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Validation of ICD-10 and CPT Codes to Identify Acute Esophageal Variceal Hemorrhage and Band Ligation among Patients with Liver Cirrhosis

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Abstract

Background & Aim: Claims databases are used ever more widely in medical research. The building blocks of such databases are the ICD-10 CM codes, which are used to identify study patients, exposures and procedures. We aimed to determine the performance characteristics of the International Classification of Diseases, Tenth Revision, Clinical Modification (ICD-10 CM) and the current procedural terminology (CPT) coding systems in identifying patients with acute esophageal variceal hemorrhage and esophageal variceal band ligation.

Methods: Both liver cirrhosis and acute gastrointestinal hemorrhage were ascertained using manual electronic medical record review. The study patients' billing records were obtained and searched for ICD-10 CM code I85.xx for esophageal variceal hemorrhage and O6L34CZ, O6L38CZ and CPT code 43244 for esophageal variceal band ligation.

Results: 1,231 patient encounters were included. Alcohol was the most common etiology for liver cirrhosis (62.3%), and hematemesis (40.5%) was the most common patient presentation. A principal diagnosis ICD-10 CM code of I85.xx was associated with high sensitivity (84.8%), specificity (88.6%), positive (PPV, 92.9%) and negative (NPV, 77.0%) predictive values for presence of esophageal varices. For esophageal variceal band ligation, the ICD-10 CM had lower sensitivity than the CPT codes (51% versus 77%, respectively). However, both systems had similar specificity (99% and 99%), positive (97% and 96%), and negative (86% and 93%) predictive values in this setting.

Conclusion: ICD-10 CM diagnostic code I85.xx and procedure codes O6L34CZ and O6L38CZ as well as CPT code 43244 accurately identified patients with acute

esophageal variceal hemorrhage and esophageal variceal band ligation, respectively.

Keywords: ICD-10 CM; Acute esophageal variceal hemorrhage; Esophageal variceal band ligation; Validation

Abbreviations

BRBPR: Bright Red Blood per Rectum; CI: Confidence Interval; CPT: Current Procedural Terminology; EGD: Esophagogastroduodenoscopy; EV: Esophageal Varices; HCC: Hepatocellular Carcinoma; ICD-10: International Classification of Diseases Tenth Revision; NAFLD: Non-Alcoholic Fatty Liver Disease; NASH: Non-Alcoholic Steatohepatitis; NPV: Negative Predictive Value; PPV: Positive Predictive Value; SD: Standard Deviation

Introduction

Liver cirrhosis and its associated complications is the fifth-leading cause of adult deaths in the United States and ranks eighth in economic cost among major health issues [1]. The natural history of liver cirrhosis is to progress from a compensated to a decompensated stage. Decompensated liver cirrhosis stage starts with the occurrence of one or more of the following complications of portal hypertension: variceal hemorrhage, hepatic encephalopathy, ascites and jaundice. The onset of decompensation is associated with significantly worse prognosis: The 1-year mortality of patients with compensated liver cirrhosis is 5.4%, while it is 20.2% for patients with decompensated liver cirrhosis [2].

Acute variceal gastrointestinal hemorrhage is a potentially fatal complication of portal hypertension. It is a leading cause of death and major morbidity among patients with liver cirrhosis [3]. Esophageal varices are the most common type of

gastrointestinal varices. They are present in approximately 50% of patients with liver cirrhosis referred for esophageal variceal screening [4]. Small varices progress to large varices at a rate of 10% to 12% annually [5]. Esophageal variceal hemorrhage occurs at a rate of 10% to 15% per year. Acute esophageal variceal hemorrhage's six-week mortality rate ranges between 15% and 25% [6,7].

Esophagogastroduodenoscopy (EGD) is the gold standard procedure used in the diagnosis and treatment of gastroesophageal variceal hemorrhage. Endoscopic variceal ligation was first proposed as a treatment for esophageal varices by Van Stiegmann et al. in 1988 [8]. Since then, band ligation is the recommended first line treatment for the management of esophageal variceal hemorrhage [9].

Although prospective randomized controlled trials yield the highest quality of evidence in medical research, they might be difficult to implement for life-threatening conditions such as acute variceal hemorrhage. Retrospective studies conducted using claims databases can be the alternative to obtaining evidence in this setting. In addition, research using claims databases is instrumental in establishing the epidemiology of medical conditions as well as in resource allocation and policy making. The building blocks of such databases are the International Classification of Diseases, Tenth Revision, Clinical Modification (ICD-10 CM) codes. Those are billing codes that are used to identify the diagnoses and procedures in claims databases-based research. Therefore, measuring the accuracy of ICD-10 CM codes in correctly and completely identifying the diagnoses and procedures they are intended to code for is a crucial first step in this type of research. The purpose of this study was to determine the performance characteristics of the ICD-10 CM coding system in identifying both patients with acute esophageal variceal hemorrhage and those who had a band ligation procedure in the hospital setting [10].

Materials and Methods

Study design and setting

This was a retrospect cohort study using medical record chart review to evaluate the performance characteristics of different ICD-10 CM codes for esophageal varices hemorrhage in a large medical database. Data was extracted from the Research Patient Data Registry (RPDR) of a large hospital and physician network in Massachusetts. This database has complete electronic medical records as well as billing information on all patients treated in any of the facilities in the network. The study period was from September 1st, 2015 to April 30th, 2019. This study was reviewed and approved by the hospital organization's institutional review board (IRB#2003P001665).

Study population and case confirmation

The inclusion criteria were: 1) patient's age of 18 years or older, 2) a personal history of liver cirrhosis, and 3) hospitalization for an acute upper gastrointestinal hemorrhage. Patients were excluded if they did not have an in-

hospital EGD or if the EGD performed did not have a clear indication of upper gastrointestinal hemorrhage. Both liver cirrhosis and acute gastrointestinal hemorrhage were ascertained using electronic medical record review. The diagnosis of liver cirrhosis was established using either liver biopsy results showing grade IV fibrosis and/or small nodular liver with heterogeneous enhancement on CT, MRI, or ultrasound scan of the abdomen. The presence of esophageal varices was ascertained through upper endoscopy reports, which clearly stated that at least 2 columns of esophageal varices of any size were present in the distal esophagus. The billing records for the study patients were then obtained and searched for ICD-10 codes I85.xx as well as K92.0-92.2. The first x in I85.xx can be either 0 or 1, in which 0 signifies esophageal varices, and 1 signifies secondary esophageal varices. The second x can be 0 for varices without bleeding and 1 for varices with bleeding. K92.0-92.2 code for hematemesis, melena and gastrointestinal hemorrhage, unspecified and served as a control population to calculate the specificity of the codes I85.xx in identifying the presence of esophageal varices. Two medical chart reviewers, both physicians who are also co-authors on this study, performed all chart reviews using a standardized data collection tool. Cases that were ambiguous in their classification were further discussed, sometimes with a third more senior physician, until consensus was obtained.

Patient characteristics and study outcomes

The patient characteristics collected were as follows: Patient age, sex, race, ethnicity, in- or out-of-state location, insurance type, cirrhosis etiology, presence of hepatocellular carcinoma, and nature of initial presentation. The primary outcome was the performance characteristics of the I85.xx ICD-10 CM codes in identifying esophageal variceal hemorrhage. Secondary outcomes were 1) performance characteristics of the I85.xx ICD-10 CM code in identifying esophageal varices when they are the most likely source of the hemorrhage 2) presence of signs of active/recent hemorrhage from the esophageal varices, and 3) performance characteristics of the ICD-10 CM procedure codes and CPT codes in identification of esophageal variceal band ligation.

Statistical analysis

Sensitivity, specificity, positive predictive value (PPV), and negative predictive value (NPV) with 95% confidence intervals (CI) were calculated using a 2 x 2 contingency table. Statistical analysis was performed with SAS 9.4 Software (Cary, NC).

Results

1231 patient encounters for 876 patients were included in the study. **Figure 1** shows the inclusion diagram. **Table 1** summarizes the demographic characteristics of the patient population. The average patient's age was 59.3 years, and almost two-thirds were male. The majority of patients were Caucasian and resided in Massachusetts, with only 12% residing out-of-state. About half of the patients had Medicare

and/or Medicaid, and about a third had private insurance. Alcoholic cirrhosis was the most common etiology of liver

cirrhosis (62%), and hematemesis (41%) and melena (39%) was the most common patient presentation.

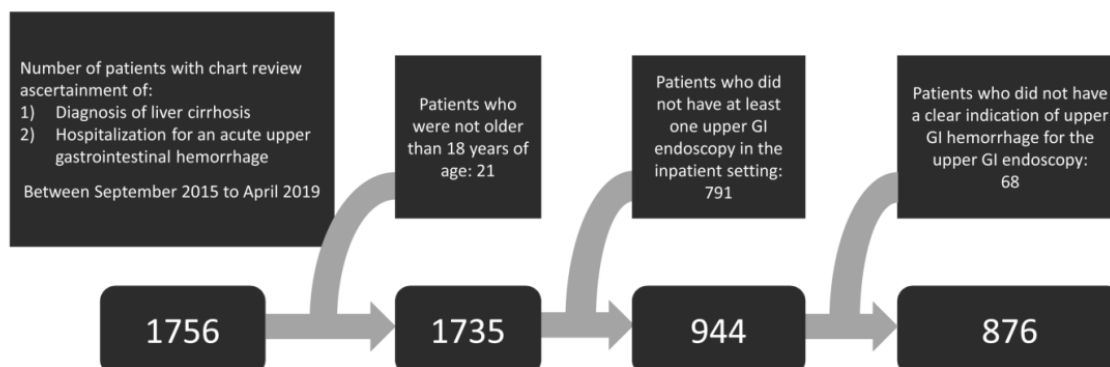


Figure 1 Screening algorithm in identifying final cohort of patients and upper gastrointestinal endoscopies.

Outline of inclusion and exclusion criteria for identifying patients for the study. The left most number indicates the initial number of patients manually screened in with subsequent removal of patients per indicated criteria towards building the final cohort of patients (far right).

Table 1 Basic patient characteristics on presentation of acute upper gastrointestinal haemorrhage.

Patient Characteristics	Number of Patients (n=876)
Age, mean ± SD	59.3 ± 13.1
Sex, Female, n (%)	312 (35.6)
Race, n (%)	
Caucasian/White	701 (80.0)
African American/Black	61 (7.0)
Asian/Pacific Islander/Native	27 (3.1)
Other/Not Documented	87 (9.9)
Ethnicity, n (%)	
Hispanic	33 (3.8)
Non-Hispanic	816 (93.2)
Unknown	27 (3.1)
Home Location, n (%)	
In-state, Massachusetts	772 (88.1)
Out-of-state	104 (11.9)
Northeast	80 (9.1)
Midwest	2 (0.2)
South	12 (1.4)
West	3 (0.3)
U.S. Territory or Abroad	7 (0.8)
Insurance Type, n (%)	

Public	435 (49.7)
Medicare	151 (17.2)
Medicaid	241 (27.5)
Medicare/Medicaid	43 (4.9)
Private/Commercial	271 (30.9)
Private + Public	34 (3.9)
None/Not Documented	136 (15.5)
Liver Cirrhosis Etiology, n (%)	
Type	
Alcohol	546 (62.3)
NAFLD/NASH	126 (14.4)
Hepatitis C	195 (22.3)
Hepatitis B	36 (4.1)
Autoimmune	40 (4.6)
Other	89 (10.2)
More Than One Etiology Present	149 (17.0)
Is HCC present?	64 (7.3)
Initial Presentation of Gastrointestinal Hemorrhage	
Hematemesis	355 (40.5)
Coffee Ground Emesis	53 (6.1)
Hematochezia/BRBPR	103 (11.8)
Melena	340 (38.8)
Drop in Hemoglobin, Unexplained	188 (21.5)

Upper endoscopy findings

Table 2 outlines relevant upper endoscopy findings. Esophageal varices were found in two thirds of all EGDs (64%). Around one-third of patients (37%) who had esophageal varices had signs of active or recent hemorrhage (red wale or

nipple sign). The vast majority (93%) of patients with active/recent esophageal variceal hemorrhage received endoscopic treatment with variceal band ligation. Gastric varices were present concomitantly with esophageal varices for 14% of patients.

Table 2 Primary and secondary outcomes.

Variables	Number of EGDs, n=1371, n (%)
Presence of Esophageal Varices	873 (63.7)
Presence of Gastric Varices	195 (14.2)
Active /Signs of Recent Hemorrhage	320 (23.3)
Band Ligation Procedure Performed	334 (24.4)

Performance characteristics of ICD-10 CM I85.xx

The ICD-10 CM code I85.xx was the principal diagnosis in 58% of all encounters. A principal diagnosis ICD-10 CM code of I85.xx was associated with high sensitivity (85%), specificity (89%), positive predictive value (93%) and negative predictive value (77%) for the presence of esophageal varices (**Figure 2**). On subgroup analysis, a principal diagnosis ICD-10 CM code of I85.x0 (without bleeding) had a sensitivity of 73%, specificity of 74%, positive predictive value of 65% and negative predictive value of 80% for the presence of esophageal varices (**Figure 3**) while code I85.x1 (with bleeding) had a sensitivity of 58%, specificity of 91%, PPV of 66%, and NPV of 91% for the presence of esophageal varices (**Figure 4**). Of note, 10 of the 31 patients (32%) with gastric varices but without esophageal varices had a principal diagnosis ICD-10 CM code of I85.xx. However, this only constituted 20% (10/51) of all false positives for the presence of esophageal varices.

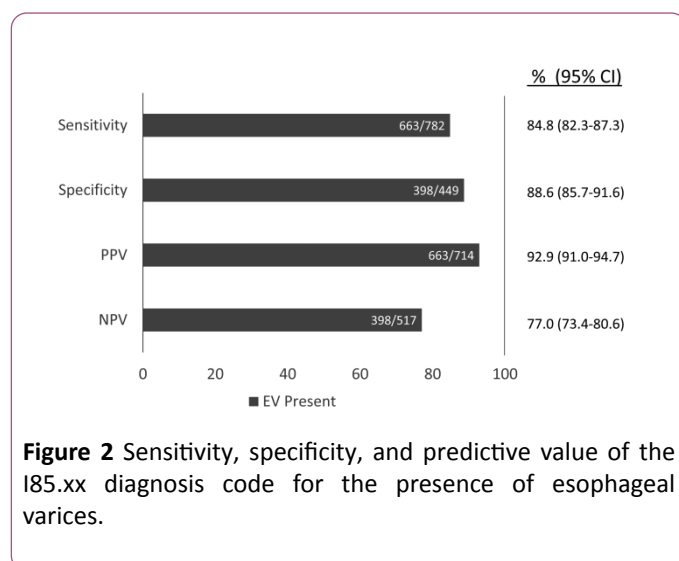


Figure 2 Sensitivity, specificity, and predictive value of the I85.xx diagnosis code for the presence of esophageal varices.

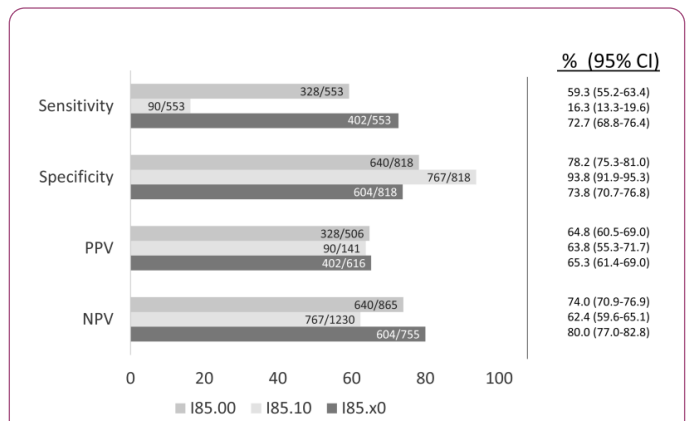


Figure 3 Sensitivity, specificity, and predictive value of the I85.x0 diagnosis code for the presence of esophageal varices without bleeding.

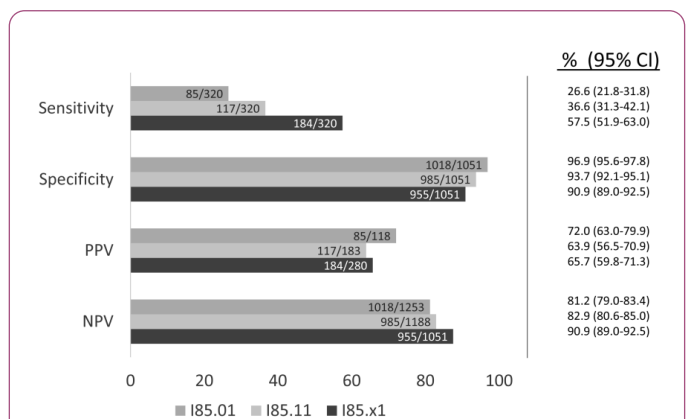


Figure 4 Sensitivity, specificity, and predictive value of the I85.x1 diagnosis code for the presence of esophageal varices with bleeding.

Most common ICD-10 CM procedure codes and CPT codes for esophageal varices band ligation and their performance characteristics

Control of esophageal hemorrhage occurred during 32% of all upper endoscopies. **Table 3** outlines the most frequently encountered ICD-10 CM procedure codes and CPT codes used to code for control of esophageal hemorrhage in the study population.

The ICD-10 CM codes O6L34CZ and O6L38CZ and the CPT code 43244 were the most common codes for esophageal variceal band ligation. The two ICD-10 codes had a combined specificity of 99%, sensitivity of 51%, positive predictive value of 97% and a negative predictive value of 86% for detecting esophageal variceal band ligation. The CPT code had similar specificity (99%), positive (96%) and negative (93%) predictive value as the ICD10- CM codes but a higher sensitivity of 77%. The combination of both ICD10-CM and CPT codes had the best performance characteristics (83%, 99%, 95%, 95% for

sensitivity, specificity, positive and negative predictive values, respectively) (Figure 5).

Table 3 Prevalence of EGD associated CPT or ICD-10 codes in the study population.

CPT/ICD-10 code	Description	Number of EGDs (n=1371), n (%)
43244	Esophagogastroduodenoscopy, flexible, transoral; with band ligation of esophageal/gastric varices	269 (19.6)
43255	esophagogastroduodenoscopy, flexible, transoral; with control of bleeding, any method	150 (10.9)
Any CPT		412 (30.1)
06L34CZ	Occlusion of Esophageal Vein with Extraluminal Device, Percutaneous Endoscopic Approach	74 (5.4)
06L38CZ	Occlusion of Esophageal Vein with Extraluminal Device, Via	100 (7.3)

	Natural or Artificial Opening Endoscopic	
Any 06L-		174 (12.7)
0W3P8ZZ	Control Bleeding in Gastrointestinal Tract, Via Natural or Artificial Opening Endoscopic	86 (6.3)
0DL58ZZ	Occlusion of Esophagus, Via Natural or Artificial Opening Endoscopic	1 (0.1)
0DQ18ZZ	Repair Upper Esophagus, Via Natural or Artificial Opening Endoscopic	2 (0.2)
0DQ28ZZ	Repair Middle Esophagus, Via Natural or Artificial Opening Endoscopic	4 (0.3)
0DQ38ZZ	Repair Lower Esophagus, Via Natural or Artificial Opening Endoscopic	9 (0.7)
0DQ48ZZ	Repair Esophagogastric Junction, Via Natural or Artificial Opening Endoscopic	1 (0.1)
Any ICD-10		277 (20.2)

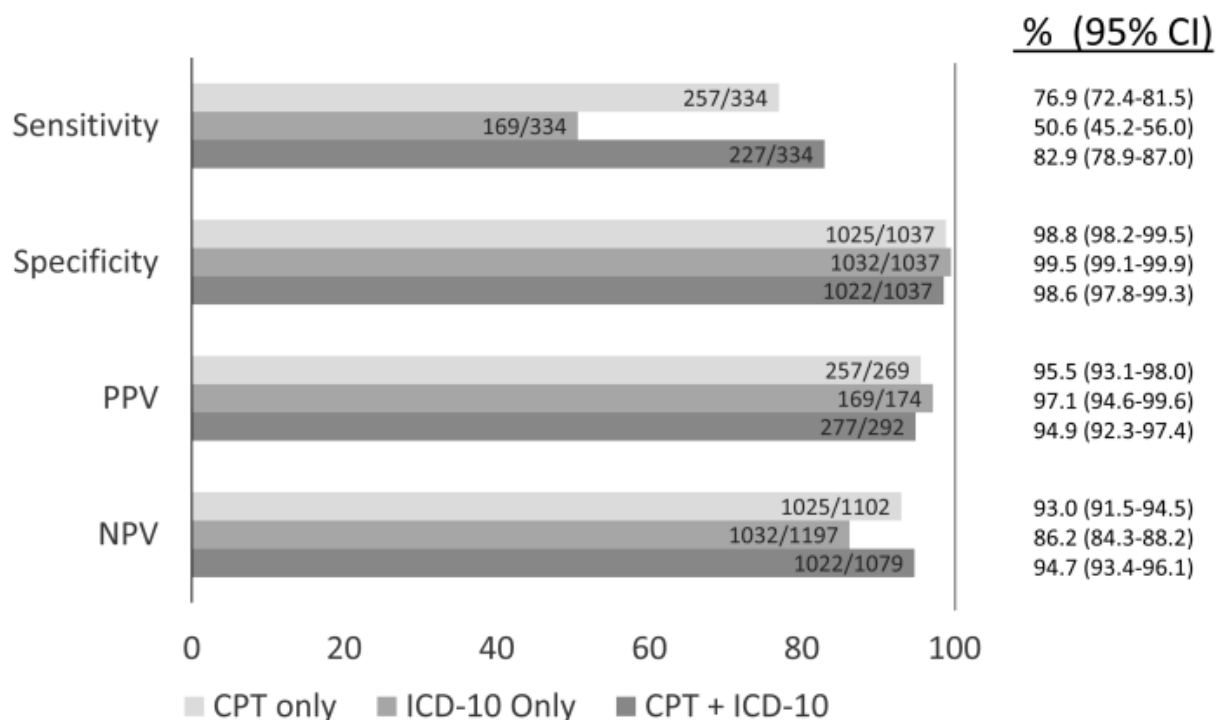


Figure 5 Sensitivity, specificity, and predictive value of CPT and ICD-10 diagnosis codes associated with band ligation of esophageal varices.

The CPT code 43244 is associated with esophageal variceal band ligation. ICD-10 codes associated with esophageal variceal band ligation include 06L34CZ and 06L38CZ.

Discussion

We demonstrate that a principal diagnosis ICD-10 CM code of I85.xx was associated with high sensitivity, specificity,

positive and negative predictive values for the presence of esophageal varices. On subgroup analysis, I85.x0 (without bleeding) had lower performance characteristics compared with code I85.xx while I85.x1 (with bleeding) had lower sensitivity and positive predictive value but similar specificity and higher negative predictive value compared with the same code. Both the ICD-10 CM codes 06L34CZ and 06L38CZ and the CPT code 43244 had excellent specificity, negative and positive

predictive value in detecting esophageal variceal band ligation. However, the CPT code had a higher sensitivity compared with the ICD-10 CM codes in this setting.

The ICD-10 CM coding system contains more than 65,000 codes compared with around 16,000 codes for the ICD-9 system. Whether this increase in the number of codes and associated administrative burden translate into better coding accuracy was uncertain to this date. To our knowledge, this is the first study to completely validate the ICD-10 codes specific for both esophageal variceal hemorrhage and esophageal varices band ligation. Previously, Mapakshi S et al. used a 325-patient group from the national Veterans Affairs (VA) Corporate Data Warehouse and showed that the positive predictive value for the combination of codes I85.xx and I84.6 (gastric varices) for the detection of varices was 90.2%, respectively 10. Unlike the current study, the authors did not calculate sensitivity or specificity, did not analyze neither esophageal and gastric varices separately nor the individual codes for esophageal varices, and did not study the performance of ICD-10 CM or CPT codes for esophageal band ligation procedure. Our study confirms the high positive predictive value for I85.xx, and expand Mapakshi S, et al. results as above to a patient population derived from hospitals of small, medium and large sizes, both teaching and non-teaching.

We tested and compared three coding strategies to identify esophageal variceal hemorrhage: I85.xx, I85.x0 and I85.xx. One challenge encountered by coders and billers (including physicians) is the choice of codes to use when non-bleeding esophageal varices are encountered in a patient without other etiology for the upper gastrointestinal hemorrhage. In an attempt to avoid billing errors and possibly fraud, some physicians enter code I85.x0 in this setting since the varices were not actively hemorrhaging at the time of endoscopy. Other physicians use codes I85.x1 since the esophageal varices, although not bleeding at the time of endoscopy, are the only possible source for the hemorrhage. We believe this is the reason why code I85.x1 has a sensitivity of only 58% but a specificity of 91%. We show that using all codes for esophageal varices (I85.xx) increases the sensitivity to 85% while maintaining the same high specificity (89%). Based on these findings, we recommend using codes I85.xx preferentially in this setting.

To our knowledge the current study is also the first to identify and examine the performance characteristics of the most commonly used codes for esophageal variceal band ligation. Since CPT codes are used for billing in the United States and ICD-10 CM procedural codes are not, our hypothesis was that CPT codes are more accurate than ICD-10 CM codes. Consistent with our hypothesis, we found that both coding systems had similar specificity, positive and negative predictive value, but that CPT codes were more sensitive. Thus, in databases where both coding systems are available, we recommend using the CPT codes preferentially. However, multiple large databases including the Agency for Healthcare Research and Quality's (AHRQ) Healthcare cost and Utilization Project (HCUP) Databases contain ICD-10 CM codes exclusively.

Those codes are still highly specific; however, they may underreport procedures due to the lower sensitivity. HCUP databases are frequently used in epidemiological research, and since 2015, the HCUP database Nationwide Emergency Department Sample (NEDS) included CPT codes for procedure performed in the Emergency Department. Although the combination of both systems has the best performance characteristics, rare are the databases that contain both coding system for the same procedure.

Our study has some limitations. First, we included hospitals and patients from Massachusetts, which might not be representative of the other states. However, we included both teaching and non-teaching hospitals, as well as small, medium and large hospitals and both tertiary care centers and community hospitals. Second, and along the same line, all hospitals participating in the study had the same electronic healthcare record, which assists physicians in coding. However, professional coders and billers reviewed all medical charts and generated the final codes entered in the files. Third, the ICD-10 codes are updated every third quarter of the year. Therefore, the codes we validated for esophageal varices and esophageal variceal band ligation might change in the future. However, the ICD-9 CM codes for esophageal varices did not change, and we expect the ICD-10 CM codes to be the same.

Our study has several advantages too. It included patients from hospital with all sizes, teaching status and designations (peripheral versus tertiary care centers). In addition, we included patients with all insurance types including uninsured patients. We also have calculated the complete performance characteristics of the coding algorithms we present. All the above help our results are generalizable to a wide range patients and treatment settings.

Conclusion

In conclusion, we have compared several algorithms to identify esophageal variceal hemorrhage and esophageal band ligation using ICD10-CM codes and CPT codes. We identified I85.xx to have the best performance characteristics in this setting, with very high sensitivity, specificity, positive and negative predictive values. For esophageal variceal band ligation, the CPT coding system had a higher sensitivity to detect the procedure compared with the ICD10-CM system, but both had very high specificity, positive and negative predictive values. Research using administrative databases can provide answers to questions when randomized clinical trials cannot be done for ethical or financial reasons. In addition, they give a real-world picture of both treatment outcomes and resource utilization. Using the coding algorithm will improve patient selection in this setting.

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