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Accuracy of ICD-10 codes for identifying hospitalizations for acute anticoagulation therapy-related bleeding events

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ABSTRACT

Introduction: Administratively coded data are frequently used in observational research to identify outcome events. With the transition to the new International Classification of Diseases coding system's 10th version (ICD-10), information is needed about the coding accuracy for bleeding events in anticoagulated patients. We aimed to determine ICD-10 code accuracy for bleeding events in anticoagulated patients admitted to the hospital.

Methods: This cross-sectional study retrospectively examined charts of anticoagulated patients who were admitted to the University of Utah Hospital between October 1, 2017 and December 31, 2017. Two trained chart abstractors blinded to ICD-10 code status independently reviewed medical charts to determine the presence or absence of bleeding events. ICD-10 code status in any diagnosis position was unblinded and code accuracy was assessed using sensitivity, specificity, positive predictive value (PPV), and negative predictive values (NPV) along with 95% confidence intervals (CI).

Results: Out of 661 admissions, 487 unique patients and 71 bleeding events were identified. Gastrointestinal tract bleeding and intracranial hemorrhage comprised 32.4% and 19.7% of bleeding events respectively. ICD-10 code sensitivity was 91.4% (95% CI, 82.3–96.8), specificity was 90.2% (87.5–92.5), PPV was 52.5% (43.2–61.6) and NPV 98.9% (97.6–99.6). Individual codes for intracranial hemorrhages and gastrointestinal tract bleeding had similar accuracy as the overall set of bleeding codes.

Conclusions: Our results demonstrate that ICD-10 codes can reliably rule-out hospitalizations for bleeding events in patients receiving anticoagulation therapy. Due to unacceptable false positive rates ICD-10 codes should not be used for identifying bleeding complications without confirmatory chart review.

1. Introduction

Many patients in the United States (US) take anticoagulants for various indications, and accurate information about their treatment is essential to evaluate therapeutic outcomes and improve care over time. Bleeding, such as intracranial hemorrhage or gastrointestinal bleeding, is the greatest risk of anticoagulant therapy which can be life-threatening [1]. Given the life-threatening nature and significant costs attributable to bleeding events, accurately estimating anticoagulant therapy-related bleeding event rates is important for efforts to improve healthcare decision making and patient safety. Much of the research supporting these efforts relies on administrative data to identify bleeding events using the International Classification of Diseases (ICD) coding system.

Problems arise when ICD codes do not accurately reflect the actual events occurring during healthcare encounters, such as a code for a bleeding event being present when no actual bleeding event occurred. Assigning ICD-10 code diagnoses is not an exact science and is open to the interpretation of a given coder. Historical conditions can be assigned codes during an acute hospitalization and “up-coding” to maximize reimbursement is a well-known phenomenon [2–4]. When such errors exist and investigators do not validate ICD codes through manual review, inaccurate data may be included in the final analysis. Accurate data is important for patient care and policy decisions.

Previous studies demonstrated the use of non-validated ICD codes to identify bleeding events may be less accurate than studies where ICD codes were validated with manual chart review [5–8]. The accuracy of ICD codes can be assessed by four common measurements: sensitivity, specificity, positive predictive value (PPV), and negative predictive value (NPV). Previous studies have evaluated the accuracy of ICD

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coding [9–19], including bleeding codes [11,12,15,16,18–20], but further studies are required to address important limitations. One of the major limitations of previous studies is their use of the 9th version of ICD codes (ICD-9), which has been phased out of use in the US (as of October 1, 2015) in favor of the 10th version (ICD-10). Another key limitation is the lack of information regarding specificity and NPVs for ICD codes in general, and the ICD-10 system specifically. Although some studies have reported specificity and NPVs for ICD-9 codes [18,19], none have determined these estimates for ICD-10. NPV and specificity values are important to ensure that when investigators conclude no bleeding occurred when patient records are without an ICD code indicative of bleeding, they are making an accurate assumption. Previous studies mostly included patients taking warfarin or other vitamin K antagonists and information regarding patients taking direct oral anticoagulants (DOACs) is lacking. To address these gaps, our study will determine the sensitivity, specificity, PPV, and NPV of ICD-10 codes for bleeding events in hospitalized patients previously prescribed any type of oral anticoagulant therapy.

2. Methods

2.1. Study design and population

This was a retrospective cross-sectional study that describes the accuracy of ICD-10 codes for bleeding events occurring at the University of Utah Hospital. The University of Utah Hospital is a 537-bed academic medical center serving patients with various types of health insurance from Utah and surrounding states. Patients were identified using a query of the University of Utah Health Enterprise Data Warehouse. Patients previously prescribed anticoagulant therapy who were admitted to the University of Utah Hospital from October 1, 2017 to December 31, 2017 for any reason were included. Anticoagulant status was based on the medication history documented at admission and verified during medical record reviews. Patients receiving all types of anticoagulants (warfarin, DOACs, and injectable anticoagulants) were included. Patients were allowed to contribute multiple inpatient stays to the analysis, with each hospitalization assessed separately for the presence of a unique bleeding event. The study was approved by the University of Utah Institutional Review Board.

2.2. Study outcomes

Bleeding events were identified via medical record review of all hospitalizations during the study period performed independently by two trained abstractors using a standardized electronic abstraction tool (REDCap, Nashville, TN). Bleeding was defined as visible or occult bleeding of any severity that was confirmed by radiologic or laboratory testing, or was directly observed by a physician. Abstractors examined physician's notes, radiology reports, progress notes, lab values, and physician orders to determine the presence or absence of an actual bleeding event as the primary reason for admission. Discrepancies between abstractors were resolved by an independent adjudicator. Abstractors were blinded to ICD-10 codes assigned to individual patient records to prevent observer bias. Demographic information and patient characteristics (indication for anticoagulation therapy, anticoagulant type, CHA_2DS_2-VASc score and Charlson Comorbidity Index) were collected electronically via database query.

2.3. Data analysis

After manual chart reviews were complete, bleeding ICD-10 codes recorded in any diagnosis position ("principal" and "other") were unveiled allowing for analysis. Validated bleeding events identified from chart review were used as the gold standard for comparing ICD-10 code accuracy. A comprehensive list of ICD-10 bleeding codes (Appendix A) was used to calculate sensitivity, specificity, PPV and NPV, which were reported along with 95% confidence intervals for any acute bleeding event and subcategories of intracranial hemorrhage, gastrointestinal bleeding, and anticoagulant type (warfarin or DOACs). Data analysis was performed using Stata Statistical Software, Release 15 (College Station, TX). Descriptive statistics were used for patient demographics and reported as frequency and proportion for nominal variables, or mean and standard deviation for continuous variables. Chi-squared or Fisher's Exact Test for nominal variables, 2-sample *t*-tests for continuous variables and the Wilcoxon Rank Sum Test for ordinal variables were used to compare patients who were and were not hospitalized for acute bleeding events where appropriate. A P-value < 0.05 was considered statistically significant.

Table 1
Baseline characteristics of anticoagulated patients admitted to the hospital categorized by bleeding event status.

	Total unique patients (N = 487)	Patients admitted for bleeding events (N = 67)	Patients admitted for other reasons (N = 420)	P-value
Age (SD)	66.0 (15.4)	69.2 (18.4)	65.4 (14.8)	0.06
Male sex (%)	277 (56.9)	42 (62.7)	237 (56.2)	0.34
Race/Ethnicity (%)				
White	412 (84.6)	56 (83.6)	356 (84.8)	0.80
Hispanic ethnicity	39 (8.0)	6 (9.0)	33 (7.8)	0.81
Black/African American	9 (1.8)	0	9 (2.1)	0.61
Pacific islander	8 (1.6)	0	8 (1.9)	0.61
American Indian or Alaska native	6 (1.2)	1 (1.5)	5 (1.2)	0.59
Asian	4 (0.8)	0	4 (1.0)	1.00
Other	9 (1.8)	4 (6.0)	5 (1.2)	0.02
Indication for anticoagulation (%)[a]				
VTE prevention	12 (2.5)	0 (0.0)	12 (2.8)	0.39
VTE treatment	166 (34.1)	25 (37.3)	141 (33.6)	0.54
Atrial fibrillation	278 (57.1)	37 (55.2)	241 (57.4)	0.74
Valve replacement	29 (6.0)	1 (1.5)	28 (6.7)	0.16
Other	45 (9.2)	5 (7.5)	40 (9.5)	0.82
Type of anticoagulation (%)[b]				
Warfarin	327 (67.1)	43 (64.2)	284 (67.5)	0.58
DOAC	149 (30.6)	22 (32.8)	127 (30.2)	0.67
Apixaban	84 (17.2)	12 (17.9)	72 (17.1)	0.88
Dabigatran	5 (1.0)	0	5 (1.2)	1.00
Edoxaban	0	0	0 (0.0)	1.00
Rivaroxaban	60 (12.3)	10 (14.9)	50 (11.9)	0.48
Other	19 (3.9)	4 (5.6)	15 (3.6)	0.31
Comorbidities				
CHA_2DS_2-VASc (IQR)[c]	5 (4, 6)	6 (4, 7)	5 (4, 6)	0.45
Charlson Com Comorbidity Index (IQR)	5 (2, 8)	5 (3, 7)	5 (2, 8)	0.77

[a] Patients could have more than one indication.
[b] Patients could be on more than one anticoagulant.
[c] Only applies to patients with atrial fibrillation.

3. Results

A total of 661 hospitalizations representing 487 patients were included in final analysis. Chart reviewers confirmed 71 bleeding events (10.7% of all hospitalizations), occurring in 67 patients. Patients were mostly White (84.6%) with a mean age of 66.0 years (± 15.4) and 56.9% were male (Table 1). Warfarin was the most commonly utilized anticoagulant (67.1%) followed by DOACs (30.6%). The most common indication for anticoagulation was atrial fibrillation (57.1%), followed by venous thromboembolism (VTE) treatment (34.1%). Differences in baseline characteristics between patients with and without confirmed

Table 2
Bleeding event types among hospitalized patients receiving anticoagulation therapy.

Types of bleeding events N (%)	Admissions due to bleeding events ($N = 71$)[a]
Gastrointestinal bleeding	23 (32.4)
Intracranial hemorrhage	14 (19.7)
Hematoma	10 (14.1)
Genitourinary bleeding	8 (11.3)
Epistaxis	1 (1.4)
Retroperitoneal bleeding	1 (1.4)
Other	12 (16.9)

[a] Some patients had more than one type of bleeding per hospitalization.

bleeding events were not statistically significant, with the exception that "other" race/ethnicity designation was higher in patients hospitalized for bleeding.

VTE – venous thromboembolism; DOAC – direct oral anticoagulant; IQR – interquartile range.

The most common bleeding events were gastrointestinal tract bleeding (32.4%), intracranial hemorrhage (19.7%), and hematoma (14.1%) (Table 2).

The sensitivity of ICD-10 coding in any diagnostic position was 91.4% (95% confidence interval [CI], 82.3–96.8%), specificity was 90.2% (87.5–92.5%), PPV was 52.5% (43.2–61.6%) and NPV was 98.9% (97.6–99.6%) (Table 3). Sensitivity, specificity, PPV, and NPV estimates for ICD-10 codes for specific types of bleeding events were similar to the overall results (Table 3). A summary of the ICD-10 bleeding codes actually used in hospitalizations for our study sample is presented in Appendix B.

4. Discussion

Our results provide evidence that when ICD-10 codes indicative of bleeding events were applied to an administrative dataset of hospitalized patients, patients without a clinically evident bleeding event were appropriately excluded (high NPV). The high sensitivity implies that ICD-10 codes capture the majority of clinically evident bleeding events (few false negatives). However, unacceptably low PPV results indicate that unverified ICD-10 codes erroneously identify a large number of bleeding events (false positives). Results were similar for subcategories of intracranial bleeding, gastrointestinal bleeding, and anticoagulant type.

To illustrate the potential error introduced by using unverified ICD-10 codes to identify hospitalizations for bleeding events, suppose our sample of hospitalized patients had been drawn from a population of anticoagulated patients with a total of 900 patient-years of anticoagulation therapy. The actual rate of bleeding events resulting in hospitalization would have been 7.1 events per 100 patient years (64 events/900 patient-years). Using unverified ICD-10 codes to identify bleeding events would have yielded a bleeding rate of 13.6 events per 100 patient-years (122 events/900 patient-years), a nearly two-fold discrepancy from the actual rate. PPV and NPV are directly related to the prevalence of bleeding in the population. Assuming all other factors remain constant, the PPV increases with increasing bleeding prevalence; and NPV decreases [21]. Thus, the observed limited utility of using ICD-10 codes to identify hospitalizations for acute bleeding in this population may be associated with the relatively low rates of bleeding resulting in hospitalization.

Table 3
Accuracy of ICD-10 Codes for Bleeding–Any Diagnosis Position.

	Sensitivity, (95% CI)	Specificity, (95% CI)	PPV, (95% CI)	NPV, (95% CI)
Any bleeding code	91.4% (82.3–96.8)	90.2% (87.5–92.5)	52.5% (43.2–61.6)	98.9% (97.6–99.6)
Intracranial hemorrhage	100.0% (78.2–100.0)	98.3% (97.0–99.1)	57.7% (36.9–76.6)	100.0% (99.4–100.0)
Gastrointestinal bleeding	95.7% (78.1–99.9)	97.2% (95.6–98.3)	55.0% (38.5–78.7)	99.8% (99.1–100.0)
Patients receiving warfarin	89.1% (76.4–96.4)	90.3% (86.9–93.0)	51.2% (39.8–62.6)	98.6% (96.8–99.6)
Patients receiving DOACs	91.3% (72.0–98.9)	88.9% (83.4–93.1)	51.2% (35.1–67.1)	98.8% (95.6–99.9)

DOAC-direct oral anticoagulant; CI-confidence interval.

The results of this study are similar to those derived from ICD-9 codes for bleeding by Delate et al. who reported a PPV of 58.1% (95% CI, 47.4–68.2%) and a NPV of 99.2% (97.8–99.8%) [18]. Therefore, within our hospital system it appears the transition to ICD-10 has not resulted in a significant change in accuracy for the identification of clinically evident bleeding events. Unlike the Delate study where only patients on warfarin were analyzed, our study included patients receiving DOACs at the time of their hospitalization. Our results differ from those reported by Shehab, et al. in a multicenter retrospective evaluation of ICD-10 coding accuracy for acute bleeding events in anticoagulated Medicare fee-for-service beneficiaries [22]. A PPV of 74.8 (95% CI, 71.1–78.3%) was reported using a set of 206 ICD-10 bleeding codes in any diagnostic position. These investigators also reported that eliminating codes that were not used or rarely used did not significantly improve PPV results (75.7% [95% CI, 72.0–79.1%]). A key methodological difference that may explain differences in PPV results between these two studies was limiting ICD-10 codes to those associated with a "present on admission" (POA) indicator in the Shehab, et al. study. It will be important to assess in future studies whether using only codes associated with the POA indicator improves PPV at the expense of reduced specificity and increased risk of false negative events.

The impact of using "principal" diagnosis vs. "other" diagnoses as the basis for identifying anticoagulation-related adverse events has been previously reported. The principal diagnosis is defined by the Uniform Hospital Discharge Data Set (UHDDS) to be "that condition established after study to be chiefly responsible for occasioning the admission of the patient to the hospital for care". Whereas "Other" diagnoses are defined by UHDDS as "all conditions that coexist at the time of admission, that develop subsequently, or that affect the treatment received and/or the length of stay. Diagnoses that relate to an earlier episode which have no bearing on the current hospital stay are to be excluded." The sequencing of ICD-10 diagnoses is not an exact science, and is open to the interpretation of a given coder and could be a potential source of the observed low PPV results observed in our study. We analyzed the accuracy and utility of ICD-10 codes for bleeding events coded in any diagnostic position ("principal" or "other") based on information reported by previous studies where it was demonstrated limiting codes to the "principal" diagnosis position results in unacceptable numbers of missed events [18,22]. It can be argued that this approach increased "false positives", however; "false positives" can be resolved through manual medical record review. In contrast "false negatives" associated with limiting ICD-10 codes to the "principal" diagnosis position is a more serious threat to accuracy because missed bleeding events will go undetected when ICD-10 codes are applied to an administrative data set.

Limitations of our study include the chart review process to identify clinically evident bleeding events being susceptible to ascertainment bias. We attempted to reduce this bias by using two chart abstractors and blinding abstractors to ICD-10 code status during chart review. Another potential limitation is the generalizability of our results. While University of Utah Health is a large academic medical system, as a tertiary referral center it may not be representative of hospitalized patients in other settings. In addition, bleeding events occurred infrequently, resulting in wide 95% confidence intervals for some parameter estimates. The study population was restricted to hospitalized patients which may have selected for patients with more severe bleeding events necessitating hospital admission. While bleeding was severe enough to

warrant hospital admission we were not able to categorize severity using accepted definitions of “major” or “clinically relevant non-major” as access to pre-hospital hemoglobin levels and number of units of red blood cells transfused was not available in all cases. It is foreseeable that patients experiencing less severe bleeding events may have been missed by this method. Finally, we were unable to examine anticoagulant use beyond what was recorded in the medical record. A strength of our approach was that it allowed estimation of values for specificity and NPV, which has been a limitation of prior studies of a similar nature [11,16,23].

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5. Conclusion

In a cohort of patients hospitalized at a large academic medical center, ICD-10 codes reliably ruled-out hospitalizations due to acute bleeding events in patient receiving anticoagulation therapy. However, ICD-10 codes were associated with unacceptable false positive rates and therefore should not be used for identifying hospitalizations for acute bleeding complications in patients receiving anticoagulation therapy without confirmatory chart review. Further refinements to the ICD-10 coding process are needed to improve their utility in conducting outcomes research using administrative datasets. Additional studies are needed to confirm our results. Future studies should evaluate whether using ICD-10 codes in conjunction with the POA indicator or other clinical parameters such as blood product administration or use of anticoagulant reversal agents can improve PPV. Alternative approaches to bleeding event identification during anticoagulation therapy such as natural language processing should also be explored.

Appendix A. Complete list of ICD-10 bleeding codes

ICD-10 code	Description
H05.23x	Hemorrhage of orbit
H21.0x	Hyphema
H31.3xx	Unspecified choroidal hemorrhage
H31.31x	Expulsive choroidal hemorrhage
H31.41x	Hemorrhagic choroidal detachment
H35.6x	Retinal hemorrhage
H35.73x	Hemorrhagic detachment of retinal pigment epithelium
H43.1x	Vitreous hemorrhage
H44.81x	Hemophthalmos
H47.02x	Hemorrhage in optic nerve sheath
H61.12x	Hematoma of pinna
I60.xx	Nontraumatic subarachnoid hemorrhage
S06.6Xxx	Traumatic subarachnoid hemorrhage
I61.x	Nontraumatic intracerebral hemorrhage
S06.34xx	Traumatic hemorrhage of right cerebrum
S06.35xx	Traumatic hemorrhage of left cerebrum
S06.36xx	Traumatic hemorrhage of cerebrum, unspecified
S06.37xx	Contusion, laceration, and hemorrhage of cerebellum
S06.38xx	Contusion, laceration, and hemorrhage of brainstem
I62.0x	Nontraumatic subdural hemorrhage
I62.1	Nontraumatic extradural hemorrhage
R58	Hemorrhage, not elsewhere classified
I85.01	Esophageal varices with bleeding
K22.11	Ulcer of esophagus with bleeding
K25.0	Acute gastric ulcer with hemorrhage
K25.2	Acute gastric ulcer with both hemorrhage and perforation
K25.4	Chronic or unspecified gastric ulcer with hemorrhage
K25.6	Chronic or unspecified gastric ulcer with both hemorrhage and perforation
K26.0	Acute duodenal ulcer with hemorrhage
K26.2	Acute duodenal ulcer with both hemorrhage and perforation
K26.4	Chronic or unspecified duodenal ulcer with hemorrhage
K26.6	Chronic or unspecified duodenal ulcer with both hemorrhage and perforation
K27.0	Acute peptic ulcer, site unspecified, with hemorrhage
K27.2	Acute peptic ulcer, site unspecified, with both hemorrhage and perforation
K27.4	Chronic or unspecified peptic ulcer, site unspecified, with hemorrhage
K27.6	Chronic or unspecified peptic ulcer, site unspecified, with both hemorrhage and perforation
K28.0	Acute gastrojejunal ulcer with hemorrhage
K28.2	Acute gastrojejunal ulcer with both hemorrhage and perforation
K28.4	Chronic or unspecified gastrojejunal ulcer with hemorrhage
K28.6	Chronic or unspecified gastrojejunal ulcer with both hemorrhage and perforation
K29.01	Acute gastritis with bleeding
K29.21	Alcoholic gastritis with bleeding
K29.31	Chronic superficial gastritis with bleeding
K29.41	Chronic atrophic gastritis with bleeding
K29.51	Unspecified chronic gastritis with bleeding
K29.61	Other gastritis with bleeding
K29.71	Gastritis, unspecified, with bleeding
K29.81	Duodenitis with bleeding
K29.91	Gastroduodenitis, unspecified, with bleeding
K31.811	Angiodysplasia of stomach and duodenum with bleeding
K92.0	Hematemesis
K50.011	Crohn's disease of small intestine with rectal bleeding
K50.111	Crohn's disease of large intestine with rectal bleeding
K50.811	Crohn's disease of both small and large intestine with rectal bleeding
K50.911	Crohn's disease, unspecified, with rectal bleeding

K51.011	Ulcerative (chronic) pancolitis with rectal bleeding
K51.211	Ulcerative (chronic) proctitis with rectal bleeding
K51.311	Ulcerative (chronic) rectosigmoiditis with rectal bleeding
K51.411	Inflammatory polyps of colon with rectal bleeding
K51.511	Left sided colitis with rectal bleeding
K51.811	Other ulcerative colitis with rectal bleeding
K51.911	Ulcerative colitis, unspecified with rectal bleeding
K55.21	Angiodysplasia of colon with hemorrhage
K57.01	Diverticulitis of small intestine with perforation and abscess with bleeding
K57.11	Diverticulosis of small intestine without perforation or abscess with bleeding
K57.13	Diverticulitis of small intestine without perforation or abscess with bleeding
K57.21	Diverticulitis of large intestine with perforation and abscess with bleeding
K57.31	Diverticulosis of large intestine without perforation or abscess with bleeding
K57.33	Diverticulitis of large intestine without perforation or abscess with bleeding
K57.41	Diverticulitis of both small and large intestine with perforation and abscess with bleeding
K57.51	Diverticulosis of both small and large intestine without perforation or abscess with bleeding
K57.53	Diverticulitis of both small and large intestine without perforation or abscess with bleeding
K57.81	Diverticulitis of intestine, part unspecified, with perforation and abscess with bleeding
K57.91	Diverticulosis of intestine, part unspecified, without perforation or abscess with bleeding
K57.93	Diverticulitis of intestine, part unspecified, without perforation or abscess with bleeding
K62.5	Hemorrhage of anus and rectum
K92.1	Melena
K92.2	Gastrointestinal hemorrhage, unspecified
M25.0xx	Hemarthrosis
M79.81	Nontraumatic hematoma of soft tissue
N83.7	Hematoma of broad ligament
N89.7	Hematocolpos
N92.0	Excessive and frequent menstruation with regular cycle
N92.1	Excessive and frequent menstruation with irregular cycle
N92.5	Other specified irregular menstruation
N93.0	Postcoital and contact bleeding
N93.8	Other specified abnormal uterine and vaginal bleeding
N93.9	Abnormal uterine and vaginal bleeding, unspecified
O71.7	Obstetric hematoma of pelvis
R04.0	Epistaxis
R04.1	Hemorrhage from throat
R04.2	Hemoptysis
R04.89	Hemorrhage from other sites in respiratory passages
R04.9	Hemorrhage from respiratory passages, unspecified
R31.0	Gross hematuria
R31.9	Hematuria, unspecified
S06.5Xxx	Traumatic subdural hemorrhage
K66.1	Hemoperitoneum

Appendix B. Frequency of ICD-10 codes actually used during hospitalizations

ICD-10 code	Name of code	# of times used
Intracranial hemorrhage		
I60.00	Nontraumatic subarachnoid hemorrhaged from unspecified carotid siphon and bifurcation	1
I60.11	Nontraumatic sub arachnoid hemorrhage right middle cerebral artery	21
I60.50	Nontraumatic subarachnoid hemorrhage from vertebral artery	1
I60.9	Nontraumatic subarachnoid hemorrhage, unspecified	5
I61.0	Nontraumatic intracerebral hemorrhage in hemisphere, subcortical	2
I61.1	Nontraumatic intracerebral hemorrhage in hemisphere, cortical	3
I61.5	Nontraumatic intracerebral hemorrhage, intraventricular	4
I61.8	Other nontraumatic intracerebral hemorrhage	5
I61.9	Nontraumatic intracerebral hemorrhage, unspecified	5
I62.00	Nontraumatic subdural hemorrhage, unspecified	9
I62.01	Nontraumatic acute subdural hemorrhage	3
I62.02	Nontraumatic subacute subdural hemorrhage	2
I62.9	Nontraumatic intracranial hemorrhage, unspecified	1
Gastrointestinal bleed		
I85.01	Esophageal varices with bleeding	1
K22.11	Ulcer of esophagus with bleeding	1
K25.4	Chronic or unspecified gastric ulcer with hemorrhage	3
K26.4	Chronic or unspecified duodenal ulcer with hemorrhage	4
K27.0	Acute peptic ulcer, site unspecified, with hemorrhage	1
K29.01	Acute gastritis with bleeding	1
K29.71	Gastritis, unspecified, with bleeding	1
K31.811	Angiodysplasia of stomach and duodenum with bleeding	1
K92.0	Hematemesis	4
K57.31	Diverticulosis of large intestine without perforation or abscess with bleeding	1
K57.91	Diverticulosis of intestine, part unspecified, without perforation or abscess with bleeding	1
K57.93	Diverticulitis of intestine, part unspecified, without perforation or abscess with bleeding	2
K62.5	Hemorrhage of anus and rectum	5
K92.1	Melena	24

K92.2	Gastrointestinal hemorrhage, unspecified	29
R04.2	Hemoptysis	3
Hemarthrosis		
M25.01	Hemarthrosis, shoulder	1
M25.051	Hemarthrosis, right hip	1
M25.061	Hemarthrosis, right knee	2
M79.81	Nontraumatic hematoma of soft tissue	10
Epistaxis		
R04.0	Epistaxis	11
Hematuria		
R31.0	Gross hematuria	13
R31.9	Hematuria, unspecified	28
Trauma intracranial hemorrhage		
S06.359A	Traumatic hemorrhage of left cerebrum with loss of consciousness of unspecified duration, initial encounter	1
S06.360A	Traumatic hemorrhage of cerebrum, unspecified, without loss of consciousness, initial encounter	3
S06.4X0A	Epidural hemorrhage without loss of consciousness, initial encounter	1
S06.4X0D	Epidural hemorrhage without loss of consciousness, subsequent encounter	1
S06.5X0A	Traumatic subdural hemorrhage without loss of consciousness, initial encounter	8
S06.5X0D	Traumatic subdural hemorrhage without loss of consciousness, subsequent encounter	9
S06.5X1A	Traumatic subdural hemorrhage with loss of consciousness of 30 min or less, initial encounter	1
S06.5X9A	Traumatic subdural hemorrhage with loss of consciousness of unspecified duration, initial encounter	2
S06.5X9D	Traumatic subdural hemorrhage with loss of consciousness of unspecified duration, subsequent encounter	1
S06.6X0A	Traumatic subarachnoid hemorrhage without loss of consciousness, initial encounter	5
S06.6X0D	Traumatic subarachnoid hemorrhage without loss of consciousness, subsequent encounter	5
S06.6X1A	Traumatic subarachnoid hemorrhage with loss of consciousness of 30 min or less, initial encounter	1
S06.6X9A	Traumatic subarachnoid hemorrhage with loss of consciousness of unspecified duration, initial encounter	2
S06.6X9D	Traumatic subarachnoid hemorrhage with loss of consciousness of unspecified duration, subsequent encounter	1
Other		
I77.74	Dissection of vertebral artery	1
I71.3	Abdominal aortic aneurysm, ruptured	1
J94.2	Hemothorax	4

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