**Supplementary Methods:**

**Data Source:**

NIS is a part of the Healthcare Quality and Utilization Project (HCUP), sponsored by the Agency for Healthcare Research and Quality (AHRQ). Data from the NIS have been used to identify, track, and analyze national trends in healthcare usage, patterns of major procedures, access, disparity of care, trends in hospitalizations, charges, quality, and outcomes. Each individual hospitalization is de-identified and maintained in NIS as a unique entry with 1 primary discharge diagnosis and up to 25 secondary diagnoses during that hospitalization. It also incorporates one primary procedure code and up to 15 secondary procedure codes. Each entry also carries information on demographic details, insurance status, co-morbidities, hospitalization outcome and length of stay.

**Validation and Quality Control:**

Annual data quality assessments of the Nationwide Inpatient Sample are performed, which guarantee the internal validity of the database. Furthermore, estimates from the NIS are compared to American Hospital Association (AHA) Annual Survey Database, the National Hospital Discharge Survey (NHDS) from the National Center for Health Statistics, and theMedPAR inpatient database from Centers of Medicare and Medicaid. These reports are published in the NIS website and show that NIS resembled typical hospitals in AHA universe in most characteristics, all NIS and NHDS estimates agreed in overall and regional comparisons, and NIS Medicare measures were consistent with MedPar statistics. These reports strengthen the external validity of NIS database. Detailed reports regarding the data comparisons and data quality of NIS are available at the following website: http://www.hcup-us.ahrq.gov/db/nation/nis/nisrelatedreports.jsp. In order to ensure that the imported data was accurate, we verified the imported data against the HCUP standard, available from the HCUP website (<http://www.hcupnet.ahrq.gov>).

**Comorbities:**

The comorbid conditions were identified from the NIS database using ICD-9 codes are listed in Supplementary Table 1.

|  |  |  |
| --- | --- | --- |
| **Comorbidty** | **ICD-9 codes** | **Description** |
| Hypertension | 401.0-401.9, 402.0, 402.00-402.91, 403.0, 403.00-403.91, 404.0 404.00-404.93, 405.0, 405.01-405.91, 437.2 | Includes complicated or uncomplicated hypertension |
| Diabetes Mellitus | 250.00-250.93, 249.00-249.91 | Includes diabetes mellitus or secondary diabetes mellitus |
| Pre-existing renal dysfunction | 585.3, 585.4, 585.5, 585.6, 585.9, V42.0, V45.1, V45.11, V45.12, V56.0, V56.1, V56.2, V56.3, V56.31, V56.32, V56.8 | Includes chronic kidney disease stage III or greater, end-stage renal disease, history of renal transplant, or an encounter for hemodialysis or peritoneal dialysis. |
| Chronic Ischemic Heart Disease | 411.0-411.8, 412, 413.0-413.9, 414.0-414.9, V45.82 | Includes history of subacute MI, old MI, angina pectoris, other forms of coronary artery disease and/or status post percutaneous coronary transluminal angioplasty |
| Acute Myocardial Infarction | 410.0-410.9 | Includes ST elevation or non-ST elevation myocardial infarction |
| History of CABG | V45.81 | Includes history of coronary artery bypass grafting |
| Ischemic cardiomyopathy | 410.0-410.9, 411.0-411.8, 412, 413.0-413.9, 414.0-414.9, V45.82, V45.81 | Composite of acute myocardial infarction, history of chronic ischemic heart disease or history of CABG |
| History of other cardiac surgery | V15.1, V43.3 | Includes history of congenital heart disease surgery, valve repair or valve replacement |
| Peripheral vascular disease | 440.0-440.9, 443.1, 443.8,443.81, 443.82, 443.89, 443.9, 447.1, V43.4 | Includes atherosclerosis of peripheral arteries, other peripheral vascular disease, stricture of artery and/or history of peripheral vascular stenting |

**Supplementary Table 1:** Descriptions and ICD-9 codes used to identify comorbid conditions from the Nationwide Inpatient Sample.

MI stands for myocardial infarction, CABG stands for coronary artery bypass grafting

**Procedural complications:** Supplementary Tables 2 & 3 show the definitions and the ICD-9 codes used to identify the procedure related complications.

|  |  |
| --- | --- |
| **Procedural Complications** | **ICD-9 Codes in secondary diagnoses fields** |
| **Bleeding Complications** | |
| **Major Bleeding** | Defined as postoperative hemorrhage or hematoma requiring transfusion, hemoperitoneum, GI bleed requiring transfusion, Other significant bleed (GU bleed or hemoptysis or epistaxis or unspecified hemorrhage requiring transfusion), or intracranial bleed |
| Postop-hemorrhage or hematoma | 998.11, 998.12 |
| Postop-hemorrhage or hematoma requiring transfusion | 998.11, 998.12 AND 99.00, 99.02. 99.03 or 99.04 (ICD-9 codes for blood or packed red cell transfusion) |
| Hemoperitoneum | 568.81 |
| GI Bleed | See appendix table 2 for GI bleed ICD-9 codes |
| Significant\* GI Bleed | ICD-9 codes for GI Bleed AND transfusion |
| GU Bleed | 596.7, 599.70, 599.71 |
| Hemoptysis | 786.3 |
| Epistaxis | 784.7 |
| Unspecified hemorrhage | 459.0 |
| Other significant bleed (combination of GU bleed, hemoptysis, epistaxis or unspecified hemorrhage requiring transfusion) | 596.7, 599.70, 599.71, 786.3, 784.7, 459.0 AND 99.00, 99.02. 99.03 or 99.04 |
| Intracranial bleed | 430, 431, 432.0, 432.1, 432.9 |
| **Infectious complications** | PSI specified codes for Central Venous Catheter related Blood Stream Infections and Post-operative Sepsis Rate PLUS  996.60, 996.61, 998.5, 998.51, 998.59 |
| Central Venous Catheter related Bloodstream Infections | PSI specified codes |
| Postoperative Sepsis Rate | PSI specified codes |
| Implant related infection | 996.60, 996.61 |
| Postoperative wound infection | 998.5, 998.51, 998.59 |
| **Cardiac complications** | Defined as iatrogenic cardiac complications, complete heart block or pericardial complications |
| Iatrogenic cardiac complications | 997.1 |
| Complete heart block | 426.0, Procedure codes 37.71, 37.72, 37.78, 37.80, 37.81 37.82, 37.83, 39.64 |
| Pericardial complications | Hemopericardium: 423.0  Cardiac tamponade: 423.3 |
| **Thromboembolic complications** | Defined as combination of systemic embolism, implant related complications (thrombosis or embolism), postoperative stroke or TIA |
| **Systemic embolism** | Precerebral circulation: 433.0-433.9  Cerebral Artery: 434.0-434.9  Mesenteric Artery: 557.0  Ophthalmic/Retinal: 362.30-362.34  Renal: 593.81  Abdominal aorta: 444.0  Thoracic aorta: 444.1  Arteries of extremities: 444.2  Other artery: 444.8  Unspecified artery: 444.9  Hepatic infarction: 573.4  Splenic infarct: 289.59 |
| **Implant related complication**  **(embolism, thrombosis, hemorrhage)** | 996.70, 996.72 |
| **Postoperative Stroke or TIA** | 997.02, 435.0, 435.1, 435.2, 435.3, 435.8, 435.9, V12.54 |
| **Iatrogenic Neurologic Complications**  **(includes postop stroke/TIA)** | ICD-9 codes for postop stroke/TIA PLUS 997.0, 997.00, 997.01 |
| **Postoperative DVT/PE** | According to PSI£  DVT: 451.11, 451.19, 451.2, 451.81, 451.9, 453.40, 453.41, 453.42, 453.8, 453.9 OR  PE: 415.1, 415.11, 415.13, 415.19 |
| **Vascular complications** | Injury to blood vessels: 900-904  Accidental puncture: 998.2, E8700-8702  Other vascular complications: 999.2, 997.7, 997.71, 997.72, 997.79, 997.2 |
| **Respiratory complications** | Pneumothorax or other iatrogenic respiratory complications |
| Pneumothorax | 512.1 |
| Other iatrogenic respiratory complications (including postoperative aspiration pneumonia) | 997.3, 997.31, 997.39 |
| **Acute renal failure** | 584.5, 584.6, 584.7, 584.8, 584.9, 586, 997.5 |
| **Acute renal failure requiring dialysis** | According to PSI£  Acute kidney failure diagnosis codes:584.5, 584.6, 584.7, 584.8, 584.9, 586, 997.5 AND Dialysis procedure codes: 39.95, 54.98 |
| **Mechanical complications** | 996.0, 996.00, 996.09 |
| **Wound dehiscence** | 998.3, 998.30, 998.31, 998.32 |
| **Hemolytic anemia** | 283.2, 283.10, 283.19, 283.9 |
| **Miscellaneous complications** | E878.1, E878.2, Complications of Anesthesia as per PSI specified codes |

**SupplementaryTable 2:** Definitions and ICD-9 codes used to identify post procedure complications after LVAD implantation.

\*Significant bleed means bleeding requiring blood or packed RBC transfusion, £PSI stands for Patient Safety Indicators, TIA = transient ischemic attack, PE = pulmonary embolism, DVT = deep vein thrombosis.

|  |  |
| --- | --- |
| **ICD-9 code** | **Description** |
| 530.21 | Ulcer of esophagus with bleeding |
| 456.0 | Esophageal varices with bleeding |
| 530.7 | Gastroesophageal laceration-hemorrhage syndrome |
| 530.82 | Esophageal hemorrhage |
| 578.0 | Hematemesis |
| 578.1 | Blood in stool |
| 578.9 | Unspecified hemorrhage of gastrointestinal tract |
| 456.20 | Esophageal varices with bleed in diseases classified elsewhere |
| 531.00 | Acute gastric ulcer with hemorrhage without obstruction |
| 531.01 | Acute gastric ulcer with hemorrhage and obstruction |
| 531.20 | Acute gastric ulcer with hemorrhage & perforation without obstruction |
| 531.21 | Acute gastric ulcer with hemorrhage & perforation &obstruction |
| 531.40 | Chronic/unspecified gastric ulcer with hemorrhage without obstruction |
| 531.41 | Chronic/unspecified gastric ulcer with hemorrhage & obstruction |
| 531.60 | Chronic/unspecified gastric ulcer with hemorrhage & perforation without obstruction |
| 531.61 | Chronic/unspecified gastric ulcer with hemorrhage, perforation & obstruction |
| 532.00 | Acute duodenal ulcer with hemorrhage without obstruction |
| 532.01 | Acute duodenal ulcer with hemorrhage & obstruction |
| 532.20 | Acute duodenal ulcer with hemorrhage & perforation without obstruction |
| 532.21 | Acute duodenal ulcer with hemorrhage, perforation & obstruction |
| 532.40 | Chronic duodenal ulcer with hemorrhage without obstruction |
| 532.41 | Chronic/unspecified duodenal ulcer with hemorrhage & obstruction |
| 532.60 | Chronic/unspecified duodenal ulcer with hemorrhage & perforation without obstruction |
| 532.61 | Chronic/unspecified duodenal ulcer with hemorrhage, perforation & obstruction |
| 533.00 | Acute peptic ulcer unspecified site with hemorrhage without obstruction |
| 533.01 | Acute peptic ulcer unspecified site with hemorrhage & obstruction |
| 533.20 | Acute peptic ulcer unspecified site with hemorrhage & perforation without obstruction |
| 533.21 | Acute peptic ulcer unspecified site with hemorrhage, perforation & obstruction |
| 533.40 | Chronic/unspecified peptic ulcer unspecified site with hemorrhage without obstruction |
| 533.41 | Chronic/unspecified peptic ulcer unspecified site with hemorrhage & obstruction |
| 533.60 | Chronic/unspecified peptic ulcer with hemorrhage & perforation without obstruction |
| 533.61 | Chronic/unspecified peptic ulcer unspecified site with hemorrhage, perforation & obstruction |
| 534.00 | Acute gastrojejunal ulcer with hemorrhage without obstruction |
| 534.01 | Acute gastrojejunal ulcer with hemorrhage & obstruction |
| 534.20 | Acute gastrojejunal ulcer with hemorrhage & perforation without obstruction |
| 534.21 | Acute gastrojejunal ulcer with hemorrhage, perforation & obstruction |
| 534.40 | Chronic/unspecified gastrojejunal ulcer with hemorrhage without obstruction |
| 534.41 | Chronic/unspecified gastrojejunal ulcer with hemorrhage & obstruction |
| 534.60 | Chronic/unspecified gastrojejunal ulcer with hemorrhage & perforation without obstruction |
| 534.61 | Chronic/unspecified gastrojejunal ulcer with hemorrhage, perforation & obstruction |
| 535.01 | Acute gastritis with hemorrhage |
| 535.11 | Atrophic gastritis with hemorrhage |
| 535.21 | Gastric mucosal hypertrophy with hemorrhage |
| 535.31 | Alcoholic gastritis with hemorrhage |
| 535.41 | Other specified gastritis with hemorrhage |
| 535.51 | Unspecified gastritis & gastroduodenitis with hemorrhage |
| 535.61 | Duodenitis with hemorrhage |
| 535.71 | Eosinophilic gastritis with hemorrhage |
| 537.83 | Angiodysplasia of stomach & duodenum with hemorrhage |
| 562.02 | Diverticulosis of small intestine with hemorrhage |
| 562.03 | Diverticulitis of small intestine with hemorrhage |
| 562.12 | Diverticulosis of colon with hemorrhage |
| 562.13 | Diverticulitis of colon with hemorrhage |
| 569.3 | Hemorrhage of rectum and anus |
| 569.85 | Angiodysplasia of intestine with hemorrhage |
| 537.84 | Dieulafoy lesion (hemorrhagic) stomach and duodenum |
| 569.86 | Dieulafoy lesion (hemorrhagic) of intestine |

**Supplementary Table 3:** Definitions and list of ICD-9 codes for gastrointestinal bleeding

**Multivariate models:**

The hierarchical logistic regression models for in-hospital mortality and LOS were adjusted for the following covariates: age, gender, hypertension, diabetes mellitus, peripheral vascular disease, pre-existing renal dysfunction, chronic ischemic heart disease, acute myocardial infarction, history of CABG, history of other cardiac surgery, bleeding complications, infectious complications, thromboembolic complications, acute renal failure, other complications, primary payer (with Medicare/Medicaid as referent), hospital region (with northeast as referent), teaching hospital, hospital bed size and annual hospital volume.