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Predictive Value of the Present-On-Admission Indicator for Hospital-Associated Hemorrhage

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Introduction:

Major hemorrhage is a common presenting diagnosis for admission to the hospital, but it can also occur during hospitalization without provocation or as a complication of anticoagulant use. Full-dose anticoagulant use is known to be the most important risk factor for in-hospital gastrointestinal bleed (GIB).[1] The ability to distinguish between hemorrhage that develops prior to hospitalization vs. hemorrhage associated with hospitalization is important for accurate quality assessment.[2] Additionally, some hospital-associated conditions, such as pressure ulcer or catheter-associated urinary tract infection, cannot be used for billing; if hospital-associated hemorrhage is added to this list, distinguishing hospital-associated hemorrhage from hemorrhage prior-to-admission will become financially relevant.

In 2007, the Centers for Medicare and Medicaid Services (CMS) introduced a present-on-admission (POA) “indicator”/flag required for most of the medical diagnoses that are listed in the mandated hospital discharge record. A provision in the Deficit Reduction Act requires the use of this POA indicator on all claims submitted to Medicare for discharges on or after October 1, 2007.[3] POA indicators may be flagged “Y” (diagnosis POA), “N” (diagnosis not POA), “U” (document insufficient to determine if condition was POA), “W” (provider unable to clinically determine if condition POA), and “1” (diagnosis exempt from POA reporting). Hospitals rely on the POA indicator to distinguish prior-to-admission diagnoses from hospital-associated diagnoses.[4] A 2011 study of the POA indicator for “secondary” diagnoses (the “principal” diagnosis, by definition, must be present at admission) found that the overall predictive value of the POA indicator for these diagnoses was 74.3%, with a tendency to select POA=Y even when the diagnosis was not present, at for profit hospitals; and to select POA=N even when the diagnosis was present on admission, at teaching hospitals.[5] Our past study of the validity of the POA indicator specifically for venous thromboembolism (VTE)[6] also found a positive predictive value (PPV) of approximately 75% for both POA=Y and POA=N. There have been previous studies of the accuracy of

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diagnosis codes for hemorrhage for the actual presence of hemorrhage[7]. No previous studies specifically assessed the accuracy of the POA indicator for hemorrhage prior-to-admission as compared to hospital associated hemorrhage.

We sought to determine the PPV of the POA indicator for hemorrhage, evaluating the POA indicators for patients with discharge diagnosis codes of GIB and intracranial hemorrhage (ICH), two of the most common and serious hemorrhagic diagnoses during hospitalization.

Materials and Methods:

Setting and Data Sources:

Our study was conducted at two university medical centers, the University of California, San Francisco (UCSF) and the University of California, Davis (UCD). Both centers are members of Vizient (formerly University Health system Consortium).[8] Both universities send Vizient clinical, billing, and administrative data including demographic information, ICD-10-CM diagnosis codes, and core measures such as mortality, length of stay, complication rates, and hospital-associated (HA) conditions. The Vizient Clinical Database/Resource Manager (CDB/RM) provides its members with encounter information, comparative inpatient and outpatient data from associated medical centers and hospitals, and core measures including patient outcomes[10]. Each medical center has access to patient data from its own institution, including patient identifiers. Each site in our study independently retrieved patient-level data from Vizient for use in analysis.

The Institutional Review Board at UCSF approved this study.

Population and Chart Selection

The study was a retrospective cohort study during the time period Jan 1, 2016 to September 30, 2016. Using the Vizient cohort database and Resource Manager ((CDB/RM), we identified and downloaded all demographic information, diagnosis codes and their associated POA indicators, and procedure codes for inpatient encounters among non-pregnant adult patients age ≥ 18 discharged *without* a principal diagnosis of GIB or ICH but with at least *one* non-principal diagnosis for GIB or ICH by ICD-10-CM code (Appendix).

Cases from each site were then stratified into four main categories based on the type of hemorrhage (GIB vs ICH), and on the POA indicator (POA=Y vs POA=N). Because each case could have more than one hemorrhage diagnosis code (i.e. both a subarachnoid hemorrhage and a bleeding peptic ulcer), each was categorized as primarily ICH or GIB based on whether the first coded hemorrhage diagnosis was for ICH or GIB. A convenience sample of forty cases from each of these eight categories (GIB at Institution #1 that was POA=Y; GIB at Institution #1 that was POA=N; GIB at Institution #2 that was POA=Y; etc.) at each individual site were randomly selected. Cases were then abstracted manually, for an expected total of 320 total cases.

Chart Review and Abstraction Criteria:

For chart abstraction we created a form using Research Electronic Data Capture (REDCap), a secure, HIPAA compliant, web-based research tool.[9] Encounter information was extracted

for each case from the Vizient download by each institution using R Programming and was uploaded into the abstraction tool. Abstraction for each site was performed by a reviewer at that site, with reviewers blinded to the POA indicator for each hemorrhage code. Each chart was reviewed to confirm that the coded hemorrhage actually occurred and to determine whether it was present on admission or occurred during the hospital stay.

Statistical Analysis:

Using the information obtained, we calculated the predictive value of POA = N for hospital-associated hemorrhage, and POA = Y for hemorrhage prior-to-admission.

All statistical and data analysis were performed using R programming (version 3.2.4) and Stata (version 14).

Results:

From January 1 to September 30 of 2016, at our institutions, there were 1260 cases with at least one secondary ICD-10-CM diagnosis code for GIB or ICH. Because several cases had 2 or more secondary diagnosis codes for hemorrhage, there were 1397 codes present in total —791 GIB POA=Y, 229 GIB POA=N, 310 ICH POA=Y, and 67 ICH POA=N. Among the 1260 cases, 934 cases had a primary GIB code (732 POA=Y, 202 POA=N) and 326 had a primary ICH code (277 POA=Y, 49 POA=N). 80 total charts from each of these four categories were randomly selected and abstracted except for the ICH POA=N group, as there were only 49 available cases. In this instance, all 49 cases were selected, giving a total of 289 charts for abstraction and 380 total diagnoses abstracted. Of the sampled cases, 40% were 66 years of age or older, 56% were male, 53% were white, and 60% had a length of stay 10 days or less. Twenty-two percent died during admission. Of the 380 diagnosis codes indicating hemorrhage 3% (n=11) did not have a hemorrhagic event on manual chart review.

Among patients with these hemorrhage codes, codes flagged POA=Y were adjudicated to be hemorrhage prior-to-admission in 141/166, for a PPV of 85% (95% confidence interval [CI], 80%−90%), whereas hemorrhage codes flagged POA=N were adjudicated as hospital associated in 179/209, for a PPV of 86% (95% CI, 82%−90%). The accuracy of the POA indicator did not vary significantly based on whether the event was an intracranial hemorrhage or gastrointestinal bleed, nor by whether the patient was taking anticoagulation at the time of admission, nor between institutions (Table).

Discussion:

In this study of inpatients with secondary diagnoses of GIB or ICH, we found the POA indicator to have high predictive value in differentiating hospital-associated hemorrhage from hemorrhage prior-to-admission, with a PPV of 85% that did not vary by diagnosis, anticoagulation status, or site.

Our results suggest that the POA indicator can help to temporally differentiate hemorrhage prior-to-admission from hospital associated hemorrhage, which will be important to studying the possible adverse effects of anticoagulation in the hospital and programs to

improve prophylactic anticoagulation, neither of which will want to confuse a contraindication (hemorrhage prior-to-admission) with a complication (hospital associated hemorrhage).[10] Furthermore, if hospital associated hemorrhage itself, like hospital-associated VTE, ever becomes a quality measure, then the differentiation of POA=Y and POA=N could become important for financial reasons. Our study helps to establish the appropriateness of the indicator for these uses and increase the confidence of researchers, quality improvement officers, and others using or planning to use the POA indicators in this way.

This study has several limitations. The institutions analyzed are both large academic medical centers within the University of California system, and the results reflect the quality of the coding at each of the hospitals, which may not be representative.[5] Unlike tests of diagnostic accuracy which begin with a population with a known proportion of the true result—i.e. patients with hemorrhage known to be prior-to-admission vs. hospital associated—we began with the "diagnostic test result"—cases coded with hemorrhage and associated POA Indicators—and abstracted for the true results; this prevented us from calculating sensitivity and specificity. However, our study had important strengths, including use of blinded chart abstraction, a lack of variability between sites, and the calculation of a PPV which will be useful to researchers who likewise work "backwards" from discharge records.

In conclusion, at two academic medical centers in the University of California system, POA indicators for hemorrhage diagnosis codes were 85% accurate in differentiating hospital associated from non-hospital associated conditions. This suggests that these indicators could be useful for quality improvement and research purposes for hemorrhage, as they are for VTE.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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Table:

Predictive Value of POA=N and POA=Y for Hemorrhage diagnoses

Diagnosis/POA combination	Coded POA=N (n)	% HA Hemorrhage (95% CI)	Coded POA=Y (n)	% Hemorrhage PTA (95% CI)
Overall	166	85% (80%–90%)	209	86% (82%–90%)
Type of Hemorrhage				
GIB	95	84% (76%–92%)	109	83% (75%–91%)
ICH	71	86% (78%–94%)	100	89% (83%–95%)
Anticoagulation Status				
Taking AC *	25	23/25: 92% (82%–100%)	38	33/38: 87% (77%–97%)
Not taking AC	134	84% (78%–90%)	165	88% (82%–94%)
Sites				
Site 1	90	83% (75%–91%)	118	90% (84%–96%)
Site 2	76	87% (79%–95%)	91	80% (72%–88%)

POA = Present on Admission. HA = Hospital Associated. PTA= Prior-to-Admission. 95% CI = 95% confidence interval GIB = Gastrointestinal Bleed. ICH= Intracranial Hemorrhage. AC=Anticoagulation

* Given the very low numbers overall, both the actual fraction and percentages are shown.