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Title

Is palliative care support associated with better quality outcomes at end of life for patients with advanced cancer? A longitudinal population cohort study

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Abstract

Objectives

This study aims to establish whether palliative care is associated with better quality outcomes at the end of life for patients with advanced cancer and to explore the duration of palliative care involvement in relation to quality of end of life care.

Setting

This study uses linked cancer patient data from the National Cancer Registry, the electronic medical record system used in primary care (SystmOne) and the electronic medical record system used within a specialist regional cancer centre. The population resided in a single city in Northern England.

Participants

Retrospective data from 2479 adult cancer patients who died between January 2010 and February 2012, were registered with a primary care provider using the SystmOne electronic health record system, and cancer was certified as a cause of death, were included in the study.

Results

Linkage yielded data on 2479 cancer patients, with 64·5% who received at least one PC event. Patients who received PC were significantly more likely to die in a hospice (39·4% versus 14·5%) and less likely to die in hospital (23·3% versus 40·1%), and were more likely to receive an opioid (53·9% versus 25·2%). Duration of PC was significantly associated with avoiding emergency hospital admissions (≥4 weeks) avoiding late chemotherapy (≥33 weeks) access to an opioid (≥4 weeks) and avoiding death in hospital (≥2 weeks).

Conclusion

For patients with advanced cancer, access to palliative care and longer duration of palliative care were significantly associated with better quality outcomes at the end of life. These findings provide evidence to support earlier integration of palliative care within oncology service delivery models.

(Word count 263 words)

Strengths and limitations of this study

- To the best of our knowledge this is the first UK study to explore the associations between duration of palliative care and quality of end of life care in a large population of patients who died from cancer.
- The data used in this study are derived from a live clinical system and as such are likely to represent errors or omissions inherent within that system.
- The definition of good quality end of life care used in this study is informed by UK policy and guidance on end of life care provision. We recognise that what constitutes good quality care at the end of life can vary by individual and that the study does not capture individual preferences or circumstances.

Introduction

Integration of palliative care alongside oncology management should be considered early in the course of illness for patients with metastatic cancer or high symptom burden, according to American Society of Clinical Oncology guidelines.[1] This recommendation is based on a number of randomised controlled trials, largely from North America, which found early palliative care was associated with improved quality of life and a reduction in acute hospital admissions and aggressive cancer treatments at the end of life.[2-6] Though there were inconsistencies across trials, in general common characteristics were an assessment and several follow up consultations by specialist palliative care teams over a period of 2–3 months, which occurred about 6–14 months before patients died.

Compared to patients recruited to these clinical trials, cancer patients in routine care are often referred to palliative care services much later in the course of their illness.[7] We recently showed that for 4650 cancer patients in Leeds, median contact was 34 days for community and hospital palliative care services.[8] This relatively short duration of palliative care in routine services might adversely impact on end of life outcomes.

Systematic reviews and pooled analyses of routinely collected data have demonstrated an association between palliative care intervention and increased proportion of home deaths as well as reduction in emergency admissions.[9,10] However, no study has quantified these associations in relation to duration of palliative care. In order to more directly inform models of service delivery, better quality data is needed on how long patients with cancer need to receive palliative care before important improvements in end of life care can be observed.

We report a retrospective cohort study that linked routinely collected data on hospital and community healthcare resource use in patients that died from cancer.

We chose this study design because it enabled us to examine the effects of palliative care service delivery in routine care for a cohort of cancer patients and minimised recruitment bias from a clinical trial design. We wanted to test the hypothesis that contact with and longer duration of palliative care would be associated with better quality outcomes at end of life for patients with advanced cancer.

Methods

Study population

Retrospective data from 2479 adult (aged at least 18 years at death) cancer patients who died between January 2010 and February 2012, resided within a single Uk city, were registered with a primary care provider using the SystmOne electronic health record system, and cancer was certified as a cause of death, were included in the study.

Data collection

Data was obtained from three sources, the Northern and Yorkshire Cancer Registry and Information Service (NYCRIS), SystmOne, and the Patient Pathway Manager (PPM). NYCRIS maintain a database of all cancers occurring in the Northern and Yorkshire region in England. SystemOne is an electronic health record system used by approximately 75% of primary care providers in Leeds. PPM is a clinical information system used at a regional specialist cancer centre to manage and coordinate patient care.

Patients eligible for the study were identified from the NYCRIS database based on address, date of death, and cause of death. The NYCRIS database provided all demographic, diagnostic, and death information. SystmOne provided opioid prescription information and community palliative care provision. PPM provided chemotherapy treatment, emergency hospital admissions and hospital based palliative care referral information. The three data sources were linked using an open pseudonymiser system to create an encrypted code based on NHS numbers.

Assessment of palliative care provision

The primary measure of palliative care provision used in this study was duration of palliative care, measured as the time in weeks, between the first recorded palliative care event and date of death. Both hospital and community based records of palliative care events were included.

The PPM system provided information on hospital based palliative care provision. For each patient included in our study every unique palliative care referral date recorded on the PPM system was identified as a unique palliative care event. Community palliative care provision was estimated from SystmOne records based on a multistage approach. In the first stage any record within SystmOne which included a palliative care based READ code or included text indicating palliative care, based on a keyword search, was included in the study. In the second stage only records which extended up to date of death and included either a READ code indicating the active provision of palliative care, or included communication with a hospice, were identified as representing palliative care provision.

The total number of palliative care events identified for each patient was a secondary measure of palliative care provision which was used as a proxy to indicate the intensity of palliative care support provided.

Outcomes

The end of life quality outcomes assessed were place of death, access to strong opioids within the last year of life, timing of last chemotherapy treatment, and emergency hospital admission up to 4 weeks before death. We chose these because a reduction in hospital use at the end of life is commonly used as a proxy for better quality care.[3,5,11-15] Recently we have demonstrated the relatively late onset of strong opioid prescribing before death in a cohort of cancer patients.[16] We judged that given the prevalence of pain in advanced cancer access to strong opioids could also be a proxy for better quality care.

Place of death was categorised as own home, hospice, hospital, care home, other or unknown. Patients with at least one strong opioid prescription were coded as yes, patients with prescriptions other than a strong opioid within the last year were coded as no. The list of strong opioids included are provided in appendix 1. Patients without a prescription were coded as missing. The timing of chemotherapy was categorised into either no chemotherapy, chemotherapy 0–4 weeks before death, or chemotherapy over 4 weeks before death. The number of emergency admissions to hospital in last 4 weeks of life were grouped into avoided emergency admission or did not avoid emergency admission (one or more emergency admissions).

Covariates

Covariates considered were age, categorised into younger than 50 years, older than 80 years, and deciles in between; sex (male or female); Indices of Multiple Deprivation (IMD) quintile (where 1 = most deprived and 5 = least deprived); cancer diagnosis; and duration of illness (in years) before death.

Statistical analysis

We used Pearson's chi-square (χ^2) to test associations between receiving palliative care and end of life quality outcomes. Post-hoc χ^2 tests were conducted for each possible 2 by 2 table comparison, adjusted using the Bonferroni correction, where outcomes included more than two categories and the χ^2 resulted in a p value of less than 0.05. The association between duration of palliative care and number of palliative care events was explored through frequency tables and the Spearman's rank correlation coefficient. Differences in median scores were compared using the Mann-Whitney U test, for two group comparisons, or the Kruskal-Wallis H test, for more than two groups. Where statistically significant results were identified from the Kruskal-Wallis H test Dunn–Bonferroni post-hoc tests for multiple comparisons of rank sums, based on the z-statistics, were conducted for each possible combination of two group comparisons.[17]

We constructed a classification tree for each end of life care outcome, using chi-squared automatic interaction detection (CHAID), to identify, for each outcome, the optimum cut-off points for duration of palliative care.[18] Each CHAID classification tree included palliative care duration as the only predictor variable. Nodes associated with the first branch of the dendrogram identified the optimum duration of palliative care cut-off points. Where the cut-off point was 0 weeks palliative care, this reflected contact with palliative care but within 7 days of death. Multivariable regression models (logistic and multinomial) were used to investigate the role of these cut-off points on end of life care outcomes, after controlling for age at death, gender, IMD deprivation quintile, first diagnosis cancer site and duration of illness. Results are presented as odds ratios (ORs) alongside 95% confidence intervals (95% CI).

Complete case analysis was undertaken. P values less than 0·05 were considered statistically significant (2-tailed). Analysis was conducted using IBM SPSS statistics version 23.

Public involvement

Patients were involved in setting the research question and in the design of the study, no patients were asked to advise on interpretation or writing up of results. The results of the research have been disseminated to the patient community through patient forums.

Results

Patient characteristics

Of the 2479 patients included in the study 64·5% (n=1598) received at least one palliative care event. Community based palliative care was received by 45·3% (n=1124), and hospital based palliative care was received by 40.0% (n=991), of patients.

Table 1 shows age ($p<0.001$), sex ($p=0.006$), and cancer diagnosis ($p=0.004$) were significantly associated with receiving palliative care. Palliative care was more likely to be received by patients who were younger or female. As a proportion of all patients within each cancer site, patients with upper gastrointestinal cancers were significantly more likely to receive palliative care while patients with lung cancer or cancers of the central nervous system were significantly less likely to receive palliative care.

(Insert Table 1 here)

The duration of palliative care provided to patients varied widely from less than one week to 343 weeks, with a median duration of 6 weeks (interquartile range 2 to 19 weeks). Most patients who received palliative care received between one and three palliative care events (median 2 events, interquartile range 1 to 3 events). There was a significant positive relationship between the duration of palliative care and number of palliative care events ($r_s=0.535$, $p<0.001$).

Place of death

Place of death was significantly associated with palliative care provision ($p<0{\cdot}001$). Post-hoc tests showed that patients who received palliative care were significantly more likely to die in a hospice (39·4% versus 14·5%, $p<0{\cdot}05$) and significantly less likely to die in hospital (23·3% versus 40·1%, $p<0{\cdot}05$), at home (26.8% versus 31.8%, $p<0.05$), or in a care home (8.7% versus 12.0%, $p<0.05$) compared to patients who did not receive palliative care (Table 2).

For the 1598 patients who received palliative care, a shorter duration of palliative care was observed for hospital deaths (median 3 weeks palliative care) compared with deaths in hospice (median 7 week palliative cares), at home (median 7 weeks palliative care) or in a care home (median 13 weeks palliative care) ($p<0{\cdot}001$). There was also a significant difference in the number of palliative care events by place of death ($p<0.001$), with the median number of palliative events in hospital equalling one event, compared with a median of two events for deaths at home, in a hospice, or in a care home (Table 2).

Receiving at least one strong opioid prescription within the last year of life

Patients who received palliative care were significantly more likely to have also been prescribed strong opioids before death compared with patients who did not receive palliative care (53·9% versus 25·2%, p<0·001).

For those patients that received palliative care (n=1598), the median duration of palliative care and the number of palliative care events were significantly higher for patients who received at least one strong opioid prescription, Table 3.

(Insert table 3 here)

Timing of last chemotherapy

A significant relationship was identified between timing of last chemotherapy and receiving palliative care (p<0·001). Post-hoc analysis showed that patients who received palliative care were more likely to have been treated with chemotherapy at any point during the course of their disease (63·6% versus 47·4% P<0·05) and were more likely to have stopped chemotherapy over four weeks before death, compared with patients not receiving palliative care (58.5% versus 42.1%, p<0.05).

For patients who received palliative care (n=1598) the duration of palliative care was significantly associated with the timing of latest chemotherapy, Table 4

(Insert table 4 here)

Emergency hospital admission within the last four weeks of life

The majority of the sample (1926 out of 2479, 77.7%) avoided emergency hospital admission in the last 4 weeks of life. A borderline significant association was identified between emergency hospital admissions in the last four weeks of life and receiving palliative care (p=0.049). For patients who received palliative care (n=1598), emergency admission was associated with a significantly shorter duration of palliative care (4 weeks versus 7 weeks, p<0·001) and significantly fewer palliative care events overall (2 events versus 2 events, p=0·010).

(Insert table 5 here)

Multivariable regressionClassification tree optimum cut-off points for each of the end of life outcomes are provided in appendix 2. Between three and five optimum duration of palliative care cut-off points were identified for the four end of life outcomes. The multivariable (multinomial) logistic regression models, using optimum cut-off points for duration of palliative care, showed overall greater odds ratios for better outcomes at the end of life with longer duration of palliative care, Figure 1. Each cut-off point within in the model represents a significantly better outcome. For example, although overall there was no association between palliative care and increased home deaths, the model shows that patients who received 2-7 weeks of palliative care had 2.96 better odds of dying at home than in hospital, and those who received more than 8 weeks of palliative care had 3.49 better odds of dying at home. Similarly, there was a clear stepwise increase in the odds of receiving an opioid prescription with each increment of palliative care duration (0-3 weeks, 4-7 weeks, 8-32 weeks and 33+ weeks)

(Insert Fig 1 here)

Discussion

Our analysis confirms existing research that better outcomes at the end of life are associated with access to palliative care services. However, we have been able to demonstrate for the first time that longer increments of palliative care are associated with increasingly better outcomes, specifically relating to place of death outside hospital, access to strong opioid, and avoiding chemotherapy and emergency hospital admission within the last 4 weeks of life. For some outcomes such as place of death at home, there appears to be a minimum duration of palliative care that is associated with higher odds of home death, suggesting that sufficient time is required to plan and co-ordinate in order to achieve this outcome for a patient. Although causality cannot be assumed, these findings provide additional evidence to support earlier integration of palliative care within oncology service delivery models.

We found patients who received palliative care were less likely to die in hospital and more likely to die in a hospice. Despite care being rated significantly lower for people who die in a hospital, compared to home, a hospice or care home[20] approximately 48% of UK cancer patients die in hospital.[21] We identified the level of palliative care involvement associated with a reduction in hospital deaths was minimal (two contacts initiated at least three weeks before death). The potential per patient saving by avoiding a hospital death proposed by the National End of Life Information Network is £958 per patient.[22]

Evidence for the impact of palliative care on home death is inconsistent. We found the rate of home deaths in patients who received palliative care was lower compared to those who did not, however the likelihood of dying at home, rather than hospital, increased as the intensity of palliative care involvement increased. A meta-analysis found palliative care had no impact on home deaths[23] while a Cochrane review undertaken the same year found it more than doubles the odds of dying at home.[24] These differences may reflect differences in the availability of hospice or palliative care services, or bias in the selection of patients suitable for palliative care. Our data suggest that duration of palliative care may account for this inconsistent relationship.

Opioid analgesia is the recommended treatment for moderate to severe pain[25] the prevalence of which in advanced cancer is estimated to be between 62% and 86%.[26] We found access to palliative care was associated with being twice as likely to have access to strong opioids however the direction of the relationship was unclear.

Administration of chemotherapy close to death usually represents poorly planned care.[27] It was encouraging to find that only 5% of our study population received chemotherapy within the last four weeks of life however this limited the potential to explore the impact of palliative care on late chemotherapy. Studies that have established an association between palliative care team involvement and lower rates of chemotherapy near the end of life have concluded that cessation of chemotherapy is due to palliative care involvement.[28] Although a referral to palliative care may help protect against late chemotherapy, our findings suggest this association is more complex and in some cases receiving chemotherapy or the cessation of chemotherapy may in fact drive the palliative care referral.

We hypothesised that patients who received palliative care would be more likely to avoid emergency hospital admissions in the last four weeks of life though we found the opposite. Further analysis revealed that only patients who received palliative care for longer than four weeks benefited in this outcome. Patients receiving under four weeks of palliative care were more likely to require emergency admission within the last four weeks of life. This might be explained by emergency hospital admission triggering palliative care involvement. Current evidence reports that 77% of emergency cancer admissions are avoidable[29] so our findings indicate there is considerable scope to reduce emergency admissions through a relatively short duration of palliative care.

This study has limitations. First, the population is derived from a single UK city. Though broadly representative of the UK cancer population in prevalence of cancer type, age, sex, and survival, the extent to which access to palliative care is representative of national and international activity is harder to determine. Secondly, the data are derived from a live clinical system and as such are likely to represent errors or omissions inherent within the system. Thirdly, we cannot assume that access to or longer duration of palliative care caused better outcomes. For some outcomes and for some patients, such as access to strong opioids or cessation of chemotherapy, it is possible that the outcome event itself triggered referral to palliative care. These are nevertheless important hypotheses to test further in terms of operationalising earlier integration of palliative care. In contrast, deaths outside hospital and increased home death appear more likely to be the result of longer duration of palliative care.

Conclusion

The research evidence to support early integration of palliative care for cancer patients[1-6] is based on relatively high intensity interventions of at least 8–12 weeks initiated approximately 6–14 months before death. Within routinely collected data, we have determined an association between duration of palliative care and important quality indicators of end of life care. Receiving two or more weeks of palliative care was associated with avoiding a hospital death. At least four weeks of palliative care was associated with a reduction in emergency hospital admissions and an increased likelihood of receiving an opioid analgesic. More than 32 weeks palliative care was associated with a reduction in Characterising palliative care services based on duration of care provides new evidence which will aid policymakers when modelling palliative care service provision. Evidence of benefit in advanced non-cancer diseases remains unclear but together with other observational evidence, our findings should stimulate similar research in these populations.

Contributors

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Competing interests

We have read and understood BMJ policy on declaration of interests and declare that we have no competing interests.

Ethical approval

The National Research Ethics Service (PR 13.YH.0301) granted ethical approval for the study.

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Data Sharing

No additional data available. Electronic health records are considered “sensitive” data in the UK by the Data Protection Act and cannot be shared via public deposition due to restrictions in place to protect patient confidentiality.

Transparency statement

The lead author affirms that the manuscript is an honest, accurate, and transparent account of the study being reported; that no important aspects of the study have been omitted; and that any discrepancies are disclosed.

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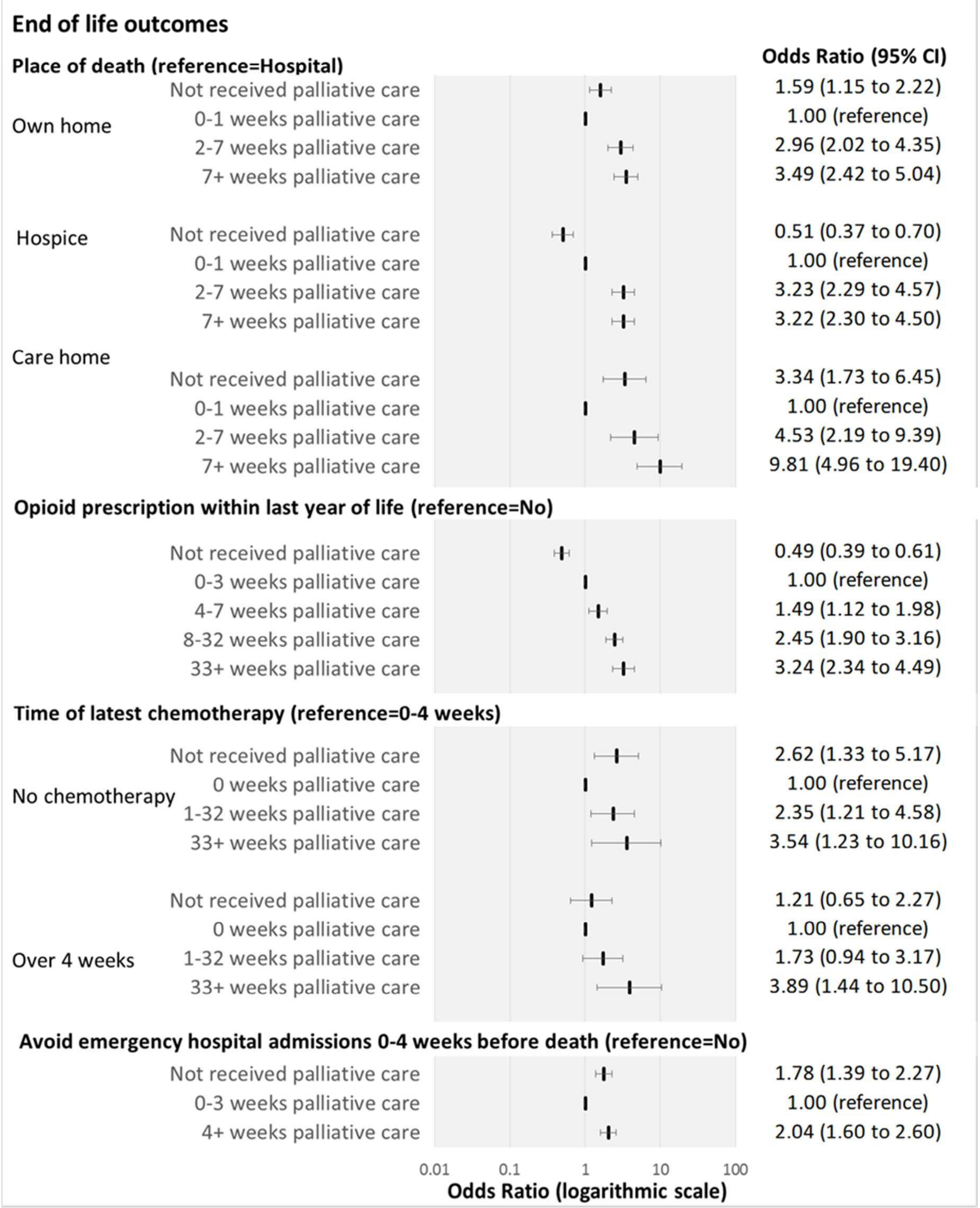

Confounding factors controlled for within the model: age at death, gender, IMD deprivation quintile, first diagnosis cancer site and duration of illness; CI: confidence intervals

Fig 1| Multivariable adjusted odds ratios from logistic and multinomial logistic regression models for end of life outcomes by duration of palliative care cut-off points

Table 1| Characteristics of the study population by palliative care provision

Characteristics	Palliative care provision (n = 2479) Not received	 Received	Post-hoc
Total number of patients: No. Row %	881 (35·5%)	1598 (64·5%)	
Age at death (years): No. Column %			
<50	35 (4·0%)	97 (6·1%)	<0.05
50-59	65 (7·4%)	184 (11·5%)	<0.05
60-69	172 (19·5%)	394 (24·7%)	<0.05
70-79	289 (32·8%)	514 (32·2%)	n/s
80+	320 (36·3%)	409 (25·6%)	<0.05
Statistical test			*(χ2(4)= 43·22, p<0·001)*
Gender: No. Column %			
Male	499 (56·6%)	813 (50·9%)	n/a
Female	382 (43·4%)	785 (49·1%)	n/a
Statistical test			*(χ2(1)= 7·57, p=0·006)*
IMD deprivation quintile: No. Column %			
Quintile 1 - Top 20% most deprived	272 (30·9%)	502 (31·4%)	n/a
Quintile 2	166 (18·8%)	315 (19·7%)	n/a
Quintile 3	142 (16·1%)	252 (15·8%)	n/a
Quintile 4	182 (20·7%)	317 (19·8%)	n/a
Quintile 5 - Top 20% least deprived	119 (13·5%)	211 (13·2%)	n/a
Missing	0 (0.0%)	1 (0.1%)	n/a
Statistical test			*(χ2(4)= 0.55, p=0.969)*
First diagnosis cancer site: No. Column %			
Head and neck	42 (4·8%)	69 (4·3%)	n/s
Upper gastrointestinal	110 (12·5%)	277 (17·3%)	<0.05
Colorectal	113 (12·8%)	214 (13·4%)	n/s
Lung	266 (30·2%)	390 (24·4%)	<0.05
Breast	81 (9·2%)	154 (9·6%)	n/s
Gynaecological	44 (5·0%)	107 (6·7%)	n/s
Prostate	83 (9·4%)	149 (9·3%)	n/s
Urological	66 (7·5%)	125 (7·8%)	n/s
Central nervous system	31 (3·5%)	32 (2·0%)	<0.05
All other cancer sites	45 (5·1%)	81 (5·1%)	n/s
Statistical test			*(χ2(9)= 24·18, p=0·004)*
Duration of illness (years)			
Median	1·28	1·26	
IQR	(0·48-3·03)	(0·52-3·20)	
Statistical test			*(M–W=701396, p=0·882)*

χ^2=Chi-square (degrees of freedom shown in brackets); M–W=Mann-Whitney U test; IQR=Interquartile range; n/a=not applicable (χ^2 not significant overall or two by two table); n/s=not significant

Table 2| Palliative care provision by place of death

Place of death	Palliative care provision (n=2479)			Sub-group receiving palliative care (n = 1598)			
	Not received	Received	Post-hoc	Number of palliative events		Duration of palliative care (weeks before death)	
	Number (%)	Number (%)		Median (IQR)	Post-hoc	Median (IQR)	Post-hoc
Own home	280 (31·8)	429 (26·8%)	<0.05	2 events (1,3)	i	7 weeks (2·5,17)	i,ii
Hospice	128 (14·5)	629 (39·4%)	<0.05	2 events (1,3)	ii	7 weeks (3,19)	iii,iv
Hospital	353 (40·1)	372 (23·3%)	<0.05	1 event (1,2)	i,ii,iii	3 weeks (1,14)	i,iii,v
Care home	106 (12·0)	139 (8·7%)	<0.05	2 events (1,3)	iii	13 weeks (4,35)	ii,iv,v
Other	1 (0·1)	0 (0·0%)	-	-		-	
Unknown	13 (1·5)	29 (1·8%)	-	-		-	
Statistical test		*(χ^2(3)= 180·52, p<0·001)*		*(K–W(3)=128·14,p<0·001)*		*(K–W(3)=75·77, p<0·001)*	

X^2=Chi-squared (degrees of freedom shown in brackets); K–W = Kruskal-Wallis H test (degrees of freedom shown in brackets); Post-hoc = multiple comparison z-test statistics comparing mean ranks for each possible two category comparison group; i,ii,iii,iv,v links categories where post-hoc comparison groups which resulted in a p value less than 0.05 (after adjusting using the Bonferroni correction); IQR=Interquartile range

Table 3| Palliative care provision by strong opioid prescription within the last twelve months of life

Strong opioid prescription within last year of life	Palliative care provision (n=2479)		Sub-group receiving palliative care (n = 1598)	
	Not received Number (%)	Received Number (%)	Number of palliative events Median (IQR)	Duration of palliative care (weeks before death) Median (IQR)
Yes	222 (25·2%)	862 (53·9%)	2 events (1,4)	9 weeks (3,26)
No	655 (74·3%)	736 (46·1%)	1 events (1,2)	4 weeks (1,12)
Missing	4 (0·5%)	0 (0.0%)		
Statistical test		*(χ^2(1)= 188·54, p<0·001)*	*(M–W=226447,<0·001)*	*(M–W=233259,p<0·001)*

χ^2=Chi-squared (degrees of freedom shown in brackets); M–W = Mann-Whitney U test; IQR=Interquartile range

Table 4| Palliative care provision by timing of latest chemotherapy

Time of latest chemotherapy	Palliative care provision (n=2479) Not received Number (%)	Received Number (%)	Post-hoc	Sub-group receiving palliative care (n = 1598) Number of palliative events Median (IQR)	Post-hoc	Duration of palliative care (weeks before death) Median (IQR)	Post-hoc
No chemotherapy	463 (52·6%)	582 (36·4%)	<0.05	2 events (1,3)	i	5 weeks (2,14)	i,ii
0-4 weeks	47 (5·3%)	82 (5·1%)	n/s	1 events (1,2)	i,ii	2 weeks (1,6)	i,iii
Over 4 weeks	371 (42.1%)	934 (58.5%)	<0.05	2 events (1,3)	ii	8 weeks (2,22)	ii,iii
Statistical test		*(χ2(2)= 63·90, p<0·001)*		*(K–W(2)=19.94, p<0·001)*		*(K–W(2)=46.58, p<0·001)*	

X^2=Chi-squared (degrees of freedom shown in brackets); K–W = Kruskal-Wallis H test (degrees of freedom shown in brackets); Post-hoc = multiple comparison z-test statistics comparing mean ranks for each possible two category comparison group; i,ii,iii,iv,v links categories where post-hoc comparison groups which resulted in a p value less than 0.05 (after adjusting using the Bonferroni correction); IQR=Interquartile range; n/s=Not significant

Table 5| Palliative care provision by emergency hospital admissions within the last four weeks of life

Avoided emergency hospital admissions 0-4 weeks before death	Palliative care provision (n=2479) Not received Number (%)	Received Number (%)	Sub-group receiving palliative care (n = 1598) Number of palliative events Median (IQR)	Duration of palliative care (weeks before death) Median (IQR)
Yes	704 (79·9%)	1222 (76·5%)	2 events (1,3)	7 weeks (2,20)
No (one or more admission)	177 (20·1%)	376 (23·5%)	2 events (1,3)	4 weeks (1,12)
Statistical test		*(χ2(1)= 3·87, p=0·049)*	*(M–W=210485, p=0·010)*	*(M–W=185814, p<0·001)*

χ^2=Chi-squared (degrees of freedom shown in brackets); M–W = Mann-Whitney U test; IQR=Interquartile range

Appendix 1. Medications identified as strong opioids

- Buprenorphine (>10mcg)
- Diamorphine
- Dipipanone (with cyclizine)
- Fentanyl
- Hydromorphone
- Meptazinol
- Morphine
- Oxycodone
- Pentazocine
- Papaveretum
- Pethidine

Appendix 2: Classification tree duration of palliative care cut-off points by end of life quality outcomes

Place of death

	Cut-off points (n=2436): number (column %)				
	Not received	0-1 weeks	2-7 weeks	8+ weeks	Total
Own home	280 (32.3%)	70 (21.1%)	148 (28.1%)	211 (29.7%)	709 (29.1%)
Hospice	128 (14.8%)	104 (31.4%)	237 (45.0%)	288 (40.5%)	757 (31.1%)
Hospital	353 (40.7%)	146 (44.1%)	105 (19.9%)	121 (17.0%)	725 (29.8%)
Care home	106 (12.2%)	11 (3.3%)	37 (7.0%)	91 (12.8%)	245 (10.1%)
Statistical test					*(χ^2(9)= 280.75, p<0·001)*
Total: Number (row %)	**867 (35.6%)**	**331 (13.6%)**	**527 (21.6%)**	**711 (29.2%)**	**2436**

Opioid prescription within last year of life

	Cut-off points (n=2475): number (column %)					
	Not received	0-3 weeks	4-7 weeks	8-32 weeks	33+ weeks	Total
Yes	222 (25.3%)	237 (41.3%)	149 (50.0%)	299 (62.8%)	177 (70.8%)	1084 (43.8%)
No	655 (74.7%)	337 (58.7%)	149 (50.0%)	177 (37.2%)	73 (29.2%)	1391 (56.2%)
Statistical test						*(χ^2(4)= 279.01, p<0·001)*
Total: Number (row %)	**877 (35.4%)**	**574 (23.2%)**	**298 (12.0%)**	**476 (19.2%)**	**250 (10.1%)**	**2475**

Time of latest chemotherapy

	Cut-off points (n=2479): number (column %)				
	Not received	0 weeks	1-32 weeks	33+ weeks	Total
No chemotherapy	463 (52.6%)	50 (30.7%)	466 (39.4%)	66 (26.4%)	1045 (42.2%)
0-4 weeks	47 (5.3%)	16 (9.8%)	60 (5.1%)	6 (2.4%)	129 (5.2%)
5+ weeks	371 (42.1%)	97 (59.5%)	659 (55.6%)	178 (71.2%)	1305(52.6%)
Statistical test					*(χ^2(3)=55.494, p<0·001)*
Total: Number (row %)	**881 (35.5%)**	**163 (6.6%)**	**1185(47.8%)**	**250 (10.1%)**	**2479**

Avoided emergency hospital admissions 0-4 weeks before death

	Cut-off points (n=2479): number (column %)			
	Not received	0-3 weeks	4+ weeks	Total
Yes	704 (79.9%)	392 (68.3%)	830 (81.1%)	1926 (77.7%)
No (one or more admission)	177 (20.1%)	182 (31.7%)	194 (18.9%)	553 (22.3%)
Statistical test				*(χ^2(2)=36.390, p<0.001)*
Total: Number (row %)	**881 (35.5%)**	**574 (23.2%)**	**1024 (41.3%)**	**2479**

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Is palliative care support associated with better quality end of life care indicators for patients with advanced cancer? A retrospective cohort study.

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Abstract

Objectives

This study aimed to establish the association between timing and provision of palliative care and quality of end-of-life care indicators in a population of patients dying of cancer.

Setting

This study uses linked cancer patient data from the National Cancer Registry, the electronic medical record system used in primary care (SystmOne) and the electronic medical record system used within a specialist regional cancer centre. The population resided in a single city in Northern England.

Participants

Retrospective data from 2479 adult cancer decedents who died between January 2010 and February 2012, were registered with a primary care provider using the SystmOne electronic health record system, and cancer was certified as a cause of death, were included in the study.

Results

Linkage yielded data on 2479 cancer decedents, with 64·5% who received at least one palliative care (PC) event. Decedents who received PC were significantly more likely to die in a hospice (39·4% versus 14·5%, $p<0.005$) and less likely to die in hospital (23·3% versus 40·1%, $p<0.05$), and were more likely to receive an opioid (53·9% versus 25·2%, $p<0.001$). Palliative care initiated more than 2 weeks before death was associated with avoiding a hospital death. (≥2 weeks, $p<0.001$), more than four weeks before death was associated with avoiding emergency hospital admissions and increased access to an opioid (≥4 weeks, $p<0.001$), and more than 33 weeks before death was associated with avoiding late chemotherapy (≥33 weeks. No chemotherapy $p=0.019$, Chemotherapy over 4 weeks $p=0.007$) and

Conclusion

For decedents with advanced cancer, access to palliative care and longer duration of palliative care were significantly associated with better end of life quality indicators.

Strengths and limitations of this study

- To the best of our knowledge this is the first UK study to explore the associations between duration of palliative care and quality of end of life care in a large population of cancer decedents.
- The data used in this study are derived from a live clinical system and as such are likely to represent errors or omissions inherent within that system.
- The definition of good quality end of life care used in this study is informed by UK policy and guidance on end of life care provision. We recognise that what constitutes good quality care at the end of life can vary by individual and that the study does not capture individual preferences or circumstances.

Introduction

Integration of palliative care alongside oncology management should be considered early in the course of illness for patients with metastatic cancer or high symptom burden, according to American Society of Clinical Oncology guidelines.[1] This recommendation is based on a number of randomised controlled trials, largely from North America, which found early palliative care was associated with improved quality of life and a reduction in acute hospital admissions and aggressive cancer treatments at the end of life.[2-6] Though there were inconsistencies across trials, in general common characteristics were an assessment and several follow up consultations by specialist palliative care teams over a period of 2–3 months, which occurred about 6–14 months before patients died.

Compared to patients recruited to these clinical trials, cancer patients in routine care are often referred to palliative care services much later in the course of their illness.[7] We recently showed that for 4650 cancer patients in Leeds, median contact was 34 days for community and hospital palliative care services.[8] The relatively short duration of palliative care in routine services might limit the opportunity for identification of needs and the subsequent provision of effective support and symptom management. This could adversely impact on end of life outcomes.

Systematic reviews and pooled analyses of routinely collected data have demonstrated an association between palliative care intervention and increased proportion of home deaths as well as reduction in emergency admissions.[9,10] However, no study has quantified these associations in relation to duration of palliative care. In order to more directly inform models of service delivery, better quality data is needed on how long patients with cancer need to receive palliative care before important improvements in end of life care can be observed.

We report a retrospective cohort study that linked routinely collected data on hospital and community healthcare resource use in cancer decedents.

We chose this study design because it enabled us to examine the effects of palliative care service delivery in routine care for a case series of cancer decedents and minimised recruitment bias from a clinical trial design. We wanted to test the hypothesis that contact with and longer duration of palliative care would be associated with better end of life care quality indicators for patients with advanced cancer.

Methods

Study population

Retrospective data from 2479 adult (aged at least 18 years at death) cancer decedents who died between January 2010 and February 2012, resided within a single UK city, were registered with a primary care provider using the SystmOne electronic health record system, and cancer was certified as a cause of death, were included in the study.

Data collection

Data was obtained from three sources, the Northern and Yorkshire Cancer Registry and Information Service (NYCRIS), SystmOne, and the Patient Pathway Manager (PPM). NYCRIS maintain a database of all cancers occurring in the Northern and Yorkshire region in England. SystemOne is an electronic health record system used by approximately 75% of primary care providers in Leeds. PPM is a clinical information system used at a regional specialist cancer centre to manage and coordinate patient care.

Decedents eligible for the study were identified from the NYCRIS database based on address, date of death, and cause of death. The NYCRIS database provided all demographic, diagnostic, and death information. SystmOne provided opioid prescription information and community palliative care provision. PPM provided chemotherapy treatment, emergency hospital admissions and hospital based palliative care referral information. The three data sources were linked using an open pseudonymiser system to create an encrypted code based on NHS numbers.

Assessment of palliative care provision

The primary measure of palliative care provision used in this study was time between first contact with palliative care and death, measured as time in weeks. Both hospital and community based records of palliative care events were included.

The PPM system provided information on hospital based palliative care referrals. For each patient included in our study every unique palliative care referral date recorded on the PPM system was identified as a unique palliative care event. Community palliative care provision was estimated using GP communications within SystmOne, based on a multistage approach. In the first stage any GP communication within SystmOne which included either a palliative care based READ code or included text indicating palliative care, based on a keyword search, was extracted from SystemOne as a list or records, with the possibility of multiple records per patient. In the second stage only records which extended up to the date of death and included either a READ code indicating the active provision of palliative care, identified through consensus between authors (see appendix 1), or included communication with a hospice, were identified as representing palliative care provision. For each patient every unique palliative care provision date recorded in SystmOne was identified as a unique palliative care event representing contact with a palliative care team member.

The total number of palliative care events identified for each patient was a secondary measure of palliative care provision which was used as a proxy to indicate the extent of palliative care support provided.

Outcomes

The end of life quality indicators assessed were informed by UK policy and international research evidence on what constitutes quality end of life care provision for patients with cancer [3,5,11-15]and included place of death, access to strong opioids within the last year of life (identified if decedents received at least one opioid prescription within the last 12 months of life), timing of last chemotherapy treatment, and emergency hospital admission up to 4 weeks before death. We chose these because a reduction in hospital use at the end of life is commonly used as a proxy for better quality care[3,5,11-15] Recently we have demonstrated the relatively late onset of strong opioid prescribing before death in a cohort of cancer patients.[16] We judged that given the prevalence of pain in advanced cancer access to strong opioids could also be a proxy for better quality care.

Place of death was categorised as own home, hospice, hospital, care home, other or unknown. Decedents with at least one strong opioid prescription were coded as yes, with prescriptions other than a strong opioid within the last year were coded as no. The list of strong opioids included are provided in appendix 2. Decedents without a prescription were coded as missing. The timing of chemotherapy was categorised into either no chemotherapy, chemotherapy 0–4 weeks before death, or chemotherapy over 4 weeks before death. The number of emergency admissions to hospital in last 4 weeks of life were grouped into avoided emergency admission or did not avoid emergency admission (one or more emergency admissions).

Covariates

Covariates considered were age, categorised into younger than 50 years, older than 80 years, and deciles in between; sex (male or female); Indices of Multiple Deprivation (IMD) quintile (where 1 = most deprived and 5 = least deprived); cancer diagnosis; and duration of illness (in years) before death.

Statistical analysis

We used Pearson's chi-square (χ^2) to test associations between receiving palliative care and end of life quality outcomes. Post-hoc χ^2 tests were conducted for each possible 2 by 2 table comparison, adjusted using the Bonferroni correction, where outcomes included more than two categories and the χ^2 resulted in a p value of less than 0.05. The association between duration of palliative care and number of palliative care events was explored through frequency tables and the Spearman's rank correlation coefficient. Differences in median scores were compared using the Mann-Whitney U test, for two group comparisons, or the Kruskal-Wallis H test, for more than two groups. Where statistically significant results were identified from the Kruskal-Wallis H test Dunn–Bonferroni post-hoc tests for multiple comparisons of rank sums, based on the z-statistics, were conducted for each possible combination of two group comparisons.[17]

We constructed a classification tree for each end of life care outcome, using chi-squared automatic interaction detection (CHAID), to identify, for each outcome, the optimum cut-off points for duration of palliative care.[18] Each CHAID classification tree included palliative care duration as the only predictor variable. Nodes associated with the first branch of the dendrogram identified the optimum duration of palliative care cut-off points. Where the cut-off point was 0 weeks palliative care, this reflected contact with palliative care but within 7 days of death. Multivariable regression models (logistic and multinomial) were used to investigate the role of these cut-off points on end of life care outcomes, after controlling for age at death, gender, IMD deprivation quintile, first diagnosis cancer site and duration of illness. Results are presented as odds ratios (ORs) alongside 95% confidence intervals (95% CI).

Complete case analysis was undertaken. P values less than 0·05 were considered statistically significant (2-tailed). Analysis was conducted using IBM SPSS statistics version 23.

Public involvement

Patients were involved in setting the research question and in the design of the study, no patients were asked for advice on interpretation or writing up of results. The results of the research have been disseminated to the patient community through patient forums.

Results

Patient characteristics

Of the 2479 patients included in the study 64·5% (n=1598) received at least one palliative care event. Community based palliative care was received by 45·3% (n=1124), and hospital based palliative care was received by 40.0% (n=991), of patients.

Palliative care was more likely to be received by decedents who were younger (p<0.001), or female (p=0.006). Cancer diagnosis (p=0.004) was significantly associated with receiving palliative care. Decedents with upper gastrointestinal cancers were significantly more likely to receive palliative care (p<0.05) while decedents with lung cancer (p<0.05) or cancers of the central nervous system (p<0.05) were significantly less likely to receive palliative care (Table 1).

Table 1| Characteristics of the study population by palliative care provision

	Palliative care provision (n = 2479)		
Characteristics	**Not received**	**Received**	**Post-hoc**
Total number of patients: No. Row %	881 (35·5%)	1598 (64·5%)	
Age at death (years): No. Column %			
<50	35 (4·0%)	97 (6·1%)	<0.05
50-59	65 (7·4%)	184 (11·5%)	<0.05
60-69	172 (19·5%)	394 (24·7%)	<0.05
70-79	289 (32·8%)	514 (32·2%)	n/s
80+	320 (36·3%)	409 (25·6%)	<0.05
Statistical test			*($\chi2(4)$= 43·22, p<0·001)*
Gender: No. Column %			
Male	499 (56·6%)	813 (50·9%)	n/a
Female	382 (43·4%)	785 (49·1%)	n/a
Statistical test			*($\chi2(1)$= 7·57, p=0·006)*
IMD deprivation quintile: No. Column %			
Quintile 1 - Top 20% most deprived	272 (30·9%)	502 (31·4%)	n/a
Quintile 2	166 (18·8%)	315 (19·7%)	n/a
Quintile 3	142 (16·1%)	252 (15·8%)	n/a
Quintile 4	182 (20·7%)	317 (19·8%)	n/a
Quintile 5 - Top 20% least deprived	119 (13·5%)	211 (13·2%)	n/a

Missing	0 (0.0%)	1 (0.1%)	n/a
Statistical test			*(χ2(4)= 0.55, p=0.969)*
First diagnosis cancer site: No. Column %			
Head and neck	42 (4·8%)	69 (4·3%)	n/s
Upper gastrointestinal	110 (12·5%)	277 (17·3%)	<0.05
Colorectal	113 (12·8%)	214 (13·4%)	n/s
Lung	266 (30·2%)	390 (24·4%)	<0.05
Breast	81 (9·2%)	154 (9·6%)	n/s
Gynaecological	44 (5·0%)	107 (6·7%)	n/s
Prostate	83 (9·4%)	149 (9·3%)	n/s
Urological	66 (7·5%)	125 (7·8%)	n/s
Central nervous system	31 (3·5%)	32 (2·0%)	<0.05
All other cancer sites	45 (5·1%)	81 (5·1%)	n/s
Statistical test			*(χ2(9)= 24·18, p=0·004)*
Duration of illness (years)			
Median	1·28	1·26	
IQR	(0·48-3·03)	(0·52-3·20)	
Statistical test			*(M–W=701396, p=0·882)*

χ^2=Chi-square (degrees of freedom shown in brackets); M–W=Mann-Whitney U test; IQR=Interquartile range; n/a=not applicable (χ^2 not significant overall or two by two table); n/s=not significant

The time between first contact with palliative care and death varied widely from less than one week to 343 weeks, with a median interval of 6 weeks (interquartile range 2 to 19 weeks). Most decedents who received palliative care received between one and three palliative care events (median 2 events, interquartile range 1 to 3 events). There was a significant positive relationship between the interval from first contact to death and number of palliative care events (r_s=0.535, p<0.001).

Place of death

Place of death was significantly associated with palliative care provision (p<0·001). Post-hoc tests showed that patients who received palliative care were significantly more likely to die in a hospice (39·4% versus 14·5%, p<0·05) and significantly less likely to die in hospital (23·3% versus 40·1%, p<0·05), at home (26.8% versus 31.8%, p<0.05), or in a care home (8.7% versus 12.0%, p<0.05) compared to patients who did not receive palliative care (Table 2).

For the 1598 decedents who received palliative care, a shorter time between first contact with palliative care and death was observed for hospital deaths (median 3 weeks palliative care) compared with deaths in hospice (median 7 week palliative cares), at home (median 7 weeks palliative care) or in a care home (median 13 weeks palliative care) (p<0·001). There was also a significant difference in the number of palliative care events by place of death (p<0.001), with the median number of palliative events in hospital equalling one event, compared with a median of two events for deaths at home, in a hospice, or in a care home (Table 2).

Table 2| Palliative care provision by place of death

Place of death	Palliative care provision (n=2479)			Sub-group receiving palliative care (n = 1598)			
	Not received	Received	Post-hoc	Number of palliative events		Time between first contact with palliative care and death	
	Number (%)	Number (%)		Median (IQR)	Post-hoc	Median (IQR)	Post-hoc
Own home	280 (31·8)	429 (26·8%)	<0.05	2 events (1,3)	i	7 weeks (2·5,17)	i,ii
Hospice	128 (14·5)	629 (39·4%)	<0.05	2 events (1,3)	ii	7 weeks (3,19)	iii,iv
Hospital	353 (40·1)	372 (23·3%)	<0.05	1 event (1,2)	i,ii,iii	3 weeks (1,14)	i,iii,v
Care home	106 (12·0)	139 (8·7%)	<0.05	2 events (1,3)	iii	13 weeks (4,35)	ii,iv,v
Other	1 (0·1)	0 (0·0%)	-	-		-	
Unknown	13 (1·5)	29 (1·8%)	-	-		-	
Statistical test	*(χ^2(3)= 180·52, p<0·001)*			*(K–W(3)=128·14,p<0·001)*		*(K–W(3)=75·77, p<0·001)*	

X^2=Chi-squared (degrees of freedom shown in brackets); K–W = Kruskal-Wallis H test (degrees of freedom shown in brackets); Post-hoc = multiple comparison z-test statistics comparing mean ranks for each possible two category comparison group; i,ii,iii,iv,v links categories where post-hoc comparison groups which resulted in a p value less than 0.05 (after adjusting using the Bonferroni correction); IQR=Interquartile range

Receiving at least one strong opioid prescription within the last year of life

Decedents who received palliative care were significantly more likely to have also been prescribed strong opioids before death compared with patients who did not receive palliative care (53·9% versus 25·2%, p<0·001).

For those decedents that received palliative care (n=1598), the the time between first contact with palliative care and death and the number of palliative care events were significantly higher for decedents who received at least one strong opioid prescription (median 9 weeks palliative care versus 4 weeks palliative care, p<0.001; median 2 palliative care events versus 1 palliative care event, p<0.001) (Table 3).

Table 3| Palliative care provision by strong opioid prescription within the last twelve months of life

Strong opioid prescription within last year	Palliative care provision (n=2479)		Sub-group receiving palliative care (n = 1598)	
	Not received	Received	Number of palliative	Time between first contact

of life	Number (%)	Number (%)	events Median (IQR)	with palliative care and death Median (IQR)
Yes	222 (25·2%)	862 (53·9%)	2 events (1,4)	9 weeks (3,26)
No	655 (74·3%)	736 (46·1%)	1 events (1,2)	4 weeks (1,12)
Missing	4 (0·5%)	0 (0.0%)		
Statistical test		*(χ^2(1)= 188·54, p<0·001)*	*(M–W=226447,<0·001)*	*(M–W=233259,p<0·001)*

χ^2=Chi-squared (degrees of freedom shown in brackets); M–W = Mann-Whitney U test; IQR=Interquartile range

Timing of last chemotherapy

A significant relationship was identified between timing of last chemotherapy and receiving palliative care (p<0·001). Post-hoc analysis showed that those who received palliative care were more likely to have been treated with chemotherapy at any point during the course of their disease (63·6% versus 47·4%, P<0·05) and were more likely to have stopped chemotherapy over four weeks before death, compared with those not receiving palliative care (58.5% versus 42.1%, p<0.05).

For patients who received palliative care (n=1598) the time between first contact with palliative care and death was significantly associated with the timing of latest chemotherapy (p<0.001) (Table 4).

Table 4| Palliative care provision by timing of latest chemotherapy

	Palliative care provision (n=2479)			Sub-group receiving palliative care (n = 1598)			
Time of latest chemotherapy	Not received	Received	Post-hoc	Number of palliative events		Time between first contact with palliative care and death	
	Number (%)	Number (%)		Median (IQR)	Post-hoc	Median (IQR)	Post-hoc
No chemotherapy	463 (52·6%)	582 (36·4%)	<0.05	2 events (1,3)	i	5 weeks (2,14)	i,ii
0-4 weeks	47 (5·3%)	82 (5·1%)	n/s	1 events (1,2)	i,ii	2 weeks (1,6)	i,iii
Over 4 weeks	371 (42.1%)	934 (58.5%)	<0.05	2 events (1,3)	ii	8 weeks (2,22)	ii,iii
Statistical test		*(χ2(2)= 63·90, p<0·001)*		*(K–W(2)=19.94, p<0·001)*		*(K–W(2)=46.58, p<0·001)*	

X^2=Chi-squared (degrees of freedom shown in brackets); K–W = Kruskal-Wallis H test (degrees of freedom shown in brackets); Post-hoc = multiple comparison z-test statistics comparing mean ranks for each possible two category comparison group; i,ii,iii,iv,v links categories where post-hoc comparison groups which resulted in a p value less than 0.05 (after adjusting using the Bonferroni correction); IQR=Interquartile range; n/s=Not significant

Emergency hospital admission within the last four weeks of life

The majority of the sample (1926 out of 2479, 77.7%) avoided emergency hospital admission in the last 4 weeks of life. A borderline significant association was identified between emergency hospital admissions in the last four weeks of life and receiving palliative care (p=0.049). For decedents who received palliative care (n=1598), emergency admission was associated with a significantly shorter time between first contact with palliative care and death (4 weeks versus 7 weeks, p<0·001) and significantly fewer palliative care events overall (2 events versus 2 events, p=0·010) (Table 5).

Table 5| Palliative care provision by emergency hospital admissions within the last four weeks of life

Avoided emergency hospital admissions 0-4 weeks before death	Palliative care provision (n=2479) Not received Number (%)	 Received Number (%)	Sub-group receiving palliative care (n = 1598) Number of palliative events Median (IQR)	 Time between first contact with palliative care and death Median (IQR)
Yes	704 (79·9%)	1222 (76·5%)	2 events (1,3)	7 weeks (2,20)
No (one or more admission)	177 (20·1%)	376 (23·5%)	2 events (1,3)	4 weeks (1,12)
Statistical test		*(χ2(1)= 3·87, p=0·049)*	*(M–W=210485, p=0·010)*	*(M–W=185814, p<0·001)*

χ^2=Chi-squared (degrees of freedom shown in brackets); M–W = Mann-Whitney U test; IQR=Interquartile range

Multivariable regression

Classification tree optimum cut-off points for each of the end of life outcomes are provided in appendix 3. Between three and five optimum cut-off points were identified for the four end of life outcomes in relation to the time between first contact with palliative care and death. The multivariable (multinomial) logistic regression models, showed overall greater odds ratios for better outcomes at the end of life with longer time between first contact with palliative care and death Figure 1. Each cut-off point within the model generally represents a significantly better outcome. For example, although overall there was no association between palliative care and increased home deaths, the model shows that decedents who received 2-7 weeks of palliative care had 2.96 better odds of dying at home than in hospital (95% CI= 2.02 to 4.35, p<0.001), and those who received more than 8 weeks of palliative care had 3.49 better odds of dying at home (95%C 2.42 to 5.04, p<0.001). Similarly, there was a clear stepwise increase in the odds of receiving an opioid prescription with longer time between first contact with palliative care and death (Not received palliative care: OR=0.49, 95% CI=0.39 to 0.61, p<0.001; 0-3 weeks palliative care: OR=1.00 95% CI=reference; 4-7 weeks palliative care: OR=1.49, 95% CI=1.12 to 1.98, p=0.006; 8-32 weeks palliative care: OR=2.45, 95% CI=1.90 to 3.16, p<0.001; 33+ weeks palliative care: OR=3.24, 95% CI=2.34 to 4.49, p<0.001).

(Insert Fig 1 here)

Discussion

Our analysis confirms existing research that better outcomes at the end of life are associated with access to palliative care services. However, we have been able to demonstrate for the first time that longer interval between first contact with palliative care and death is associated with increasingly better outcomes, specifically relating to place of death outside hospital, access to strong opioid, and avoiding chemotherapy and emergency hospital admission within the last 4 weeks of life. For some outcomes such as place of death at home, there appears to be a minimum interval between first contact with palliative care and death that is associated with higher odds of home death. This suggests that sufficient time is required to plan and co-ordinate in order to achieve this outcome for a patient. Although causality cannot be assumed, these findings provide additional evidence to support earlier assessment of palliative care needs within oncology service delivery models.

We found decedents who received palliative care were less likely to die in hospital and more likely to die in a hospice. Whilst it is important to acknowledge that for some patients dying in hospital represents appropriate end of life care, for most, care is rated significantly lower for people who die in a hospital, compared to home, a hospice or care home.[20] Despite this, approximately 48% of UK cancer patients die in hospital.[21] We identified the level of palliative care involvement associated with a reduction in hospital deaths was minimal (two contacts initiated at least three weeks before death). The potential per patient saving by avoiding a hospital death proposed by the National End of Life Information Network is £958 per patient.[22]

Evidence for the impact of palliative care on home death is inconsistent. We found the rate of home deaths in decedents who received palliative care was lower compared to those who did not, however the likelihood of dying at home, rather than hospital, increased as the level of palliative care involvement increased. A meta-analysis found palliative care had no impact on home deaths[23] while a Cochrane review undertaken the same year found it more than doubles the odds of dying at home.[24] These differences may reflect differences in the availability of hospice or palliative care services, or bias in the selection of suitable patients for palliative care. Our data suggest that the interval between first contact with palliative care and death may account for this inconsistent relationship.

Opioid analgesia is the recommended treatment for moderate to severe pain[25] the prevalence of which in advanced cancer is estimated to be between 62% and 86%[26] and patients who die of cancer typically require increasing doses of opioids as their disease progresses.[27] We found access to palliative care was associated with being twice as likely to have access to strong opioids. However whether the referral to palliative care triggers the opioid prescription or the opioid prescription triggers the palliative care referral is unclear.

Administration of chemotherapy close to death usually represents poorly planned care.[28] It was encouraging to find that only 5% of our study population received chemotherapy within the last four weeks of life however this limited the potential to explore the impact of palliative care on late chemotherapy. Studies that have established an association between palliative care team involvement and lower rates of chemotherapy near the end of life have concluded that cessation of chemotherapy is due to palliative care involvement.[29] Although a referral to palliative care may help protect against late chemotherapy, our findings suggest this association is more complex and in some cases receiving chemotherapy or the cessation of chemotherapy may in fact trigger the palliative care referral.

We hypothesised that decedents who received palliative care would be more likely to avoid emergency hospital admissions in the last four weeks of life though we found the opposite. Further analysis revealed that only decedents in whom first contact with palliative care was longer than four weeks before death benefited in this outcome. Decedents whose first contact occurred less than four weeks before death were more likely to require emergency admission within the last four weeks of life. This might be explained by emergency hospital admission triggering palliative care involvement. Current evidence reports that 77% of emergency cancer admissions are avoidable[30] so our findings indicate there is considerable scope to reduce emergency admissions provided palliative care is initiated at least 4 weeks before death

This study has limitations. First, the population is derived from a single UK city. Though broadly representative of the UK cancer population in prevalence of cancer type, age, sex, and survival, the extent to which the level of palliative care involvement is representative of national and international activity is harder to determine. Secondly, the data are derived from a live clinical system and as such are likely to represent errors or omissions inherent within the system. This was moderated by restricting linkage to a single electronic system (SystmOne) which had the best potential for reliable linkage. We acknowledge that though we included a range of potential confounder variables in the regression modelling the choice of confounders was limited by the availability and reliability of data within our datasets. Thirdly, we cannot assume that referral to or longer interval between first contact with palliative care and death caused better outcomes. For some patients, and for some outcomes (such as access to strong opioids or cessation of chemotherapy), it is possible that the outcome event itself triggered referral to palliative care. These are nevertheless important hypotheses to test further in terms of operationalising earlier integration of palliative care. In contrast, deaths outside hospital and increased home death appear more likely to be the result of longer interval from first contact with palliative care.

Conclusion

The research evidence to support early integration of palliative care for cancer patients[1-6] is based on relatively high intensity interventions of at least 8–12 weeks initiated approximately 6–14 months before death. Within routinely collected data, we have determined an association between longer interval from first contact with palliative care to death and important quality indicators of end of life care. Palliative care initiated more than two weeks before death was associated with avoiding a hospital death; and initiated more than four weeks before death was associated with a reduction in emergency hospital admissions and an increased likelihood of receiving an opioid analgesic. Palliative care initiated more than 32 weeks before death was associated with a reduction in chemotherapy in the last four weeks of life.

Characterising the impact of palliative care services based on interval between first contact and death provides new evidence which will aid policymakers when modelling palliative care service provision. Evidence of benefit in advanced non-cancer diseases remains unclear but together with other observational evidence, our findings should stimulate similar research in these populations.

Contributors

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Final approval of manuscript: All authors

Accountable for all aspects of the work: All authors

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Competing interests

We have read and understood BMJ policy on declaration of interests and declare that we have no competing interests.

Ethical approval

The National Research Ethics Service (PR 13.YH.0301) granted ethical approval for the study.

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Data Sharing

No additional data available. Electronic health records are considered “sensitive” data in the UK by the Data Protection Act and cannot be shared via public deposition due to restrictions in place to protect patient confidentiality.

Transparency statement

The lead author affirms that the manuscript is an honest, accurate, and transparent account of the study being reported; that no important aspects of the study have been omitted; and that any discrepancies are disclosed.

Legend for Fig 1

Fig 1| Multivariable adjusted odds ratios from logistic and multinomial logistic regression models for end of life outcomes by time between first contact with palliative care and death cut-off points

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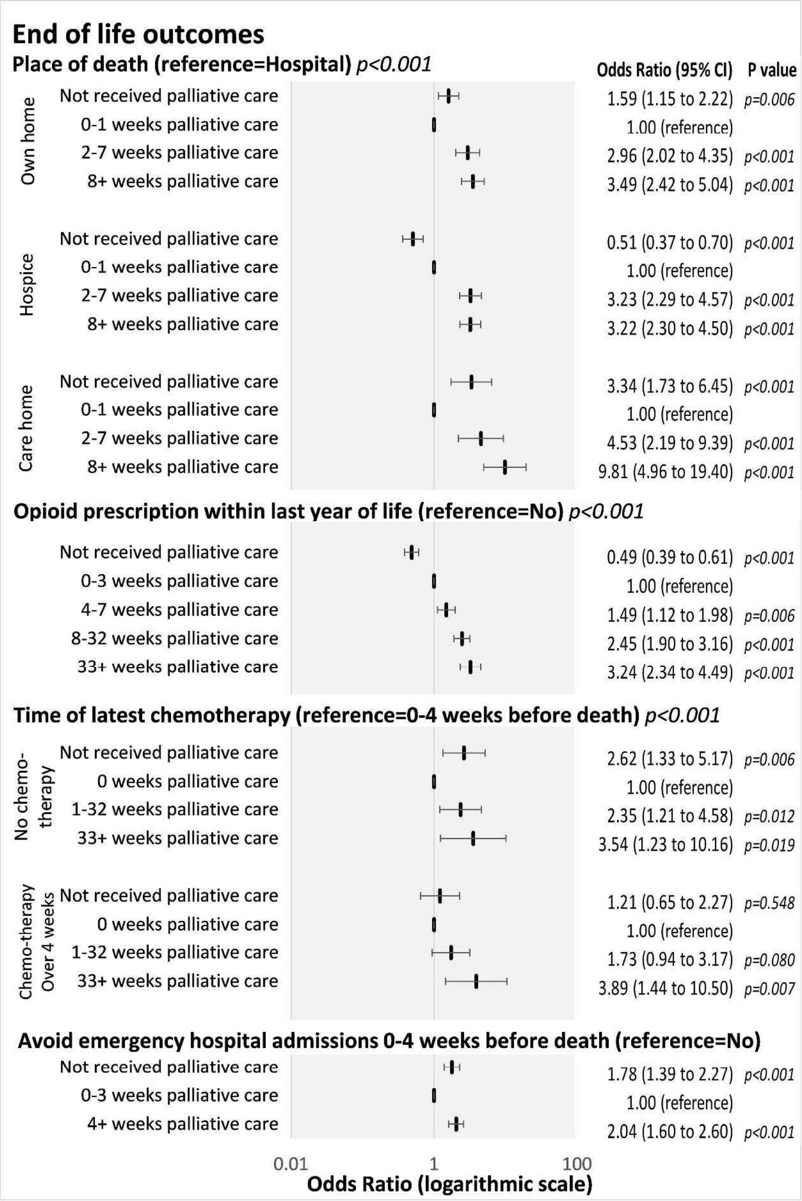

Figure 1

343x512mm (300 x 300 DPI)

Appendix 1: READ codes extracted from SystmOne

READ codes	**Indicate active palliative care?**
(1Z01.) Terminal illness - late stage	No
(8BA2.) End of life care	No
(8H6A.) Refer to terminal care consult	Yes
(8H7L.) Refer for terminal care	Yes
(9EB5.) DS 1500 Disability living allowance completed	No
(Xa9tS) For resuscitation	No
(Xa9tT) Not for resuscitation	No
(XaAex) Referral to palliative care service	Yes
(XaAg6) Referral to palliative care physician	Yes
(XaAPW) Under care of palliative care physician	Yes
(XaAT5) Seen by palliative care physician	Yes
(XaAWN) Seen by palliative care medicine - service	Yes
(XaEJE) Palliative care	No
(XaIlk) Referred to community specialist palliative care team	Yes
(XaIpI) Palliative treatment	Yes
(XaIpl) Final days pathway	No
(XaIpX) Preferred place of death	No
(XaIse) Specialist palliative care treatment	Yes
(XaIsy) Preferred place of death discussed with patient	No
(XaIt6) Specialist palliative care treatment – day care	Yes
(XaIt7) Specialist palliative care treatment - outpatient	Yes
(XaJ3g) Preferred place of death: home	No
(XaJ3h) Preferred place of death: hospice	No
(XaJ3j) Preferred place of death: hospital	No
(XaJ3k) Preferred place of death: nursing home	No

(XaJv2) On gold standards palliative care framework	No
(XaLwc) Resuscitation discussed with patient	No
(XaLwd) Resuscitation discussed with carer	No
(XaMhi) Liverpool care pathway for the dying	No
(XaPmq) Issue of palliative care anticipatory medication box	No
(XaQ8S) Anticipatory palliative care	No
(XaQg1) Last days of life	No
(XaQzq) Preferred place of death: pt unable to express preference	No
(XaQzr) Preferred place of death: discussion not appropriate	No
(XaQzt) Preferred place of death: patient undecided	No
(XaR50) GSF supportive care stage 1 - advancing disease	No
(XaR53) GSF supportive care stage 2 - increasing decline	No
(XaR5A) GSF supportv care stge 3 - last days: cat C - wks prognosis	No
(XaRFF) Has end of life advance care plan	No
(XaRFG) On end of life care register	No
(XaX46) GSF supportv care stge 3 - last days: cat B - mth prognosis	No
(ZV57C) [V]Palliative care	No

Appendix 2. Medications identified as strong opioids

- Buprenorphine (>10mcg)
- Diamorphine
- Dipipanone (with cyclizine)
- Fentanyl
- Hydromorphone
- Meptazinol
- Morphine
- Oxycodone
- Pentazocine
- Papaveretum
- Pethidine

Appendix 3: Classification tree duration of palliative care cut-off points by end of life quality outcomes

Place of death

	Cut-off points (n=2436): number (column %)				
	Not received	**0-1 weeks**	**2-7 weeks**	**8+ weeks**	**Total**
Own home	280 (32.3%)	70 (21.1%)	148 (28.1%)	211 (29.7%)	709 (29.1%)
Hospice	128 (14.8%)	104 (31.4%)	237 (45.0%)	288 (40.5%)	757 (31.1%)
Hospital	353 (40.7%)	146 (44.1%)	105 (19.9%)	121 (17.0%)	725 (29.8%)
Care home	106 (12.2%)	11 (3.3%)	37 (7.0%)	91 (12.8%)	245 (10.1%)
Statistical test					*(χ^2(9)= 280.75, p<0·001)*
Total: Number (row %)	**867 (35.6%)**	**331 (13.6%)**	**527 (21.6%)**	**711 (29.2%)**	**2436**

Opioid prescription within last year of life

	Cut-off points (n=2475): number (column %)					
	Not received	**0-3 weeks**	**4-7 weeks**	**8-32 weeks**	**33+ weeks**	**Total**
Yes	222 (25.3%)	237 (41.3%)	149 (50.0%)	299 (62.8%)	177 (70.8%)	1084 (43.8%)
No	655 (74.7%)	337 (58.7%)	149 (50.0%)	177 (37.2%)	73 (29.2%)	1391 (56.2%)
Statistical test						*(χ^2(4)= 279.01, p<0·001)*
Total: Number (row %)	**877 (35.4%)**	**574 (23.2%)**	**298 (12.0%)**	**476 (19.2%)**	**250 (10.1%)**	**2475**

Time of latest chemotherapy

	Cut-off points (n=2479): number (column %)				
	Not received	**0 weeks**	**1-32 weeks**	**33+ weeks**	**Total**
No chemotherapy	463 (52.6%)	50 (30.7%)	466 (39.4%)	66 (26.4%)	1045 (42.2%)
0-4 weeks	47 (5.3%)	16 (9.8%)	60 (5.1%)	6 (2.4%)	129 (5.2%)
5+ weeks	371 (42.1%)	97 (59.5%)	659 (55.6%)	178 (71.2%)	1305(52.6%)
Statistical test					*(χ^2(3)=55.494, p<0·001)*
Total: Number (row %)	**881 (35.5%)**	**163 (6.6%)**	**1185(47.8%)**	**250 (10.1%)**	**2479**

Avoided emergency hospital admissions 0-4 weeks before death

	Cut-off points (n=2479): number (column %)			
	Not received	**0-3 weeks**	**4+ weeks**	**Total**
Yes	704 (79.9%)	392 (68.3%)	830 (81.1%)	1926 (77.7%)
No (one or more admission)	177 (20.1%)	182 (31.7%)	194 (18.9%)	553 (22.3%)
Statistical test				*(χ^2(2)=36.390, p<0.001)*
Total: Number (row %)	**881 (35.5%)**	**574 (23.2%)**	**1024 (41.3%)**	**2479**

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Is palliative care support associated with better quality end of life care indicators for patients with advanced cancer? A retrospective cohort study

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Title

Is palliative care support associated with better quality end of life care indicators for patients with advanced cancer? A retrospective cohort study.

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Abstract

Objectives

This study aimed to establish the association between timing and provision of palliative care and quality of end-of-life care indicators in a population of patients dying of cancer.

Setting

This study uses linked cancer patient data from the National Cancer Registry, the electronic medical record system used in primary care (SystmOne) and the electronic medical record system used within a specialist regional cancer centre. The population resided in a single city in Northern England.

Participants

Retrospective data from 2479 adult cancer decedents who died between January 2010 and February 2012, were registered with a primary care provider using the SystmOne electronic health record system, and cancer was certified as a cause of death, were included in the study.

Results

Linkage yielded data on 2479 cancer decedents, with 64·5% who received at least one palliative care (PC) event. Decedents who received PC were significantly more likely to die in a hospice (39·4% versus 14·5%, $p<0.005$) and less likely to die in hospital (23·3% versus 40·1%, $p<0.05$), and were more likely to receive an opioid (53·9% versus 25·2%, $p<0.001$). Palliative care initiated more than 2 weeks before death was associated with avoiding a hospital death. (≥2 weeks, $p<0.001$), more than four weeks before death was associated with avoiding emergency hospital admissions and increased access to an opioid (≥4 weeks, $p<0.001$), and more than 33 weeks before death was associated with avoiding late chemotherapy (≥33 weeks. No chemotherapy $p=0.019$, Chemotherapy over 4 weeks $p=0.007$) and

Conclusion

For decedents with advanced cancer, access to palliative care and longer duration of palliative care were significantly associated with better end of life quality indicators.

Strengths and limitations of this study

- To the best of our knowledge this is the first UK study to explore the associations between duration of palliative care and quality of end of life care in a large population of cancer decedents.
- The data used in this study are derived from a live clinical system and as such are likely to represent errors or omissions inherent within that system.

- The definition of good quality end of life care used in this study is informed by UK policy and guidance on end of life care provision. We recognise that what constitutes good quality care at the end of life can vary by individual and that the study does not capture individual preferences or circumstances.

Introduction

Integration of palliative care alongside oncology management should be considered early in the course of illness for patients with metastatic cancer or high symptom burden, according to American Society of Clinical Oncology guidelines.[1] This recommendation is based on a number of randomised controlled trials, largely from North America, which found early palliative care was associated with improved quality of life and a reduction in acute hospital admissions and aggressive cancer treatments at the end of life.[2-6] Though there were inconsistencies across trials, in general common characteristics were an assessment and several follow up consultations by specialist palliative care teams over a period of 2–3 months, which occurred about 6–14 months before patients died.

Compared to patients recruited to these clinical trials, cancer patients in routine care are often referred to palliative care services much later in the course of their illness.[7] We recently showed that for 4650 cancer patients in Leeds, median contact was 34 days for community and hospital palliative care services.[8] The relatively short duration of palliative care in routine services might limit the opportunity for identification of needs and the subsequent provision of effective support and symptom management. This could adversely impact on end of life outcomes.

Systematic reviews and pooled analyses of routinely collected data have demonstrated an association between palliative care intervention and increased proportion of home deaths as well as reduction in emergency admissions.[9,10] However, no study has quantified these associations in relation to duration of palliative care. In order to more directly inform models of service delivery, better quality data is needed on how long patients with cancer need to receive palliative care before important improvements in end of life care can be observed.

We report a retrospective cohort study that linked routinely collected data on hospital and community healthcare resource use in cancer decedents.

We chose this study design because it enabled us to examine the effects of palliative care service delivery in routine care for a case series of cancer decedents and minimised recruitment bias from a clinical trial design. We wanted to test the hypothesis that contact with and longer duration of palliative care would be associated with better end of life care quality indicators for patients with advanced cancer.

Methods

Study population

Retrospective data from 2479 adult (aged at least 18 years at death) cancer decedents who died between January 2010 and February 2012, resided within a single UK city, were registered with a primary care provider using the SystmOne electronic health record system, and cancer was certified as a cause of death, were included in the study.

Data collection

Data was obtained from three sources, the Northern and Yorkshire Cancer Registry and Information Service (NYCRIS), SystmOne, and the Patient Pathway Manager (PPM). NYCRIS maintain a database of all cancers occurring in the Northern and Yorkshire region in England. SystemOne is an electronic health record system used by approximately 75% of primary care providers in Leeds. PPM is a clinical information system used at a regional specialist cancer centre to manage and coordinate patient care.

Decedents eligible for the study were identified from the NYCRIS database based on address, date of death, and cause of death. The NYCRIS database provided all demographic, diagnostic, and death information. SystmOne provided opioid prescription information and community palliative care provision. PPM provided chemotherapy treatment, emergency hospital admissions and hospital based palliative care referral information. The three data sources were linked using an open pseudonymiser system to create an encrypted code based on NHS numbers.

Assessment of palliative care provision

The primary measure of palliative care provision used in this study was time between first contact with palliative care and death, measured as time in weeks. Both hospital and community based records of palliative care events were included.

The PPM system provided information on hospital based palliative care referrals. For each patient included in our study every unique palliative care referral date recorded on the PPM system was identified as a unique palliative care event. Community palliative care provision was estimated using GP communications within SystmOne, based on a multistage approach. In the first stage any GP communication within SystmOne which included either a palliative care based READ code or included text indicating palliative care, based on a keyword search, was extracted from SystemOne as a list or records, with the possibility of multiple records per patient. In the second stage only records which extended up to the date of death and included either a READ code indicating the active provision of palliative care, identified through consensus between authors (see appendix 1), or included communication with a hospice, were identified as representing palliative care provision. For each patient every unique palliative care provision date recorded in SystmOne was identified as a unique palliative care event representing contact with a palliative care team member.

The total number of palliative care events identified for each patient was a secondary measure of palliative care provision which was used as a proxy to indicate the extent of palliative care support provided.

Outcomes

The end of life quality indicators assessed were informed by UK policy and international research evidence on what constitutes quality end of life care provision for patients with cancer [3,5,11-15]and included place of death, access to strong opioids within the last year of life (identified if decedents received at least one opioid prescription within the last 12 months of life), timing of last chemotherapy treatment, and emergency hospital admission up to 4 weeks before death. We chose these because a reduction in hospital use at the end of life is commonly used as a proxy for better quality care[3,5,11-15] Recently we have demonstrated the relatively late onset of strong opioid prescribing before death in a cohort of cancer patients.[16] We judged that given the prevalence of pain in advanced cancer access to strong opioids could also be a proxy for better quality care.

Place of death was categorised as own home, hospice, hospital, care home, other or unknown. Decedents with at least one strong opioid prescription were coded as yes, with prescriptions other than a strong opioid within the last year were coded as no. The list of strong opioids included are provided in appendix 2. Decedents without a prescription were coded as missing. The timing of chemotherapy was categorised into either no chemotherapy, chemotherapy 0–4 weeks before death, or chemotherapy over 4 weeks before death. The number of emergency admissions to hospital in last 4 weeks of life were grouped into avoided emergency admission or did not avoid emergency admission (one or more emergency admissions).

Covariates

Covariates considered were age, categorised into younger than 50 years, older than 80 years, and deciles in between; sex (male or female); Indices of Multiple Deprivation (IMD) quintile (where 1 = most deprived and 5 = least deprived); cancer diagnosis; and duration of illness (in years) before death.

Statistical analysis

We used Pearson's chi-square (χ^2) to test associations between receiving palliative care and end of life quality outcomes. Post-hoc χ^2 tests were conducted for each possible 2 by 2 table comparison, adjusted using the Bonferroni correction, where outcomes included more than two categories and the χ^2 resulted in a p value of less than 0.05. The association between duration of palliative care and number of palliative care events was explored through frequency tables and the Spearman's rank correlation coefficient. Differences in median scores were compared using the Mann-Whitney U test, for two group comparisons, or the Kruskal-Wallis H test, for more than two groups. Where statistically significant results were identified from the Kruskal-Wallis H test Dunn–Bonferroni post-hoc tests for multiple comparisons of rank sums, based on the z-statistics, were conducted for each possible combination of two group comparisons.[17]

We constructed a classification tree for each end of life care outcome, using chi-squared automatic interaction detection (CHAID), to identify, for each outcome, the optimum cut-off points for duration of palliative care.[18] Each CHAID classification tree included palliative care duration as the only predictor variable. Nodes associated with the first branch of the dendrogram identified the optimum duration of palliative care cut-off points. Where the cut-off point was 0 weeks palliative care, this reflected contact with palliative care but within 7 days of death. Multivariable regression models (logistic and multinomial) were used to investigate the role of these cut-off points on end of life care outcomes, after controlling for age at death, gender, IMD deprivation quintile, first diagnosis cancer site and duration of illness. Results are presented as odds ratios (ORs) alongside 95% confidence intervals (95% CI).

Complete case analysis was undertaken. P values less than 0·05 were considered statistically significant (2-tailed). Analysis was conducted using IBM SPSS statistics version 23.

Public involvement

Patients were involved in setting the research question and in the design of the study, no patients were asked for advice on interpretation or writing up of results. The results of the research have been disseminated to the patient community through patient forums.

Results

Patient characteristics

Of the 2479 patients included in the study 64·5% (n=1598) received at least one palliative care event. Community based palliative care was received by 45·3% (n=1124), and hospital based palliative care was received by 40.0% (n=991), of patients.

Palliative care was more likely to be received by decedents who were younger (p<0.001), or female (p=0.006). Cancer diagnosis (p=0.004) was significantly associated with receiving palliative care. Decedents with upper gastrointestinal cancers were significantly more likely to receive palliative care (p<0.05) while decedents with lung cancer (p<0.05) or cancers of the central nervous system (p<0.05) were significantly less likely to receive palliative care (Table 1).

Table 1| Characteristics of the study population by palliative care provision

	Palliative care provision (n = 2479)		
Characteristics	**Not received**	**Received**	**Post-hoc**
Total number of patients: No. Row %	881 (35·5%)	1598 (64·5%)	
Age at death (years): No. Column %			
<50	35 (4·0%)	97 (6·1%)	<0.05
50-59	65 (7·4%)	184 (11·5%)	<0.05
60-69	172 (19·5%)	394 (24·7%)	<0.05
70-79	289 (32·8%)	514 (32·2%)	n/s
80+	320 (36·3%)	409 (25·6%)	<0.05
Statistical test			*(χ2(4)= 43·22, p<0·001)*
Gender: No. Column %			
Male	499 (56·6%)	813 (50·9%)	n/a
Female	382 (43·4%)	785 (49·1%)	n/a
Statistical test			*(χ2(1)= 7·57, p=0·006)*
IMD deprivation quintile: No. Column %			
Quintile 1 - Top 20% most deprived	272 (30·9%)	502 (31·4%)	n/a
Quintile 2	166 (18·8%)	315 (19·7%)	n/a
Quintile 3	142 (16·1%)	252 (15·8%)	n/a
Quintile 4	182 (20·7%)	317 (19·8%)	n/a
Quintile 5 - Top 20% least deprived	119 (13·5%)	211 (13·2%)	n/a

Missing	0 (0.0%)	1 (0.1%)	n/a
Statistical test			*(χ2(4)= 0.55, p=0.969)*
First diagnosis cancer site: No. Column %			
Head and neck	42 (4·8%)	69 (4·3%)	n/s
Upper gastrointestinal	110 (12·5%)	277 (17·3%)	<0.05
Colorectal	113 (12·8%)	214 (13·4%)	n/s
Lung	266 (30·2%)	390 (24·4%)	<0.05
Breast	81 (9·2%)	154 (9·6%)	n/s
Gynaecological	44 (5·0%)	107 (6·7%)	n/s
Prostate	83 (9·4%)	149 (9·3%)	n/s
Urological	66 (7·5%)	125 (7·8%)	n/s
Central nervous system	31 (3·5%)	32 (2·0%)	<0.05
All other cancer sites	45 (5·1%)	81 (5·1%)	n/s
Statistical test			*(χ2(9)= 24·18, p=0·004)*
Duration of illness (years)			
Median	1·28	1·26	
IQR	(0·48-3·03)	(0·52-3·20)	
Statistical test			*(M–W=701396, p=0·882)*

χ^2=Chi-square (degrees of freedom shown in brackets); M–W=Mann-Whitney U test; IQR=Interquartile range; n/a=not applicable (χ^2 not significant overall or two by two table); n/s=not significant

The time between first contact with palliative care and death varied widely from less than one week to 343 weeks, with a median interval of 6 weeks (interquartile range 2 to 19 weeks). Most decedents who received palliative care received between one and three palliative care events (median 2 events, interquartile range 1 to 3 events). There was a significant positive relationship between the interval from first contact to death and number of palliative care events (r_s=0.535, p<0.001).

Place of death

Place of death was significantly associated with palliative care provision (p<0·001). Post-hoc tests showed that patients who received palliative care were significantly more likely to die in a hospice (39·4% versus 14·5%, p<0·05) and significantly less likely to die in hospital (23·3% versus 40·1%, p<0·05), at home (26.8% versus 31.8%, p<0.05), or in a care home (8.7% versus 12.0%, p<0.05) compared to patients who did not receive palliative care (Table 2).

For the 1598 decedents who received palliative care, a shorter time between first contact with palliative care and death was observed for hospital deaths (median 3 weeks palliative care) compared with deaths in hospice (median 7 week palliative cares), at home (median 7 weeks palliative care) or in a care home (median 13 weeks palliative care) (p<0·001). There was also a significant difference in the number of palliative care events by place of death (p<0.001), with the median number of palliative events in hospital equalling one event, compared with a median of two events for deaths at home, in a hospice, or in a care home (Table 2).

Table 2| Palliative care provision by place of death

Place of death	Palliative care provision (n=2479)			Sub-group receiving palliative care (n = 1598)			
	Not received	Received	Post-hoc	Number of palliative events		Time between first contact with palliative care and death	
	Number (%)	Number (%)		Median (IQR)	Post-hoc	Median (IQR)	Post-hoc
Own home	280 (31·8)	429 (26·8%)	<0.05	2 events (1,3)	i	7 weeks (2·5,17)	i,ii
Hospice	128 (14·5)	629 (39·4%)	<0.05	2 events (1,3)	ii	7 weeks (3,19)	iii,iv
Hospital	353 (40·1)	372 (23·3%)	<0.05	1 event (1,2)	i,ii,iii	3 weeks (1,14)	i,iii,v
Care home	106 (12·0)	139 (8·7%)	<0.05	2 events (1,3)	iii	13 weeks (4,35)	ii,iv,v
Other	1 (0·1)	0 (0·0%)	-	-		-	
Unknown	13 (1·5)	29 (1·8%)	-	-		-	
Statistical test			*(χ^2(3)= 180·52, p<0·001)*	*(K–W(3)=128·14,p<0·001)*			*(K–W(3)=75·77, p<0·001)*

X^2=Chi-squared (degrees of freedom shown in brackets); K–W = Kruskal-Wallis H test (degrees of freedom shown in brackets); Post-hoc = multiple comparison z-test statistics comparing mean ranks for each possible two category comparison group; i,ii,iii,iv,v links categories where post-hoc comparison groups which resulted in a p value less than 0.05 (after adjusting using the Bonferroni correction); IQR=Interquartile range

Receiving at least one strong opioid prescription within the last year of life

Decedents who received palliative care were significantly more likely to have also been prescribed strong opioids before death compared with patients who did not receive palliative care (53·9% versus 25·2%, p<0·001).

For those decedents that received palliative care (n=1598), the the time between first contact with palliative care and death and the number of palliative care events were significantly higher for decedents who received at least one strong opioid prescription (median 9 weeks palliative care versus 4 weeks palliative care, p<0.001; median 2 palliative care events versus 1 palliative care event, p<0.001) (Table 3).

Table 3| Palliative care provision by strong opioid prescription within the last twelve months of life

Strong opioid prescription within last year	Palliative care provision (n=2479)		Sub-group receiving palliative care (n = 1598)	
	Not received	Received	Number of palliative	Time between first contact

of life	Number (%)	Number (%)	events Median (IQR)	with palliative care and death Median (IQR)
Yes	222 (25·2%)	862 (53·9%)	2 events (1,4)	9 weeks (3,26)
No	655 (74·3%)	736 (46·1%)	1 events (1,2)	4 weeks (1,12)
Missing	4 (0·5%)	0 (0.0%)		
Statistical test		*(χ^2(1)= 188·54, p<0·001)*	*(M–W=226447,<0·001)*	*(M–W=233259,p<0·001)*

χ^2=Chi-squared (degrees of freedom shown in brackets); M–W = Mann-Whitney U test; IQR=Interquartile range

Timing of last chemotherapy

A significant relationship was identified between timing of last chemotherapy and receiving palliative care (p<0·001). Post-hoc analysis showed that those who received palliative care were more likely to have been treated with chemotherapy at any point during the course of their disease (63·6% versus 47·4%, P<0·05) and were more likely to have stopped chemotherapy over four weeks before death, compared with those not receiving palliative care (58.5% versus 42.1%, p<0.05).

For patients who received palliative care (n=1598) the time between first contact with palliative care and death was significantly associated with the timing of latest chemotherapy (p<0.001) (Table 4).

Table 4| Palliative care provision by timing of latest chemotherapy

Time of latest chemotherapy	Palliative care provision (n=2479) Not received Number (%)	Received Number (%)	Post-hoc	Sub-group receiving palliative care (n = 1598) Number of palliative events Median (IQR)	Post-hoc	Time between first contact with palliative care and death Median (IQR)	Post-hoc
No chemotherapy	463 (52·6%)	582 (36·4%)	<0.05	2 events (1,3)	i	5 weeks (2,14)	i,ii
0-4 weeks	47 (5·3%)	82 (5·1%)	n/s	1 events (1,2)	i,ii	2 weeks (1,6)	i,iii
Over 4 weeks	371 (42.1%)	934 (58.5%)	<0.05	2 events (1,3)	ii	8 weeks (2,22)	ii,iii
Statistical test		*(χ2(2)= 63·90, p<0·001)*		*(K–W(2)=19.94, p<0·001)*		*(K–W(2)=46.58, p<0·001)*	

X^2=Chi-squared (degrees of freedom shown in brackets); K–W = Kruskal-Wallis H test (degrees of freedom shown in brackets); Post-hoc = multiple comparison z-test statistics comparing mean ranks for each possible two category comparison group; i,ii,iii,iv,v links categories where post-hoc comparison groups which resulted in a p value less than 0.05 (after adjusting using the Bonferroni correction); IQR=Interquartile range; n/s=Not significant

Emergency hospital admission within the last four weeks of life

The majority of the sample (1926 out of 2479, 77.7%) avoided emergency hospital admission in the last 4 weeks of life. A borderline significant association was identified between emergency hospital admissions in the last four weeks of life and receiving palliative care (p=0.049). For decedents who received palliative care (n=1598), emergency admission was associated with a significantly shorter time between first contact with palliative care and death (4 weeks versus 7 weeks, p<0·001) and significantly fewer palliative care events overall (2 events versus 2 events, p=0·010) (Table 5).

Table 5| Palliative care provision by emergency hospital admissions within the last four weeks of life

Avoided emergency hospital admissions 0-4 weeks before death	Palliative care provision (n=2479) Not received Number (%)	Received Number (%)	Sub-group receiving palliative care (n = 1598) Number of palliative events Median (IQR)	Time between first contact with palliative care and death Median (IQR)
Yes	704 (79·9%)	1222 (76·5%)	2 events (1,3)	7 weeks (2,20)
No (one or more admission)	177 (20·1%)	376 (23·5%)	2 events (1,3)	4 weeks (1,12)
Statistical test		*(χ2(1)= 3·87, p=0·049)*	*(M–W=210485, p=0·010)*	*(M–W=185814, p<0·001)*

χ^2=Chi-squared (degrees of freedom shown in brackets); M–W = Mann-Whitney U test; IQR=Interquartile range

Multivariable regression

Classification tree optimum cut-off points for each of the end of life outcomes are provided in appendix 3. Between three and five optimum cut-off points were identified for the four end of life outcomes in relation to the time between first contact with palliative care and death. The multivariable (multinomial) logistic regression models, showed overall greater odds ratios for better outcomes at the end of life with longer time between first contact with palliative care and death Figure 1. Each cut-off point within the model generally represents a significantly better outcome. For example, although overall there was no association between palliative care and increased home deaths, the model shows that decedents who received 2-7 weeks of palliative care had 2.96 better odds of dying at home than in hospital (95% CI= 2.02 to 4.35, p<0.001), and those who received more than 8 weeks of palliative care had 3.49 better odds of dying at home (95%C 2.42 to 5.04, p<0.001). Similarly, there was a clear stepwise increase in the odds of receiving an opioid prescription with longer time between first contact with palliative care and death (Not received palliative care: OR=0.49, 95% CI=0.39 to 0.61, p<0.001; 0-3 weeks palliative care: OR=1.00 95% CI=reference; 4-7 weeks palliative care: OR=1.49, 95% CI=1.12 to 1.98, p=0.006; 8-32 weeks palliative care: OR=2.45, 95% CI=1.90 to 3.16, p<0.001; 33+ weeks palliative care: OR=3.24, 95% CI=2.34 to 4.49, p<0.001).

(Insert Fig 1 here)

Discussion

Our analysis confirms existing research that better outcomes at the end of life are associated with access to palliative care services. However, we have been able to demonstrate for the first time that longer interval between first contact with palliative care and death is associated with increasingly better outcomes, specifically relating to place of death outside hospital, access to strong opioid[19], and avoiding chemotherapy and emergency hospital admission within the last 4 weeks of life. For some outcomes such as place of death at home, there appears to be a minimum interval between first contact with palliative care and death that is associated with higher odds of home death. This suggests that sufficient time is required to plan and co-ordinate in order to achieve this outcome for a patient.

We found decedents who received palliative care were less likely to die in hospital and more likely to die in a hospice. Whilst it is important to acknowledge that for some patients dying in hospital represents appropriate end of life care, for most, care is rated significantly lower for people who die in a hospital, compared to home, a hospice or care home.[20] Despite this, approximately 48% of UK cancer patients die in hospital.[21] We identified the level of palliative care involvement associated with a reduction in hospital deaths was minimal (two contacts initiated at least three weeks before death). The potential per patient saving by avoiding a hospital death proposed by the National End of Life Information Network is £958 per patient.[22]

Evidence for the impact of palliative care on home death is inconsistent. We found the rate of home deaths in decedents who received palliative care was lower compared to those who did not, however the likelihood of dying at home, rather than hospital, increased as the level of palliative care involvement increased. A meta-analysis found palliative care had no impact on home deaths[23] while a Cochrane review undertaken the same year found it more than doubles the odds of dying at home.[24] These differences may reflect differences in the availability of hospice or palliative care services, or bias in the selection of suitable patients for palliative care. Our data suggest that the interval between first contact with palliative care and death may account for this inconsistent relationship.

Opioid analgesia is the recommended treatment for moderate to severe pain[25] the prevalence of which in advanced cancer is estimated to be between 62% and 86%[26] and patients who die of cancer typically require increasing doses of opioids as their disease progresses.[27] We found access to palliative care was associated with being twice as likely to have access to strong opioids. However whether the referral to palliative care triggers the opioid prescription or the opioid prescription triggers the palliative care referral is unclear.

Administration of chemotherapy close to death usually represents poorly planned care.[28] It was encouraging to find that only 5% of our study population received chemotherapy within the last four weeks of life however this limited the potential to explore the impact of palliative care on late chemotherapy. Studies that have established an association between palliative care team involvement and lower rates of chemotherapy near the end of life have concluded that cessation of chemotherapy is due to palliative care involvement.[29] Although a referral to palliative care may help protect against late chemotherapy, our findings suggest this association is more complex and in some cases receiving chemotherapy or the cessation of chemotherapy may in fact trigger the palliative care referral.

We hypothesised that decedents who received palliative care would be more likely to avoid emergency hospital admissions in the last four weeks of life though we found the opposite. Further analysis revealed that only decedents in whom first contact with palliative care was longer than four weeks before death benefited in this outcome. Decedents whose first contact occurred less than four weeks before death were more likely to require emergency admission within the last four weeks of life. This might be explained by emergency hospital admission triggering palliative care involvement. Current evidence reports that 77% of emergency cancer admissions are avoidable[30] so our findings indicate there is considerable scope to reduce emergency admissions provided palliative care is initiated at least 4 weeks before death

This study has limitations. First, the population is derived from a single UK city. Though broadly representative of the UK cancer population in prevalence of cancer type, age, sex, and survival, the extent to which the level of palliative care involvement is representative of national and international activity is harder to determine. Secondly, the data are derived from a live clinical system and as such are likely to represent errors or omissions inherent within the system. This was moderated by restricting linkage to a single electronic system (SystmOne) which had the best potential for reliable linkage. We were unable to include data on prevalence and severity of specific symptoms and underlying disease (especially at time of any referral to palliative care) as these are not routinely coded in UK health data. It cannot be assumed therefore that referral to or longer interval between first contact with palliative care and death caused better outcomes. However, for all patients within our study population, the decision as to whether they received palliative care was made on rigorously applied eligibility criteria.[31] This provides greater confidence in asserting that most if not all of the 65% of patients in our cohort who were referred to palliative care had active, progressive advanced disease and a high symptom burden, and that most if not all of the 35% of patients who did not receive palliative care had stable inactive disease. It is therefore unlikely lower symptom burden or disease severity among the palliative care population explains more than a very small component of our observed results.

For some patients, and for some outcomes (such as access to strong opioids or cessation of chemotherapy), it is possible that the outcome event itself triggered referral to palliative care. These are nevertheless important hypotheses to test further in terms of operationalising earlier integration of palliative care. In contrast, deaths outside hospital and increased home death appear more likely to be the result of longer interval from first contact with palliative care.

Conclusion

The research evidence to support early integration of palliative care for cancer patients[1-6] is based on relatively high intensity interventions of at least 8–12 weeks initiated approximately 6–14 months before death. Within routinely collected data, we have determined an association between longer interval from first contact with palliative care to death and important quality indicators of end of life care. Palliative care initiated more than two weeks before death was associated with avoiding a hospital death; and initiated more than four weeks before death was associated with a reduction in emergency hospital admissions and an increased likelihood of receiving an opioid analgesic. Palliative care initiated more than 32 weeks before death was associated with a reduction in chemotherapy in the last four weeks of life.

Characterising the impact of palliative care services based on interval between first contact and death provides new evidence which will aid policymakers when modelling palliative care service provision. Evidence of benefit in advanced non-cancer diseases remains unclear but together with other observational evidence, our findings should stimulate similar research in these populations.

Contributors

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Competing interests

We have read and understood BMJ policy on declaration of interests and declare that we have no competing interests.

Ethical approval

The National Research Ethics Service (PR 13.YH.0301) granted ethical approval for the study.

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Data Sharing

No additional data available. Electronic health records are considered “sensitive” data in the UK by the Data Protection Act and cannot be shared via public deposition due to restrictions in place to protect patient confidentiality.

Transparency statement

The lead author affirms that the manuscript is an honest, accurate, and transparent account of the study being reported; that no important aspects of the study have been omitted; and that any discrepancies are disclosed.

Legend for Fig 1

Fig 1| Multivariable adjusted odds ratios from logistic and multinomial logistic regression models for end of life outcomes by time between first contact with palliative care and death cut-off points

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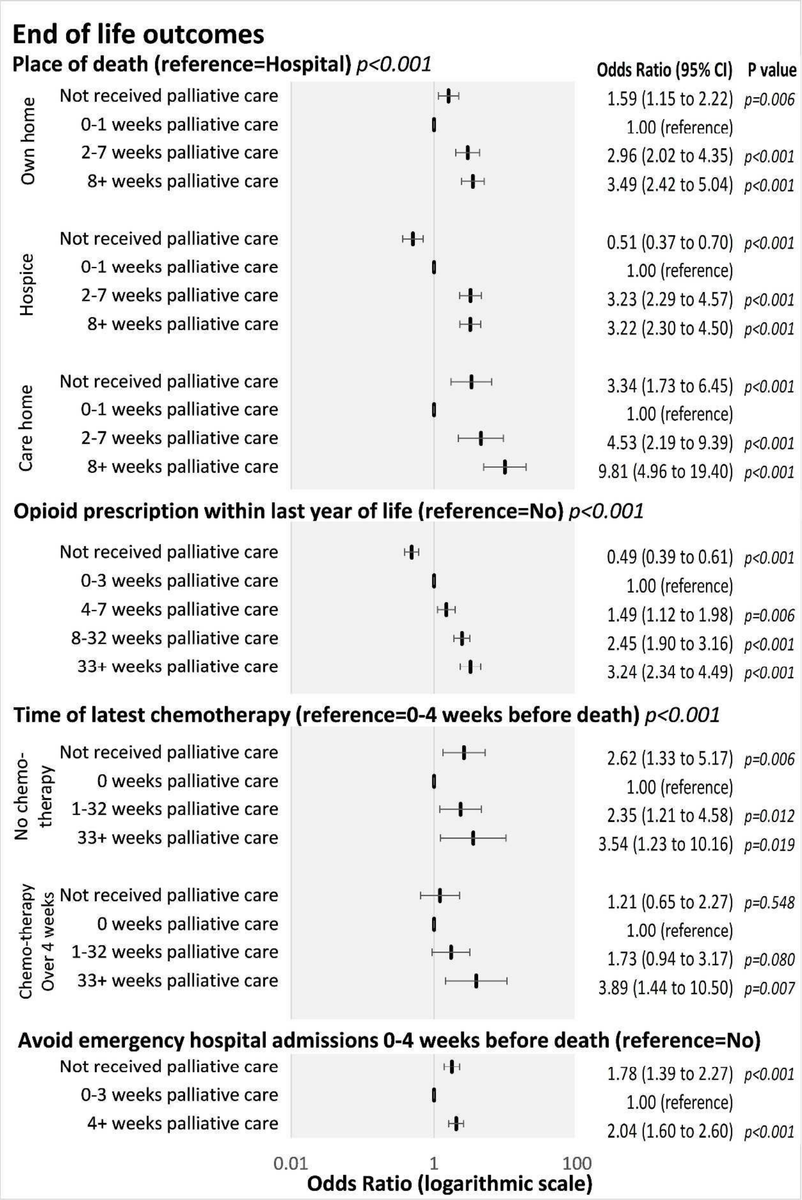

Figure 1

343x512mm (300 x 300 DPI)

Appendix 1: READ codes extracted from SystmOne

READ codes	**Indicate active palliative care?**
(1Z01.) Terminal illness - late stage	No
(8BA2.) End of life care	No
(8H6A.) Refer to terminal care consult	Yes
(8H7L.) Refer for terminal care	Yes
(9EB5.) DS 1500 Disability living allowance completed	No
(Xa9tS) For resuscitation	No
(Xa9tT) Not for resuscitation	No
(XaAex) Referral to palliative care service	Yes
(XaAg6) Referral to palliative care physician	Yes
(XaAPW) Under care of palliative care physician	Yes
(XaAT5) Seen by palliative care physician	Yes
(XaAWN) Seen by palliative care medicine - service	Yes
(XaEJE) Palliative care	No
(XaIlk) Referred to community specialist palliative care team	Yes
(XaIpI) Palliative treatment	Yes
(XaIpl) Final days pathway	No
(XaIpX) Preferred place of death	No
(XaIse) Specialist palliative care treatment	Yes
(XaIsy) Preferred place of death discussed with patient	No
(XaIt6) Specialist palliative care treatment – day care	Yes
(XaIt7) Specialist palliative care treatment - outpatient	Yes
(XaJ3g) Preferred place of death: home	No
(XaJ3h) Preferred place of death: hospice	No
(XaJ3j) Preferred place of death: hospital	No
(XaJ3k) Preferred place of death: nursing home	No

(XaJv2) On gold standards palliative care framework	No
(XaLwc) Resuscitation discussed with patient	No
(XaLwd) Resuscitation discussed with carer	No
(XaMhi) Liverpool care pathway for the dying	No
(XaPmq) Issue of palliative care anticipatory medication box	No
(XaQ8S) Anticipatory palliative care	No
(XaQg1) Last days of life	No
(XaQzq) Preferred place of death: pt unable to express preference	No
(XaQzr) Preferred place of death: discussion not appropriate	No
(XaQzt) Preferred place of death: patient undecided	No
(XaR50) GSF supportive care stage 1 - advancing disease	No
(XaR53) GSF supportive care stage 2 - increasing decline	No
(XaR5A) GSF supportv care stge 3 - last days: cat C - wks prognosis	No
(XaRFF) Has end of life advance care plan	No
(XaRFG) On end of life care register	No
(XaX46) GSF supportv care stge 3 - last days: cat B - mth prognosis	No
(ZV57C) [V]Palliative care	No

Appendix 2. Medications identified as strong opioids

- Buprenorphine (>10mcg)
- Diamorphine
- Dipipanone (with cyclizine)
- Fentanyl
- Hydromorphone
- Meptazinol
- Morphine
- Oxycodone
- Pentazocine
- Papaveretum
- Pethidine

Appendix 3: Classification tree duration of palliative care cut-off points by end of life quality outcomes

Place of death

	Cut-off points (n=2436): number (column %)				
	Not received	**0-1 weeks**	**2-7 weeks**	**8+ weeks**	**Total**
Own home	280 (32.3%)	70 (21.1%)	148 (28.1%)	211 (29.7%)	709 (29.1%)
Hospice	128 (14.8%)	104 (31.4%)	237 (45.0%)	288 (40.5%)	757 (31.1%)
Hospital	353 (40.7%)	146 (44.1%)	105 (19.9%)	121 (17.0%)	725 (29.8%)
Care home	106 (12.2%)	11 (3.3%)	37 (7.0%)	91 (12.8%)	245 (10.1%)
Statistical test					*(χ^2(9)= 280.75, p<0·001)*
Total: Number (row %)	**867 (35.6%)**	**331 (13.6%)**	**527 (21.6%)**	**711 (29.2%)**	**2436**

Opioid prescription within last year of life

	Cut-off points (n=2475): number (column %)					
	Not received	**0-3 weeks**	**4-7 weeks**	**8-32 weeks**	**33+ weeks**	**Total**
Yes	222 (25.3%)	237 (41.3%)	149 (50.0%)	299 (62.8%)	177 (70.8%)	1084 (43.8%)
No	655 (74.7%)	337 (58.7%)	149 (50.0%)	177 (37.2%)	73 (29.2%)	1391 (56.2%)
Statistical test						*(χ^2(4)= 279.01, p<0·001)*
Total: Number (row %)	**877 (35.4%)**	**574 (23.2%)**	**298 (12.0%)**	**476 (19.2%)**	**250 (10.1%)**	**2475**

Time of latest chemotherapy

	Cut-off points (n=2479): number (column %)				
	Not received	**0 weeks**	**1-32 weeks**	**33+ weeks**	**Total**
No chemotherapy	463 (52.6%)	50 (30.7%)	466 (39.4%)	66 (26.4%)	1045 (42.2%)
0-4 weeks	47 (5.3%)	16 (9.8%)	60 (5.1%)	6 (2.4%)	129 (5.2%)
5+ weeks	371 (42.1%)	97 (59.5%)	659 (55.6%)	178 (71.2%)	1305(52.6%)
Statistical test					*(χ^2(3)=55.494, p<0·001)*
Total: Number (row %)	**881 (35.5%)**	**163 (6.6%)**	**1185(47.8%)**	**250 (10.1%)**	**2479**

Avoided emergency hospital admissions 0-4 weeks before death

	Cut-off points (n=2479): number (column %)			
	Not received	**0-3 weeks**	**4+ weeks**	**Total**
Yes	704 (79.9%)	392 (68.3%)	830 (81.1%)	1926 (77.7%)
No (one or more admission)	177 (20.1%)	182 (31.7%)	194 (18.9%)	553 (22.3%)
Statistical test				*(χ^2(2)=36.390, p<0.001)*
Total: Number (row %)	**881 (35.5%)**	**574 (23.2%)**	**1024 (41.3%)**	**2479**