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Variation in the treatment of cervical cancer patients and the effect of consultant workload on survival: A population-based study

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ABSTRACT

This population-based study aimed to investigate the extent of variation in the treatment of patients diagnosed with cervical cancer between 1995 and 2000, and the relationship between workload and survival, looking at managing consultants and clinical oncologists. Cases were identified from the Northern and Yorkshire Cancer Registry ($n = 1500$) and divided into three groups according to their gynaecologists' or clinical oncologists' annual cervical cancer workload; 'low' (1–3 new patients), 'intermediate' (4–11 new patients) and 'high' (12 + new patients). Over the study period, there was a decrease in the proportion of patients treated by low workload gynaecologists. After adjustment for age, stage and socioeconomic status, higher gynaecologist workload was associated with improved survival but this was not statistically significant. No such trend was found for clinical oncologist workload. During the 1990s, there were moves to establish more specialised care of gynaecological cancers, with referral to multidisciplinary teams. The trends observed in this study are consistent with the goals of policy.

1. Introduction

Carcinoma of the cervix is the second most common cancer in females worldwide.[1] In the UK, 2942 women were diagnosed with cervical cancer in 2002, a rate of 9.7 per 100,000 population.[2] The treatment and prognosis of women with cervical cancer is largely dependent on the extent of disease at the time of diagnosis. Early carcinomas should be treated by radical hysterectomy and pelvic lymphadenectomy. Surgery and radiotherapy (RT) are equally effective in terms of survival for early stage cancers, however, surgery should be offered whenever possible as it is associated with fewer side-effects (such as bladder and bowel dysfunction, and sexual discomfort). RT should be offered in more advanced cases when surgery is unlikely to remove the tumour completely or in patients who are unfit for surgery.[3]

During the 1990s, gynaecological oncology became recognised as a designated sub-speciality in the UK. In 1997, in response to the Calman-Hine report,[4] the Royal College of Obstetricians and Gynaecologists and the British Gynaecological Cancer Society recommended that women with gynaecologic malignancy be managed by multidisciplinary teams, and that for complex surgical procedures, a minimum throughput is essential to maintain expertise.[5] However, no clear guidance

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was given as to what the minimum throughput should be. The document states that in centres providing an accredited training programme, the trainees should undertake a minimum of 20 cases annually to ensure adequate experience, but does not give any further guidance post-qualification. With regard to clinical oncologists, who deal with the non-surgical aspect of oncology such as the administration of RT, the document states that they should have at least three sessions per week dedicated to gynaecological oncology.

Previous studies have attempted to investigate the relationship between workload and outcomes for cervical cancer,[6,7] but these have taken the form of audits and case-note reviews. Analysis undertaken in the Yorkshire region using cancer registry data found a significant survival advantage for patients treated by gynaecologists with a workload of over 8 patients per year (RR 0.80, 95% CI 0.66–0.98) between 1986 and 1994.[8] Since this time, there has been a substantial but gradual change in the provision of cancer services, in response to government policy. Although the transition from a more general to a more specialist model for clinical management was recommended in 1995, specific guidance for gynaecological cancer was not available until 1999 when the NHS Executive guidance on improving outcomes in gynaecological cancers was published,[9] increasing pressure for service reconfiguration with more centralised multidisciplinary specialist teams.

This study extends the previous analyses to cover the period 1995–2000, when changes were beginning to take place. We use population-based cancer registry data to investigate the extent of variation in the treatment of patients diagnosed with cancer of the cervix, and explore the relationship between workload and survival, looking at both managing consultants and clinical oncologists.

2. Materials and methods

All invasive cervical cancer cases diagnosed between 1995 and 2000 in the former Yorkshire Health Authority were identified from the Northern and Yorkshire Cancer Registry and Information Services (NYCRIS) database. NYCRIS is a population-based cancer registry that records all malignancies diagnosed amongst 6.7 million residents of the Northern and Yorkshire region. From the sample of 1550 identified patients, 50 (38 treated outside the region and 12 with rare histological types) were excluded.

Information on prognostic factors (such as patient age, tumour stage and histological type) and treatment information were downloaded from the NYCRIS database. Tumour stage was based on the International Federation of Gynecology and Obstetrics (FIGO) staging system (available from the patient notes) and recorded as I, II, III, IV or missing. Histological type was grouped into four categories: adenocarcinoma (AC), squamous cell carcinoma (SCC), mixed or other. Socioeconomic status was determined by matching patient postcodes to enumeration district Carstairs deprivation scores,[10] which were subsequently categorised into quintiles. Patients were then divided into three approximately equal sized groups according to their gynaecologists' workload. These were defined as 'low' (1–3 patients per year), 'intermediate' (4–11 patients per year) and 'high' (12 or more patients per year). Consultant workloads were calculated as the median number of new cervical cancer patients they managed every year. Patients who had more than one gynaecologist recorded were grouped according to the gynaecologist who performed the most radical treatment. The same cut-offs were then used to divide the patients according to their clinical oncologists' workload, however, due to the skewed distribution the resulting groups were not of equal size.

Survival was defined as the time difference between the date of diagnosis and the date of death (the registry routinely receives copies of all death certificates of registered cancer patients from the NHS Central Register maintained by the Office for National Statistics) or censoring (31st December 2005). Kaplan–Meier 5-year survival estimates[11] were calculated and multivariable analyses were performed using the Cox proportional hazards regression model.[12] Estimates of the relative risks of death were examined in relation to the patient and tumour characteristics, the workload of their managing gynaecologist and, if they received RT, their clinical oncologist. All analyses were performed using STATA 9.0 (StataCorp, TX, USA).

3. Results

The total number of cervical cancer patients included in the study was 1500. The study population is described in Table 1. Nearly a third of patients (34%) were younger than 40 years at the time of diagnosis and another third (35%) were aged between 40 and 59 years. The median age at the time of diagnosis was 46 years. Over half of all patients (57%) were diagnosed with stage I disease. Older patients had more advanced tumours, with the median age at the time of diagnosis increasing from 40 years in stage I cases, to 58 years in stage II, 63 years in stage III and 70 years in stage IV cases. Information on stage was missing in 5% of cases and this varied from 3% of those aged under 40–12% aged over 75 years. Patients who lived in more affluent areas were diagnosed with earlier stages tumours. While 63% of those in the most affluent quintile had stage I cancers, only 49% of patients in the most deprived quintile were diagnosed with the same stage cancer. Three percent of patients in the most affluent quintile were diagnosed with stage IV disease, compared to 5% of those in the most deprived quintile.

Sixty percent of patients had surgical treatment, 46% had RT and 7% had chemotherapy. There were no substantial changes in treatment choice over time (data not shown). Younger patients had higher rates of surgery in contrast to older patients. Nearly 89% of patients younger than 40 years had surgery in comparison to 26% of 60–74 years old and 10% of older than 75. For RT, 25% of the youngest age group received this type of treatment compared to 65% of women older than 75 years. Patients with stage I disease were more likely to receive surgery, although this decreased with age (Fig. 1). Patients with stage II or III disease were more likely to receive RT and this was the case in all age groups. Thirty-nine percent of patients with stage IV disease received no treatment. The majority of these were in the 60–74 years and over 75 years of age group.

Of the 1500 patients, 1474 (98%) were managed by a gynaecologist. Of the remaining 26 patients, seven received RT from

Table 1 – Description of the study population and 5-year Kaplan–Meier survival estimates

Variable		N (%)	Survival (95% CI)
Age (years)	>40	510 (34.0)	85.1 (81.7–87.9)
	40–59	519 (34.6)	70.3 (66.2–74.1)
	60–74	259 (17.3)	40.9 (34.8–46.8)
	75+	212 (14.1)	17.3 (12.5–22.8)
Stage	I	849 (56.6)	86.8 (84.3–88.9)
	II	302 (20.1)	43.5 (37.9–49.0)
	III	190 (12.7)	18.4 (13.3–24.2)
	IV	77 (5.1)	4.0 (1.1–10.2)
	Missing	82 (5.5)	43.0 (32.0–53.6)
Carstairs quintile	1 (most affluent)	214 (14.3)	72.9 (66.4–78.3)
	2	318 (21.3)	60.9 (55.3–66.0)
	3	306 (20.5)	63.5 (57.8–68.6)
	4	321 (21.5)	61.1 (55.6–66.2)
	5 (most deprived)	337 (22.5)	59.8 (54.4–64.8)
Year of diagnosis	1995	266 (17.7)	62.8 (56.7–68.3)
	1996	258 (17.2)	62.1 (55.9–67.7)
	1997	249 (16.6)	61.1 (54.8–66.9)
	1998	256 (17.1)	64.1 (57.9–69.6)
	1999	257 (17.1)	68.6 (62.5–73.9)
	2000	214 (14.3)	57.9 (51.0–64.2)
Histology	Adenocarcinoma	216 (14.4)	61.6 (54.7–67.7)
	Squamous cell	1135 (75.7)	65.7 (62.9–68.4)
	Mixed	70 (4.7)	51.4 (39.2–62.4)
	Other	79 (5.3)	34.3 (23.7–45.1)
Treatment	Surgery only	698 (46.5)	93.6 (91.5–95.2)
	Surgery + RT	207 (13.8)	62.3 (55.3–68.5)
	RT only	475 (31.7)	31.8 (27.7–36.0)
	Other	10 (0.7)	10.0 (0.5–35.8)
	None	110 (7.3)	6.7 (3.0–12.6)
Gynaecologist workload (median annual no. patients)	<4	467 (31.7)	50.0 (45.4–54.4)
	4–11	452 (30.7)	64.1 (59.5–68.3)
	12+	555 (37.7)	75.3 (71.5–78.7)
Oncologist workload (median annual no. patients)	<4	66 (10.6)	34.9 (23.7–46.3)
	4–11	127 (20.4)	40.9 (32.4–49.3)
	12+	430 (69.0)	41.2 (36.5–45.8)
Overall		1500 (100)	62.9 (60.4–65.3)

a clinical oncologist, one received chemotherapy only and 18 received no treatment. There were 100 gynaecologists managing patients during the study period. Thirty four of these treated one patient per year and one treated 27 patients per year. When the gynaecologists were split into three groups according to their workload, there were 32%, 31% and 38% of patients in the low, intermediate and high workload groups (Table 2). The proportion of patients treated by low workload gynaecologists reduced from 37% in 1995 to 28% in 2000, whilst the proportion treated by intermediate workload gynaecologists increased from 24% to 40% and the proportion treated by high workload gynaecologists decreased from 40% to 33%.

Patients in the high workload group were younger than those in the low workload group (43% <40 years compared to 24%). They were also more likely to have early stage disease (73% stage I compared to 42%) and were more likely to receive surgery (82% compared to 39%) than those in the low workload group. There was no difference in the distribution of patients by deprivation quintile and workload group. There were no differences in the proportion of women receiving RT when looked at by gynaecologist workload group and stage of disease. However, patients managed by high workload gynaecologists were more likely to receive surgery alone or surgery and RT for stages I, II and III disease. For example, 97.1%, 92.7% and 77.7% of patients with stage I cancer managed by high, intermediate and low workload gynaecologists underwent surgery (with or without RT).

There were 16 clinical oncologists treating the 682 RT patients and their workload varied from one patient per year to 40 per year. There were fewer patients being treated by oncologists with low workloads, with 11%, 20% and 69% of patients in the low, intermediate and high workload groups. Thirty-nine percent of patients were treated by the clinical oncologist with the highest workload. During the study period, the proportion of patients treated by a clinical oncologist reduced from 53% in 1995 to 39% in 1999 and increased again to 50% in 2000.

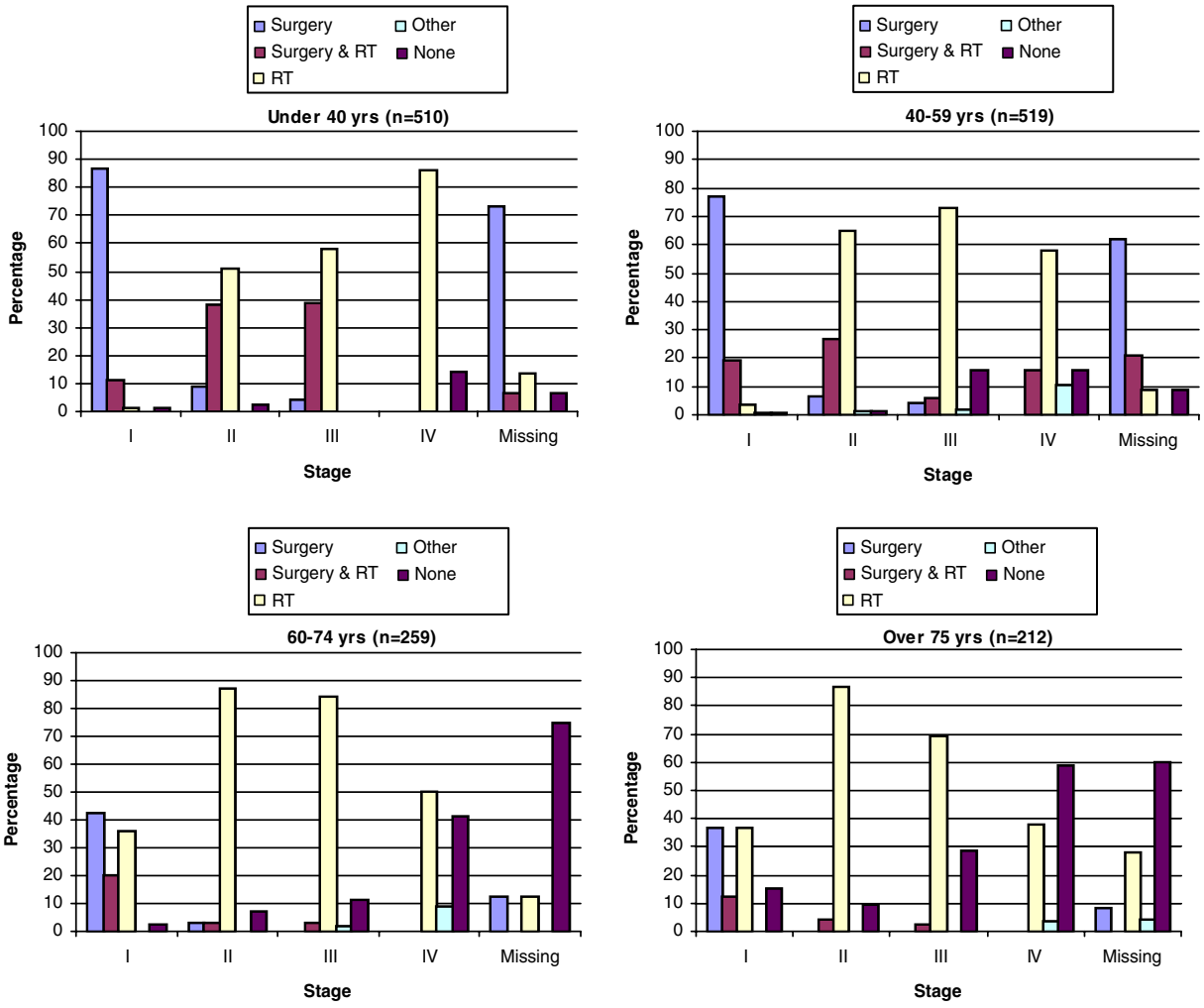

Fig. 1 – Type of treatment received by cervical cancer patients by stage and age group.

Table 2 – Number and percentage of patients in each workload group by year of diagnosis

Year	Workload (median no. patients treated per year)			Total
	<4	4–11	12+	
1995	96 (36.5)	64 (24.3)	103 (39.2)	263 (100)
1996	80 (31.6)	70 (27.7)	103 (40.7)	253 (100)
1997	93 (38.6)	65 (27.0)	83 (34.4)	241 (100)
1998	69 (27.5)	79 (31.5)	103 (41.0)	251 (100)
1999	71 (27.8)	90 (35.3)	94 (36.9)	255 (100)
2000	58 (27.5)	84 (39.8)	69 (32.7)	211 (100)
Total	467 (31.7)	452 (30.7)	555 (37.7)	1474 (100)

Overall 5-year survival was 62.9% (95% CI 60.4–65.3). In univariable analyses, patients diagnosed before the age of 40 had a 5-year survival of 85.1% (95% CI 81.7–87.9), whilst those diagnosed at 75 years or older had a 5-year survival of 17.3% (95% CI 12.5–22.8) (Table 1). Patients diagnosed in the early stages of the disease had a better prognosis, with 86.8% (95% CI 84.3–88.9) of stage I cases surviving five years in comparison to only 4.0% (95% CI 1.1–10.2) of stage IV cases. Living in a more affluent area was also associated with improved survival, whilst year of diagnosis had no significant effect on survival. There was no significant difference between patients diagnosed with SCC and AC, but both had improved survival compared to those with 'other' less common histological types. Those who had only surgical treatment had significantly better 5-year survival (93.6%; 95% CI 91.5–95.2) than patients who received a combination of surgery and RT (62.3%; 95% CI 55.3–68.5) or RT only (31.8%; 95% CI 27.7–36.0). Those receiving no treatment had a 5-year survival of just 6.7% (95% CI 3.0–12.6). Patients managed by high workload gynaecologists had a better prognosis, with 5-year survival of 75.3% (95% CI 71.5–78.7), compared to patients managed by intermediate workload gynaecologists (64.1%; 95% CI 59.5–68.3) or low

workload gynaecologists (50.0%; 95% CI 45.4–54.4). The workload of clinical oncologists did not significantly influence patients' survival. Five-year survival was 41.2% (95% CI 36.5–45.8) for patients treated by high workload oncologists, 40.9% (95% CI 32.4–49.3) for patients treated by intermediate workload oncologists and 34.9% (95% CI 23.7–46.3) for those treated by low workload oncologists.

Multivariable analysis confirmed the significant effects of age and stage on survival, whilst deprivation was no longer significant (year of diagnosis and histology were not included in the final model as these were not significant in univariable analyses) (Table 3). After adjustment, the effect of gynaecologist workload was no longer significant. Patients managed by high workload gynaecologists had a hazard ratio (HR) of 0.81 (95% CI 0.64–1.01) in comparison to a baseline of 1.00 for patients of low workload gynaecologists. Patients managed by intermediate workload gynaecologists had a HR of 0.85 (95% CI 0.68–1.05). Separate analysis of the patients treated with RT confirmed the non-significant effect of clinical oncologist workload on survival. Univariable HRs were 0.87 (95% CI 0.59–1.28) and 0.80 (95% CI 0.57–1.12) for patients treated by intermediate and high workload oncologists (in comparison to a baseline of 1.00 for low workload oncologists).

4. Discussion

This study extended an analysis previously carried out in Yorkshire, which found a survival advantage for patients treated by high workload gynaecologists (more than eight patients per year). In univariable analysis, gynaecologist workload significantly influenced survival, with patients managed by high workload gynaecologists (12 or more new cervical cancer patients per year) having better survival than medium (4–11 new patients) and low (less than 4 new patients) workload gynaecologists. After adjustment for patient factors, those treated by high and intermediate workload gynaecologists had improved survival compared to those treated by low workload gynaecologists, but this was no longer formally statistically significant. Age and stage had the largest attenuating effects on workload, and were the most important prognostic factors in survival from cervical cancer. The results show that low workload gynaecologists were more likely to see patients who were older and had more advanced disease. It may be that, during this period of transitional change, it was thought more appropriate to refer patients with a better prognosis to specialists, although we have no direct evidence to support this.

Table 3 – Crude and adjusted Cox Proportional Hazards regression analysis of 5-year survival of patients with cervical cancer

Variable		Crude HR (95% CI)	Adjusted HR[a] (95% CI)
Age (years)	<40	1.00	1.00
	40–59	2.13 (1.60–2.84)	1.59 (1.18–2.13)
	65–74	5.44 (4.09–7.23)	2.50 (1.85–3.39)
	75+	10.39 (7.80–13.84)	3.63 (2.66–4.95)
Stage	I	1.00	1.00
	II	5.87 (4.62–7.46)	3.74 (2.88–4.85)
	III	12.90 (10.05–16.56)	8.14 (6.20–10.69)
	IV	27.23 (19.76–37.51)	18.61 (13.29–26.06)
Carstairs quintile	1 (most affluent)	1.00	1.00
	2	1.58 (1.13–2.23)	1.24 (0.88–1.75)
	3	1.54 (1.10–2.18)	1.12 (0.80–1.59)
	4	1.62 (1.15–2.27)	1.16 (0.82–1.65)
	5 (most deprived)	1.78 (1.28–2.48)	1.17 (0.84–1.64)
Year of diagnosis	1995	1.00	–
	1996	0.98 (0.73–1.32)	–
	1997	1.02 (0.75–1.37)	–
	1998	0.95 (0.71–1.28)	–
	1999	0.84 (0.62–1.14)	–
	2000	1.14 (0.84–1.55)	–
Histology	Adenocarcinoma	1.00	–
	Squamous	0.82 (0.64–1.06)	–
	Mixed	1.38 (0.91–2.08)	–
	Other	1.97 (1.29–3.01)	–
Gynaecologist workload (median annual no. patients)	<4	1.00	1.00
	4–11	0.65 (0.53–0.80)	0.85 (0.68–1.05)
	12+	0.41 (0.33–0.51)	0.81 (0.64–1.01)

N = 1397 excluding missing Carstairs score (4 cases) and stage (82 cases).

a Adjusted for age, stage, Carstairs quintile and gynaecologist workload. Year of diagnosis and histology were excluded from the multivariable analysis as they were not significant in univariable analyses (although patients with 'other' histological types had a worse survival, this only represented 55 patients). Estimates were not adjusted for treatment as it was highly correlated with stage and violated the proportional hazards assumption.

Previous studies have demonstrated a relationship between hospital and physician workload and patient outcomes (such as mortality after surgery, rate of complications and overall survival) for some types of cancers, such as cancer of the pancreas,[13] colon,[14] breast[15] and prostate.[16] Such results have been most striking for certain low frequency, high risk operations, such as pancreatectomy and esophagectomy. However, not all commonly performed surgical procedures have undergone detailed scrutiny.[17] Studies looking at gynaecological cancers have tended to focus on ovarian cancer, and have suggested a survival advantage in those treated by specialists[18–20] but no significant relationship with surgeon workload.[19,21] Only a few studies have looked at the management of cervical cancer patients. One such study reported on an audit of the management of patients in Southern England.[7] This reported that 59% of women were treated 'appropriately', 20% under-treated and 21% over-treated (in relation to local guidelines). Appropriateness of treatment, such as the type of surgery received in relation to the stage and type of disease, increased with higher stages of disease and higher hospital workload of cervical cancer. Another UK study by Clarke and colleagues investigated the influence of diagnostic throughput of gynaecologists (number of cases diagnosed) on survival outcome.[6] They found no evidence of an association, regardless of how throughput was defined.

During the 1990s, the organisation of gynaecological cancer services began to change with moves towards a more specialist model for gynaecological oncology. This occurred in response to changes in training, and was given greater impetus following the response to the Calman-Hine report in 1997 and two years later by the improving outcomes guidance. These defined the way services ought to be provided, with multidisciplinary teams of specialists in gynaecological oncology, and they promoted the idea that non-specialists should stop performing radical surgery and refer patients to specialist teams for these procedures. The implementation of these changes in England was part of the NHS Cancer Plan published in 2000,[22] monitored through National Peer Review using explicit published measures.

During the period of this study, there were very few specialist gynaecological oncologists (4–6 per year) and workload has been used as a proxy for such specialism. Between 1995 and 2000, substantial numbers of patients were treated by low volume gynaecologists. The number decreased over the time period, but it is not possible to tell whether this was influenced by the guidelines, as there are indications that the number of patients being treated by low workload gynaecologist was decreasing before 1995.[8] Only one gynaecologist managed more than 20 patients per year, the figure recommended for those in training, and only five managed more than 10 patients per year.

Clinical oncologist workload showed no significant effect on survival. This is despite the fact that RT in the pelvis is complex to deliver safely and requires expertise and modern equipment to give best results. A possible reason for the absence of an effect is that many important outcomes which might have differentiated poorer from better RT outcomes are related to quality of life rather than survival, such as side-effects, continuing symptoms and longer term complications from the RT. This study did not have data on such outcomes. This analysis may also have lacked statistical power due to the smaller number of patients receiving RT, the smaller number of clinical oncologists involved and the smaller variation in clinical oncologist workloads. Only four clinical oncologists treated more than 10 patients a year and one treated nearly 40% of all patients. There are no guidelines with which to compare these figures. Furthermore, little information exists about whether there is a relationship between volume and outcome for a wide variety of non-surgical cancer interventions.[17]

Surgery is the preferable treatment option modality in early stage disease due to more predictable and manageable complications and the option for preservation of ovarian hormonal production.[23] In this study, 91% of patients with stage I disease had surgical treatment, either alone or with RT. However, this decreased with age, from 98% in those aged under 40 years to 49% in those aged over 75 years. Patients managed by low workload gynaecologists were less likely to receive surgery than those managed by high workload gynaecologists for stages I, II and III disease. Part of this may be due to the older age of the patients managed by low workload gynaecologists. It may also be an indication that patients managed by low workload gynaecologist receive less 'appropriate' treatment; however, assessing this requires a more detailed analysis looking at the type of surgery received in relation to cancer histology.

This study found that older women were more likely to be diagnosed with advanced tumours. This has been reported by studies from several countries, including France, the Netherlands and the US.[23–27] The observation of a younger age among patients with early disease could be a reflection of more frequent use of cervical smears among young women.[23] Screening is routinely offered to women aged between 20 and 64. In this study, 25% (382) of women were aged over 64 at the time of diagnosis and so would not have been routinely invited for screening. This partly explains why the older women were diagnosed in more advanced stages and have poorer survival than those cases picked up by screening.

In this study, 5-year survival was 62.9%. This is slightly higher than the European average of 60% reported by the EUROCARE-3 study[28] but very similar to the 63.1% reported for England during 1998–2001.[29] In multivariable analyses, age and stage were found to have significant effects on survival. In this study, patients aged over 75 had a fourfold higher risk of mortality compared to those aged under 40. Wright and colleagues reported that even after adjusting for disease stage, comorbidity and treatment, US women aged over 70 years are more likely to die from cervical cancer than their younger counterparts.[27] Compared to patients with stage I disease, the HRs for Stages II, III and IV disease were 4, 8 and 19. These compare well with figures of 5, 10 and 19 from the Netherlands.[26] After adjustment, the effect of deprivation was no longer statistically significant. The deprivation effect seen in the univariable analyses appears to be related to stage at diagnosis and suggests that the women from more deprived areas presented at a later stage with more advanced disease. Regarding histological type, the results have been conflicting with some studies finding SCC to be associated with a better prognosis[26] and others not.[6,30] In this study,

there was no difference in survival between patients diagnosed with SCC and AC.

This study is one of only a few to have looked at the relationship between workload and survival in cervical cancer patients, and is the only UK study to have used population-based cancer registry data. Staging data were available in 95% of cases and so the results should not be biased by missing information. However, data were not available to examine other clinical outcomes such as treatment related morbidity or disease recurrence, which may also be associated with workload. We were also unable to look at the relationship between survival and workload after 2000, as full 5-year follow-up is not available for this population and any apparent change in the relationship would be biased by the reduced follow-up period.

In conclusion, during the 1990s national and professional policy documents supported moves to establish more specialised care of gynaecological cancers, with referral of patients to multidisciplinary specialist teams. During this time of transition, between 1995 and 2000, there is evidence that a declining proportion of patients were managed by low workload gynaecologists. However, no increase was observed in the proportion of patients managed by higher workload consultants. Regarding survival, there was a trend for patients managed by high and intermediate workload gynaecologists to have improved survival compared to low workload gynaecologists, though this was not statistically significant. These trends are consistent with the goals of policy; however, these issues should be re-investigated in the period following implementation of the 1999 Improving Outcomes Guidance, which may have had more of an impact on the distribution of workloads and the number of specialist gynaecological oncologists and their resulting relationship with patient outcomes.

Conflict of interest statement

None declared.

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