NPCA
National Prostate Cancer Audit

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Variation in the treatment of men with high-risk/locally advanced prostate cancer in England

NPCA: Short Report

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EXECUTIVE SUMMARY

Background

Approximately one third of men with high-risk or locally advanced prostate cancer do not receive radical surgery or radiotherapy treatment in England and Wales. Many factors are implicated in this potential 'under-treatment' but little is known about the between-hospital variation. In this short report, we examine geographical variation in the management of high-risk or locally advanced prostate cancer in England, explore determinants for receipt of treatment, establish between-hospital variation and investigate possible reasons for this.

Methods

The National Prostate Cancer Audit (NPCA) database was used to identify men diagnosed with high-risk or locally advanced prostate cancer in England and identify the treatments these men received. The NPCA database is made up of English Cancer Registry data linked at patient level to radiotherapy and hospital administrative databases. Multilevel multivariable random-effects logistic regression was used to estimate associations between receiving radical treatment within 1 year of diagnosis and patient characteristics (age, comorbidities, socioeconomic deprivation status and ethnicity). Hospital-level variation in receipt of radical treatment was explored visually using funnel plots. The intra-class correlation coefficient (ICC) was used to quantify the between-hospital variation in a fully adjusted random-intercept logistic regression model.

Results

53,890 men diagnosed between January 2014 and December 2017 at 128 hospitals were included and 35,037 (65.0%) received radical treatment. Men were more likely to receive radical treatment if they were younger (lower age was the strongest predictor), less deprived, had fewer comorbidities and were of non-Black ethnicity. 16.3% of men aged ≥80 years received radical treatment compared with 81.1% of men aged <70 years (adjusted odds ratio 0.04, 95% confidence interval 0.03-0.05).

The proportion of men undergoing radical treatment varied by hospital. For men aged ≥80 years old this proportion ranged from 0 to 51.9% (80% of hospitals: 4.3-31.6%) while in men under 70 years the range was from 13.6 to 94.8% (80% of hospitals 38.7-73.5%). The ICC for men aged ≥80 years was 23.5% (95% confidence interval 17.9-30.2%) compared with 4.8% (95% confidence interval 3.5-6.4%) for men aged less than 70 years indicating much less variation in the treatment of this younger age group. The ICC for other covariates was not significantly different implying these factors do not explain the variation.

Conclusion

In summary, there is less variation seen in how men, who are younger than 80 and have potentially curable prostate cancer, are managed in England compared to older men. However, deprivation and Black ethnicity are associated with potential 'under-treatment'. The outcomes that result from this variation and the implementation of shared decision-making are areas to be investigated further.

Patient Summary

This study used English hospital data to assess how men with curable prostate cancer are managed. We found that there is a larger variation across hospitals in how older men are managed compared with younger men. Overall, we also found that men from more deprived areas or men of Black ethnicity were less likely to receive potential curative treatment. It was not possible to explore the reasons for these results with the data available to us and further investigations are needed to help to understand and address these discrepancies in treatment. The findings from this study highlight the importance of patient involvement in shared decision-making about the most appropriate treatment.

INTRODUCTION

The latest figures from the National Prostate Cancer Audit (NPCA) show that in 2017-18 over 47,000 men were diagnosed with prostate cancer in England and that 41% had high-risk or locally advanced disease (1). Locally advanced disease refers to prostate cancer that has spread outside of the prostate capsule (and/or to the pelvic lymph nodes) but is distinct from metastatic prostate cancer where the prostate cancer has spread to more distant sites. It is well established that radical treatment of the prostate is important for improved survival of these men and that watchful waiting should only be reserved for men whose life expectancy is under 10 years (2). The proportion of men potentially 'under-treated' – when radical treatment is not received by men who are eligible for it – is on average 32% across England. This is thought to be as a consequence of a number of factors. Previous studies have shown that age, co-morbidities, Black ethnicity and socio-economic status are all associated with 'under-treatment' in prostate cancer and treatment rates overall have been shown to differ across England and Wales (range of proportion receiving radical treatment: 44% to 85%) (3-6). That said, radical treatment for high-risk or locally advanced prostate cancer is not always appropriate, particularly in frail older men, and therefore the term 'under-treatment' is not always valid. Hence, it is referred to as potential 'under-treatment' in this report. Management decisions are often complex and require a balance between estimated life expectancy, the absolute benefit of more complex treatment to the individual and the side-effect profile of the specific treatments available.

Patient volume, the overall number of patients being treated annually by a centre, is thought to be associated with better outcomes overall (7, 8) and for this reason cancer services in the UK have been centralised since 2000 into high-volume centres, particularly for surgery. However, there is no evidence to suggest that this centralisation has affected whether men within the English NHS with high-risk or locally advanced disease undergo radical treatment or not (9). It is therefore important to further investigate variation between hospitals within a hub-and-spoke system made up of referring district general hospitals and specialist treatment centres (10).

In this short report, we examine geographical variation in the management of high-risk or locally advanced prostate cancer in England, explore determinants for receipt of treatment, establish between-hospital variation and investigate possible reasons for this. Given the NPCA receives English and Welsh data from different data sources it was not possible to include Wales within this analysis.

MATERIAL AND METHODS

Patient population

All men who were newly diagnosed with high-risk or locally advanced prostate cancer between 1st January 2014 and 31st December 2017 were identified from the English Cancer Registry using the ICD-10 diagnosis code C61 (10). This initial database was linked at patient level with two routine databases: firstly, Hospital Episode Statistics (HES), a database of all hospital admissions in the English NHS which is a source of surgery-specific information about operation type and date (11). Secondly, the National Radiotherapy Data Set (RTDS), a national database that contains standardised data from all NHS hospital providers of radiotherapy services in England (12).

Prostate cancer risk was based on TNM stage (13), Gleason score, and PSA level (hereafter referred to as 'cancer characteristics'), according to a modified D'Amico risk stratification algorithm developed previously by the NPCA (14). The final cohort for analysis included 53,890 men with high-risk or locally advanced prostate cancer diagnosed at 128 hospitals (**Figure 1**). As we were focussing on men in this risk group only, men were excluded if they had advanced disease (n = 23,292, 14.7%), intermediate-risk disease (n = 53,225, 33.5%), low-risk disease (n = 12,893, 8.1%) or if prostate cancer risk was unknown (n = 15,105, 9.5%). 19 hospitals were excluded to ensure that all strata of each baseline characteristic included at least 10 men. There were only 34 hospitals where at least 10 Black men were diagnosed within the study period and so ethnicity could not be included in any analysis of variation according to diagnosing hospital.

Baseline characteristics

English Cancer Registry data was used to identify the diagnosing hospital, the date of diagnosis, cancer characteristics, ethnicity and age at diagnosis for each man. Cancer characteristics were used for stratifying disease status but also to provide baseline information (15). Men were categorised into the ethnic groups White, Asian, Black and Other as defined in the 2001 census (16). Men with Chinese or Mixed backgrounds were categorised with 'Other' due to small numbers. The Royal College of Surgeons (RCS) Charlson score was used to identify any co-morbid conditions captured in the HES record within one year prior to diagnosis (17). Socioeconomic deprivation status was determined for patients from the English 2012 Index of Multiple Deprivation (IMD) based on their area of residence and divided according to quintiles of the national distribution (18).

Outcome variable

The OPCS Classification of Interventions and Procedures (OPCS-4) code 'M61' was used to identify the men in the HES record who underwent a radical prostatectomy and the date of their operation (19). The RTDS data item 'treatment modality' was used to select men who underwent radiotherapy and/or brachytherapy and the date of their treatment. Brachytherapy information was also supplemented from the HES record with the following OPCS-4 codes: 'X653 - Delivery of a fraction of interstitial radiotherapy' and 'M706 - Radioactive seed implantation into prostate' or 'M712 - Implantation of radioactive substance into prostate'.

Statistical analysis

Multilevel multivariable random-effects logistic regression was used to estimate associations between receiving radical treatment and patient characteristics: age, comorbidities, socioeconomic deprivation status and ethnicity (20). A random intercept was modelled for each hospital to adjust for clustering within hospitals (21). Missing data for ethnicity (6.6%) were replaced with substituted values using statistical imputation Missing values were replaced with ten sets of plausible values and Rubin's rules were then used to combine the adjusted odds ratios (aOR) (22).

Hospital-level variation in receipt of radical treatment was explored visually using funnel plots to establish whether the between-hospital variation in the proportion of patients receiving radical treatment was greater than expected by chance alone (23). Five adjusted funnel plots were generated: one for all patients and one for each of the 5-year age brackets.

The intra-class correlation coefficient (ICC) was used to quantify the between-hospital variation in a fully adjusted random-intercept logistic regression model. The ICC represents the proportion of the total variance that is between hospitals, despite adjustment for all other determinants. A larger ICC represents a greater degree of between-hospital variation when compared across different strata.

To identify sources of between-hospital variation, the ICC was estimated in 10 strata of the cohort: men aged 70-74 years, 75-79 years and ≥80 years versus men aged <70 years; non-comorbid (Charlson = 0) versus comorbid men (Charlson ≥1); and less deprived (IMD 1-2) versus more deprived men (IMD 3-5). One risk-adjustment model was estimated in all patients and also used for each stratum. Ethnicity was not explored in this way due to low patient numbers in non-White ethnicity strata and so variation was only explored on a national, not a hospital level for this variable.

RESULTS

Determinants of potential 'under-treatment'

Of the 53,890 men with high-risk/locally advanced prostate cancer, 35,037 men (65.0%) were identified as receiving radical treatment (**Table 1**). Over the course of the study period the proportion of men receiving radical treatment increased from 61.6% in 2014 to 67.7% in 2017. A slight stage shift was seen within this time with more T3 disease diagnosed (71.0% to 75.5%) but with little difference in Gleason score or nodal status.

Between the ages of 70 and 80 years there was a decline in treatment rates as shown in **Figure 2**, irrespective of the number of comorbidities. Age was the strongest predictor for receipt of radical treatment, after adjustment for all other factors. Compared with 81.1% of patients aged <70 years who received radical treatment, 73.6%, 59.6% and 16.3% of those aged 70-74 years (adjusted OR 0.65, 95% confidence interval 0.61-0.70), 75-79 years (aOR 0.34, 95% CI 0.31-0.37) and ≥80 years (aOR 0.04, 95% CI 0.03-0.05) received radical treatment, respectively.

Men were more likely to receive radical treatment if they were less deprived, had fewer comorbidities and were of non-Black ethnicity (all $P<0.001$). The overall proportion of Black men who received radical treatment was 61% compared to 65% of White men (**Table 1**). Analysis with adjustment for all other factors confirmed that the likelihood of receiving radical treatment for Black men was lower compared with White men (aOR 0.75 95% CI 0.66-0.87). The same patterns were also evident when the analysis was restricted to men

aged less than 70. There were no significant differences in the likelihood of men of Asian or Other ethnicity receiving radical treatment compared to men of White ethnicity. Importantly, 40% of the men of Black ethnicity were from the most deprived group compared to 23%, 22% and 12% of the men of Asian, Other and White ethnicity indicating a disparity between deprivation status and ethnicity.

A further analysis was carried out to investigate the receipt of radical treatment across the four age groups according to Charlson score, deprivation status and ethnicity (**Table 2**). A downward trend in the proportion of men receiving radical treatment was observed with increasing age for each factor. Treatment rates were lowest for the oldest age group compared with the youngest, irrespective of Charlson score (no comorbidities vs at least one comorbidity), deprivation status (least deprived vs most deprived) or ethnicity. The observation of lower treatment rates for men of Black ethnicity remained across all age groups. Men of White or Asian ethnicity had similar treatment rates across all age groups: 81.9% and 81.7% for men aged <70 years, and 16.3% and 18.4% for men aged ≥80 years, respectively. In contrast the treatment rates for men of Black ethnicity were 72.1% and 10.0% for men aged <70 years and aged ≥80 years, respectively.

Variation between hospitals

The ICC for patients ≥80 years was 23.5% (95% CI 17.9-30.2%) compared with 7.1% (95% CI 5.2-9.5%) for patients aged 75-79, 4.1% (95% CI 2.8-5.8%) for patients aged 70-74 and 4.8% (95% CI 3.5-6.4%) for patients aged less than 70 years, which shows a significantly greater proportion of the total variance to be between hospitals in elderly patients compared with younger patients. A sensitivity analysis showed that variation did not differ when the age group of men aged less than 70 years was sub-divided into men aged less than 60 and men aged 60 to 69. Differences in ICCs by comorbidity and socioeconomic status were not statistically significant, indicating that variation was similar between groups (**Figure 3**). Ethnicity could not be explored geographically in this way due to insufficient patient numbers in non-White ethnicity strata across English hospitals.

Receipt of radical treatment among men with high-risk or locally advanced prostate cancer varied substantially between the 128 diagnosing hospitals. The proportion of men undergoing radical treatment varied by hospital (ranging for all men from 35.5 to 82.0% - **Figure 4a**). For men aged ≥80 years old, this ranged from 0 to 51.9% (80% of hospitals: 4.3-31.6% - **Figure 4e**). In comparison, for men aged 75-79 years, 70-74 years and less than 70 years this ranged from 13.6 to 94.8% (80% of hospitals: 38.7-73.5% - **Figure 4d**), 16.9 to 93.9% (80% of hospitals: 61.7-83.0% - **Figure 4c**) and 50.3 to 94.2% (80% of hospitals: 72.3-88.9% - **Figure 4b**), respectively.

Adjustment for factors in the multivariable model did not reduce hospital variation. Assuming differences were to arise from random errors alone, the expected number of hospitals outside the inner (95%) and outer (99.8%) funnel limits for all analyses would be 6.4 and 0.3, respectively. For patients ≥80 years old, 58 hospitals lay outside the inner funnel limits (34 below – treating a lower proportion of patients, and 24 above – treating a higher proportion of patients) and 30 hospitals lay outside the outer funnel limits (16 below and 14 above) (**Figure 4b**). This was comparatively higher than for the other age groups (75-79 years: 43 and 20 hospitals; 70-74 years: 25 and 11 hospitals; <70 years: 43 and 18 hospitals, for hospitals that lay outside the inner and outer funnel limits, respectively – **Figure 4c to 4e**). The increase in the number of hospitals outside the funnel limits between

the latter two age groups did not translate into any statistically significant difference in the ICC values.

DISCUSSION AND CONCLUSIONS

This large observational study of over 50,000 men with high-risk or locally advanced prostate cancer has shown that there is significant variation in the receipt of radical treatment in England but treatment rates have increased from 62% to 68% between 2014/15 and 2017/18. Between January 2014 and December 2017, 35% of men with high-risk or locally advanced prostate cancer did not receive radical treatment. As would be expected, age and number of comorbidities were identified as determinants of the receipt of radical treatment in these men. Socio-economic deprivation and Black ethnicity were also identified as determinants of the receipt of radical treatment, the reasons for which are unclear. There was also a clear disparity between deprivation status and ethnicity, more so for Black ethnicity than Asian or Other ethnicity, indicating that these factors are interlinked and should be considered together.

Encouragingly, there was little geographical variation in how the prostate cancer of younger men (<80 years) was managed, indicating that consistent management decisions were being made for these men. However, a significantly greater proportion of between-hospital variation was found in men aged 80 years or above, suggesting there was less consistency across the country in how the prostate cancer of elderly patients was managed compared to younger men.

Determinants of potential 'under-treatment'

In line with findings in other studies, we have shown that older age, number of co-morbidities, socio-economic deprivation and Black ethnicity are associated with potential 'under-treatment' (3-6). Other factors such as marital and carer status are likely to be contributing to this variation but this information is not collected through routine data sources. Variation in the treatment of prostate cancer with respect to ethnicity and socio-economic deprivation has been shown previously within the US health system but not within the publicly-funded English NHS (5).

It is unclear how this inequity of treatment occurs and it is of particular concern given that prostate cancer is more common in Black men and that these men should be more likely to be offered a PSA test in primary care (24). This discrepancy in the delivery of radical treatment requires urgent evaluation to understand why men eligible for radical treatment are not receiving it and to ensure that access to radical treatment is equitable notwithstanding social deprivation or ethnicity. How shared-decision making impacts on these treatment decisions also needs to be explored.

As expected, age was a major factor in management choices in locally advanced prostate cancer (25) despite there being no age limit given for radical treatment in international guidelines (2, 26). It is important that other factors are incorporated into decision-making processes given that older men (76 to 85 years) who receive androgen deprivation therapy (ADT) alone risk decrements in cause-specific and overall survival compared to those who receive radical radiotherapy combined with ADT (27).

Clearly treating all elderly patients with high-risk or locally advanced disease radically is not always appropriate given their higher co-morbidity burden and reduced life

expectancy. The PR07 trial showed that after 7 years, 19% of men died from their prostate cancer when treated with ADT only, compared to 9% who received both radiotherapy and ADT (28). These trial findings have now changed clinical practice, meaning that men with locally advanced prostate cancer are likely to survive longer (29). The benefits of treatment for more frail patients remain less certain. Furthermore, this trial only included men aged less than 80 who were reasonably fit (performance status of two or less) (28). Therefore, the prostate cancer-specific mortality expected from 'watchful waiting' in older and more frail men would be even lower than that reported, given they would be more likely to die from competing causes. The difficulty of providing an accurate prediction of life expectancy makes these treatment decisions particularly complex.

Variation between hospitals

Encouragingly, there was no between-hospital variation observed according to comorbidity or socioeconomic status. The observation of between-hospital variation and age is a novel finding for men with prostate cancer but has been shown for other cancer groups, for example in adjuvant chemotherapy use for older patients with Stage III colon cancer in England (30). It has also been identified that patient selection for colorectal surgery, especially in older patients, also varies between countries and this can have a detrimental effect on survival (31).

There are three categories of unwarranted variation in clinical practice: variations in "effective care and patient safety", variations in "supply-sensitive care" (the availability of healthcare resources) and variations in "preference-sensitive care" (when two or more treatment options are available) (32). Variation in how high-risk prostate cancer in elderly men is managed is likely to be a consequence of both effective care and preference-sensitive care.

With respect to effective care, treating elderly patients has to be balanced against life expectancy but it is also important to avoid the potential 'under-treatment' of otherwise healthy patients simply on the basis of their age. Treatment should be reserved for the fitter patients within this group but it needs to be recognised that not all men will benefit from radical treatment and they should not be necessarily labelled as being potentially 'under-treated'. The prediction of life expectancy and patient fitness is difficult and variation in how these factors are assessed across providers is likely to be contributing to the results. A geriatric assessment has been named by the International Society of Geriatric Oncology as the most appropriate way to assess fitness for active treatment for cancer, whereby men are stratified according to frailty, not age. However, it is uncertain as to how frequently this is used in routine practice (33).

A further consideration is that older men are susceptible to worse side effects of treatment and therefore any assessment of fitness should also be balanced with respect to this (25). Equally, how patients evaluate the impact of these side effects against the potential benefits of treatment within their own decision-making processes may also be contributing to the variation observed.

How clinicians make decisions is evidently complex and clinician recommendation has been shown to be a strong determinant of why older patients accept or decline cancer treatment (34). Altogether, these findings highlight the importance of patient and multi-clinician input in shared decision-making which involves the clinician giving a patient personalised information on the options for treatment, and the likely potential risks and benefits, as well as supporting the patient to make the decision based on what is important

to that individual. Clinicians should also be encouraged to use a geriatric assessment when making treatment recommendations. How these decisions can be made more effective needs to be explored further if some of the evident discrepancies in treatment delivery are to be improved. Examples of how to do this may include the involvement of wider multi-disciplinary team discussions, care of the elderly teams and joint clinics (with urology and oncology input).

Conclusions

More than one-third of men in England with high-risk or locally advanced prostate cancer do not receive radical local treatment. Factors associated with this potential 'under-treatment' include older age, increasing number of co-morbidities, higher socio-economic deprivation and Black ethnicity. The reasons behind treatment differences according to ethnicity and socio-economic status will be explored further by the NPCA. These findings will inform the development of appropriate interventions to resolve the current inequity in the receipt of radical treatment.

It is encouraging that generally consistent management decisions are being made for men younger than 80 with potentially curable prostate cancer. However, there is greater variation across the country in whether older men receive treatment. The outcomes that result from these choices, as well as the importance of shared decision-making, are areas to be investigated further within the prostate cancer community.

In addition, hospitals within England and Wales can keep up to date with their own results with respect to treatment rates in all the NPCA Annual Reports published since 2014 (https://www.npca.org.uk/reports/).

Figure 1. Flow chart showing inclusion of patients in study.

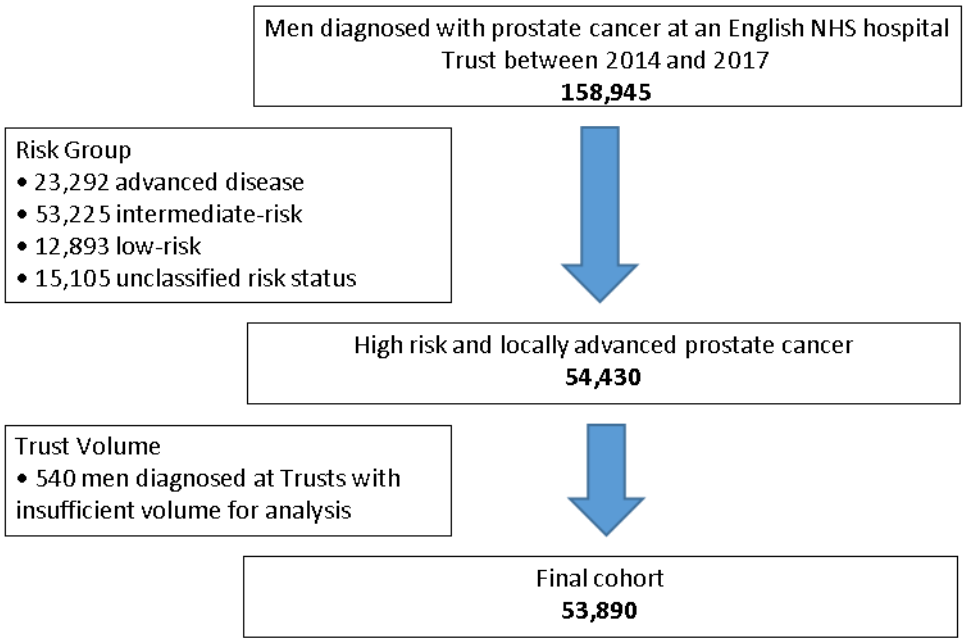


Figure 2. Graph showing percentage of men with high-risk/locally advanced prostate cancer who receive radical treatment within 12 months according to age at diagnosis.

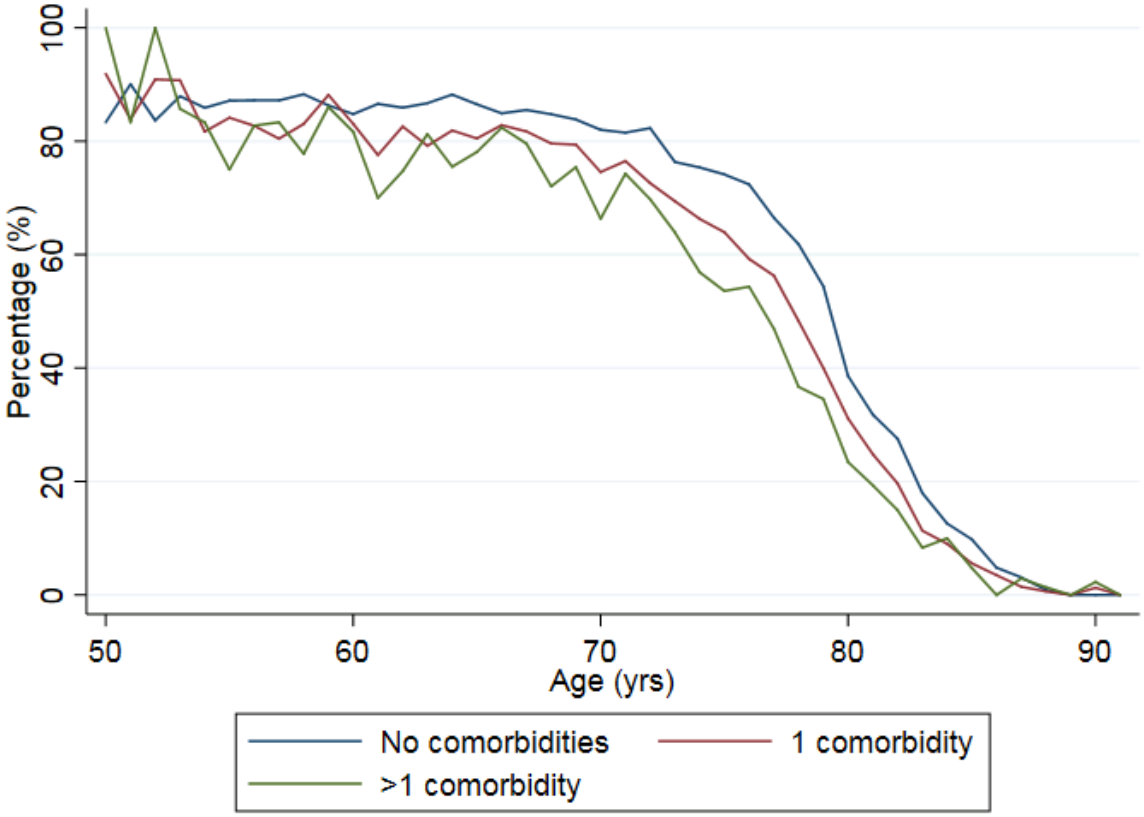
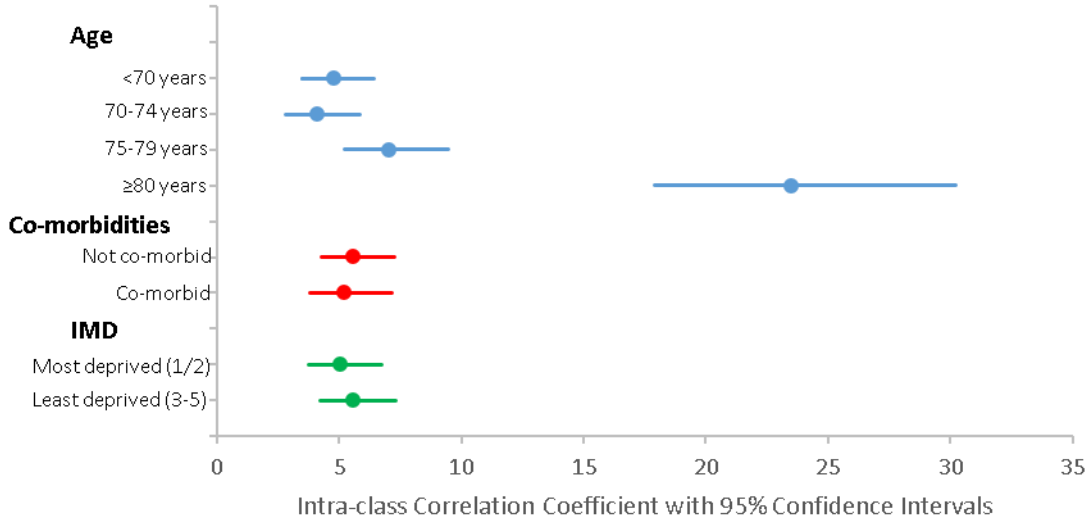


Figure 3. The proportion of the total variation that is between hospital Trusts according to age, comorbidities and socioeconomic status.

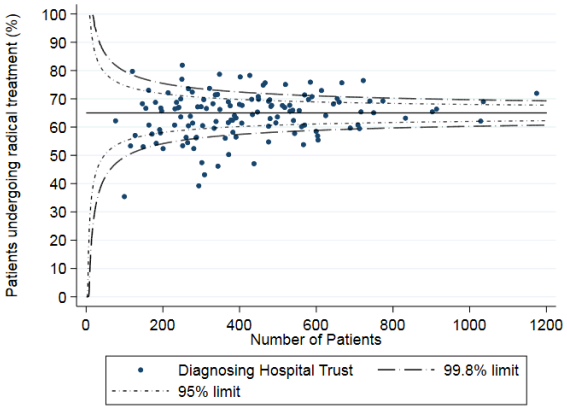


Abbreviations: IMD – Index of Multiple Deprivation

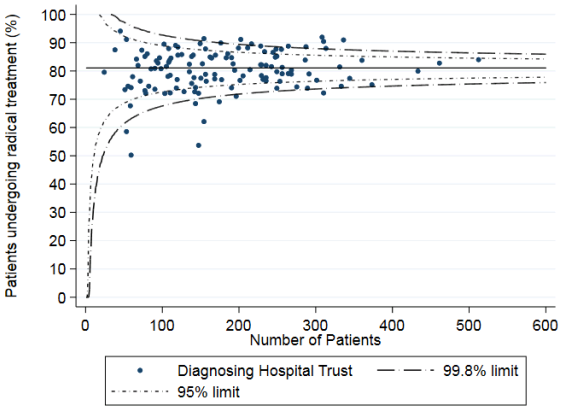
Figure 4. Funnel plots showing the proportion of men with high-risk/locally advanced disease who receive radical treatment within 12 months at each hospital Trust, adjusted for all patient factors in **Table 1**.

(a) All men; (b) Men aged ≥80 years; (c) Men aged between 75 and 79 years; (d) Men aged between 70 and 74 years; (e) Men aged <70 years.

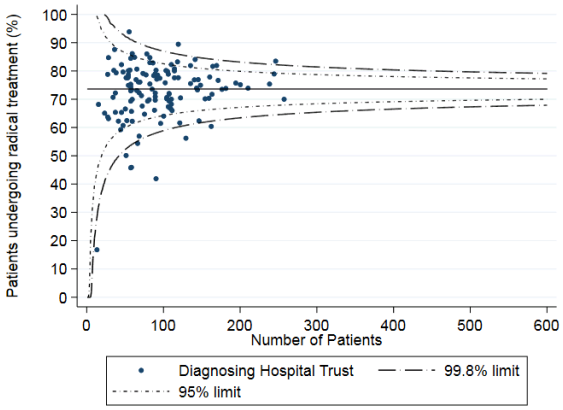
A. Receipt of radical treatment by English NHS hospital Trust for all patients (adjusted)



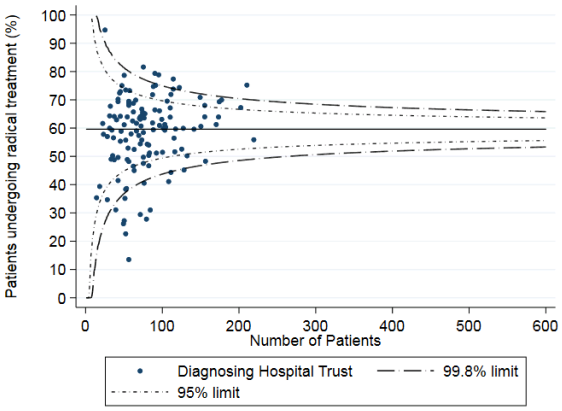
B. Receipt of radical treatment by English NHS hospital Trust for patients <70 years (adjusted)



C. Receipt of radical treatment by English NHS hospital Trust for patients 70-74 years (adjusted)



D. Receipt of radical treatment by English NHS hospital Trust for patients 75-79 years (adjusted)



E. Receipt of radical treatment by English NHS hospital Trust for patients ≥80 years (adjusted)

Table 1. Distribution of patient characteristics and their effect on receipt of radical treatment.

	Total		Received radical treatment		*P* value	Adjusted odds ratios*	
	n = 53,890	**%**	**n = 35,037**	**%**	**X^2**	**95% CI**	***P* values**
Age (years)					**<0.001**		**<0.001**
<70	23,054	42.8	18,687	81.1		1	
70-74	12,030	22.3	8,857	73.6		0.65 (0.61-0.70)	
75-79	10,219	19.0	6,093	59.6		0.34 (0.31-0.37)	
≥80	8,587	15.9	1,400	16.3		0.04 (0.03-0.05)	
RCS Charlson score					**<0.001**		**<0.001**
0	39,845	73.9	27,236	68.4		1	
1	8,967	16.6	5,341	59.6		0.77 (0.72-0.82)	
≥2	5,078	9.4	2,460	48.4		0.51 (0.47-0.55)	
Deprivation status (national quintiles)					**<0.001**		**<0.001**
1 (least deprived)	12,806	23.8	8,673	67.7		1	
2	13,465	25.0	8,910	66.2		0.96 (0.91-1.02)	
3	11,387	21.1	7,374	64.8		0.87 (0.81-0.94)	
4	9,179	17.0	5,805	63.2		0.82 (0.76-0.89)	
5 (most deprived)	7,053	13.1	4,275	60.6		0.69 (0.63-0.75)	
Ethnicity					**0.005**		**<0.001**
White	48,236	93.8	31,384	65.1		1	
Asian	1,018	2.0	679	66.7		1.07 (0.89-1.27)	
Black	1,479	2.9	899	60.8		0.75 (0.66-0.87)	
Other±	696	1.4	455	65.4		0.92 (0.77-1.09)	
Missing	2,461		1,620				

* Adjusted for patient demographics and tumour characteristics (T stage, N stage, Gleason score and PSA).

± Chinese, Mixed backgrounds or any other ethnic group

Table 2. Proportion of patients receiving radical treatment for high-risk/locally advanced disease according to comorbidities, socioeconomic deprivation status and ethnicity.

	<70 years			70-74 years			75-79 years			≥80 years		
	N	n (%)		N	n (%)		N	n (%)		N	n (%)	
RCS Charlson Score												
0	18,271	15,020	(82.2)	8,832	6,693	(75.8)	7,107	4,502	(63.3)	5,635	1,021	(18.1)
≥1	4,783	3,667	(76.7)	3,198	2,164	(67.7)	3,112	1,591	(51.1)	2,952	379	(12.8)
Deprivation status												
1-2	10,726	8,889	(82.9)	6,116	4,685	(76.6)	5,111	3,221	(63.0)	4,318	788	(18.2)
3-5	12,328	9,798	(79.5)	5,914	4,172	(70.5)	5,108	2,872	(56.2)	4,269	612	(14.3)
Ethnicity												
White	20,049	16,419	(81.9)	10,939	8,111	(74.1)	9,291	5,554	(59.8)	7,956	1,297	(16.3)
Asian	470	384	(81.7)	204	149	(73.0)	208	121	(58.2)	136	25	(18.4)
Black	867	625	(72.1)	218	129	(59.2)	254	131	(51.6)	140	14	(10.0)
Other	379	302	(79.7)	130	92	(70.8)	102	54	(52.9)	85	7	(8.2)
Missing	1,286	955	(74.3)	541	377	(69.7)	362	231	(63.8)	271	57	(21.0)

ACKNOWLEDGEMENTS

Data for this report is based on patient-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 Public Health England (PHE).

GLOSSARY

Co-morbidity
Medical condition(s) or disease process(es) that are additional to the disease under investigation (in this case, prostate cancer).

Charlson Co-morbidity Score
A commonly used scoring system for medical co-morbidities. The score is calculated based on the absence and presence of specific medical conditions in the Hospital Episode Statistics (HES) database.

Healthcare Quality Improvement Partnership (HQIP)
HQIP aims to promote quality improvement in patient outcomes, and in particular, to increase the impact that clinical audit, outcome review programmes and registries have on healthcare quality in England and Wales. HQIP is led by a consortium of the Academy of Medical Royal Colleges, the Royal College of Nursing and National Voices.

Hospital Episode Statistics (HES)
A database that contains data on all inpatients treated within NHS trusts in England. This includes details of admissions, diagnoses and treatments.

International Classification of Diseases, Tenth Revision (ICD-10)
This is the World Health Organisation international standard diagnostic classification, and is used to code diagnoses and complications within the Hospital Episode Statistics database of the English NHS.

Intra-class correlation coefficient (ICC)
A descriptive statistic to describe between-group variation where a larger ICC in one strata of patients represents more variation compared to another strata. In this case the groups are individual hospital Trusts.

Multilevel multivariable random-effects logistic regression
A statistical method used to model the probability of an event occurring whilst taking account of hierarchical data (i.e. cases are grouped into hospital Trusts) and adjusting for other important factors.

NHS Trust
An NHS organisation that provides acute care services in England which is made up of one or more hospitals.

Royal College of Surgeons of England (RCS)
An independent professional body committed to enabling surgeons to achieve and maintain the highest standards of surgical practice and patient care. As part of this it supports audit and the evaluation of clinical effectiveness of surgery.

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