

# Gastric Antral Vascular Ectasia: Trends of Hospitalizations, Biodemographic Characteristics, and Outcomes With Watermelon Stomach

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## Abstract

**Background:** Gastric antral vascular ectasia (GAVE) syndrome is a rare but significant cause of acute or chronic gastrointestinal (GI) bleeding, particularly in the elderly. The primary objective of this study was to determine the biodemographic characteristics, adverse outcomes, and the impact of GAVE hospitalizations on the US healthcare system.

**Methods:** This retrospective database cross-sectional study used the National Inpatient Sample (NIS) from 2001 to 2011 to identify all adult hospitalizations with a primary discharge diagnosis of GAVE, with and without hemorrhage, using the International Classification of Diseases, Ninth Revision (ICD-9) codes. Individuals less than 17 years of age were excluded from the study. The outcomes included biodemographic characteristics, comorbidity measures, and inpatient mortality and the burden of the disease on the US healthcare system in terms of healthcare cost and utilization.

**Results:** We noted an increase in the total hospitalizations for GAVE from 25,423 in 2001 to 44,787 in 2011. Furthermore, GAVE hospitalizations with hemorrhage rose from 19,168 in 2001 to 27,679 in 2011 while GAVE hospitalization without hemorrhage increased from 6,255 in 2001 to 17,108 in 2011. We also noted a female predominance, the proportional trend of which did not show significant difference from 2001 to 2011. For GAVE hospitalizations, the inpatient

mortality decreased from 2.20% in 2001 to 1.73% in 2011. However, the cost of hospitalization increased from \$11,590 in 2001 to \$12,930 in 2011. After adjusting for possible confounders, we observed that the presence of hemorrhage in GAVE hospitalizations was associated with an increased risk of mortality (odds ratio (OR): 1.27; 95% confidence interval (CI): 1.1 - 1.46; P = 0.001).

**Conclusions:** For the study period, the total number of GAVE hospitalizations increased with an increase noted in the proportion of GAVE hospitalizations without bleeding, reflecting an improvement in diagnostic and therapeutic techniques. Although inpatient mortality for GAVE slightly decreased, we noted a significant increase in the cost of care likely secondary to increased use of advanced and expensive interventions.

**Keywords:** Gastric antral vascular ectasia; Hemorrhage; Outcome; Mortality; Predictors of mortality; Nationwide inpatient sample; Comorbidities; Cost of care

## Introduction

Gastric antral vascular ectasia (GAVE) syndrome was first described by Rider et al in 1953 [1]. It was further investigated 25 years later by van Vliet et al in a case series of three patients. In those patients, van Vliet et al reported the presence of a spotty red pre-pyloric antrum [2]. Based on the endoscopic view of the gastric mucosa, GAVE is known by names such as “watermelon stomach” which is characterized by the presence of red spots organized in stripes radially moving away from pylorus and “honeycomb stomach” as these red spots are arranged in a diffused fashion [3, 4]. Although these red spots, also known as angioectasias, are most frequently noted in the gastric antrum, they can be found anywhere in the gastrointestinal (GI) tract [5]. As per current literature, GAVE accounts for almost 4% of all non-variceal GI bleeding and 6% of upper GI bleeds in patients with liver cirrhosis [6]. However, there is significant gap in knowledge about the disease entity as there have been no population-based studies in the USA. Therefore, we used the National Inpatient Sample (NIS) database to analyze biodemographic characteristics, hospitalization rates, and

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comorbidities associated with GAVE hospitalizations. We also determine inpatient mortality, predictors of inpatient mortality and attempt to understand the economic impact of the disease on the US healthcare system in terms of healthcare costs and resource utilization. Furthermore, we strongly advocate for the need for additional large prospective multi-center study to further investigate GAVE, particularly in an elder demographic.

## Materials and Methods

### Source of data

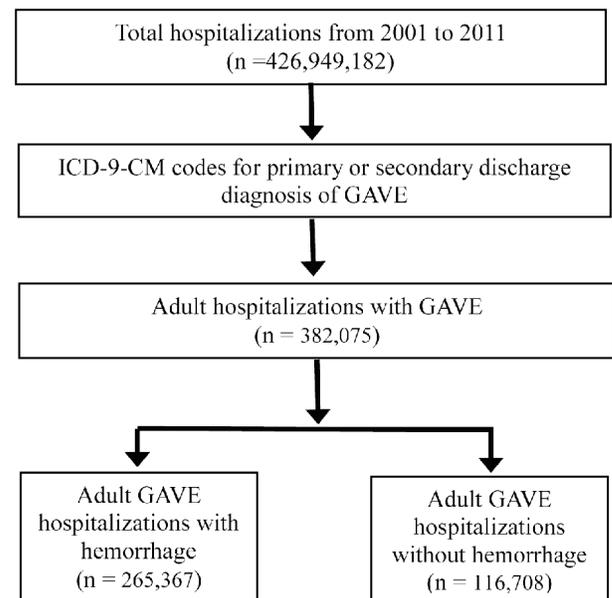
We analyzed the NIS database from 2001 to 2011 to identify hospitalizations with a primary discharge diagnosis of GAVE, with and without hemorrhage, using the International Classification of Diseases, Ninth Revision (ICD-9) codes. NIS, designed by the Agency for Healthcare Research and Quality (AHRQ), is the largest all-payer inpatient database in the USA. NIS is designed to provide a 20% classified sample of community health care systems in the USA which correlates to national estimates. The data are compiled yearly and contain discharge information from over 1,200 hospitals located across the states [7]. The internal validity of the database is guaranteed by the annual data quality assessments, while comparisons with data sources like the American Hospital Association (AHA) Annual Survey of Hospitals, National Hospital Discharge Survey from the National Center for Health Statistics, and Medicare Provider and Analysis Review (MedPAR) inpatient data from the Centers for Medicare and Medicaid Services guarantee the external validity [8].

### Study design

Our study was exempt from Institutional Review Board (IRB) as it did not have any identifiable patient data. This cross-sectional retrospective study queried the NIS database from 2001 to 2011 to identify GAVE hospitalizations, with and without hemorrhage, using the ICD-9 codes (Fig. 1). Individuals less than 17 years of age were excluded from the study. We determined the total number of hospitalizations, biodemographic characteristics, comorbidity measures, adverse outcomes, and the burden of the disease on the US healthcare system. The NIS data were merged with cost-to-charge ratio (CCR) files to calculate estimated cost of hospitalizations [9].

### Variable and statistical analysis

We used the SAS 9.4 (SAS Institute Inc., Cary, NC, USA) software for statistical analyses. The analysis was performed using the hospital-level discharge weights provided by NIS to obtain national estimates as NIS represents a 20% stratified random sample of US hospitals. GAVE hospitalizations per million were calculated by dividing the number of these hospitalizations per year by the US census population from 2001 to 2011. GAVE hospitalizations were also calculated in subgroups of age (18 - 34, 35 - 49, 50 - 64, 65 - 79, and  $\geq 80$  years old), gender,



**Figure 1.** Sequential derivation of the study population for GAVE hospitalizations from 2001 to 2011. GAVE: gastric antral vascular ectasia; ICD-9-CM: International Classification of Diseases, Ninth Revision, Clinical Modification.

race (White, Black, Hispanic, Asian or Pacific Islander, Native American, and other), insurance status (Medicare, Medicaid, private insurance, self-pay/other), hospital location (Northeast, Midwest, South, West), and teaching status of the hospital. We used the Cochran-Armitage trend test to calculate the trends for categorical variables and Wilcoxon rank sum test to assess continuous variables. These methods have been used in previous NIS-based studies [8, 10, 11]. We used the multivariate logistic regression model to determine predictors of mortality. A P value less than 0.05 was considered statistically significant.

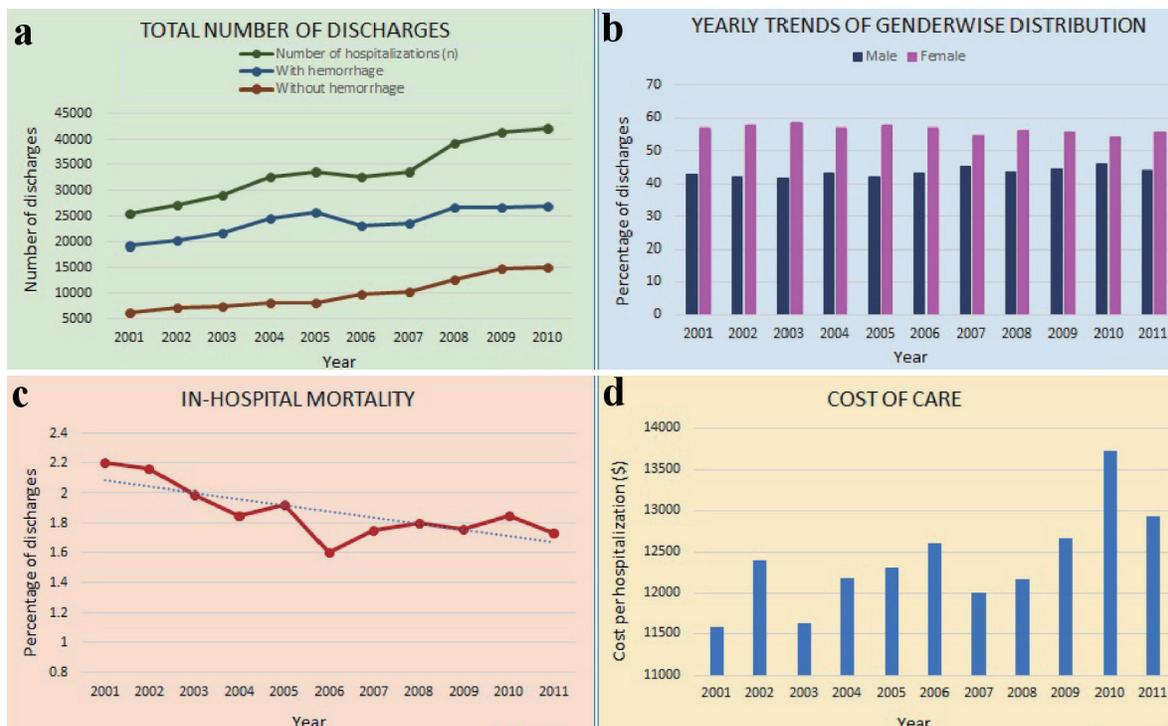
## Results

### Demographics

We noted a significant increase in total number of GAVE hospitalizations for the study period (Fig. 2a) from 25,423 in 2001 to 44,787 in 2011 (Table 1). GAVE hospitalizations with hemorrhage rose from 19,168 in 2001 to 27,679 in 2011, while GAVE hospitalization without hemorrhage increased from 6,255 in 2001 to 17,108 in 2011 (Table 1). Furthermore, we noted a significant female (Fig. 2b) and White predominance throughout the study period ( $P < 0.001$ ). The 65 - 79 age group had the highest number of GAVE hospitalizations for the study period (Table 1).

### AHRQ comorbidities

As per our analysis for 2011, the two most common diagnosis



**Figure 2.** Description of characteristics of GAVE hospitalizations. (a) Total number of discharges with GAVE. (b) Gender distribution for GAVE hospitalizations. (c) Inpatient mortality for GAVE hospitalizations. (d) Cost of care for GAVE hospitalizations. GAVE: gastric antral vascular ectasia.

associated with GAVE hospitalizations included hypertension and renal failure (Table 2). For GAVE hospitalizations, the proportion of patients with hypertension increased significantly from 39.6% in 2002 to 69.6% in 2011 ( $P < 0.0001$ , Table 2) and the proportion of patients with renal failure increased from 24.31% in 2002 to 50.87% in 2011 (Table 2). Additionally, we also noted an increase for other comorbid conditions such as liver disease, diabetes mellitus, obesity, and peripheral vascular disease (Table 2).

### All-cause inpatient mortality

We noted a decrease in inpatient mortality rates for GAVE hospitalizations from 2.20% in 2001 to 1.73% in 2011 ( $P < 0.0001$ , Fig. 2c).

### Cost of care

The cost of management for GAVE hospitalizations increased significantly (Fig. 2d) from \$11,590 in 2001 to \$12,930 in 2011 after adjusting for inflation (Table 1).

### Predictors of mortality

After adjusting for possible confounders such as age, sex, race and Elixhauser comorbidity index for GAVE hospitalizations,

we observed that the presence of hemorrhage was associated with increased risk of mortality (OR 1.27; 95% CI: 1.1 - 1.46;  $p = 0.001$ ) (Table 3). Furthermore, every one-point increase in the Elixhauser co-morbidity index significantly increased the risk of inpatient mortality (odds ratio (OR): 1.18; 95% confidence interval (CI): 1.14 - 1.22;  $P < 0.0001$ ). Additionally, Hispanics admitted to the hospital with GAVE had a high risk of mortality (OR: 1.25; 95% CI: 1.01 - 1.55;  $P = 0.04$ , Table 3). However, increasing age, hospital bed size, teaching status of the hospital, and type of insurance showed no significant association with risk of mortality.

### Discussion

GAVE is an uncommon but often severe cause of acute or chronic GI bleeding. It is usually seen in elderly patients and comprises of almost 4% of all non-variceal GI bleeding in the general population. The pathogenesis of this acquired disease is currently not well understood. However, it appears to be multifactorial given dissimilar endoscopic appearances such as watermelon and honeycomb patterns [5]. Studies have implicated the role of mechanical stress from gastric peristalsis, abnormal antral motor response to food particles, catecholamines, and autoantibodies in the pathogenic process [12-14]. Histologically, the condition is characterized by the presence of vascular ectasia of mucosal capillaries, intravascular fibrin thrombosis, fibrohyalinosis, and spindle cell proliferation [5, 15]. From a clinical perspective, there is significant paucity of

**Table 1.** Baseline Characteristics of Gastric Antral Vascular Ectasia (GAVE) Hospitalizations From 2001 to 2011

	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	P value
Number of hospitalizations	25,423	27,218	28,978	32,799	33,724	32,773	33,669	39,278	41,390	42,036	44,787	<0.0001
With hemorrhage	19,168	20,115	21,594	24,616	25,619	23,032	23,505	26,587	26,581	26,872	27,679	<0.0001
Without hemorrhage	6,255	7,103	7,384	8,183	8,105	9,742	10,165	12,690	14,809	15,164	17,108	<0.0001
Age in years (%)												
18 - 34	0.54	0.59	0.5	0.5	0.49	0.51	0.5	0.67	0.57	0.66	0.72	<0.0001
35 - 49	3.08	3.33	2.81	3.34	2.94	3.4	3.01	2.98	3.47	3.3	3.18	0.035
50 - 64	11.19	12.28	12.78	12.78	14.03	14.05	14.58	15.8	16.11	18.24	17.64	<0.0001
65 - 79	44.99	46.23	47.01	45.69	44.89	44.14	44.08	42.33	43.29	42.3	41.7	<0.0001
≥ 80	40.03	37.52	36.83	37.66	37.56	37.85	37.8	38.17	36.49	35.45	36.71	<0.0001
Gender (%)												
Male	43.1	42.22	41.68	43.17	42.21	43.19	45.14	43.75	44.35	45.8	44	<0.0001
Female	56.9	57.78	58.32	56.82	57.78	56.81	54.83	56.25	55.64	54.18	55.99	
Race (%)												
White	58.19	54.46	54.31	56.7	58.81	57.67	52.88	59.97	62.66	64.57	65.92	<0.0001
Black	10.86	11.67	13.21	12.72	9.65	11.7	12.61	12.57	12.8	15.41	14.47	<0.0001
Hispanic	5.38	5.9	6.52	4.71	4.67	6.62	5.4	5.86	7.1	7.36	7.58	<0.0001
Others	1.98	2.47	2.32	2.14	2.32	2.77	2.54	3.08	3.31	3	2.92	<0.0001
Hospital region (%)												
Northeast	21.55	22.55	21.34	21.62	21.88	22.29	18.95	20.38	21.1	20.64	20.11	<0.0001
Midwest	23.14	22.18	25.86	23.75	22.75	24.27	26.98	24.46	25.33	25.61	25.35	<0.0001
South	40.95	37.37	38.35	40.14	39.39	36.97	39.47	40.83	39.1	39.51	40.12	0.0002
West	14.36	17.89	14.45	14.49	15.98	16.47	14.61	14.33	14.48	14.24	14.42	<0.0001
Hospital location (%)												
Rural	9.99	10.74	12.13	7.93	8.63	7.33	8.77	7.97	7.39	8.59	7.07	<0.0001
Urban nonteaching	48.94	49.47	45.97	51.83	55.34	49.7	49.34	49.9	47.75	47.68	46.01	<0.0001
Urban teaching	41.06	39.79	41.87	40.23	36.03	42.6	41.52	42.13	43.63	42.96	46.24	<0.0001
Median household income (%)												
Quartile 1	7.72	5.05	28.17	26.95	26.25	25.98	28.29	27.03	27.28	28	29.1	<0.0001
Quartile 2	23.74	19.6	26.08	26.14	25.13	24.83	24.96	28.71	25.8	26.29	23.74	<0.0001
Quartile 3	27	24.42	24.68	22.62	25.79	23.99	23.56	21.89	24.26	23.66	25.67	<0.0001
Quartile 4	40.47	48.64	19.1	22.59	21.31	23.42	21.37	20.94	20.75	20.02	19.9	<0.0001
Mode of payment (%)												
Medicare	81.85	81.19	82.88	81.3	81.72	81.43	80.74	77.62	77.65	77.56	79.09	<0.0001
Medicaid	3.44	4.1	4.04	3.71	3.7	3.91	3.46	4.11	4.76	5.33	4.65	<0.0001
Private insurance	12.25	12.58	10.66	12.68	12.15	11.85	13.33	15.31	14.27	14.01	13.07	<0.0001
Others (includes self-pay)	2.37	2.09	2.28	2.24	2.4	2.64	2.4	2.92	3.09	2.97	2.87	<0.0001
Admission day (%)												0.002
Weekday	81.38	80.44	81.07	81.14	80.38	81.23	80.6	80.18	80.62	81.11	80.15	
Weekend	18.62	19.56	18.93	18.86	19.62	18.77	19.4	19.82	19.38	18.89	19.85	
Inpatient mortality (%)	2.2	2.16	1.99	1.85	1.92	1.6	1.75	1.8	1.76	1.85	1.73	<0.0001
Cost of care (\$)	11,590	12,394	11,636	12,190	12,313	12,609	12,012	12,179	12,659	13,724	12,930	<0.0001

**Table 2.** Comorbidities Associated With Gastric Antral Vascular Ectasia (GAVE) Hospitalizations From 2002 to 2011

AHRQ comorbidity measures (%)	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	P value
Obesity	2.03	2.45	2.83	3.42	3.75	4.59	5.5	7.08	7.76	9.44	< 0.0001
Hypertension	39.6	49.33	54.58	53.61	59.96	61.69	61.86	65.38	66.76	69.6	< 0.0001
Diabetes mellitus	26.73	27.68	27.36	29.12	31.08	32.48	33.3	34.22	35.38	36.63	< 0.0001
Congestive heart failure	21.76	22.8	24.29	25.46	24.85	25.54	23.35	24.38	24.35	25.44	0.0002
Chronic obstructive pulmonary disease	26.64	28.03	29.4	30.06	32.1	31.75	28.17	29.67	30.27	30.68	< 0.0001
Peripheral vascular disease	8.23	8.68	9.47	9.85	10.17	11.93	13.1	13.27	14.11	14.74	< 0.0001
Renal failure	24.31	26.16	28.97	31.9	38.97	42.36	42	46.32	47.88	50.87	< 0.0001
Neurological disorders	7.02	6.08	7.16	6.36	7.32	8.18	9.07	9.34	9.21	10.38	< 0.0001
Anemia	24.9	26.4	26.92	28.78	30.66	30.94	34.18	35.75	36.42	38.96	< 0.0001
Solid tumor without metastasis	9.63	2.04	2.2	1.94	2.13	2.65	2.35	2.63	2.72	3.05	< 0.0001
Weight loss	2.33	2.36	2.94	3.42	4.27	3.68	4.92	5.35	7.17	7.96	< 0.0001
Rheumatic disorders	2.66	2.64	3.39	3.41	3.84	4.2	3.89	4.64	4.31	4.62	< 0.0001
Psychiatric disorders	6.24	6.6	7.07	8.3	9.95	9.75	11.69	12.17	13.21	15.74	< 0.0001
Liver disease	6.2	6.7	7.04	7.19	7.35	8.03	9.5	10.72	12.04	13.37	< 0.0001

AHRQ: Agency for Healthcare Research and Quality.

data on GAVE in an inpatient setting. Hence, this study was designed to identify the epidemiology, associated comorbidities, and adverse outcomes of GAVE hospitalizations while detailing the disease burden on the US healthcare system.

In our study, we noted a significant increase in total number of GAVE hospitalizations with and without hemorrhage. The number of hospitalizations increased from 25,423 in 2001 to 44,787 in 2011 accounting for a 76% increase in a span of just 11 years. This may be because of increased awareness and widespread availability of newer diagnostic tools and techniques across the USA. Additionally, patients with GAVE are known to have higher recurrence of bleeding after endoscopic intervention, and blood loss in these patients may continue for a chronic duration. Literature reports that up to 62% of patients with GAVE may remain transfusion dependent [16]. Hence, we believe that it is imperative to identify patient demographics and establish risk factors for GAVE hospitalizations to design a robust management plan to reduce morbidity and mortality.

It has been well established that GAVE is more commonly seen in women compared to men [17]. As per literature, the most common presenting sign for GAVE in women is anemia secondary to chronic gastric bleeding [18, 19]. In our study population, a female predominance was noted which was in line with current literature, but there is no established pathophysiologic cause for this female predominance [18, 19]. However, it is worth noting that studies investigating the use of anti-neoplastic drugs in women with gastric adenocarcinoma and gastric stromal tumors have reported the presence of GAVE [20, 21]. This suggests that there may be a neoplastic or drug-induced pathophysiology for GAVE in these women [20, 21].

In literature, a retrospective cohort study by Smith et al on 135 patients revealed a significant correlation of GAVE with liver disease, diabetes mellitus, body mass index (BMI), and vascular disease [16]. Similarly in our study, we noted increasing proportion of patients with comorbidities such as hypertension, renal failure, cirrhosis, diabetes mellitus, obesity, and peripheral vascular disease in these hospitalizations (Table 2). Comorbidities that affect vascular remodeling may have a key role to play in the pathogenesis of GAVE.

Moreover, studies have reported an all-cause inpatient mortality of around 1.4% for GAVE patients. In our study, the mortality rate for GAVE hospitalizations in 2011 was noted to be 1.73%, which was a downtrend from the 2.20% from 2001. This may be because of wider availability of diagnostic tools and improvement in therapeutic techniques over the years. Additionally, the lower rates of mortality may in part be due to an increasing prevalence of GAVE without hemorrhage compared to GAVE with hemorrhage, which is known to be major contributor to the mortality rate. Furthermore, literature has reported higher rates of mortality for GAVE patients refractory to traditional therapies undergoing surgical intervention. A 30-day mortality of 50% and a perioperative mortality of 7.4% have been reported in patients undergoing surgery [6]. However, there is paucity of large-scale study describing mortality rates in patients undergoing endoscopic or pharmacologic interventions.

Although GAVE is a relatively rare cause of upper GI bleeding, it can cause significant and severe bleeding leading to adverse outcomes such as mortality, especially in elderly

**Table 3.** Predictors of Mortality for Gastric Antral Vascular Ectasia (GAVE) Hospitalizations From 2001 to 2011

Characteristics	Odds ratio	95% confidence interval	P value
Hemorrhage	1.27	1.10 - 1.46	0.001
Elixhauser comorbidity index (every 1-point increase)	1.18	1.14 - 1.22	< 0.0001
Age (years)			
18 - 44	Reference		
45 - 64	1.05	0.62 - 1.78	0.84
65 - 84	1.17	0.69 - 1.97	0.57
≥ 85	1.46	0.85 - 2.50	0.17
Gender			
Male	Reference		
Female	0.841	0.745 - 0.951	0.0055
Race			
White	Reference		
Black	0.88	0.73 - 1.06	0.17
Hispanic	1.25	1.01 - 1.55	0.04
Others	1.30	0.96 - 1.75	0.09
Hospital bed size			
Small	0.92	0.75 - 1.13	0.44
Medium	0.93	0.81 - 1.08	0.35
Large	Reference		
Hospital region			
Northeast	Reference		
Midwest	0.89	0.73 - 1.08	0.22
South	0.99	0.84 - 1.16	0.91
West	1.06	0.88 - 1.28	0.55
Hospital type (%)			
Rural	0.82	0.62 - 1.07	0.15
Urban nonteaching	0.89	0.78 - 1.01	0.07
Teaching	Reference		
Primary insurance (%)			
Medicare/Medicaid	Reference		
Private including HMO	0.92	0.74 - 1.16	0.49
Uninsured/self-pay	0.93	0.60 - 1.46	0.76

HMO: Health Maintenance Organization.

patients with multiple comorbidities [22]. In this study, we attempted to identify the predictors of inpatient mortality for GAVE hospitalizations. After adjusting for confounders, we report that the presence of hemorrhage and every one-point increase in Elixhauser comorbidity index was associated with significantly increased risk of inpatient mortality for GAVE hospitalizations. Furthermore, literature reports a higher prevalence of GAVE in Caucasians followed by the African American population [23]. However, there exists a significant gap in knowledge in terms of the racial distribution and subset of the population at the highest risk of mortality from GAVE. In our study, we found that the Hispanic population had a high risk of inpatient mortality,

but we did not find statistical significance in the mortality rates for other races. Additionally, increasing age, hospital bed size, teaching status of the hospital, and type of insurance showed no significant association with the risk of mortality.

From a treatment perspective, endoscopic interventions including argon plasma coagulation (APC), endoscopic band ligation, neodymium-doped: yttrium-aluminum-garnet (Nd:YAG) laser treatment, cryotherapy, and radiofrequency have all been demonstrated in the literature [24-26]. The data supporting endoscopic resolution of GAVE are limited. In a study conducted by Garg et al in 2017, endoscopic resolution was reported in only 40% of GAVE patients undergoing APC [27].

Moreover, recurrence of bleeding has been reported in about 35-80% of patients treated with APC [25, 28]. Furthermore, antrectomy has shown benefit in refractory cases, but carries a high mortality risk [29]. Other experimental therapeutic options include hormonal therapy such as estrogen-progesterone therapy, tranexamic acid, methylprednisolone, thalidomide, and cyclophosphamide [26, 30-35].

Like any study, this study is not without limitations. The selection of the study samples relies on a retrospective database which stores data using specific codes known as the ICD-9 codes. The errors associated with coding process could have confounded some of our findings. Additionally, this study included data for the 2001 to 2011 study period. Therefore, there may be limitations in the generalizability of the data to the more recent time period. Furthermore, this was a retrospective study; hence, all biases seen in database retrospective studies are applicable to our study. However, despite these limitations, the large sample size which closely reflects the US population and the analytical study design yielded higher power for our study results. Additionally, this is also one of the first nationwide study looking at the burden and outcomes of GAVE in the US population.

## Conclusions

For the study period, the total number of GAVE hospitalizations increased significantly with a higher increase in the proportion noted for GAVE hospitalizations without bleeding. This was most likely due to widespread availability of diagnostic tools and improvement in therapeutic techniques. We also noted that the risk of mortality increases significantly with presence of hemorrhage for GAVE hospitalizations. Although inpatient mortality for GAVE hospitalizations decreased slightly over the study period, there was a significant increase in the cost of care for these patients likely due to increased use of advanced and expensive interventions.

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## Conflict of Interest

The authors report no conflict of interest.

## Informed Consent

Not applicable.

## Author Contributions

Conception and design: Shantanu Solanki, Asim Kichloo, and Khwaja Fahad Haq. Administrative support: Dhanshree Solanki, Darshan Lal, and Jagmeet Singh. Provision of study materials or patients: Shantanu Solanki. Collection and assembly of data: Shantanu Solanki. Data analysis and interpretation: Shantanu Solanki, Asim Kichloo, and Dushyant Singh Dahiya. Manuscript writing: all authors. Final approval of manuscript: all authors.

## Data Availability

We used and/or analyzed the NIS database 2016 and 2017, available online at <http://www.hcup-us.ahrq.gov>. The NIS is a large publicly available all-payer inpatient care database in the USA, containing data on more than 7 million hospital stays yearly. Its large sample size is ideal for developing national and regional estimates and enables analyses of rare conditions, uncommon treatments, and special populations.

## Abbreviations

GAVE: gastric antral vascular ectasia; GI: gastrointestinal; NIS: National Inpatient Sample; AHRQ: Agency for Healthcare Research and Quality; AHA: American Hospital Association; MedPAR: Medicare Provider and Analysis Review; IRB: Institutional Review Board; CCR: cost-to-charge ratio; BMI: body mass index; APC: argon plasma coagulation; Nd: YAG: neodymium-doped, yttrium-aluminum-garnet

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