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The impact of the Calman-Hine report on the processes and outcomes of care for Yorkshire's breast cancer patients

E. Morris[1]*, R. A. Haward[1,2], M. S. Gilthorpe[3], C. Craigs[2] & D. Forman[1,2]

[1]*Cancer Epidemiology Group, Centre for Epidemiology and Biostatistics, The University of Leeds, Arthington House, Cookridge Hospital, Leeds S16 6QB;* [2]*Northern and Yorkshire Cancer Registry and Information Service, Arthington House, Cookridge Hospital, Leeds LS16 6QB;* [3]*Biostatistics Unit, Centre for Epidemiology and Biostatistics, The University of Leeds, 30–32 Hyde Terrace, Leeds LS2 9LN, UK*

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Background: The 1995 Calman-Hine plan outlined radical reform of the UK's cancer services with the aim of improving outcomes and reducing inequalities in National Health Service cancer care. Its main recommendation was to concentrate care into the hands of site-specialist multidisciplinary teams. This study aimed to determine whether these teams improved processes and outcomes of care for breast cancer patients.

Patients and methods: All patients diagnosed and treated with breast cancer in the Yorkshire region of the UK from 1995 to 2000 were identified within the Northern and Yorkshire Cancer Registry and Information Service database. Changes in the use of breast-conserving surgery, adjuvant radiotherapy following breast-conserving surgery and 5-year survival were assessed among these patients in relation to their managing breast cancer team's degree of adherence to the manual of cancer service standards (which outlines the specification of the 'ideal' breast cancer team) and the extent of site specialisation of each team's surgeons.

Results: Variation was observed in the extent to which the breast cancer teams in Yorkshire had conformed to the Calman-Hine recommendations. Increases in adherence to the recommendations in the manual of cancer service standards were associated with a reduction in the use of breast-conserving surgery [odds ratio (OR) = 0.83, 95% confidence interval (CI) = 0.70–0.98, $P < 0.01$]. Increases in both surgical specialisation (OR = 1.23, 95% CI = 1.00–1.55, $P = 0.06$) and adherence to the manual of cancer service standards (OR = 1.22, 95% CI = 0.97–1.52, $P = 0.05$) were associated with the increased use of radiotherapy following breast-conserving surgery. There was a trend towards improved 5-year survival (hazard ratio = 0.93, 95% CI = 0.86–1.01, $P = 0.10$) in relation to increasing surgical site specialisation. All these effects were present after adjustment for the casemix factors of age, stage of disease, socio-economic background and year of diagnosis.

Conclusions: The extent of implementation of the Calman-Hine report has been variable and, on the basis of limited clinical and organisational information available, its recommendations appear to be associated with improvements in processes and outcomes of care for breast cancer patients.

Key words: breast neoplasms, Calman-Hine, cancer teams, specialisation, workload

introduction

Breast cancer occurs in ~42 000 women in the UK each year and it kills ~12 000 of those diagnosed [1]. In the mid-1990s it became clear that the UK survival rate fell below that in other Western European countries [2] with good resources and well-organised care. In consequence, improving survival and ensuring a high quality of care for all has become a top priority for the Government.

The strategy by which the Government hoped to achieve this was outlined in the 1995 Calman-Hine report [3] and the subsequent National Health Service (NHS) Cancer Plan [4]. These documents recommended that care should be organised into the hands of site specialists in each relevant discipline, working together in multidisciplinary cancer teams (MDTs). Detailed specifications of whom and how these teams should be composed were provided in the 1996 Improving Outcomes Guidance (IOG) in Breast Cancer [5].

These reforms were unusual as they aimed to improve outcomes through the reconfiguration of facilities and personnel, rather than through the introduction of a new health technology. The recommendations originated from data

Correspondence to: Dr E. Morris, Cancer Epidemiology Group, Centre for Epidemiology and Biostatistics, The University of Leeds, Arthington House, Cookridge Hospital, Leeds LS16 6QB, UK. Tel: +44-113-3924135; Fax: +44-113-3924132; E-mail: eva.morris@nycris.leedsth.nhs.uk

suggesting that high workload or specialist doctors offered better outcomes than their low workload or generalist counterparts [6, 7]. Unfortunately, however, the evidence available to substantiate this hypothesis is not conclusive [8, 9] and, as a consequence, not all within the health service subscribe to the idea.

Despite the equivocal evidence base, the reforms have been a flagship NHS policy and substantial resources have been invested in their implementation. The aim of this population-based longitudinal study was to quantify the extent to which the Calman-Hine recommendations of multidisciplinary team formation and surgical site specialisation in breast cancer had been translated into practice by 2000, in the Yorkshire region of the UK. In addition, the study sought to determine, using routine cancer registry data, if these changes were, as the Government hypothesised, associated with improvements in the outcome of breast cancer patients.

patients and methods

All female patients diagnosed with breast cancer (ICD10 code C50) from 1995 to 2000 in the former Yorkshire Regional Health Authority were identified via the Northern and Yorkshire Cancer Registry and Information Service (NYCRIS). Routinely recorded information about patients' disease and its management was downloaded. Any patients for whom such information was missing (due to death certificate only registration or who were managed by their GP's, privately or outside the region) were excluded.

In 2000, 13 breast cancer teams provided cancer care within the study region. All patients, identified via NYCRIS, were allocated to a team on the basis of their hospital of diagnosis or (before 1998) their initial hospital of attendance.

assessment of Calman-Hine implementation

Two methods of assessing Calman-Hine implementation were adopted. The first assessed the formation of multidisciplinary teams and the second the move from general surgeons to site-specialist management.

growth of breast cancer teams. In 2001, the Department of Health published National Accreditation standards [10] based on the original IOG that detailed the criteria to which the 'ideal' breast cancer team should adhere. To assess the growth of the study's teams, a team score based on each unit's adherence to these criteria over time was developed. A questionnaire was devised which asked whether each criterion had been met in each year from 1995 to 2000. By determining the number (and percentage) of standards that had been met in each year, charts of the time scale of team formation could be produced.

the move towards site specialisation. Another measure of implementation was the move towards site-specialist surgical care. The surgeon performing the main surgical procedure of each patient was identified. The speciality of this surgeon was determined by looking up their entries in the 2001 Medical Directory [11] or on the website http://www.specialistinfo.com [12]. In both these resources, the consultant cites their own specialist interests. If no specialism could be identified, or a doctor chose to define themselves as a general surgeon, they were allocated to a specialism on the basis of their annual median workload. A threshold was set for a breast specialist surgeon as one whose annual median workload exceeded 30 new cases per year based on the IOG. The proportion of patients in each year and in each team receiving their main surgery from either a self-declared or high workload specialist was then calculated.

statistical analyses

Multilevel (random effects) binary logistic regression models were used to assess how the Calman-Hine changes are associated with care outcomes. Models were developed with the cancer team as a random effect (at level 2), allowing for within-team correlation among team patient outcomes (at level 1). As the ultimate aim of Calman-Hine was to improve survival, multilevel proportional hazards (frailty) models were also used to assess survival at 5 years. All models were developed within the MLwiN software (version 2.02).

Main outcomes (dependant variables) were chosen based upon recommendations given in the IOG document. This document stated that breast-conserving surgery should be available to patients with appropriate tumours and all patients who opt for breast-conserving surgery should undergo postoperative radiotherapy. These measures of patient health care were, therefore, selected as dependant variables in the form of a binary outcome (i.e. patients who received such surgery and the accompanying radiotherapy coded 1 and those who did not coded 0).

Covariates (explanatory variables) included age (in the categories <60, 61–70, 71–80 and >80 years), the Townsend material area deprivation score of each patient (derived according to the enumeration district of residence at diagnosis), year of diagnosis, stage at diagnosis (I, II, III/IV, I/II and II/III or unknown) and increases in either of the Calman-Hine implementation scores (per quartile increase in team score or surgical specialisation score). A Townsend score was unable to be allocated to 186 patients. To ensure these individuals were included in the model, they were allocated the mean Townsend score of the population. Linear assumptions were tested for all continuous variables (Townsend score and year of diagnosis) and were found to be valid. Continuous covariates were centred (i.e. each case had the population mean of the variable arithmetically subtracted from it) to improve estimation procedures.

Bivariate correlations among all covariates were examined to assess potential problems due to collinearity, as such collinearity might bias the analyses [13, 14]. Where strong correlations were observed between time (year of diagnosis) and the Calman-Hine implementation scores, analyses were undertaken across two time periods, 1995–2000 and 1996–1998 separately, in an attempt to limit the effect of collinearity. The narrower time period of 1996–1998 was chosen because the correlations between time and the Calman-Hine implementation scores were minimal and this period also corresponds to the time when the main guidance documents about service reform in breast cancer were published, and the rate of change in practice towards the Calman-Hine recommendations should have been greatest.

results

study population

A total of 12 961 patients were diagnosed with breast cancer in the study area from 1995 to 2000. Of these, 1042 were excluded due to missing management information as they were managed extra regionally ($n = 70$), were managed by their GP ($n = 60$), were treated as private patients ($n = 856$), were death certificate only registrations ($n = 28$) or had missing NYCRIS information ($n = 28$). This left a study population of 11 919 cases (91.9%). Characteristics of this population are given in Table 1.

degree of Calman-Hine implementation

adherence to manual of cancer service standards. Of the 13 teams, 10 completed questionnaires for the project. Figure 1 demonstrates the rate of growth of these teams. Although there

was a definite change in practice over the study period, no team adhered to all the requirements of team structure and function laid out in the manual of cancer service standards by 2000.

breast surgical site specialisation. A total of 85 surgeons carried out breast cancer surgery on the entire study population and the overall annual median workload was six cases per year (range 1–122). The annual median workload of the specialists among them was 51 (range 10–122). Figure 2 illustrates the proportion of patients receiving their surgery from such a specialist over the study period. In some teams, the majority of patients received their surgery from specialists from the outset of the study period but in others a substantial proportion of patients failed to be managed by specialists throughout the study period. Overall, however, there does appear to have been a shift in practice, with surgery being concentrated into the hands of breast specialists.

Table 1. Characteristics of the study population

Characteristics	1995–2000		1996–1998	
	n	%	*n*	%
Age (years)				
≤60	5629	47.2	2755	46.9
61–70	2498	20.9	1264	21.5
71–80	2399	20.1	1151	19.6
≥81	2346	11.7	708	12.0
Townsend quintile[a] (most affluent ↓ most deprived)				
1	2349	19.7	1138	19.5
2	2345	19.7	1111	19.0
3	2353	19.8	1182	20.1
4	2340	19.7	1182	20.1
5	2346	19.7	1174	19.9
Unknown	158	1.3	77	1.3
Stage[b]				
I	1014	8.5	532	9.1
II	1829	15.4	870	14.8
III/IV	4526	37.9	2238	38.1
I/II	3061	25.7	1432	24.4
II/III	1378	11.6	728	12.4
Unknown	111	0.9	78	1.3

[a]Patients' with unknown Townsend scores were still included in the models by allocating them the mean score of the population.
[b]Tumor–node–metastasis stage was included as a categorical variable in the models using the groupings I, II, III/IV, I/II, II/III or unknown.

change in process and outcomes according to extent of Calman-Hine implementation

use of breast-conserving surgery. Of the study population, 61.3% received breast-conserving surgery, though the rate varied across teams and over time. Table 2 shows that in 1995, the median percentage use of this treatment across the teams was 72.5% (range 47.8%–77.6%) but by 2000 this had fallen to 56.8% (range 43.4%–67.5%).

The results of the multilevel analyses, summarised in Table 3, indicate what proportion of the change in practice was associated with the implementation of the Calman-Hine recommendations. In models adjusting for casemix and year of diagnosis, a quartile increase in team score was associated with a 17% reduction in the odds of using breast-conserving surgery [odds ratio (OR) = 0.83, 95% confidence interval (CI) = 0.70–0.98]. The correlations between time and team score were, however, high in the model and so another model was explored, with reduced collinearity, for the time period 1996–1998. This also demonstrated a significant 48% reduction in the odds of using breast-conserving surgery in relation to a quartile increase in team score (OR = 0.52, 95% CI = 0.33–0.81).

In contrast, although a quartile increase in surgical site specialisation was associated with a reduced trend in the odds of using breast-conserving surgery, the effect was not statistically significant (OR = 0.99, 95% CI = 0.84–1.17). A more marked, but similarly nonsignificant, effect was observed in the model with reduced collinearity for the reduced time period (OR = 0.86, 95% CI = 0.59–1.26).

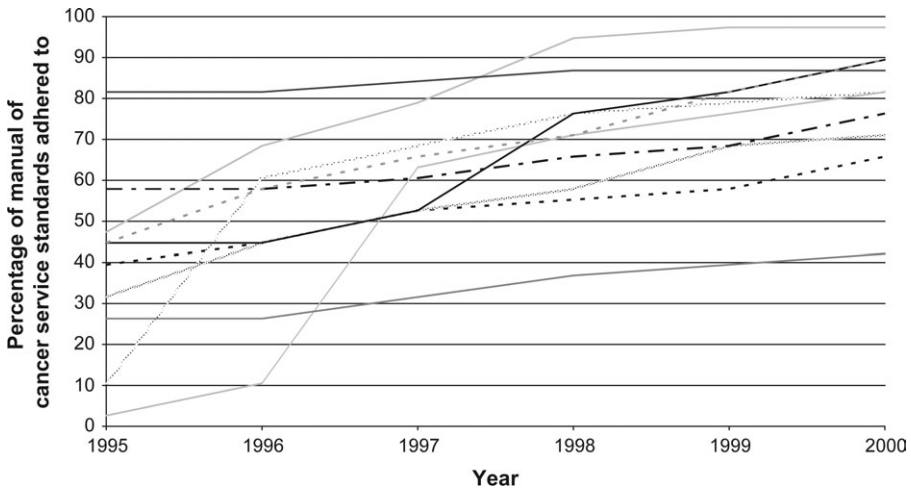

Figure 1. Adherence of breast cancer teams to the manual of cancer service standards over time.

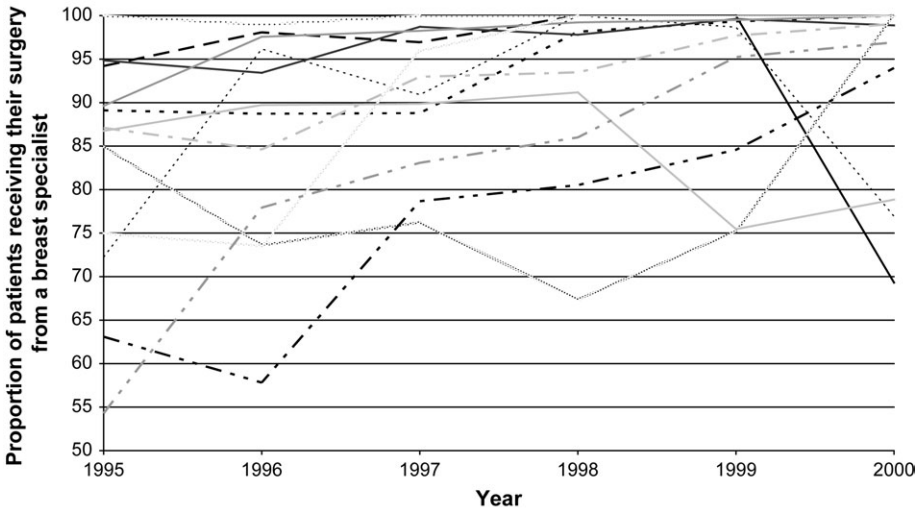

Figure 2. Proportion of patients in each team receiving their initial surgery from a breast specialist surgeon over time.

Table 2. Median percentage use of breast-conserving surgery and accompanying radiotherapy across the breast cancer teams

Year	Use of breast-conserving surgery		Use of radiotherapy following breast-conserving surgery	
	Median	Range	Median	Range
1995	72.5	47.8–77.6	59.6	38.6–90.3
1996	67.5	52.8–89.4	65.5	26.3–82.0
1997	62.7	48.9–81.9	70.0	46.3–85.1
1998	58.3	51.1–79.4	76.7	51.0–83.0
1999	57.9	39.7–76.0	82.5	66.0–90.9
2000	56.8	43.4–67.5	80.4	60.7–88.8

use of breast-conserving surgery and accompanying radiotherapy. During the full study period, 72.1% of the patients managed with breast-conserving surgery received some form of postoperative radiotherapy. In 1995, its median percentage use across the teams was 59.6% (range 38.6%–90.3%) but by 2000 it had risen to 80.4% (range 60.7%–88.8%). Table 2 illustrates the change in percentage administration across the teams and the study period.

Models established to determine what proportion of the change in practice was associated with Calman-Hine implementation are summarised in Table 4. A quartile increase in the team score was associated with a statistically significant 22% increase in the odds of using postoperative radiotherapy following breast-conserving surgery (OR = 1.22, 95% CI = 0.97–1.52). In the reduced collinearity model, the effect was more marked and again statistically significant (OR = 2.01, 95% CI = 1.09–3.68).

For a quartile increase in surgical specialisation, the odds of using postoperative radiotherapy were elevated significantly by 23% (OR = 1.23, 95% CI = 0.99–1.53), potentially suggesting that increasing surgeon specialisation is linked to the increased use of this treatment. In the shorter duration model, the trend reversed to become a nonsignificant 11% reduction in the odds of using postoperative radiotherapy (OR = 0.89, 95% CI = 0.55–1.44). The impact of collinearity for this outcome, therefore, confuses the findings and no causal inferences can be made.

five-year survival. Across the entire study period, the overall 5-year survival rate was 69.7% (95% CI = 68.9%–70.5%). The median 5-year survival rate across teams was 68.7% but ranged from 64.9% to 73.4%. Results for the multilevel analyses to assess whether or not improvements in survival were associated with the Calman-Hine implementations are summarised in Table 5.

A quartile increase in team score was associated with a 4% reduction in the risk of death, but the effect was not statistically significant [hazard ratio (HR) = 0.96, 95% CI = 0.89–1.02]. No effect was observed in the reduced collinearity model covering the time period of 1996–1998 (HR = 1.01, 95% CI = 0.93–1.09).

In contrast, a quartile increase in surgical specialisation was associated with a 7% reduction in the risk of death (HR = 0.93, 95% CI = 0.86–1.01), even though the effect was not statistically significant. However, in the reduced collinearity model, the effect was more marked and became statistically significant (HR = 0.88, 95% CI = 0.78–0.99).

discussion

From 1995 to 2000 the Calman-Hine recommendations, in terms of team formation and surgical site specialisation, were implemented at varying rates by the breast cancer teams of Yorkshire. Although in some hospitals, teams were functioning according to some Calman-Hine principles from the outset, in no areas were all the recommendations fully realised by the end of the study period.

Attempting to determine statistically if these shifts in the organisation of care were associated with improvements in cancer treatment and outcome was complex due to the multilevel nature of the data and the collinearity of variables. However, there was evidence to indicate that team growth was associated with a reduction in the use of breast-conserving

Table 3. ORs for the use of breast-conserving surgery in breast cancer patients, in relation to the year of diagnosis and the Calman-Hine implementation scores

	1995–2000						1996–1998					
	Unadjusted			Casemix adjusted			Unadjusted			Casemix adjusted		
	OR	95% CI	*P* value	OR	95% CI	*P* value	OR	95% CI	*P* value	OR	95 % CI	*P* value
Year of diagnosis	0.93	0.91–0.95	<0.01	0.91	0.89–0.93	<0.01	0.35	0.32–0.37	<0.01	0.88	0.82–0.95	<0.01
Team score per quartile increase	0.81	0.74–0.88	<0.01	0.83	0.70–0.98	0.03	0.64	0.50–0.81	<0.01	0.52	0.33–0.81	<0.01
Specialisation score per quartile increase	0.82	0.71–0.94	<0.01	0.99	0.84–1.17	0.91	0.74	0.55–1.00	0.05	0.86	0.59–1.26	0.45

OR, odds ratio; CI, confidence interval.

Table 4. Odds ratios for the use of radiotherapy following breast-conserving surgery in breast cancer patients, in relation to the year of diagnosis and the Calman-Hine implementation scores

	1995–2000						1996–1998					
	Unadjusted			Casemix adjusted			Unadjusted			Casemix adjusted		
	OR	95% CI	*P* value	OR	95% CI	*P* value	OR	95% CI	*P* value	OR	95% CI	*P* value
Year of diagnosis	1.20	1.16–1.25	<0.01	1.19	1.14–1.23	<0.01	1.29	1.17–1.42	<0.01	1.26	1.15–1.39	<0.01
Team score per quartile increase	1.65	1.47–1.86	<0.01	1.22	0.97–1.52	0.05	2.61	1.89–3.61	<0.01	2.01	1.09–3.68	0.01
Specialisation score per quartile increase	1.92	1.59–2.33	<0.01	1.23	0.99–1.53	0.06	1.74	1.16–2.61	0.01	0.89	0.55–1.44	0.64

OR, odds ratio; CI, confidence interval.

Table 5. Cox proportional hazards models assessing 5-year survival

	1995–2000						1996–1998					
	Unadjusted			Casemix adjusted			Unadjusted			Casemix adjusted		
	HR	95% CI	*P* value	HR	95% CI	*P* value	HR	95% CI	*P* value	HR	95% CI	*P* value
Year of diagnosis	0.93	0.92–0.95	<0.01	0.95	0.93–0.97	<0.01	0.93	0.89–0.98	<0.01	0.96	0.91–1.01	0.10
Team score per quartile increase	0.84	0.79–0.88	<0.01	0.96	0.89–1.02	0.18	0.99	0.92–1.06	0.83	1.01	0.93–1.09	0.83
Specialisation score per quartile increase	0.87	0.79–0.94	<0.01	0.93	0.86–1.01	0.10	0.91	0.81–1.02	0.10	0.88	0.78–0.99	0.03

HR, hazard ratio; CI, confidence interval.

surgery and there was a trend towards greater use of postoperative radiotherapy in patients who received such operations. Increasing surgical site specialisation was also associated with a trend towards the greater use of postoperative radiotherapy in patients receiving breast-conserving surgery. There was a trend towards improvement in 5-year survival in relation to Calman-Hine implementation scores, but the effects only reached statistical significance in relation to surgical site specialisation. These data indicate, therefore, that complete adherence to the Calman-Hine principles may improve care for breast cancer patients.

Recently, concern has been expressed over the past practice of one surgeon operating in Bradford and whose patients are included in this study [15]. The concern relates to this individual's referral rates for postoperative radiotherapy following breast-conserving surgery, which were arguably too low [15, 16]. As this treatment pattern in the Bradford team may have been an anomaly, we repeated all the analyses but excluded this team. The results were consistent with our original findings, with increasing team score linked to a decreased odds of using of breast-conserving surgery (OR = 0.86, 95% CI = 0.72–1.03) and increasing surgical specialisation linked to an increased odds of using radiotherapy following breast-conserving surgery (OR = 1.18, 95% CI = 0.95–1.47). In the absence of the Bradford team, the effects were not statistically significant, though the reduction in the size of the dataset clearly reduces statistical power. It may also be, however, an indication of the effectiveness of the reforms. The potential problem that was highlighted in Bradford, where the available evidence suggested a surgeon was failing to collaborate effectively with oncologists, was exactly the sort of situation the formation of multidisciplinary teams was intended to resolve. It was believed that the collaborative working of groups of clinicians from different specialisms

would ensure that all aspects of patient care were optimised. For example, all those who would benefit from postoperative radiotherapy would be referred for it. The first UK guidelines that stated that the gold standard treatment of breast cancer should involve adjuvant radiotherapy, if breast-conserving surgery was to be adopted, were published during the course of this study [5, 17]. Therefore, the instigation of teams should, in theory, have hastened their implementation. It could be argued that it was the formation of the multidisciplinary team in Bradford and the subsequent influence of the other team members that redressed the low radiotherapy referral rate and corrected the substandard practice. The significant changes in practice observed overall, therefore, add support to the hypothesis that the Calman-Hine restructuring has assisted in optimising care.

A similar effect may explain the unexpected reduction in the use of breast-conserving surgery observed in the study. Other work has demonstrated that the use of this treatment has increased over time [18, 19] and particularly in relation to specialist surgical treatment [20]. However, substantial geographic [21] and surgeon variation [22] has also been observed and patients' preferences may vary in relation to many factors [23, 24]. One potential explanation for the decrease in its use in this population may be related to the accessibility of the appropriate adjuvant radiotherapy. Over this time period, the evidence emerged to indicate that radiotherapy should follow this type of surgery and breast cancer professional bodies recommended that the gold standard treatments should be either breast-conserving surgery and radiotherapy or mastectomy [15]. However, at the same time, radiotherapy services in Yorkshire became increasingly overstretched [25]. This may have influenced surgeons and patients to opt for mastectomy rather than wait for the accompanying adjuvant treatment required.

Deciding on a measure that truly corresponded to the extent of implementation of the Calman-Hine ideas was difficult. Two main themes of the original report were, firstly, ensuring that site-specialist doctors and nurses, rather than generalists, managed patients and, secondly, that all disciplines should meet regularly to discuss and plan the optimal care pathway for each patient. The two markers chosen were, therefore, surgical site specialisation and the extent of multidisciplinary team formation. The validity of the methods we used to quantify these measures could, however, be questioned.

The team scores were generated by the collation of data recalled and researched by each cancer team. While some were meticulous in their collection others were (frequently due to time constraints) more haphazard and, hence, the quality of the results may have been affected. In addition, we demanded no evidence that the criteria the teams said they adhered to had been, in fact, complied with and, in the current climate, some may have been tempted to exaggerate their adherence to the new cancer service recommendations.

There are also questions around what the team score actually measured. Its composition was based around adherence to administrative criteria laid out in the Manual of Cancer Service Standards. Thus, it is possible that while a team may attain all the required criteria they may still not have practised as an effective team in the way Calman-Hine envisaged. Conversely, a team could be working in a collaborative fashion but fail to adhere to any of the administrative recommendations and so have attained a poor team score. As such, the use of this team score may be rather a blunt measure.

The alternative Calman-Hine implementation score looking at surgical site specialisation may also be problematic. The definition of specialisation chosen was that which the surgeons themselves declared or if this could not be obtained, their annual surgical workload was used. The median workload of the specialist surgeons was only 51 cases per year and this could be considered low for true breast cancer specialists. However, this figure may not be truly representative, as some surgeons worked at the boundaries of the region and so managed patients who lived outwith the NYCRIS cancer registry region. The data held by the registry may, therefore, only represent a fraction of their true patient volume and could reduce the apparent median workload. It was for this reason that a composite of self-declared specialisation and workload were used to define the measure. It was not, however, a perfect method for distinguishing between specialists and generalists and could again be a rather blunt surrogate. In the future, perhaps comparing outcomes between named team and other surgeons would be a more reliable method for distinguishing between specialists and nonspecialists.

Similarly, we were limited by the amount of treatment information available. NYCRIS collects only basic treatment details and this limited our ability to use pertinent and revealing outcome measures, such as, whether postoperative radiotherapy was administered at the optimal dosage in the correct number of fractions and within the correct time frame opposed to whether it was given at all. This was unavoidable, even though NYCRIS possesses one of the most extensive registry treatment datasets in the UK; the lack of routine, population-based national data on cancer treatment remains a general problem.

A final limitation of the study is the difficulty of distinguishing between changes in practice due to the Calman-Hine changes and those arising from other sources. In all the statistical models, a time factor was included in an attempt to distinguish between changes over time *per se* and those due to Calman-Hine. This time factor was included in all the models and yet the Calman-Hine implementation scores remained statistically significant in many analyses. This suggests that the Calman-Hine changes may have induced change over and above that occurring naturally due to changes in the medical evidence base or other organisational factors in the NHS.

This study provides some of the first formal evidence to demonstrate that the Calman-Hine reports recommendations have been implemented and that these changes have improved NHS cancer care. It supports previously reported work that suggests that although initiated, MDTs were still not adhering to all Calman-Hine recommendations by 2001 [26, 27]. Similarly, it supports others measuring the extent of implementation in terms of surgical site specialisation, where it has been shown that there has been a move towards surgical specialisation [27–29] but the shift is neither uniform nor complete.

Other studies have also demonstrated that surgical specialisation is associated with improvements in survival [6, 7, 30, 31]. Indeed, it was many of these studies that were used as

the evidence base for the development of the Calman-Hine Guidance [32]. It is reassuring to note, therefore, that the centralisation of breast cancer surgery into the hands of a specialist few, instigated by the Calman-Hine report, appears to have been translated into the anticipated survival benefit for patients.

This study's methodology has also been used to assess the impact of the Calman-Hine changes on colorectal cancer care [27]. In bowel cancer, increasing adherence to the manual of cancer service standards was associated with improved 5-year survival, while the increased use of gold standard treatments was associated with management by a specialist surgeon. In this study, specialisation was linked to improved 5-year survival and increasing adherence to the manual of cancer service standards was associated with the use of gold standard treatments. It is not clear why the different surrogates for Calman-Hine implementation are associated with improvements in different outcomes across the two cancer sites. A potential explanation is that innate differences may exist in how breast and colorectal cancer teams interact and function [33]. Alternatively, it may be that their level of development was different over the time period of the study [29]. Publicity and campaigns [34] to redress inequities in breast cancer care inspired much of the Calman-Hine process and, before the report's publication, management of this disease was already reasonably specialised. In contrast, the move towards surgical specialisation in colorectal cancer was much slower and has occurred as a consequence of the Calman-Hine plan. The shift in colorectal cancer practice was probably much greater over this time period than it was for breast cancer and this could explain the different patterns and effect sizes of outcomes observed.

This study has shown that routine data can be used to monitor the impact of policy change in the NHS. In addition, it provides evidence to show that the implementation of the Calman-Hine report has improved outcomes in breast cancer. The work also suggests that unacceptable variations in patterns of treatment and outcome remain and this must be recognised and addressed if Calman-Hine is to achieve its ultimate aim of a uniformly high standard of care for all. As there is little reason to suspect that the situation in Yorkshire is radically different from that across the rest of the England, it seems fair to assume that our results reflect the national situation. The value of the analyses is, however, limited by the timeliness and restricted nature of the clinical and organisational data available. To comprehensively assess the full impact of such policy changes, routine datasets must be expanded to include more clinically meaningful data items and more detailed information on the structure and organisation of services. Based on the data currently available, this study provides cautious support for the current NHS policy of cancer service reorganisation.

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