with a cytology or clinical basis of diagnosis were found to have a significantly higher risk of death within the first 2 months after diagnosis compared to patients who had a histological diagnosis.

There are also distinct patient and tumour characteristics linked with a higher risk of dying in the first year following an ovarian cancer diagnosis. These include age (with older patients having a higher risk of dying), stage (with stage 4 patients having the highest risk of dying), a higher burden of comorbidities, emergency presentation and a more deprived IMD quintile. For those women in the most deprived quintile, the risk of dying from ovarian cancer within the first 2 months following diagnosis significantly increases by 50% when compared to women in the least deprived quintile. The low percentage of patients diagnosed with ovarian cancer living in the most deprived areas may indicate underdiagnosis in this group, possibly due to barriers to accessing care.

The data shows that patients diagnosed via an emergency presentation had the highest likelihood of mortality across all short-term mortality time periods. It is known that patients diagnosed from emergency presentations generally suffer worse outcomes due to advanced stage of disease.<sup>15</sup> Analysis also shows that women referred to diagnosis by the non-urgent route have significantly higher rates of short-term mortality within 0 to 2 months and 2 to 6 months from diagnosis than those placed on an urgent GP referral by Two Week Wait. This suggests either that women are not being referred urgently when they should be, are not being

seen quickly enough through a non-urgent referral or are being referred to a different specialty for assessment of the non-specific symptoms of ovarian cancer, delaying the diagnostic process and resulting in poorer prognosis. A supplementary graph of route to diagnosis by Cancer Alliance for ovarian cancer patients with short-term mortality is displayed in Appendix 10.

The data also shows that whether or not women are diagnosed within a specialist gynaecological cancer centre, with the more specialist care this offers, impacts on their risk of dying. Within 2 months of diagnosis nearly twice as many women (18%) diagnosed at a trust that did not have a cancer centre die within 2 months. After adjustment for confounding variables, this effect remained significant for patients dying within 2 to 6 months from diagnosis. This could be because diagnosis and progression to first treatment pathway is more efficient if the patient is diagnosed by a trust with a gynaecological cancer centre. This may partly be due to a greater awareness of ovarian cancer amongst other services within the hospital, such as care of the elderly, gastroenterology, colorectal surgery, respiratory teams etc.

Although some variation in short-term mortality exists between Cancer Alliances, case-mix adjusted mortality rates suggest that much of this variation can be explained by the different patient populations, rather than actual geographical differences in diagnosis and treatment for ovarian cancer patients between Cancer Alliances. This is in contrast to other indicators, including the variation in survival at CCG level found in the OCAFP Profile report<sup>1</sup>. It is therefore possible that any geographic variation that does exist has a smaller footprint than a Cancer Alliance. Although the OCAFP profile report found large differences at Cancer Alliance level for net survival rates, the methodology in this report does differ displaying mortality rates as opposed to net survival rates. Furthermore, the net survival rates in the profile report are only standardised by patient age at diagnosis. The mortality rates in this report adjust for many additional variables which may help to explain some of the short-term mortality variation seen at Alliance level e.g. stage at diagnosis or route to diagnosis. Both reports found that South East London Cancer Alliance had the lowest ovarian cancer patient short-term mortality rate and South Yorkshire, Bassetlaw, North Derbyshire and Hardwick Cancer Alliance had the highest rate. In addition, the Alliances that were less likely to deliver any treatment from the OCAFP treatment report show greater rates of short-term mortality in this report.<sup>1</sup>

In conclusion, the data presented here shows the difference diagnosing women at an early stage makes, and the benefits of specialist provision. It also demonstrates worrying inequalities in outcomes for women from poorer backgrounds. Identifying how to ensure all women have timely access to appropriate treatment and addressing any barriers they face will be critical in reducing the number of women dying within the first year of diagnosis. Future research could examine the significance of comorbidities using patient frailty, as described by *Gilbert et al* (2018), as opposed to the Charlson index which demonstrates an underestimate of comorbidities in this cohort of patients.<sup>16</sup> In addition, the differences in short-term mortality between women diagnosed at specialist gynaecological cancer centres vs those that are not warrants further investigation. Finally, future research could further investigate variation in short-term mortality at a more granular geographical level e.g. trust.

## Limitations

### Data completeness

Missing data was evident for performance status (63.4%), Charlson comorbidity index (0.7%), ethnicity (4.6%), routes to diagnosis (2.3%) and stage at diagnosis (16.9%). Missing data can still provide useful insight for some covariates, for example patients with an unknown stage at diagnosis could indicate the patient was too unwell to receive histological staging. For covariates with small proportions of missing data, missing cases were grouped in to an 'unknown' bucket. This allows for patients with missing data to be included in analyses, however care should be taken during interpretation as missing data can lead to biased estimates and invalid conclusions, due to either inaccurate estimates or heterogeneity in the cases with missing data.<sup>17</sup> The percentage of missing data for performance status was much higher, at over half of the cases. For this reason, performance status was included only by way of a sensitivity analysis as reported in Appendix 9.

### Charlson comorbidity scores

Charlson comorbidity scores were defined for each tumour by linking to non-ovarian primary cancers in the cancer registry or pre-defined comorbid medical conditions documented within an inpatient setting prior to the diagnosis of ovarian cancer. A list of medical conditions considered as comorbidities and the score assigned to each is described in Appendix 11. This list is not exhaustive. As such, the Charlson comorbidity score may be an underestimate of a patient's true comorbidity burden. This derivation is such that the score is dependent on the recording of particular diagnoses (listed in Appendix 11) during patient admission, and may therefore underestimate the burden of comorbidity by missing diagnoses that are exclusively documented in outpatient or primary care settings, are not listed in Appendix 11 or occur outside of the time period of between 3 and 27 months prior to the cancer diagnosis of interest. However, a comparison of Charlson comorbidity indexes derived for a fixed general population cohort of adults aged >20 years found that an index based on secondary care data performed at least as well as one that utilised primary care data for the prediction of case-mix adjusted all-cause mortality.<sup>18</sup>

Despite this, the index does not reflect the true burden of all comorbid disease that may influence clinical decision making. In addition to potential limitations of the index itself, in relation to ovarian cancer, 84.3% of patients in the cohort were assigned a Charlson comorbidity score of zero, representing patients without any record of another primary cancer in the cancer registry or a predefined comorbid medical condition documented within an inpatient setting within the specified time period. That more than four-fifths of tumours in the cohort received a comorbidity score of zero sits at odds with the age profile of the ovarian cancer cohort, and research elsewhere for other tumour sites that demonstrated a broad range of comorbid medical conditions.<sup>19</sup> Nevertheless, the Charlson comorbidity index captures at least some of the variation in the short-term mortality, whereby patients with higher scores were reported as having higher rates of short-term mortality.

### Residual confounding

The logistic regression models attempt to control for bias by cofounder adjustment of numerous patient demographics and tumour characteristics between Cancer Alliances that might

confound the main association under study. Despite this adjustment, there is still likely to be some residual confounding remaining which has not been accounted for. Some of the differences seen may be attributable to residual confounding rather than real disparities in clinical practice, such as geographic differences in patient frailty or treatment which have not been adjusted for in the models.

## Geographies

Cancer Alliances and CCGs (used to assign GP to population ratio) were derived according to the residence of patients at the time of their respective diagnosis. This may have differed from the location of the hospital(s) at which a patient was diagnosed or treated. Cancer centres were derived from the trust at which a patient was diagnosed and whether the trust had a specialist gynaecological cancer centre as of 2021. Patients may receive diagnosis, care or treatments at multiple hospitals (and possibly across different Cancer Alliances and CCGs). Therefore, it is possible that variation in outcomes is a result of this effect, rather than differing practice. Adjusting for trust at diagnosis as a random effect in the models may have helped to control for some of this variation.

## Deprivation

Deprivation was also assigned according to the residence of patients at diagnosis. People in England can move residence frequently, and with deprivation being linked to more long-term factors, the deprivation for the area of residence at the time of diagnosis may not be an accurate reflection of the patient's deprivation status. In addition to this, deprivation is a geographical measure applied to an individual so there is possibility for ecological fallacy.<sup>20</sup>

## GP to population ratio

The GP to population ratio uses GP headcounts rather than the number of full-time equivalent GPs. The term "headcount" relates to distinct individuals and includes full-time and part-time GPs, and GPs in training. Care should be taken when interpreting this data as it does not show the number of full-time equivalent GPs (summing part-time hours of multiple staff), and therefore will not reflect the number of hours GPs work in the day and the potential number of patients that can be seen by the practice. Moreover, the GP ratio of the CCG may shift over time and so at 2018 may not be reflective of the ratio when the patient first interacted with the healthcare system.

# Appendix 1: Methodology

## Cohort definition

Women diagnosed with ovary, fallopian tube and primary peritoneal carcinomas ('ovarian cancers') between 1<sup>st</sup> January 2013 and 31<sup>st</sup> December 2018 in England were included in the cohort. Data were extracted for finalised registrations from the National Cancer Registration dataset for England within the National Disease Registration Service.<sup>21</sup> Cases were identified according to the following ICD-10/O-2 codes:

- C56 (malignant neoplasm of ovary); or,
- C57 (malignant neoplasm of other and unspecified female genital organs); or,
- C48 (malignant neoplasm of retroperitoneum and peritoneum), excluding sarcomas: 8693, 8800, 8801, 8802, 8803, 8804, 8805, 8806, 8963, 8990, 8991, 9040, 9041, 9042, 9043, 9044, 8810, 8811-8921, 9120-9373, 9490, 9500, 9530-9582; or,
- D39.1 (neoplasm of uncertain or unknown behaviour of ovary).

Only patients with a gender of female recorded at diagnosis were included in the cohort to minimise the risk disclosure associated with transmen who retain ovaries.

## Exclusions

Borderline malignancies were excluded from the cohort as these patients do not exhibit short-term mortality to be studied and could inflate the estimates. Borderline malignancies were defined as tumours with an ICD-10 site code of C56, C57 or C48 and morphology code in ICD-O-2 8442, 8444, 8451, 8463, 8473, 8472 or 8462, or tumours with ICD-10 site code D39.1 and morphology code in ICD-O-2 8144, 8260, 8313, 8380, 8381, 8440, 8441, 8460, 8470, 8480, 8481, 9000, 9013, 9014 or 9015.

Patients were also excluded from the analysis due to the following data quality reasons; missing NHS numbers, embarked patients (patient stopped being registered in England and Wales for primary care on a specified date, such as in the case of moving outside of England), missing vital status date, known issues with the vital status, unknown basis of diagnosis or patients identified via death certificate only.

To provide patient level analysis rather than tumour level analysis, only the earliest ovarian tumour diagnosis (excluding borderlines) in the study period for each patient was selected. Patients were not excluded from the cohort if they have had a later cancer diagnosis of any cancer site, or a previous diagnosis of a different cancer site.

## Defining short-term mortality groups

Mortality is defined as the number of deaths occurring from a particular cause in a specific time interval. The association between patient demographics and tumour characteristics and mortality can change across the first year of diagnosis. To examine this variation in detail, patients were assigned to 4 groups: patients who died within 0 to 2 months (0 to 60 days), 2 to

6 months (61 to 180 days), 6 to 12 months (181 to 365 days), or patients who did not die within the 12 months following diagnosis. Time was calculated as the number of days between the date of diagnosis for the patient's first ovarian tumour between 2013-2018 (excluding borderlines) and their date of death.

Dates of death were determined using vital status and vital status date information available within the cancer registry data. Vital status measures if a patient is alive or not at a given date. Each patient in the cancer registry is checked annually and assigned a status at a nominal follow-up date. Records for patients not known to be dead are sent to the Data Access Tracing Service (DATS) from NHS Digital or "traced" every quarter. Tracing returns a vital status of alive, dead or embarked (patient stopped being registered in England and Wales for primary care on a specified date, such as in the case of moving outside of England) or null (record not found in DATS). If a patient is dead DATS will return a date of death as the vital status date. Patients are lost to follow up where the record is null or embarked as it is not known if a patient is alive or not. This is only around 1% of patients in the registry and these patients are not included in this analysis.

## Defining patient demographics and tumour characteristics

### Tumour morphology

Tumours were classified by site (ICD-10) and morphology (ICD-O-2), following classifications defined in the OCAFP Disease Profile in England report and the Get Data Out programme, into 'malignant epithelial', 'sex cord-stromal and germ cell', 'miscellaneous and unspecified' and 'non-specific site'. C57.7, C57.8, C57.9 were all classified as 'Non-specific site'.<sup>1,5</sup> These groupings were designed by the National Disease Registration Services ovarian cancer site-specific lead with advice from clinicians, charity sector members and a pathologist with the aim of designing the best, clinically meaningful groups.

### Basis of registry diagnosis

Basis of diagnosis describes how a patient was diagnosed with cancer. There are 8 classifications for basis of diagnosis.<sup>22</sup> Analysis in this report refers to a diagnosis via clinical, histology or cytology methods. Patients with a death certificate only or unknown basis of diagnosis were not included in this report. A clinical investigation includes clinical diagnoses where a diagnosis is made before death, but without the benefit of other diagnostic tools, clinical investigation using diagnostic techniques such as imaging (e.g. X-ray, endoscopy or ultrasound scan), exploratory surgery or autopsy without a tissue diagnosis, or diagnosis with biochemical and/or immunological markers specific to the tumour site. In this analysis a histological diagnosis was defined as diagnoses by histological examination of tissue from a primary tumour or metastasis (tissue from a secondary site). A cytological diagnosis involves examination of cells from a primary or secondary site via any method including fluids aspirated using endoscopes or needles, or microscopic examination of peripheral blood films and trephine bone marrow aspirates.

### Stage at diagnosis

Stage at diagnosis was defined by the cancer registry based on information from multiple sources. Cancer registration officers use all data submitted on a case provided by the diagnosing trust via the MDT, supplemented with pathology reports and clinical investigations to record the most accurate stage at diagnosis. Ovarian cancers were staged using FIGO but if this was not available TNM (Tumour, Node, Metastasis) stage was used by the registry. Only cancers where the site and morphology allow the tumour to be assigned to a specific staging system can have a stage at diagnosis; this aligns with cases reported to the UK and Ireland Association of Cancer Registries (UKIACR) Performance Indicators. Stage is recorded as a number between 1 to 4, where 4 indicates a more advanced disease. Where there was insufficient stage data, or a cancer is not stageable, stage at diagnosis is indicated as 'unknown'.

## Routes to diagnosis

Patients were assigned to one of the eight routes to diagnosis by linking data with the National Cancer Registration and Analysis Service's routes to diagnosis dataset.<sup>8</sup> This dataset uses data from Hospital Episode Statistics (HES), Cancer Waiting Times (CWT), cancer screening programmes and cancer registration data from the National Cancer Registration Dataset (NCRD).<sup>21</sup> The eight routes to diagnosis categories in the dataset are:

- Screen detected: Cancer detected via screening programmes (for breast, cervical or bowel)
- Two-Week Wait (TWW): Cancer detected via urgent GP referral with suspicion of cancer
- Emergency presentation: Any emergency route (A&E, emergency GP referral, transfer, consultant outpatient referral, admission or attendance)
- GP referral: Routine and urgent referrals except for patients referred by TWW
- Inpatient elective: Where no earlier admission can be found before admission from a waiting list, booked or planned
- Other outpatient: Elective route starting with an outpatient appointment (through self-referral, consultant to consultant, other or unknown referral)
- Death certificate only: Patients with a death certificate diagnosis flagged by the registry in the NCDR and no data available from inpatient or outpatient HES, CWT or screening
- Unknown: No data available from inpatient or outpatient HES, CWT or screening

The screen detected route is not valid for ovarian cancers as no screening programme for ovarian cancers currently exists. The screen detected route is therefore not included in this analysis. Patients with a death certificate only diagnosis are also excluded from analysis as these patients would not have a follow up period from diagnosis to study. GP referral, inpatient elective and other outpatient were grouped into a 'non-urgent' route for analysis to indicate a non-urgent 'GP-initiated' route. The four routes defined for analysis were:

- Two-Week Wait (TWW)
- Emergency presentation
- Unknown
- Non-urgent: Combining GP referral, inpatient elective and other outpatient

## Index of Multiple Deprivation

Deprivation in this report uses the English Index of Multiple Deprivation (IMD) to assign small area geographies into quintiles, where 5 is the least deprived and 1 is the most deprived. This provides a relative measure of deprivation in the area of a patient's residence. Deprivation was defined for each patient by linking their postcode at the time of diagnosis to a 2011 ONS census Lower Super Output Area (LSOA). The 2015 index is used for diagnoses in 2013, and the 2019 index is used for diagnoses between 2014 and 2018.

## Charlson comorbidity index

Comorbidities are pre-existing conditions that affect a patient's prognosis and ability to undergo treatment. For this report, the burden of comorbidity is described using the Charlson comorbidity index.<sup>12</sup> A score is assigned to each tumour by identifying the patient within whom the cancer occurred and looking for a number of pre-defined chronic health conditions documented within the cancer registry and hospital inpatient episodes that occurred between 3 and 27 months prior to the cancer diagnosis of interest. Higher scores are indicative of a greater burden of comorbid disease, though the index is not comprehensive; comorbid conditions not considered by the Charlson comorbidity index or otherwise only documented within an outpatient or primary care setting are not identified. Please see Appendix 11 for a list of medical conditions considered as comorbidities and the score assigned of 1, 2, 3 or 6 depending on the risk of dying associated with each one. A Charlson comorbidity index score of 0 indicates that a patient did not have any other cancers or comorbidities listed in Appendix 11 recorded in the cancer registry or HES admitted patient care dataset within the time period specified. No score was assigned where a patient could not be linked to HES.

## Performance status

Performance status is a WHO (World Health Organisation) measure of a patient's physical ability to perform general daily living activities. It is captured as a score between 0 and 4, according to the adult Eastern Cooperative Oncology Group (ECOG) scale, where 4 indicates complete disability and total confinement to a bed or chair.<sup>23</sup>

## Cancer treatment

Based on the type of treatment and the order in which treatment was received, each patient was assigned to one of the following treatment categories following the method outlined in the OCAFP Geographic variation in ovarian, fallopian tube and primary peritoneal cancer treatment in England report:<sup>1</sup>

- No surgery or chemotherapy
- Primary surgery with adjuvant chemotherapy (i.e. surgery followed by chemotherapy)
- Neoadjuvant chemotherapy with interval debulking surgery (i.e. chemotherapy followed by surgery)
- Chemotherapy but no surgery
- Primary surgery but no chemotherapy

## Geography

Geographical variation in short-term mortality was analysed at Cancer Alliance level according to regions defined in 2018. These disaggregate England into 19 geographic areas that bring together clinicians and managers from different hospital trusts and other health and social care organisations with the aim of coordinating the diagnosis and treatment of cancer patients in the local area. The Cancer Alliance was assigned according to the main residence of the patient on the date of diagnosis. NHS trusts were adjusted for in the model as a random effect to account for patient differences at a trust level. An NHS trust is an organisational unit within the National Health Service in England, generally serving either a geographical area or a specialised function. The trust was assigned as the trust the patient was diagnosed at.

## Cancer centre

A cancer centre is a hospital that provides specialist care for cancer patients. A list of specialist gynaecological cancer centres as of 2021 were provided by the British Gynaecological Cancer Society and can be found in Appendix 12. Patients were assigned as having a cancer centre if the trust that they were diagnosed at had a specialist gynaecological cancer centre as of 2021.

## GP to population ratio

The GP to population ratio is a crude rate of the number of registered General Practitioners per 10,000 population in a Clinical Commissioning Group (CCG). Rates should reflect the GP to population ratio during 2018. GP data from NHS Digital was used to extract a list of General Practitioner's membership of GP Practices active as of 2018.<sup>24,25</sup> This data was linked via postcode to provide the number of GPs per CCG. General Practitioners were filtered to those that were registered at a practice during 2018. GPs included were those who had joined the practice before 01-01-2018 and had not left at time of analysis or left after 01-01-2018. The number of GPs per CCG was then divided by the 2018 ONS population count for the CCG, then multiplied by 10,000. GP to population ratios were assigned to patients using the CCG according to the main residence of the patient on the date of diagnosis. The GP to population ratios were split into tertiles for analysis; low=3.53-5.94, medium=5.95-7.09, high=7.10-10.84.

## Statistical analysis

Descriptive statistics and bivariate analysis were presented in the first section of the report by calculating crude mortality rates across patient demographics and tumour characteristics. For each short-term mortality group, crude mortality rates were calculated as the number of women who died within the short-term mortality group timeframe divided by the total number of women in the cohort.

To further examine mortality within the 3 short-term mortality time periods, patients were split into 3 separate datasets, each with a cohort that excluded patients that had died prior to the short-term mortality interval being investigated. Chi-squared tests were used to test the statistical significance of differences in mortality rates for each patient demographic and tumour characteristic investigated. For each short-term mortality timeframe, crude mortality rates were calculated as the number of women who died within the short-term mortality timeframe divided by the total number of women alive at the start of the short-term mortality timeframe. 95% confidence intervals were also calculated using the Wilson score method.<sup>4</sup>

## Short-term mortality in ovarian, fallopian tube and primary peritoneal carcinomas across England

Two mixed effects logistic regression models were fitted to estimate the association of factors within each of the short-term mortality groups; death within diagnosis to 2 months, 2 to 6 months or 6 to 12 months. The dependent variable, death within the 3 time periods, was considered as a binary outcome. The models were built with trust at diagnosis as a random effect accounting for patients clustered within hospital trusts. The first multivariable analysis model adjusted for the following covariates:

- age at diagnosis
- tumour morphology
- stage at diagnosis
- deprivation quintile
- ethnicity
- comorbidity
- Trust at diagnosis as a random effect
- For diagnosis to 2 months only, basis of diagnosis was also included to adjust for lead time bias

The second model additionally adjusted for:

- Route to diagnosis
- Cancer centre

The covariates to include in the model were defined by existing literature and *a priori* knowledge, along with significance testing using chi-squared tests. Model fit was tested via Akaike Information Criterion (AIC) and Bayesian Information Criterion (BIC). Multivariable models were fitted to estimate mortality independently associated with each factor. Interactions were also investigated but model fit was inferior. Variables were tested for collinearity via the variance inflation factor (VIF). Model fit was also assessed via the ROC curve (Area Under the Curve, AUC) and predicted probabilities to assess the percentage of observations correctly predicted by the model. Estimates were presented as odds ratios. The logit link function transformed the binary outcome to the continuous log-odds scale via the logit transformation, removing constraints of the linear predictor, producing easily interpretable coefficients.<sup>26</sup>

The models were then used to calculate predicted mortality which was compared to observed mortality to give a case-mix adjusted mortality rate for each Cancer Alliance. The case-mix adjusted mortality rates were calculated as follows:

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

where:

**Observed deaths** is the total number of patients in each Alliance who died within the time period.

**Predicted deaths** is the sum of the predicted probability of death for each patient within the Alliance. Predicted probability is calculated from the case-mix adjusted model accounting for differences in the patient and tumour factors listed above for patients within each Alliance.

**Population rate** is the mortality rate for all of the patients included in the analysis (observed deaths in the population within the time period/number of patients diagnosed in the population within the time period).

The case-mix adjusted rates take into account differences between patient populations across Alliances by producing estimates based on an average group of patients across all Alliances, rather than just the single Alliance's patient population. This means that the rates can then be compared between Alliances.

Crude and adjusted mortality rates were presented in funnel plots to examine which Alliances have higher or lower mortality than expected based on the average cohort of patients.<sup>14</sup> Each point on a funnel plot represents a Cancer Alliance. The crude or adjusted mortality rate is shown on the vertical axis and the number of patients diagnosed in the Cancer Alliance is shown on the horizontal axis. Estimates from Cancer Alliances with a greater number of patients are more precise, and appear further to the right-hand side of the plot. A Cancer Alliance with an estimate above the middle line suggests that patients within the Alliance have a higher mortality rate than the population average, with estimates below the line indicating a lower mortality rate. The 2 pairs of dashed lines on the funnel plot show the distribution of Cancer Alliance mortality rates around the national average and represent the bounds of statistical confidence around the average value. The inner set of dashed lines represents 2 standard deviations (SD) from the population average and the outer set represents 3 SD, being approximately equivalent to 95.0% and 99.7% confidence intervals, respectively. Any observation plotted outside of these dashed lines will have a confidence interval that does not include the average value and was considered to be an outlier with a significantly different rate to that expected based on their size and the national average mortality rate. Some random variation in the probability of treatment is expected between regions such that some points will sit outside of the dashed lines through chance alone. This should be taken into consideration when interpreting funnel plots (for example, five out of every 100 observations are likely to lie outside the 2 SD funnel). Observations plotted between the 2 dashed control limit lines, should also be considered as their rates appear slightly different (rather than significantly different) to those expected.

All analyses were performed using R version 4.1.2.<sup>27</sup>

## Appendix 2: Cohort demographics

**Table 1:** The number of patients diagnosed with ovary, fallopian tube or primary peritoneal carcinomas (excluding borderlines) in England between 2013 and 2018, and the proportion of these patients dying in the first year after diagnosis (within 2 months, 2 to 6 months, 6 to 12 months, or patients that survived longer than 1 year). This is split by patient demographics and tumour characteristics.

Descriptives	Diagnosed (n)	Deaths during diagnosis to 2 months (n,%)	Deaths during 2 to 6 months (n,%)	Deaths during 6 to 12 months (n,%)	Survived longer than 1 year (n,%)
<b>Total patients</b>	33442	4548 (13.6)	2815 (8.4)	2756 (8.2)	23323 (69.7)
<b>Year of diagnosis</b>					
2013	5556	715 (12.87)	428 (7.70)	492 (8.86)	3921 (70.57)
2014	5713	747 (13.08)	478 (8.37)	446 (7.81)	4042 (70.75)
2015	5535	807 (14.58)	480 (8.67)	428 (7.73)	3820 (69.02)
2016	5647	819 (14.50)	500 (8.85)	438 (7.76)	3890 (68.89)
2017	5491	734 (13.37)	466 (8.49)	475 (8.65)	3816 (69.50)
2018	5500	726 (13.20)	463 (8.42)	477 (8.67)	3834 (69.71)
<b>Tumour site</b>					
C48	2316	347 (14.98)	251 (10.84)	262 (11.31)	1456 (62.87)
C56	28019	3913 (13.97)	2414 (8.62)	2344 (8.37)	19348 (69.05)
C57	2584	258 (9.98)	136 (5.26)	142 (5.50)	2048 (79.26)
D39	523	30 (5.74)	14 (2.68)	8 (1.53)	471 (90.06)
<b>Tumour morphology</b>					
Clear cell carcinoma	1422	42 (2.95)	55 (3.87)	110 (7.74)	1215 (85.44)
Endometrioid carcinoma	2073	27 (1.30)	41 (1.98)	54 (2.60)	1951 (94.11)
Miscellaneous and unspecified	2509	1287 (51.30)	444 (17.70)	207 (8.25)	571 (22.76)
Mucinous carcinoma	1900	66 (3.47)	74 (3.89)	82 (4.32)	1678 (88.32)
Non-specific site	678	254 (37.46)	110 (16.22)	60 (8.85)	254 (37.46)
Other malignant epithelial	6110	1639 (26.82)	920 (15.06)	722 (11.82)	2829 (46.30)
Serous carcinoma	17072	1218 (7.13)	1149 (6.73)	1496 (8.76)	13209 (77.37)
Sex cord-stromal and germ cell	1678	15 (0.89)	22 (1.31)	25 (1.49)	1616 (96.31)

Short-term mortality in ovarian, fallopian tube and primary peritoneal carcinomas across England

Descriptives		Diagnosed (n)	Deaths during diagnosis to 2 months (n,%)	Deaths during 2 to 6 months (n,%)	Deaths during 6 to 12 months (n,%)	Survived longer than 1 year (n,%)
<b>Stage at diagnosis</b>	1	6346	53 (0.84)	50 (0.79)	106 (1.67)	6137 (96.71)
	2	1950	51 (2.62)	64 (3.28)	86 (4.41)	1749 (89.69)
	3	12144	1168 (9.62)	1002 (8.25)	1146 (9.44)	8828 (72.69)
	4	7343	1542 (21.00)	967 (13.17)	904 (12.31)	3930 (53.52)
	Unknown	5659	1734 (30.64)	732 (12.94)	514 (9.08)	2679 (47.34)
<b>Basis of registry diagnosis</b>	Histology	27841	1951 (7.01)	1766 (6.34)	2210 (7.94)	21914 (78.71)
	Cytology	2455	870 (35.44)	419 (17.07)	288 (11.73)	878 (35.76)
	Clinical	3146	1727 (54.90)	630 (20.03)	258 (8.20)	531 (16.88)
<b>Route to Diagnosis</b>	Two Week Wait	12200	566 (4.64)	723 (5.93)	956 (7.84)	9955 (81.60)
	Emergency presentation	10035	3095 (30.84)	1322 (13.17)	984 (9.81)	4634 (46.18)
	Non-urgent	10432	792 (7.59)	710 (6.81)	765 (7.33)	8165 (78.27)
	Unknown	775	95 (12.26)	60 (7.74)	51 (6.58)	569 (73.42)
<b>Treatment group</b>	No surgery or chemotherapy	6778	3859 (56.93)	1464 (21.60)	471 (6.95)	984 (14.52)
	Primary surgery with adjuvant chemotherapy	8639	23 (0.27)	164 (1.90)	412 (4.77)	8040 (93.07)
	Neoadjuvant chemotherapy with interval debulking surgery	6291	1 (0.02)	40 (0.64)	398 (6.33)	5852 (93.02)
	Chemotherapy but no surgery	6346	444 (7.00)	962 (15.16)	1339 (21.10)	3601 (56.74)
	Primary surgery but no chemotherapy	5388	221 (4.10)	185 (3.43)	136 (2.52)	4846 (89.94)
<b>Age at diagnosis (years)</b>	0-29	746	5 (0.67)	18 (2.41)	10 (1.34)	713 (95.58)
	30-39	904	14 (1.55)	23 (2.54)	29 (3.21)	838 (92.70)
	40-49	2587	88 (3.40)	76 (2.94)	98 (3.79)	2325 (89.87)
	50-59	5723	241 (4.21)	192 (3.35)	336 (5.87)	4954 (86.56)
	60-69	8331	656 (7.87)	450 (5.40)	606 (7.27)	6619 (79.45)
	70-79	9038	1414 (15.65)	890 (9.85)	969 (10.72)	5765 (63.79)
	80+	6113	2130 (34.84)	1166 (19.07)	708 (11.58)	2109 (34.50)
<b>English Index of Multiple Deprivation (quintiles)</b>	Quintile 5 (least deprived)	7293	873 (11.97)	585 (8.02)	630 (8.64)	5205 (71.37)

Short-term mortality in ovarian, fallopian tube and primary peritoneal carcinomas across England

Descriptives		Diagnosed (n)	Deaths during diagnosis to 2 months (n,%)	Deaths during 2 to 6 months (n,%)	Deaths during 6 to 12 months (n,%)	Survived longer than 1 year (n,%)
<b>Ethnicity</b>	Quintile 4	7339	929 (12.66)	568 (7.74)	615 (8.38)	5227 (71.22)
	Quintile 3	7133	963 (13.50)	635 (8.90)	571 (8.01)	4964 (69.59)
	Quintile 2	6210	897 (14.44)	545 (8.78)	510 (8.21)	4258 (68.57)
	Quintile 1 (most deprived)	5467	886 (16.21)	482 (8.82)	430 (7.87)	3669 (67.11)
	White	29587	3998 (13.51)	2544 (8.60)	2507 (8.47)	20538 (69.42)
	Black	520	47 (9.04)	34 (6.54)	32 (6.15)	407 (78.27)
	Asian	1142	79 (6.92)	54 (4.73)	65 (5.69)	944 (82.66)
	Chinese	97	8 (8.25)	3 (3.09)	6 (6.19)	80 (82.47)
	Other	402	30 (7.46)	25 (6.22)	22 (5.47)	325 (80.85)
	Mixed	157	15 (9.55)	10 (6.37)	13 (8.28)	119 (75.80)
	Unknown	1537	371 (24.14)	145 (9.43)	111 (7.22)	910 (59.21)
<b>Charlson comorbidity index</b>	0	28207	3355 (11.89)	2123 (7.53)	2255 (7.99)	20474 (72.58)
	1	2704	512 (18.93)	329 (12.17)	241 (8.91)	1622 (59.99)
	2	1355	289 (21.33)	190 (14.02)	147 (10.85)	729 (53.80)
	>2	948	331 (34.92)	152 (16.03)	98 (10.34)	367 (38.71)
	Not recorded	228	61 (26.75)	21 (9.21)	15 (6.58)	131 (57.46)
<b>Performance status at diagnosis</b>	0	5620	132 (2.35)	193 (3.43)	315 (5.60)	4980 (88.61)
	1	3920	164 (4.18)	245 (6.25)	402 (10.26)	3109 (79.31)
	2	1504	198 (13.16)	231 (15.36)	213 (14.16)	862 (57.31)
	3	937	315 (33.62)	185 (19.74)	121 (12.91)	316 (33.72)
	4	249	156 (62.65)	49 (19.68)	17 (6.83)	27 (10.84)
	Not recorded	21212	3583 (16.89)	1912 (9.01)	1688 (7.96)	14029 (66.14)
<b>Cancer Alliance at diagnosis</b>	Cheshire and Merseyside	1640	224 (13.66)	170 (10.37)	141 (8.60)	1105 (67.38)
	East Midlands	2515	389 (15.47)	242 (9.62)	214 (8.51)	1670 (66.40)
	East of England	4145	598 (14.43)	397 (9.58)	338 (8.15)	2812 (67.84)

Short-term mortality in ovarian, fallopian tube and primary peritoneal carcinomas across England

Descriptives	Diagnosed (n)	Deaths during diagnosis to 2 months (n,%)	Deaths during 2 to 6 months (n,%)	Deaths during 6 to 12 months (n,%)	Survived longer than 1 year (n,%)
Greater Manchester	1626	221 (13.59)	118 (7.26)	100 (6.15)	1187 (73.00)
Humber, Coast and Vale	927	130 (14.02)	83 (8.95)	62 (6.69)	652 (70.33)
Kent and Medway	1166	166 (14.24)	98 (8.40)	92 (7.89)	810 (69.47)
Lancashire and South Cumbria	1101	152 (13.81)	92 (8.36)	90 (8.17)	767 (69.66)
North Central and North East London	1295	119 (9.19)	78 (6.02)	89 (6.87)	1009 (77.92)
North East and Cumbria	2037	285 (13.99)	191 (9.38)	168 (8.25)	1393 (68.38)
North West and South West London	1609	159 (9.88)	101 (6.28)	110 (6.84)	1239 (77.00)
Peninsula	1403	226 (16.11)	114 (8.13)	138 (9.84)	925 (65.93)
Somerset, Wiltshire, Avon and Gloucestershire	1820	218 (11.98)	133 (7.31)	143 (7.86)	1326 (72.86)
South East London	789	77 (9.76)	42 (5.32)	54 (6.84)	616 (78.07)
South Yorkshire, Bassetlaw, North Derbyshire and Hardwick	1145	179 (15.63)	103 (9.00)	136 (11.88)	727 (63.49)
Surrey and Sussex	2087	268 (12.84)	179 (8.58)	185 (8.86)	1455 (69.72)
Thames Valley	1357	163 (12.01)	105 (7.74)	118 (8.70)	971 (71.55)
Wessex	1814	264 (14.55)	170 (9.37)	171 (9.43)	1209 (66.65)
West Midlands	3509	526 (14.99)	297 (8.46)	289 (8.24)	2397 (68.31)
West Yorkshire and Harrogate	1457	184 (12.63)	102 (7.00)	118 (8.10)	1053 (72.27)
<b>Cancer centre</b>					
Cancer centre	18646	1891 (10.14)	1248 (6.69)	1365 (7.32)	14142 (75.84)
No cancer centre	14796	2657 (17.96)	1567 (10.59)	1391 (9.40)	9181 (62.05)
<b>GP to population ratio</b>					
Low	11182	1546 (13.83)	912 (8.16)	894 (7.99)	7830 (70.02)
Medium	11174	1507 (13.49)	992 (8.88)	897 (8.03)	7778 (69.61)
High	11086	1495 (13.49)	911 (8.22)	965 (8.70)	7715 (69.59)

Short-term mortality in ovarian, fallopian tube and primary peritoneal carcinomas across England

**Table 2:** Cohort of patients used in logistic regression models. The number of patients diagnosed with ovary, fallopian tube or primary peritoneal carcinomas (excluding borderlines) in England between 2013 and 2018, and the proportion of patients dying in the first year after diagnosis. Patients alive at the start of each short-term mortality time period were included in the cohort for logistic regression models for that specific time period. Crude percentages and p-values from chi-squared tests are presented to show the significance between the differences of those that die in the short-term mortality group and those that do not, for each patient demographic and tumour characteristic.

Descriptives		Diagnosis to 2 months			2 to 6 months			6 to 12 months			Survived longer than 1 year (n)
		Diagnosed (n)	Deaths during diagnosis to 2 months (n,%)	p-value	Alive at day 61 (n)	Deaths during 2 to 6 months (n,%)	p-value	Alive at day 181 (n)	Deaths during 6 to 12 months (n,%)	p-value	
<b>Total patients</b>		33442	4548 (13.6)		28894	2815 (9.7)		26079	2756 (10.6)		23,323
<b>Year of diagnosis</b>	2013	5556	715 (12.87)	0.021	4841	428 (8.8)	0.183	4413	492 (11.1)	0.171	3,921
	2014	5713	747 (13.08)		4966	478 (9.6)		4488	446 (9.9)		4,042
	2015	5535	807 (14.58)		4728	480 (10.2)		4248	428 (10.1)		3,820
	2016	5647	819 (14.50)		4828	500 (10.4)		4328	438 (10.1)		3,890
	2017	5491	734 (13.37)		4757	466 (9.8)		4291	475 (11.1)		3,816
	2018	5500	726 (13.20)		4774	463 (9.7)		4311	477 (11.1)		3,834
<b>Tumour site</b>	C48	2316	347 (14.98)	<0.001	1969	251 (12.7)	<0.001	1718	262 (15.3)	<0.001	1,456
	C56	28019	3913 (13.97)		24106	2414 (10.0)		21692	2344 (10.8)		19,348
	C57	2584	258 (9.98)		2326	136 (5.8)		2190	142 (6.5)		2,048
	D39	523	30 (5.74)		493	14 (2.8)		479	8 (1.7)		471
<b>Tumour morphology</b>	Clear cell carcinoma	1422	42 (2.95)	<0.001	1380	55 (4.0)	<0.001	1325	110 (8.3)	<0.001	1,215
	Endometrioid carcinoma	2073	27 (1.30)		2046	41 (2.0)		2005	54 (2.7)		1,951
	Miscellaneous and unspecified	2509	1287 (51.30)		1222	444 (36.3)		778	207 (26.6)		571
	Mucinous carcinoma	1900	66 (3.47)		1834	74 (4.0)		1760	82 (4.7)		1,678
	Non-specific site	678	254 (37.46)		424	110 (25.9)		314	60 (19.1)		254
	Other malignant epithelial	6110	1639 (26.82)		4471	920 (20.6)		3551	722 (20.3)		2,829
	Serous carcinoma	17072	1218 (7.13)		15854	1149 (7.2)		14705	1496 (10.2)		13,209

Short-term mortality in ovarian, fallopian tube and primary peritoneal carcinomas across England

Descriptives		Diagnosis to 2 months			2 to 6 months			6 to 12 months			Survived longer than 1 year (n)
		Diagnosed (n)	Deaths during diagnosis to 2 months (n,%)	p-value	Alive at day 61 (n)	Deaths during 2 to 6 months (n,%)	p-value	Alive at day 181 (n)	Deaths during 6 to 12 months (n,%)	p-value	
<b>Stage at diagnosis</b>	Sex cord-stromal and germ cell	1678	15 (0.89)		1663	22 (1.3)		1641	25 (1.5)		1,616
	1	6346	53 (0.84)	<0.001	6293	50 (0.8)	<0.001	6243	106 (1.7)	<0.001	6,137
	2	1950	51 (2.62)		1899	64 (3.4)		1835	86 (4.7)		1,749
	3	12144	1168 (9.62)		10976	1002 (9.1)		9974	1146 (11.5)		8,828
	4	7343	1542 (21.00)		5801	967 (16.7)		4834	904 (18.7)		3,930
<b>Basis of registry diagnosis</b>	Unknown	5659	1734 (30.64)		3925	732 (18.6)		3193	514 (16.1)		2,679
	Histology	27841	1951 (7.01)	<0.001	25890	1766 (6.8)	<0.001	24124	2210 (9.2)	<0.001	21,914
	Cytology	2455	870 (35.44)		1585	419 (26.4)		1166	288 (24.7)		878
<b>Route to Diagnosis</b>	Clinical	3146	1727 (54.90)		1419	630 (44.4)		789	258 (32.7)		531
	Two Week Wait	12200	566 (4.64)	<0.001	11634	723 (6.2)	<0.001	10911	956 (8.8)	<0.001	9,955
	Emergency presentation	10035	3095 (30.84)		6940	1322 (19.0)		5618	984 (17.5)		4,634
	Non-urgent	10432	792 (7.59)		9640	710 (7.4)		8930	765 (8.6)		8,165
<b>Treatment group</b>	Unknown	775	95 (12.26)		680	60 (8.8)		620	51 (8.2)		569
	No surgery or chemotherapy	6778	3859 (56.93)	<0.001	2919	1464 (50.2)	<0.001	1455	471 (32.4)	<0.001	984
	Primary surgery with adjuvant chemotherapy	8639	23 (0.27)		8616	164 (1.9)		8452	412 (4.9)		8,040
	Neoadjuvant chemotherapy with interval debulking surgery	6291	1 (0.02)		6290	40 (0.6)		6250	398 (6.4)		5,852
	Chemotherapy but no surgery	6346	444 (7.00)		5902	962 (16.3)		4940	1339 (27.1)		3,601
	Primary surgery but no chemotherapy	5388	221 (4.10)		5167	185 (3.6)		4982	136 (2.7)		4,846
<b>Age at diagnosis (years)</b>	0-29	746	5 (0.67)	<0.001	741	18 (2.4)	<0.001	723	10 (1.4)	<0.001	713
	30-39	904	14 (1.55)		890	23 (2.6)		867	29 (3.3)		838
	40-49	2587	88 (3.40)		2499	76 (3.0)		2423	98 (4.0)		2,325

Short-term mortality in ovarian, fallopian tube and primary peritoneal carcinomas across England

Descriptives		Diagnosis to 2 months			2 to 6 months			6 to 12 months			Survived longer than 1 year (n)
		Diagnosed (n)	Deaths during diagnosis to 2 months (n,%)	p-value	Alive at day 61 (n)	Deaths during 2 to 6 months (n,%)	p-value	Alive at day 181 (n)	Deaths during 6 to 12 months (n,%)	p-value	
	50-59	5723	241 (4.21)		5482	192 (3.5)		5290	336 (6.4)		4,954
	60-69	8331	656 (7.87)		7675	450 (5.9)		7225	606 (8.4)		6,619
	70-79	9038	1414 (15.65)		7624	890 (11.7)		6734	969 (14.4)		5,765
	80+	6113	2130 (34.84)		3983	1166 (29.3)		2817	708 (25.1)		2,109
<b>English Index of Multiple Deprivation (quintiles)</b>	Quintile 5 (least deprived)	7293	873 (11.97)	<0.001	6420	585 (9.1)	0.004	5835	630 (10.8)	0.937	5,205
	Quintile 4	7339	929 (12.66)		6410	568 (8.9)		5842	615 (10.5)		5,227
	Quintile 3	7133	963 (13.50)		6170	635 (10.3)		5535	571 (10.3)		4,964
	Quintile 2	6210	897 (14.44)		5313	545 (10.3)		4768	510 (10.7)		4,258
	Quintile 1 (most deprived)	5467	886 (16.21)		4581	482 (10.5)		4099	430 (10.5)		3,669
<b>Ethnicity</b>	White	29587	3998 (13.51)	<0.001	25589	2544 (9.9)	<0.001	23045	2507 (10.9)	<0.001	20,538
	Black	520	47 (9.04)		473	34 (7.2)		439	32 (7.3)		407
	Asian	1142	79 (6.92)		1063	54 (5.1)		1009	65 (6.4)		944
	Chinese	97	8 (8.25)		89	3 (3.4)		86	6 (7.0)		80
	Other	402	30 (7.46)		372	25 (6.7)		347	22 (6.3)		325
	Mixed	157	15 (9.55)		142	10 (7.0)		132	13 (9.8)		119
	Unknown	1537	371 (24.14)		1166	145 (12.4)		1021	111 (10.9)		910
	<b>Charlson comorbidity index</b>	0	28207	3355 (11.89)	<0.001	24852	2123 (8.5)	<0.001	22729	2255 (9.9)	<0.001
1	2704	512 (18.93)		2192	329 (15.0)		1863	241 (12.9)		1,622	
2	1355	289 (21.33)		1066	190 (17.8)		876	147 (16.8)		729	
>2	948	331 (34.92)		617	152 (24.6)		465	98 (21.1)		367	
Not recorded	228	61 (26.75)		167	21 (12.6)		146	15 (10.3)		131	

Short-term mortality in ovarian, fallopian tube and primary peritoneal carcinomas across England

Descriptives	Diagnosis to 2 months			2 to 6 months			6 to 12 months			Survived longer than 1 year (n)	
	Diagnosed (n)	Deaths during diagnosis to 2 months (n,%)	p-value	Alive at day 61 (n)	Deaths during 2 to 6 months (n,%)	p-value	Alive at day 181 (n)	Deaths during 6 to 12 months (n,%)	p-value		
<b>Performance status at diagnosis</b>	0	5620	132 (2.35)	<0.001	5488	193 (3.5)	<0.001	5295	315 (5.9)	<0.001	4,980
	1	3920	164 (4.18)		3756	245 (6.5)		3511	402 (11.4)		3,109
	2	1504	198 (13.16)		1306	231 (17.7)		1075	213 (19.8)		862
	3	937	315 (33.62)		622	185 (29.7)		437	121 (27.7)		316
	4	249	156 (62.65)		93	49 (52.7)		44	17 (38.6)		27
	Not recorded	21212	3583 (16.89)		17629	1912 (10.8)		15717	1688 (10.7)		14,029
<b>Cancer Alliance at diagnosis</b>	Cheshire and Merseyside	1640	224 (13.66)	<0.001	1416	170 (12.0)	<0.001	1246	141 (11.3)	<0.001	1,105
	East Midlands	2515	389 (15.47)		2126	242 (11.4)		1884	214 (11.4)		1,670
	East of England	4145	598 (14.43)		3547	397 (11.2)		3150	338 (10.7)		2,812
	Greater Manchester	1626	221 (13.59)		1405	118 (8.4)		1287	100 (7.8)		1,187
	Humber, Coast and Vale	927	130 (14.02)		797	83 (10.4)		714	62 (8.7)		652
	Kent and Medway	1166	166 (14.24)		1000	98 (9.8)		902	92 (10.2)		810
	Lancashire and South Cumbria	1101	152 (13.81)		949	92 (9.7)		857	90 (10.5)		767
	North Central and North East London	1295	119 (9.19)		1176	78 (6.6)		1098	89 (8.1)		1,009
	North East and Cumbria	2037	285 (13.99)		1752	191 (10.9)		1561	168 (10.8)		1,393
	North West and South West London	1609	159 (9.88)		1450	101 (7.0)		1349	110 (8.2)		1,239
	Peninsula	1403	226 (16.11)		1177	114 (9.7)		1063	138 (13.0)		925
	Somerset, Wiltshire, Avon and Gloucestershire	1820	218 (11.98)		1602	133 (8.3)		1469	143 (9.7)		1,326
	South East London	789	77 (9.76)		712	42 (5.9)		670	54 (8.1)		616
	South Yorkshire, Bassetlaw, North Derbyshire and Hardwick	1145	179 (15.63)		966	103 (10.7)		863	136 (15.8)		727

Short-term mortality in ovarian, fallopian tube and primary peritoneal carcinomas across England

Descriptives		Diagnosis to 2 months			2 to 6 months			6 to 12 months			Survived longer than 1 year (n)
		Diagnosed (n)	Deaths during diagnosis to 2 months (n,%)	p-value	Alive at day 61 (n)	Deaths during 2 to 6 months (n,%)	p-value	Alive at day 181 (n)	Deaths during 6 to 12 months (n,%)	p-value	
Cancer centre	Surrey and Sussex	2087	268 (12.84)		1819	179 (9.8)		1640	185 (11.3)		1,455
	Thames Valley	1357	163 (12.01)		1194	105 (8.8)		1089	118 (10.8)		971
	Wessex	1814	264 (14.55)		1550	170 (11.0)		1380	171 (12.4)		1,209
	West Midlands	3509	526 (14.99)		2983	297 (10.0)		2686	289 (10.8)		2,397
	West Yorkshire and Harrogate	1457	184 (12.63)		1273	102 (8.0)		1171	118 (10.1)		1,053
	Cancer centre	18646	1891 (10.14)	<0.001	16755	1248 (7.4)	<0.001	15507	1365 (8.8)	<0.001	14,142
	No cancer centre	14796	2657 (17.96)		12139	1567 (12.9)		10572	1391 (13.2)		9,181
GP to population ratio	Low	11182	1546 (13.83)	0.694	9636	912 (9.5)	0.108	8724	894 (10.2)	0.123	7,830
	Medium	11174	1507 (13.49)		9667	992 (10.3)		8675	897 (10.3)		7,778
	High	11086	1495 (13.49)		9591	911 (9.5)		8680	965 (11.1)		7,715

## Appendix 3: Factors associated with ovarian cancer patient mortality between 0 and 2 months following a diagnosis

**Table 3:** Crude mortality rates and odds ratios from mixed effects logistic regression models for factors associated with patient mortality between 0 and 2 months from diagnosis.

Variables		Crude mortality rates		Minimally adjusted mortality rates				Maximally adjusted mortality rates			
		%	95% CI	OR	95% CI	SE	P-value	OR	95% CI	SE	P-value
<b>(Intercept)</b>				0.0	(0.0,0.0)	0.0	0.000	0.0	(0.0,0.0)	0.0	0.000
<b>Basis of diagnosis</b>	Histology (ref)	7.0	(6.7,7.3)								
	Cytology	35.4	(33.6,37.4)	2.8	(2.5,3.1)	0.2	0.000	2.2	(1.9,2.4)	0.1	0.000
<b>Age at diagnosis (years)</b>	Clinical	54.9	(53.2,56.6)	3.0	(2.6,3.4)	0.2	0.000	2.4	(2.1,2.8)	0.2	0.000
	0-29	0.7	(0.3,1.6)	0.1	(0.0,0.3)	0.1	0.000	0.1	(0.0,0.3)	0.1	0.000
	30-39	1.5	(0.9,2.6)	0.2	(0.1,0.4)	0.1	0.000	0.2	(0.1,0.3)	0.1	0.000
	40-49	3.4	(2.8,4.2)	0.3	(0.3,0.4)	0.0	0.000	0.3	(0.3,0.4)	0.0	0.000
	50-59	4.2	(3.7,4.8)	0.4	(0.3,0.4)	0.0	0.000	0.4	(0.3,0.4)	0.0	0.000
	60-69	7.9	(7.3,8.5)	0.6	(0.5,0.6)	0.0	0.000	0.6	(0.5,0.6)	0.0	0.000
	70-79 (ref)	15.6	(14.9,16.4)								
	80+	34.8	(33.7,36.0)	1.5	(1.3,1.6)	0.1	0.000	1.4	(1.3,1.6)	0.1	0.000
<b>Tumour morphology</b>	Serous carcinoma (ref)	7.1	(6.8,7.5)								
	Clear cell carcinoma	3.0	(2.2,4.0)	1.3	(1.0,1.8)	0.2	0.090	1.5	(1.0,2.0)	0.2	0.028
	Endometrioid carcinoma	1.3	(0.9,1.9)	0.8	(0.5,1.2)	0.2	0.213	0.9	(0.6,1.3)	0.2	0.448
	Miscellaneous and unspecified	51.3	(49.3,53.2)	3.2	(2.7,3.7)	0.3	0.000	3.0	(2.5,3.5)	0.3	0.000
	Mucinous carcinoma	3.5	(2.7,4.4)	1.6	(1.2,2.1)	0.2	0.001	1.7	(1.3,2.2)	0.2	0.000
	Non-specific site	37.5	(33.9,41.2)	2.9	(2.4,3.6)	0.3	0.000	2.8	(2.2,3.4)	0.3	0.000
	Other malignant epithelial	26.8	(25.7,28.0)	2.9	(2.7,3.2)	0.1	0.000	2.7	(2.5,3.0)	0.1	0.000
<b>Stage at diagnosis</b>	Sex cord-stromal and germ cell	0.9	(0.5,1.5)	0.4	(0.2,0.7)	0.1	0.000	0.4	(0.2,0.7)	0.1	0.001
	1 (ref)	0.8	(0.6,1.1)								
	2	2.6	(2.0,3.4)	2.4	(1.6,3.6)	0.5	0.000	2.4	(1.6,3.7)	0.5	0.000
	3	9.6	(9.1,10.2)	7.0	(5.2,9.4)	1.1	0.000	6.0	(4.5,8.1)	0.9	0.000
	4	21.0	(20.1,21.9)	13.0	(9.7,17.5)	2.0	0.000	10.2	(7.6,13.7)	1.6	0.000
	Unknown	30.6	(29.5,31.9)	12.0	(8.9,16.2)	1.8	0.000	9.5	(7.1,12.9)	1.5	0.000
<b>Index of Multiple Deprivation</b>	Quintile 5 (least deprived) (ref)	12.0	(11.2,12.7)								
	Quintile 4	12.7	(11.9,13.4)	1.1	(1.0,1.3)	0.1	0.028	1.1	(1.0,1.2)	0.1	0.105

Short-term mortality in ovarian, fallopian tube and primary peritoneal carcinomas across England

Variables		Crude mortality rates		Minimally adjusted mortality rates				Maximally adjusted mortality rates			
		%	95% CI	OR	95% CI	SE	p-value	OR	95% CI	SE	p-value
<b>Ethnicity</b>	Quintile 3	13.5	(12.7,14.3)	1.2	(1.1,1.3)	0.1	0.005	1.1	(1.0,1.3)	0.1	0.036
	Quintile 2	14.4	(13.6,15.3)	1.3	(1.1,1.4)	0.1	0.000	1.2	(1.1,1.4)	0.1	0.001
	Quintile 1 (most deprived)	16.2	(15.3,17.2)	1.7	(1.5,1.9)	0.1	0.000	1.5	(1.4,1.8)	0.1	0.000
	White (ref)	13.5	(13.1,13.9)								
	Black	9.0	(6.9,11.8)	0.8	(0.6,1.2)	0.2	0.288	0.7	(0.5,1.0)	0.1	0.082
	Asian	6.9	(5.6,8.5)	0.7	(0.6,1.0)	0.1	0.031	0.7	(0.5,0.9)	0.1	0.008
	Chinese	8.2	(4.2,15.4)	1.4	(0.6,3.2)	0.6	0.434	1.5	(0.6,3.6)	0.7	0.337
	Other	7.5	(5.3,10.5)	1.0	(0.7,1.5)	0.2	0.965	0.9	(0.6,1.4)	0.2	0.573
	Mixed	9.6	(5.9,15.2)	1.2	(0.6,2.3)	0.4	0.571	1.4	(0.7,2.6)	0.4	0.330
	Unknown	24.1	(22.1,26.3)	1.5	(1.3,1.8)	0.1	0.000	1.5	(1.3,1.8)	0.1	0.000
<b>Charlson comorbidity index</b>	0 (ref)	11.9	(11.5,12.3)								
	1	18.9	(17.5,20.5)	1.2	(1.0,1.3)	0.1	0.009	1.1	(1.0,1.3)	0.1	0.113
	2	21.3	(19.2,23.6)	1.1	(1.0,1.3)	0.1	0.141	1.1	(0.9,1.3)	0.1	0.457
	>2	34.9	(31.9,38.0)	1.7	(1.4,2.0)	0.1	0.000	1.6	(1.3,1.9)	0.1	0.000
	Not recorded	26.8	(21.4,32.9)	1.8	(1.3,2.7)	0.4	0.002	3.0	(2.0,4.4)	0.6	0.000
<b>Route to diagnosis</b>	Two Week Wait (ref)	4.6	(4.3,5.0)								
	Emergency presentation	30.8	(29.9,31.8)					4.3	(3.9,4.8)	0.2	0.000
	Non-urgent	7.6	(7.1,8.1)					1.5	(1.3,1.7)	0.1	0.000
	Unknown	12.3	(10.1,14.8)					1.3	(1.0,1.8)	0.2	0.050
<b>Cancer centre</b>	Cancer centre (ref)	10.1	(9.7,10.6)								
	No cancer centre	18.0	(17.3,18.6)					1.1	(1.0,1.3)	0.1	0.016

## Appendix 4: Factors associated with ovarian cancer patient mortality between 2 and 6 months following a diagnosis

Table 4: Crude mortality rates and odds ratios from mixed effects logistic regression models for factors associated with patient mortality between 2 and 6 months from diagnosis.

Variables	Crude mortality rates		Minimally adjusted mortality rates				Maximally adjusted mortality rates			
	%	95% CI	OR	95% CI	SE	P-value	OR	95% CI	SE	P-value
<b>(Intercept)</b>			0.0	(0.0,0.0)	0.0	0.000	0.0	(0.0,0.0)	0.0	0.000
<b>Age at diagnosis (years)</b>										
0-29	2.4	(1.5,3.8)	0.5	(0.3,0.8)	0.1	0.005	0.4	(0.3,0.7)	0.1	0.002
30-39	2.6	(1.7,3.8)	0.4	(0.3,0.6)	0.1	0.000	0.4	(0.2,0.6)	0.1	0.000
40-49	3.0	(2.4,3.8)	0.3	(0.3,0.4)	0.0	0.000	0.3	(0.3,0.4)	0.0	0.000
50-59	3.5	(3.0,4.0)	0.4	(0.3,0.4)	0.0	0.000	0.4	(0.3,0.4)	0.0	0.000
60-69	5.9	(5.4,6.4)	0.5	(0.5,0.6)	0.0	0.000	0.5	(0.5,0.6)	0.0	0.000
70-79 (ref)	11.7	(11.0,12.4)								
80+	29.3	(27.9,30.7)	2.3	(2.1,2.6)	0.1	0.000	2.3	(2.1,2.6)	0.1	0.000
<b>Tumour morphology</b>										
Serous carcinoma (ref)	7.2	(6.9,7.7)								
Clear cell carcinoma	4.0	(3.1,5.2)	1.8	(1.4,2.4)	0.3	0.000	1.9	(1.4,2.6)	0.3	0.000
Endometrioid carcinoma	2.0	(1.5,2.7)	1.2	(0.9,1.7)	0.2	0.278	1.3	(0.9,1.8)	0.2	0.125
Miscellaneous and unspecified	36.3	(33.7,39.1)	4.2	(3.5,4.9)	0.3	0.000	3.8	(3.2,4.5)	0.3	0.000
Mucinous carcinoma	4.0	(3.2,5.0)	2.2	(1.7,2.9)	0.3	0.000	2.4	(1.8,3.1)	0.3	0.000
Non-specific site	25.9	(22.0,30.3)	3.1	(2.4,4.0)	0.4	0.000	3.0	(2.3,3.9)	0.4	0.000
Other malignant epithelial	20.6	(19.4,21.8)	3.1	(2.8,3.4)	0.2	0.000	2.9	(2.6,3.2)	0.2	0.000
Sex cord-stromal and germ cell	1.3	(0.9,2.0)	0.6	(0.4,0.9)	0.1	0.012	0.6	(0.4,0.9)	0.1	0.018
<b>Stage at diagnosis</b>										
1 (ref)	0.8	(0.6,1.0)								
2	3.4	(2.6,4.3)	4.2	(2.9,6.2)	0.8	0.000	4.4	(3.0,6.4)	0.9	0.000
3	9.1	(8.6,9.7)	10.9	(8.1,14.8)	1.7	0.000	10.2	(7.5,13.9)	1.6	0.000
4	16.7	(15.7,17.7)	19.4	(14.3,26.5)	3.1	0.000	16.8	(12.3,22.9)	2.7	0.000
Unknown	18.6	(17.5,19.9)	13.1	(9.6,17.9)	2.1	0.000	11.6	(8.5,15.9)	1.9	0.000
<b>Index of Multiple Deprivation</b>										
Quintile 5 (least deprived) (ref)	9.1	(8.4,9.8)								
Quintile 4	8.9	(8.2,9.6)	1.0	(0.9,1.2)	0.1	0.685	1.0	(0.9,1.2)	0.1	0.848
Quintile 3	10.3	(9.6,11.1)	1.2	(1.1,1.4)	0.1	0.001	1.2	(1.1,1.4)	0.1	0.004
Quintile 2	10.3	(9.5,11.1)	1.3	(1.1,1.5)	0.1	0.001	1.2	(1.1,1.4)	0.1	0.002
Quintile 1 (most deprived)	10.5	(9.7,11.4)	1.5	(1.3,1.7)	0.1	0.000	1.4	(1.2,1.6)	0.1	0.000

Short-term mortality in ovarian, fallopian tube and primary peritoneal carcinomas across England

Variables		Crude mortality rates		Minimally adjusted mortality rates			Maximally adjusted mortality rates				
		%	95% CI	OR	95% CI	SE	P-value	OR	95% CI	SE	P-value
<b>Ethnicity</b>	White (ref)	9.9	(9.6,10.3)								
	Black	7.2	(5.2,9.9)	0.9	(0.6,1.3)	0.2	0.547	0.8	(0.5,1.2)	0.2	0.292
	Asian	5.1	(3.9,6.6)	0.7	(0.5,0.9)	0.1	0.016	0.7	(0.5,0.9)	0.1	0.009
	Chinese	3.4	(1.2,9.4)	0.7	(0.2,2.2)	0.4	0.499	0.7	(0.2,2.3)	0.4	0.546
	Other	6.7	(4.6,9.7)	1.2	(0.8,1.8)	0.3	0.497	1.0	(0.7,1.6)	0.2	0.856
	Mixed	7.0	(3.9,12.5)	1.1	(0.6,2.3)	0.4	0.698	1.3	(0.6,2.5)	0.5	0.513
	Unknown	12.4	(10.7,14.5)	1.1	(0.9,1.3)	0.1	0.446	1.1	(0.9,1.3)	0.1	0.506
<b>Charlson comorbidity index</b>	0 (ref)	8.5	(8.2,8.9)								
	1	15.0	(13.6,16.6)	1.4	(1.2,1.6)	0.1	0.000	1.4	(1.2,1.6)	0.1	0.000
	2	17.8	(15.6,20.2)	1.5	(1.3,1.8)	0.1	0.000	1.5	(1.2,1.8)	0.1	0.000
	>2	24.6	(21.4,28.2)	1.9	(1.5,2.3)	0.2	0.000	1.8	(1.4,2.2)	0.2	0.000
	Not recorded	12.6	(8.4,18.5)	1.4	(0.8,2.3)	0.4	0.257	1.7	(1.0,2.9)	0.5	0.069
<b>Route to diagnosis</b>	Two Week Wait (ref)	6.2	(5.8,6.7)								
	Emergency presentation	19.0	(18.1,20.0)					2.4	(2.1,2.6)	0.1	0.000
	Non-urgent	7.4	(6.9,7.9)					1.2	(1.1,1.4)	0.1	0.001
	Unknown	8.8	(6.9,11.2)					1.2	(0.9,1.7)	0.2	0.194
<b>Cancer centre</b>	Cancer centre (ref)	7.4	(7.1,7.9)								
	No cancer centre	12.9	(12.3,13.5)					1.2	(1.1,1.4)	0.1	0.004

## Appendix 5: Factors associated with ovarian cancer patient mortality between 6 and 12 months following a diagnosis

**Table 5:** Crude mortality rates and odds ratios from mixed effects logistic regression models for factors associated with patient mortality between 6 and 12 months from diagnosis.

Variables	Crude mortality rates		Minimally adjusted mortality rates				Maximally adjusted mortality rates			
	%	95% CI	OR	95% CI	SE	P-value	OR	95% CI	SE	P-value
<b>(Intercept)</b>			0.0	(0.0,0.0)	0.0	0.000	0.0	(0.0,0.0)	0.0	0.000
<b>Age at diagnosis (years)</b>										
0-29	1.4	(0.8,2.5)	0.2	(0.1,0.4)	0.1	0.000	0.2	(0.1,0.4)	0.1	0.000
30-39	3.3	(2.3,4.8)	0.4	(0.3,0.6)	0.1	0.000	0.4	(0.2,0.5)	0.1	0.000
40-49	4.0	(3.3,4.9)	0.3	(0.3,0.4)	0.0	0.000	0.3	(0.3,0.4)	0.0	0.000
50-59	6.4	(5.7,7.0)	0.5	(0.4,0.6)	0.0	0.000	0.5	(0.4,0.6)	0.0	0.000
60-69	8.4	(7.8,9.0)	0.6	(0.5,0.6)	0.0	0.000	0.6	(0.5,0.6)	0.0	0.000
70-79 (ref)	14.4	(13.6,15.2)								
80+	25.1	(23.6,26.8)	1.7	(1.6,2.0)	0.1	0.000	1.7	(1.5,1.9)	0.1	0.000
<b>Tumour morphology</b>										
Serous carcinoma (ref)	10.2	(9.7,10.7)								
Clear cell carcinoma	8.3	(6.9,9.9)	2.5	(2.0,3.1)	0.3	0.000	2.6	(2.1,3.2)	0.3	0.000
Endometrioid carcinoma	2.7	(2.1,3.5)	0.9	(0.7,1.2)	0.1	0.533	1.0	(0.7,1.3)	0.1	0.771
Miscellaneous and unspecified	26.6	(23.6,29.8)	2.5	(2.0,3.0)	0.3	0.000	2.3	(1.9,2.8)	0.2	0.000
Mucinous carcinoma	4.7	(3.8,5.7)	1.8	(1.4,2.3)	0.2	0.000	1.8	(1.4,2.4)	0.2	0.000
Non-specific site	19.1	(15.1,23.8)	1.7	(1.3,2.4)	0.3	0.001	1.7	(1.2,2.3)	0.3	0.001
Other malignant epithelial	20.3	(19.0,21.7)	2.3	(2.1,2.6)	0.1	0.000	2.3	(2.0,2.5)	0.1	0.000
Sex cord-stromal and germ cell	1.5	(1.0,2.2)	0.5	(0.3,0.7)	0.1	0.000	0.5	(0.3,0.7)	0.1	0.001
<b>Stage at diagnosis</b>										
1 (ref)	1.7	(1.4,2.0)								
2	4.7	(3.8,5.8)	2.8	(2.1,3.8)	0.4	0.000	2.9	(2.1,3.9)	0.4	0.000
3	11.5	(10.9,12.1)	7.1	(5.7,8.9)	0.8	0.000	6.8	(5.4,8.5)	0.8	0.000
4	18.7	(17.6,19.8)	11.9	(9.5,15.0)	1.4	0.000	10.8	(8.6,13.7)	1.3	0.000
Unknown	16.1	(14.9,17.4)	7.8	(6.2,10.0)	1.0	0.000	7.3	(5.8,9.4)	0.9	0.000
<b>Index of Multiple Deprivation</b>										
Quintile 5 (least deprived) (ref)	10.8	(10.0,11.6)								
Quintile 4	10.5	(9.8,11.3)	1.0	(0.9,1.1)	0.1	0.820	1.0	(0.9,1.1)	0.1	0.698
Quintile 3	10.3	(9.5,11.1)	1.0	(0.9,1.1)	0.1	0.971	1.0	(0.9,1.1)	0.1	0.750
Quintile 2	10.7	(9.9,11.6)	1.1	(1.0,1.3)	0.1	0.149	1.1	(0.9,1.2)	0.1	0.266
Quintile 1 (most deprived)	10.5	(9.6,11.5)	1.2	(1.0,1.4)	0.1	0.022	1.1	(1.0,1.3)	0.1	0.078

Short-term mortality in ovarian, fallopian tube and primary peritoneal carcinomas across England

Variables		Crude mortality rates		Minimally adjusted mortality rates				Maximally adjusted mortality rates			
		%	95% CI	OR	95% CI	SE	p-value	OR	95% CI	SE	p-value
<b>Ethnicity</b>	White (ref)	10.9	(10.5,11.3)								
	Black	7.3	(5.2,10.1)	0.8	(0.5,1.1)	0.2	0.194	0.7	(0.5,1.1)	0.1	0.120
	Asian	6.4	(5.1,8.1)	0.8	(0.6,1.0)	0.1	0.074	0.8	(0.6,1.0)	0.1	0.056
	Chinese	7.0	(3.2,14.4)	1.0	(0.4,2.4)	0.4	0.967	1.0	(0.4,2.5)	0.5	0.925
	Other	6.3	(4.2,9.4)	0.9	(0.5,1.3)	0.2	0.484	0.8	(0.5,1.3)	0.2	0.373
	Mixed	9.8	(5.8,16.1)	1.5	(0.8,2.8)	0.5	0.200	1.5	(0.8,2.8)	0.5	0.172
	Unknown	10.9	(9.1,12.9)	1.0	(0.8,1.3)	0.1	0.791	1.1	(0.8,1.3)	0.1	0.645
<b>Charlson comorbidity index</b>	0 (ref)	9.9	(9.5,10.3)								
	1	12.9	(11.5,14.5)	1.1	(0.9,1.3)	0.1	0.228	1.1	(0.9,1.3)	0.1	0.363
	2	16.8	(14.5,19.4)	1.3	(1.1,1.6)	0.1	0.003	1.3	(1.1,1.6)	0.1	0.006
	>2	21.1	(17.6,25.0)	1.6	(1.2,2.0)	0.2	0.000	1.5	(1.2,1.9)	0.2	0.002
	Not recorded	10.3	(6.3,16.3)	1.3	(0.7,2.3)	0.4	0.440	1.5	(0.8,2.8)	0.5	0.159
<b>Route to diagnosis</b>	Two Week Wait (ref)	8.8	(8.2,9.3)								
	Emergency presentation	17.5	(16.5,18.5)					1.7	(1.6,1.9)	0.1	0.000
	Non-urgent	8.6	(8.0,9.2)					1.1	(1.0,1.2)	0.1	0.083
	Unknown	8.2	(6.3,10.7)					0.9	(0.6,1.2)	0.1	0.325
<b>Cancer centre</b>	Cancer centre (ref)	8.8	(8.4,9.3)								
	No cancer centre	13.2	(12.5,13.8)					1.1	(1.0,1.3)	0.1	0.023

## Appendix 6: Ovarian cancer patient mortality by Cancer Alliance between 0 and 2 months following a diagnosis

**Table 6:** Crude and case-mix adjusted mortality rates by Cancer Alliance at diagnosis for ovarian cancer patient mortality between 0 and 2 months after diagnosis. The minimally adjusted model included basis of diagnosis, age at diagnosis, tumour morphology, stage at diagnosis, deprivation quintile, ethnicity, comorbidity, trust at diagnosis as a random effect. The maximally adjusted model additionally adjusted for route to diagnosis and whether the trust at diagnosis housed a specialist gynaecological cancer centre.

Cancer Alliance	Diagnosed (n)	Unadjusted mortality rate	95% CI	Minimally adjusted mortality rate	95% CI	Maximally adjusted mortality rate	95% CI
Cheshire and Merseyside	1,640	13.7	(12.1,15.4)	13.2	(12.6,13.9)	13.2	(12.6,13.9)
East Midlands	2,515	15.5	(14.1,16.9)	14.3	(13.7,14.8)	14.6	(14.0,15.1)
East of England	4,145	14.4	(13.4,15.5)	14.1	(13.7,14.5)	14.2	(13.7,14.6)
Greater Manchester	1,626	13.6	(12.0,15.3)	14.2	(13.5,14.9)	14.4	(13.7,15.1)
Humber, Coast and Vale	927	14.0	(11.9,16.4)	14.0	(13.1,14.9)	13.9	(13.0,14.8)
Kent and Medway	1,166	14.2	(12.3,16.4)	14.4	(13.5,15.2)	14.7	(13.8,15.5)
Lancashire and South Cumbria	1,101	13.8	(11.9,16.0)	14.1	(13.3,14.9)	14.1	(13.2,14.9)
North Central and North East London	1,295	9.2	(7.7,10.9)	12.2	(11.5,12.8)	11.9	(11.3,12.6)
North East and Cumbria	2,037	14.0	(12.6,15.6)	14.1	(13.4,14.7)	14.2	(13.6,14.8)
North West and South West London	1,609	9.9	(8.5,11.4)	13.2	(12.5,13.8)	12.6	(12.0,13.2)
Peninsula	1,403	16.1	(14.3,18.1)	13.6	(12.8,14.3)	13.6	(12.9,14.3)
Somerset, Wiltshire, Avon and Gloucestershire	1,820	12.0	(10.6,13.6)	13.2	(12.6,13.8)	13.3	(12.7,13.9)
South East London	789	9.8	(7.9,12.0)	13.0	(12.1,13.9)	12.6	(11.7,13.5)
South Yorkshire, Bassetlaw, North Derbyshire and Hardwick	1,145	15.6	(13.6,17.9)	14.2	(13.4,15.0)	14.2	(13.4,15.0)
Surrey and Sussex	2,087	12.8	(11.5,14.3)	12.7	(12.1,13.2)	12.6	(12.0,13.1)
Thames Valley	1,357	12.0	(10.4,13.8)	12.9	(12.2,13.5)	12.9	(12.2,13.6)
Wessex	1,814	14.6	(13.0,16.3)	12.9	(12.3,13.4)	12.8	(12.2,13.4)
West Midlands	3,509	15.0	(13.8,16.2)	13.7	(13.3,14.2)	13.7	(13.2,14.1)
West Yorkshire and Harrogate	1,457	12.6	(11.0,14.4)	13.5	(12.8,14.2)	13.4	(12.7,14.0)

## Appendix 7: Ovarian cancer patient mortality by Cancer Alliance between 2 and 6 months following a diagnosis

**Table 7:** Crude and case-mix adjusted mortality rates by Cancer Alliance at diagnosis for ovarian cancer patient mortality between 2 and 6 months after diagnosis. The minimally adjusted model included age at diagnosis, tumour morphology, stage at diagnosis, deprivation quintile, ethnicity, comorbidity, trust at diagnosis as a random effect. The maximally adjusted model additionally adjusted for route to diagnosis and whether the trust at diagnosis housed a specialist gynaecological cancer centre.

Cancer Alliance	Alive at day 61 (n)	Unadjusted mortality rate	95% CI	Minimally adjusted mortality rate	95% CI	Maximally adjusted mortality rate	95% CI
Cheshire and Merseyside	1,416	12.0	(10.4,13.8)	10.8	(10.2,11.3)	10.8	(10.3,11.4)
East Midlands	2,126	11.4	(10.1,12.8)	10.3	(9.9,10.8)	10.6	(10.2,11.1)
East of England	3,547	11.2	(10.2,12.3)	10.3	(10.0,10.6)	10.4	(10.0,10.7)
Greater Manchester	1,405	8.4	(7.1,10.0)	9.5	(9.0,10.0)	9.4	(8.9,9.9)
Humber, Coast and Vale	797	10.4	(8.5,12.7)	10.1	(9.4,10.8)	10.2	(9.5,10.9)
Kent and Medway	1,000	9.8	(8.1,11.8)	10.1	(9.5,10.8)	10.4	(9.7,11.0)
Lancashire and South Cumbria	949	9.7	(8.0,11.7)	10.8	(10.1,11.5)	10.7	(10.0,11.4)
North Central and North East London	1,176	6.6	(5.3,8.2)	8.8	(8.3,9.3)	8.6	(8.1,9.1)
North East and Cumbria	1,752	10.9	(9.5,12.4)	10.6	(10.1,11.1)	10.7	(10.2,11.2)
North West and South West London	1,450	7.0	(5.8,8.4)	8.8	(8.4,9.3)	8.5	(8.1,9.0)
Peninsula	1,177	9.7	(8.1,11.5)	8.8	(8.3,9.3)	8.8	(8.3,9.3)
Somerset, Wiltshire, Avon and Gloucestershire	1,602	8.3	(7.0,9.8)	9.3	(8.9,9.8)	9.5	(9.0,9.9)
South East London	712	5.9	(4.4,7.9)	8.2	(7.6,8.8)	7.9	(7.3,8.5)
South Yorkshire, Bassetlaw, North Derbyshire and Hardwick	966	10.7	(8.9,12.8)	10.1	(9.5,10.7)	10.1	(9.5,10.8)
Surrey and Sussex	1,819	9.8	(8.6,11.3)	9.5	(9.1,10.0)	9.4	(9.0,9.9)
Thames Valley	1,194	8.8	(7.3,10.5)	9.0	(8.5,9.5)	8.9	(8.4,9.4)
Wessex	1,550	11.0	(9.5,12.6)	9.5	(9.0,10.0)	9.6	(9.1,10.1)
West Midlands	2,983	10.0	(8.9,11.1)	9.5	(9.2,9.9)	9.4	(9.1,9.8)
West Yorkshire and Harrogate	1,273	8.0	(6.6,9.6)	9.2	(8.7,9.7)	8.9	(8.4,9.4)

## Appendix 8: Ovarian cancer patient mortality by Cancer Alliance between 6 and 12 months following a diagnosis

**Table 8:** Crude and case-mix adjusted mortality rates by Cancer Alliance at diagnosis for ovarian cancer patient mortality between 6 and 12 months after diagnosis. The minimally adjusted model included age at diagnosis, tumour morphology, stage at diagnosis, deprivation quintile, ethnicity, comorbidity, trust at diagnosis as a random effect. The maximally adjusted model additionally adjusted for route to diagnosis and whether the trust at diagnosis housed a specialist gynaecological cancer centre.

Cancer Alliance	Alive at day 181 (n)	Unadjusted mortality rate	95% CI	Minimally adjusted mortality rate	95% CI	Maximally adjusted mortality rate	95% CI
Cheshire and Merseyside	1,246	11.3	(9.7,13.2)	11.5	(10.9,12.1)	11.5	(10.8,12.1)
East Midlands	1,884	11.4	(10.0,12.9)	10.8	(10.3,11.3)	11.0	(10.5,11.4)
East of England	3,150	10.7	(9.7,11.9)	10.8	(10.4,11.2)	10.8	(10.5,11.2)
Greater Manchester	1,287	7.8	(6.4,9.4)	9.4	(8.9,10.0)	9.2	(8.7,9.7)
Humber, Coast and Vale	714	8.7	(6.8,11.0)	9.7	(9.0,10.4)	9.6	(8.9,10.3)
Kent and Medway	902	10.2	(8.4,12.3)	10.2	(9.5,10.9)	10.5	(9.8,11.2)
Lancashire and South Cumbria	857	10.5	(8.6,12.7)	11.4	(10.6,12.1)	11.4	(10.6,12.1)
North Central and North East London	1,098	8.1	(6.6,9.9)	9.9	(9.3,10.4)	9.8	(9.2,10.3)
North East and Cumbria	1,561	10.8	(9.3,12.4)	11.3	(10.7,11.8)	11.3	(10.8,11.9)
North West and South West London	1,349	8.2	(6.8,9.7)	9.7	(9.2,10.2)	9.4	(8.9,9.9)
Peninsula	1,063	13.0	(11.1,15.1)	11.1	(10.4,11.7)	11.2	(10.5,11.9)
Somerset, Wiltshire, Avon and Gloucestershire	1,469	9.7	(8.3,11.4)	10.1	(9.5,10.6)	10.2	(9.7,10.7)
South East London	670	8.1	(6.2,10.4)	10.1	(9.3,10.8)	9.8	(9.0,10.5)
South Yorkshire, Bassetlaw, North Derbyshire and Hardwick	863	15.8	(13.5,18.3)	12.8	(11.9,13.7)	13.0	(12.1,13.9)
Surrey and Sussex	1,640	11.3	(9.8,12.9)	10.4	(9.9,10.9)	10.4	(9.9,10.9)
Thames Valley	1,089	10.8	(9.1,12.8)	10.4	(9.8,11.0)	10.3	(9.7,11.0)
Wessex	1,380	12.4	(10.8,14.2)	10.7	(10.1,11.3)	10.8	(10.2,11.4)
West Midlands	2,686	10.8	(9.6,12.0)	10.3	(9.9,10.7)	10.2	(9.9,10.6)
West Yorkshire and Harrogate	1,171	10.1	(8.5,11.9)	10.3	(9.7,10.9)	10.1	(9.5,10.7)

## Appendix 9: Sensitivity analysis

63.4% of ovarian cancer patients included in the cohort had an unknown performance status (PS). For this reason, performance status was not included in the mixed effects logistic regression models as it may have reduced the models' statistical power and led to biased estimates and invalid conclusions.<sup>16</sup> Despite this, performance status is known to play an important role in treatment decisions and therefore patient mortality. Accordingly, a sensitivity analysis was undertaken to estimate the association between performance status and short-term mortality within 2 months from diagnosis. Only the time period up to 2 months from diagnosis was investigated in this sensitivity analysis because most variation in patient mortality was seen here (Appendix 2). Only patients with a known performance status value were included in this analysis, restricting the cohort to a sub-group of 12,230 patients (original cohort n=33,442). Mixed effects logistic regression models were built, with and without adjustment for performance status, along with all other covariates previously adjusted for.

Table 9 shows that ovarian cancer patients with a higher performance status (worse capabilities of daily living activities) have a higher odds of dying within 2 months from diagnosis compared to patients with a performance status of 0 (fully capable in daily activities). Adjusted mortality rates show there was a statistically significant difference in mortality within 2 months from diagnosis between patients with a performance status of 0 and those with a performance status of 2, 3 or 4, with the greatest probability of dying among patients with a performance status of 4 (OR: 12.9).

Crude and adjusted mortality rates in this sub-group were much lower than evident in the full cohort. Figure 23 (without performance status in the model), and Figure 24 (adjusting for performance status), show that including performance status in the model results in reduced mortality rates but with slightly wider variation (2 Alliances moved beyond 2 SDs of the average).

**Table 9:** Odds ratios from mixed effects logistic regression models for factors associated with patient mortality between 0 and 2 months from diagnosis, for only patients with a known performance status.

Variables	Adjusted mortality rates without PS				Adjusted mortality rates with PS				
	OR	95% CI	SE	p-value	OR	95% CI	SE	p-value	
<b>(Intercept)</b>	0.0	(0.0, 0.0)	0.0	0.000	0.0	(0.0, 0.0)	0.0	0.000	
<b>Basis of diagnosis</b>	Cytology	2.0	(1.7, 2.5)	0.2	0.000	1.7	(1.3, 2.1)	0.2	0.000
	Clinical	2.6	(1.9, 3.6)	0.4	0.000	1.4	(1.0, 2.0)	0.3	0.050
<b>Age at diagnosis (years)</b>	0-29	0.1	(0.0, 0.7)	0.1	0.024	0.1	(0.0, 1.0)	0.1	0.052
	30-39	0.1	(0.0, 0.5)	0.1	0.004	0.2	(0.1, 0.9)	0.1	0.029
	40-49	0.2	(0.1, 0.4)	0.1	0.000	0.3	(0.2, 0.5)	0.1	0.000
	50-59	0.3	(0.2, 0.4)	0.0	0.000	0.4	(0.3, 0.5)	0.1	0.000
	60-69	0.5	(0.4, 0.6)	0.1	0.000	0.6	(0.5, 0.7)	0.1	0.000
	80+	1.5	(1.2, 1.8)	0.1	0.000	1.2	(1.0, 1.5)	0.1	0.043
<b>Tumour morphology</b>	Clear cell carcinoma	2.4	(1.4, 4.0)	0.6	0.001	2.6	(1.5, 4.3)	0.7	0.000
	Endometrioid carcinoma	0.9	(0.4, 2.1)	0.4	0.889	1.0	(0.4, 2.2)	0.4	0.982

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Variables		Adjusted mortality rates without PS				Adjusted mortality rates with PS			
		OR	95% CI	SE	p-value	OR	95% CI	SE	p-value
<b>Stage at diagnosis</b>	Miscellaneous and unspecified	3.1	(2.2, 4.6)	0.6	0.000	3.3	(2.2, 4.9)	0.7	0.000
	Mucinous carcinoma	2.0	(1.1, 3.5)	0.6	0.017	1.7	(1.0, 3.1)	0.5	0.070
	Non-specific site	2.4	(1.5, 3.9)	0.6	0.001	1.9	(1.1, 3.2)	0.5	0.019
	Other malignant epithelial	2.8	(2.3, 3.3)	0.3	0.000	2.6	(2.2, 3.2)	0.3	0.000
	Sex cord-stromal and germ cell	0.7	(0.2, 2.2)	0.4	0.599	0.7	(0.2, 2.1)	0.4	0.517
	2	2.5	(1.1, 5.5)	1.0	0.025	2.2	(1.0, 4.9)	0.9	0.062
	3	7.4	(4.2,13.3)	2.2	0.000	6.7	(3.7,12.1)	2.0	0.000
	4	9.9	(5.5,17.7)	2.9	0.000	8.1	(4.5,14.6)	2.4	0.000
<b>Index of Multiple Deprivation</b>	Unknown	9.2	(5.1,16.8)	2.8	0.000	7.8	(4.2,14.4)	2.4	0.000
	Quintile 4	1.2	(0.9, 1.5)	0.1	0.147	1.1	(0.9, 1.4)	0.1	0.459
	Quintile 3	1.3	(1.0, 1.6)	0.2	0.061	1.2	(0.9, 1.5)	0.2	0.269
	Quintile 2	1.2	(1.0, 1.6)	0.2	0.106	1.1	(0.9, 1.5)	0.2	0.379
	Quintile 1 (most deprived)	1.8	(1.4, 2.3)	0.2	0.000	1.6	(1.2, 2.1)	0.2	0.000
<b>Ethnicity</b>	Black	0.7	(0.3, 1.6)	0.3	0.441	0.6	(0.3, 1.5)	0.3	0.274
	Asian	0.5	(0.3, 1.0)	0.2	0.060	0.4	(0.2, 0.9)	0.2	0.016
	Chinese	3.3	(0.9,11.5)	2.1	0.065	3.0	(0.8,11.4)	2.0	0.111
	Other	0.4	(0.1, 1.1)	0.2	0.063	0.4	(0.1, 1.3)	0.2	0.118
	Mixed	2.2	(0.6, 8.3)	1.5	0.228	2.1	(0.6, 8.0)	1.4	0.263
	Unknown	2.4	(1.7, 3.5)	0.5	0.000	2.3	(1.6, 3.5)	0.5	0.000
	1	1.0	(0.8, 1.3)	0.1	0.780	0.9	(0.7, 1.2)	0.1	0.394
	2	1.1	(0.8, 1.5)	0.2	0.744	0.8	(0.6, 1.2)	0.2	0.369
>2	1.8	(1.3, 2.7)	0.4	0.002	1.6	(1.1, 2.3)	0.3	0.023	
<b>Charlson comorbidity index</b>	Not recorded	3.8	(1.3,10.9)	2.0	0.012	4.0	(1.3,12.4)	2.3	0.016
	Emergency presentation	3.8	(3.2, 4.6)	0.4	0.000	2.6	(2.2, 3.2)	0.3	0.000
	Non-urgent	1.2	(0.9, 1.5)	0.1	0.181	1.1	(0.9, 1.4)	0.1	0.473
	Unknown	0.6	(0.2, 1.5)	0.3	0.282	0.6	(0.2, 1.4)	0.3	0.220
<b>Route to diagnosis</b>	No cancer centre	1.2	(1.1, 1.5)	0.1	0.011	1.2	(1.0, 1.5)	0.1	0.035
	1					1.1	(0.9, 1.4)	0.1	0.391
	2					2.4	(1.8, 3.1)	0.3	0.000
<b>Cancer centre Performance status</b>	3					5.6	(4.4, 7.3)	0.7	0.000
	4					12.9	(8.9,18.6)	2.4	0.000

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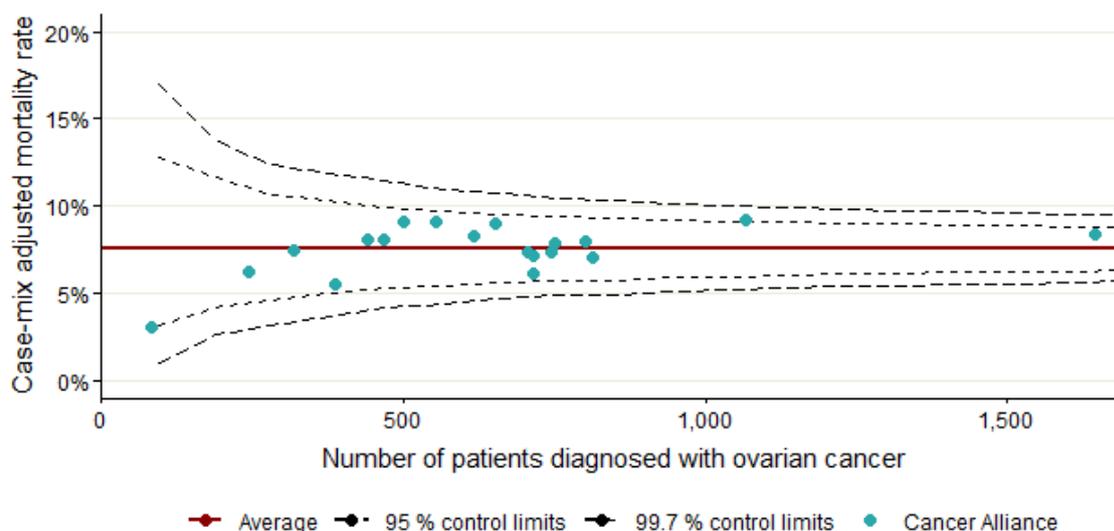


Figure 23: Case-mix adjusted (excluding performance status) short-term mortality rate within 2 months of an ovarian cancer diagnosis for patients with a known performance status by Cancer Alliance, England 2013-2018

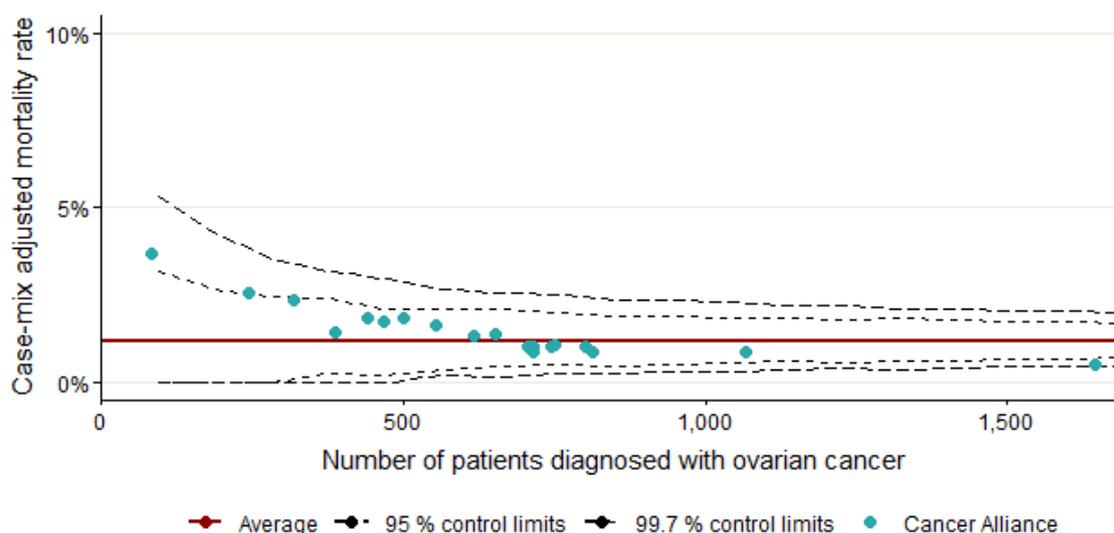


Figure 24: Case-mix adjusted (including performance status) short-term mortality rate within 2 months of an ovarian cancer diagnosis for patients with a known performance status by Cancer Alliance, England 2013-2018

## Appendix 10: Route to diagnosis by Cancer Alliance in patients with short-term mortality

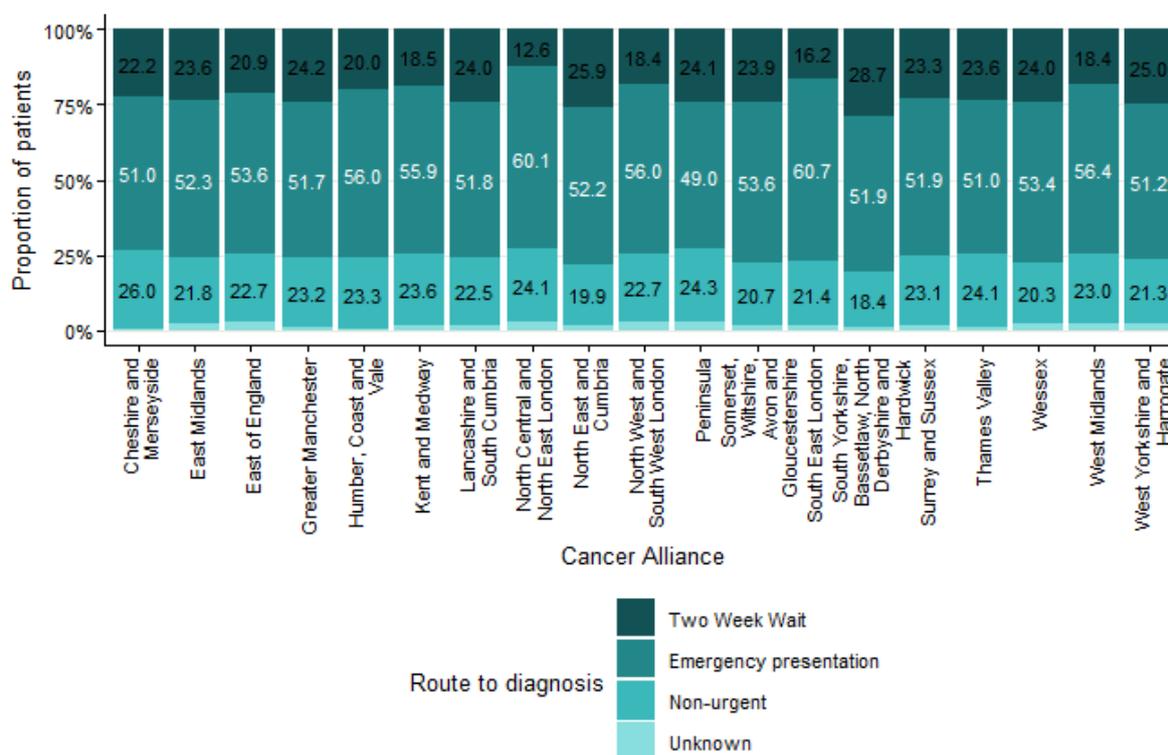


Figure 25: Proportion of short-term mortality ovary, fallopian tube or primary peritoneal carcinoma patients by route to diagnosis and Cancer Alliance, England 2013-2018

## Appendix 11: Comorbidity conditions

Description	Charlson score	Notes
Acute myocardial infarction	1	
Congestive heart failure	1	
Peripheral vascular disease	1	
Cerebral vascular accident	1	
Dementia	1	
Pulmonary disease	1	
Connective tissue disorder	1	
Peptic ulcer	1	
Diabetes	1	Only highest score is counted
Diabetes complications	2	
Paraplegia	2	
Renal disease	2	
Cancer	2	Derived from cancer registry data rather than HES data.
Metastatic cancer	N/A	
Liver disease	1	Only highest score is counted
Severe liver disease	3	
HIV	6	

## Appendix 12: List of trusts containing specialist gynaecological cancer centres in 2021

Trust code	Trust name
RR7	GATESHEAD HEALTH NHS FOUNDATION TRUST
RTR	SOUTH TEES HOSPITALS NHS FOUNDATION TRUST
RXN	LANCASHIRE TEACHING HOSPITALS NHS FOUNDATION TRUST
RWA	HULL UNIVERSITY TEACHING HOSPITALS NHS TRUST
RR8	LEEDS TEACHING HOSPITALS NHS TRUST
REP	LIVERPOOL WOMEN'S NHS FOUNDATION TRUST
R0A	MANCHESTER UNIVERSITY NHS FOUNDATION TRUST
RHQ	SHEFFIELD TEACHING HOSPITALS NHS FOUNDATION TRUST
RL4	ROYAL WOLVERHAMPTON NHS TRUST
RXK	SANDWELL & WEST BIRMINGHAM HOSPITALS NHS TRUST
RKB	UNIVERSITY HOSPITALS COVENTRY & WARWICKSHIRE NHS TRUST
RJE	UNIVERSITY HOSPITALS OF NORTH MIDLANDS NHS TRUST
RTG	UNIVERSITY HOSPITALS OF DERBY & BURTON NHS FOUNDATION TRUST
RNS	NORTHAMPTON GENERAL HOSPITAL NHS TRUST
RWE	UNIVERSITY HOSPITALS OF LEICESTER NHS TRUST
RX1	NOTTINGHAM UNIVERSITY HOSPITALS NHS TRUST
RGT	CAMBRIDGE UNIVERSITY HOSPITALS NHS FOUNDATION TRUST
RDE	EAST SUFFOLK & NORTH ESSEX NHS FOUNDATION TRUST
RM1	NORFOLK & NORWICH UNIVERSITY HOSPITALS NHS FOUNDATION TRUST
RAJ	SOUTHEND UNIVERSITY HOSPITAL NHS FOUNDATION TRUST
RWG	WEST HERTFORDSHIRE HOSPITALS NHS TRUST
R1H	BARTS HEALTH NHS TRUST
RJ1	GUY'S & ST THOMAS' NHS FOUNDATION TRUST
RYJ	IMPERIAL COLLEGE HEALTHCARE NHS TRUST
RPY	ROYAL MARSDEN NHS FOUNDATION TRUST
RRV	UNIVERSITY COLLEGE LONDON HOSPITALS NHS FOUNDATION TRUST
RTE	GLOUCESTERSHIRE HOSPITALS NHS FOUNDATION TRUST
RBA	TAUNTON & SOMERSET NHS FOUNDATION TRUST
RA7	UNIVERSITY HOSPITALS BRISTOL NHS FOUNDATION TRUST
RD1	ROYAL UNITED HOSPITALS BATH NHS FOUNDATION TRUST
REF	ROYAL CORNWALL HOSPITALS NHS TRUST

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<b>Trust code</b>	<b>Trust name</b>
RH8	ROYAL DEVON & EXETER NHS FOUNDATION TRUST
RTH	OXFORD UNIVERSITY HOSPITALS NHS FOUNDATION TRUST
RD3	POOLE HOSPITAL NHS FOUNDATION TRUST
RHU	PORTSMOUTH HOSPITALS NHS TRUST
RHM	UNIVERSITY HOSPITAL SOUTHAMPTON NHS FOUNDATION TRUST
RWF	MAIDSTONE & TUNBRIDGE WELLS NHS TRUST
RVV	EAST KENT HOSPITALS UNIVERSITY NHS FOUNDATION TRUST
RA2	ROYAL SURREY COUNTY HOSPITAL NHS FOUNDATION TRUST
RXH	BRIGHTON & SUSSEX UNIVERSITY HOSPITALS NHS TRUST

## Appendix 13: Glossary

Term	Acronym	Description
Borderline/non-Borderline		Borderline ovarian tumours are abnormal cells that form in the tissue covering the ovary. They are different to ovarian cancer because they do not grow into the supportive tissue of the ovary (the stroma). They tend to grow slowly and in a more controlled way than cancer cells. The main treatment for borderline tumours is surgery. Most women are cured and have no further problems. There is a small risk of the tumour coming back. Very rarely, the borderline tumour cells change into cancer cells.
Cancer Alliances	CA	The 19 Cancer Alliances in England bring together the key organisations in their regions to coordinate cancer care and to plan for and lead delivery of improved outcomes for patients locally.
Cancer centre/unit		Cancer units provide diagnostic services for their local populations and refer cases of suspected or confirmed ovarian cancer to their local gynaecological cancer centre. Cancer centres house specialist gynae oncology MDTs and provide diagnostic and treatment services for patients referred from local cancer units.
Cancer registry	NCRAS	The National Cancer Registration and Analysis Service (NCRAS) collects data on all cases of cancer that occur in people diagnosed in England. The data is used to support public health, healthcare and research.
Carcinoma		Category of types of cancer that develop from epithelial cells.
Case-mix adjusted		A case-mix adjusted rate takes into account differences between patient populations by providing estimates based on an average group of patients. This allows for rates to be compared across geographies or time periods.
Comorbidity		A disease or condition that someone has in addition to the health problem being studied or treated (i.e. cancer).
Crude mortality rate		Mortality rate derived directly from the counts of relevant patients and the size of the cohort. For example, the crude mortality rate of ovarian, fallopian tube and primary peritoneal carcinomas in 2017 is the number of women who died and such tumours diagnosed divided by the number of women included in the cohort.
Fallopian tube		Fallopian tubes carry eggs from the ovaries to the uterus. Serous carcinomas of the fallopian tube are considered to be the same disease entity as serous cancers of the ovary and primary peritoneal carcinoma, which is why cancers at all 3 sites are collected in this report.
FIGO stage	FIGO	System for staging of gynaecological cancers, published by the International Federation of Gynaecology and Obstetrics (FIGO).

Term	Acronym	Description
ICD codes	ICD	International Classification of Diseases is a medical classification and coding list for the identification of diseases, signs and symptoms, abnormal findings, complaints, social circumstances and external causes of injury or diseases, as maintained by the World Health Organization (WHO). ICD-10 classifies cancers by site and behaviour (malignancy) and ICD-O classifies cancers by site, morphology and behaviour.
Malignant		Malignant tumours are considered to be cancer. Malignant means characterised by the tendency to become progressively worse. Often characterised by anaplasia, invasiveness and /or metastases.
Morphology		Morphology is the type of a tumour, as diagnosed by a pathologist looking at the shape of the cells through a microscope. The morphological type of a tumour can be important in understanding how to treat that tumour and what expected outcomes might be. The morphology categories include the main subtypes of epithelial ovarian cancers (serous, endometrioid, clear cell, mucinous and other epithelial), categories for cases where the pathology detail was unspecified or the site was unspecified in the data, and the separate category of sex code stromal and germ cell tumours.
Mortality		Cancer mortality is the number of deaths from cancer in a specific population within a specific period of time. It usually only includes deaths where cancer is mentioned as an underlying cause of death on death certificates. Cancer mortality rates are a standard measure of the frequency of deaths from cancer within a specific period of time relative to a fixed population size.
Multidisciplinary team	MDT	MDTs bring together experts in specific areas of medicine and care, and usually meet every week to discuss the diagnosis, treatment and care of individual cancer patients.
NHS trusts		NHS hospital trusts are organisational units within the National Health Service in England, providing secondary health services in a particular local area.
Performance status		Performance status is an attempt to quantify cancer patients' general well-being and activities of daily life. This is captured as a WHO (World Health Organization) score between 0 and 4.
Peritoneum		The peritoneum is the serous membrane forming the lining of the abdominal cavity.
Primary peritoneal carcinomas	C48	Cancer of the epithelial cells in the peritoneum. Primary peritoneal carcinomas are considered to be the same disease entity as serous carcinomas of the ovarian or fallopian tube, which is why cancers at all 3 sites are collected in this report.
Routes to diagnosis	RtD	A route to diagnosis describes the pathway a patient took through the healthcare system, and the interactions the patient made with primary and/or secondary care before receiving a cancer diagnosis.

<b>Term</b>	<b>Acronym</b>	<b>Description</b>
Stage		Stage describes the extent or severity of a person's cancer. Diagnosis at an earlier stage leads to improved prognosis, treatments and outcomes in comparison with cancers diagnosed at a later stage.
World Health Organization	WHO	The World Health Organization directs and coordinates international health within the United Nations system. The WHO classification systems for cancer sites are used in the cancer registry

## Appendix 14: Useful links

<p>Ovarian Cancer Audit Feasibility Pilot homepage</p> <p>Information about this project and links to outputs.</p>	<p><a href="http://ncin.org.uk/ocafp">http://ncin.org.uk/ocafp</a></p>
<p>NCRAS gynae hub ovarian cancer resources</p> <p>Reports, briefings and other resources on ovarian cancer from NCRAS</p>	<p><a href="http://ncin.org.uk/cancer_type_and_topic_specific_work/cancer_type_specific_work/gynaecological_cancer/gynaecological_cancer_hub/resources/ovarian_cancer">http://ncin.org.uk/cancer_type_and_topic_specific_work/cancer_type_specific_work/gynaecological_cancer/gynaecological_cancer_hub/resources/ovarian_cancer</a></p>
<p>CancerData</p> <p>NCRAS hub for incidence and mortality data by geographies, Routes to Diagnosis and treatment data for cancers including ovary.</p>	<p><a href="https://www.cancerdata.nhs.uk/incidence">https://www.cancerdata.nhs.uk/incidence</a></p> <p><a href="https://www.cancerdata.nhs.uk/mortality">https://www.cancerdata.nhs.uk/mortality</a></p> <p><a href="https://www.cancerdata.nhs.uk/routestodiagnosis">https://www.cancerdata.nhs.uk/routestodiagnosis</a></p> <p><a href="https://www.cancerdata.nhs.uk/treatments">https://www.cancerdata.nhs.uk/treatments</a></p>
<p>CancerStats I</p> <p>For N3 (NHS) connections only, requires signup. Incidence and mortality with greater geographical granularity than CancerData.</p>	<p><a href="https://nww.cancerstats.nhs.uk/">https://nww.cancerstats.nhs.uk/</a></p>
<p>CancerStats II</p> <p>For N3 (NHS) connections only, requires signup. Select Audits &gt; OCAFP for project outputs including data completeness report.</p>	<p><a href="https://cancerstats.ndrs.nhs.uk/">https://cancerstats.ndrs.nhs.uk/</a></p>
<p>Data Resource Profile: National Cancer Registration Dataset in England</p> <p>Information about the registry dataset used for this report.</p>	<p><a href="https://doi.org/10.1093/ije/dyz076">https://doi.org/10.1093/ije/dyz076</a></p>
<p>Get Data Out: Ovary, fallopian tube and primary peritoneal carcinomas</p> <p>Routine data from NCRAS on small groups of ovarian cancer patients since 2013. Incidence, Routes to Diagnosis, treatment, survival.</p>	<p><a href="https://www.cancerdata.nhs.uk/getdataout/ovary">https://www.cancerdata.nhs.uk/getdataout/ovary</a></p> <p><a href="https://www.cancerdata.nhs.uk/getdataout/data">https://www.cancerdata.nhs.uk/getdataout/data</a></p>
<p>Progress in cancer survival, mortality, and incidence in seven high-income countries 1995–2014 (ICBP SURVMARK-2): a population-based study, The Lancet Oncology, Arnold et al. 2019</p> <p>International comparison of cancer incidence, mortality and survival, including ovarian cancer</p>	<p><a href="https://doi.org/10.1016/S1470-2045(19)30456-5">https://doi.org/10.1016/S1470-2045(19)30456-5</a></p>

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<p>Stage breakdown by CCG 2017</p> <p>NCRAS stage data for sites including ovary, split by CCG.</p>	<p><a href="http://www.ncin.org.uk/view?rid=3864">http://www.ncin.org.uk/view?rid=3864</a></p>
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