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Prevalence and Inpatient Hospital Outcomes of Malignancy-Related Ascites in the United States

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Abstract

Objective: Malignancy-related ascites (MRA) is the terminal stage of many advanced cancers, and the treatment is mainly palliative. This study looked for epidemiology and inpatient hospital outcomes of patients with MRA in the United States using a national database. **Methods:** The current study was a cross-sectional analysis of 2015 National Inpatient Sample data and consisted of patients ≥18 years with MRA. Descriptive statistics were used for understanding demographics, clinical characteristics, and MRA hospitalization costs. Multivariate regression models were used to identify predictors of length of hospital stay and in-hospital mortality. **Results:** There were 123 410 MRA hospitalizations in 2015. The median length of stay was 4.7 days (interquartile range [IQR]: 2.5-8.6 days), median cost of hospitalization was US$43 543 (IQR: US$23 485-US$82 248), and in-hospital mortality rate was 8.8% (n = 10 855). Multivariate analyses showed that male sex, black race, and admission to medium and large hospitals were associated with increased hospital length of stay. Factors associated with higher in-hospital mortality rates included male sex; Asian or Pacific Islander race; beneficiaries of private insurance, Medicaid, and self-pay; patients residing in large central and small metro counties; nonelective admission type; and rural and urban nonteaching hospitals. **Conclusions:** Our study showed that many demographic, socioeconomic, health care, and geographic factors were associated with hospital length of stay and in-hospital mortality and may suggest disparities in quality of care. These factors could be targeted for preventing unplanned hospitalization, decreasing hospital length of stay, and lowering in-hospital mortality for this population.

Keywords

malignancy-related ascites, epidemiology, length of stay, in-hospital mortality, cost, National Inpatient Sample

Introduction

Peritoneal carcinomatosis is a complication of many gastrointestinal and gynecological malignancies. A number of abdominal and pelvic cancers such as pancreatic, ovarian, uterine, and colorectal; extra-abdominal cancers such as lung, breast, and lymphomas are associated with peritoneal carcinomatosis.[1] This condition leads to malignancy-related ascites (MRA), which is accumulation of fluid in the peritoneal cavity due to increased vascular permeability and obstruction of the lymphatic capillaries by malignant cells. Accompanying symptoms include abdominal distention, nausea and vomiting, pain, anorexia, fatigue, difficulty in breathing, and disproportionate weight gain due to fluid accumulation.[2] In majority of the patients, interventions such as chemotherapy are ineffective, and treatments usually include palliative measures such as dietary restrictions, diuretics, and regular and intermittent large-volume paracenteses.[3] Malignancy-related ascites carries poor prognosis and survival rates.[4] In addition, this condition significantly worsens quality of life by increasing symptom burden and hospitalizations.[5]

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Malignancy-related ascites is a rare condition found in 7% of all ascites cases, and available data on the prevalence and economic burden of this condition are scarce.[6] Although there are some studies evaluating the effects of clinical factors on hospital length of hospital stay and in-hospital mortality among a limited number of patients with MRA, detailed, large database, and epidemiological analyses are lacking, especially at the national level.[4,7,8] In this study, we tried to understand the epidemiology and inpatient hospital outcomes of patients with MRA in the United States using a national database.

Methods

Data Source and Study Design

For this study, we analyzed 2015 National Inpatient Sample (NIS) data. National Inpatient Sample is sponsored by a Federal-State-Industry partnership by the Agency of Healthcare Research and Quality (AHRQ) as a part of Healthcare Cost and Utilization Project.[9] National Inpatient Sample is a nationally representative and largest all-payer database publicly available for research purposes. National Inpatient Sample includes weighted data of more than 35 million hospitalizations every year. National Inpatient Sample annually collects a 20% stratified sample of all discharge data from US hospitals except from rehabilitation and long-term facilities and acute-care hospitals. *International Classification of Diseases, Ninth and Tenth Revisions, Clinical Modification* (*ICD-9-CM* and *ICD-10-CM*) codes are used for structuring and categorizing NIS data into clinically meaningful sections.

Study Population and Measures

For this study, we extracted a subset of NIS data including adult patients ≥18 years, with MRA as a primary or secondary diagnosis, determined by *ICD-9-CM* (158.8, 158.9, 197.6, 789.51) or *ICD-10-CM* (C481, C48, C786, R180) diagnosis codes. Hence, the study sample includes patients with ascites admitted for ascites as well as other reasons. Using Clinical Classifications Software (CCS) codes 11 to 44, we identified the type of cancer in patients already having MRA diagnosis. The primary outcome was prevalence of MRA hospitalization. The secondary outcomes were hospital length of stay, in-hospital mortality, and hospitalization cost.

Statistical Analysis

SAS version 9.4 (SAS Institute) with procedures specifically created for complex survey data were used for the analyses. Descriptive statistics were used to understand the demographics, clinical characteristics, and costs of MRA hospitalization and were expressed in terms of median, interquartile range (IQR), and percentage. Multivariate regression models were used to find the relationship between independent and outcome variables (length of stay and in-hospital mortality). Since the percentage of missing data was small, and data were not missing completely on random, we used NOMCAR option during regression analysis. $P < .05$ was considered statistically significant.

Results

Characteristics of the Patients

There were 35 769 942 weighted hospitalizations recoded in the year 2015. Among them, 123 410 (0.35%) were identified as MRA (Table 1). The median age of the sample was 63.2 years (IQR: 54.2-71.9 years), and 65.6% were females. Majority of the sample were whites (67.4%), followed by blacks (14.3%), Hispanic (10.2%), and Asian or Pacific Islanders (4.6%). Slightly less than half of the sample (48.1%) were Medicare beneficiaries, followed by private insurance (35.0%) and Medicaid (12.2%). Slightly more than three-fourths (77.8%) of the admissions were nonelective. Majority of MRA hospitalizations were in large (61.3%) as opposed to medium (24.9%) or small hospitals (13.8%). When evaluated by hospital type, (rural, urban nonteaching, or urban teaching), urban teaching hospitals had the largest proportion of patients with MRA (76.9%). Evaluation by geographic regions revealed almost similar distributions in Northeast (23.2%), Midwest (22.2%), and West (20.5%), while the South being the exception had the largest proportion of MRA admissions (34.1%; Table 1).

Common Cancer Types Among Patients With MRA

The most common primary malignancies were ovary (27.2%), gastrointestinal organs and peritoneum (20.5%), colon (11.7%), pancreas (6.4%), stomach (5.7%), uterus (5.2%), and breast (3.7%). Among males, most common primary malignancies were gastrointestinal organs and peritoneum (6.6%), colon (6.0%), pancreas (3.2%), male genital organs (3.1%), and stomach (3.0%). Among females, most common primary malignancies were ovary (27.2%), gastrointestinal organs and peritoneum (13.9%), colon (5.7%), uterus (5.2%), breast (3.7%), and pancreas (3.2%; Table 2).

Hospital Length of Stay, Mortality, and Cost

The median length of stay was 4.7 days (IQR: 2.5-8.6 days), and median cost of hospitalization was $43 543 (IQR: $23 485-$82 248; Table 3). This accounted for a total hospitalization cost of $6.4 billion in 2015. The differences in median length of stay and hospitalization costs by patient characteristics are shown in Table 3. The overall in-hospital mortality rate was 8.8% (n = 10 855), among males 10.8% (n = 4600) and among females 7.7% (n = 6255). The mortality rates according to patient characteristics are shown in Table 3.

Factors Associated With Length of Stay and Mortality

Multivariate analyses showed that factors such as male sex (odds ratio [OR]: 1.06; 95% CI: 1.01-1.12), black race (OR: 1.18; 95% CI: 1.09-1.28), and admission to medium hospitals

Table 1. Characteristics of the Patients Hospitalized with Malignancy-Related Ascites in the United States in 2015.[a]

Variable	n (%)
Unweighted sample	24 682 (100.0%)
Weighted sample	123 410
Age, years, median (IQR)	63.2 (54.2-71.9)
Sex, n (%)	
Male	42 415 (34.4%)
Female	80 995 (65.6%)
Race, n (%)	
White	78 640 (67.4%)
Black	16 745 (14.3%)
Hispanic	11 875 (10.2%)
Asian or Pacific Islander	5330 (4.6%)
Native American	545 (0.5%)
Other	3610 (3.1%)
Primary payer, n (%)	
Medicare	59 315 (48.1%)
Medicaid	15 080 (12.2%)
Private	43 170 (35.0%)
Self-pay	2695 (2.2%)
No charge	355 (0.3%)
Other	2700 (2.2%)
Location of patients' residence, n (%)	
Large central counties	40 910 (33.3%)
Large fringe counties	33 100 (27.0%)
Medium metro counties	22 710 (18.5%)
Small metro counties	10 155 (8.3%)
Micropolitan counties	9075 (7.4%)
Not metropolitan or micropolitan counties	6860 (5.6%)
Admission type, n (%)	
Nonelective	95 580 (77.8%)
Elective	27 310 (22.2%)
Hospital region, n (%)	
Northeast	28 680 (23.2%)
Midwest	27 380 (22.2%)
South	42 065 (34.1%)
West	25 285 (20.5%)
Hospital bed size, n (%)	
Small	17 080 (13.8%)
Medium	30 695 (24.9%)
Large	75 635 (61.3%)
Hospital type, n (%)	
Rural	5585 (4.5%)
Urban nonteaching	22 895 (18.6%)
Urban teaching	94 930 (76.9%)

Abbreviation: IQR, interquartile range.
[a]Elective admissions include nonemergency admissions, and nonelective include admissions from the emergency department.

(OR: 1.24; 95% CI: 1.14-1.34) and large hospitals (OR: 1.31; 95% CI: 1.22-1.41) were associated with prolonged hospital length of stay (Table 4). The top 3 malignancies associated with longer hospital length of stay were hematologic malignancies (lymphoma and leukemia) and uterine and colon cancers (Table 4). Factors associated with shorter hospital length of stay were being a private insurance beneficiary (OR: 0.88; 95% CI: 0.82-0.94), having self-paid insurance (OR: 0.82; 95% CI: 0.69-0.98), being admitted to hospitals in the Midwest (OR: 0.89; 95% CI: 0.82-0.96), the west (OR: 0.83; 95% CI: 0.77-0.90), rural hospitals (OR: 0.64; 95% CI: 0.56-0.74), and urban nonteaching hospitals (OR: 0.83; 95% CI: 0.78-0.89). Please see Table 4 for reference categories.

Table 2. Primary Malignancy Types Among Patients Hospitalized with Malignancy-Related Ascites.[a]

Primary malignancy types	Male, % (SE)	Female, % (SE)	Total
Stomach	3.0% (0.33)	2.7% (0.31)	5.7% (0.45)
Colon	6.0% (0.46)	5.7% (0.45)	11.7% (0.62)
Liver	1.9% (0.27)	1.6% (0.24)	3.5% (0.36)
Pancreas	3.2% (0.35)	3.2% (0.34)	6.4% (0.48)
GI organs and peritoneum	6.6% (0.48)	13.9% (0.67)	20.5% (0.78)
Lung and bronchus	0.6% (0.15)	0.5% (0.13)	1.1% (0.20)
Breast	0.04% (0.04)	3.7% (0.37)	3.7% (0.37)
Uterus	-	5.2% (0.43)	5.2% (0.43)
Ovary	-	27.2% (0.86)	27.2% (0.86)
Other female genital organs	-	3.4% (0.35)	3.4% (0.35)
Male genital organs	3.1% (0.34)	-	3.1% (0.34)
Melanomas of skin	1.8% (0.26)	1.3% (0.22)	3.1% (0.34)
Urinary	1.4% (0.23)	1.4% (0.22)	2.8% (0.32)
Lymphomas and leukemia	1.1% (0.21)	1.5% (0.23)	2.6% (0.31)

Abbreviations: GI, gastrointestinal; SE, standard error.
[a]Cancer with unspecified primary, secondary malignancies, and malignant neoplasm without specification of site were excluded from this analysis.

Factors associated with higher in-hospital mortality rates were being male (OR: 1.34; 95% CI: 1.22-1.48), belonging to Asian or Pacific Islander race (OR: 1.29; 95% CI: 1.05-1.60), being private insurance (OR: 1.29; 95% CI: 1.13-1.47) or Medicaid (OR: 1.23; 95% CI: 1.03-1.47) beneficiaries, having self-paid insurance (OR: 1.60; 95% CI: 1.17-2.17), residing in large central (OR: 1.18; 95% CI: 1.03-1.34) and small metro counties (OR: 1.24; 95%; CI: 1.02-1.51), nonelective admission type (OR: 2.40; 95% CI: 2.06-2.79), and being admitted to rural (OR: 1.37; 95% CI: 1.06-1.78) and urban nonteaching (OR: 1.16; 95% CI: 1.03-1.31) hospitals. The top 3 malignancies associated with higher in-hospital mortality were liver, lung and bronchus, and secondary malignancies. Please see Table 4 for reference categories.

Discussion

To the best of our knowledge, this is the first study that looked for prevalence and inpatient burden of MRA hospitalization using a national database. In the year 2015, there were 123 295 MRA hospitalizations, and total hospitalization cost was nearly $6.4 billion.

In our study, MRA was most commonly seen in ovarian cancer, followed by cancers of gastrointestinal organs and peritoneum, colon, pancreas, stomach, uterus, and breast. Other studies have reported similar associations between MRA and type of cancer; however, relative percentages and order of frequencies were different.[4,7] For example, in a retrospective study of 209 patients with cancer, MRA was most commonly

Table 3. Hospitalization Length, Charges, and Mortality for Malignancy-Related Ascites in the United States in 2015.

Variable	Length of stay in days, median (IQR)	Total charge in us dollars, median (IQR)	In-hospital mortality, n (%)
Entire cohort	4.7 (2.5-8.6)	43 543 (23 485-82 248)	10 855 (8.8%)
Sex			
Male	4.8 (2.5-8.9)	44 184 (23 673-84 971)	4600 (10.8%)
Female	4.7 (2.4-8.5)	43 184 (23 335-80 796)	6255 (7.7%)
Race			
White	4.7 (2.4-8.4)	42 547 (23 030-79 606)	6645 (8.4%)
Black	5.2 (2.6-9.7)	42 736 (23 196-80 962)	1590 (9.5%)
Hispanic	4.9 (2.4-8.8)	51 437 (27 927-10 0552)	975 (8.2%)
Asian or Pacific Islander	4.6 (2.5-8.7)	53 458 (27 573-102 105)	600 (11.3%)
Native American	4.0 (2.1-8.5)	36 142 (22 904-69 520)	65 (11.9%)
Other	5.1 (2.5-9.1)	51 551 (26 597-95 724)	420 (11.6%)
Primary payer			
Medicare	4.9 (2.5-8.7)	43 034 (23 595-81 224)	5190 (8.8%)
Medicaid	4.9 (2.5-9.6)	45 796 (23 870-90 738)	1330 (8.8%)
Private	4.6 (2.4-8.3)	44 150 (23 658-82 538)	3645 (8.4%)
Self-pay	4.5 (2.3-8.5)	39 017 (22 760-73 863)	300 (11.1%)
No charge	4.7 (2.4-9.1)	39 860 (20 678-72 696)	25 (7.0%)
Other	4.2 (2.0-8.1)	37 215 (16 758-73 932)	340 (12.6%)
Location of patients' residence			
Large central counties	4.8 (2.4-8.8)	50 015 (27 227-94 287)	3945 (9.6%)
Large fringe counties	4.8 (2.5-8.5)	43 977 (23 138-83 883)	2720 (8.2%)
Medium metro counties	4.8 (2.5-8.6)	41 932 (22 782-77 689)	1770 (7.8%)
Small metro counties	4.7 (2.5-8.4)	37 239 (21 356-68 399)	915 (9.0%)
Micropolitan counties	4.5 (2.5-8.2)	35 370 (18 417-66 043)	840 (9.3%)
Not metropolitan or micropolitan counties	4.4 (2.3-8.7)	34 757 (18 714-65 919)	595 (8.7%)
Admission type			
Nonelective	4.7 (2.4-8.9)	40 485 (21 873-78 549)	9725 (10.1%)
Elective	4.8 (2.7-7.8)	54 600 (32 177-93 934)	1100 (4.0%)
Hospital region			
Northeast	4.9 (2.5-9.0)	46 805 (24 714-89 303)	2790 (9.7%)
Midwest	4.6 (2.5-8.2)	37 496 (20 881-67 184)	2005 (7.3%)
South	4.9 (2.5-8.9)	39 910 (21 547-74 444)	3620 (8.6%)
West	4.4 (2.3-8.1)	56 873 (30 593-107 652)	2440 (9.7%)
Hospital size			
Small	4.3 (2.2-7.9)	35 923 (19 257-70 966)	1575 (9.2%)
Medium	4.7 (2.5-8.6)	41 962 (22 724-80 389)	2795 (9.1%)
Large	4.9 (2.5-8.8)	45 955 (24 907-85 664)	6485 (8.6%)
Hospital type			
Rural	3.8 (2.1-7.3)	23 805 (12 725-43 878)	660 (11.8%)
Urban nonteaching	4.5 (2.3-8.1)	42 555 (22 752-80 347)	2290 (10.0%)
Urban teaching	4.8 (2.5-8.8)	45 268 (24 648-85 210)	7905 (8.3%)

Abbreviation: IQR, interquartile range.

seen in ovarian (38%), pancreaticobiliary (21%), gastric (18%), esophageal (4%), colorectal (4%), and breast (3%) cancer.[4] The greater proportion of female patients observed in our study was also seen in another smaller study that reported 140 (67%) females of 209 MRA hospitalizations.[4] This could be because common cancers among females are more likely to cause ascites. For example, breast, uterine, and ovarian cancers, which constitute the first, fourth, and tenth most common cancers among females are more commonly associated with MRA, whereas prostate cancer, which is the most common cancer among males, is not associated with MRA.[10] For cancers that are non-sex-specific such as lymphomas, leukemia, lung, and gastrointestinal cancers, MRA rates were similar between the sexes.

In our study, the median hospital length of stay for MRA was 4.7 days. Patient-specific factors that were associated with longer hospital length of stay were male sex, black race, and admission to medium and large hospitals and may suggest existing disparities in quality of care. In addition, some types of cancers were also associated with longer hospital length of stay. Many studies have discussed the effects of treatment options on hospital length of stay among patients with MRA.[11-14] However, the effects of patient-specific variables on hospital length of stay have not been adequately discussed,

Table 4. The Effects of Selected Predictor Variables on Inpatient Mortality and Length of Stay.

Variable	Length of stay, transformed coefficient (95% CI)[a]	Died during hospitalization, OR (95% CI)
Age	0.99 (0.98-1.00)	1.01 (1.00-1.02)
Sex		
Male	1.06 (1.01-1.12)[b]	1.34 (1.22-1.48)[b]
Female	Reference	Reference
Race		
White	Reference	Reference
Black	1.18 (1.09-1.28)[b]	1.12 (0.97-1.29)
Hispanic	1.04 (0.95-1.14)	0.93 (0.78-1.11)
Asian or Pacific Islander	1.08 (0.95-1.23)	1.29 (1.05-1.60)[b]
Native American	1.01 (0.70-1.47)	1.12 (0.58-2.16)
Other	1.09 (0.94-1.27)	1.41 (1.11-1.80)[b]
Primary payer		
Private	0.88 (0.82-0.94)[b]	1.29 (1.13-1.47)[b]
Medicare	Reference	Reference
Medicaid	1.03 (0.93-1.13)	1.23 (1.03-1.47)[b]
Self-pay	0.82 (0.69-0.98)[b]	1.60 (1.17-2.17)[b]
No charge	0.86 (0.51-1.46)	0.99 (0.39-2.50)
Other	0.72 (0.60-0.87)[b]	1.75 (1.30-2.36)[b]
Location of patients' residence		
Large central counties	1.00 (0.93-1.07)	1.18 (1.03-1.34)[b]
Large fringe counties	Reference	Reference
Medium metro counties	1.02 (0.94-1.10)	0.95 (0.81-1.11)
Small metro counties	1.06 (0.95-1.17)	1.24 (1.02-1.51)[b]
Micropolitan counties	1.07 (0.94-1.20)	1.17 (0.92-1.49)
Not metropolitan or micropolitan counties	1.01 (0.88-1.15)	1.20 (0.94-1.55)
Admission type		
Nonelective	0.98 (0.92-1.03)	2.40 (2.06-2.79)[b]
Elective	Reference	Reference
Hospital region		
Northeast	Reference	Reference
Midwest	0.89 (0.82-0.96)[b]	0.71 (0.61-0.83)[b]
South	0.99 (0.92-1.06)	0.87 (0.76-0.98)[b]
West	0.83 (0.77-0.90)[b]	0.92 (0.80-1.06)
Hospital size		
Small	Reference	Reference
Medium	1.24 (1.14-1.34)[b]	0.98 (0.84-1.15)
Large	1.31 (1.22-1.41)[b]	0.92 (0.80-1.06)
Hospital type		
Rural	0.64 (0.56-0.74)[b]	1.37 (1.06-1.78)[b]
Urban nonteaching	0.83 (0.78-0.89)[b]	1.16 (1.03-1.31)[b]
Urban teaching	Reference	Reference
Primary types of malignancies		
Stomach	1.49 (1.03-2.15)[b]	2.09 (1.03-4.24)[b]
Colon	2.10 (1.63-2.70)[b]	1.11 (0.55-2.25)
Liver	1.04 (0.68-1.57)	3.91 (1.92-7.93)[b]
Pancreas	1.10 (0.79-1.53)	2.32 (1.17-4.57)[b]
GI organs and peritoneum	1.21 (0.97-1.52)	1.11 (0.60-2.04)
Lung and bronchus	1.40 (0.65-3.01)	3.33 (1.93-4.73)[b]
Breast	0.79 (0.53-1.17)	0.95 (0.28-3.24)
Uterus	1.94 (1.19-3.17)[b]	1.87 (0.73-4.73)
Ovary	Reference	Reference
Other female genital organs	1.53 (1.02-2.30)[b]	0.71 (0.16-3.06)
Male genital organs	0.93 (0.62-1.41)	0.87 (0.26-2.91)
Melanomas of skin	1.45 (1.01-2.08)[b]	2.36 (0.98-5.71)
Urinary	0.91 (0.68-1.39)	1.87 (0.73-4.73)
Lymphomas and leukemia	2.40 (1.52-3.79)[b]	1.96 (0.71-5.42)
Cancer with unspecified primary	1.15 (0.68-1.93)	0.44 (0.06-3.31)
Secondary malignancies	1.66 (1.44-1.91)[b]	2.35 (1.54-3.59)[b]
Malignant neoplasm without specification of site	1.49 (1.26-1.77)[b]	2.83 (1.81-4.44)[b]

[a] Antilogarithms of β coefficient.
[b] Significant values.

and our study is one of the first few to address this gap. Malignancy-related ascites is a serious condition for which treatment is primarily palliative, and hence treatment options should be minimally invasive and hospital stay should be minimal.[14,15] Studies have also shown that starting palliative care early in the course of the treatment results in significant improvement in symptom burden, survival rate, patient and caregiver satisfaction, quality of life, and length of stay.[16,17] In addition, targeting patient-specific factors and disparities found in our study could additionally decrease hospital length of stay in patients with MRA.

In our study, in-hospital mortality rates were 8.8%, suggesting a relatively higher short-term mortality among MRA hospitalization. In general, life expectancy ranges between 10 and 23 weeks after diagnosis of MRA and depends on several treatment and patient factors.[4,8] However, our study looked for deaths that occurred in hospital only and not after discharge. Hence, we cannot not entirely compare our findings to previous studies on survival characteristics in MRA. In our study, sex, race, residence location, admission type, hospital region, and hospital type were associated with in-hospital mortality rates, again indicating disparities in quality of care. There are very few studies that looked for predictors of in-hospital mortality among patients with MRA.[4,7] For example, Mackey et al showed that liver metastasis, low serum albumin, and edema were associated with higher in-hospital mortality, while ovarian cancer was associated with lower in-hospital mortality.[18] Similarly, Garrison et al showed that patients with MRA having primary cancer of female genital organs had higher survival rates, while those with foregut adenocarcinoma had lower survival rates.[8] A study by Ayantunde et al showed that poor performance status measured by Karnofsky index scoring system, cancer type, liver metastases, lower serum albumin, and higher urea levels were associated with lower survival rates.[7] In addition to these predictors, our study provides many patient specific factors that could affect in-hospital mortality.

We found that nearly 78% of MRA hospitalizations were nonelective admissions. This finding appears to very high given that MRA is a condition that could be managed in the outpatient settings with facilities for ascetic fluid drainage. This is likely reflective of the fact that very few medical centers or facilities have outpatient clinics for routine ascites drainage, forcing physicians to send patients with malignant ascites to the emergency department and admit them to inpatient services. This is additionally taxing to the health care system because every MRA hospitalization incurs an average expenditure of \$44 000, accounting to a total of \$6.4 billion nationally in 2015 alone. Our findings suggest that much of these expenditures could be avoided by providing home hospice care, where patients with MRA could managed by trained professionals in the comfort of their homes.

Strengths and Limitations

One of the main strengths of this study was that we had access to data from a relatively large number of patients with MRA, given the rarity of this condition. This was possible because NIS annually gathers nationally representative weighted data from more than 35 million hospitalizations in the United States. This relatively large sample size is useful for conducting multivariate analyses and understanding the variables that predicted the outcomes. National Inpatient Sample is a nationally representative sample, and results of our study could be considered MRA estimates for the entire United States. Despite these strengths, there were some limitations. The *ICD-9-CM*, *ICD-10-CM*, and CCS codes were used to identify MRA and different types of primary cancers. Despite the specificity of these codes, there could be some coding errors leading to misclassification biases. National Inpatient Sample does not have data on clinical settings, imaging tests, or ascitic fluid analyses to independently confirm MRA diagnosis. In addition, NIS does not have follow-up data and discharge destination, and hence we could not understand disease course and survival characteristics in this population. National Inpatient Sample excludes personal identifiers for confidentiality. Because of this, we were not able to differentiate between first and subsequent hospitalization. Patients who were readmitted were considered as independent new admissions, thus obliterating the difference between index case and readmitted case. This could have overestimated MRA hospitalization in our study. Finally, NIS does not record the cause of death and this limited us from understanding whether all in-hospital deaths in MRA hospitalization are attributable to this condition.

Conclusions

Our study used a large-scale database such as NIS to provide nationwide estimates of MRA hospitalization and outcomes. Many demographic, socioeconomic, health care, and geographic factors explored in this study were associated with hospital length of stay and in-hospital mortality and may suggest disparities in quality of care. These factors could be targeted for preventing unplanned hospitalization, decreasing hospital length of stay, and lowering in-hospital mortality for this population.

Declaration of Conflicting Interests

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