On-going and planned colorectal cancer clinical outcome analyses

Eva Morris

Cancer Research UK Bobby Moore Career Development Fellow

National Cancer Data Repository

- Numerous routine health data sources available but none contain information about all aspects of patient care
- Cancer registry data contains info about every incident tumour and outcomes
- Hospital Episode Statistics (HES) contains detailed information about treatment
- Linking such datasets together creates a resource that enables the full patient pathway to be tracked

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Colorectal cancer data within the NCDR

- Current Linkages
  - Cancer registry data – all tumours diagnosed between 1990 & 2008
  - ONS dataset – all tumours diagnosed between 1971 & 2008
  - HES in-patient data - ~5 million episodes
  - National Bowel Cancer Audit Programme – all tumours diagnosed between April 2006 & July 2009
  - NHS Bowel Cancer Screening Programme dataset - >5 million invitations, 56,784 +ve FOBt kits, >4,000 tumours
  - Clinical trials data
  - Primary care data – GPRD

- Linkages planned or underway
  - HES outpatient data
  - Genetic data
  - Radiotherapy Episode Statistics
  - Cancer Waiting Times

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England, Norway, Sweden Survival Project

- The survival of colorectal cancer patients varies substantially across Europe
- UK's survival rates are relatively poor
- Majority of the studies investigate survival differences at five years but differences at earlier time points may be more revealing

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Methods

- All individuals diagnosed with colorectal cancer between 1996 and 2004 in England, Norway and Sweden
- Examined
  - Five-year cumulative relative period survival
  - Excess death rates
  - Stratified by
    - Age (<50, 50-59, 60-69, 70-79, ≥80)
    - Period of follow-up (0-3 months, 3months-1 year, 1-2 years & 2-5 years)
- Calculated the number of ‘avoidable’ deaths per year if English colorectal patients had the same survival experience of Norwegian patients

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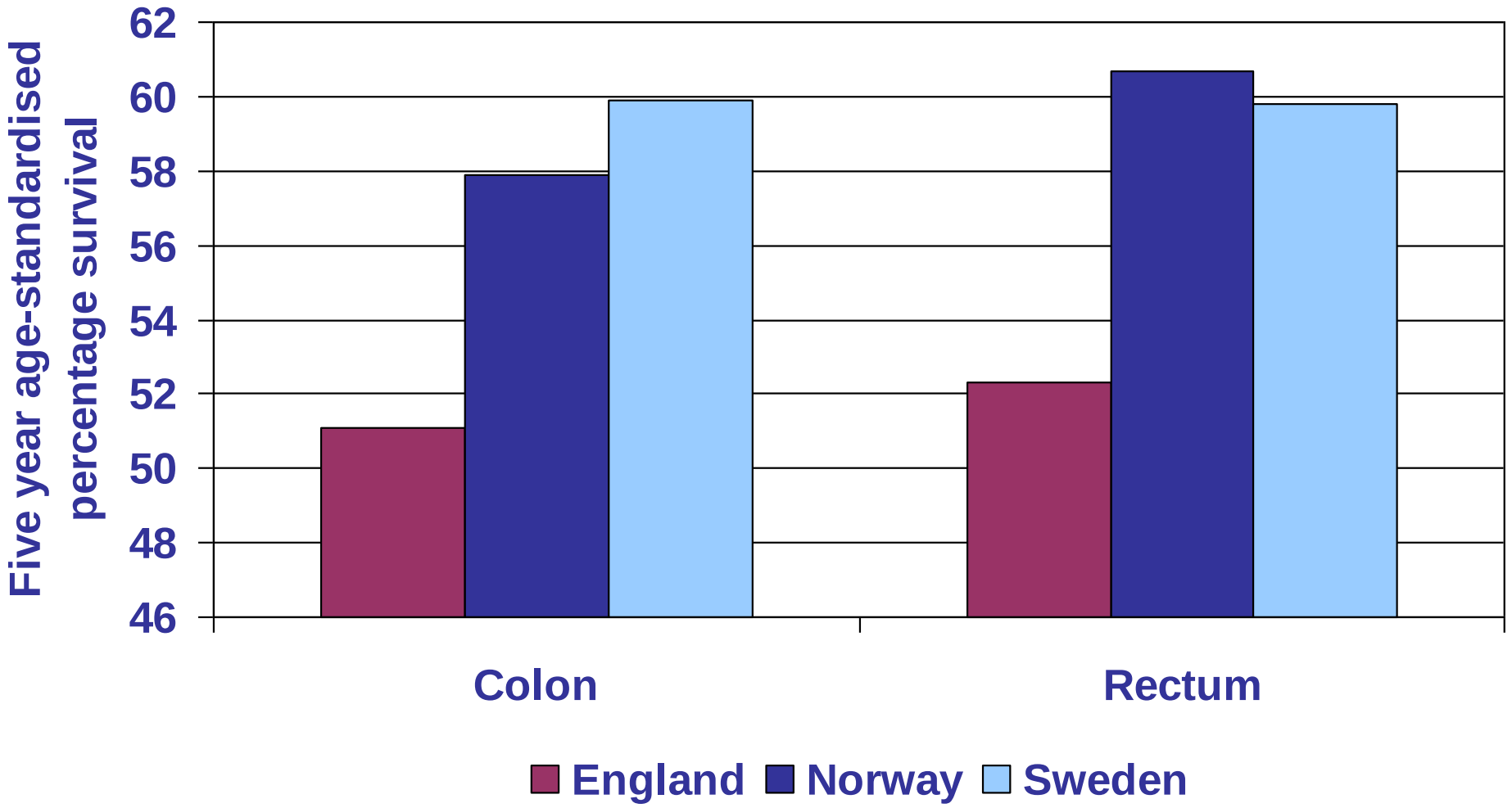

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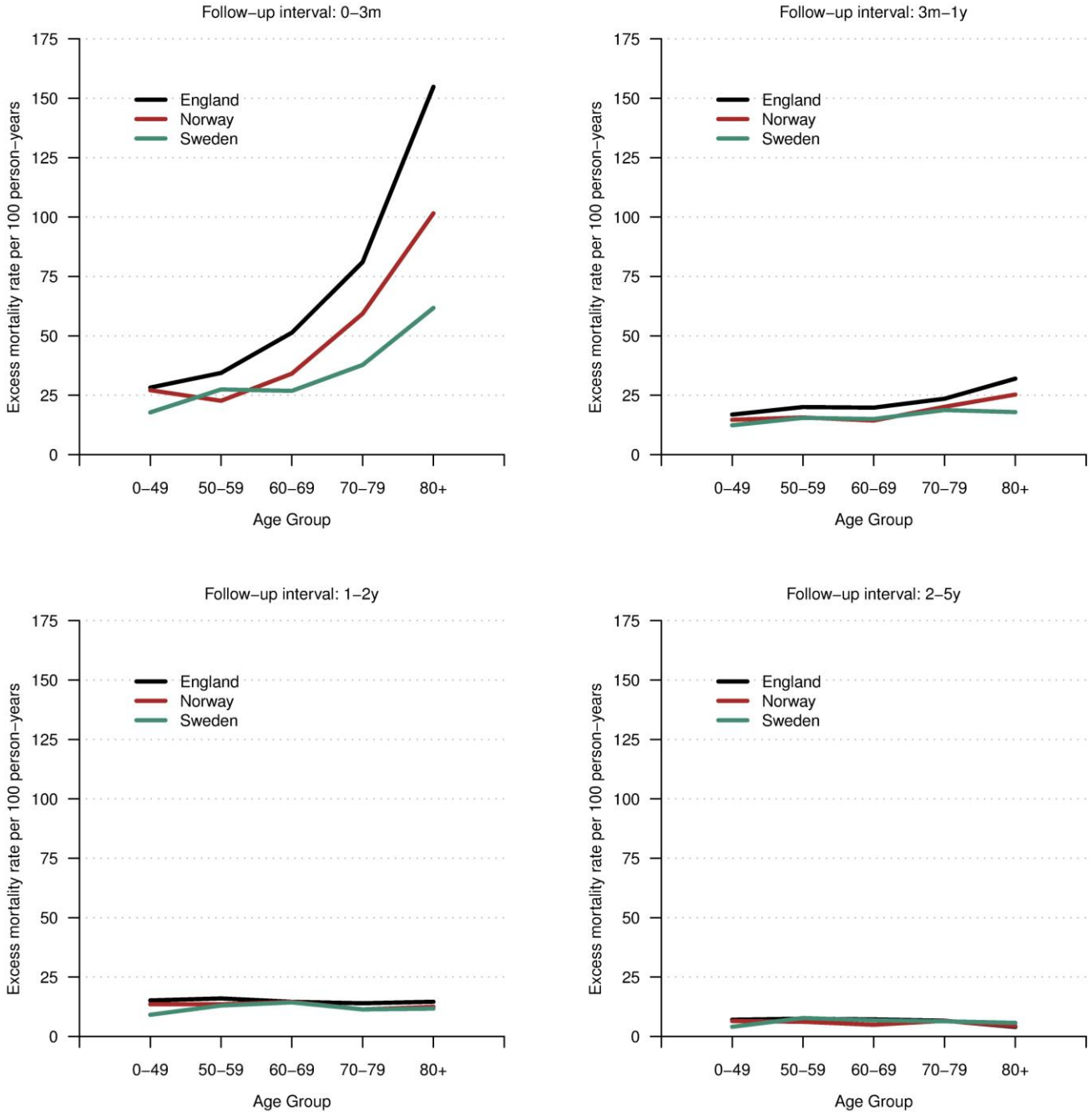
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Follow−up interval: 3m−1y
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Excess mortality rate per 100 person−years
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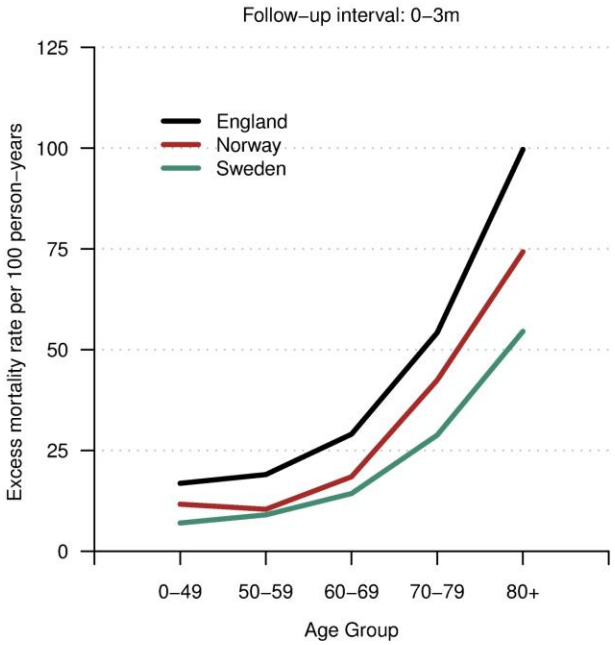
Age Group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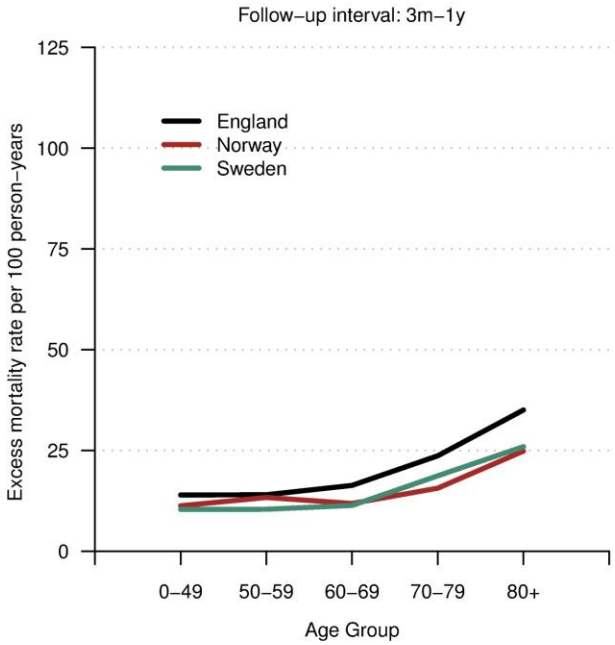
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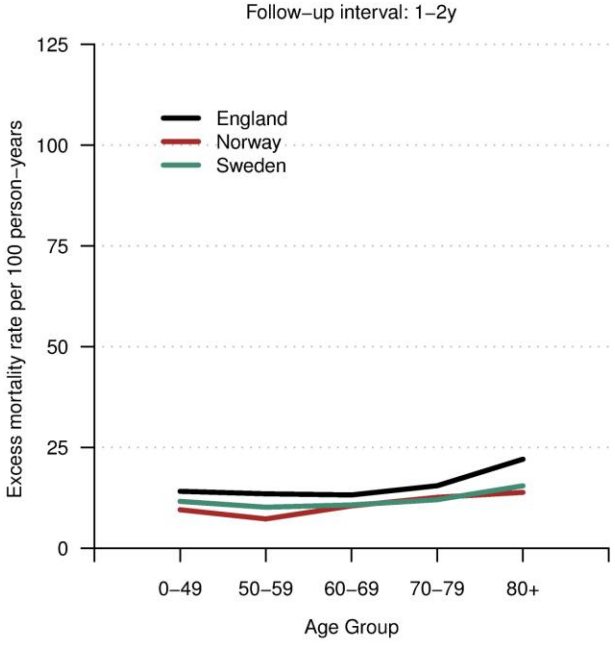
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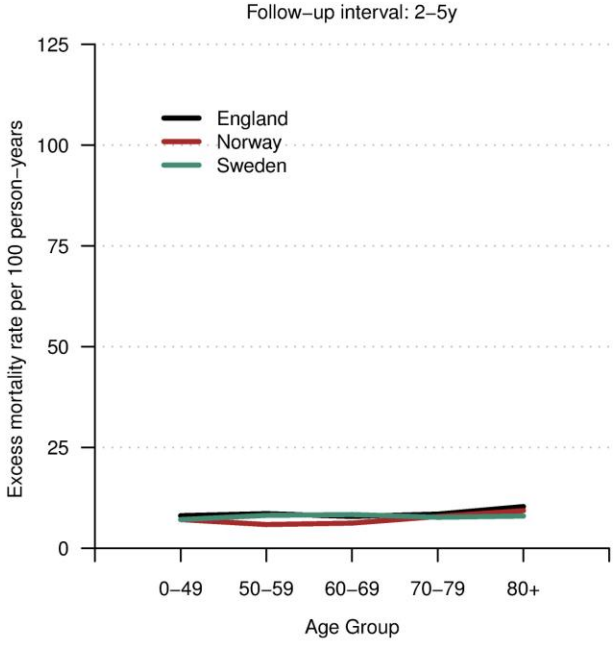
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‘Avoidable’ Deaths

13.6% of excess deaths in colon cancer and 16.8% of excess deaths in rectal cancer could have been avoided within five years of follow-up

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Survival by socio-economic status

- Survival differences reported across socio-economic groups with those residing in more deprived areas tending to have worse outcomes

- Used same methodology to compare survival across socio-economic groups in England

- Very similar effects observed

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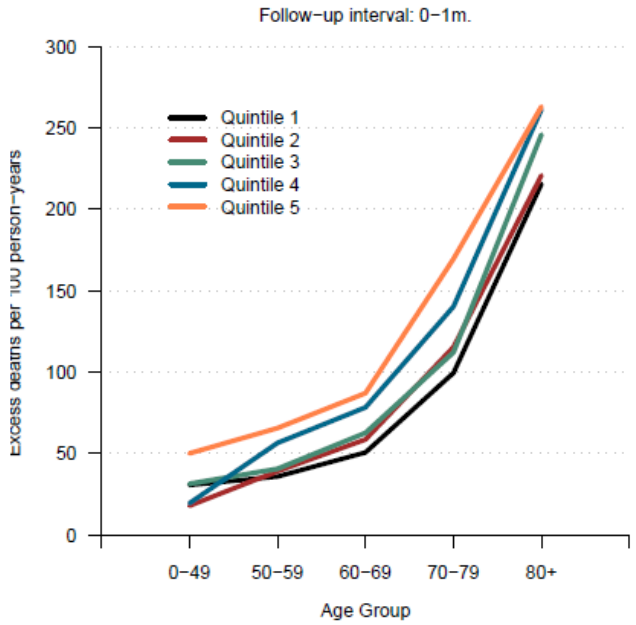
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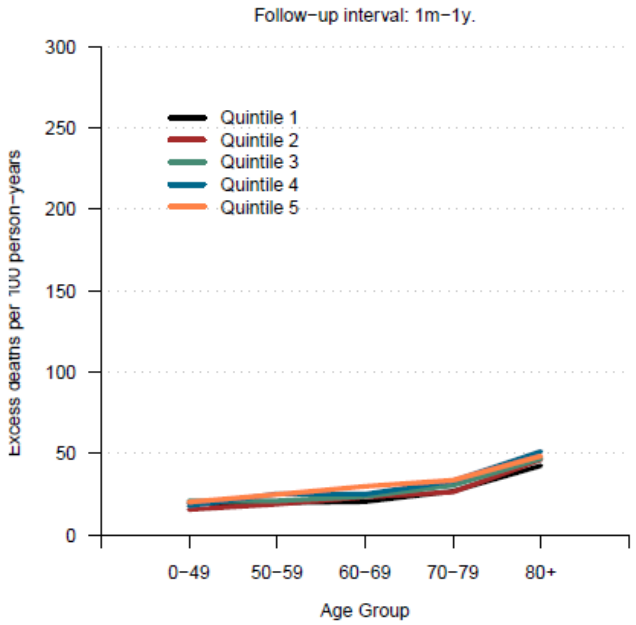
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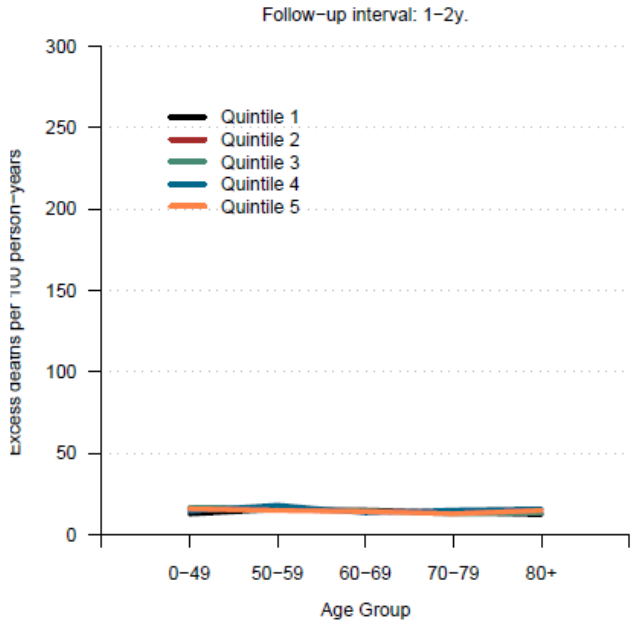
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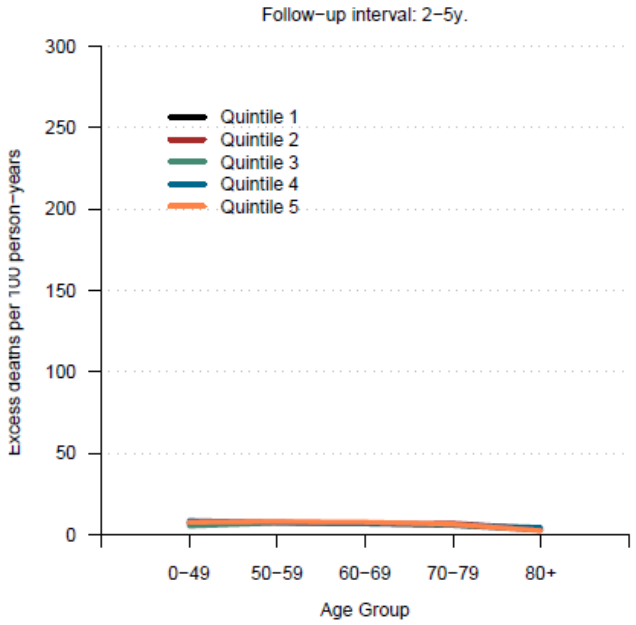
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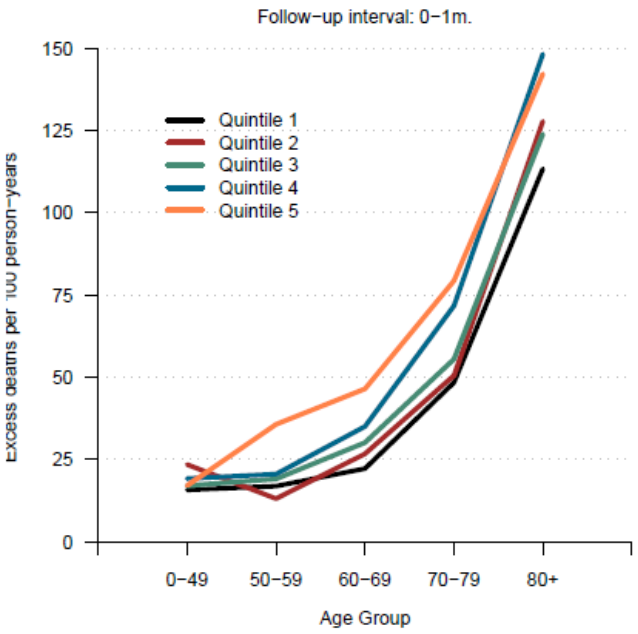
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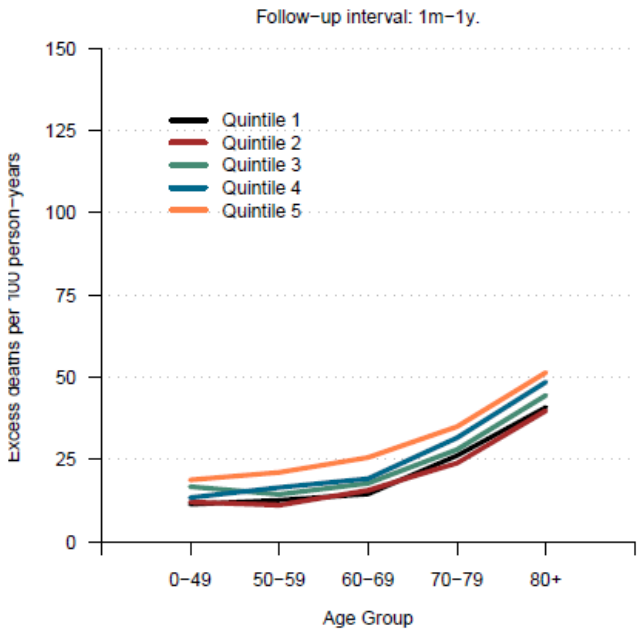
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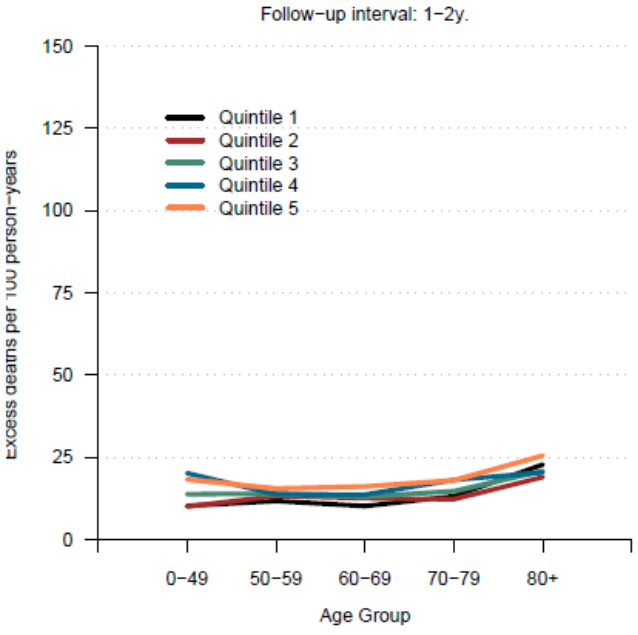
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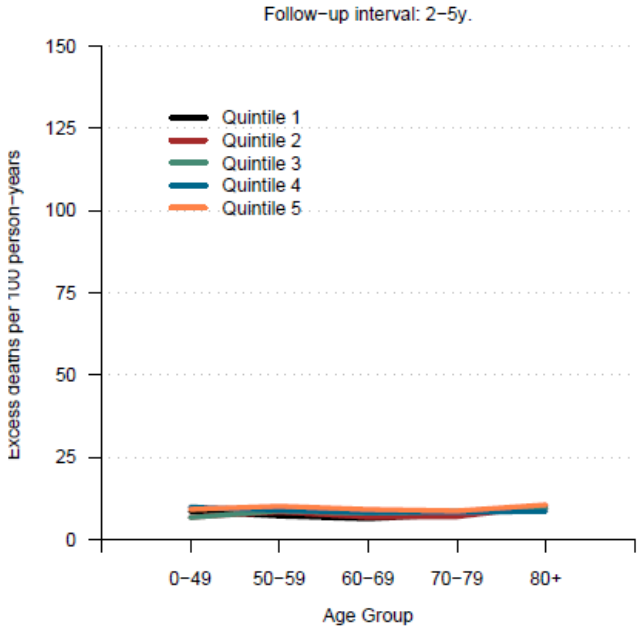
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Early Deaths

- Study comparing the characteristics of those who die rapidly after diagnosis compared to those who survive longer
- Individuals dying rapidly
  - Were older
  - Had higher stage (or unstaged) disease
  - Less likely to have surgery
  - More likely to live in deprived areas
- Further work ongoing to investigate how these patients present with their disease (2WW, standard GP referral, A&E, screening etc)

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Post-Operative Mortality

- Increasing demand for the NHS to publish clinical outcomes such as operative mortality by hospital trust to inform patient choice

- Figures must take account of differences in casemix of patient populations & surgical workloads

- Aimed to assess variation in the risk-adjusted 30-day operative mortality for colorectal cancer patients across hospital trusts within the English NHS

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Methods 1

- Information on every patient receiving a major resection for colorectal cancer and treated in the English NHS between 1998 and 2006 was obtained from the National Cancer Data Repository

- Investigated whether the following factors were associated with 30-day post-operative mortality
  - Year of diagnosis
  - Age
  - Sex
  - Dukes' stage
  - Socio-economic status
  - Tumour site
  - Charlson co-morbidity score
  - Operation type (elective/emergency)

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Methods 2

- Stage missing for 24,453 (15.1%) of study population and socio-economic information missing in 404 (0.25%) cases. Complete information for all other variables
- Missing information handled using multiple imputation
- Multi-level logistic binary regression used to investigate the factors associated with death within 30-days of surgery
- Funnel plots were used to investigate variation in the risk-adjusted mortality rates between Trusts

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Study Population

- 160,290 patients received a major resection for colorectal cancer over the study period
- Treated in 150 different trusts and 28 different cancer networks
- Overall operative mortality rate was 6.7%

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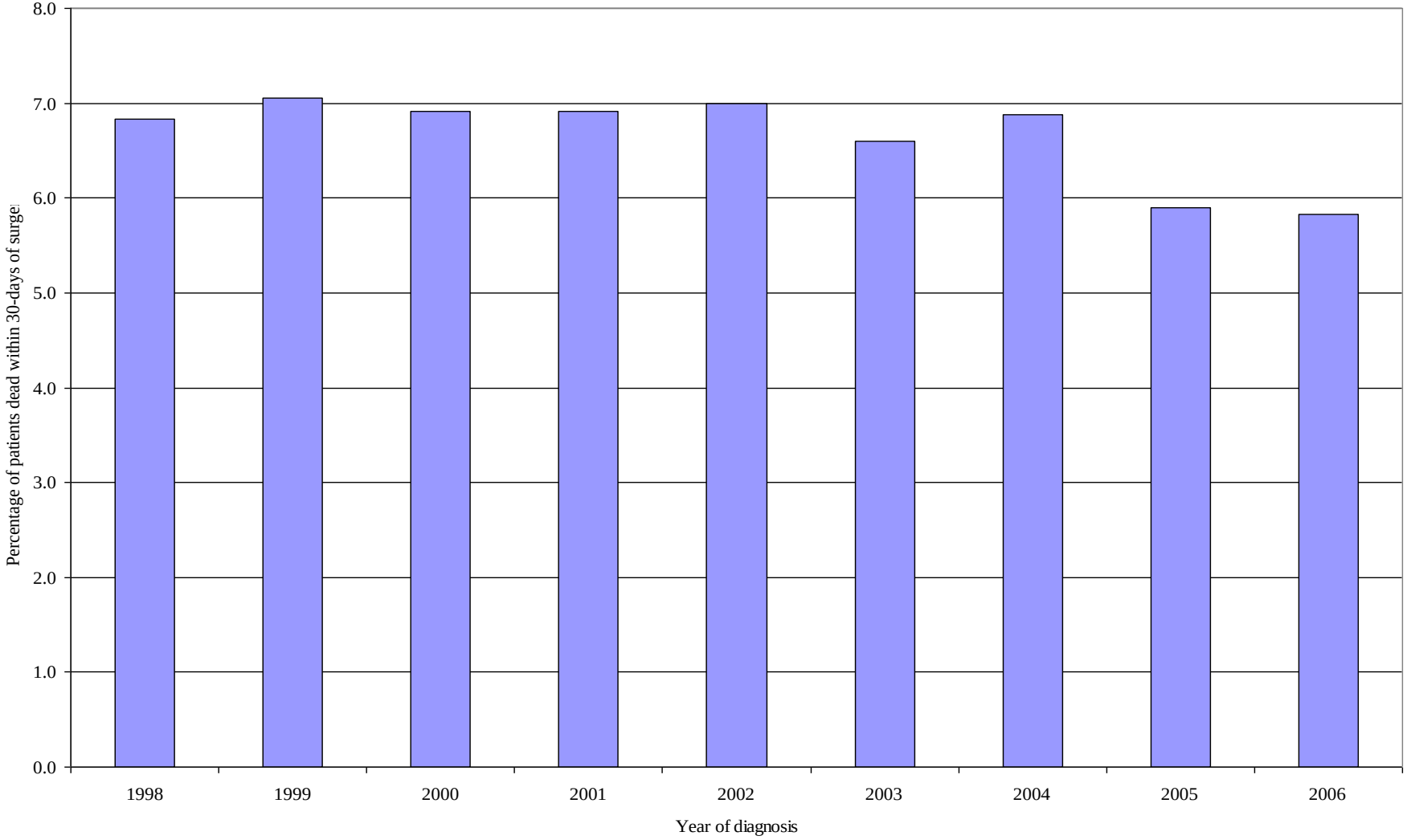
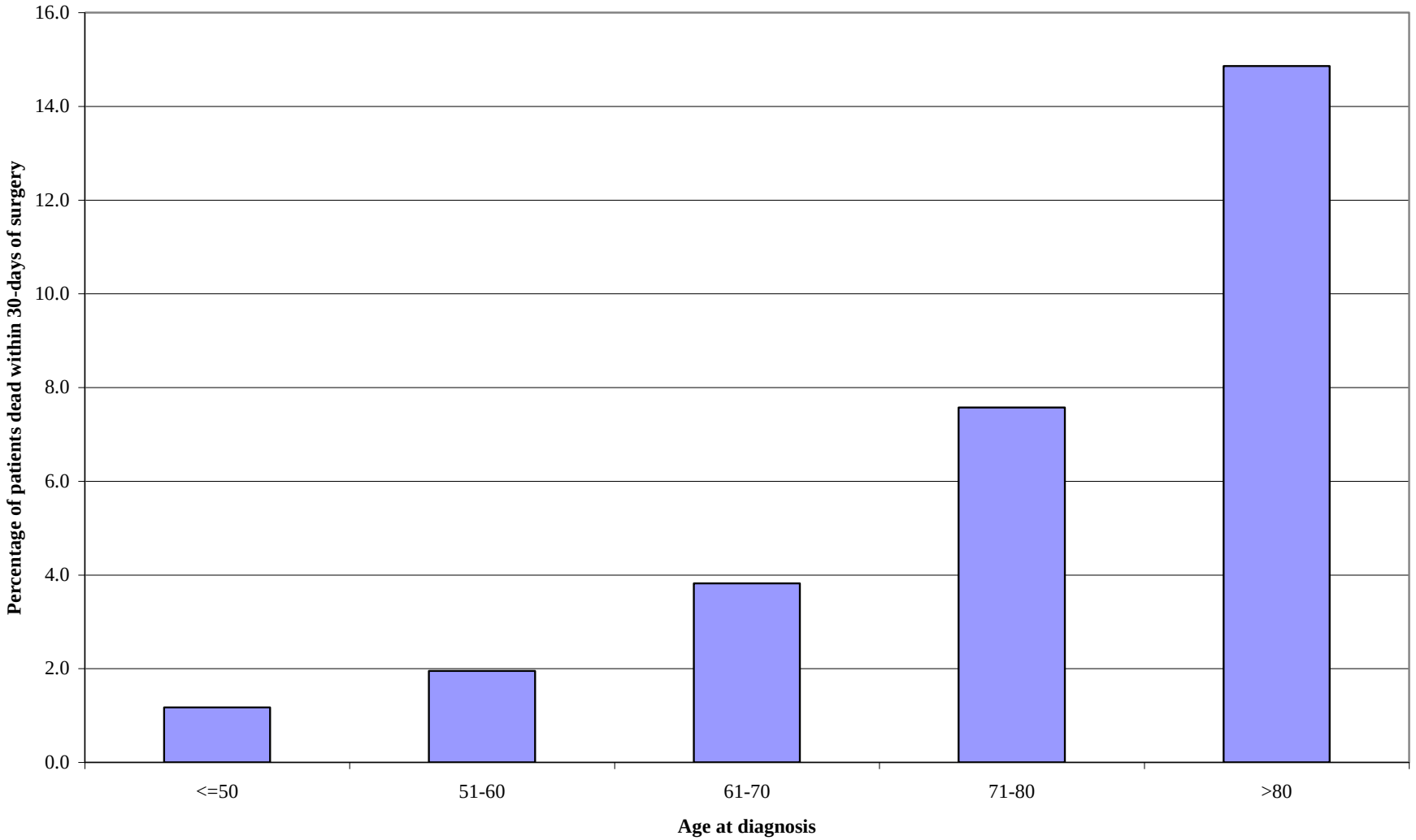
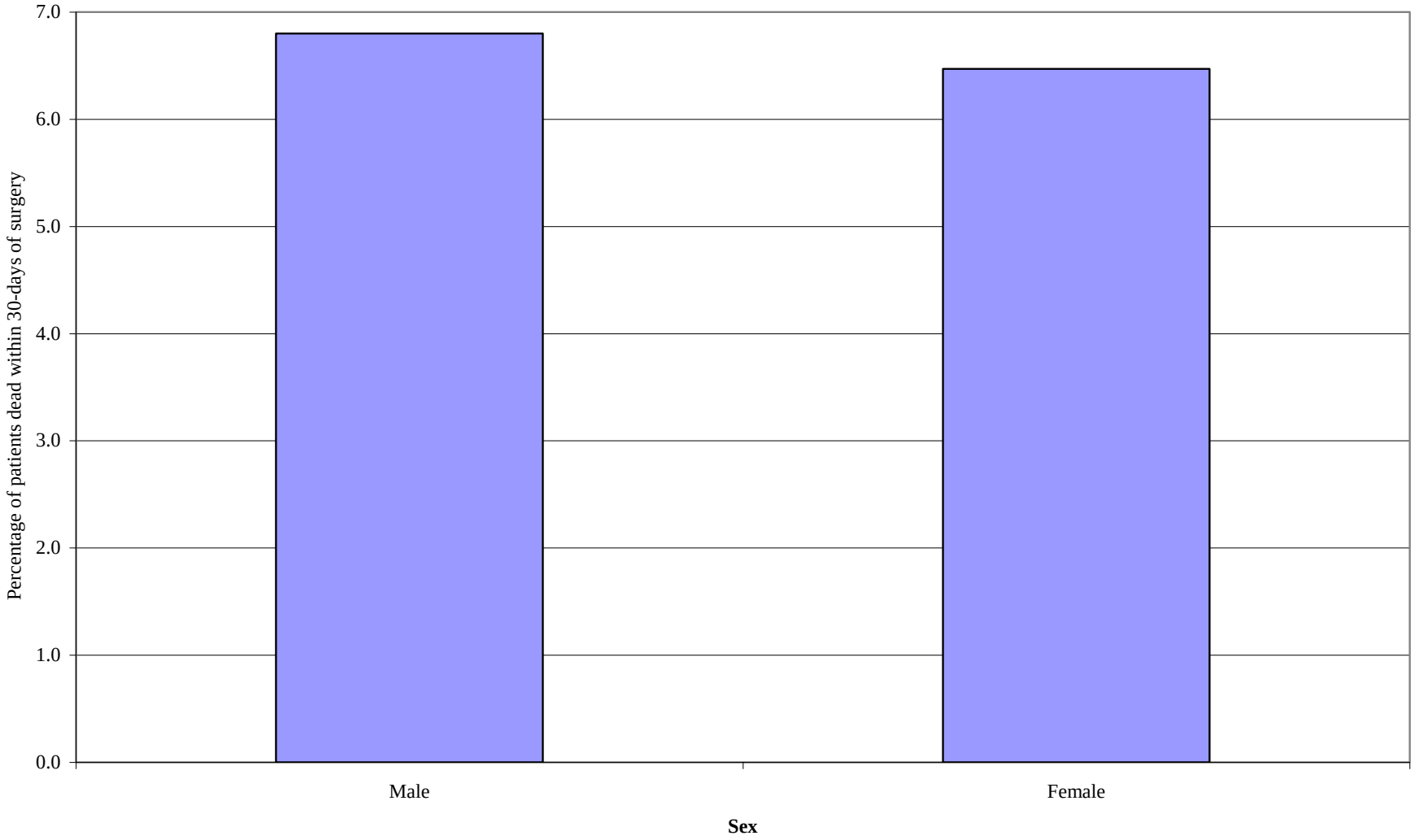
Post-operative mortality in relation to year of diagnosis



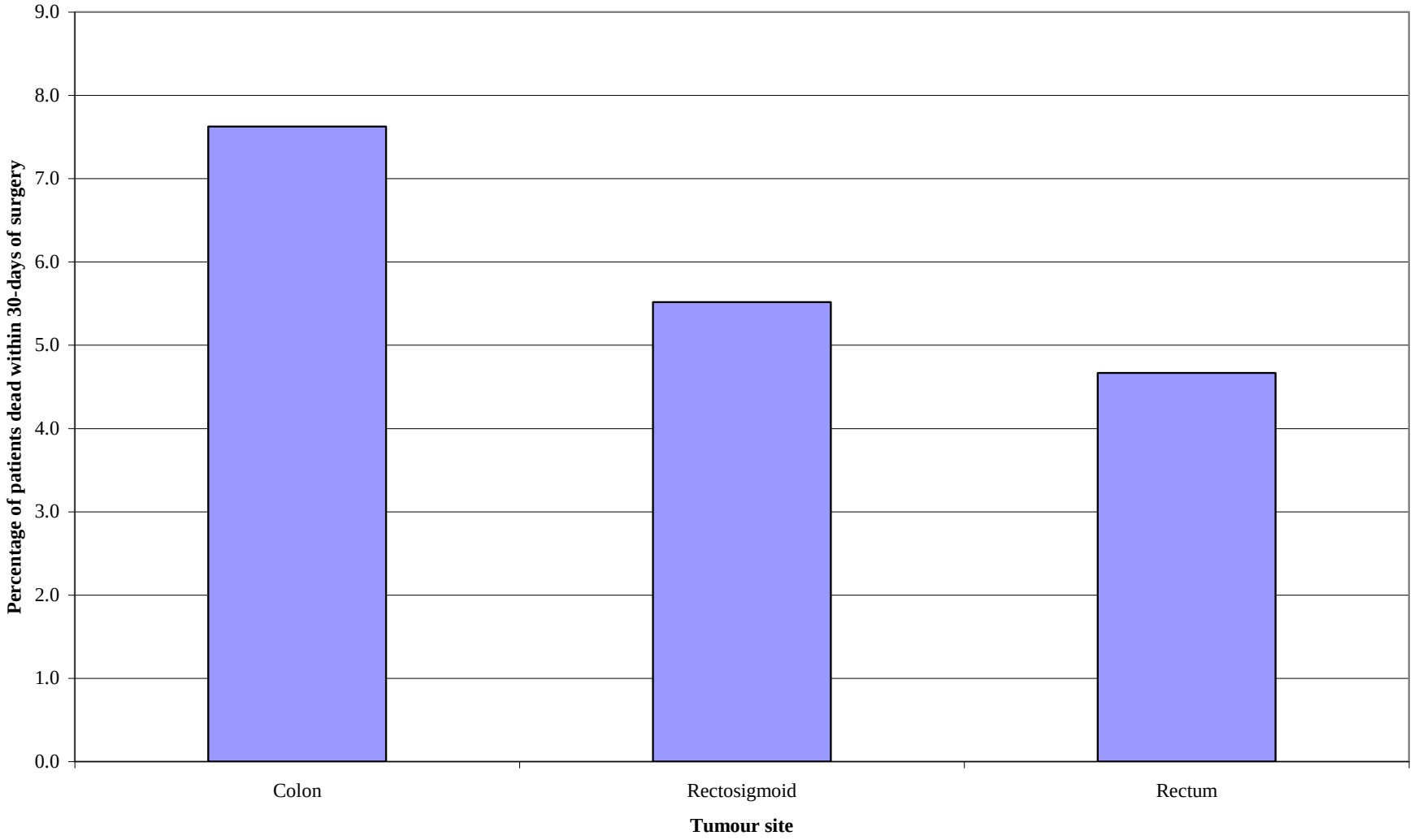
Post-operative mortality in relation to age at surgery



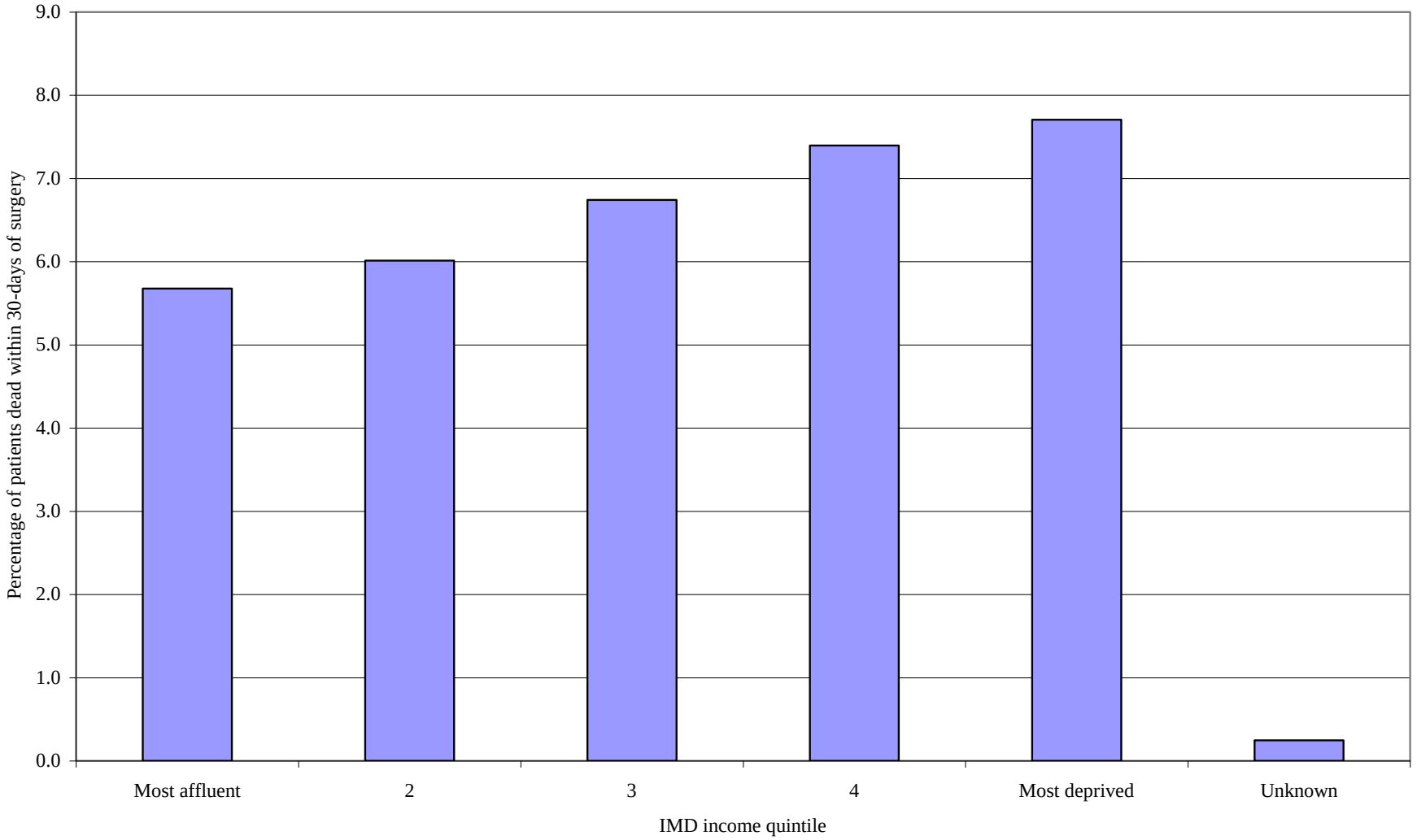
Post-operative mortality in relation to sex



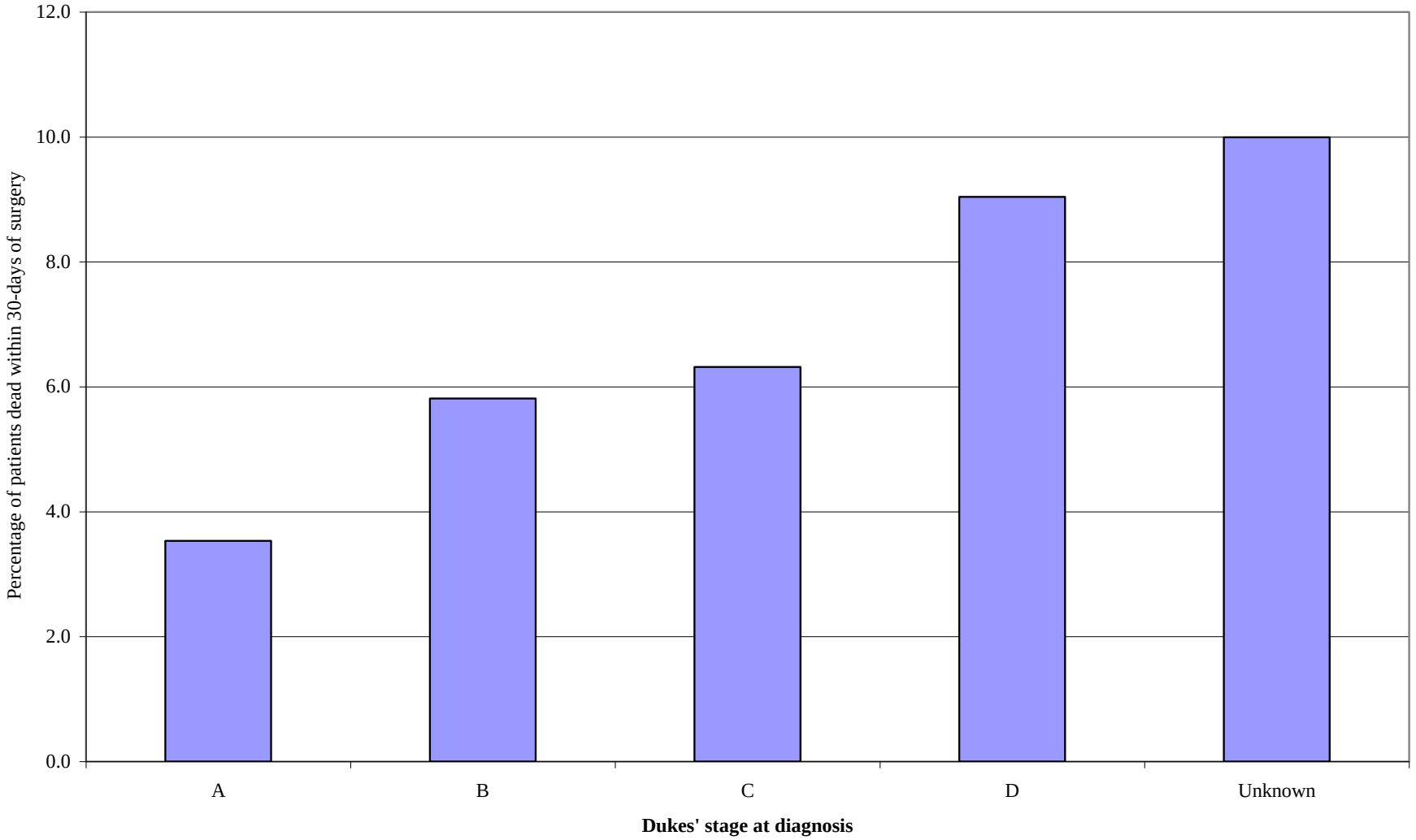
Post-operative mortality in relation to tumour site



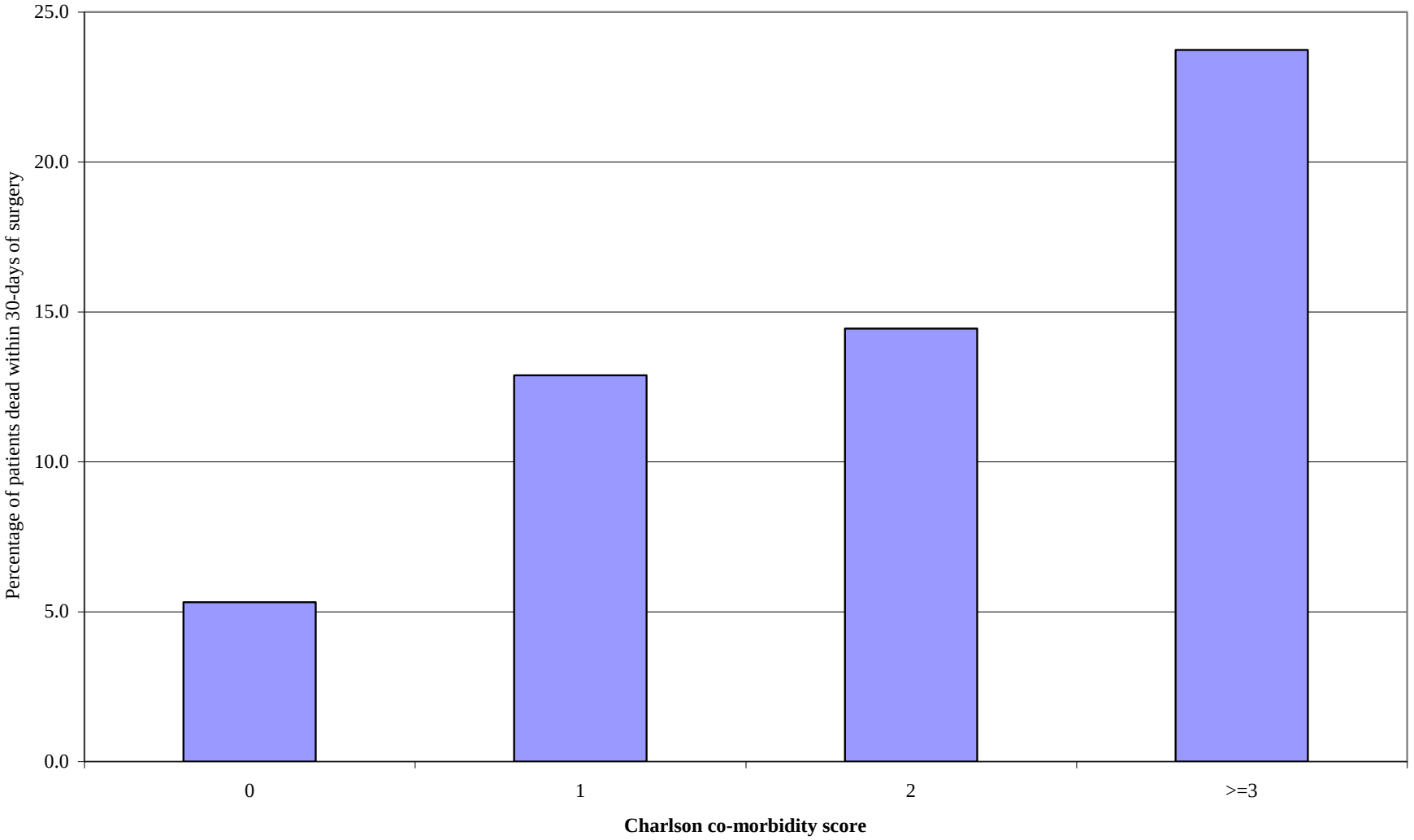
Post-operative mortality in relation to IMD income quintile



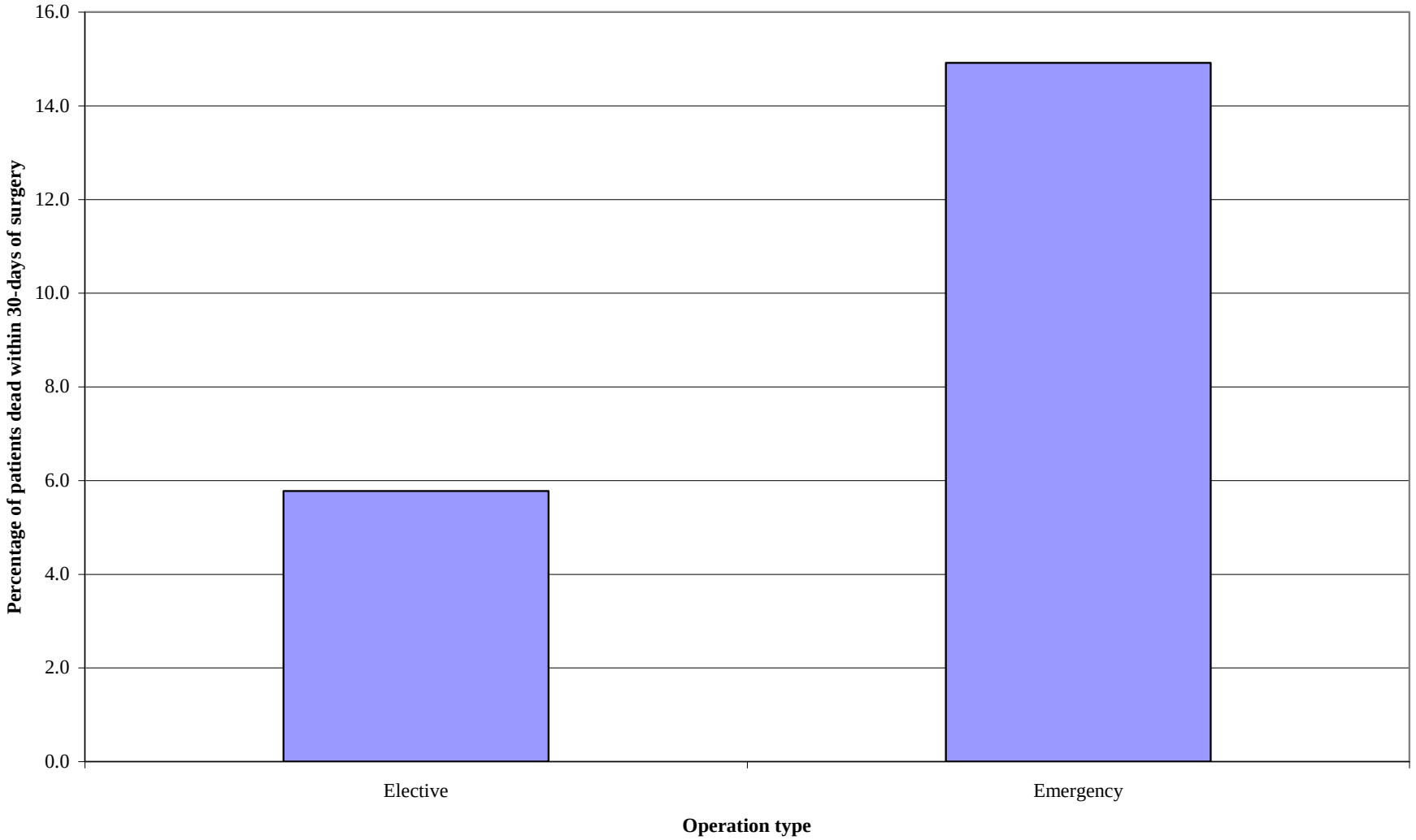
Post-operative mortality in relation to stage at diagnosis



Post-operative mortality in relation to Charlson co-morbidity score



Post-operative mortality in relation to operation type



Model

- Multi-level (random effects) binary logistic regression model
- Hierarchy of patients (level 1) clustered within Trusts (level 2) within Cancer Networks (level 3)
- Dependant variable – death within 30-days of surgery
- Explanatory variables
  - age, sex, resection type, IMD quintile, year of diagnosis, Dukes stage, Charlson score, tumour site

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Characteristic		Odds Ratio	95% CI
Year of operation (per year)		0.97	0.97 – 0.98
Age at surgery (per 10 year increase)		1.08	1.08 – 1.08
Sex	Male	1.00	
	Female	0.83	0.79 – 0.86
Dukes' stage	A	1.00	
	B	1.23	1.12 – 1.35
	C	1.54	1.40 – 1.69
	D	2.50	2.24 – 2.78
IMD income category	Most affluent	1.00	
	2	1.03	0.96 – 1.10
	3	1.11	1.04 – 1.19
	4	1.22	1.13 – 1.30
	Most deprived	1.32	1.23 – 1.42
Cancer site	Colon	1.00	
	Rectosigmoid	0.88	0.82 – 0.96
	Rectum	0.94	0.89 – 0.99
Charlson co-morbidity score	0	1.00	
	1	2.05	1.94 – 2.18
	2	2.43	2.25 – 2.62
	≥3	4.38	3.98 – 4.82
Operation type	Elective	1.00	
	Emergency	2.67	2.53 – 2.82

Funnel plots

- Created using ‘funnelcompar’ command in Stata
- Each individual’s probability of death calculated from risk-adjusted model
- Calculated the expected and observed number of deaths in each Trust
- Ratios calculated and standardised into Trust mortality rates
- Any Trusts outside the 99.8% control limits considered to be outliers

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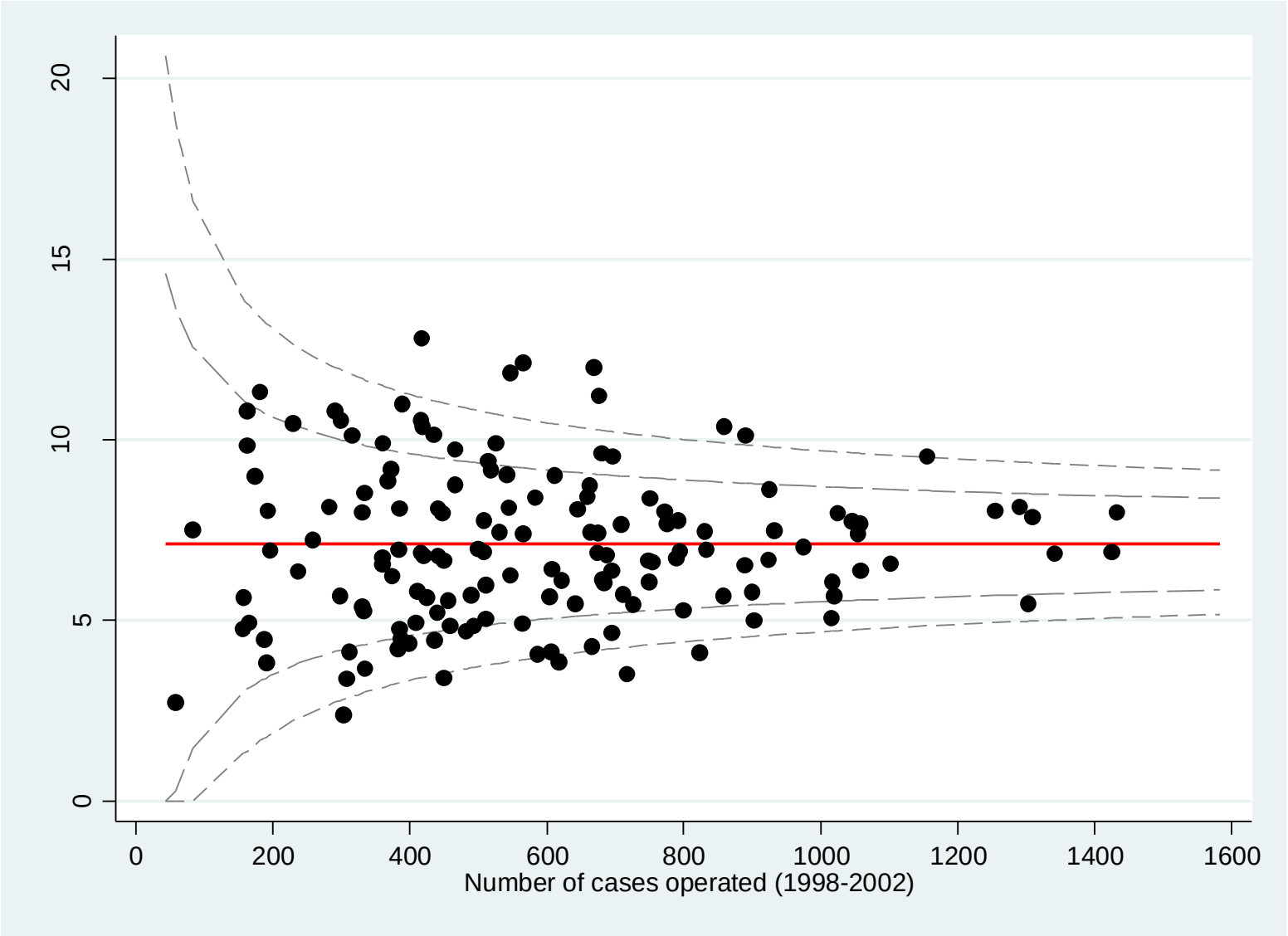
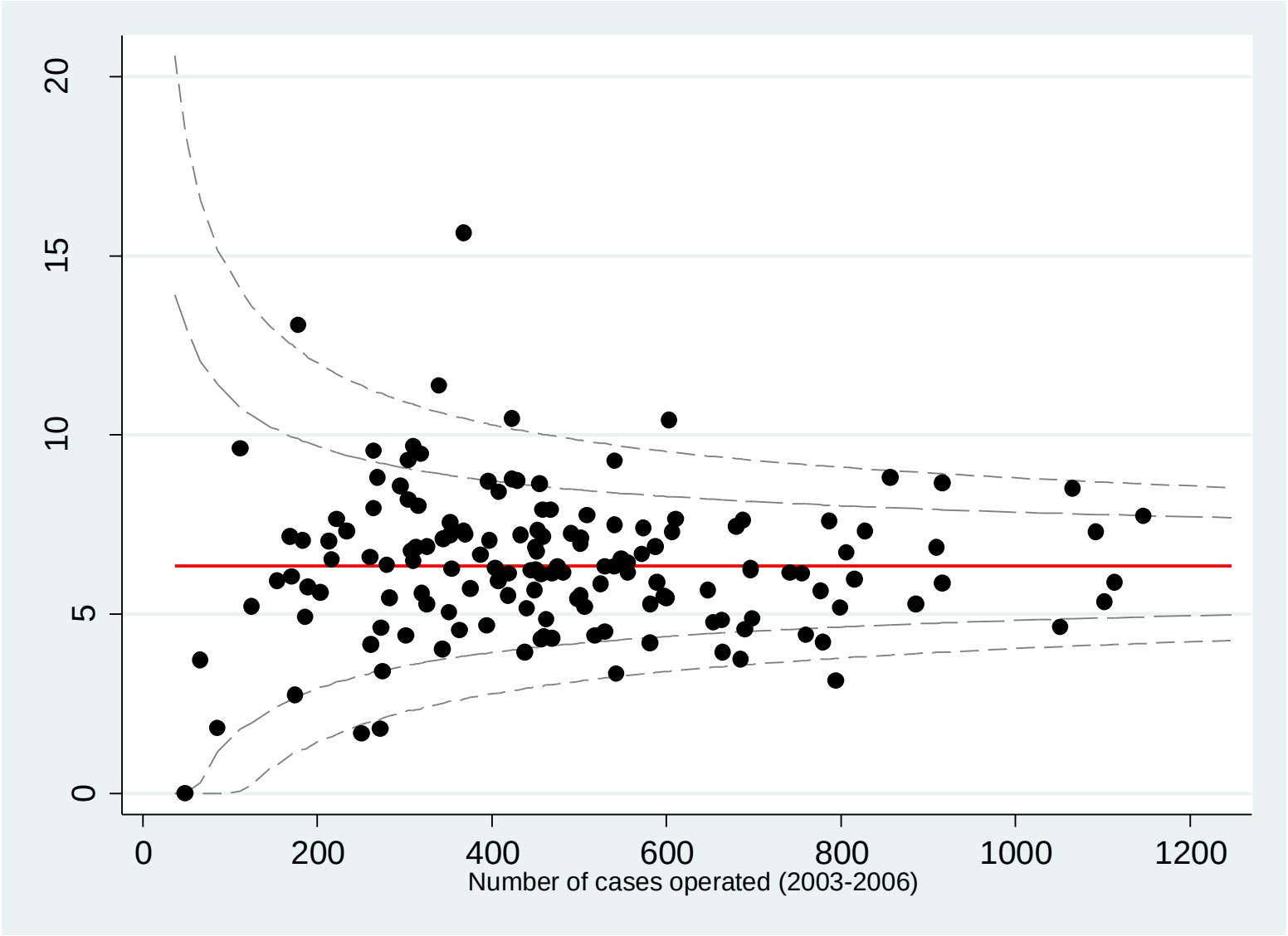
Variation in operative mortality across trusts 1998-2002



Variation in operative mortality across trusts 2003-2006



Conclusions

- Preliminary results indicate
  - Significant variation in 30-day post-operative mortality in relation to patient factors
  - Significant variation in 30-day post-operative mortality between Trusts that is independent of casemix
  - Three Trusts with significantly worse outcomes than expected and one with significantly better outcomes in both the time periods examined
- Risk-adjusted mortality control charts provide an appropriate method of determining extent of variation & statistically significant outliers
- Demonstrates value of the National Cancer Data Repository

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Dissemination

- Study based on routine data
  - CONS
    - May contain inaccuracies
    - May not contain sufficient detail to enable appropriate casemix adjustment
    - Out of date (further delay in this study due to peer review of methods)
  - PROS
    - Routine data submitted by hospitals and is the basis for Trust payments and for commissioning
    - Auditing outcomes improves care
- Demand for such information to be made public but difficult to present results alongside the caveats to the data

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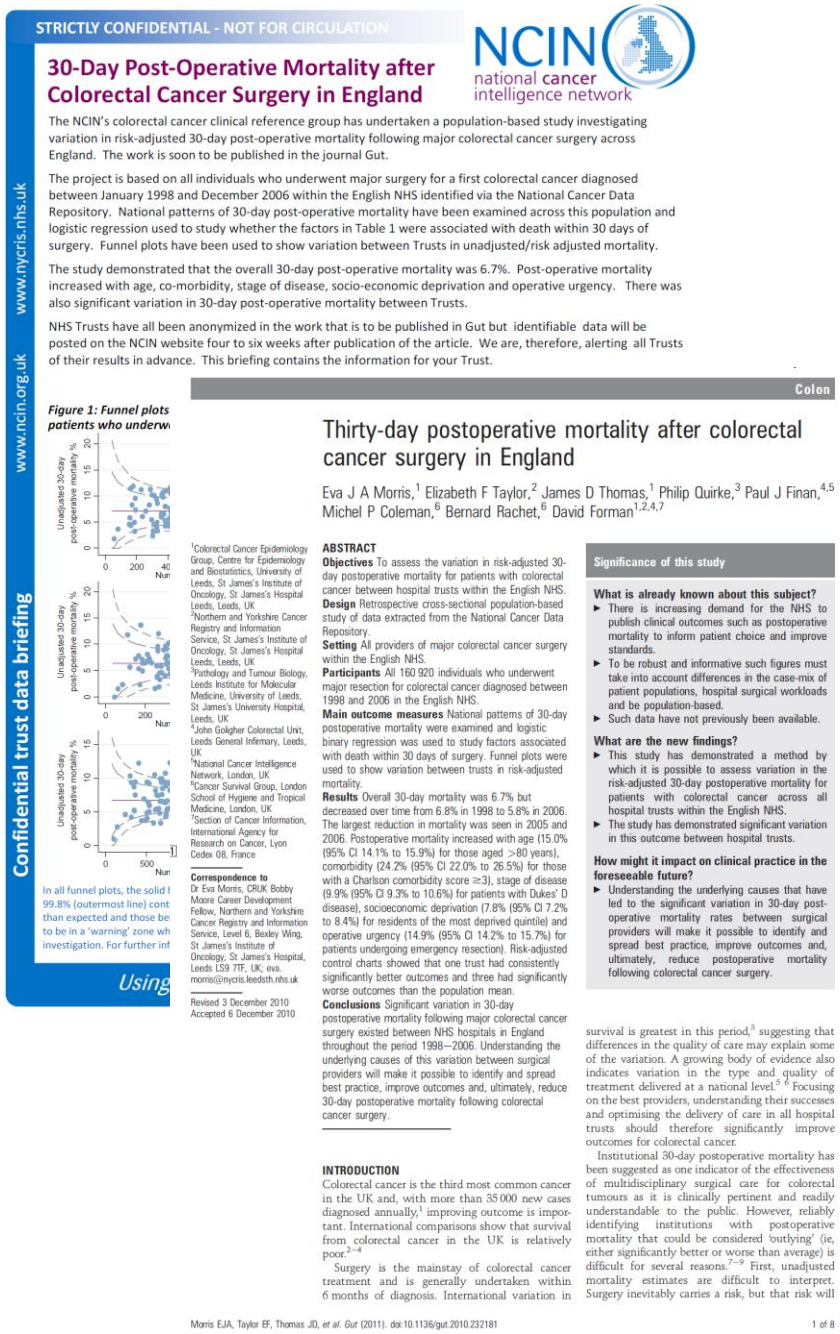

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Confidential trust data briefing

www.ncin.org.uk www.nycris.nhs.uk

30-Day Post-Operative Mortality after Colorectal Cancer Surgery in England

NCIN national cancer intelligence network

The NCIN's colorectal cancer clinical reference group has undertaken a population-based study investigating variation in risk-adjusted 30-day post-operative mortality following major colorectal cancer surgery across England. The work is soon to be published in the journal Gut.

The project is based on all individuals who underwent major surgery for a first colorectal cancer diagnosed between January 1998 and December 2006 within the English NHS identified via the National Cancer Data Repository. National patterns of 30-day post-operative mortality have been examined across this population and logistic regression used to study whether the factors in Table 1 were associated with death within 30 days of surgery. Funnel plots have been used to show variation between Trusts in unadjusted/risk adjusted mortality.

The study demonstrated that the overall 30-day post-operative mortality was 6.7%. Post-operative mortality increased with age, co-morbidity, stage of disease, socio-economic deprivation and operative urgency. There was also significant variation in 30-day post-operative mortality between Trusts.

NHS Trusts have all been anonymized in the work that is to be published in Gut but identifiable data will be posted on the NCIN website four to six weeks after publication of the article. We are, therefore, alerting all Trusts of their results in advance. This briefing contains the information for your Trust.

Figure 1: Funnel plots patients who underw

In all funnel plots, the solid l 99.8% (outermost line) cont than expected and those be to be in a 'warning' zone wh investigation. For further inf

Using

Colon

Thirty-day postoperative mortality after colorectal cancer surgery in England

Eva J A Morris,[1] Elizabeth F Taylor,[2] James D Thomas,[1] Philip Quirke,[3] Paul J Finan,[4,5] Michel P Coleman,[6] Bernard Rachet,[6] David Forman[1,2,4,7]

[1]Colorectal Cancer Epidemiology Group, Centre for Epidemiology and Biostatistics, University of Leeds, St James's Institute of Oncology, St James's Hospital Leeds, Leeds, UK
[2]Northern and Yorkshire Cancer Registry and Information Service, St James's Institute of Oncology, St James's Hospital Leeds, Leeds, UK
[3]Pathology and Tumour Biology, Leeds Institute for Molecular Medicine, University of Leeds, St James's University Hospital, Leeds, UK
[4]John Goligher Colorectal Unit, Leeds General Infirmary, Leeds, UK
[5]National Cancer Intelligence Network, London, UK
[6]Cancer Survival Group, London School of Hygiene and Tropical Medicine, London, UK
[7]Section of Cancer Information, International Agency for Research on Cancer, Lyon Cedex 08, France

Correspondence to
Dr Eva Morris, CRUK Bobby Moore Career Development Fellow, Northern and Yorkshire Cancer Registry and Information Service, Level 6, Bexley Wing, St James's Institute of Oncology, St James's Hospital, Leeds LS9 7TF, UK; eva.morris@nycris.leedsth.nhs.uk

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ABSTRACT

Objectives To assess the variation in risk-adjusted 30-day postoperative mortality for patients with colorectal cancer between hospital trusts within the English NHS.
Design Retrospective cross-sectional population-based study of data extracted from the National Cancer Data Repository.
Setting All providers of major colorectal cancer surgery within the English NHS.
Participants All 160 920 individuals who underwent major resection for colorectal cancer diagnosed between 1998 and 2006 in the English NHS.
Main outcome measures National patterns of 30-day postoperative mortality were examined and logistic binary regression was used to study factors associated with death within 30 days of surgery. Funnel plots were used to show variation between trusts in risk-adjusted mortality.
Results Overall 30-day mortality was 6.7% but decreased over time from 6.8% in 1998 to 5.8% in 2006. The largest reduction in mortality was seen in 2005 and 2006. Postoperative mortality increased with age (15.0% (95% CI 14.1% to 15.9%) for those aged >80 years), comorbidity (24.2% (95% CI 22.0% to 26.5%) for those with a Charlson comorbidity score ≥3), stage of disease (9.9% (95% CI 9.3% to 10.6%) for patients with Dukes' D disease), socioeconomic deprivation (7.8% (95% CI 7.2% to 8.4%) for residents of the most deprived quintile) and operative urgency (14.9% (95% CI 14.2% to 15.7%) for patients undergoing emergency resection). Risk-adjusted control charts showed that one trust had consistently significantly better outcomes and three had significantly worse outcomes than the population mean.
Conclusions Significant variation in 30-day postoperative mortality following major colorectal cancer surgery existed between NHS hospitals in England throughout the period 1998—2006. Understanding the underlying causes of this variation between surgical providers will make it possible to identify and spread best practice, improve outcomes and, ultimately, reduce 30-day postoperative mortality following colorectal cancer surgery.

Significance of this study

What is already known about this subject?
- There is increasing demand for the NHS to publish clinical outcomes such as postoperative mortality to inform patient choice and improve standards.
- To be robust and informative such figures must take into account differences in the case-mix of patient populations, hospital surgical workloads and be population-based.
- Such data have not previously been available.

What are the new findings?
- This study has demonstrated a method by which it is possible to assess variation in the risk-adjusted 30-day postoperative mortality for patients with colorectal cancer across all hospital trusts within the English NHS.
- The study has demonstrated significant variation in this outcome between hospital trusts.

How might it impact on clinical practice in the foreseeable future?
- Understanding the underlying causes that have led to the significant variation in 30-day post-operative mortality rates between surgical providers will make it possible to identify and spread best practice, improve outcomes and, ultimately, reduce postoperative mortality following colorectal cancer surgery.

INTRODUCTION

Colorectal cancer is the third most common cancer in the UK and, with more than 35 000 new cases diagnosed annually,[1] improving outcome is important. International comparisons show that survival from colorectal cancer in the UK is relatively poor.[2–4]

Surgery is the mainstay of colorectal cancer treatment and is generally undertaken within 6 months of diagnosis. International variation in survival is greatest in this period,[3] suggesting that differences in the quality of care may explain some of the variation. A growing body of evidence also indicates variation in the type and quality of treatment delivered at a national level.[5 6] Focusing on the best providers, understanding their successes and optimising the delivery of care in all hospital trusts should therefore significantly improve outcomes for colorectal cancer.

Institutional 30-day postoperative mortality has been suggested as one indicator of the effectiveness of multidisciplinary surgical care for colorectal tumours as it is clinically pertinent and readily understandable to the public. However, reliably identifying institutions with postoperative mortality that could be considered 'outlying' (ie, either significantly better or worse than average) is difficult for several reasons.[7–9] First, unadjusted mortality estimates are difficult to interpret. Surgery inevitably carries a risk, but that risk will

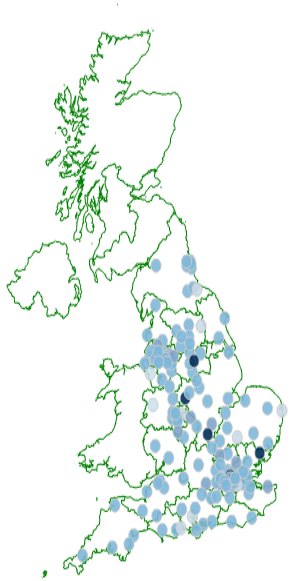
- Trust and Network briefings prepared for all in England
- Trusts, Cancer Networks, Cancer Registries, Regional Directors of Public Health and Medical Directors of Strategic Health Authorities notified of results relevant to them in January 2011
- Paper and identifiable results published April 2011

30-day post operative mortality following major colorectal surgery

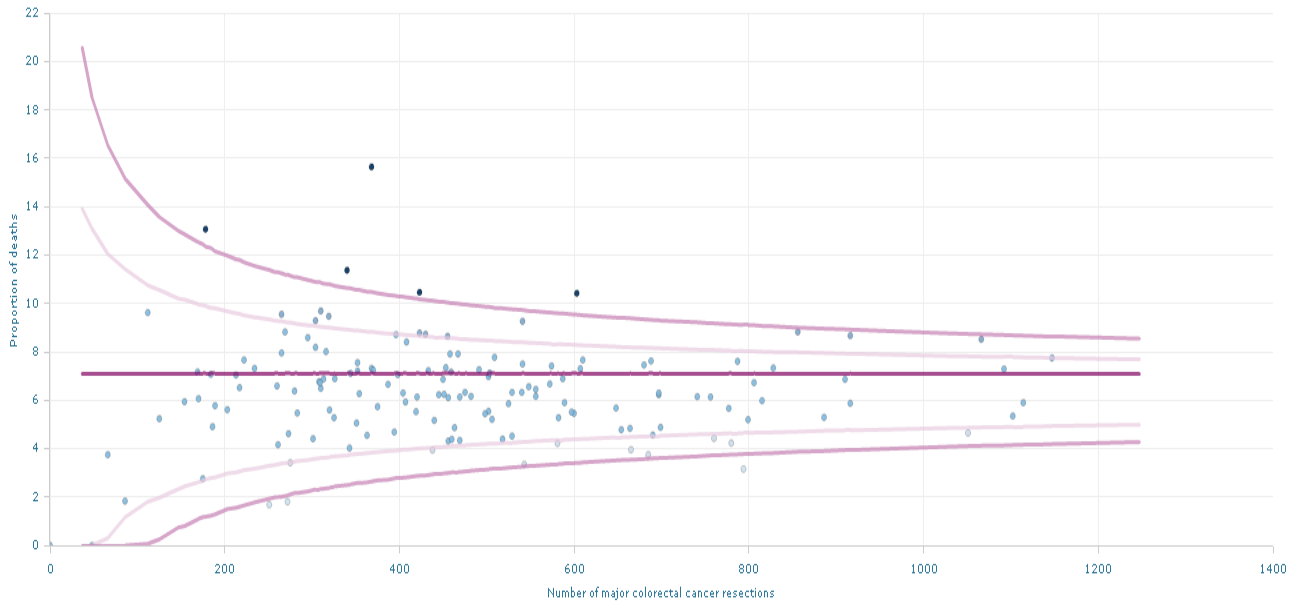
30-day post-operative mortality by trust >> Risk adjusted 30-day post-operative mortality >> 2003-2006

Networks/Trusts | Data | Print | Show/Hide Location List | Help | Save

Map



Funnel Plot



Overall 1998-2006 | 1998-2002 | 2003-2006

Legend

- 30-day post-operative mortality by trust
- Very Low
- Low
- Normal
- High
- Very High

Background

This eAtlas contains de-anonymised results for a study examining 30-day post-operative mortality after colorectal cancer surgery in England. This chart has been adjusted for patient case mix factors. Full details about the methods used to generate these data are available in the journal article Morris EJA, Taylor EF, Thomas JD et al, Thirty-day post-operative mortality after colorectal cancer surgery in England. Gut; 2011: online early doi 10.1136/gut.2010.232181

In the funnel plot the solid horizontal line represents the national 30-day post-operative mortality rate for England. The other lines are the 95% (_____) and 99.8% (_____) control limits. Organisations that lie above the upper control limits have significantly worse 30-day post-operative mortality rates than expected and those below the lower control limits significantly better. Trusts lying outside the 95% control limits can be considered to be in the 'warning' zone whilst those outside the upper 99.8% control limits are in the 'alarm' zone. Such differences may warrant further investigation. For further information on interpreting funnel plots see SpeigelhalterDJ, Funnel plots for comparing institutional performance. Stats Med 2005; 24:1185-1202

Clinical outcomes for 2011/12

- 30-day post-operative mortality (updated to include data to 2008)
- Use of laparoscopic surgery
- Surgical patterns (Major/local excisions, bypass)
- Permanent stomas
- Resection of liver/lung metastases
- Use of stents
- Management of anal cancer
- Use of radiotherapy in rectal cancer
- Length of post-operative stay
- Returns to surgery/readmission to hospital within 30 days of initial operation
- Management of polyp cancers

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Feedback from Trusts/Networks

- How should this information be fed back ?
- Are the data robust and accurate? Are there local datasets we can check against?
- What outcomes would be most useful to examine?
- What can we do to ensure our data are used in a clinically useful manner?

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