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How we use hospice: Hospice enrollment patterns and costs in elderly ovarian cancer patients

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HIGHLIGHTS

- Black ovarian cancer patients have a higher risk of unenrolling from hospice compared to white patients.
- Hospice enrollment is associated with lower paid amounts from Medicare as long as a patient remains enrolled in hospice.
- A third of patients received at least one life extending or invasive care procedure following unenrollment from hospice

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ABSTRACT

Objective. To describe disparities in patterns of hospice use and end-of-life costs among ovarian cancer patients.

Methods. Using Texas Cancer Registry-Medicare data, ovarian cancer patients deceased 2005–2012 with >12 months of continuous Medicare coverage before death were included. Descriptive statistics and multivariable logistic regressions were used to evaluate patterns of hospice use. Cost and resource utilization was obtained from Medicare claims and analyzed using a non-parametric Mann-Whitney test.

Results. 2331 patients were assessed: 1788 (77%) white, 359 (15%) Hispanic, 158 (7%) black and 26 (1%) other. 1756 (75%) enrolled in hospice prior to death but only 1580 (68%) died with hospice. 176 (10%) of 1756 patients unenrolled and died without hospice. 346 (20%) unenrolled from hospice multiple times. From 2008 to 2012, patients were less likely to unenroll from hospice prior to death. Black patients were more likely to unenroll from hospice prior to death (OR 2.07 [1.15–3.73]; $p = 0.02$) compared to white patients. The median amount paid by Medicare during the last six months of life was $38,530 for those in hospice compared to $49,942 if never enrolled in hospice ($p < 0.0001$) and was higher for black and Hispanic patients compared to white patients. 30% hospice unenrolled patients and 40% multiply enrolled hospice patients received at least one life extending or invasive care procedure following unenrollment from hospice.

Conclusion. Recently, more patients remain enrolled in hospice, but black patients have a higher risk of unenrollment. Hospice enrollment was associated with lower costs as long as a patient did not unenroll from hospice.

1. Introduction

Care at the end of life varies dramatically among patients in terms of the setting, intensity and invasiveness of care. Opting for less intensive and invasive care at the end of life has been suggested to improve quality of life and also lower healthcare costs [1–5]. Due to this, the American Society of Clinical Oncology Quality Oncology Practice Initiative, the National Quality Forum and the Physician Consortium for Performance Improvement have published guidelines recommending against aggressive medical care at the end of life [6–8]. Utilization of hospice services enables patients with a heavy symptom burden to avoid more intensive care at the end of life.

Acceptance of hospice care is increasing on a national level, including among patients with ovarian cancer, the deadliest gynecologic malignancy [9–12]. However, disparities still exist among ovarian cancer patients with regard to hospice usage and receiving invasive end of

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life care [11–14]. Ovarian cancer patients of minority race and ethnicity and those of lower socioeconomic status have less hospice use and more aggressive end of life care, similar to patterns seen in other disease sites [15,16].

Our objective with this analysis was to further characterize variation in hospice usage among ovarian cancer patients. In addition, we endeavored to describe the care usage by patients after unenrollment from hospice and quantify the associated Medicare costs related to this care among ovarian cancer patients of varying racial and ethnic groups in Texas.

2. Patients and methods

Following Institutional Review Board approval, patients who were Texas residents 66 years old or older at the time of death, whose only lifetime cancer was histologically confirmed ovarian cancer, who died from 2005 to 2012, had at least 30 days from diagnosis to death and who had at least 13 months of continuous Medicare A and B enrollment and no HMO enrollment before death were selected from the Texas Cancer Registry (TCR). The TCR is the fourth largest statewide population-based registry in the United States and collects information on cancers treated in Texas [17,18]. Data are collected and utilized in accordance with standardized registry rules similar to other national cancer registries such as the Surveillance, Epidemiology, and End Results Program. The TCR meets the National Program of Cancer Registries, Centers for Disease Control and Prevention high quality data standards and is Gold Certified by the North American Association of Central Cancer Registries (NAACCR). Linking the TCR to claims data from Medicare allows for analysis of information on demographics, comorbidities, tumor characteristics and inpatient, outpatient and hospice care received as well as associated costs.

A multivariable logistic regression model was used in order to examine associations between covariates of interest and patterns of hospice utilization and cost. Covariates in the regression model included year of death, age at death, race/ethnicity, geographic categorization (urban versus rural), educational and poverty level, stage at diagnosis, length of time from diagnosis to death (months), and Charlson Comorbidity Index. Geographic categorization was defined according to previously published criteria [19]. Educational and poverty levels were divided into quartiles by the percentage of residents in each census tract older than age 25 with either less than a high school degree or income below the state defined poverty level according to TCR census data. Charlson Comorbidity Index values were determined from the 12-month period leading up to the final 30 days of life.

Any hospice enrollment prior to death, any unenrollment in hospice, and more than one enrollment in hospice prior to death were analyzed. Patients who re-enrolled in hospice on the same day as unenrollment were not considered to have truly unenrolled as this could represent an administrative process of re-enrollment instead of a patient's decision to leave hospice. We also assessed medical claims that were processed after unenrollment from hospice and whether patients experienced invasive or life-extending procedures after enrollment and prior to death. Invasive and life-extending procedures were defined as previously published (Appendix) [12,13,20,21]. Briefly, invasive procedures were considered to be surgeries requiring anesthesia, arterial line placement, central line placement, endoscopy, interventional radiology procedures, radiation therapy, and pelvic examinations with tissue sampling but procedures which could be considered palliative such as paracentesis, thoracentesis or procedures to place abdominal, chest or gastric drainage catheters were excluded [13,20]. Life-extending procedures included intubation, cardiopulmonary resuscitation, and placement of a feeding tube. Feeding tubes placed solely for the purpose of venting to relieve discomfort were excluded as they were considered to be palliative [12,21].

To assess Medicare costs for patients and to determine which interventions were received by patients after hospice unenrollment or between multiple enrollments in hospice, Medicare claims billed within last year prior to their date of death were pulled from Medpar, Outpatient, Physician/Supplier (NCH), DME and Hospice files. The variables included for calculation of the amount paid by Medicare included REIMBAMT and BILTOTPD from the MEDPAR files, LINEPMT from the NCH and DME files, RPRVDPMT from the Outpatient and Hospice files. Only costs reimbursed by Medicare were included in the total cost. In order to adjust for the dollar inflation over the years, all dollars were adjusted to 2015 US dollars using the Prospective Pricing Index for inpatient claims and the Medicare Economic Index for outpatient claims [22,23]. We examined Medicare costs from three different time periods prior to patients' death: final year of life, final 6 months of life, and final 30 days of life. Total costs were calculated from all five Medicare files described above. Distributions of patients' Medicare costs including mean and median were obtained. Due to the skewness in medical costs data, to compare the Medicare costs between different cohort groups, Nonparametric Mann-Whitney tests were conducted to compare the median costs difference; and the extended estimating equations (EEE) methods were used to run the power generalized linear regression modeling (pGLM) in order to obtain the adjusted mean difference between compared cohort groups [24]. The unadjusted mean differences were obtained using univariate analysis on mean distributions. We compared two groups of patients, from the full cohort ($N = 2331$), and the subcohort of only hospice enrolled patients ($N = 1756$), respectively. In the full cohort, we compared patients who never enrolled in hospice ($n = 575$) vs. patients who enrolled in hospice at least once after being diagnosed with ovarian cancer ($n = 1756$). In the subcohort of patients who enrolled in hospice at least once, we compared the patients who unenrolled at least once before death and who eventually died without hospice ($n = 176$) to the patients who remained enrolled in hospice until death. Total mean costs were adjusted for hospice unenrollment, year of death, age at death, race, stage, months from diagnosis to death, comorbidity, education, poverty, and geographic category.

SAS version 9.4 (SAS Institute, Cary, NC) and STATA version 14.2 (StataCorp, College Station, Texas) were used to perform the statistical analysis. Model diagnostics included the Hosmer-Lemeshow Goodness-of-Fit Test for each multivariable logistic regression model. A p-value of 0.05 or less was considered to be significant.

3. Results

A total of 2331 patients were included. There were 1788 (77%) white, 359 (15%) Hispanic, 158 (7%) black and 26 (1%) other patients. A total of 1756 (75%) patients enrolled in hospice prior to death but only 1580 (68%) died while enrolled in hospice. Among the 1756 patients who ever enrolled in hospice, 176 (10%) unenrolled from hospice prior to death and died while not enrolled in hospice. 346 (20%) patients unenrolled from hospice multiple times. 143 (41%) of those patients who unenrolled from hospice at least once died without hospice and 33 (10%) of these patients unenrolled multiple times prior to dying without hospice. The median hospice enrollment duration among the 1580 patients who died while enrolled in hospice was 18 days. Among patients who unenrolled from hospice, the median duration of hospice enrollment was 23 days and the median time between unenrollment from hospice and death was 14 days. Patient characteristics are described in Table 1.

Patients who died during the more recent years of 2008 through 2012 were more likely to remain enrolled in hospice compared to prior years (Table 2). Despite these recent improvements in hospice enrollment, we found racial differences among the 176 patients who unenrolled and died without hospice. Black patients were more likely to unenroll from hospice prior to death compared to white patients (OR 2.07 [1.15–3.73]; $p = 0.02$). There was no significant difference found between white and Hispanic (OR 1.24 [0.76–2.04]; $p = 0.39$) or

Table 1
Patient Characteristics.

	$N = 2331$	%
Age at death		
66–70	502	22
71–75	560	24
76–80	494	21
>80	775	33
Ethnicity		
White	1788	77
Hispanic	359	15
Non-Hispanic Black	158	7
Other	26	1
Stage		
Distant	1632	70
Localized	163	7
Regional	335	14
Unknown	201	9
Charlson Comorbidity Index		
0–1	1650	71
2+	681	29
Region		
Urban	1849	79
Rural	482	21
Enrolled in hospice prior to death	1756	75
Died while enrolled in hospice	1580	68
Enrolled in hospice multiple times	346	15

other (OR 0.78 [0.10–6.24]; $p = 0.81$) racial and ethnic groups in terms of likelihood of unenrolling from hospice prior to death.

We next examined the records of the 346 patients who enrolled in hospice multiple times. Of these, most (90%) eventually died while enrolled in hospice. There were no racial or ethnic disparities between those who only enrolled once in hospice and those who enrolled multiple times. Compared to white patients, patients of black (OR 0.95 [0.55–1.64]; $p = 0.84$), Hispanic (OR 1.11 [0.77–1.60]; $p = 0.59$) and other (OR 0.54 [0.12–2.43]; $p = 0.42$) race and ethnicity were equally likely to unenroll multiple times in hospice prior to death. Factors that were found to be significant predictors of those patients with multiple hospice enrollments compared to a single enrollment were a longer duration of time from diagnosis to death (OR1.61 [1.25–2.06]; $p < 0.001$) and being older than 80 (OR 1.81 [1.29–2.55]; $p < 0.001$) compared to younger patients.

Among the 176 patients who unenrolled from hospice prior to death, 53 (30%) received at least one life extending or invasive procedure or required multiple emergency room visits or an ICU admission following unenrollment from hospice. In addition, 40% of those 346 patients who enrolled multiple times in hospice received at least one life extending or invasive procedure or required multiple emergency room visits or an ICU admission following unenrollment from hospice. Among patients who unenrolled from hospice prior to death or who enrolled multiple times, approximately 10% had an admission to the intensive care unit (ICU), 10% received chemotherapy, 30% had more than one admission to the hospital and just under 20% underwent a life-extending or invasive procedure just prior to death. The types of intensive and invasive care received by patients following unenrollment from hospice are summarized in Table 3.

In order to assess the economic impact of hospice usage on Medicare, we compared the median amount paid by Medicare, including the amount paid for hospice services, for patients who ever enrolled in hospice to those who never enrolled in hospice. The median amount paid by Medicare during the last year of life was $62,546 for those in hospice compared to $68,816 for those who never enrolled in hospice ($p = 0.03$). For patients enrolled in hospice, the median amount paid by Medicare was $38,530 and $6029 during the last six months and 30 days of life, respectively. Compared to the median amount paid by Medicare of those who never enrolled in hospice during the last six months ($49,942) and 30 days of life ($19,139), hospice usage was associated with statistically significant decreases in cost ($p < 0.001$ for both 6 months of 30 days of life). This decrease in the amount paid by Medicare, however, was no longer significant if patients unenrolled from hospice prior to death. Though the median amount paid by Medicare was overall less among patients who enrolled in hospice and died with hospice, this amount was not significantly different compared to those patients who ever unenrolled from hospice, except during the last six months of life. The median amount paid among patients who enrolled in hospice and died with hospice was $62,339 versus $70,627 for patients who ever unenrolled from hospice during the last year ($p = 0.08$), $37,824 versus $43,220 during the last six months ($p = 0.04$) and $6102 versus $5205 during the last 30 days of life ($p = 0.27$).

We also assessed the mean adjusted paid amounts from Medicare for the same time periods. The mean amount paid by Medicare was less if a patient ever enrolled in hospice and stayed enrolled in hospice. The mean amount paid during the last year of life for a patient who enrolled at least once in hospice was $78,322, during the last six months $52,002 and during the last 30 days $13,240, which were all significantly less than the amounts paid for patients who never enrolled in hospice (one year $91,570, six months $71,301, 30 days $27,548; $p < 0.05$ for all values) and remained significantly different after adjusting for race, stage, comorbidities and multiple hospice enrollments. Similarly, if patients remained enrolled in hospice until death, compared to unenrolling prior to death, the mean amount paid by Medicare was less. The mean amount paid for those who remained enrolled in hospice during the last year of life was $77,474 (compared to $85,936), six months $51,286 (compared to $58,435) and 30 days $13,222 (compared to $13397) and these differences were all significant to $p < 0.05$ after adjusting for unenrollment of hospice, year of death, age at death, race, stage, months from diagnosis to death, comorbidity, education, poverty, and geographic category. Table 4 summarizes these findings.

The power generalized linear regression modeling also found significant differences in mean amount paid by Medicare between races

Table 2
Logistic Regression Analysis of Hospice Unenrollment Prior to Death.*

	OR [CI]	*P*-value
Year of death		
2005	Ref.	
2006	0.98 [0.59–1.61]	0.93
2007	1.15 [0.71–1.87]	0.56
2008	0.42 [0.23–0.76]	0.004
2009	0.48 [0.27–0.85]	0.01
2010	0.15 [0.06–0.36]	<0.0001
2011	0.15 [0.06–0.35]	<0.0001
2012	0.25 [0.12–0.53]	0.0003
Race/ethnicity		
Non-Hispanic White	Ref.	
Non-Hispanic Black	2.07 [1.15–3.73]	0.02
Hispanic	1.24 [0.76–2.04]	0.39

* Adjusted for race, stage, comorbidities, age, year of death, time from diagnosis to death, geographic categorization, poverty level and educational level.

Table 3
Invasive Care Received Prior to Death Among Patients Who Died After Unenrolling from Hospice or with Multiple Hospice Enrollments.

	Hospice unenrollment before death $N = 176$ (%)	Multiple hospice enrollments $N = 346$ (%)
Life extending and invasive procedure	29 (16)	58 (17)
ICU admission	17 (10)	25 (7)
>1 ER visit	42 (24)	122 (35)
>1 hospital admission	51 (29)	104 (30)
Receipt of chemotherapy	19 (11)	45 (13)
Life extending or invasive procedure, ICU admission or multiple ER visits	53 (30)	139 (40)

Table 4
Total Median and Mean Cost to Medicare by Hospice Usage Pattern Over Time.

	Never enrolled in hospice	Enrolled in hospice	*P*-value	Stay enrolled in hospice	Unenrolled from hospice	*P*-value
Last year of life						
Median	$68,816	$62,546	0.03	$62,339	$70,627	0.08
Mean*	$91,570	$78,322	<0.05	$77,474	$85,936	<0.05
Last 6 months of life						
Median	$49,942	$38,530	<0.0001	$37,824	$43,220	0.04
Mean*	$71,301	$52,002	<0.05	$51,286	$58,435	<0.05
Last 30 days of life						
Median	$19,139	$6029	<0.0001	$6102	$5205	0.266
Mean*	$27,548	$13,240	<0.05	$13,222	$13,397	<0.05

* Adjusted for race, stage, comorbidities, age, year of death, time from diagnosis to death, geographic categorization, poverty level, educational level and multiple hospice enrollments.

during the last year, six months and 30 days of life. When assessing the entire cohort of 2331 patients, after adjusting for unenrollment of hospice, year of death, age at death, race, stage, months from diagnosis to death, comorbidity, education, poverty, and geographic category, being of black race was consistently associated with increased mean amount paid by Medicare during all time periods compared to white patients. During the final year of life, being of black race was associated with an increase amount paid of $10,632, during the final six months an increase of $6864 and during the final 30 days of life an increase of $1772 compared to being of white race with all values significant to $p < 0.05$. Being of Hispanic ethnicity was associated with an increase in amount paid by Medicare during the final six month of life of $1497 and the final 30 days of life of $1242 compared to being a non-Hispanic white patient, also significant to $p < 0.05$. Being of Hispanic ethnicity was not associated with an increased mean amount paid by Medicare during the final year of life compared to being a non-Hispanic white patient.

4. Conclusions

In conclusion, we found significant differences in patterns of hospice usage among elderly ovarian cancer patients according to year of death, race, ethnicity, duration of disease and age. We also found that utilizing hospice was cost-saving from a Medicare perspective, as long as the patient did not unenroll from hospice at any point prior to death. One important and reassuring finding, which has been echoed by other publications, was that the most recent years of this data (2008–2012) demonstrated a trend toward patients increasingly remaining enrolled in hospice until death [12,25]. It is too early to tell if this pattern of increasing hospice utilization will translate across all racial and ethnic groups evenly.

Looking within the larger cohort, we found that among patients who ever enrolled in hospice, black patients were more likely than white patients to unenroll from hospice. This is consistent with data from other disease sites as well ovarian cancer data that suggest non-white patients are less likely to use hospice, despite an overall trend among all races and ethnicities of increasing hospice enrollment over time [10–12,15,25,26].

We found, however, no racial or ethnic disparities among patients with multiple hospice enrollments. Rather, being of older age and having a longer time from diagnosis to death was associated with multiple hospice enrollments. One possible explanation for this finding is that patients of older age and patients with a longer duration of time from diagnosis to death may unenroll from hospice for additional interventions for other medical comorbidities or disease processes. Though any unenrollment and repeated enrollment in hospice that occurred on the same day was excluded as this was thought to represent the administrative process, data were incomplete for some patients. Therefore, some of these multiple hospice enrollments could represent an administrative process rather than a patient's decision to unenroll and enroll again. Unfortunately, our data were not able to further assess this.

Our analysis also revealed that a significant number of patients who unenrolled from hospice underwent invasive or life-extending procedures. This finding is similar to another recent study of ovarian cancer patients which found that end of life care remains intensive and invasive for many patients despite an increasing acceptance of hospice [12]. While there is inherent difficulty in assessing outcomes posthumously, these data suggest a conflict in ideology between hospice and avoidance of invasive and intensive care near the end of life and unenrolling from hospice in order to receive such invasive procedures. An important area of future research is the exploration of patterns of events that lead to patients enrolled in hospice choosing to undergoing invasive or intensive care and if these scenarios can or should be avoided. More research is needed to determine if some or all of these hospice unenrollments could have been predicted and avoided. Research in other cancer sites support that many admissions to the hospital near the end of life are potentially avoidable [27]. A major factor, however, is the role the patients' and families' perceptions of hospice care play in the decision to accept hospice. Studies suggest that self-reported family satisfaction with end of life care is high even when the timing of hospice enrollment is very brief, such as a week or less, between hospice enrollment and death [28,29]. This is in contrast to studies which have formally assessed bereavement and dissatisfaction in caregivers following a patient's death. Such studies have found that less intensive and invasive care at the end of life with earlier hospice enrollment results in less prolonged grief or post-traumatic stress and an overall better perception of the medical care received [30,31]. Until there is a better understanding of how to overcome the barriers to enrolling early, and remaining enrolled in hospice, unenrollment from hospice for invasive and intensive care will likely continue.

The final major finding in our analysis was that there was a decrease in the amount paid by Medicare for patients who enroll in hospice. This reduction in Medicare payment is supported by other studies across multiple disease sites [32–35]. We found there was a reduction in the amount paid by Medicare across all time frames that we examined including the final year, six months and 30 days of life. This significant reduction in the amount paid, however, was lost if the patient unenrolled from hospice prior to death. We also found that being of black or Hispanic race/ethnicity was associated with higher amounts paid by Medicare during the final year, six months and 30 days of life. A recent publication assessing the cost of care at the end of life among ovarian cancer patients reported similar end of life costs to our analysis, supporting the accuracy of our estimates of costs [36]. Given the percentage of patients who elected to unenroll from hospice and undergo more invasive care, this finding of losing the reduction in the amount paid by Medicare is not surprising. The median length of time in hospice from first enrollment to death was only 18 days. The possible financial benefit to the Medicare system would be expected to be modest given the brevity of hospice enrollment. In addition, when we assessed the effect of a patient unenrolling and then enrolling again in hospice multiple times prior to death, we found that the amount paid related to hospice services dramatically increased across all time periods studied. Given that it has been estimated that a quarter of lifetime healthcare

expenditure occurs during the final year of life, choosing healthcare usage wisely can carry significant fiscal consequences [37].

The strengths of this analysis include a large sample size with racial and ethnic diversity within a single type of cancer. By only focusing on ovarian cancer, the patterns of care usage can more easily be interpreted by practitioners who care for these patients. In addition, the number of claims analyzed was substantial. This allowed for cost estimates and a description of events which occurred after hospice unenrollment. To our knowledge, this is the first publication to describe hospice usage and unenrollment patterns among ovarian cancer patients.

Limitations of this analysis include the inherent retrospective nature of assessing outcomes that occur prior to death and the reliance on coding and claims data, which can be inaccurate or incomplete. In addition, parts of this analysis were conducted within sub-groups of patients which had more limited power to find significant differences. Another potential limitation is the possibility of including patients who had multiple hospice enrollments due to an administrative process of remaining in hospice and not due to an intentional unenrollment and re-enrollment in hospice. In order to attempt to avoid this type of error, we chose to exclude patients who re-enrolled in hospice on the same day as unenrollment. There could still remain inaccuracy and overestimation in identifying which patients intentionally enrolled in hospice again after choosing to unenroll. Finally, without the benefit of individual patient level data, the motivations and explanations for these patterns of hospice usage and unenrollment, including patient reported outcomes or quality of life, can only be hypothesized.

End of life care for ovarian cancer patients, similar to other disease sites, is an important component of their overall oncologic care. Obtaining a better understanding of how hospice is used, or not used, by patients and the reasons behind these decisions can inform practice patterns and future areas of research across medical specialties.

Conflicts of interest

The following authors report conflicts of interest: Larissa A. Meyer, MD (Honoraria: TRM Oncology; Research Funding: AstraZeneca). All remaining authors report no conflicts of interest.

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Author contributions

All authors contributed to the study design, analysis and manuscript preparation.

Appendix A. Medicare claims codes for invasive care and life extending procedures

Treatment or events	Sources	Code(s)
Intensive Care Unit (ICU)	CPT/HCPCS	'99291', '99292', '32000', '32002', '32020', '31500'
Emergency Room Visits (ERvisit)	CPT/HCPCS	'99281', '99282', '99283', '99284', '99285'
	Revenue center code	0450–0459, 0981
	Place of service code	23
Life extending procedures		
Cardiopulmonary resuscitation	ICD 9 procedure codes	'9293'
	CPT/HCPCS	'92950'
Feeding tube placement	ICD 9 procedure codes	'431', '432', exclude 96.07
	CPT/HCPCS	'43246', '43572', '43750', '43752', '43760', '43761', '43830', '43831', '43832', '43870', '49440', '74340','74350'
Insertion of a breathing tube for assisted ventilation	ICD 9 procedure codes	'311', '312', '967', '9671', '9672', 9601–9605
	CPT/HCPCS	'31500'
Invasive procedures		
Arterial line placement	ICD 9 procedure codes	'3891'
	CPT/HCPCS	'36620', '36625'
Central line placement	ICD 9 procedure codes	'3893', '3897'
	CPT/HCPCS	'36556', '36558', '36561', '36563', '36565', '36566', '36578', '36580', '36582', '36583'
Endoscopy	ICD 9 procedure codes	'3321', '3322', '3323'
	CPT/HCPCS	44388–44397, 45330–45345, 45378–45392, '31622', '31623', '31624', '31643', '43200', '43202', '43219', '43220', '43226', '43235', '43239', '43241', '43246', '43248', '43249', '43456', '43458', '91110'
Interventional radiology	CPT/HCPCS	35470–35476, 35490–35495, 36215–36218, 36245–36248, 37184–37188, 37201–37206, 75660–75685, 75992–75996, 77001–77003, 77011–77014, 79005–79999, '36000', '36005', '36010', '36011', '36012', '36100', '36120', '36140', '36145', '36160', '36200', '36299', '36870', '37195', '37210', '37215', '37216', '37620', '61624', '61626', '61630', '61635', '75625', '75630', '75650', '75658', '75705', '75710' '75716', '75722', 75724', '75726', '75731', '75733', '75736', '75756', '75790', '75820', '75822', '75825', '75827', '75831', '75833', '75840', '75842', '75860', '75870', '75872', '75880', '75889', '75891', '75894', '75896', '75898', '75940', '75960', '75961', '75962', '75964', '75966', '75968', '75978', '77021', '77022', '77031', '77032'
Pelvic examinations with tissue sampling	CPT/HCPCS	'57454', '57455', '57456', '57460', '57461', '57500', '57505',

(*continued*)

Treatment or events	Sources	Code(s)
Radiotherapy	CPT/HCPCS	'57520', '57522', '58100', '58110', '57100' 77371–77373, 77401–77423, 77427–77499, 77520–77525, 77600–77615, 77750–77799, '55920', '57155', '58346', '61793', '77399', '77620', '79005', '79101', '79200', '79300', '79403', '79440', '79445', '79999', '92974'
Surgeries requiring anesthesia	CPT/HCPCS	00100–00104, 00145–00148, 00210–00222, 00540–00550, 00560–00567, 00860–00873, 00920–00930, 01920–01926, 01930–01936, 01951–01953, 01960–01969, 01990–01996, '00120', '00124', '00126', '00140', '00142', '00144', '00160', '00162', '00164', '00170', '00172', '00174', '00176', '00190', '00192', '00300', '00320', '00322', '00326', '00350', '00352', '00400', '00402', '00404', '00406', '00410', '00420', '00450', '00452', '00454', '00470', '00472', '00474', '00500', '00520', '00522', '00524', '00528', '00529', '00530', '00532', '00534', '00537', '00539', '00580', '00600', '00604', '00620', '00622', '00625', '00626', '00630', '00632', '00634', '00635', '00640', '00670', '00700', '00702', '00730', '00740', '00750', '00752', '00754', '00756', '00770', '00790', '00792', '00794', '00796', '00797', '00800', '00802', '00810', '00820', '00830', '00832', '00834', '00836', '00840', '00842', '00844', '00846', '00848', '00850', '00851', '00855', '00857', '00880', '00882', '00884', '00900', '00902', '00904', '00906', '00908', '00910', '00912', '00914', '00916', '00918', '00932', '00934', '00936', '00938', '00940', '00942', '00944', '00946', '00948', '00950', '00952', '00955', '01000', '01110', '01112', '01120', '01130', '01140', '01150', '01160', '01170', '01173', '01180', '01190', '01200', '01202', '01210', '01212', '01214', '01215', '01220', '01230', '01232', '01234', '01240', '01250', '01260', '01270', '01272', '01274', '01300', '01320', '01340', '01360', '01380', '01382', '01390', '01392', '01400', '01402', '01404', '01420', '01430', '01432', '01440', '01442', '01444', '01460', '01462', '01464', '01470', '01472', '01474', '01480', '01482', '01484', '01486', '01490', '01500', '01502', '01520', '01522', '01600', '01610', '01620', '01622', '01630', '01632', '01634′, '01636', '01638', '01650', '01652', '01654', '01656', '01670', '01680', '01682', '01700', '01710', '01712', '01714', '01716', '01730′, '01732', '01740', '01742', '01744', '01756', '01758', '01760', '01770', '01772', '01780', '01782', '01784', '01800', '01810′, '01820', '01829', '01830', '01832', '01840', '01842', '01844', '01850', '01852', '01860', '01900', '01902', '01904', '01905', '01906', '01908′,

(*continued*)

Treatment or events	Sources	Code(s)
		'01910', '01912', '01914', '01916', '01918', '01958'.
	CPT/HCPCS exclusions	'00101', '00146', '00213', '00217', '00219', '00221', '00543', '00545', '00547', '00549', '00564', '00565', '00861', '00863', '00867', '00871', '00923', '00925', '00927', '00929', '01923', '01934', '01993', '01994'
Receipt of chemotherapy		
	ICD 9 diagnosis codes	V581, V662, V672
	ICD 9 procedure codes	'9925'
	Revenue center code	'0331', '0332', '0335'
	CPT/HCPCS	'J8520', 'J8521', 'J8530', 'J8560', 'J8600', 'J8610', 'J8999', J9000–J9999, 96400–96549, Q0083–Q0085, G0355–G0363, G0921–G0932
	CPT/HCPCS exclusions	'J9003', 'J9165', 'J9175', 'J9202', 'J9209', 'J9212', 'J9220', 'J9221', 'J9222', 'J9223', 'J9224', 'J9225', 'J9226', 'J9213', 'J9214', 'J9215', 'J9216', 'J9217', 'J9218', 'J9219', 'J9240', 'J9295', 'J9381', 'J9395'

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