

The impact of the Marie Curie Nursing Service on place of death and hospital use at the end of life

Research report

Xavier Chitnis, Theo Georgiou, Adam Steventon and Martin Bardsley

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More than half of all deaths in England and Wales occur in hospital, even though most people would prefer to die at home. The use of hospital and other care services rises rapidly in the last few weeks of life. End-of-life care has the potential to improve quality of life, reduce the need for expensive and often unwanted emergency hospital care, and help more people to die in a place of their choosing. The Marie Curie Nursing Service (MCNS) provides home-based end-of-life care to around 28,000 people at the end of life in the UK every year.

Here we report on the impact of the MCNS on place of death and hospital use at the end of life. We have compared a large cohort of people who received MCNS care to a group of controls, retrospectively selected from the population of England, who died between 2009 and 2011. The evaluation focused on whether MCNS care allowed more people to die at home, and whether it reduced the use and costs of hospital care at the end of life.

The number of deaths in England is forecast to rise significantly over the next 20 years. This, combined with increasing recognition of the importance of improving care at the end of life, means that there is an urgent need to identify models of care that reduce demand for expensive hospital treatment and allow people to die in a place of their choice. Together with studies of the impact of home-based end-of-life care on quality of life, the findings of this evaluation should be of value to those planning end-of-life care services.

Key Points

- Home-based palliative care has the potential to improve care at the end of life by reducing the demand for costly and often undesirable hospital care, and allowing more people to die at home.
- We investigated place of death and the level of hospital care at the end of life for a cohort of people who received care from the Marie Curie Nursing Service (MCNS). These were matched using a range of demographic and clinical characteristics to a group of controls retrospectively selected from the population of England, who died between 2009 and 2011.
- 76.7% of those who received MCNS care died at home, while only 7.7% died in hospital. In contrast, 35.0% of the controls died at home, while 41.6% died in hospital.
- People who received MCNS care were less likely to use all forms of hospital care than controls. 11.7% of MCNS patients had an emergency admission at the end of life, compared to 35% of controls; while 7.9% of MCNS patients had an A&E attendance, compared to 28.7% of controls. Across most types of care, MCNS patients used between a third and half of the level of hospital care of controls.
- We found significant differences in the costs of both planned and unplanned hospital care between MCNS patients and controls. Total hospital costs for MCNS patients were £1,140 per person less than for controls from the first contact with MCNS until death. However, this figure should be considered alongside other costs, including the cost of the MCNS itself and possible impacts on other services.
- Our approach allowed us to look at sub-groups of patients. We found that the impact of MCNS care in terms of people dying at home and use of hospital care was greater for people without a history of cancer. There was also a significantly greater reduction in overall crude hospital costs among MCNS patients with no history of cancer (£1,475), compared to those with cancer (£1,044).
- Although these results show a significant impact of MCNS care on activity at the end of life, it is possible that unobserved systematic differences existed between MCNS patients and matched controls. For example, MCNS patients may have been more amenable to care at home than the controls for some reason not recorded in administrative datasets.
- These results provide evidence that home-based nursing care can reduce hospital use at the end of life, and help more people to die at home. With an increasingly tight financial climate and a rising number of deaths among the very elderly, our findings provide evidence of the potential benefits of home-based nursing care, and support the case for increasing investment in such services so as to improve care for people at the end of life.

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1. Introduction

A number of studies have shown that use of hospital and social care increases towards the end of life (Bardsley and others, 2010; Maddams and others, 2011; Pot and others, 2009; Rosenwax and others, 2011; Van den Block and others, 2007). A significant number of people have an unplanned hospital admission in the last few weeks of life and, as a consequence, there is a substantial rise in the cost of health care as death approaches (Bardsley and others, 2010).

Surveys consistently suggest that the majority of people would prefer to die or be cared for at the end of life at home (Gomes and others, 2010; 2012b; Higginson, 2003). However, in England and Wales, 54% of people died in hospital in 2010, with only 21% of deaths taking place at home (Office for National Statistics, 2011a). Although the proportion of home deaths rose from 2004 to 2010, with the increase particularly seen in people with cancer (Gomes and others, 2012a), the proportion of people who die at home in England and Wales has been found to be significantly lower than in some other developed countries (Cohen and others, 2008; 2010; World Health Organization, 2004).

Due to the ageing population, it is predicted that the annual number of deaths will increase by 17% between 2012 and 2030, with a growing proportion of deaths being among the very elderly (Gomes and Higginson, 2008). With a sustained period of flat or falling health care expenditure seemingly likely, the growth in inpatient hospital care that would be required to cope with the rising number of deaths (based on current patterns of where people die) would seem implausible. This highlights the growing need for effective home or community-based end-of-life care services.

Palliative care at the end of life aims to prevent and alleviate the symptoms of illness for people when curative treatment is no longer possible. Care should also address the wider psychological, social and practical needs of people as they approach death (National Institute for Health and Clinical Excellence, 2011). Such care can be delivered in institutional settings such as hospitals and hospices, via community services, or at home. Various models of home-based end-of-life care exist, ranging from those that primarily offer nursing and personal care, to others that involve multidisciplinary specialist teams. In theory, home or community-based end-of-life care should result both in more people being able to die at home, and in reduced demand for unplanned hospital care.

The National Audit Office (NAO) review of end-of-life care (National Audit Office, 2008) concluded that palliative care had a number of benefits: reducing symptoms, improving quality of life and reducing costs through fewer hospital admissions. They found that the evidence was stronger for people with cancer, although there was also evidence of some benefits for people with heart failure (Lorenz and others, 2008). The NAO report also modelled possible cost savings associated with reduced hospital use due to palliative care. They estimated that the annual cost of end-of-life care for people with cancer was around £1.8 billion. They concluded that a shift to palliative care resulting in 20% fewer emergency admissions and five fewer bed-days per person would save £171 million per year. For people with organ failure, they estimated the total cost for people in the last year of life to be £553 million. Similar reductions in emergency admissions and bed-days would see this figure fall by around £112 million.

A recent review of palliative care funding in England (Hughes-Hallett and others, 2011) identified huge variation in the amount primary care trusts (PCTs) spend on palliative care services. The review estimated that around 75% of those who die each year could benefit from palliative care, and that there are likely to be around 90,000 people annually who would benefit from palliative care but do not receive it. It also calculated that the introduction of a properly funded palliative care system would lead to 60,000 fewer in-hospital deaths and a reduction in hospital costs of £180 million annually by 2021.

However, it is important to recognise that the potential benefits of palliative and end-of-life care may be more than purely economic. Hospitals are widely recognised to be an inappropriate place for many people to die; it has been suggested that around a third of people who die in hospital might have been able to die at home (Abel and others, 2009). A recent survey of families of people who died (Office for National Statistics, 2011b) found that 54% of respondents whose relative died at home rated the quality of care in the last three months of life as outstanding or excellent; compared to a third of those whose relative died in hospital. The survey results also showed that relatives of those who died at home rated coordination of hospital, GP and community services more highly than relatives of those who died in hospital did. They were also much more likely to say that the deceased person was treated with dignity and respect in the last few days of life. These findings are consistent with the conclusions of studies that have suggested that quality of life and satisfaction with care are higher among people who receive palliative care services (Lorenz and others, 2008; National Audit Office, 2008).

There is also evidence from several countries that palliative and end-of-life home care is associated with a higher probability of dying at home, or at least not dying in hospital (Shepperd and others, 2011). A large study in Canada (Barbera and others, 2010) found that people with cancer who received palliative home care in the six months before death had a much lower chance of dying in hospital. An American randomised trial found that, compared to people receiving usual care, those with a terminal illness who received palliative home care provided by a multidisciplinary team were much more likely to die at home; were more satisfied with their quality of care; were less likely to visit the emergency department or have a hospital admission; and had lower costs (Brumley and others, 2007). Recent studies in Spain also found that people with access to palliative home care were more likely to die at home and less likely to require emergency hospital care (Alonso-Babarro and others, 2011; 2012). A large-scale review identified several factors associated with home death, including the degree of social support, and the availability and intensity of use of home care (Gomes and Higginson, 2006).

Consistent with the analyses carried out by the NAO, studies have also found evidence that palliative care can reduce health care use and costs at the end of life. A small Spanish study of 155 people with cancer reported that the direct health care costs of those who received specialist palliative home care were very significantly lower than those who did not (Serra-Prat and others, 2001). A small American randomised controlled trial (RCT) of patients with metastatic lung cancer found that those who received outpatient palliative care services had better quality of life and fewer symptoms of depression, and survived around two months longer than those who received standard care (Temel and others, 2010). The study also found that those who received palliative care were less likely to receive aggressive treatment towards the end of life, which is likely to be reflected in lower hospital costs. An Italian study found that people with cancer who received palliative home care spent significantly less time in hospital than a control group did (Costantini and others, 2003). Similarly, an Israeli study

reported very significantly lower hospital use and costs among people with terminal cancer who received home-based specialist palliative care, compared to a group without access to such services (Tamir and others, 2007). Lastly, a large palliative care programme in Catalonia, Spain, has reported higher levels of patient and carer satisfaction, and significant cost savings (around £1,800 per person) following the introduction of inpatient, outpatient and home-based palliative care services (Gómez-Batiste and others, 2012).

The vast majority of the literature on palliative and end-of-life care has focused on people with cancer (Lorenz and others, 2008). This means that there is a relative dearth of knowledge about what might be the most suitable and effective end-of-life services for people with non-cancer terminal conditions. One of the relatively few studies to look specifically at non-cancer patients found significant reductions in direct and indirect costs over three months among people with multiple sclerosis who received multi-professional palliative care, compared to those who did not (Higginson and others, 2009). Overall, around 17% of people who receive specialist palliative care have conditions other than cancer, although only 10% of those who receive home-based palliative care have non-cancer conditions (National Council for Palliative Care, 2012). In a recent survey of the bereaved (Office for National Statistics, 2011b), relatives of those with non-cancer conditions who used hospice care were much more likely to rate it as poor than those whose relatives had cancer. They were also less likely to feel that their relative had received very good pain relief. This points to an urgent need for better information on the end-of-life care needs of people with conditions other than cancer.

Marie Curie Nursing Service

Marie Curie Cancer Care (MCCC) employs more than 2,700 nurses, doctors and other health and social care professionals in its nine hospices and the Marie Curie Nursing Service (MCNS). The MCNS was introduced in 1958 to provide nursing care and support to people in their own home. The MCNS is staffed by registered nurses and senior healthcare assistants who provide home-based care to around 28,000 people at the end of life annually in the UK. Although it initially focused on caring for people with cancer, it has increasingly provided care to people with other conditions. The MCNS offers a number of different models of care:

- Planned – eight or nine-hour shifts of usually overnight nursing care, booked in advance.
 - Reactive – similar to planned care, but available at short notice.
 - Multi-visit – shorter episodes of care, usually with multiple visits per nursing shift.
 - Rapid response – urgent support in response to crises occurring ‘out of hours’.
- May involve either home visits or telephone support.

There have been a few studies of the MCNS. A 2004 review (Taylor and Carter, 2004) suggested the care offered by the MCNS was likely to be cost-effective, with potentially £2 saved for every £1 spent on such services. However, this was based on estimated costs rather than being an empirical study of the actual impact of MCNS care. Another study looked at the place of death of over 26,000 people who received MCNS care (Higginson and Wilkinson, 2002). It found that 94% of people were able to die at home, with increasing likelihood of home death associated with a shorter time from referral to death. However, place of death was only recorded for around half of the cohort. The authors attempted to establish place of death for a sample of 105 cases for whom it was

missing; these cases had a much lower rate of home deaths, suggesting the initial figure was an over-estimate.

The Nuffield Trust was commissioned by MCCC to carry out an evaluation of the impact of the MCNS on patient outcomes and hospital usage.¹ Key questions were:

1. Are people who receive MCNS care more likely to die at home?
2. Does the MCNS reduce unplanned hospital use at the end of life?

As a secondary aim, we also wanted to investigate whether the impact (if any) of MCNS care varied as a function of factors such as having a history of cancer, the number of long-term conditions, and the type of service received.

There are various ways of approaching these questions. One approach would have been to develop a prospective randomised trial that allocated people either to receive MCNS care, or usual care. Although the gold standard approach, randomised trials are complex and often require new data collections. Instead, we carried out a retrospective analysis of service use by people who received MCNS care, compared to a matched control group selected from among other people who died. This approach has a number of advantages, such as being able to use existing administrative datasets, and being a relatively inexpensive method that can be applied quickly to large samples.

About Marie Curie Cancer Care

Marie Curie Cancer Care gives people with all terminal illnesses the choice to be looked after in their preferred place of care at the end of life. The charity's nursing service provides high-quality end-of-life care to make it possible for people to spend their last days at home rather than in hospital.

The Marie Curie Nursing Service provides hands-on care and emotional support for people in their own homes, day and night. The nursing service also provides discharge support to get people home from hospital, integrated health and social care so that patients can be cared for at home, and urgent care to help manage patients' symptoms at home and prevent unnecessary hospital admissions.

The charity has nine Marie Curie Hospices providing specialist care and support for people with terminal illnesses and their families. Each hospice offers inpatient and outpatient care, as well as day services to promote people's quality of life. Additionally, most Marie Curie Hospices offer a variety of community based services.

¹ This evaluation was focused only on care provided by the MCNS. Therefore, references in the report to Marie Curie care or Marie Curie patients relate only to the MCNS, rather than to care provided by Marie Curie hospices.

2. Methods

2.1 General approach

The aim of this study was to evaluate the impact of MCNS care by selecting a group of matched controls from among the population of England, whose place of death and use of hospital care and costs could be compared to people who received care from the MCNS. The evaluation used pseudonymised datasets: we received confirmation from the Ethics and Confidentiality Committee of the National Information Governance Board (NIGB) that individual consent was not required from participants for us to use pseudonymous data.

2.2 Datasets

a) Marie Curie Nursing Service activity dataset

MCCC provided the Nuffield Trust with a dataset consisting of all booked visits for people who received MCNS care from January 2009 to November 2011. No person-identifiable information was included in this dataset; Lower Super Output Area (LSOA) was provided instead of the postcode, and year of birth was supplied rather than the full date. For each visit the dataset also included the type of staff member, the type of service (for example, planned, rapid response or multi-visit), and the duration of the visit. This dataset used the same set of study IDs that were provided to the NHS Information Centre for the purposes of obtaining pseudonymised hospital activity data (see below).

b) Hospital Episode Statistics

Our analyses made use of inpatient, outpatient and A&E Hospital Episode Statistics (HES) datasets which cover all NHS-funded secondary care in England.

c) Office for National Statistics mortality data

For this project we needed the date and place of death for all those who received MCNS care and the controls. This was obtained from the Office for National Statistics (ONS)-HES linked mortality record, which contains death information for every individual who has had a hospital contact in England since 2000. The Nuffield Trust holds approved researcher status with the ONS, and received approval to use HES-linked mortality data in this project.

2.3 Data linkage

MCCC supplied a dataset of personal demographic information to the Trusted Data Linkage Service (TDLS) at the NHS Information Centre for health and social care (IC). This dataset consisted of a study ID generated by MCCC and the name, sex, date of birth, NHS Number (where available), and postcode for all those who were in contact with the MCNS between January 2009 and November 2011. The IC used these data to attempt to trace NHS Numbers for the entire cohort via the Personal Demographics Service (PDS). Once the NHS Number tracing was complete, the IC linked the NHS Numbers to the identifiers used in the HES datasets. The IC then provided the Nuffield Trust with a pseudonymous mapping from study ID to HES ID for each participant (where an NHS Number and HES ID could be found). This method preserved

participants' anonymity by ensuring that the Nuffield Trust did not have access to information that would allow individuals to be identified.

2.4 Selection of Marie Curie patients and controls

a) Marie Curie patients (cases)

The MCNS cohort consisted of all those who received MCNS care between January 2009 and November 2011. After data linkage, a series of cleaning steps were applied to the dataset, for example to remove those who did not have a mortality record. Only people who lived in England were included as HES only covers care provided in English hospitals. Further details of the process used to create the final study cohort are provided in section 3.1.

b) Matched controls

Controls were drawn from all those who died in England between January 2009 and November 2011 (as recorded in the ONS-HES linked mortality file). A number of exclusions were applied to the pool of possible controls before matching took place. These included removing anyone aged under 18, anyone with an external cause of death (National End of Life Care Intelligence Network, 2011), and anyone who died in a care home. These exclusions were intended to identify people who were likely to be unsuitable controls. Table 3.4 in section 3 summarises the steps that were applied to create the pool of potential controls.

Ideally, the matched controls would have had the characteristics that were used to identify cases as being eligible for MCNS care. These would include being at the end of life and considered suitable for care at home. However, these criteria do not map naturally onto variables that are recorded in HES, so instead we used proxies. We matched cases and controls individually on a range of demographic, diagnostics and prior hospital use variables.

The matching worked through each case in turn and involved two stages. Initially, a series of exact matching criteria were applied to the pool of potential controls in order to reduce the number of possible matches. These criteria were that controls must have died within 90 days of the case (to avoid possible confounding effects of service changes over time), be the same sex, and be matched on overall history of cancer (in that a case with cancer recorded in the preceding three years could only be matched to a control who also had a history of cancer in the preceding three years).

Our primary outcome measures included hospital use and hospital costs following the first visit by the MCNS (section 2.6). For each MCNS patient the first visit date was thus taken as our study index date. For each possible control it was necessary to calculate an equivalent index date. We did this such that the number of days between the index date and the date of death was the same for a case and for their possible controls (for example, if the case had their first visit 14 days before death, the index date for the matched control was 14 days before their death). The process for establishing the index date for each matched control is illustrated in Figure 2.1 on page 13.

By definition, cases could not be in hospital on the day that they first received MCNS care. Were controls to be selected who were in hospital on the index date, it would have significantly skewed the result. For example, controls that were already in hospital would

have to be discharged before they could be admitted again. This would reduce the number of admissions seen in the control group post-index date. Conversely, controls in hospital on the index date would already be incurring hospital costs. This again would have skewed any analysis of post-index date hospital costs. Therefore, the matching ensured that a control could only be selected if they were not in the middle of a hospital spell on the index date for the matched case. A control could be selected if they were admitted or discharged on the index date.

Once the pool of possible controls for each case had been reduced by these criteria, we selected the control who was most similar to the case across a number of variables, using the multidimensional distance measure known as the Mahalanobis metric (Mahalanobis, 1936). The variables included in the Mahalanobis matching were:

- age
- area-level socioeconomic deprivation score (IMD (Index of Multiple Deprivation) 2010 score for the LSOA of the postcode)
- number of emergency admissions in the month/year before the index date
- number of elective admissions in the month/year before the index date
- number of outpatient attendances in the month/year before the index date
- number of A&E attendances in the month/year before the index date
- number of chronic conditions¹
- history of six cancer types (lung, upper and lower GI (gastrointestinal), sarcoma, CUP (cancer of unknown primary origin), brain and CNS (central nervous system))²
- number of different cancers/conditions associated with ageing.³

The diagnostic variables for MCNS cases were based on diagnoses recorded on hospital admissions in the three years preceding their first MCNS visit. For potential controls they were based on diagnoses recorded on admissions in the three years preceding the month before death.

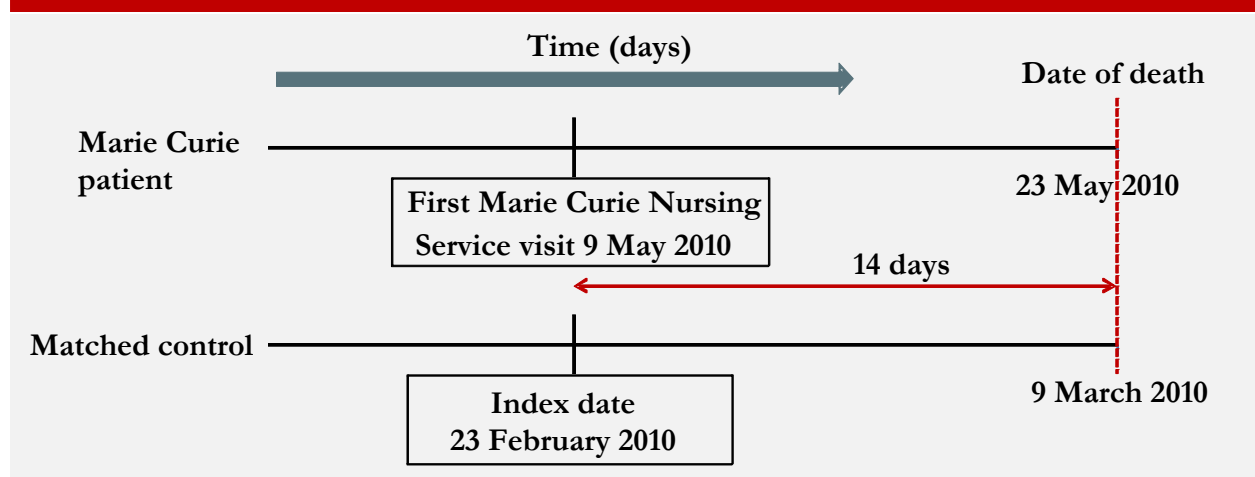
We selected a single control per case using matching without replacement so that the control group would consist of unique individuals. Standardised differences were calculated between the MCNS cases and the pool of potential controls before and after matching. The standardised difference is defined as the difference in means divided by the pooled standard deviation (sd). A difference of 10% or more is taken to be an indication of substantial difference between groups (Normand and others, 2001).

¹ From a list consisting of: sickle cell anaemia, diabetes, hypertension, congestive heart failure, COPD (chronic obstructive pulmonary disease), ischaemic heart disease, asthma, angina, cerebrovascular disease, arthritis or other connective tissue disorder, and renal failure.

² These cancers were chosen as the most commonly recorded among the MCNS cases.

³ For those cases and potential controls with a history of cancer, this variable was the number of different cancers recorded in the preceding three years. Recorded cancer diagnoses were categorised using a modified version of the definitions used for cancer waiting times reporting. For those cases and potential controls without a history of cancer, this variable was the number of conditions associated with ageing recorded in the preceding three years. The eligible conditions were UTI (urinary tract infection), senility, pneumonia, cerebrovascular illness, dementia, other cognitive disorders and fractures.

Figure 2.1. Process for calculating the index date for matched controls



2.5 Hospital costs

For each case and matched control we estimated their hospital costs in the year up to the index date and the period after until death. Costs were taken from the Payment by Results (PbR) national tariff or Reference Costs,¹ and so do not directly reflect the costs paid by commissioners.

a) Inpatient spells

Admitted patient care spells were primarily costed on a Healthcare Resource Group (HRG) basis using the 2010/11 mandatory and non-mandatory national tariffs. Where national tariff prices were not available, 2007/08 national Reference Costs (adjusted for inflation) were used, as they formed the basis of the 2010/11 national tariff. If neither of these sources provided costs for a HRG, average specialty costs were applied. The spell cost was then converted to a daily figure, and summed over the number of days within the month or quarter covered by the spell.

Critical care costs were included and were modelled rather than applied directly due to concerns about the completeness of the critical care minimum data set (CCMDS). The rate of critical care utilisation by HRG was derived from HES records for 2005/06, prior to the introduction of CCMDS. This rate of critical care days per ordinary care days was then applied to activity in the HES inpatient datasets. Critical care costs were estimated using national Reference Costs as outlined above.

b) Outpatient attendances

As with inpatient costs, prices were either taken from the 2010/11 national tariff where there was a mandatory HRG or treatment specialty price, or otherwise derived from the 2007/08 Reference Costs. Costs of unbundled activity were included where applicable.

Radiotherapy, chemotherapy and some high-cost drugs generate an unbundled HRG but are excluded from the national tariff and in 2010/11 did not have a non-mandatory

¹ Reference Costs are the unit costs to the NHS of providing specified types of care. They are submitted by NHS providers and form the basis of the PbR national tariff.

tariff. These elements (particularly the former two) are likely to represent a significant proportion of the costs of care for people with cancer. In order to capture these costs, we applied the 2007/08 Reference Costs (adjusted for inflation) for all unbundled HRGs whose costs were not included in the spell or attendance core HRG price as set out in PbR guidance (Department of Health, 2010).

c) Accident & emergency attendances

A&E visits were all costed using the 2010/11 national mandatory tariff. This provides a limited set of costs, based on the version 3.2 HRG code of the visit.

2.6 Statistical methods

Our primary outcome measures were the proportion of people who died at home, and hospital utilisation and secondary care costs in the period after the index date until death.

To test the effect of MCNS care on hospital use, we constructed multivariate regression models. These adjusted for residual differences (after matching) between intervention and matched control patients in terms of age, deprivation, ethnicity, number of chronic conditions, number of conditions associated with ageing, number of different cancers and prior hospital use.

For ‘count’ variables such as the number of hospital admissions per head, we used Poisson regression. The coefficients were exponentiated to produce the Incidence Rate Ratio (IRR), which is a measure of the relative impact on hospital admissions (that is, the percentage change). We also wanted to estimate absolute impacts (the difference in the numbers of admissions per head). Absolute impacts were assessed using ‘predicted population margins’. Thus, we estimated the mean number of admissions that would be expected for intervention and control patients if the data were balanced, for example, if patients in the intervention and control groups were the same in terms of other variables that were controlled for (such as age). The predicted population margins were estimated for intervention and control patients on the inverse-linked scale; differences were taken and approximate confidence intervals estimated based on a pooled estimate of the standard deviation.

Differences in hospital costs were analysed using ordinary least-squares regression and with differences assessed using the predicted population margins, for consistency with the Poisson regression analyses of hospital use.

3. Results

3.1 Marie Curie Nursing Service cohort

a) Data linkage and cleaning

MCCC supplied 56,878 records to the IC. This included 17,691 people who had been referred to the MCNS but who had not received a service. These people were excluded from the MCNS cohort but were eligible to be selected as matched controls.

From the remaining records there was a potential cohort of 38,728 people (as indicated by a unique study identifier), of which 97% could be linked to a HES ID, leaving only 1,146 individual records that could not be linked. A series of cleaning steps were then applied to remove records with missing or inconsistent data (see Table 3.1). The ONS mortality file only included people who had been admitted to hospital since 2000, so a significant number of records were excluded from people who had only had an outpatient or A&E attendance from 2000 onwards. This gave a final cohort of 31,107 people.

Description	Count	Number remaining in cohort
People (patient IDs) in MCNS activity file	38,728	38,728
People who could not be linked to a HES ID	1,146	37,582
Number of distinct HES IDs	37,521	37,521
People without an ONS death record	4,622	32,899
People with an ONS death record but no information	23	32,876
No LSOA or Welsh LSOA	7	32,869
People without MCNS activity (removing cancelled visits and visits after death date)	531	32,338
People excluded due to complex registrations	104	32,234
People who did not receive an MCNS visit in the three months before death	1,127	31,107
Final cohort for analysis		31,107

b) Cohort characteristics

Table 3.2 and Figure 3.1 summarise the key characteristics of the MCNS cohort. 73.1% died at home, with 7.4% dying in hospital. The median period of time between first receiving MCNS care and death was eight days. Around three quarters (76.9%) had a malignant cancer diagnosis recorded on an inpatient hospital episode in the three years prior to receiving MCNS care.

Table 3.2. Characteristics of Marie Curie cohort (N=31,107)	
Measure	Mean (sd)
Age (years)	75.2 (12.1)
Female	47.6%
Deprivation (IMD)	20 (14.2)
History of cancer	76.9%
Number of different cancers (in preceding three years)	1.6 (1.3)
Number of chronic conditions	1.5 (1.5)
Number of conditions associated with ageing	0.7 (1)
Median number of days from first MCNS visit to death	8
Dying at home	73.1%
Dying in hospital	7.4%
Dying in a hospice	12.4%
Dying in a care home	4.8%

Figure 3.1. Demographic characteristics of Marie Curie patients (N=31,107)

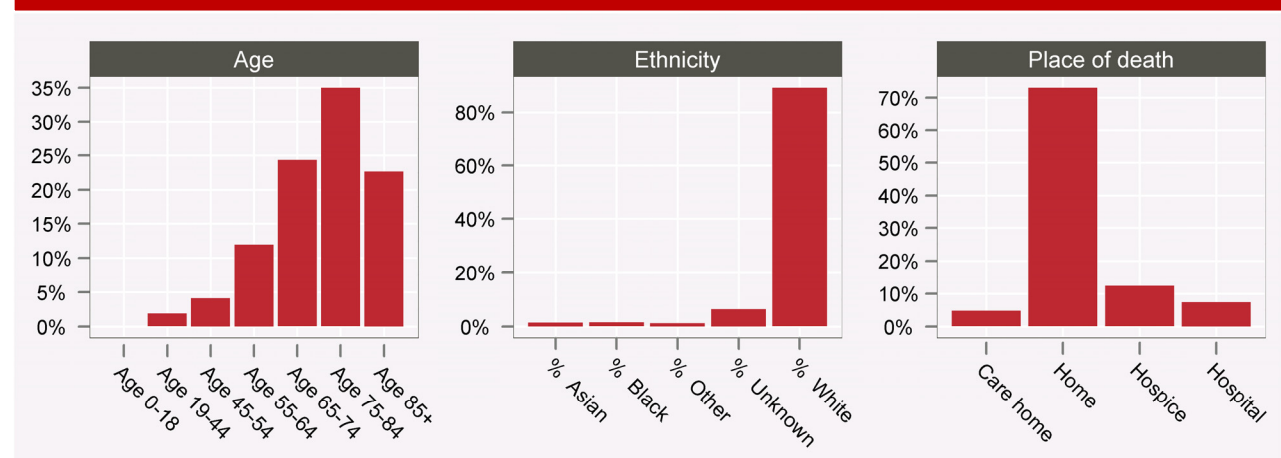
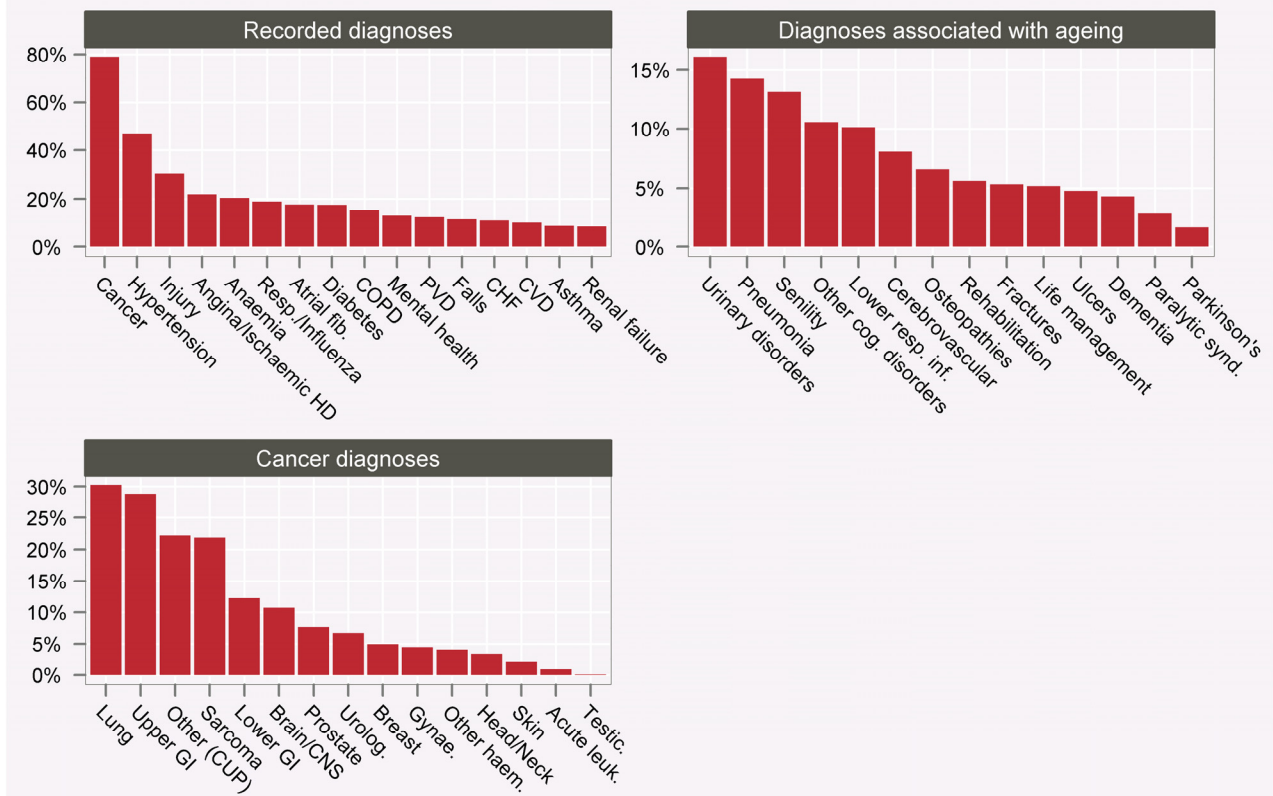


Figure 3.2 summarises the clinical characteristics of those who received MCNS care. The most common cancers were lung, upper GI, sarcoma and CUP. Conditions associated with ageing were relatively common, with over 15% of cases having a hospital admission where a UTI was recorded as a diagnosis, and more than 10% having senility recorded.

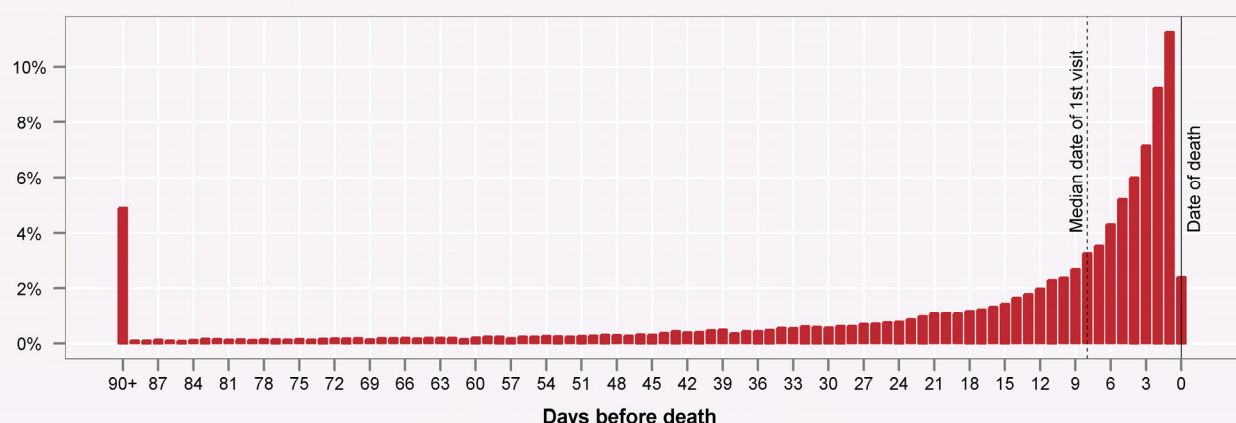
Figure 3.2. Clinical characteristics of those who received Marie Curie care (N=31,107)*

*CHF: Congestive heart failure; CVD: Cardiovascular disease; HD: heart disease; PVD: Peripheral vascular disease

Following discussion with MCCC, it was decided to exclude cases and potential controls that had died in a care home from the subsequent matching analyses. We have previously shown that older people in care homes tend to have lower levels of hospital use than others (Bardsley and others, 2012). Given that the MCNS is not generally available to people in care homes, it would be unfair to compare use of services between cases that lived at home and controls that were in care homes.

c) *When did people start receiving Marie Curie Nursing Service care?*

Many people first received MCNS care relatively close to death, with 50% starting care only in the last week or so of life. 4.7% of people first received MCNS care more than three months before death (Figure 3.3).

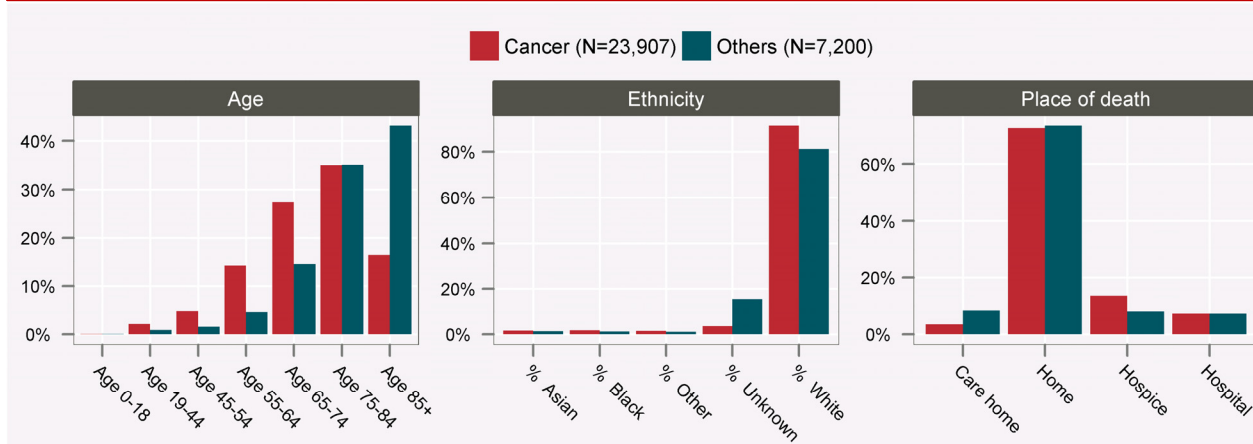
Figure 3.3. Date of first Marie Curie visit, relative to death

d) Cohort characteristics by history of cancer

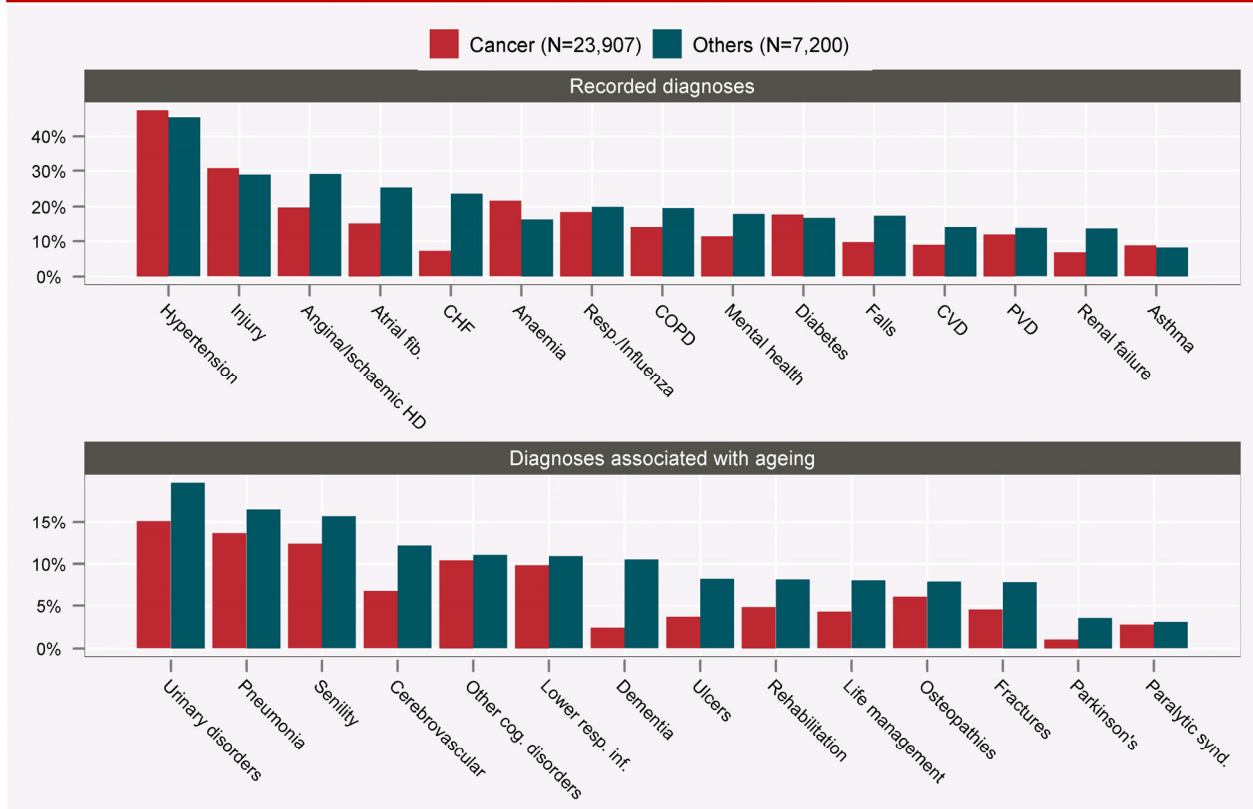
Given that nearly a quarter of the cohort did not have a recent history of cancer, we were interested in the profile of this sub-group. Table 3.3 and Figure 3.4 summarise the key characteristics of the whole cohort, split by whether or not they had a history of malignant cancer in the preceding three years. Those without a recent history of cancer were significantly older and more likely to die in a care home, but less likely to die in a hospice.

Table 3.3. Characteristics of Marie Curie cohort, by history of cancer

Measure	Mean (sd)	
	History of cancer (N=23,907)	No recent history of cancer (N=7,200)
Age (years)	73.3 (11.8)	81.3 (11.0)
Female	46.1%	52.7%
Deprivation (IMD)	20.1 (14.3)	19.8 (13.9)
Number of chronic conditions	1.4 (1.4)	1.9 (1.8)
Number of conditions associated with ageing	0.7 (0.9)	0.9 (1.2)
Median number of days from first MCNS visit to death	8	7
Dying at home	72.9%	73.7%
Dying in hospital	7.4%	7.4%
Dying in a hospice	13.6%	8.2%
Dying in a care home	3.6%	8.5%

Figure 3.4. Demographic characteristics of Marie Curie cohort, by history of cancer

MCNS patients without a recent history of cancer had a much higher rate of heart failure, COPD and renal failure than those with cancer. They also had a higher rate of most conditions associated with ageing, including UTIs, dementia, falls, fractures and Parkinson's disease. Over 10% had a history of cerebrovascular disease in the three years prior to first receiving MCNS care (Figure 3.5).

Figure 3.5. Clinical characteristics of Marie Curie cohort, by history of cancer

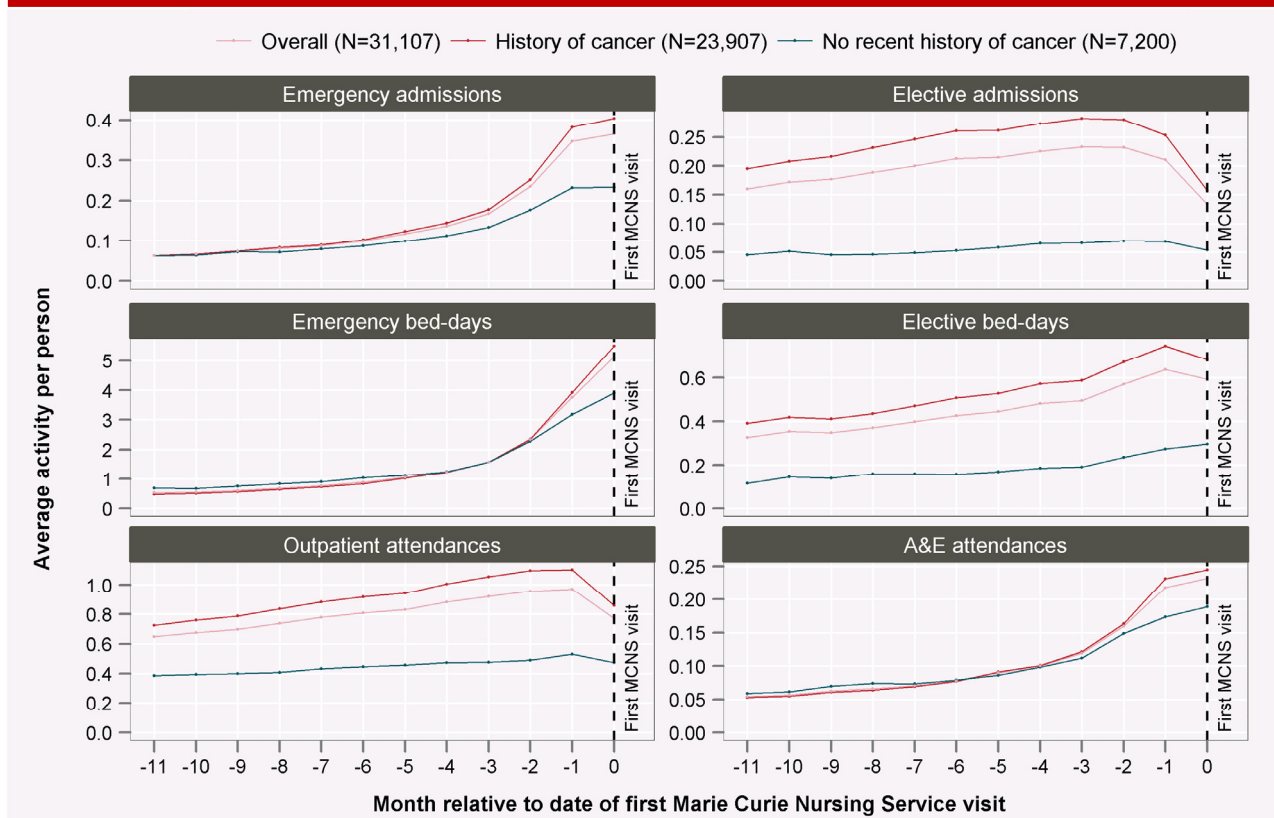
An analysis of the ONS mortality records showed that around a third of people with no inpatient cancer diagnosis in the three years before receiving MCNS care had cancer recorded as the underlying cause of death. The reason for this discrepancy is unclear. It may be due to diagnosis only being made upon or around the time of death, or people

not receiving aggressive treatment for their cancer (and therefore not having a hospital admission where cancer was recorded).

e) What was the pattern of hospital use before receiving Marie Curie Nursing Service care?

Figure 3.6 plots the average hospital activity per person by month for the 12 months before the first date they received MCNS care; overall and also split by history of cancer. Unplanned admissions and A&E attendances rose throughout the preceding 12 months. Elective admissions and outpatient attendances also rose through most of the preceding year, but began to fall in the final month or two before people started receiving MCNS care. This may reflect the end of aggressive curative treatment. This pattern was seen both for people with and without a history of cancer. Hospital activity in the year preceding the start of MCNS care was generally lower among those with no recent history of cancer, particularly in terms of planned care.

Figure 3.6. Hospital activity in the year before receiving Marie Curie care



Further analyses of the characteristics of the cohort, focusing on the different types of MCNS care received, are provided in Appendix A.

3.2 Matching

a) Characteristics of Marie Curie Nursing Service patients and matched controls

After data linkage, cleaning and excluding those who died in a care home, a final cohort of 29,538 people who received MCNS care was created for matching.

The initial cohort of potential controls was drawn from all those who died in England between January 2009 and November 2011 who had not received MCNS care. As set out earlier, a series of exclusions were applied to the initial set of around 1.2 million people before matching (Table 3.4).

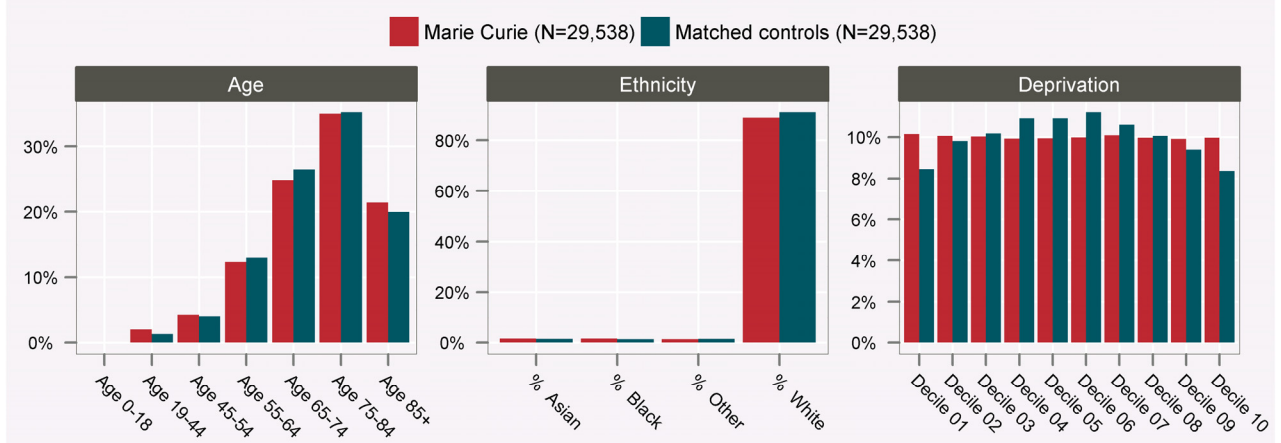
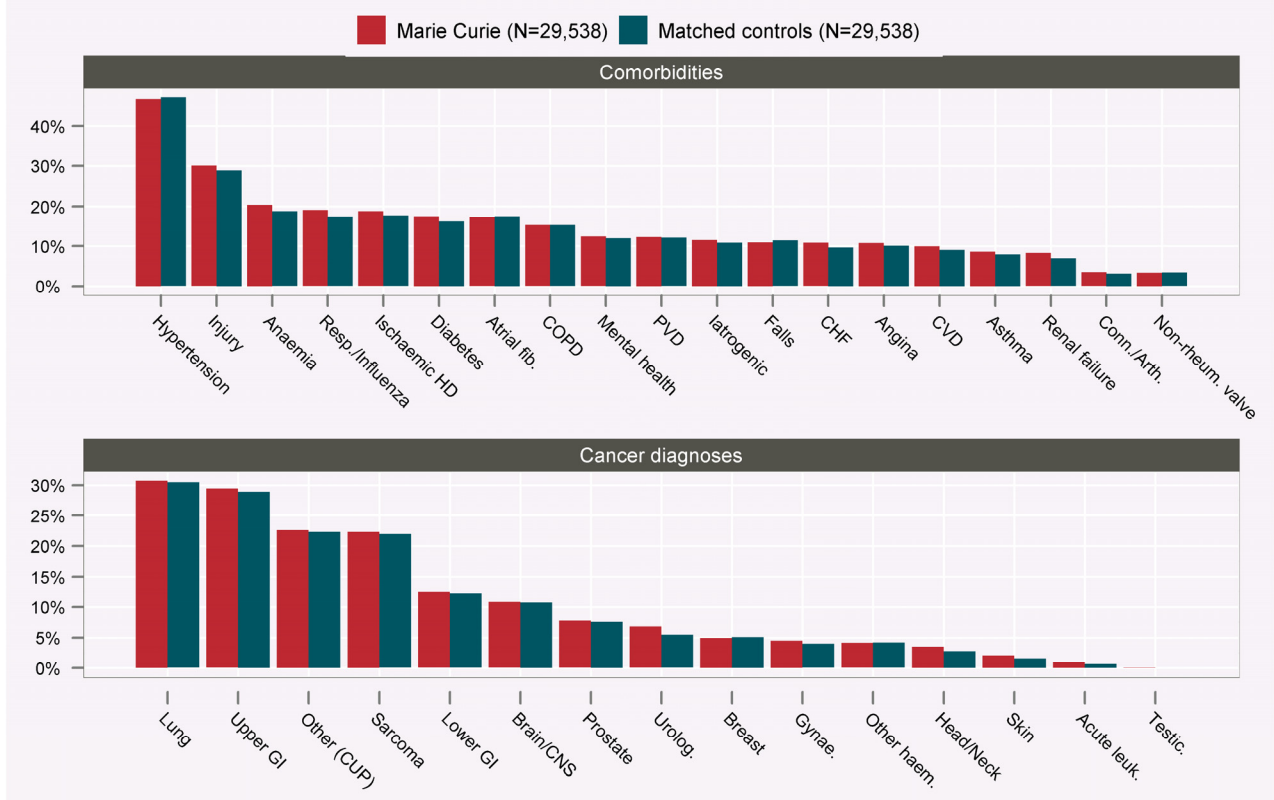
Table 3.4. Process for creating pool of potential controls		
Description	Count	Number remaining in control pool
People who died (according to ONS) between January 2009 and November 2011	1,226,000	1,226,000
People who received care from the Marie Curie Nursing Service	32,976	1,193,024
People for whom no year of birth available (calculated from HES records)	46,874	1,146,150
People with an external cause of death	28,587	1,117,563
No LSOA available (from HES records)	50,135	1,067,428
People with an incomplete ONS mortality record	9,733	1,057,695
People who died in a care home	178,286	879,409
People aged <18 at death	5,985	873,424
Pool of potential controls		873,424

Standardised differences were calculated between the MCNS cases and the pool of potential controls before and after matching. A difference of 10% or more was taken to be an indication of substantial difference between groups (Normand and others, 2001).

Before matching, there were a number of significant differences between the groups (Table B1 in Appendix B). For example, compared to the potential controls, those who received MCNS care were younger and less deprived, but much more likely to have been diagnosed with cancer. Potential controls were much more likely to have been diagnosed with dementia or congestive heart failure, and to have had a recent history of falls and fractures.

After matching, the controls and MCNS patients were much more similar in terms of demographic, morbidity and prior hospital use variables, with no standardised differences of greater than 10% (Table B2 in Appendix B). Table 3.5 and Figures 3.7 and 3.8 summarise the demographic and clinical characteristics of the cases and matched controls. Figure B1 in Appendix B shows how well cases and controls were matched on history of individual cancers.

Table 3.5. Characteristics of Marie Curie patients and matched controls		
	Mean (sd)	
Measure	Marie Curie	Matched controls
Age	74.8 (12.1)	74.7 (11.4)
Female	47%	47%
Deprivation (IMD)	20.1 (14.3)	19.5 (13.3)
Number of chronic conditions	1.50 (1.52)	1.43 (1.42)
Number of conditions associated with ageing	0.70 (0.97)	0.65 (0.96)

Figure 3.7. Demographic characteristics of Marie Curie patients and matched controls**Figure 3.8. Clinical characteristics of Marie Curie patients and matched controls**

b) Prior hospital use and costs of Marie Curie Nursing Service patients and matched controls

The MCNS patients and controls were very well matched in terms of all types of hospital use in the year prior to the index date, although those who subsequently received MCNS care had slightly more elective admissions, bed-days, and outpatient attendances (Figure 3.9). However, the size of these differences was small (Table B2 in Appendix B).

Although we did not include cost variables in the matching, MCNS patients and controls were very similar in terms of hospital costs across all types of care in the year before the index date (Figure 3.10).

Given that MCNS cases with no recent history of cancer had a very different profile of diagnoses and prior hospital use, we also calculated standardised differences separately for this sub-group of cases and controls (Table B3 in Appendix B). Again, the cases and controls were very well matched across demographic, clinical and prior hospital use variables (see Figures B2–B4 in Appendix B).

c) Where did Marie Curie Nursing Service patients and matched controls live?

Figure 3.11 shows where MCNS patients and the matched controls lived, at local authority level. Areas with a significant number of people in receipt of MCNS care included Cornwall, Birmingham, Leeds, Lincolnshire and Durham. The distribution of the matched controls was relatively similar.

Figure 3.9. Hospital activity for Marie Curie patients and controls in the year preceding the index date

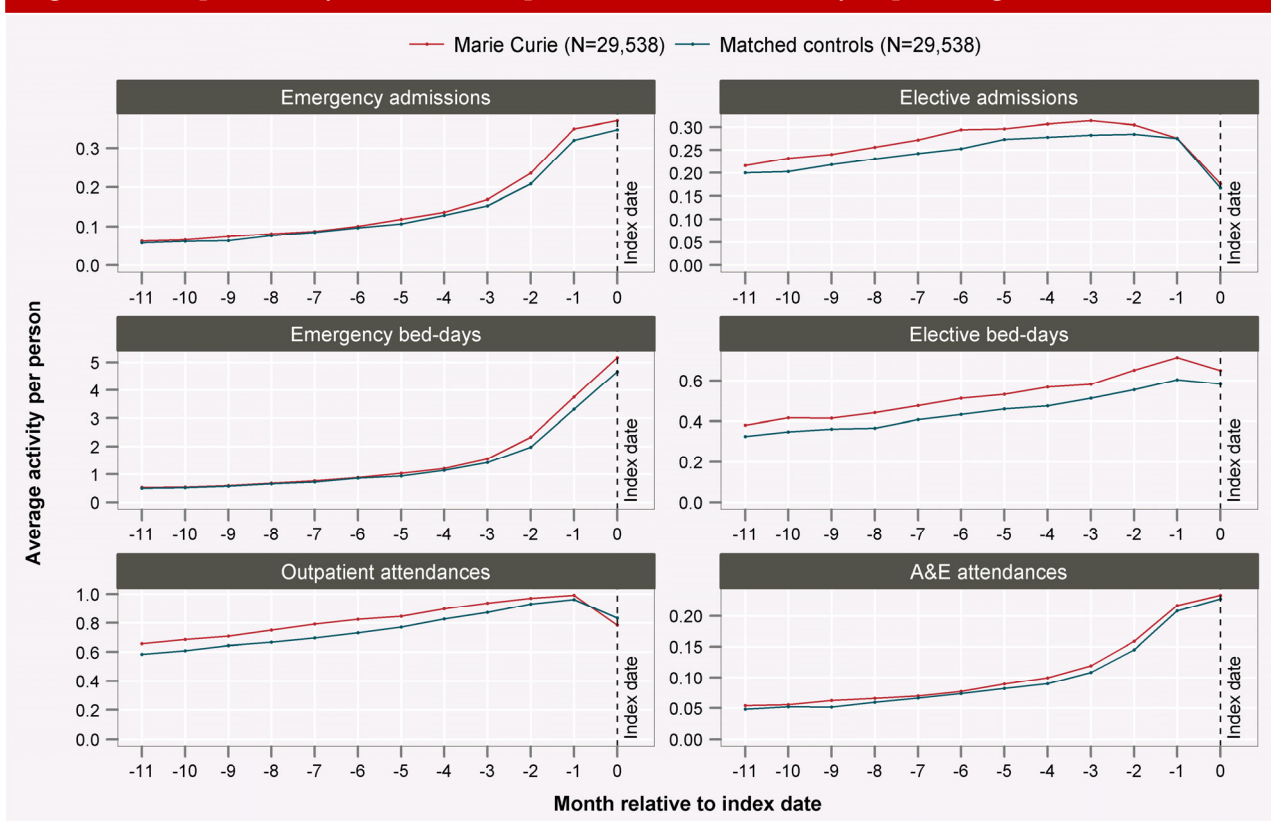
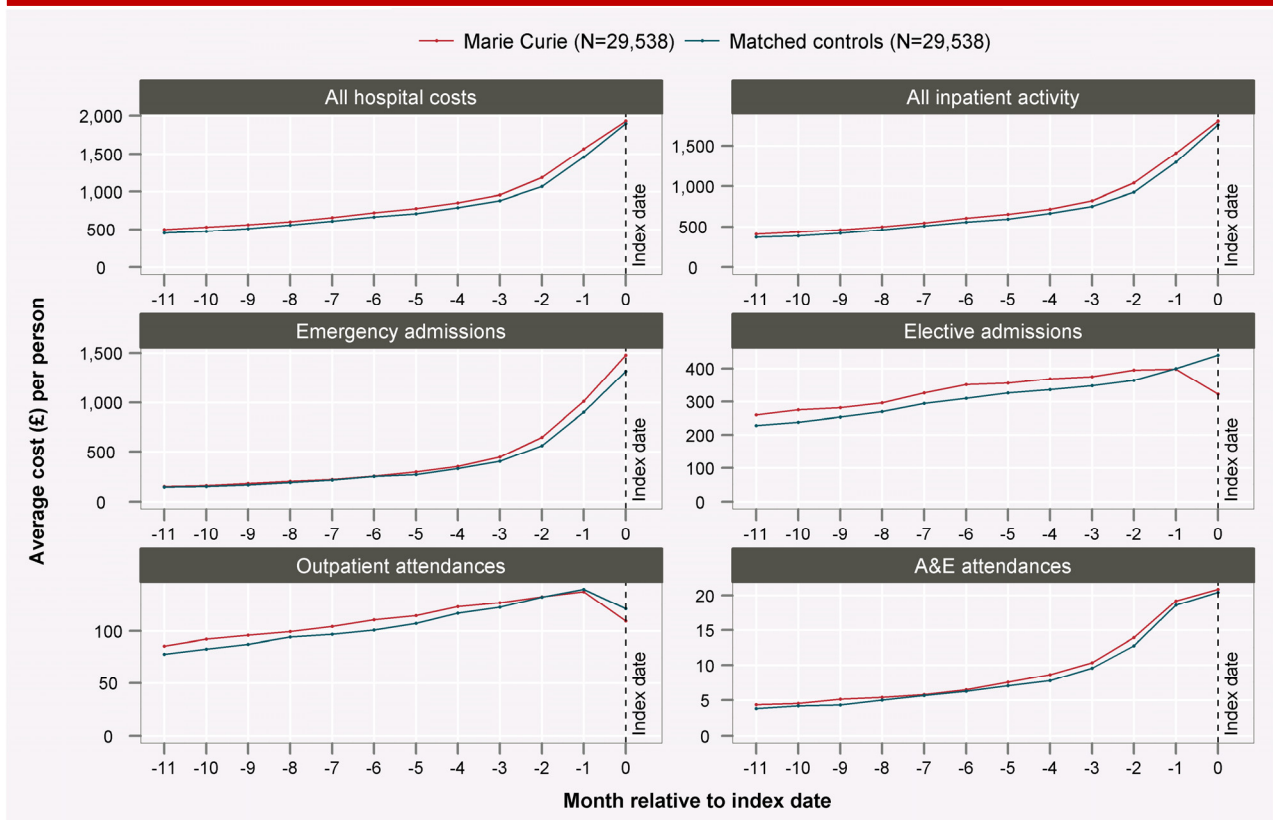
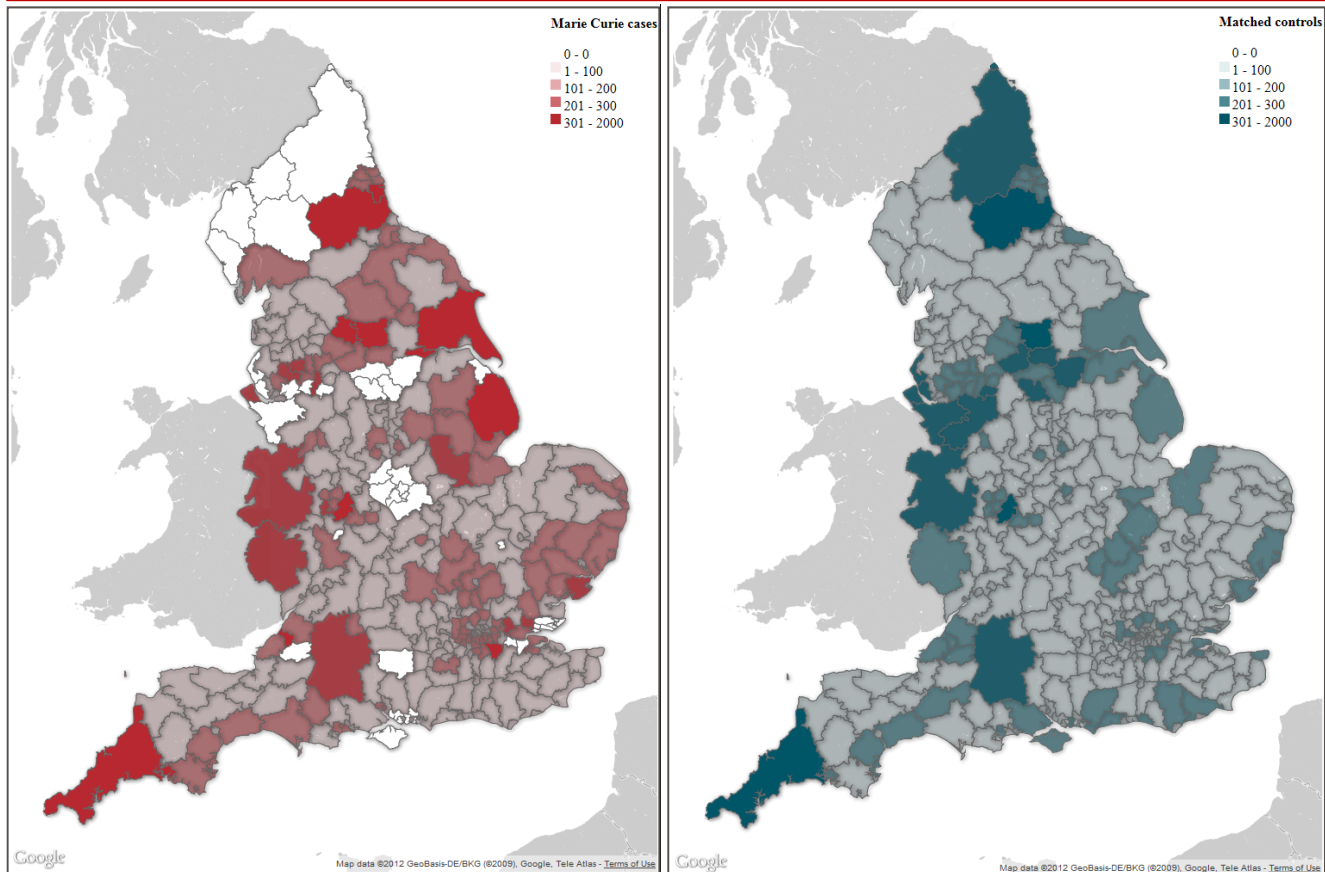


Figure 3.10. Average hospital costs of Marie Curie patients and controls for the year before the index date**Figure 3.11. Local authority of residence of Marie Curie patients and matched controls**

3.3 Where did Marie Curie Nursing Service patients and controls die?

a) Overall

Place of death was a key outcome measure. 76.7% of those who received MCNS care died at home, with 7.7% dying in hospital. In contrast, 34.9% of the matched controls died at home, with 41.6% dying in hospital (Figure 3.12 and Table 3.6). The difference in the proportion dying at home was highly statistically significant (unadjusted odds ratio = 6.16, 95% confidence interval 5.94 to 6.38, $p < 0.001$). The effects remained statistically significant in a more complex model that adjusted for demographic, diagnostic and prior hospital use variables (adjusted odds ratio = 6.97, 95% confidence interval 6.71 to 7.25, $p < 0.001$).

Figure 3.12. Place of death for Marie Curie patients and matched controls

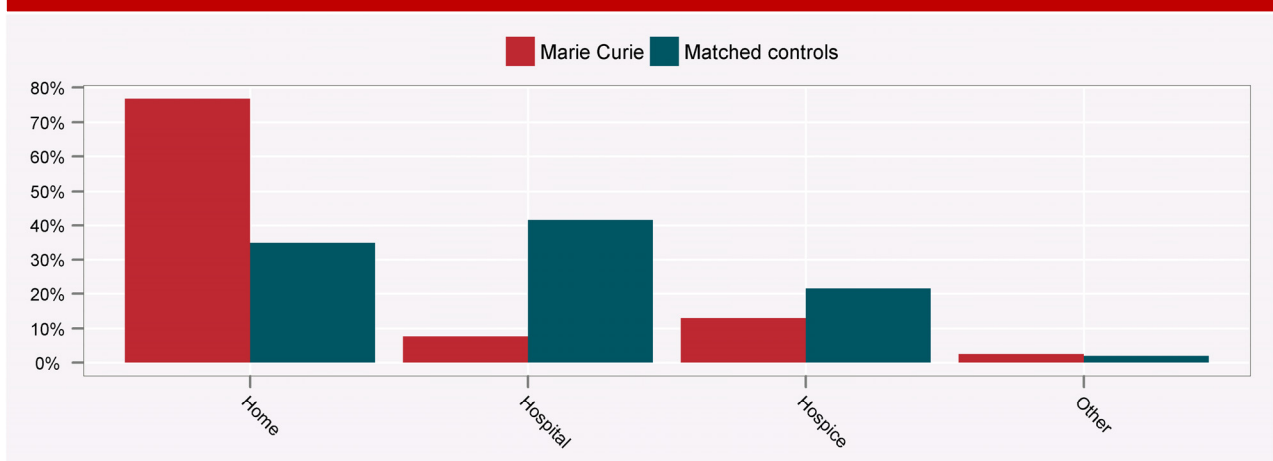


Table 3.6. Place of death for Marie Curie patients and controls

Group	Place of death			
	Home	Hospital	Hospice	Other
Marie Curie	76.7%	7.7%	13.0%	2.5%
Matched controls	34.9%	41.6%	21.5%	2.0%

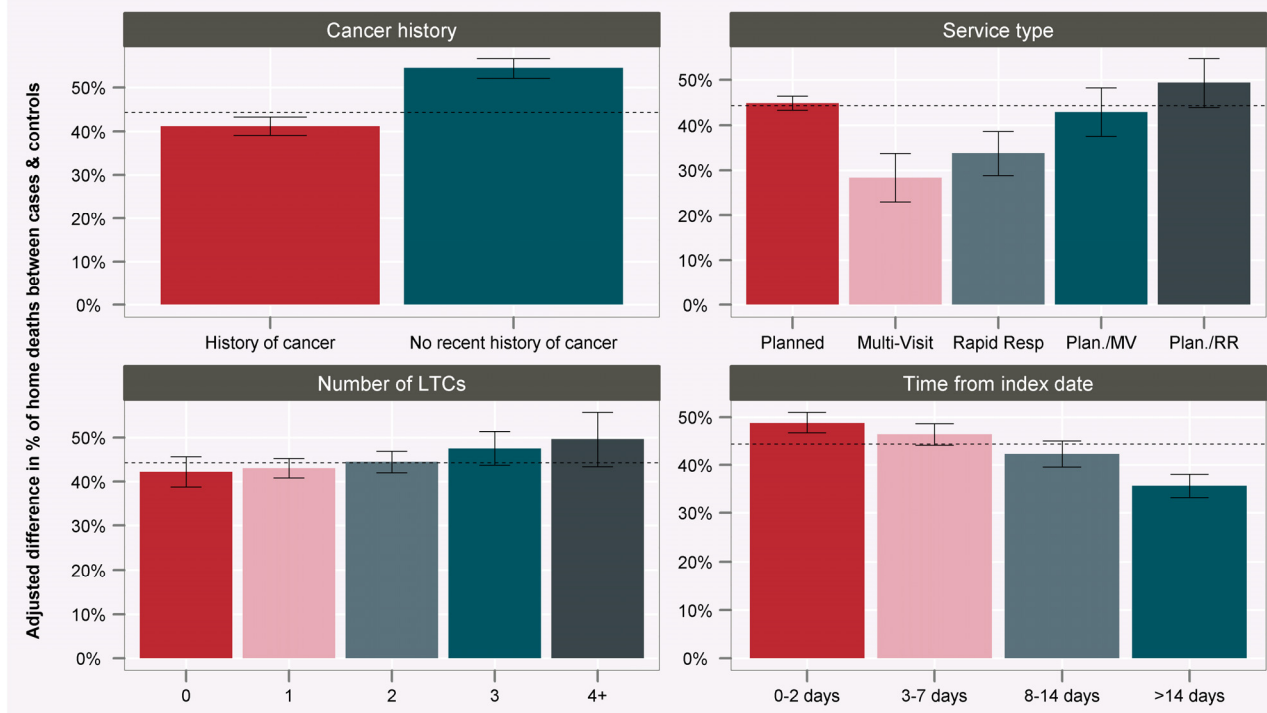
b) Place of death by sub-group

Table 3.7 summarises the proportion of MCNS cases and controls that died at home, split by different sub-groups. For the analysis by service type, controls were assigned the service type of their matched case. All other analyses were as specified; for example, cases with one long-term condition were compared to controls with one long-term condition. One striking result was that the proportion of MCNS patients who died at home was higher for those who started receiving MCNS care closer to death.

We fitted regression models to test hypotheses about whether differences in the proportion of people who died at home were greater for pre-defined sub-groups of patients (Figure 3.13). In each chart, the dotted line is the adjusted difference in the proportion of home deaths between MCNS patients and controls in the whole sample (44%). Where the confidence limits for one of the sub-groups do not overlap this dotted line, we can conclude that the effect for the sub-group is significantly larger (or smaller) than the effect in the whole sample.

The results show that the difference between MCNS patients and controls in the proportion of people who died at home was significantly larger than the overall effect for people with no recent history of cancer, but smaller for people with cancer. It was also smaller than the overall difference for people who received multi-visit or rapid response care only. Lastly, the difference in the proportion of MCNS patients and controls that died at home was significantly larger for those where the index date was less than three days before death, but smaller for those where it was more than two weeks before.

Table 3.7. Proportion of deaths at home, by sub-group				
Factor	Group	Marie Curie	Matched controls	Difference
Cancer history	No recent history of cancer	80.6%	28.6%	52.0%
	History of cancer	75.6%	36.7%	38.9%
Marie Curie service type	Multi-visit	58.8%	32.3%	26.5%
	Planned	77.3%	34.9%	42.4%
	Rapid response	68.4%	37.9%	30.5%
	Planned/Multi-visit	78.4%	35.0%	43.4%
	Planned/Rapid response	82.8%	33.5%	49.3%
Number of long-term conditions (LTCs)	0	76.3%	36.4%	39.9%
	1	76.4%	35.7%	40.7%
	2	76.8%	34.5%	42.3%
	3	78.1%	32.8%	45.3%
	4+	77.5%	30.2%	47.3%
Time from index date to death	0-2 days	91.8%	44.4%	47.4%
	3-7 days	83.8%	38.7%	45.1%
	8-14 days	73.6%	32.0%	41.6%
	>14 days	62.2%	26.6%	35.6%

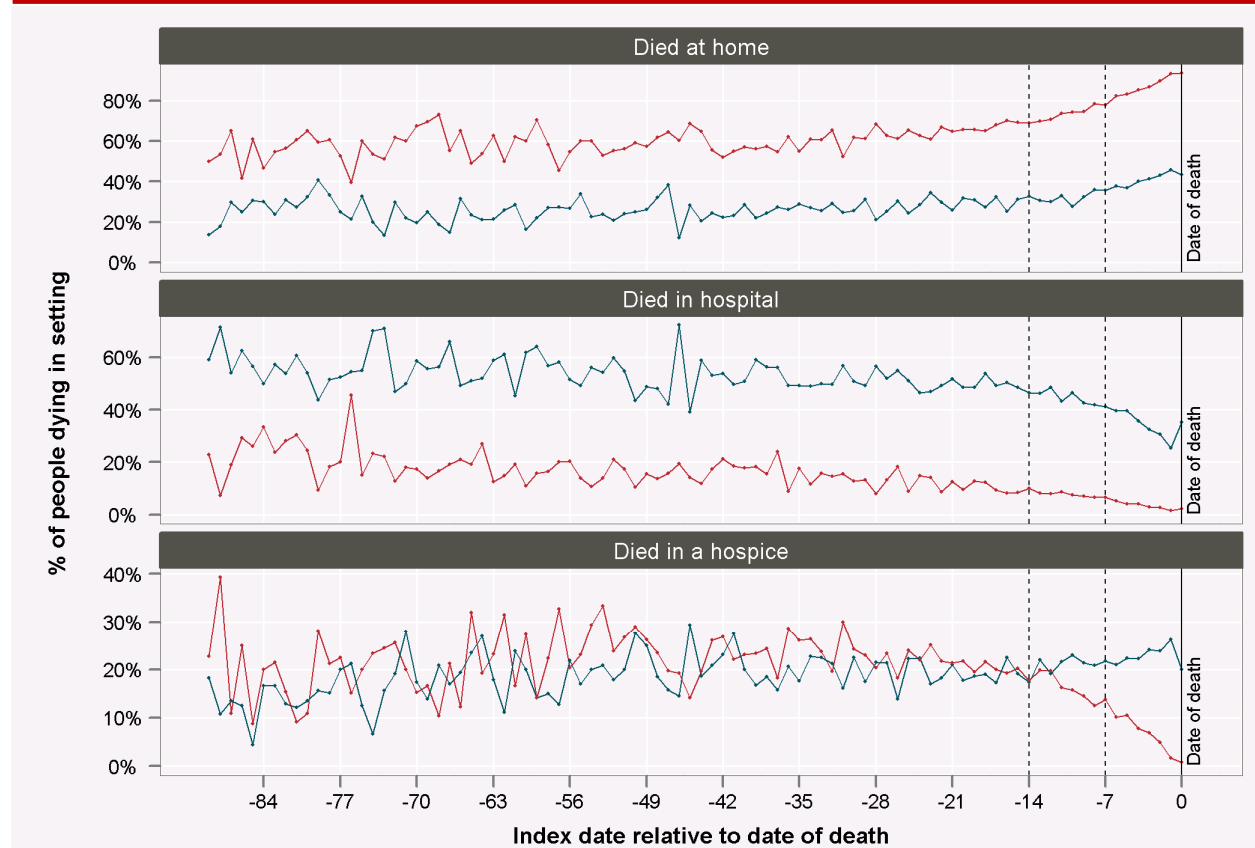
Figure 3.13. Adjusted absolute difference between Marie Curie cases and matched controls in % of home deaths, by sub-group

c) Place of death by time from index date

The finding that stands out from Table 3.7 is that the likelihood of dying at home differed significantly according to when people first came into contact with the MCNS. It might be hypothesised that being in contact with palliative care services for longer would be more likely to permit proper planning, and therefore for someone to die in their place of choice. However, our results suggest that later contact with MCNS care was associated with a higher likelihood of dying at home.

To explore this further, we calculated the proportion of MCNS patients and controls that died in home, in hospital or in a hospice, by the time from index date to death (Figure 3.14). The proportion of MCNS patients who died at home was fairly stable at around 50% to 60% for those who first received MCNS care two to three months before death, but rose steadily for those who started care in the last month of life. Although the proportion of home deaths was higher for MCNS cases who first received care closer to death, MCNS patients were much more likely to die at home and less likely to die in hospital than matched controls, regardless of when they started receiving care. Interestingly, the proportion of controls that died at home was also higher for those whose index date was closer to death. This may in part reflect the fact that controls could not be in hospital on the index date.

Figure 3.14. Place of death for Marie Curie patients and matched controls by time from index date to death



3.4 What was the effect of the Marie Curie Nursing Service on hospital use?

a) Did the use of hospital care differ between cases and controls post-index date?

People who received MCNS care were significantly less likely to use all forms of hospital care after the index date. Table 3.8 summarises the proportion of cases and controls that used hospital care, including odds ratios adjusted for demographic, diagnostic and prior hospital use variables.

Activity type	Marie Curie	Matched controls	Odds ratio (adjusted)	P value
Emergency admissions	11.7%	35.0%	0.19 (0.18 to 0.20)	p<0.001
Elective admissions	3.0%	6.7%	0.413 (0.412 to 0.414)	p<0.001
Outpatient attendances	8.4%	18.7%	0.32 (0.30 to 0.34)	p<0.001
A&E attendances	7.9%	28.7%	0.17 (0.16 to 0.18)	p<0.001

There are two ways of looking at the effect of MCNS care on hospital use. One way is to look at the relative size of any change using the IRR. This expresses the relative impact of the intervention; for example, an IRR of 0.5 would mean that MCNS patients had half the number of admissions of controls. The second approach is to look at the magnitude of the *absolute difference* in hospital use. We have chosen to use both as we feel that they are complementary measures.

Table 3.9 summarises the estimated effects. Use of all types of hospital care was significantly lower in those who received MCNS care compared to matched controls. Across most forms of activity, MCNS patients had between a third and half of the level of hospital use seen in controls.

Table 3.9. Hospital activity for Marie Curie patients and matched controls					
	Mean (sd) activity per person				
Activity type	Marie Curie	Matched controls	Crude difference	IRR	P value
Emergency admissions	0.15 (0.48)	0.44 (0.73)	-0.29	0.34	<.0001
Elective admissions	0.06 (0.78)	0.14 (1.16)	-0.08	0.47	<.0001
Outpatient attendances	0.25 (1.65)	0.52 (2.01)	-0.27	0.46	<.0001
A&E attendances	0.10 (0.38)	0.34 (0.63)	-0.24	0.28	<.0001
Emergency bed-days	1.32 (5.59)	3.60 (8.97)	-2.28	0.37	<.0001
Elective bed-days	0.25 (2.38)	0.45 (3.35)	-0.20	0.58	<.0001

Figure 3.15 displays the number of emergency hospital admissions per 1,000 people by day (relative to death). Each plot is for a different subset of cases and controls, split by their index date relative to death. It shows that the cases and controls were well matched in terms of emergency admissions before the index date, but that emergency admissions stayed static or fell in those who received MCNS care, but rose sharply among matched controls in all subsets after the index date.

b) Did the impact of Marie Curie Nursing Service care on hospital use vary by history of cancer?

Figure 3.6 (page 20) showed that MCNS patients with a history of cancer had higher levels of use of all forms of hospital activity than those without did. Given this, it is interesting to examine whether the differences seen above between cases and controls were similar for those with and without cancer.

Table 3.10 (page 31) summarises average hospital activity per person after the index date until death for MCNS cases and controls, split by whether or not they had a recent history of cancer. The IRR results show that cases with no recent history of cancer had 27% of the number of emergency admissions of their controls, while it was 37% for those with a history of cancer. Similar patterns were seen for other types of activity, except elective admissions where the IRR was lower for MCNS patients with cancer.

Figure 3.15. Number of emergency admissions by day per 1,000 people over last three months of life, by index date

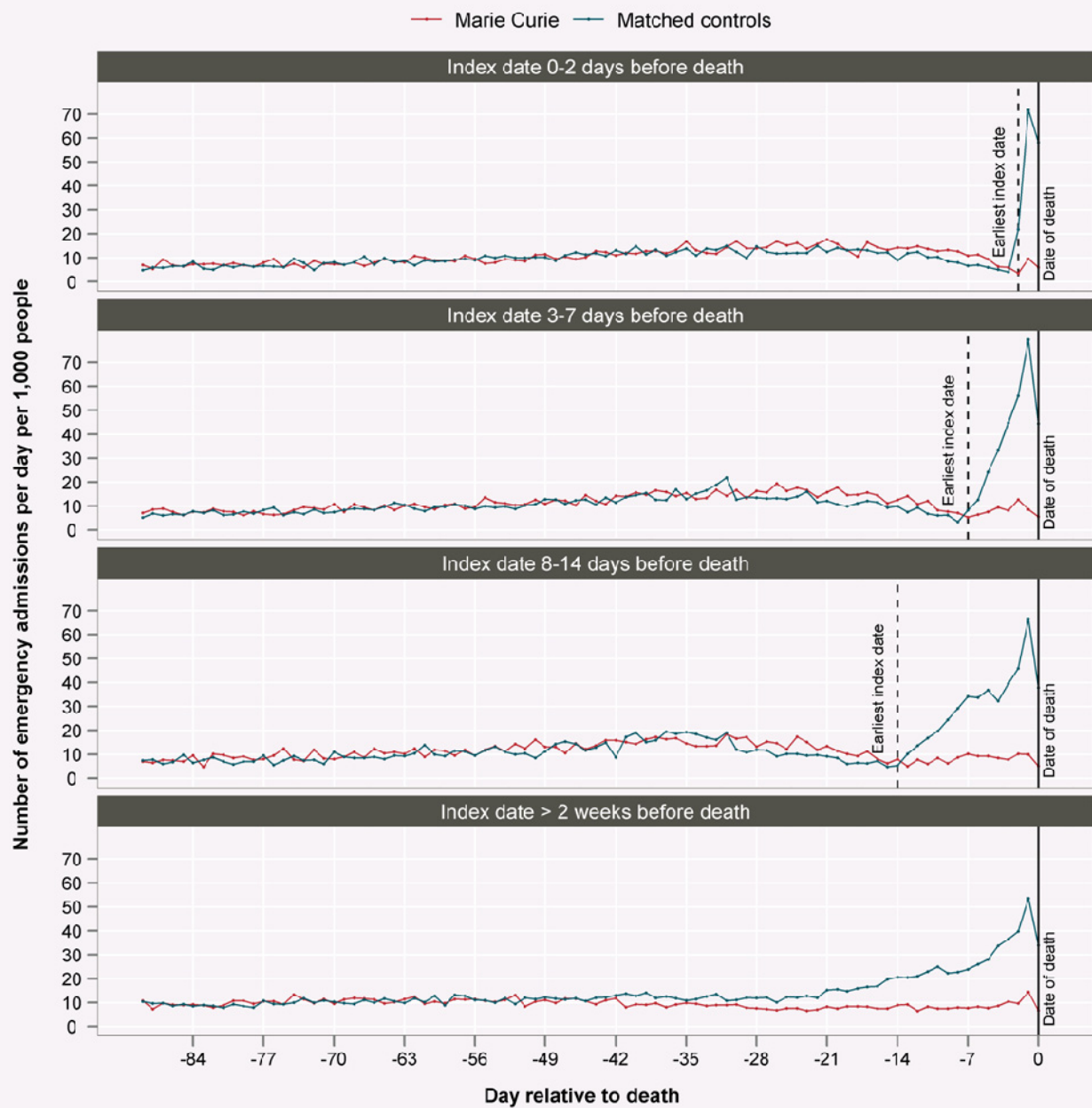
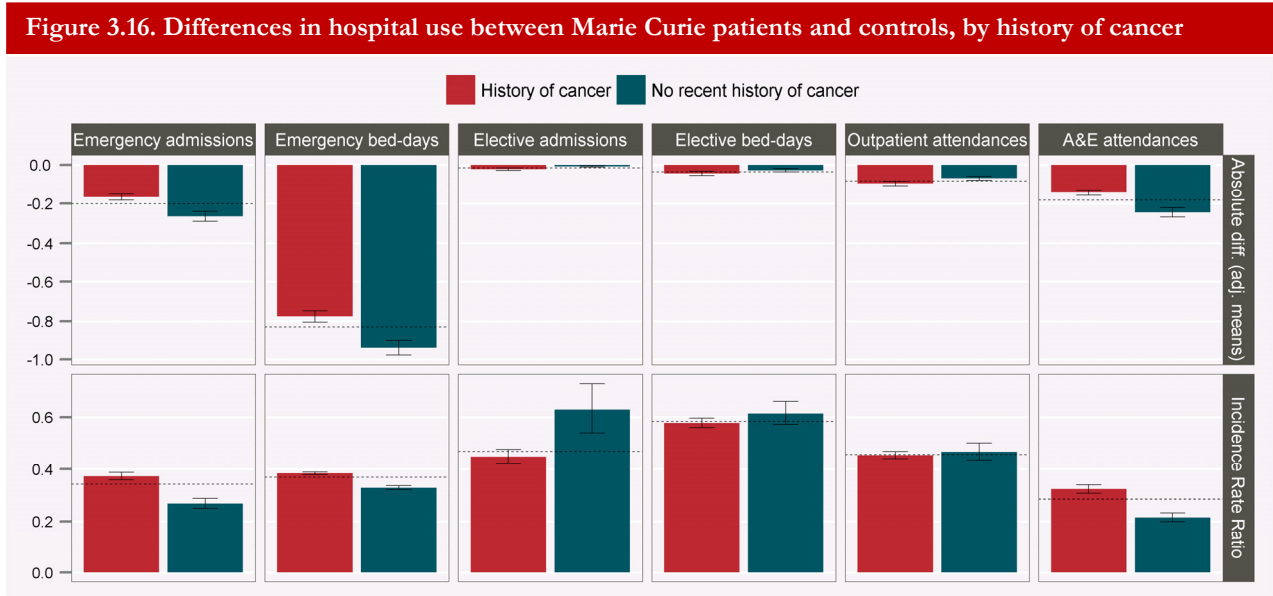


Table 3.10. Hospital activity for Marie Curie patients and matched controls, by history of cancer					
		Mean (sd) activity per person			
Activity type	Group	Marie Curie	Matched controls	Crude difference	IRR
Emergency admissions	History of cancer	0.15 (0.46)	0.40 (0.72)	-0.25	0.37
Emergency admissions	No recent history of cancer	0.15 (0.53)	0.59 (0.73)	-0.44	0.27
Elective admissions	History of cancer	0.07 (0.84)	0.16 (1.26)	-0.09	0.45
Elective admissions	No recent history of cancer	0.04 (0.52)	0.07 (0.64)	-0.03	0.63
Outpatient attendances	History of cancer	0.27 (1.76)	0.56 (2.15)	-0.29	0.45
Outpatient attendances	No recent history of cancer	0.18 (1.14)	0.37 (1.39)	-0.19	0.47
A&E attendances	History of cancer	0.09 (0.35)	0.28 (0.60)	-0.19	0.32
A&E attendances	No recent history of cancer	0.12 (0.45)	0.55 (0.69)	-0.43	0.21
Emergency bed-days	History of cancer	1.30 (5.29)	3.39 (8.90)	-2.09	0.38
Emergency bed-days	No recent history of cancer	1.38 (6.51)	4.34 (9.17)	-2.96	0.33
Elective bed-days	History of cancer	0.27 (2.49)	0.49 (3.45)	-0.22	0.58
Elective bed-days	No recent history of cancer	0.18 (1.96)	0.31 (2.97)	-0.13	0.61

Figure 3.16 shows the absolute difference in adjusted mean activity and the IRR for cases and controls, split by whether or not people had a history of cancer. The dotted line indicates the adjusted overall difference between cases and controls for each type of activity, estimated above. Where the confidence limits for a sub-group do not overlap the overall difference, this indicates that the effect for that sub-group was significantly less or more than the overall effect.

The results for the adjusted per person absolute difference show that there was a significantly greater impact of receiving MCNS care among those without a recent history of cancer for emergency admissions, emergency bed-days and A&E attendances. Conversely, for elective admissions and outpatient attendances there was a significantly greater reduction compared to controls for MCNS cases with cancer, but a smaller fall among cases without a recent history of cancer.



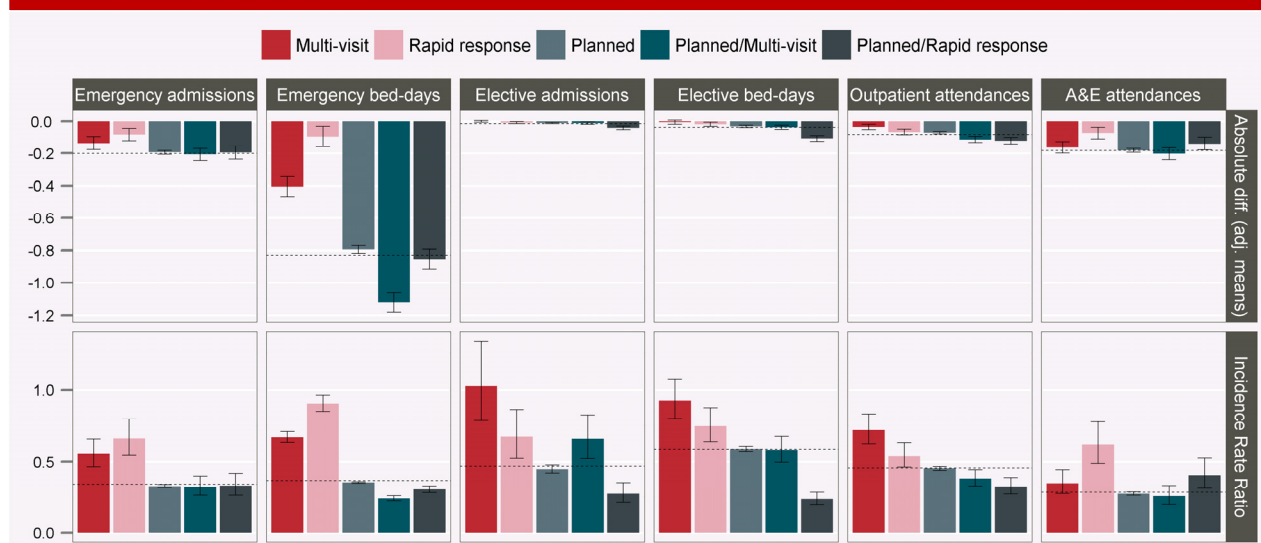
c) Did the impact of Marie Curie Nursing Service care vary by type of service?

The vast majority of the MCNS cohort (91%) received a standard package of planned care, consisting of nine-hour day or overnight care. However, as described earlier, Marie Curie has introduced a range of different service types. We examined whether there was a differential impact according to the type of service provided. Table 3.11 summarises the average post-index date use of different types of hospital care by the type of service received (controls were assigned the service type of their matched case).

Figure 3.17 (page 34) shows the IRR and adjusted absolute differences between cases and controls, split by type of service that the cases received. It is clear that MCNS care had a smaller impact on hospital use for those who received multi-visit or rapid response care alone. The effect on those receiving planned services was generally in line with the overall effect – this is unsurprising given that this group accounted for 91% of the MCNS cohort. For those people who received more than one type of Marie Curie service, the difference in hospital use compared to controls was significantly larger than the overall effect for some types of hospital activity, particularly emergency bed-days and outpatient attendances.

Table 3.11. Hospital activity for Marie Curie patients and controls, by type of service					
		Mean (sd) activity per person			
Activity type	Service type	Marie Curie	Matched controls	Crude Difference	IRR
Emergency admissions	Planned	0.14 (0.47)	0.44 (0.72)	-0.30	0.33
Emergency admissions	Multi-visit only	0.28 (0.62)	0.52 (0.79)	-0.24	0.55
Emergency admissions	Rapid response only	0.22 (0.51)	0.33 (0.63)	-0.11	0.66
Emergency admissions	Planned/Multi-visit	0.21 (0.58)	0.66 (0.93)	-0.45	0.32
Emergency admissions	Planned/Rapid response	0.19 (0.59)	0.58 (0.83)	-0.39	0.33
Elective admissions	Planned	0.05 (0.66)	0.12 (0.89)	-0.07	0.45
Elective admissions	Multi-visit only	0.14 (0.91)	0.17 (0.85)	-0.03	1.03
Elective admissions	Rapid response only	0.12 (0.72)	0.25 (1.52)	-0.13	0.67
Elective admissions	Planned/Multi-visit	0.24 (2.77)	0.30 (1.25)	-0.06	0.66
Elective admissions	Planned/Rapid response	0.16 (1.13)	0.50 (5.53)	-0.34	0.27
Outpatient attendances	Planned	0.24 (1.66)	0.49 (1.96)	-0.25	0.45
Outpatient attendances	Multi-visit only	0.44 (1.59)	0.61 (1.77)	-0.17	0.72
Outpatient attendances	Rapid response only	0.30 (1.10)	0.59 (2.03)	-0.29	0.54
Outpatient attendances	Planned/Multi-visit	0.43 (1.81)	1.12 (2.98)	-0.69	0.38
Outpatient attendances	Planned/Rapid response	0.32 (1.17)	1.00 (3.08)	-0.68	0.32
A&E attendances	Planned	0.09 (0.37)	0.34 (0.63)	-0.25	0.27
A&E attendances	Multi-visit only	0.13 (0.43)	0.37 (0.62)	-0.24	0.35
A&E attendances	Rapid response only	0.14 (0.44)	0.23 (0.50)	-0.09	0.62
A&E attendances	Planned/Multi-visit	0.12 (0.50)	0.50 (0.80)	-0.38	0.26
A&E attendances	Planned/Rapid response	0.16 (0.51)	0.40 (0.67)	-0.24	0.41
Emergency bed-days	Planned	1.24 (5.43)	3.53 (8.91)	-2.29	0.35
Emergency bed-days	Multi-visit only	2.81 (7.64)	4.22 (8.70)	-1.41	0.67
Emergency bed-days	Rapid response only	2.22 (6.56)	2.51 (6.48)	-0.29	0.91
Emergency bed-days	Planned/Multi-visit	1.59 (7.53)	6.78 (13.12)	-5.19	0.24
Emergency bed-days	Planned/Rapid response	1.54 (5.41)	4.99 (9.72)	-3.45	0.30
Elective bed-days	Planned	0.24 (2.36)	0.42 (3.21)	-0.18	0.59
Elective bed-days	Multi-visit only	0.47 (2.52)	0.55 (3.13)	-0.08	0.93
Elective bed-days	Rapid response only	0.30 (2.01)	0.54 (3.80)	-0.24	0.75
Elective bed-days	Planned/Multi-visit	0.48 (3.69)	0.79 (4.25)	-0.31	0.58
Elective bed-days	Planned/Rapid response	0.29 (1.88)	1.15 (7.00)	-0.86	0.24

Figure 3.17. Differences in hospital use between Marie Curie patients and controls, by type of service



d) Was the effect of Marie Curie Nursing Service care influenced by long-term conditions?

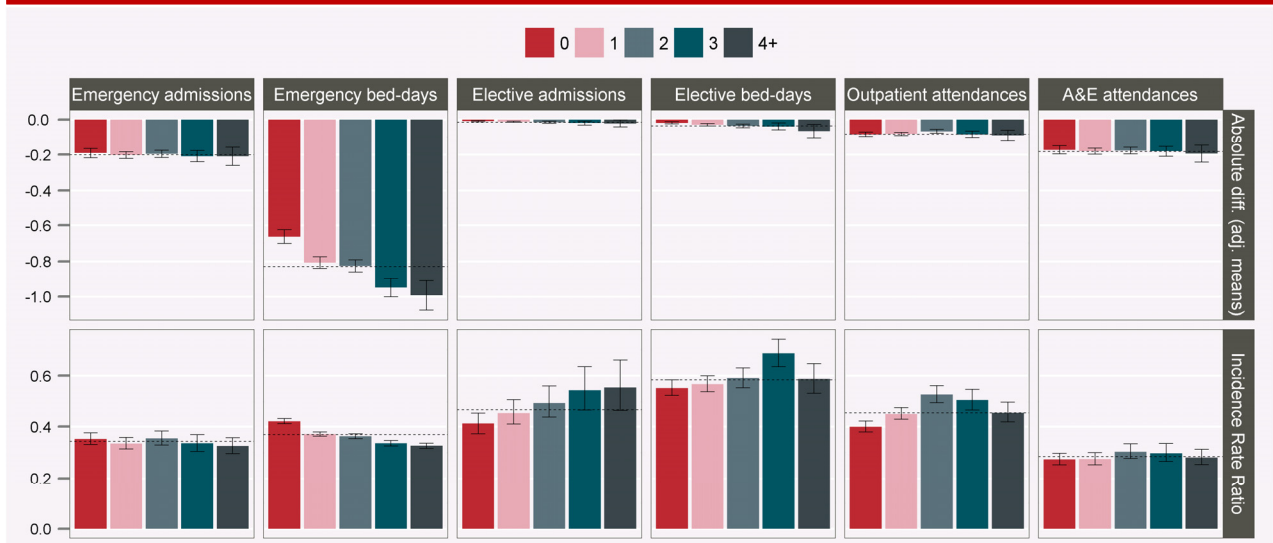
We have already shown that people who receive palliative home care at the end of life have significantly lower use of all forms of hospital care than matched controls.

However, it would be useful to understand whether particular groups of people seem to benefit more or less from this type of care. People with multiple chronic conditions are likely to be particularly heavy users of health (and other) care services. Therefore, it is interesting to consider whether the effects of palliative home care vary according to an individual's level of morbidity.

Table 3.12 shows the average use of different types of hospital care between the index date and death by MCNS patients and matched controls, as well as the relative and absolute differences between them, according to the number of LTCs recorded in inpatient hospital records in the preceding three years. It shows that use of unplanned care among both MCNS patients and controls rose in line with the number of LTCs, while no such pattern was evident for planned care.

Figure 3.18 (page 36) shows that the impact of MCNS care on emergency bed-day use was lower among those with no LTCs recorded, and significantly greater among those with at least three chronic illnesses. This was true both in terms of the absolute and relative difference. There were few other changes, with a greater reduction in elective admissions and outpatient attendances among those with no LTCs, and a smaller impact among those with two or three conditions.

Table 3.12. Hospital activity for Marie Curie patients and matched controls, by number of long-term conditions					
		Mean (sd) activity per person			
Activity type	Number of LTCs	Marie Curie	Matched controls	Crude difference	IRR
Emergency admissions	0	0.13 (0.42)	0.39 (0.65)	-0.26	0.35
Emergency admissions	1	0.14 (0.45)	0.42 (0.70)	-0.28	0.33
Emergency admissions	2	0.16 (0.51)	0.46 (0.74)	-0.30	0.35
Emergency admissions	3	0.17 (0.55)	0.52 (0.81)	-0.35	0.34
Emergency admissions	4+	0.19 (0.58)	0.60 (0.89)	-0.41	0.32
Elective admissions	0	0.06 (0.48)	0.14 (0.84)	-0.08	0.41
Elective admissions	1	0.06 (0.56)	0.13 (0.74)	-0.07	0.46
Elective admissions	2	0.06 (0.77)	0.14 (1.08)	-0.08	0.49
Elective admissions	3	0.08 (1.29)	0.15 (2.26)	-0.07	0.54
Elective admissions	4+	0.07 (1.16)	0.13 (1.40)	-0.06	0.55
Outpatient attendances	0	0.24 (1.54)	0.50 (1.88)	-0.26	0.40
Outpatient attendances	1	0.24 (1.57)	0.53 (2.24)	-0.29	0.45
Outpatient attendances	2	0.27 (1.80)	0.50 (1.74)	-0.23	0.53
Outpatient attendances	3	0.28 (2.06)	0.56 (2.29)	-0.28	0.51
Outpatient attendances	4+	0.25 (1.33)	0.51 (1.87)	-0.26	0.46
A&E attendances	0	0.08 (0.32)	0.28 (0.54)	-0.20	0.27
A&E attendances	1	0.09 (0.34)	0.31 (0.59)	-0.22	0.28
A&E attendances	2	0.10 (0.40)	0.36 (0.63)	-0.26	0.30
A&E attendances	3	0.12 (0.43)	0.41 (0.71)	-0.29	0.30
A&E attendances	4+	0.15 (0.49)	0.54 (0.85)	-0.39	0.28
Emergency bed-days	0	1.15 (4.97)	2.74 (6.81)	-1.59	0.42
Emergency bed-days	1	1.26 (5.51)	3.38 (8.90)	-2.12	0.37
Emergency bed-days	2	1.33 (5.46)	3.84 (9.10)	-2.51	0.36
Emergency bed-days	3	1.46 (5.96)	4.57 (10.71)	-3.11	0.34
Emergency bed-days	4+	1.76 (7.08)	5.57 (12.12)	-3.81	0.33
Elective bed-days	0	0.22 (2.07)	0.42 (3.10)	-0.20	0.55
Elective bed-days	1	0.26 (2.40)	0.46 (3.36)	-0.20	0.57
Elective bed-days	2	0.26 (2.40)	0.48 (3.59)	-0.22	0.59
Elective bed-days	3	0.31 (3.10)	0.46 (3.86)	-0.15	0.69
Elective bed-days	4+	0.22 (2.30)	0.38 (2.95)	-0.16	0.59

Figure 3.18. Differences in hospital use between Marie Curie patients and controls, by number of long-term conditions

e) *Was the impact of the Marie Curie Nursing Service influenced by duration of care?*

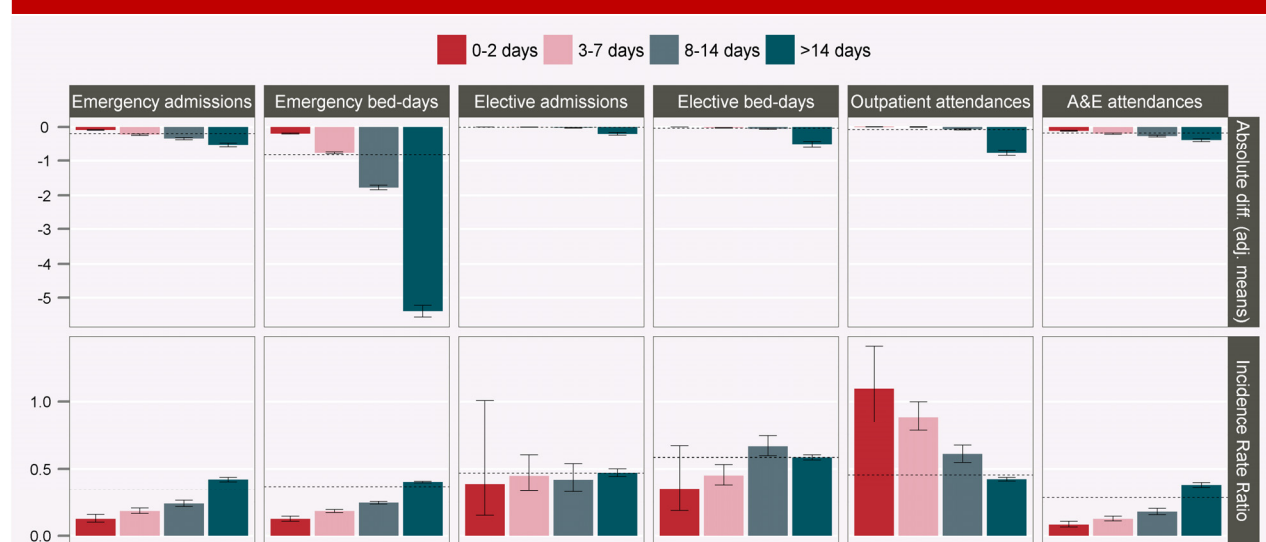
We have already seen that the length of time between the index date and death had a significant influence on the proportion of deaths that occurred at home (Figure 3.14 on page 28). It might be hypothesised that the longer a person is in contact with a palliative care service such as Marie Curie, the greater the potential impact on hospital use. Of course, this analysis has the advantage of knowing how long people survived after starting to receive services; this would not be the case in practice.

Table 3.13 shows the average use of hospital care after the index date, split by the time between the index date and death. Unsurprisingly, across all types of care, hospital activity rose sharply for both groups the longer the time from index date to death.

Figure 3.19 plots the absolute and relative impact of receiving MCNS care, split by the time from the index date until death. It shows an interesting difference between the absolute and relative change. Across all activity types the magnitude of the absolute change increased with time from index date to death. Specifically, across all activity types the absolute impact for those who only received MCNS care in the last two days of life was significantly lower than the overall effect, while it was very significantly larger for those who started receiving MCNS care more than two weeks before death. Conversely, for emergency admissions, emergency bed-days and A&E admissions, the relative impact was greater among those with a shorter time from the index date until death. This is likely to be due to the very low levels of activity after the index date in these groups, meaning that a small effect could be a large relative difference.

Table 3.13. Post-index date hospital activity for Marie Curie cases and matched controls, by time from index date to death

Activity type	Time from index date to death	Mean (sd) activity per person		Crude difference	Incidence Rate Ratio
		Marie Curie	Matched controls		
Emergency admissions	0-2 days	0.01 (0.12)	0.10 (0.32)	-0.09	0.13
Emergency admissions	3-7 days	0.05 (0.22)	0.25 (0.47)	-0.20	0.18
Emergency admissions	8-14 days	0.10 (0.31)	0.41 (0.56)	-0.31	0.24
Emergency admissions	>14 days	0.35 (0.72)	0.86 (0.95)	-0.51	0.42
Elective admissions	0-2 days	0.00 (0.03)	0.00 (0.05)	0.00	0.39
Elective admissions	3-7 days	0.01 (0.10)	0.02 (0.15)	-0.01	0.45
Elective admissions	8-14 days	0.02 (0.15)	0.04 (0.26)	-0.02	0.42
Elective admissions	>14 days	0.17 (1.33)	0.38 (1.96)	-0.21	0.47
Outpatient attendances	0-2 days	0.02 (0.28)	0.02 (0.19)	0.00	1.09
Outpatient attendances	3-7 days	0.07 (0.88)	0.07 (0.39)	0.00	0.88
Outpatient attendances	8-14 days	0.13 (1.23)	0.18 (0.63)	-0.05	0.61
Outpatient attendances	>14 days	0.62 (2.54)	1.39 (3.25)	-0.77	0.42
A&E attendances	0-2 days	0.01 (0.10)	0.12 (0.33)	-0.11	0.08
A&E attendances	3-7 days	0.03 (0.16)	0.21 (0.42)	-0.18	0.13
A&E attendances	8-14 days	0.05 (0.24)	0.31 (0.49)	-0.26	0.18
A&E attendances	>14 days	0.23 (0.58)	0.62 (0.85)	-0.39	0.38
Emergency bed-days	0-2 days	0.03 (0.22)	0.21 (0.59)	-0.18	0.12
Emergency bed-days	3-7 days	0.16 (0.80)	0.89 (1.70)	-0.73	0.18
Emergency bed-days	8-14 days	0.54 (1.96)	2.20 (3.46)	-1.66	0.24
Emergency bed-days	>14 days	3.51 (9.13)	8.81 (13.77)	-5.3	0.40
Elective bed-days	0-2 days	0.00 (0.05)	0.01 (0.09)	-0.01	0.35
Elective bed-days	3-7 days	0.03 (0.33)	0.06 (0.49)	-0.03	0.45
Elective bed-days	8-14 days	0.11 (1.00)	0.16 (1.06)	-0.05	0.66
Elective bed-days	>14 days	0.67 (4.01)	1.20 (5.64)	-0.53	0.58

Figure 3.19. Differences in hospital use between Marie Curie patients and controls, by time from index date to death

3.5 What was the impact of the Marie Curie Nursing Service on hospital costs?

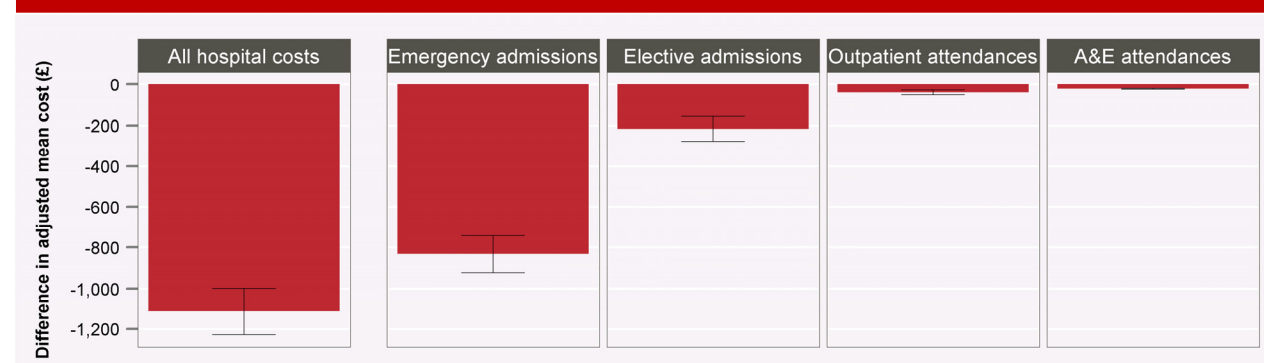
a) What was the overall difference in hospital costs between MCNS patients and controls?

Table 3.14 summarises the average costs per person of hospital care in the period after the index date until death. Linear regression analyses showed very significant differences in costs between MCNS patients and controls across all types of activity. Overall, a person who received MCNS care incurred over £1,100 less in hospital costs in the time between the index date and death, compared to a control over the same period. The vast bulk of the difference was accounted for by reductions in emergency admission costs, although significant reductions were seen across all types of hospital care.

Activity type	Mean (sd) hospital costs per person				
	Marie Curie	Matched controls	Crude difference	F Value	P value
Emergency admissions	£463 (£1,758)	£1,293 (£2,531)	- £830	2464.2	<.0001
Elective admissions	£106 (£961)	£350 (£1,736)	- £244	369.8	<.0001
Outpatient attendances	£33 (£212)	£76 (£340)	- £43	329.1	<.0001
A&E attendances	£9 (£34)	£31 (£60)	- £22	3586.3	<.0001
All hospital activity	£610 (£2,172)	£1,750 (£3,377)	- £1,140	2682.3	<.0001

Figure 3.20 plots the difference in adjusted mean costs between cases and controls by activity type.

Figure 3.20. Adjusted differences between Marie Curie patients and controls in average hospital costs (per person)



b) Did the difference in costs between Marie Curie Nursing Service patients and controls vary according to history of cancer?

The following sections report on a series of analyses testing whether the differences in hospital costs between cases and controls were concentrated in particular sub-groups. As described earlier, the key test in these analyses is whether the differences for particular groups are bigger or smaller than those seen overall between MCNS patients and controls.

Table 3.15 shows the mean costs of hospital care post-index date for cases and controls, divided by whether or not they had a history of cancer. Generally people with a history of cancer who received MCNS care had slightly higher costs than those without cancer.

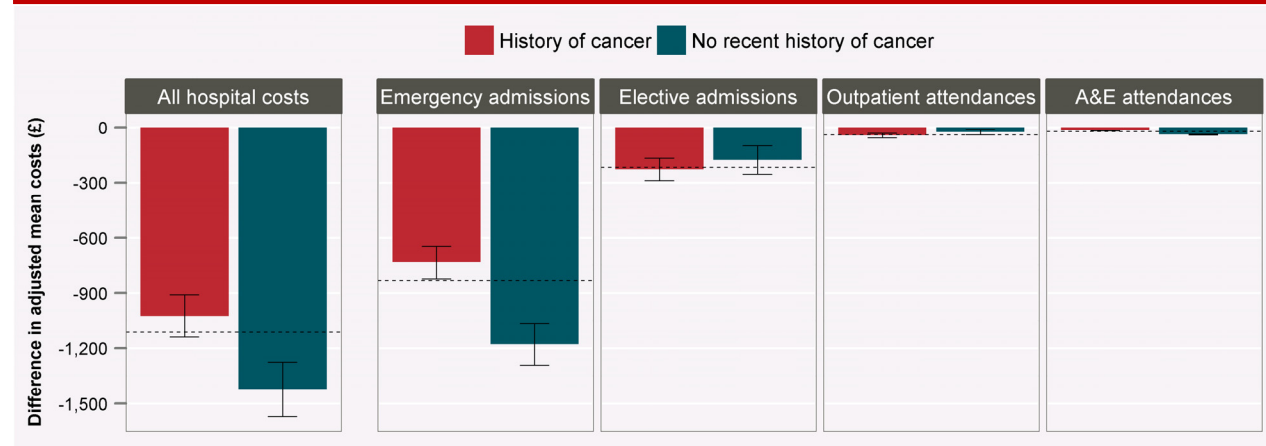
However, this was not true of controls where overall costs were higher for those without a recent history of cancer. The most striking effect was that the raw difference in secondary care costs between cases and controls was substantially greater for the group without cancer (£1,475 versus £1,044).

		Mean (sd) hospital costs per person		
Activity type	Group	Marie Curie	Matched controls	Crude difference
Emergency admissions	History of cancer	£470 (£1,758)	£1,197 (£2,529)	- £727
	No recent history of cancer	£438 (£1,758)	£1,629 (£2,509)	- £1,191
Elective admissions	History of cancer	£115 (£1,001)	£366 (£1,781)	- £251
	No recent history of cancer	£74 (£806)	£293 (£1,568)	- £219
Outpatient attendances	History of cancer	£35 (£227)	£83 (£373)	- £48
	No recent history of cancer	£24 (£147)	£50 (£175)	- £26
A&E attendances	History of cancer	£8 (£32)	£26 (£56)	- £18
	No recent history of cancer	£10 (£41)	£50 (£67)	- £40
All hospital activity	History of cancer	£628 (£2,195)	£1,672 (£3,435)	- £1,044
	No recent history of cancer	£547 (£2,088)	£2,022 (£3,149)	- £1,475

Figure 3.21 plots the difference in adjusted mean hospital costs per person between MCNS patients and controls, by history of cancer. The dotted line is the overall difference in adjusted costs between MCNS cases and controls. Where confidence intervals for a sub-group overlap the overall group difference, then we can conclude that the effect is significantly different in that sub-group.

The reduction in total hospital costs among MCNS patients was significantly greater than the overall group difference for those without a recent history of cancer. This was largely due to lower costs of emergency admissions and A&E attendances. The reduction in the costs of planned care among MCNS patients was similar regardless of cancer history.

Figure 3.21. Adjusted differences between Marie Curie patients and controls in average hospital costs, by history of cancer



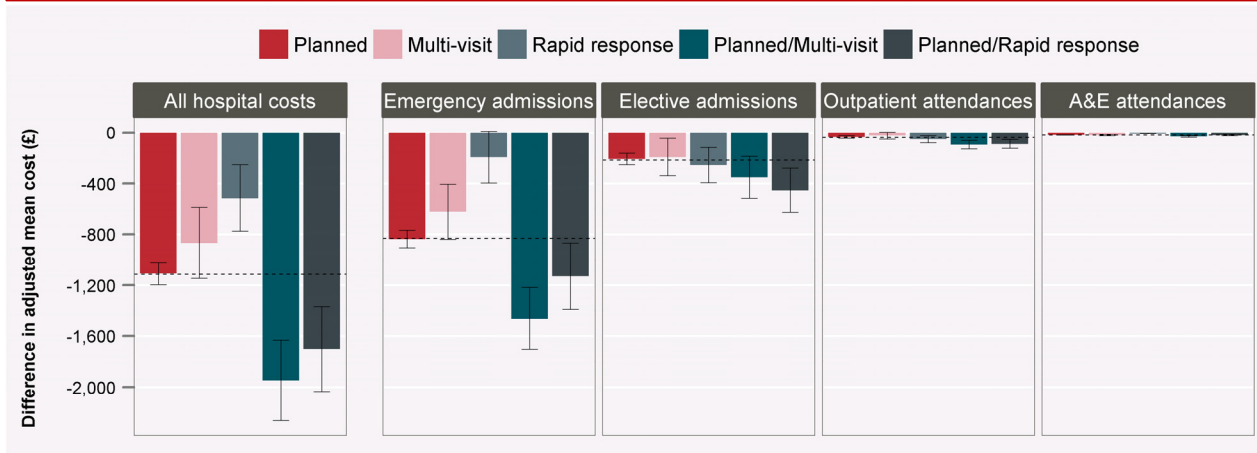
c) *Was the difference in costs between MCNS patients and controls affected by the type of MCNS care?*

Table 3.16 summarises the average hospital care costs after the index date until death of MCNS patients and controls, split by the type of service received (every control was assigned the Marie Curie service type of their matched case). The costs of hospital care after the index date for those who received MCNS care were higher among those who received multi-visit or rapid response care only, and lowest for those who received only planned care. This was largely driven by differences in the costs of emergency admissions.

Table 3.16. Post-index date hospital costs for Marie Curie patients and matched controls, by type of service				
		Mean (sd) hospital costs per person		
Activity type	Service type	Marie Curie	Matched controls	Crude difference
Emergency admissions	Planned	£439 (£1,729)	£1,275 (£2,524)	-£836
Emergency admissions	Multi-visit only	£873 (£2,136)	£1,486 (£2,473)	-£613
Emergency admissions	Rapid response only	£769 (£1,921)	£948 (£2,125)	-£179
Emergency admissions	Planned/Multi-visit	£540 (£1,961)	£2,022 (£3,057)	-£1,482
Emergency admissions	Planned/Rapid response	£579 (£2,033)	£1,706 (£2,747)	-£1,127
Elective admissions	Planned	£100 (£962)	£337 (£1,709)	-£237
Elective admissions	Multi-visit only	£204 (£1,093)	£414 (£1,810)	-£210
Elective admissions	Rapid response only	£148 (£856)	£435 (£2,055)	-£287
Elective admissions	Planned/Multi-visit	£140 (£894)	£503 (£1,698)	-£363
Elective admissions	Planned/Rapid response	£144 (£956)	£636 (£2,401)	-£492
Outpatient attendances	Planned	£32 (£215)	£72 (£332)	-£40
Outpatient attendances	Multi-visit only	£54 (£189)	£87 (£299)	-£33
Outpatient attendances	Rapid response only	£37 (£141)	£92 (£379)	-£55
Outpatient attendances	Planned/Multi-visit	£53 (£231)	£161 (£434)	-£108
Outpatient attendances	Planned/Rapid response	£40 (£154)	£141 (£559)	-£101
A&E attendances	Planned	£8 (£34)	£31 (£60)	-£23
A&E attendances	Multi-visit only	£12 (£41)	£35 (£59)	-£23
A&E attendances	Rapid response only	£12 (£40)	£21 (£47)	-£9
A&E attendances	Planned/Multi-visit	£11 (£46)	£47 (£78)	-£36
A&E attendances	Planned/Rapid response	£14 (£46)	£37 (£65)	-£23
All hospital activity	Planned	£579 (£2,137)	£1,716 (£3,348)	-£1,137
All hospital activity	Multi-visit only	£1,142 (£2,635)	£2,022 (£3,308)	-£880
All hospital activity	Rapid response only	£967 (£2,218)	£1,496 (£3,324)	-£529
All hospital activity	Planned/Multi-visit	£745 (£2,366)	£2,732 (£3,885)	-£1,987
All hospital activity	Planned/Rapid response	£777 (£2,795)	£2,520 (£4,143)	-£1,743

Figure 3.22 plots the differences in adjusted mean costs between cases and controls, by activity and service type. The differences in costs between cases and controls for those who received planned care were exactly in line with the overall group effect. This is unsurprising, as this group made up the vast majority of the cohort. Compared to controls, those who received rapid response care had significantly smaller reductions in overall hospital costs. This was largely due to a much smaller difference in emergency admission costs. The differences in costs for those who received multi-visit care generally were in line with the overall difference, although strongly tending towards smaller cost reductions. Those cases who received multi-visit or rapid response services in addition to planned care showed significantly greater reductions in costs compared to controls.

Figure 3.22. Adjusted differences between Marie Curie patients and controls in average hospital costs, by type of service



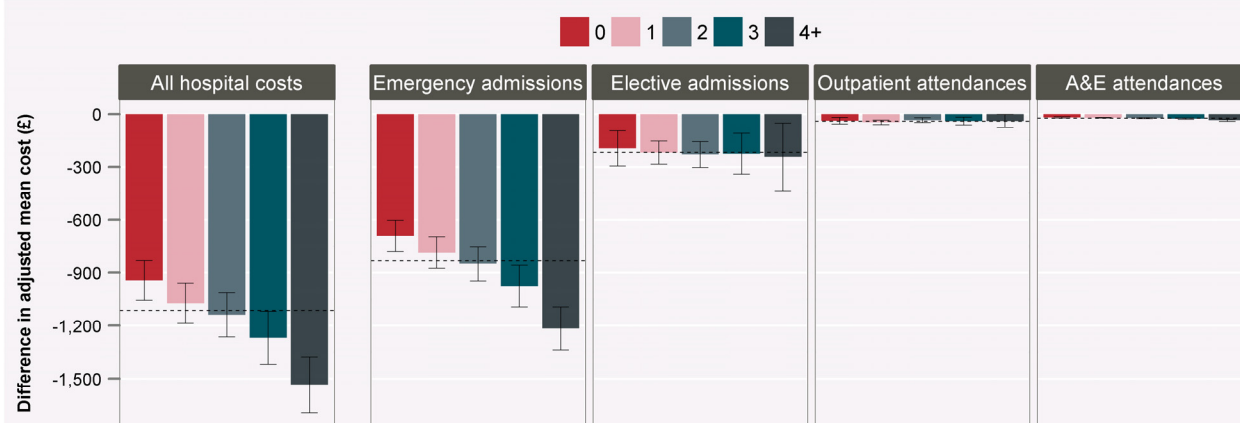
d) *Did the number of chronic illnesses affect cost differences between Marie Curie Nursing Service patients and controls?*

Table 3.17 shows the crude mean costs of hospital care per person between the index date and death split by the number of LTCs recorded on hospital admissions. Unsurprisingly, hospital costs increased with the number of LTCs for both MCNS patients and controls, driven predominantly by increasing emergency admission costs.

Figure 3.23 plots the difference in the adjusted mean costs between MCNS cases and controls, by type of hospital care and the number of LTCs. Previously we showed a significantly larger reduction in emergency bed-day use for MCNS patients with at least three chronic conditions, but a smaller reduction among those with no chronic illnesses (Figure 3.18 on page 36). Consistent with that, the analysis of costs showed that the reduction in hospital costs among MCNS patients was significantly larger than the overall effect for those with three (-£1,269) or four-plus LTCs (-£1,534), while it was much lower for those with no chronic conditions recorded (-£943). These differences were primarily due to significant changes in costs associated with emergency admissions and A&E attendances. For planned inpatient and outpatient care, the cost differences between cases and controls were in line with the overall group effect, regardless of the number of LTCs.

Table 3.17. Post-index date hospital costs for Marie Curie patients and matched controls, by number of LTCs

		Mean (sd) hospital costs per person		
Activity type	Number of LTCs	Marie Curie	Matched controls	Crude difference
Emergency admissions	0	£414 (£1,645)	£1,099 (£2,208)	-£685
Emergency admissions	1	£452 (£1,743)	£1,227 (£2,476)	-£775
Emergency admissions	2	£466 (£1,688)	£1,334 (£2,569)	-£868
Emergency admissions	3	£528 (£2,071)	£1,532 (£2,897)	-£1,004
Emergency admissions	4+	£562 (£1,871)	£1,786 (£3,047)	-£1,224
Elective admissions	0	£98 (£845)	£309 (£1,528)	-£211
Elective admissions	1	£110 (£943)	£355 (£1,865)	-£245
Elective admissions	2	£110 (£957)	£376 (£1,728)	-£266
Elective admissions	3	£125 (£1,243)	£384 (£1,928)	-£259
Elective admissions	4+	£93 (£993)	£375 (£1,764)	-£282
Outpatient attendances	0	£31 (£183)	£72 (£296)	-£41
Outpatient attendances	1	£32 (£204)	£82 (£421)	-£50
Outpatient attendances	2	£35 (£225)	£73 (£261)	-£38
Outpatient attendances	3	£39 (£306)	£82 (£363)	-£43
Outpatient attendances	4+	£32 (£164)	£73 (£313)	-£41
A&E attendances	0	£7 (£29)	£26 (£51)	-£19
A&E attendances	1	£8 (£31)	£28 (£55)	-£20
A&E attendances	2	£9 (£37)	£33 (£60)	-£24
A&E attendances	3	£10 (£40)	£38 (£69)	-£28
A&E attendances	4+	£13 (£45)	£49 (£80)	-£36
All hospital activity	0	£550 (£1,983)	£1,506 (£2,967)	-£956
All hospital activity	1	£600 (£2,140)	£1,692 (£3,394)	-£1,092
All hospital activity	2	£619 (£2,143)	£1,815 (£3,374)	-£1,196
All hospital activity	3	£701 (£2,630)	£2,036 (£3,898)	-£1,335
All hospital activity	4+	£700 (£2,290)	£2,284 (£3,856)	-£1,584

Figure 3.23. Adjusted differences between Marie Curie patients and controls in average hospital costs, by number of LTCs

e) *Was the impact of Marie Curie Nursing Service care on hospital costs affected by the time from index date to death?*

Earlier we showed that a longer time between the index date and death was associated with a much greater reduction in hospital use (Figures 3.15 and 3.19; pages 30 and 37) among MCNS patients.

Table 3.18 summarises the average costs of hospital care for MCNS patients and matched controls split by the time from the index date until death. Unsurprisingly, hospital costs increased with a longer period between index date and death for both cases and controls. This was true across all types of hospital care. Across all activity types there is a clear gradient, with the difference in the average cost per person between MCNS cases and controls increasing with more time between the index date and death. The difference in the unadjusted mean costs per person between cases and controls increased from £176 for those who only received care in the last two days of life, to nearly £2,300 for those where the period from index date to death was more than two weeks.

Table 3.18. Post-index date hospital costs for Marie Curie patients and controls, by time from index date to death

		Mean (sd) hospital costs per person		
Activity type	Time from index date to death	Marie Curie	Matched controls	Crude difference
Emergency admissions	0-2 days	£15 (£142)	£148 (£553)	-£133
Emergency admissions	3-7 days	£108 (£557)	£593 (£1,241)	-£485
Emergency admissions	8-14 days	£260 (£939)	£1,091 (£1,684)	-£831
Emergency admissions	>14 days	£1,156 (£2,790)	£2,745 (£3,584)	-£1,589
Elective admissions	0-2 days	£1 (£42)	£35 (£245)	-£34
Elective admissions	3-7 days	£10 (£136)	£113 (£679)	-£103
Elective admissions	8-14 days	£38 (£389)	£194 (£843)	-£156
Elective admissions	>14 days	£288 (£1,617)	£834 (£2,806)	-£546
Outpatient attendances	0-2 days	£4 (£35)	£4 (£31)	£0
Outpatient attendances	3-7 days	£9 (£99)	£12 (£67)	-£3
Outpatient attendances	8-14 days	£17 (£138)	£29 (£103)	-£12
Outpatient attendances	>14 days	£80 (£336)	£200 (£558)	-£120
A&E attendances	0-2 days	£1 (£9)	£10 (£30)	-£9
A&E attendances	3-7 days	£2 (£15)	£19 (£40)	-£17
A&E attendances	8-14 days	£5 (£22)	£28 (£47)	-£23
A&E attendances	>14 days	£21 (£53)	£57 (£81)	-£36
All hospital activity	0-2 days	£21 (£155)	£197 (£611)	-£176
All hospital activity	3-7 days	£130 (£592)	£737 (£1,400)	-£607
All hospital activity	8-14 days	£320 (£1,036)	£1,342 (£1,846)	-£1,022
All hospital activity	>14 days	£1,546 (£3,451)	£3,837 (£4,856)	-£2,291

Figure 3.24 plots the difference in adjusted means between cases and controls. For MCNS patients where the post-index date period was more than 14 days, the cost reduction compared to controls was very significantly greater than the overall group effect for all types of activity. Conversely, for those who received care for a week or less, the cost reductions across all types of hospital care were significantly less than the overall difference.

Figure 3.24. Adjusted differences between Marie Curie patients and controls in average hospital costs, by time from index date until death

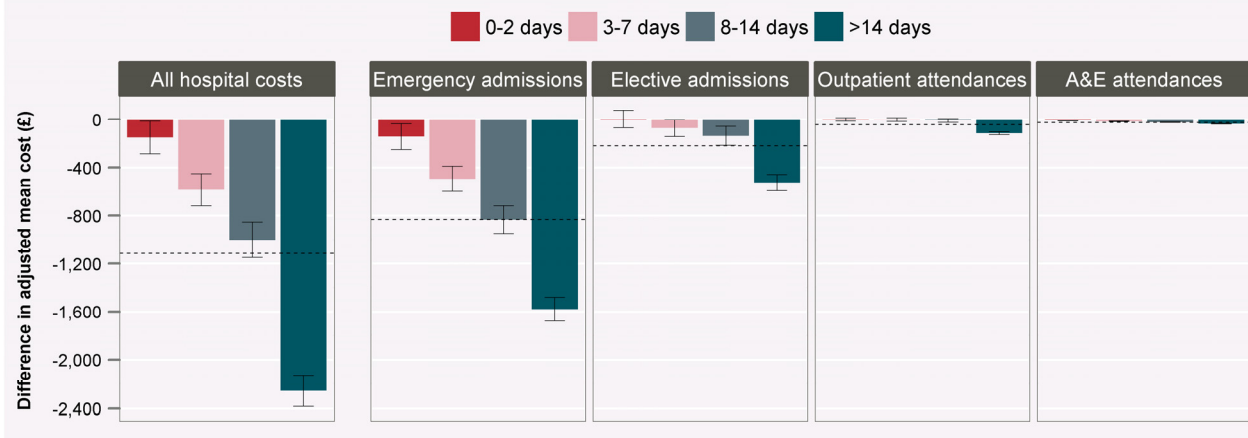
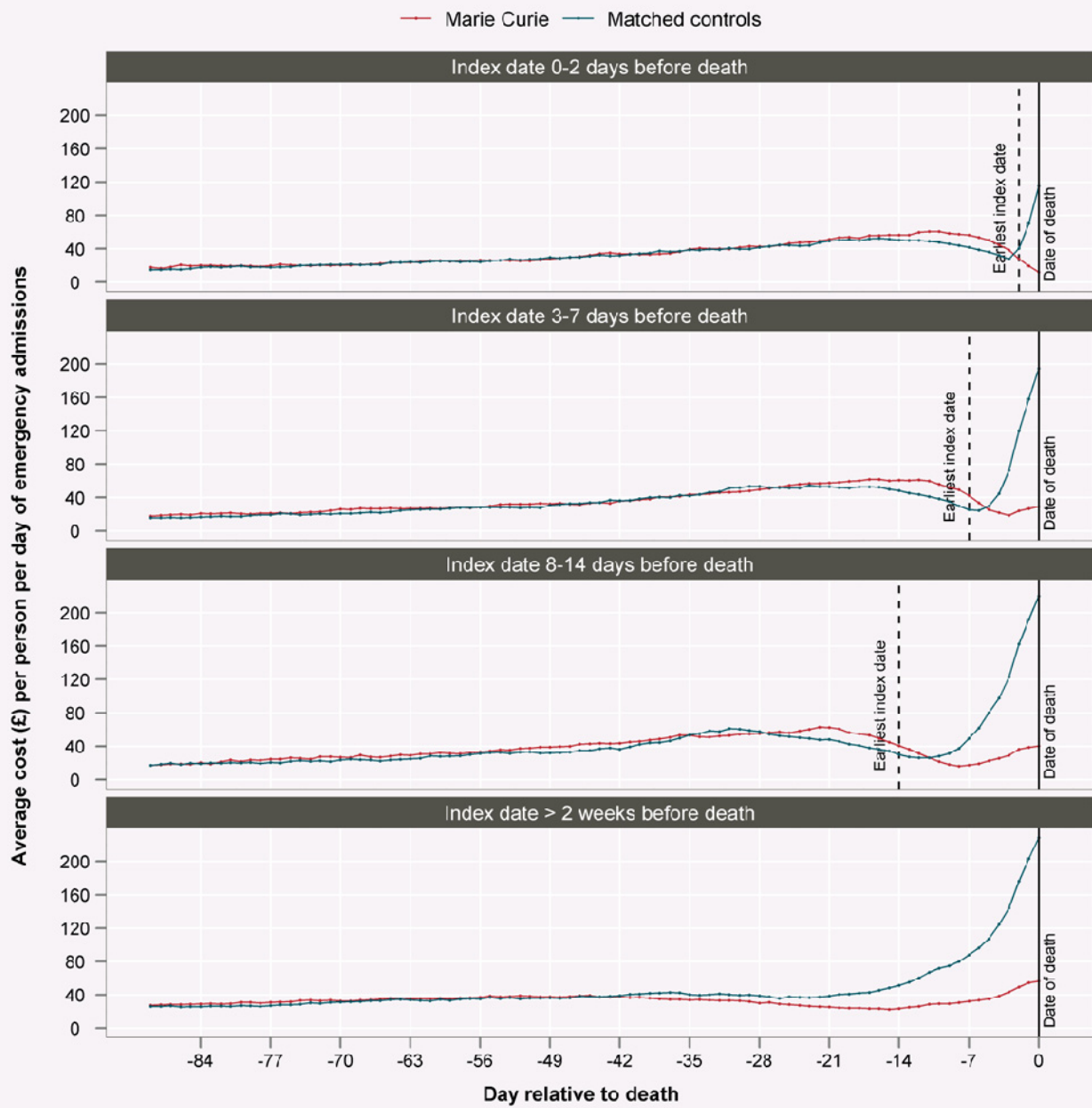


Figure 3.25 displays the average cost of emergency hospital care per person by day (relative to death). Each plot is for a different subset of MCNS patients and controls, split by their index date relative to death. It shows that the MCNS cases and controls were well matched in terms of average cost per day before the index date, but that after the index date costs stayed relatively stable or fell in those who received MCNS care, but rose sharply among matched controls in all subsets.

Figure 3.25. Average cost of emergency inpatient care by day for three months before death, by index date

4. Discussion

Summary

This study investigated hospital use, hospital costs and place of death among a large cohort of people who received Marie Curie Nursing Service (MCNS) care at the end of life, and a group of matched controls. The key findings were that people who received MCNS care were more than twice as likely to die at home as were matched controls (76.7% versus 34.9%). Those who received MCNS care also had significantly lower hospital use than controls: this was seen for all types of hospital activity, including unplanned and planned inpatient admissions, outpatient attendances and A&E attendances. The differences in hospital use between MCNS patients and matched controls were large: those who received MCNS care had around a third of the number of emergency admissions and A&E attendances compared to controls, and fewer than half the number of elective admissions and outpatient attendances. As a consequence, the costs of hospital care for those who received MCNS care were lower than controls, with an average reduction of more than £1,100 per person. However, this does not represent an absolute cost saving, as other costs – such as providing MCNS care – would need to be offset against this figure.

Comparison to previous studies and sub-group effects

Our overall findings of a higher rate of home deaths, and lower hospital use and costs among those who received home-based end-of-life care, are broadly consistent with the existing literature (Alonso-Babarro and others, 2011; 2012; Barbera and others, 2010; Brumley and others, 2007; Costantini and others, 2003; Gomes and Higginson, 2006; Gómez-Batiste and others, 2012; Lorenz and others, 2008; National Audit Office, 2008; Serra-Prat and others, 2001; Tamir and others, 2007).

One of the more surprising findings of this study was that the differences between cases and controls were generally larger for people with no recent history of cancer than for those who had cancer. Compared to matched controls, MCNS patients with no recent history of cancer were more likely to die at home than those with cancer. The average difference in hospital costs between cases and controls was around £1,000 for people with cancer, but nearly £1,500 for those with other conditions. Most studies have focused on people with cancer, and the evidence for the benefits of palliative care has generally been found to be stronger for cancer (Lorenz and others, 2008). However, a randomised trial of people with multiple sclerosis found that the direct and indirect costs of those who received multidisciplinary palliative care were around £1,800 lower than controls (Higginson and others, 2009).

It is worth noting that in a census of PCT commissioners, people with conditions other than cancer were reported as having the greatest level of unmet need for palliative care services in England (National Audit Office, 2008). While the proportion of people who receive specialist palliative care who have non-cancer illnesses is rising, only 10% of people who receive palliative home care have a non-cancer diagnosis (National Council for Palliative Care, 2012). Also, evidence from a recent survey of the bereaved showed that relatives of people without cancer rated the quality of hospice care and pain control as worse than relatives of people with cancer (Office for National Statistics, 2011b). This raises the possibility that services such as home-based palliative care may provide

an effective service model for this group of people. However, the non-cancer cohort had a wide range of diagnoses; therefore future studies should consider whether there are conditions that particularly benefit from home-based palliative care.

Our results showed that the type of home-based end-of-life care was a significant factor on hospital utilisation and costs. People who received the 'standard' planned service of nine-hour day or overnight care (either alone, or in conjunction with other types of MCNS care) were much more likely to die at home than those who only received multi-visit or rapid response services. Similarly, for people who received the planned package of care, the average cost reduction compared to controls was around £1,100, while it was significantly smaller for those who received only multi-visit or rapid response care at around £900 and £500, respectively. Those who received multi-visit or rapid response care in addition to planned care had the biggest reduction in costs compared to controls. However, the number of MCNS patients who received a service other than planned care alone was small, and so significant caution is needed in interpreting these results.

An interesting pattern emerged around the effect of the time of the first contact with the MCNS. Consistent with an earlier study (Higginson and Wilkinson, 2002), people whose first home-care visit was closer to death had a higher likelihood of dying at home than those who were in contact with the MCNS for longer. However, compared to matched controls, much greater reductions in hospital activity and costs were seen among cases that were in earlier contact with the MCNS. For those who started receiving MCNS care at least two weeks before death, the average reduction in hospital costs was over £2,200 per person.

One explanation for this is that there was a much greater opportunity to influence future hospital use among people who began to receive MCNS care earlier. However, those people who started receiving MCNS care earlier also had much more chance for things to go wrong and therefore to end up being admitted to hospital close to death. Those who only started receiving MCNS care later had managed to remain at home until very close to death, perhaps because their condition was relatively well managed, or because they had access to family or other support that enabled them to live at home. For them, there was a very short window in which they might develop problems necessitating hospital admission. It should also be noted that regardless of when they first began to receive the service, people who received MCNS care were consistently much more likely to die at home than were controls.

The proportion of people who died in a hospice was significantly lower among those who received MCNS care than among matched controls (13.0% versus 21.5%). Interestingly, the proportion of MCNS patients that died in a hospice fell sharply for those who only received care in the last few days of life (Figure 3.14, page 28). One interpretation of this is that MCNS care may, for some people, be sufficient to allow them to die at home, where otherwise they would need to go into hospice care. However, this is speculative as we did not have information on individuals' preferred place of death.

One of our secondary analyses focused on whether the impact of MCNS care differed according to the degree of morbidity. We found limited evidence of any differential effect: the difference in the proportion of home deaths between cases and controls was

very similar regardless of the number of LTCs. In terms of hospital activity, we observed a significantly greater reduction in emergency bed-day use among people with more chronic illnesses. This in turn led to an increasing difference in hospital costs between case and controls as a function of chronic disease burden; compared to controls MCNS patients with no recorded chronic conditions had an average cost reduction of around £950, but this rose to over £1,500 in those with four or more illnesses.

Strengths and weaknesses of the analysis

Our results suggest that people who receive MCNS care have lower hospital use and hospital costs than matched controls. However, this was not a full economic evaluation, and so it is likely that at least some of these cost differences might be accounted for by other services. Obviously there is the cost of providing the MCNS itself. However, it is also possible that keeping people at home at the end of life would increase the demand for other community services, including district nursing, primary care and social care. Future work should explore the impact of home-based nursing services on the broader set of health and care services (National End of Life Care Programme, 2012). The Palliative Care Funding Pilot sites set up as a result of the recent palliative care funding review may provide relevant information on the costs of these services (Hughes-Hallett and others, 2011). As well as the direct costs of health and care services, future studies should also take account of the indirect costs to family members and other carers of a person remaining at home at the end of life.

While there have been a number of studies that have investigated the effect of home care on hospital use and place of death, including RCTs, we believe this is the first large-scale retrospective study that has sought to use matched controls. The main weakness in non-randomised studies is that there may be systematic differences between intervention and non-intervention patients that are not taken into account in the analysis. Although the groups in this evaluation were similar in terms of demographic and clinical characteristics, prior hospital use and hospital costs, there are likely to be characteristics that influence individuals' suitability for home-based end-of-life care that are not recorded in routine administrative data. For example, groups could have differed in terms of the availability of family or other carer support, as well as their preferred place of death. This could potentially have a large impact on the findings if, for example, MCNS patients were more amenable to home care or had greater informal support than controls. Future research should aim to explore the potential impact of these factors, for example through an RCT.

The limits of the accuracy of the matching are also relevant when considering the impact of different types of MCNS care. We found that the difference in hospital costs between cases and controls was smaller for those cases who received rapid response care compared other types of MCNS care. Rapid response care is provided in the event of a crisis, as an alternative to 999 services. Therefore, ideally a control group for this subset of cases would have consisted of people who also had a crisis. This is potentially feasible, although tricky, and was beyond the scope of this evaluation. Therefore it may be that the controls for this small subset of cases were not well matched on what might be an important characteristic. This might partly explain the relatively small impact of MCNS care seen for this group.

The analyses of impact on hospital use relied on an assumption that MCNS care did not alter remaining life expectancy. Thus, the hospital use of controls was analysed over the same number of days as for MCNS cases. Palliative and end-of-life care might either reduce survival time (if it means that patients choose to cease intensive hospital care that prolongs life), or extend it (due to improved symptom control and quality of life). There is little evidence on this, although a study of people with metastatic lung cancer found that those who had early access to palliative care survived longer than those who did not receive early palliative care (Temel and others, 2010).

Although none of the matched controls had received MCNS care, it is very likely that some of them received inpatient, community or home-based palliative care from an NHS or voluntary organisation, including hospices. Routine information flows do not currently exist to capture much of this activity, and so the extent of it is unknown. However, the aim of this study was to compare people who received MCNS care against those receiving 'usual care'. As such, 'usual care' could be expected to reflect a wide range of care pathways. These pathways are likely to incur widely different costs and so future research should examine these further.

Implications

The size of the end-of-life population who might benefit from the type of home-based care offered by the MCNS is unclear. It is possible that such services are already provided to most of those for whom they would be suitable; that is, the saturation point has been reached. However, a recent review of palliative care funding in England (Hughes-Hallett and others, 2011) suggested that around 75% of the nearly 500,000 people who die each year would be suitable for some form of palliative care. They also estimated that around 90,000 people who would benefit from palliative care die each year without receiving any. This suggests that there is significant potential to increase the number of people who have access to such services.

In an increasingly tight financial climate for public services, there is a drive to identify models of service delivery that can reduce demand for expensive hospital care while maintaining or improving the quality and experience of patient care. End-of-life care is one of the 12 workstreams of the government's QIPP (Quality, Innovation, Productivity and Prevention) programme. Key aims are to increase the number of people dying in their usual place of residence, and to reduce the number of emergency admissions in the last year of life. Our findings are clearly relevant to the policy goals of this programme, in that they provide evidence of the potential benefits of home-based end-of-life nursing schemes, such as that operated by Marie Curie. Our results provide support for increasing investment in such services so as to improve care for people at the end of life.

Appendix A – Characteristics of those receiving Marie Curie Nursing Service care

This appendix provides further details on the demographic and clinical characteristics of people who received Marie Curie Nursing Service (MCNS) care. It explores whether the characteristics of people who received care differed according to the type of nursing service that they received.

Using the activity data provided by Marie Curie, each individual in the cohort was assigned to one of five service types:

- Planned – those who received planned or reactive care only.
- Multi-visit – those who received multi-visit care only.
- Rapid response – those who received rapid response care only.
- Planned/Multi-visit – those who received both planned and multi-visit care.
- Planned/Rapid response – those who received both planned and rapid response care.

Figures A1 and A2 summarise the demographic characteristics of the five groups. Those who received planned care accounted for the vast majority of the cohort. This is not surprising as the other service models are relatively recent innovations. The groups were relatively similar on most demographic measures. However, those who received multi-visit or rapid response care only were much less likely to die at home, and more likely to die in hospital, than those who received planned care, either alone or in combination with one of the other service types. Interestingly, nearly 20% of those who received rapid response care died in a care home, although the group size was relatively small. The groups were also similar on prevalence of most diagnoses.

Figure A1. Characteristics of people who received Marie Curie care, by type of service

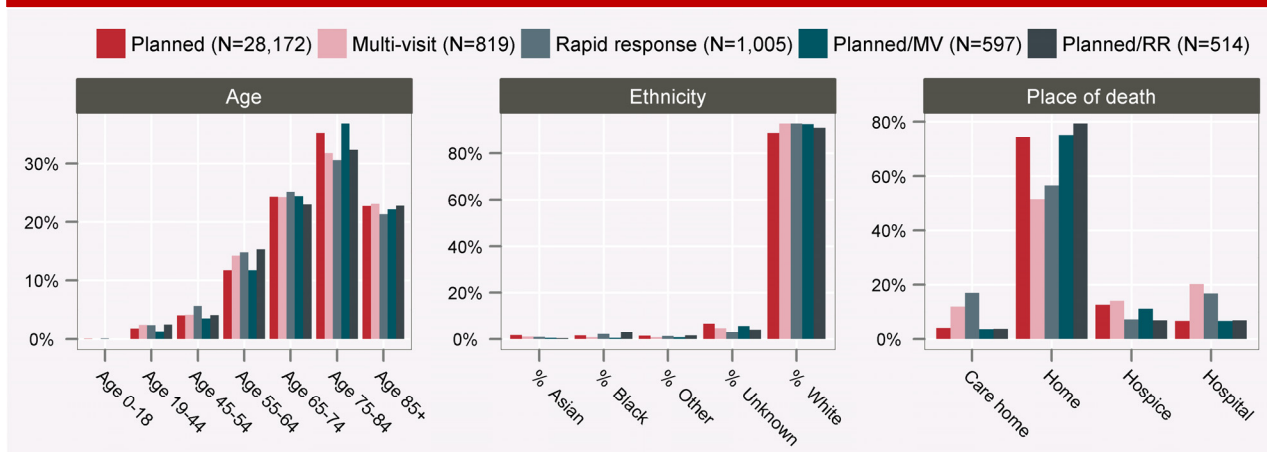


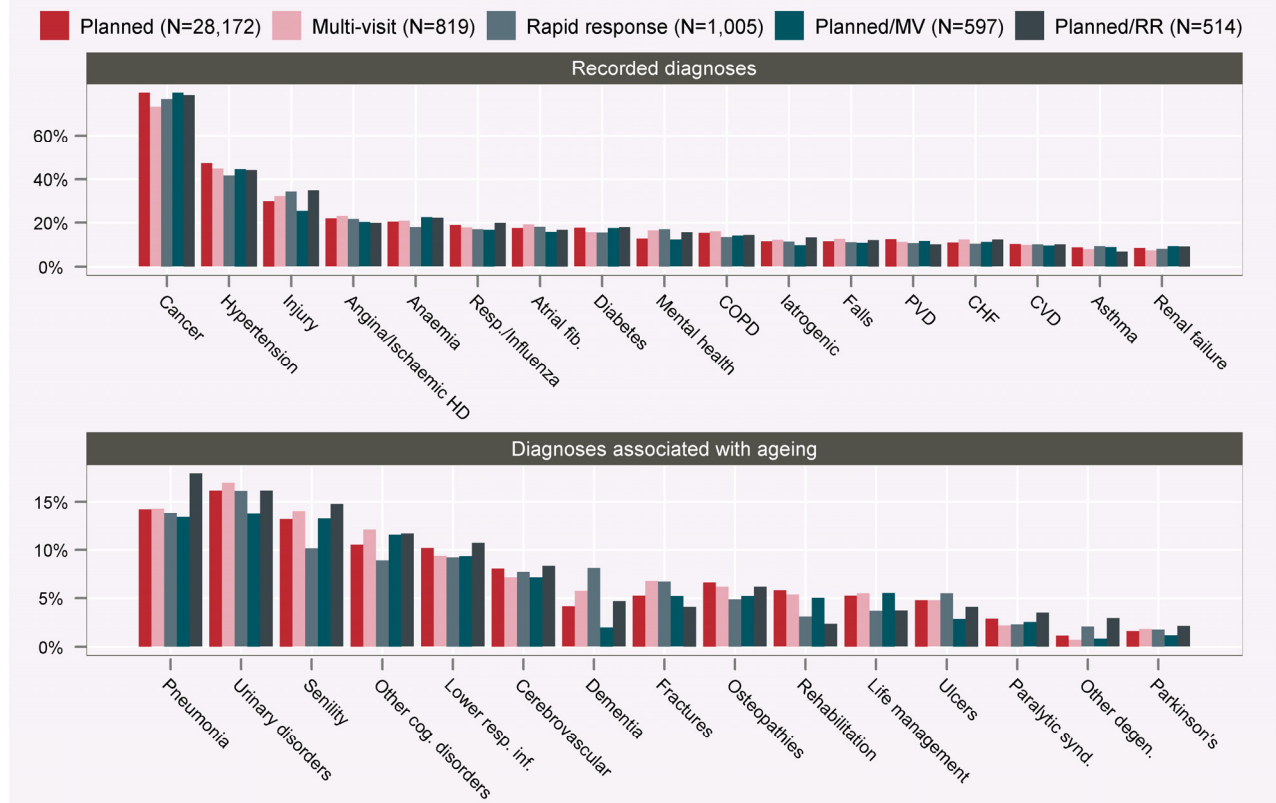
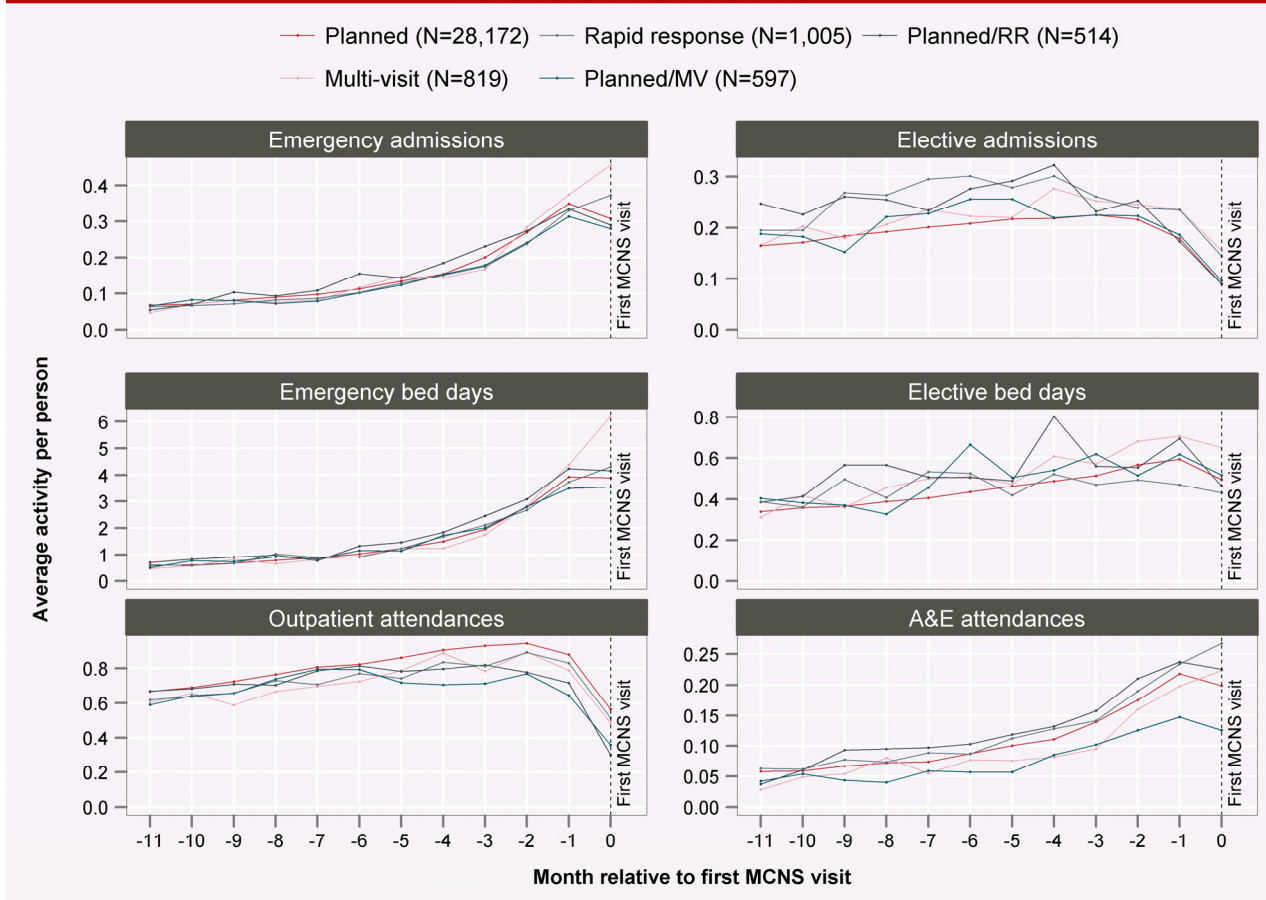
Figure A2. Clinical characteristics of Marie Curie cohort, by type of service

Table A1 summarises the average amount of MCNS care people received, split by type of service. On average, people received around six visits each, with around 52 hours of care in total. This was largely due to people that received planned care only, who made up the vast majority of the cohort. Those people who received both planned and multi-visit services had the highest number of visits and hours of care.

Table A1. Intensity of Marie Curie care by service type

Service type	Number of people	Mean (sd) number of visits		Mean (sd) number of hours	
		Planned	Multi-visit/Rapid response	Planned	Multi-visit/Rapid response
Planned	28,172	6.0 (11.7)	-	51.0 (96.7)	-
Multi-visit	819	-	8.3 (21.4)	-	7.9 (15.7)
Rapid response	1,005	-	2.7 (3.6)	-	2.1 (21.7)
Planned/Multi-visit	597	9.1 (15.8)	22.7 (55.4)	75.7 (134.1)	18.6 (39.3)
Planned/Rapid response	514	7.4 (15.9)	4.4 (4.4)	64.7 (136.5)	2.3 (3.0)
Overall	31,107	6.1 (11.9)	8.7 (28.6)	51.8 (98.5)	7.1 (24.2)

Figure A3 plots the average hospital activity per person for the 12 months prior to receiving MCNS care, by the type of service that people received. There were no clear differences between the groups in prior hospital use. Across all service types, unplanned hospital use increased in the 12 months beforehand, while planned activity began to drop in the month or two before people first received MCNS care.

Figure A3. Hospital activity for Marie Curie cohort in year before receiving care, by type of service

Appendix B – Further information on matching

Tables B1–B3 summarise differences between MCNS patients and controls before matching (B1), after matching (B2), and for the subset of MCNS patients and controls who did not have a recent history of cancer (B3).

Table B1. Standardised differences between Marie Curie cases and pool of potential controls before matching				
Type	Measure	Marie Curie	Potential controls	Standardised difference
Age	Mean age	74.8 (12.1)	77.3 (13.2)	20.0%
Sex	Female	47.0%	49.2%	4.3%
Deprivation	Deprivation (mean IMD)	20.1 (14.3)	22.7 (15.8)	17.5%
Ethnicity	White	89.2%	87.6%	4.7%
Number of conditions	Long-term conditions	1.5 (1.5)	1.6 (1.7)	6.4%
	Cancers	1.6 (1.35)	0.5 (1.0)	91.0%
	Conditions associated with ageing	0.7 (1.0)	0.9 (1.2)	15.6%
Comorbidities	Diabetes	17.5%	16.9%	1.6%
	Hypertension	46.7%	44.3%	4.9%
	CHF	10.8%	15.5%	13.8%
	COPD	15.3%	15.9%	1.6%
	Injury	30.0%	30.9%	1.8%
	Falls	11.0%	17.1%	17.7%
	Non-rheumatic valve disorder	3.4%	4.7%	6.6%
	Mental health	12.4%	16.8%	12.4%
	Ischaemic heart disease	18.8%	21.7%	7.3%
	Asthma	8.6%	8.2%	1.5%
	Angina	10.8%	12.4%	4.9%
	Anaemia	20.4%	16.4%	10.3%
	Atrial fibrillation	17.3%	21.5%	10.8%
	CVD	10.0%	12.5%	7.8%
	Arthritis/connective tissue disorders	3.5%	3.8%	1.8%
	PVD	12.3%	12.8%	1.4%
	Renal failure	8.3%	9.3%	3.8%
	Respiratory/Influenza	19.1%	15.6%	9.1%
Diagnoses associated with ageing	Parkinson's disease	1.6%	2.1%	3.9%
	Paralytic syndromes	2.8%	2.8%	0.4%
	Cerebrovascular illness	7.9%	11.0%	10.5%
	Pneumonia	14.3%	15.4%	3.1%
	Lower respiratory infection	10.1%	10.3%	0.7%
	Ulcers	4.6%	7.0%	10.2%
	Osteopathies	6.5%	7.0%	2.0%
	Urinary disorders	15.7%	18.0%	6.0%
	Other cognitive disorders	10.3%	10.8%	1.7%
	Senility	12.8%	14.7%	5.3%
	Fractures	5.1%	8.4%	13.2%
	Rehabilitation	5.5%	8.3%	10.8%
	Life management	5.0%	5.9%	3.6%
	Dementia	3.7%	8.8%	21.0%
Cancer diagnoses	Head/Neck	3.5%	1.4%	13.6%
	Other (CUP)	22.6%	7.2%	44.3%
	Upper GI	29.4%	8.6%	55.0%
	Lower GI	12.4%	4.4%	29.3%
	Acute leukaemia	0.9%	0.5%	4.5%
	Other haematological cancer	4.2%	2.8%	7.2%
	Prostate	7.7%	3.5%	18.6%
	Urological	6.8%	2.9%	18.0%
	Lung	30.7%	9.5%	54.8%
	Sarcoma	22.3%	6.6%	45.9%
	Breast	5.0%	2.2%	14.6%
	Skin	2.1%	0.7%	11.8%
	Brain/CNS	10.8%	2.2%	35.3%
	Gynaecological	4.5%	1.7%	16.4%

Table B2. Standardised differences between Marie Curie patients and controls after matching

Type	Measure	Marie Curie	Matched controls	Standardised difference
Age	Mean age	74.8 (12.1)	74.7 (11.4)	1.1%
Sex	Female	47.0%	47.0%	0.0%
Deprivation	Deprivation (mean IMD)	20.1 (14.3)	19.5 (13.3)	3.9%
Ethnicity	White	89.2%	91.2%	6.9%
Number of conditions	Long-term conditions	1.50 (1.52)	1.43 (1.42)	4.8%
	Cancers	1.63 (1.35)	1.58 (1.30)	3.9%
	Conditions associated with ageing	0.70 (0.97)	0.65 (0.96)	5.3%
Comorbidities	Diabetes	17.5%	16.2%	3.5%
	Hypertension	46.7%	47.1%	0.8%
	CHF	10.8%	9.7%	3.9%
	COPD	15.3%	15.3%	0.0%
	Injury	30.0%	28.9%	2.6%
	Falls	11.0%	11.4%	1.5%
	Mental health	12.4%	12.0%	1.3%
	Ischaemic heart disease	18.8%	17.7%	2.7%
	Asthma	8.6%	7.9%	2.5%
	Angina	10.8%	10.1%	2.2%
	Anaemia	20.4%	18.8%	4.1%
	Atrial fibrillation	17.3%	17.5%	0.6%
	CVD	10.0%	9.1%	3.1%
	PVD	12.3%	12.1%	0.6%
	Renal failure	8.3%	7.0%	4.7%
	Respiratory/Influenza	19.1%	17.4%	4.3%
Diagnoses associated with ageing	Paralytic syndromes	2.8%	2.3%	3.1%
	Cerebrovascular illness	7.9%	7.4%	2.2%
	Pneumonia	14.3%	13.3%	2.9%
	Lower respiratory infection	10.1%	9.4%	2.3%
	Ulcers	4.6%	4.2%	1.9%
	Osteopathies	6.5%	6.2%	1.1%
	Urinary disorders	15.7%	13.9%	5.2%
	Other cognitive disorders	10.3%	8.7%	5.5%
	Senility	12.8%	11.8%	3.0%
	Fractures	5.1%	5.8%	3.2%
	Rehabilitation	5.5%	6.0%	1.8%
	Life management	5.0%	4.3%	3.5%
	Dementia	3.7%	3.9%	0.9%
Cancer diagnoses	Head/Neck	3.5%	2.8%	4.2%
	Other (CUP)	22.6%	22.3%	0.7%
	Upper GI	29.4%	28.9%	1.1%
	Lower GI	12.4%	12.2%	0.8%
	Acute leukaemia	0.9%	0.7%	2.9%
	Other haematological cancers	4.2%	4.2%	0.2%
	Prostate	7.7%	7.6%	0.7%
	Urological	6.8%	5.5%	5.5%
	Lung	30.7%	30.5%	0.6%
	Sarcoma	22.3%	21.9%	0.9%
	Breast	5.0%	5.1%	0.7%
	Skin	2.1%	1.6%	3.6%
	Brain/CNS	10.8%	10.7%	0.3%
	Gynaecological	4.5%	4.0%	2.7%
Prior hospital activity	Emergency admissions (prior year)	1.85 (1.77)	1.70 (1.60)	8.6%
	Elective admissions (prior year)	3.19 (7.22)	2.91 (7.23)	3.9%
	Outpatient attendances (prior year)	9.85 (10.50)	9.13 (9.40)	7.2%
	A&E attendances (prior year)	1.30 (1.67)	1.21 (1.50)	5.6%
	Emergency bed-days (prior year)	19.03 (23.00)	17.28 (21.1)	7.9%
	Elective bed-days (prior year)	5.58 (11.88)	4.69 (10.56)	7.9%

Those MCCC patients without a history of cancer were older and had a different profile of recorded diagnoses. The table and figures following summarise the quality of the matching for this subset of cases.

Table B3. Standardised differences after matching between Marie Curie cases and controls without cancer

Type	Measure	Marie Curie	Matched controls	Standardised difference
Age	Mean age	80.9 (11.0)	81.1 (10.3)	2.4%
Sex	Female	51.4%	51.4%	0.0%
Deprivation	Deprivation (mean IMD)	19.8 (14.1)	19.6 (13.3)	1.6%
Ethnicity	White	80.9%	86.1%	14.0%
Number of conditions	Long-term conditions	1.86 (1.83)	1.84 (1.75)	1.4%
	Conditions associated with ageing	0.90 (1.20)	0.88 (1.16)	1.6%
Comorbidities	Diabetes	16.8%	18.4%	4.0%
	Hypertension	45.2%	48.0%	5.4%
	CHF	23.8%	21.4%	5.7%
	COPD	20.1%	18.4%	4.3%
	Injury	28.1%	30.5%	5.1%
	Iatrogenic	7.0%	7.3%	1.2%
	Falls	16.5%	19.4%	7.6%
	Non-rheumatic valve disorder	6.9%	6.8%	0.6%
	Mental health	16.8%	16.8%	0.0%
	Ischaemic heart disease	25.6%	26.4%	1.9%
	Asthma	8.2%	8.0%	0.7%
	Angina	14.4%	14.6%	0.6%
	Anaemia	16.3%	15.6%	1.9%
	Atrial fibrillation	25.0%	27.0%	4.6%
	CVD	13.8%	13.5%	0.9%
	Arthritis/connective tissue disorders	4.6%	4.4%	1.0%
	PVD	14.0%	14.5%	1.6%
	Renal failure	13.6%	10.5%	9.4%
	Respiratory/Influenza	20.5%	16.5%	10.5%
Diagnoses associated with ageing	Parkinson's disease	3.6%	2.4%	7.0%
	Other movement disorders	0.9%	0.4%	6.1%
	Other degenerative condition	2.5%	2.2%	1.7%
	Paralytic syndromes	3.0%	2.7%	2.1%
	Cerebrovascular disease	12.0%	12.1%	0.5%
	Pneumonia	16.8%	14.4%	6.8%
	Lower respiratory infection	10.9%	11.0%	0.3%
	Ulcers	8.0%	8.2%	0.8%
	Osteopathies	7.9%	7.6%	1.1%
	Urinary disorders	18.7%	16.9%	4.8%
	Other cognitive disorders	10.4%	10.5%	0.1%
	Senility	15.2%	15.0%	0.6%
	Fractures	7.4%	9.3%	6.8%
	Rehabilitation	8.2%	9.3%	3.9%
	Life management	8.0%	6.9%	4.5%
	Dementia	9.1%	9.6%	1.6%
Hospital activity	Emergency admissions (prior year)	1.42 (1.81)	1.34 (1.69)	4.9%
	Elective admissions (prior year)	1.11 (7.6)	1.11 (8.44)	0%
	Outpatient attendances (prior year)	5.56 (9.63)	5.07 (8.64)	5.4%
	A&E attendances (prior year)	1.21 (1.73)	1.18 (1.62)	1.8%
	Emergency bed-days (prior year)	18.17 (27.65)	16.92 (26.25)	4.6%
	Elective bed-days (prior year)	2.34 (10.17)	2.01 (9.26)	3.4%

Figure B1 show the proportion of MCNS patients with a particular cancer who were matched to a control with the same cancer type recorded. A significant proportion of people had more than one type of cancer recorded in the preceding three years. This chart is based on individual cancers; therefore a MCNS patient with three different cancers would feature three times, once for each cancer.

Figure B1. Proportion of Marie Curie patients matched to a control with the same cancer type

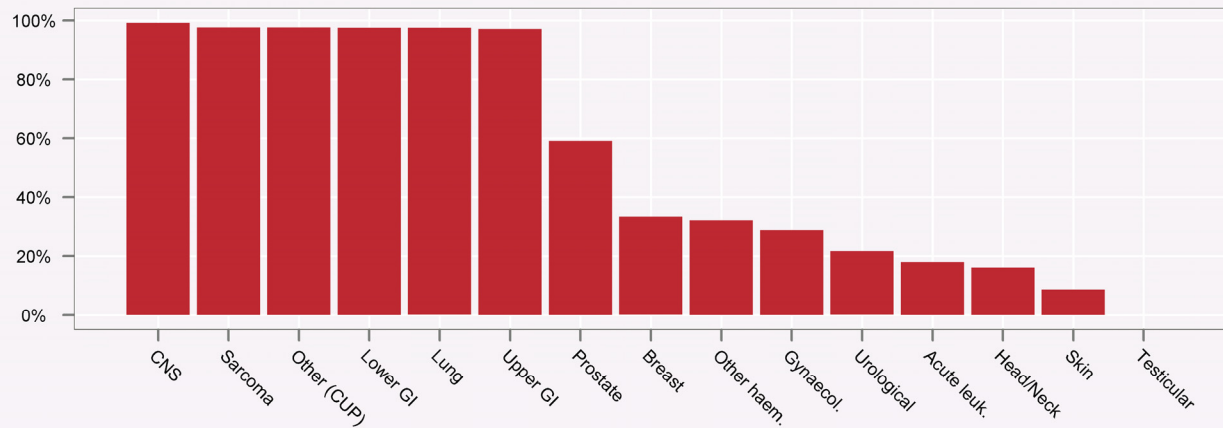


Figure B2. Demographic characteristics of Marie Curie patients and controls with no recent cancer history

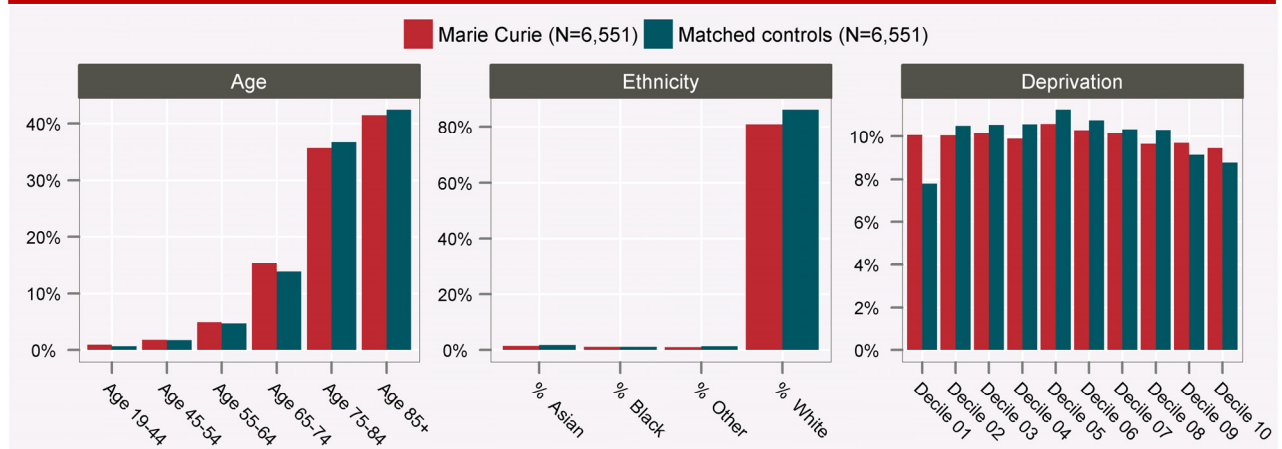
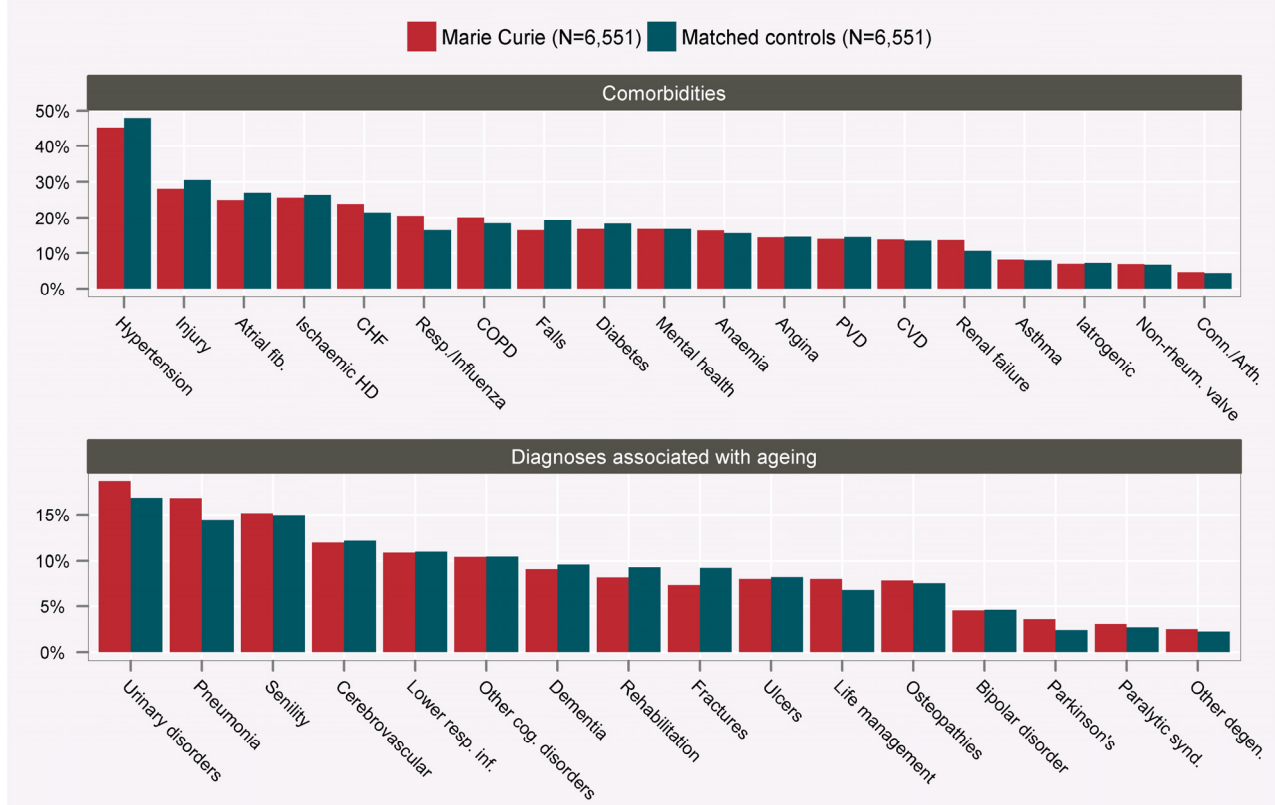
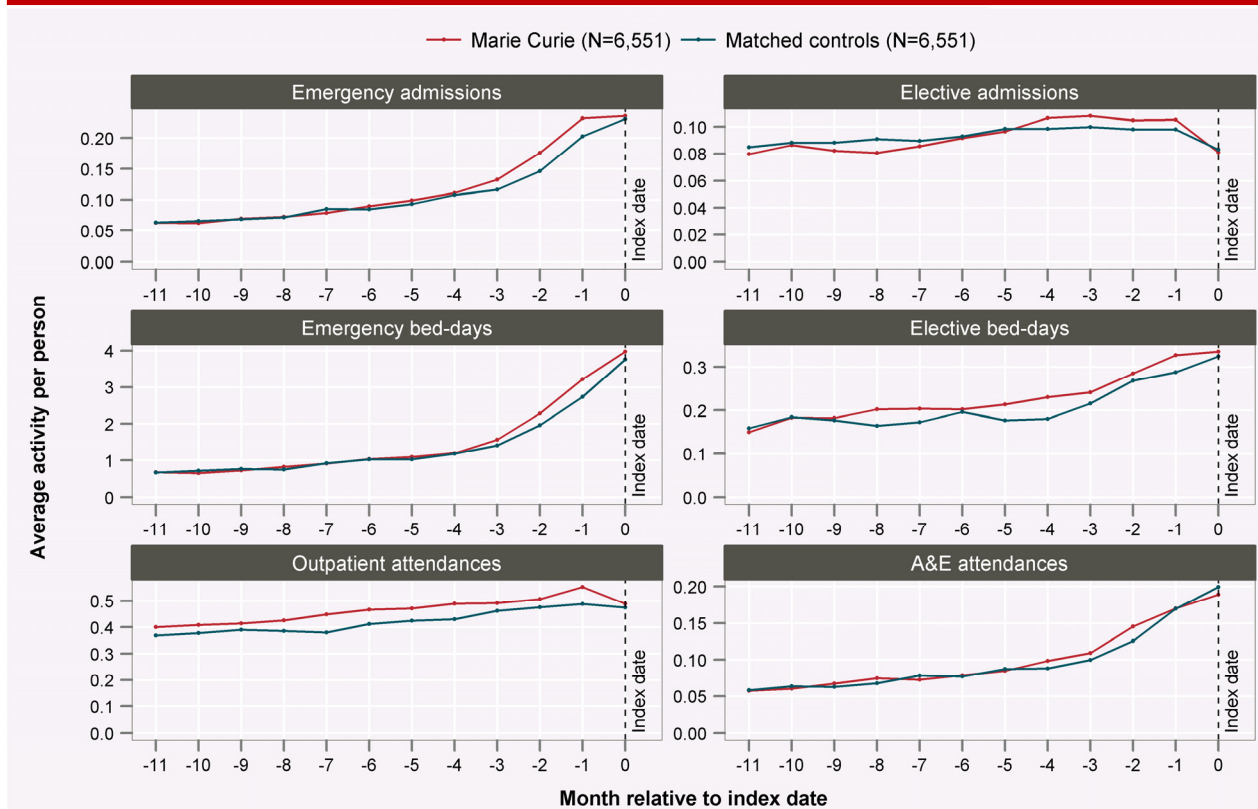


Figure B3. Clinical characteristics of Marie Curie patients and controls with no recent cancer history**Figure B4. Timeseries chart of hospital activity in the year preceding the index date, for Marie Curie cases and controls with no recent history of cancer**

Appendix C – Further analyses by service type

The main report contains analyses of the impact of MCNS care by the type of service provided (controls being allocated the service type of their matched case). A relatively small subset of cases received both planned care, and either multi-visit or rapid response care. In the main report these cases were treated as separate sub-groups. For completeness, here we show results using a simpler grouping of service types, with all those who received multi-visit or rapid response care assigned to the multi-visit or rapid response groups, regardless of whether or not they also received planned care.

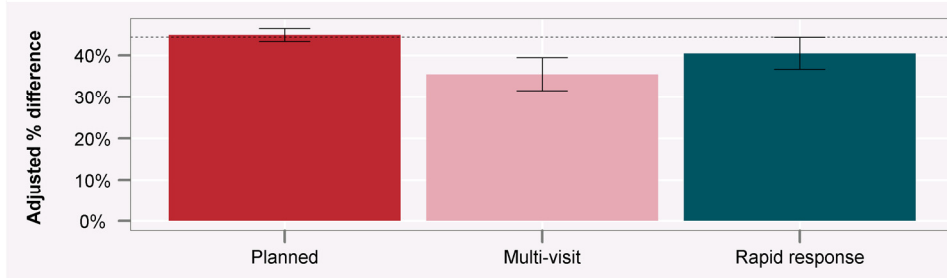
Place of death

Table C1 summarises the percentage of deaths at home by aggregated service type (controls were assigned the service type of their matched case). Figure C1 plots the adjusted difference in the percentage of home deaths (after fitting a logistic regression model) between cases and controls. The dotted line is the overall adjusted difference in home deaths between cases and controls. Where the confidence limits do not overlap the dotted line, this indicates a significant difference from the overall group effect.

The results show that there was a significant smaller increase in the proportion of home deaths among those who received multi-visit or rapid response, either alone or in combination with planned care, compared to the overall increase seen for those who received MCNS care.

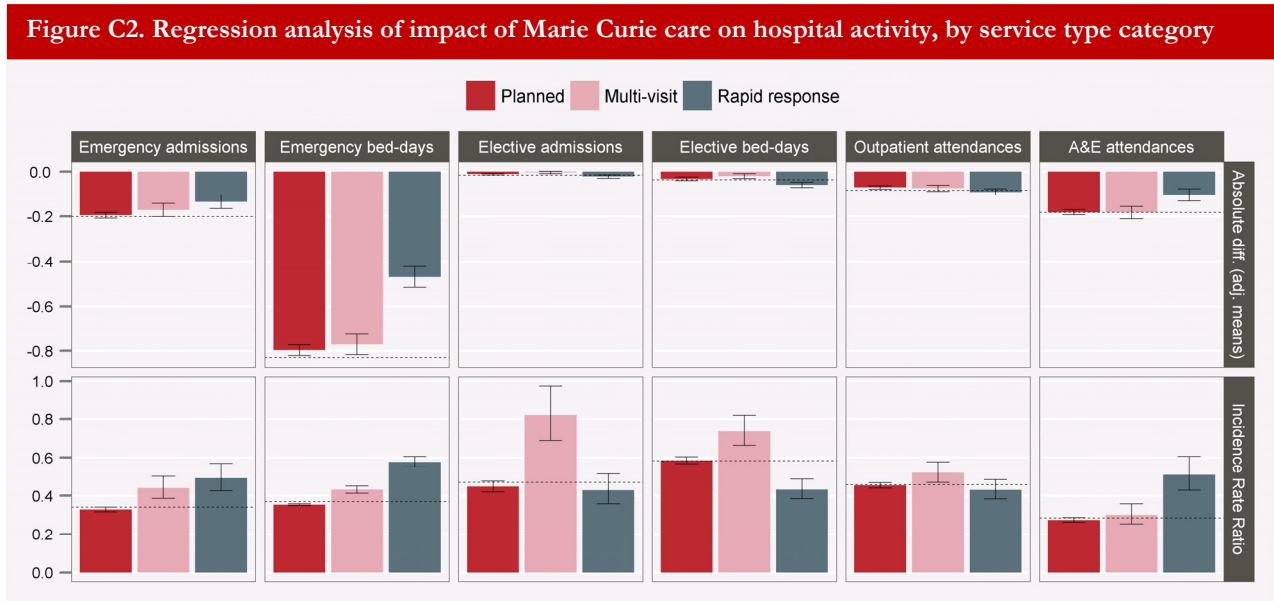
Service type category	Marie Curie	Matched controls
Planned	77%	35%
Multi-visit	67%	34%
Rapid response	74%	36%

Figure C1. Adjusted difference between Marie Curie patients and matched controls in % of home deaths, by service type category



Hospital activity

The top row of Figure C2 plots the adjusted absolute per person difference in hospital activity between MCNS patients and matched controls, while the bottom row shows the Incidence Rate Ratio (effectively service use among MCNS patients as a percentage of the adjusted rate among controls). As previously, the dotted line is the overall difference between cases and controls. Looking at the absolute effect, there was a significantly smaller effect for rapid response care for emergency and elective inpatient care. For people who received multi-visit care, the difference between controls was smaller than the overall effect for emergency admissions and bed-days, and A&E attendances, but larger for elective bed-days.

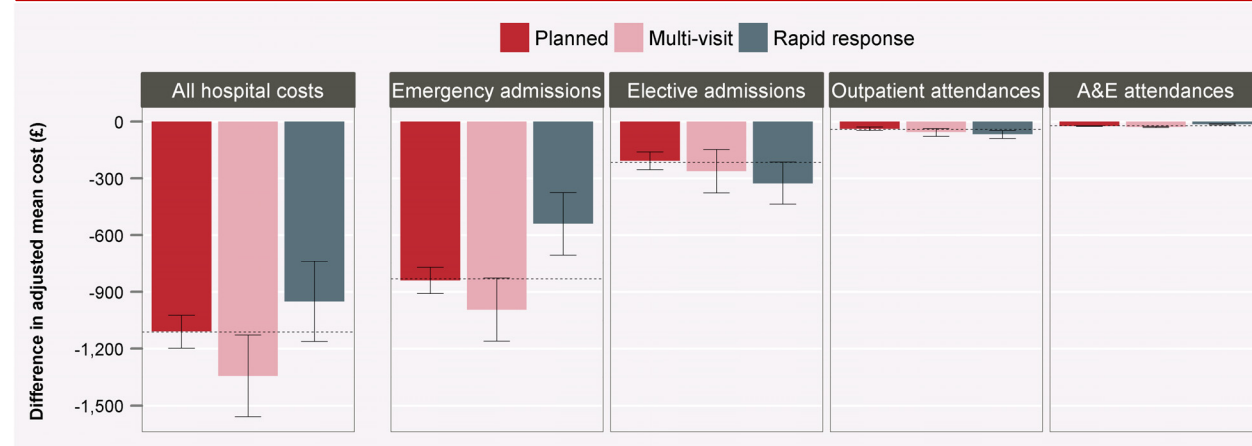


Hospital costs

Table C2 shows the unadjusted hospital costs of MCNS patients and controls, by service type category. Figure C3 shows the adjusted difference in hospital costs between MCNS patients and controls, split by service type category. The difference in total hospital costs between people who received multi-visit care and their matched controls was significantly larger than the overall difference between MCNS patients and controls. This was largely due to a greater reduction in emergency admission costs. However, it should be noted that, as shown in Figure 3.22 (page 41), this effect was primarily driven by people who received both planned and multi-visit care.

Table C2. Post-index date hospital costs for Marie Curie cases and matched controls, by service type category

		Mean (sd) hospital costs per person		
Activity type	Service type category	Marie Curie	Matched controls	Crude difference
Emergency admissions	Multi-visit	£726 (£2,066)	£1,722 (£2,757)	-£996
Elective admissions	Multi-visit	£176 (£1,010)	£453 (£1,762)	-£277
Outpatient attendances	Multi-visit	£53 (£209)	£120 (£366)	-£67
A&E attendances	Multi-visit	£11 (£43)	£40 (£68)	-£29
All hospital activity	Multi-visit	£967 (£2,527)	£2,335 (£3,590)	-£1,368
Emergency admissions	Planned	£439 (£1,729)	£1,275 (£2,524)	-£836
Elective admissions	Planned	£100 (£962)	£337 (£1,709)	-£237
Outpatient attendances	Planned	£32 (£215)	£72 (£332)	-£40
A&E attendances	Planned	£8 (£34)	£31 (£60)	-£23
All hospital activity	Planned	£579 (£2,137)	£1,716 (£3,348)	-£1,137
Emergency admissions	Rapid response	£699 (£1,964)	£1,228 (£2,402)	-£529
Elective admissions	Rapid response	£147 (£894)	£509 (£2,191)	-£362
Outpatient attendances	Rapid response	£38 (£146)	£110 (£454)	-£72
A&E attendances	Rapid response	£13 (£42)	£27 (£55)	-£14
All hospital activity	Rapid response	£896 (£2,448)	£1,875 (£3,681)	-£979

Figure C3. Adjusted differences in hospital costs between Marie Curie cases and controls, by service type category

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