Racial disparities in surgical treatment of type A acute aortic dissection

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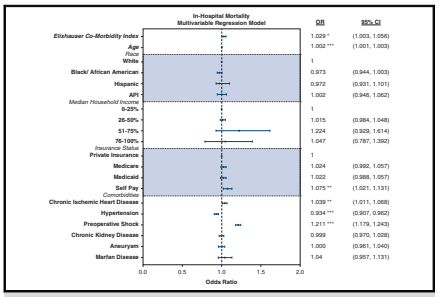
ABSTRACT

Objective: To determine whether there are racial disparities associated with mortality, cost, and length of hospital stay after surgical repair of type A acute aortic dissection (TAAAD).

Methods: Patient data from 2015 to 2018 were collected using the National Inpatient Sample. In-hospital mortality was the primary outcome. Multivariable logistical modeling was used to identify factors independently associated with mortality.

Results: Among 3952 admissions, 2520 (63%) were White, 848 (21%) were Black/African American, 310 (8%) were Hispanic, 146 (4%) were Asian and Pacific Islander (API), and 128 (3%) were classified as Other. Black/African American and Hispanic admissions presented with TAAAD at a median age of 54 years and 55 years, respectively, whereas White and API admissions presented at a median age of 64 years and 63 years, respectively ($P < .0001$). Additionally, there were higher percentages of Black/African American (54%; n = 450) and Hispanic (32%; n = 94) admissions living in ZIP codes with the lowest median household income quartile. Despite these differences on presentation, when adjusting for age and comorbidity, there was no independent association between race and in-hospital mortality and no significant interactions between race and income on in-hospital mortality.

Conclusions: Black and Hispanic admissions present with TAAAD a decade earlier than White and API admissions. Additionally, Black and Hispanic TAAAD admissions are more likely to come from lower-income households. After adjusting for relevant cofactors, there was no independent association between race and in-hospital mortality after surgical treatment of TAAAD. (JTCVS Open 2023;14:46-76)



No independent association found between race and TAAAD mortality.

CENTRAL MESSAGE

Black and Hispanic patients with type A acute aortic dissection (TAAAD) present a decade earlier than White patients with TAAAD. However, there was no independent association between race and hospital mortality after TAAAD surgical treatment.

PERSPECTIVE

Although mortality rate of type A acute aortic dissection (TAAAD) has been decreasing, few studies have investigated how mortality is distributed across race. Our findings suggest that Black and Hispanic patients with TAAAD are exposed to factors that predispose them to presenting a decade earlier than White patients with TAAAD. We found no independent association between race and mortality, but further investigation is needed to determine long-term outcomes.

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The National Inpatient Sample (NIS) is a restricted access public release database under strict internal security and is a limited data set as defined by HIPAA (45 CFR §164.514(c)). Access is governed by a HIPAA-compliant restrictive data use agreement. This study was considered exempt from Institutional Review Board approval because the Healthcare Cost and Utilization Project-NIS contains deidentified patient information.

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Abbreviations and Acronyms

API = Asian American and Pacific Islander
AD = aortic dissection
CVD = cardiovascular disease
ICD-10 = International Classification of Diseases, 10th Revision
LOS = length of stay
MI = myocardial infarction
NIS = National Inpatient Survey
TAAAD = type A acute aortic dissection

▶ Video clip is available online.

Type A acute aortic dissection (TAAAD) is a rare, yet severe cardiovascular disease (CVD), with an in-hospital mortality rate of 10% to 49%.[1-3] Given its high mortality and morbidity, several studies have been dedicated to the diagnosis and treatment of TAAAD, and mortality rates have decreased steadily over the past several decades.[4]

Despite these advances, few comprehensive studies to date have investigated how these improvements in management have been distributed across race and ethnicity. This dearth of data is surprising given the significant evidence demonstrating a higher CVD burden in Black and nonwhite Hispanic patients. Several other demographic factors, such as insurance status, are significantly associated with severity of presentation and mortality from aortic procedures.[5] Hypertension, a primary risk factor for TAAAD, has a higher prevalence and more severe presentation in Black and nonwhite Hispanic populations.[6-8] Similarly, Black and nonwhite Hispanic patients have a higher prevalence of diabetes and dyslipidemia, and are at greater risk of developing associated cardiovascular complications.[9,10] Additionally, the prevalence, complication rate, and mortality associated with acute CVD are higher in Black and nonwhite Hispanic patients.[11,12]

Given the existing CVD disparities, the emergent nature of TAAAD provides a unique window into the processes of surgical care. Our hypothesis was that the greater acuity of these patients would highlight or aggravate previously observed disparities in care. Further investigation might identify patient populations with a higher incidence and mortality and potentially determine opportunities for improvement in the delivery of equitable care. Therefore, in this study, we aimed to identify whether there are racial disparities associated with mortality, cost, and hospital length of stay (LOS) after surgical repair of TAAAD (Video Abstract).

METHODS

Identifying the Cohort

Patient data were collected using the National Inpatient Sample (NIS) from the fourth quarter of 2015 through 2018 (n = 21,401,460). The NIS is the largest in-patient all-payer database that contains deidentified data from 20% of the nation's total discharges, representing >96% of the US population. The NIS is a restricted-access public release database and is a limited data set as defined by HIPAA [45 CFR §164.514(c)(2)]. Access is governed by a HIPAA-compliant restrictive data use agreement. This study was exempt from Institutional Review Board approval because the NIS contains deidentified patient information. Patient data in the NIS during this period were codified using the International Classification of Diseases, 10th Revision (ICD-10) codes.

The NIS database receives racial demographic data from state-level partner organizations but does not record how each state collects demographic data. The database contains RACE as a combined racial/ethnic demographic variable with the following options: White, Black, Hispanic, Asian and Pacific Islander, Native American, and Other. If a data source provided both racial and ethnic data for an admission (ie, race, Black; ethnicity, Hispanic), the NIS ethnic data take precedence.

Identifying the TAAAD Patient Population

Patients were identified as having a TAAAD using the following criteria. Patients with aortic dissection were identified using the thoracic or thoracoabdominal aortic dissection ICD-10 codes (I71.01, I71.03; n = 18,431). Patients who underwent surgery for TAAAD were selected through any admission that included a surgical procedure code on the ascending aorta (n = 4943) (Table E1). It should be noted that coding of dissection does not permit distinction of ascending aortic dissection from any thoracic or thoracoabdominal dissection. Therefore, the only way to distinguish ascending aortic dissection was through the surgical codes, which make this distinction. Therefore, assessment of patients who may have presented with TAAAD but did not have surgery cannot be identified in this database. To distinguish patients with a TAAAD, nonelective admissions were selected (n = 4188) (Figure 1). We then stratified the patient population based on the RACE variable from the NIS and removed admissions with no associated RACE value (n = 236), which created a final cohort of 2520 White admissions, 848 Black/African American admissions, 310 Hispanic admissions, 146 API admissions, and 128 admissions identified as "Other."

Demographic data, including age, socioeconomic status, and insurance status, and hospital data, including teaching status, region, and bed size, are provided by the NIS for each admission. Comorbidity conditions, including hypertension, prior cardiac surgery, diabetes, and peripheral vascular disease 2, were defined by a combination of ICD-10 diagnosis and procedural codes and stratified by the NIS race category (Table E2).

Defining Outcomes

The primary outcome for the study was in-hospital mortality of TAAAD, measured by the DIED variable. Secondary outcomes included LOS and cost of stay (TOTCHG). All charges were adjusted using the cost-to-charge ratio data provided in supplemental NIS files. Postprocedural complications were identified as a secondary outcome by combining several ICD-10 diagnosis and procedural codes (Table E3). The metric "any complication" was defined as any admission containing any ICD-10 code that described a postprocedural complication. Because the NIS does not use "present on admission" modifiers, it was difficult to determine whether certain complications, such as stroke and renal failure, were antecedent or subsequent to the surgical procedure and therefore are not reported or included in the primary outcome analysis.

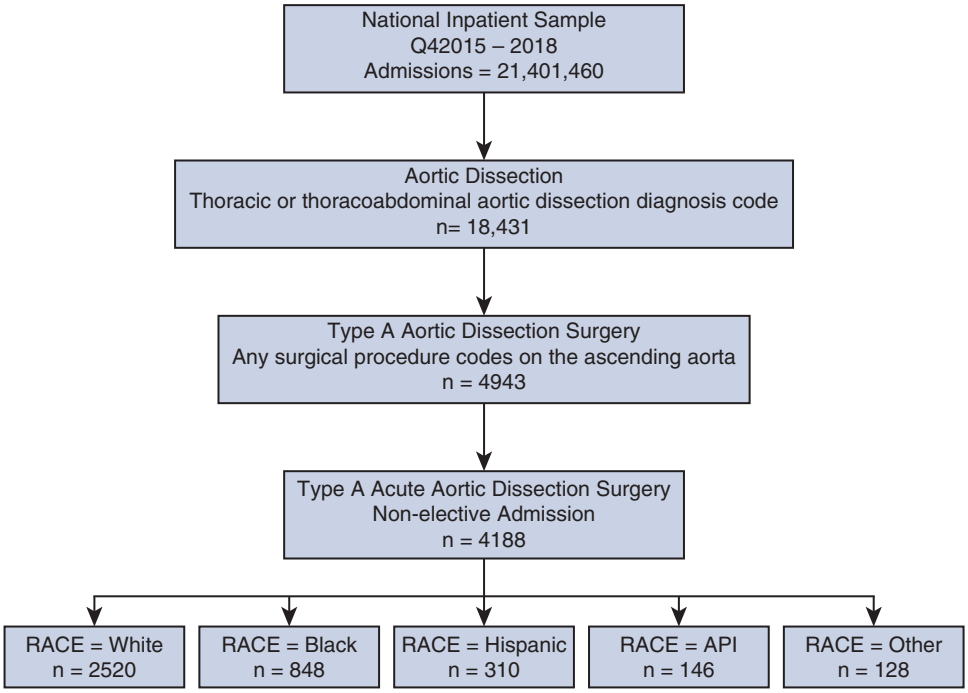

FIGURE 1. Type A acute aortic dissection cohort selection was done using the National Inpatient Sample database for 2015 to 2018. Nonelective admissions were included if there was a thoracic or thoracoabdominal dissection diagnosis code and a surgical procedure code on the ascending aorta for a final cohort of 4204 admissions. This cohort was then stratified by the race variable. *API*, Asian and Pacific Islander.

Statistical Analysis

To identify significant differences between racial groups in both the demographic and comorbid variables, we performed the chi-square or Fisher exact test, as appropriate, for frequency analysis of discrete variables. For continuous demographic variables, which were all non-normally distributed via Kolmogorov–Smirnov/Shapiro–Wilk tests, the Kruskal–Wallis test was used to determine significance. Factors that varied significantly among different racial groups were identified using a 2-sided P value $< .05$. These variables were included in a multivariable regression model to determine race's independent impact on the primary and secondary outcomes. To minimize missing data (n = 322), the "missRanger" R package was used for imputation before regression modeling. Admissions with an ICD-10 code included in Ehlers–Danlos syndrome, Turner syndrome, or congenital aortic insufficiency were excluded from multivariable regression modeling owing to insufficient sample size, per NIS HIPAA restrictions. The "other" racial category also was excluded from multivariable regression modeling. Two comorbidity index scores (readmit_score, mortal_score) were calculated using the Elixhauser Comorbidity software. Cubic spline regression was done to determine the relationship between the Elixhauser Comorbidity Index and mortality (Figure E1), and 0 was chosen as an inflection point to redefine the Elixhauser score as a dichotomous variable.

RESULTS

Demographics

Using the NIS, from the fourth quarter of 2015 to 2018, we identified a final TAAAD cohort of 3952 patient admissions. Sixty-three percent of these admissions were White (n = 2520), 21% were Black/African American (n = 848), 8% were Hispanic (n = 310), 4% were API (n = 146), and 3% identified as Other (n = 128) (Figure 2).

The majority of admissions in each racial group were from large urban teaching hospitals (Table 1). Most of Black/African American (52%) and Hispanic (42%) admissions were in hospitals located in the South, and the majority of API (71%) admissions were at hospitals in the

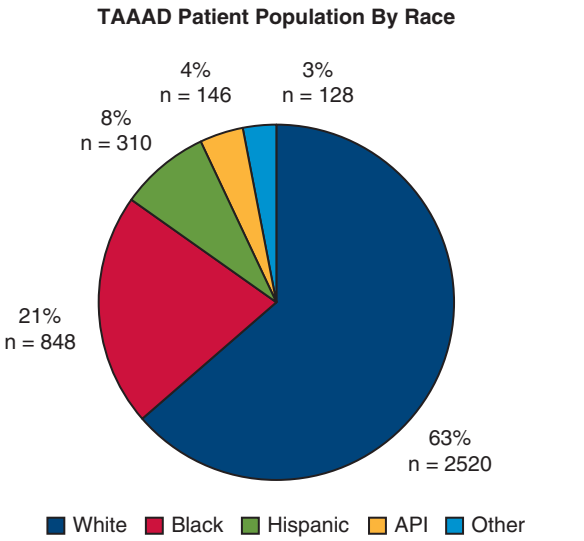

FIGURE 2. Type A acute aortic dissection (*TAAAD*) cohort by race. The final cohort of TAAAD admissions included 2520 White admissions, 848 Black admissions, 310 Hispanic admissions, 146 Asian and Pacific Islander (*API*) admissions, and 128 admissions classified as Other.

TABLE 1. Demographic and comorbid characteristics of patients with TAAAD

Characteristic	White (N = 2520)	Black/African American (N = 848)	Hispanic (N = 310)	API (N = 146)	Other (N = 128)	*P* value
Demographics						
Female sex, n (%)	876 (35)	290 (34)	82 (26)	58 (40)	50 (39)	.02
Age, yr, median (IQR)	64 (54-73)	54 (45-62)	55 (45-65)	63 (53-72)	57 (49.5-68.5)	<.0001
Insurance status, n (%)						<.0001
Medicare	1208 (48)	222 (26)	82 (26)	52 (36)	42 (33)	
Medicaid	282 (11)	208 (25)	70 (23)	30 (21)	32 (25)	
Private insurance	860 (34)	308 (37)	108 (35)	54 (37)	40 (32)	
Self-pay	96 (4)	66 (8)	34 (11)	8 (5)	10 (8)	
No charge	6 (0.2)	12 (1)	2 (1)	0 (0)	0 (0)	
Other	58 (2)	26 (3)	14 (5)	2 (1)	2 (2)	
Median household income, percentile, n (%)						<.0001
0-25	522 (21)	450 (54)	94 (32)	14 (10)	34 (27)	
26-50	582 (24)	154 (19)	64 (22)	32 (23)	28 (22)	
51-75	684 (28)	120 (15)	82 (28)	22 (15)	20 (16)	
75-100	676 (27)	102 (12)	56 (19)	74 (52)	44 (35)	
Patient location, n (%)						<.0001
"Central" metro counties ≥1 million people	562 (23)	390 (47)	160 (54)	72 (51)	72 (57)	
"Fringe" metro counties ≤1 million people	680 (27)	158 (19)	62 (21)	28 (20)	38 (30)	
Metro counties with 250,000-999,999 people	560 (22)	162 (19)	58 (19)	30 (21)	8 (6)	
Metro counties with 50,000-249,999 people	258 (10)	54 (6)	6 (2)	6 (4)	2 (2)	
Micropolitan counties	262 (11)	28 (3)	4 (1)	2 (1)	4 (3)	
Non-metro/micropolitan counties	172 (7)	44 (5)	8 (3)	4 (3)	2 (2)	
Hospital region, n (%)						<.0001
Northeast	546 (22)	102 (12)	52 (17)	10 (7)	48 (38)	
Midwest	602 (24)	214 (25)	12 (4)	20 (14)	14 (11)	
South	762 (30)	438 (52)	130 (42)	12 (8)	32 (25)	
West	610 (24)	94 (11)	116 (37)	104 (71)	34 (27)	
Hospital division, n (%)						<.0001
New England	166 (7)	20 (2)	12 (4)	2 (1)	4 (3)	
Middle Atlantic	380 (15)	82 (10)	40 (13)	8 (5)	44 (34)	
East North Central	404 (16)	182 (21)	6 (2)	10 (7)	12 (9)	
West North Central	198 (8)	32 (4)	6 (2)	10 (7)	2 (2)	
South Atlantic	432 (17)	268 (32)	72 (23)	8 (5)	16 (13)	
East South Central	154 (6)	76 (9)	6 (2)	2 (1)	0 (0)	
West South Central	176 (7)	94 (11)	52 (17)	2 (1)	16 (13)	
Mountain	188 (7)	22 (3)	16 (5)	4 (3)	2 (2)	
Pacific	422 (17)	72 (8)	100 (32)	100 (68)	32 (25)	
Hospital size, n (%)						.42
Small	142 (6)	46 (5)	16 (5)	10 (7)	8 (6)	
Medium	452 (18)	130 (15)	56 (18)	18 (12)	16 (13)	
Large	1926 (76)	672 (79)	238 (77)	118 (81)	104 (81)	
Hospital teaching status, n (%)						.0003
Rural	26 (1)	4 (1)	2 (1)	0 (0)	0 (0)	
Urban nonteaching	196 (9)	28 (4)	22 (8)	14 (11)	6 (5)	
Urban teaching	2012 (90)	722 (96)	250 (91)	118 (89)	108 (95)	
Comorbidities, n (%)						
Hypertension	1982 (79)	784 (92)	274 (88)	122 (84)	110 (86)	<.0001
Peripheral vascular disease	48 (2)	24 (3)	2 (1)	0 (0)	0 (0)	.02
Chronic ischemic heart disease	610 (24)	150 (18)	52 (17)	28 (19)	26 (20)	.0002
Cardiac inflammation	14 (1)	2 (0.2)	0 (0)	2 (1)	0 (0)	.19
History of transient ischemic attack/cerebral infarction	110 (4)	26 (3)	22 (7)	4 (3)	10 (8)	.009
History of circulatory disease	80 (3)	22 (3)	2 (1)	0 (0)	0 (0)	.005

(Continued)

TABLE 1. Continued

Characteristic	White (N = 2520)	Black/African American (N = 848)	Hispanic (N = 310)	API (N = 146)	Other (N = 128)	*P* value
Prior cardiac surgery	232 (9)	50 (6)	24 (8)	10 (7)	12 (9)	.04
Presence of cardiac pacemaker	52 (2)	8 (1)	2 (1)	2 (1)	0 (0)	.05
Preoperative shock	576 (23)	166 (20)	78 (25)	26 (18)	24 (19)	.09
Aortic aneurysm	274 (11)	68 (8)	24 (8)	16 (11)	28 (22)	<.0001
Chronic obstructive pulmonary disease	336 (13)	108 (13)	16 (5)	14 (10)	18 (14)	.001
Diabetes	188 (7)	106 (13)	36 (12)	10 (7)	4 (3)	<.0001
Chronic kidney disease	346 (13.7)	280 (33)	70 (22.6)	26 (17.8)	18 (14.1)	<.0001
Obesity	278 (11)	150 (18)	50 (16)	6 (4)	12 (9)	<.0001
Noncompliance	4 (0.2)	4 (0.5)	0 (0)	0 (0)	0 (0)	.35
Marfan disease	48 (1.9)	12 (1.4)	8 (2.5)	0 (0)	2 (1.6)	.31

API, Asian and Pacific Islander; *IQR*, interquartile range; *TAAAD*, type A acute aortic dissection.

West. Conversely, White admissions were distributed evenly throughout the various hospital regions ($P < .0001$) (Table 1).

Although hospital size did not differ by racial group ($P = .42$), there was a discrepancy in the age at admission ($P < .0001$). Black/African American and Hispanic admissions presented with TAAAD at a median age of 54 years and 55 years, respectively, whereas White and API admissions presented at a median age of 64 years and 63 years, respectively. On average, these data demonstrate that Black/African American and Hispanic admissions present with TAAAD approximately a decade earlier than their White and API counterparts nationwide.

The majority of Black/African American (47%), Hispanic (54%), and API (51%) admissions were in urban, densely populated metro counties. In contrast, there was a more even distribution of White admissions between urban and metro counties ($P < .0001$). Furthermore, consistent with the literature,[13] higher percentages of Black/African American (54%) and Hispanic admissions (32%) lived in ZIP codes belonging to the lowest median household income quartile ($0 to ~$44,000). Comparatively, the highest percentage of White admissions (28%) lived in ZIP codes from the third-highest household income quartile (~$55,000 to $74,000), and the highest percentage of API admissions (52%) lived in ZIP codes in the highest household median quartile ($74,000+) ($P < .0001$). Additionally, Black/African American (25%) patients had the highest percentage of admissions covered by Medicaid. Given that White and API admissions tended to be older than other racial groups, they correspondingly had higher percentages of their admissions covered by Medicare (White, 48%; API, 36%) ($P < .0001$).

Comorbidity Trends

The most widely reported comorbidities for TAAAD include cardiovascular conditions, such as hypertension, diabetes, and prior cardiac surgery, have previously been demonstrated to be present at higher rates in underserved patient populations.[10-12] Similarly, in our TAAAD admissions cohort, 92% of Black/African American admissions, 88% of Hispanic admissions, and 84% of API admissions had a diagnosis of hypertension, compared to 79% of White admissions ($P < .0001$) (Table 1). Additionally, there were higher rates of diabetes and obesity in Black/African American and Hispanic admissions ($P = .0001$) (Table 1). Chronic ischemic heart disease was found at a higher proportion in White admissions (24%) compared to Black/African American admissions (18%), Hispanic admissions (17%), and API admissions (19%) ($P = .0002$). Rates of preoperative shock were largely comparable across the different racial groups ($P = .09$).

Primary and Secondary Outcomes

When studying our primary outcome of in-hospital mortality, White admissions had the highest raw mortality at 17%, and Black/African American admissions had the lowest rate of raw mortality at 11% ($P < .0001$) (Table 2). There were no significant differences among racial groups in several different types of postoperative complications, including pulmonary complications, hemorrhage, and stroke (all $P > .05$). API admissions had the highest rate of postprocedural shock/cardiac failure (22%), and Black/African American admissions had the lowest rate of postprocedural shock/cardiac failure (13%). Similarly, API admissions had the highest rates of adverse reactions following a procedure (23%), whereas Black/African American and Hispanic admissions had the lowest (12% and 14%, respectively). The overall complication rate also was not significantly different across the racial groups ($P = .24$) (Table 2).

Another secondary outcome that we investigated was resource utilization. Black/African American, Hispanic, and API admissions all had a median LOS of 11 days, and White admissions had a median LOS of 10 days ($P < .0001$) (Table 2). Additionally, Hispanic admissions

TABLE 2. Unadjusted mortality and complication rates of TAAAD

Outcomes	White (N = 2520)	Black/African American (N = 848)	Hispanic (N = 310)	API (N = 146)	Other (N = 128)	*P* value
Discharge status, n (%)						
Died	438 (17)	90 (11)	38 (12)	22 (15)	14 (11)	<.0001
Resource utilization						
Length of stay, d, median (IQR)	10 (6-16)	11 (7-18)	11 (7-17)	11 (7-16)	13.5 (7.5-23)	<.0001
Total cost, USD, median (IQR)	290,259 (195,413-459,875)	291,043 (201,132-485,816)	364,646 (252,824-634,016)	291,469 (205,979-584,779)	368,511 (231,915-620,019)	<.0001
Complications						
Any complication	1142 (45)	374 (44)	138 (45)	70 (48)	70 (55)	.24
Postprocedure shock/cardiac failure	400 (16)	110 (13)	46 (15)	32 (22)	32 (25)	.002
Pulmonary complications	616 (24)	240 (28)	76 (25)	28 (19)	36 (28)	.07
Hemorrhage/hematoma/seroma	182 (7)	72 (8)	22 (7)	8 (5)	12 (9)	.55
Stroke	52 (2)	12 (1)	2 (1)	4 (3)	4 (3)	.22
Adverse reaction	430 (17)	102 (12)	42 (14)	34 (23)	34 (27)	<.0001
Catheter-related complication	14 (1)	0 (0)	0 (0)	0 (0)	0 (0)	.09
Postprocedure hypertension	14 (1)	8 (1)	6 (2)	2 (1)	0 (0)	.06
Other unspecified complications	24 (1)	4 (0.5)	2 (1)	0 (0)	0 (0)	.36

API, Asian and Pacific Islander; *IQR*, interquartile range; *TAAAD*, type A acute aortic dissection.

had the highest total cost at $364,646, and White admissions had the lowest total cost at $290,259 ($P < .0001$).

Multivariable Regression Model

After determining the demographic and comorbid factors that differed significantly among racial groups, we built multivariable logistic regression models using these variables to determine race's independent association with mortality. The Elixhauser Comorbidity Index, a composite comorbidity score validated for use with administrative data, was significantly associated with mortality (odds ratio [OR], 1.029; 95% confidence interval [CI], 1.003-1.056). While the highest raw mortality was observed in White admissions, there was ultimately no association between race and hospital mortality in our multivariable model (Table 3, Figure 3). Additionally, median household income and hospital location also were not associated with mortality. We also ran analyses with several interaction variables to check for an interaction between race or median income in the setting of TAAAD mortality, but found none (Table 4). However, several comorbid variables, including increasing age (OR, 1.002; 95% CI, 1.001-1.003), chronic ischemic heart disease (OR, 1.039; 95% CI, 1.011-1.068), and preoperative shock (OR, 1.211; 95% CI, 1.011-1.068), were associated with higher mortality in TAAAD admissions. Private insurance status was more protective against TAAAD in-hospital mortality compared to the self-pay option (OR, 1.075; 95% CI, 1.021-1.131). Unexpectedly, hypertension was associated with a protective effect against mortality from TAAAD (OR, 0.934; 95% CI, 0.907-0.962). Chronic kidney disease (OR, 0.999; 95% CI, 0.970-1.028), aneurysm (OR, 1.000; 95% CI, 0.961-1.040), and Marfan syndrome (OR, 1.04; 95% CI, 0.957-1.131) showed no association with mortality.

Although there was no association between race and mortality, we found that race was significantly associated with our secondary outcomes. Specifically, Hispanic admissions were associated with both increased LOS (day 1.615; 95% CI, 0.142-3.088) and increased cost of stay (cost $156,615.55; 95% CI, $105,193.82-$208,039.28) compared to White admissions. Interestingly, API admissions also showed an increased cost of stay (cost 249,059.36, 95% CI 177,622.48-320,496.23). Demographic characteristic such as median household income and insurance status, and comorbid variables, such as hypertension, ischemic heart disease, and preoperative shock, also were associated with both LOS and cost of stay (Table 3).

DISCUSSION

TAAAD is an acute medical condition with a high mortality and severe postoperative complications. Given these risks, and the emergent nature of treatments, this syndrome provides a unique opportunity to investigate the impact of race and ethnicity on presentation and outcomes associated

TABLE 3. Independent variables associated with mortality, length of stay, and cost of stay for TAAAD

Variable	OR/estimate*	95% CI	*P* value
In-hospital mortality			
Age	*1.002*	*1.001-1.003*	*<.0001*
Elixhauser comorbidity index	*1.029*	*1.003-1.056*	*.027*
Race			
White (reference)			
Black/African American	0.973	0.944-1.003	.072
Hispanic	0.972	0.931-1.1013	.2
API	1.002	0.946-1.062	.933
Median household income percentile			
0-25	1		
26-50	1.015	0.984-1.048	.346
51-75	1.224	0.929-1.614	.367
76-100	1.047	0.787-1.392	.720
Insurance			
Private insurance	1		
Medicare	1.024	0.992-1.057	.137
Medicaid	1.022	0.988-1.057	.214
Self-pay	*1.075*	*1.021-1.131*	*.006*
Other	0.995	0.930-1.065	.322
Hypertension	*0.934*	*0.907-0.962*	*<.0001*
Chronic ischemic heart disease	*1.039*	*1.011-1.068*	*.006*
Preoperative shock	*1.211*	*1.179-1.243*	*<.0001*
Chronic kidney disease	0.999	0.970-1.028	.937
Aneurysm	1.000	0.961-1.040	.993
Marfan syndrome	1.04	0.957-1.131	.351
Length of stay			
Elixhauser comorbidity index	*1.256*	*0.358-2.156*	*.006*
Race			
White (reference)	1		
Black/African American	0.327	−0.725 to 1.380	.5
Hispanic	*1.615*	*0.142-3.088*	*.032*
API	0.452	−1.566 to 2.471	.66
Insurance status			
Private insurance	1		
Medicare	0.672	−0.425 to 1.768	.229
Medicaid	*1.900*	*0.705-3.086*	*.001*
Self-pay	*−1.844*	*−3.639 to −0.049*	*.044*
Other	−3.285	−9.016 to 2.446	.261
Median household income percentile			
0-25	1		
26-50	*−2.0633*	*−3.516 to −1.311*	*<.0001*
51-75	*−2.1297*	*−3.619 to −1.433*	*<.0001*
76-100	*−1.2002*	*−3.041 to −0.803*	*.0348*
Hypertension	*−1.701*	*−2.738 to −0.664*	*.001*
Chronic ischemic heart disease	−0.290	−1.243 to 0.669	.556
Preoperative shock	*1.675*	*0.745-2.605*	*<.0001*
Chronic kidney disease	*3.800*	*2.781-4.812*	*<.0001*
Aneurysm	−0.955	−2.322 to 0.413	.171
Marfan syndrome	*6.558*	*3.651-9.465*	*<.0001*
Associated cost, USD			
Elixhauser comorbidity index	*85,140.79*	*53,726.66-116,554.92*	*<.0001*
Race			
White (reference)	1		
Black/African American	−3046.50	−39,814.08 to 33,721.08	.871

(Continued)

TABLE 3. Continued

Variable	OR/estimate*	95% CI	*P* value
Hispanic	*156,616.55*	*105,193.82-208,039.28*	*<.0001*
API	*249,059.36*	*177,622.48-320,496.23*	*<.0001*
Insurance status			
Private insurance	1		
Medicare	11,087.86	−4883.800 to 71,790.56	.087
Medicaid	6171.81	−17,133.25 to 66,078.58	.249
Self-pay	−17,023.80	−120,779.43 to 4602.75	.069
Other	19,325.53	−244,740.33 to 155,398.20	.662
Median household income percentile, n (%)			
0-25	1		
26-50	−5020.85	(−43,587.93, 33,546.23)	.799
51-75	−19,933.29	(−58,132.83, 18,266.25)	.306
76-100	*41,412.52*	*(2211.11, 80,613.93)*	*.038*
Hypertension	*−63,238.99*	*(−99,445.26, −27,032.71)*	.0006
Chronic ischemic heart disease	*−31,608.43*	*(−65,011.43, 1794.56)*	.064
Preoperative shock	*123,883.67*	*(91,403.90, 156,363.44)*	*<.0001*
Chronic kidney disease	*128,167.62*	*(92,702.63, 163,632.61)*	*<.0001*
Aneurysm	−46,862.50	(−94,720.90, 995.91)	.055
Marfan syndrome	66,230.72	−35,270.98 to 167,732.42	.201

Italics denote statistical significance with *P* value <.05. *OR*, Odds ratio; *CI*, confidence interval; *API*, Asian and Pacific Islander; *TAAAD*, type A acute aortic dissection. *OR for in-hospital mortality; estimates for length of stay and associated cost.

with emergent cardiac surgical care. Our results show that Black and Hispanic admissions present with TAAAD a decade earlier than White and API admissions. We also found that higher proportions of Black/African American and Hispanic admissions were from the lowest median household income quartile and had Medicaid insurance. Despite these differences on presentation, we found no significant association between race and surgical TAAAD in-hospital mortality. Hispanic admissions were associated with longer LOS and higher cost of stay, and API admissions had a higher associated cost of stay (Video 1).

These data suggest that Black and Hispanic patients may be exposed to healthcare disparities that precede and predispose patients to TAAAD. Black and Hispanic patients were shown to present with TAAAD a decade earlier than White and API patients, suggesting greater exposure to TAAAD risk factors earlier in life. Two factors that may contribute to this earlier age of onset are insurance status and socioeconomic status. In our TAAAD cohort, we found higher rates of Black/African American and Hispanic patients who either were from the lowest median income quartile or were covered by Medicaid. Patients of lower socioeconomic status have been shown to have poorer access to healthy diet, are at higher risk for developing substance abuse disorders, and have higher rates of hypertension, obesity, and diabetes, all of which are risk factors for TAAAD.[14] Therefore, reducing early exposure through primary prevention may be an effective strategy to address the early presentation of minority patients.

Discrimination by healthcare providers in the primary care context also may contribute to these differences in presentation. Physicians have been shown to carry implicit bias against underserved patient populations, perceiving Black and Hispanic patients as "less cooperative, less compliant, and less responsible."[15] Treatment biases such as these understandably have led to a growing distrust of healthcare providers and the treatments that they prescribe in underrepresented patient populations.[7] One observed effect is a lower rate of adherence to hypertensive medication regimens in Black patient populations, which is a reported risk factor for TAAAD.[7] Strengthening these provider–patient relationships can improve earlier screening and improve treatment adherence, which may reduce the risk for TAAAD.

Despite disparities in presentation, it is encouraging that we found no racial disparities when looking at the association between race and TAAAD surgical mortality. This remained true even with the addition of several interaction factors, such as socioeconomic status. Interestingly, these findings run counter to other acute cardiovascular conditions. For example, Black patients have been reported to have worse surgical outcomes after abdominal aortic aneurysm repair, vascular trauma, and hemodialysis.[16-18] Black race has been associated with increased mortality in coronary artery bypass surgery, even after accounting for socioeconomic and clinical factors.[19] Results are not uniform for all cardiac operations, however. A recent analysis in Michigan revealed that, when adjusting for clinical factors, race was not associated with mitral surgical selection or with operative outcome.[20]

Although not the case for all surgical emergencies, it may be the case that an aspect of TAAAD surgical treatment is

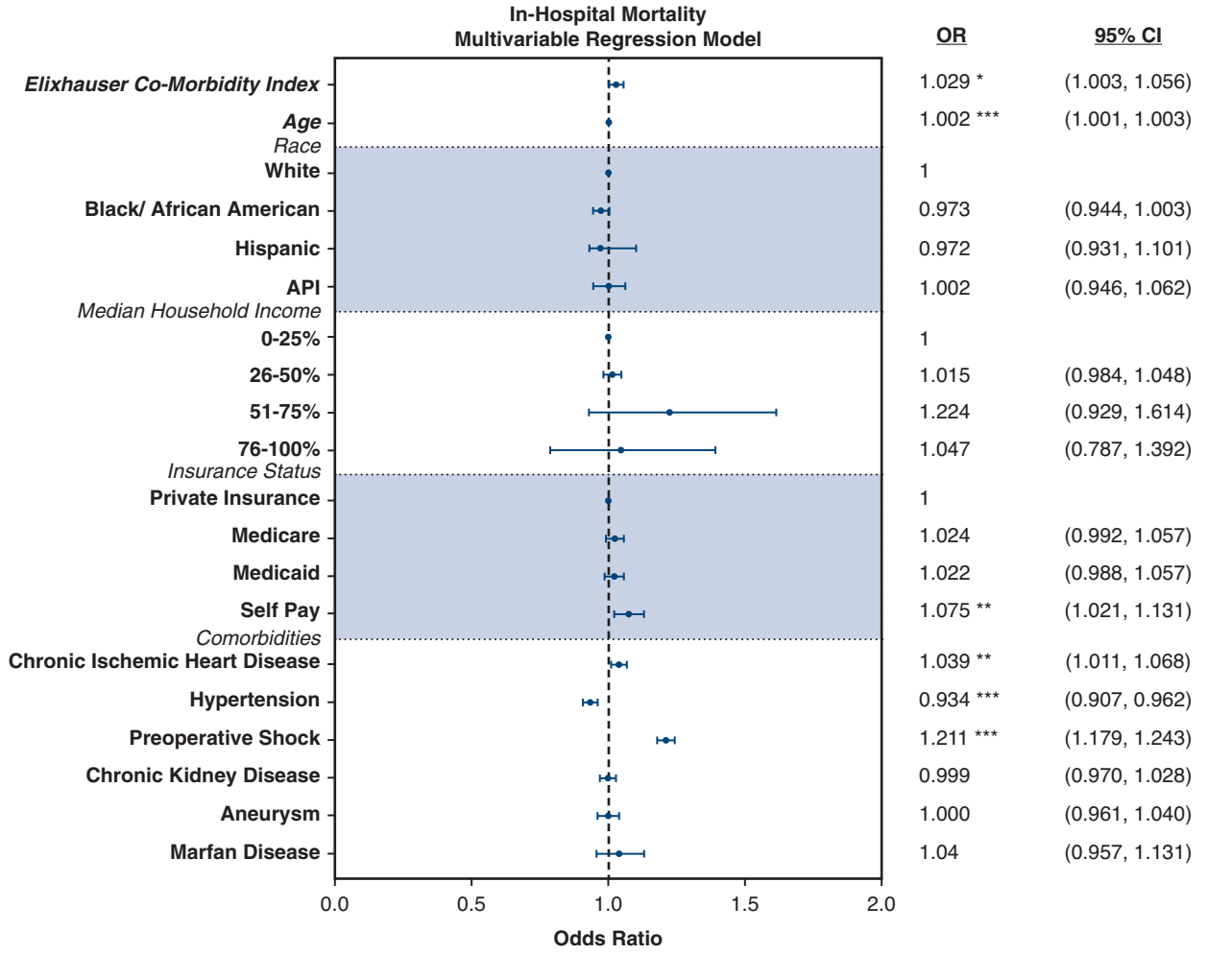

FIGURE 3. Multivariable regression model of in-hospital mortality. Forest plot representation of a multivariable regression model of in-hospital mortality, showing the Elixhauser Comorbidity Index, age, and race. Both the Elixhauser Comorbidity Index (odds ratio [*OR*], 1.046; 95% confidence interval [*CI*], 1.001-1.093) and age (OR, 1.029; 95% CI, 1.017-1.041) were independently associated with type A acute aortic dissection in-hospital mortality. However, race was not found to be independently associated with mortality. *$P \leq .05$, **$P \leq .01$, ***$P \leq .001$. *API*, Asian and Pacific Islander.

able to equitably address the immediate mortality risk in all patient populations. Similarly, Yammine and colleagues[18] found that Black TAAAD patients presented earlier with greater comorbidities compared to White patients but had a lower in-hospital mortality rate. However, they also found significantly higher reintervention rates in Black patients, which also was noted in the Michigan mitral study, which similarly points to the fact that although surgical or endovascular treatment may benefit minority patient populations in the immediate context, care beyond the acute setting may need significant improvement.

Additionally, we found that Hispanic admissions were the only ethnic group demonstrating longer LOS. Interestingly, we found no significant difference in the total postoperative complication rate when stratified by race, a variable that drives longer hospital admissions (Table 2). This finding could be due to a limitation of the NIS database, as we were unable to study many of the complications commonly associated with TAAAD, such as acute myocardial infarction, acute kidney injury, and pulmonary embolism. However, several studies also demonstrated prolonged LOS in Hispanic patient populations despite a similar rate of complications.[21-24] It has been speculated that these race-specific differences could be due to disparities in housing security, which could affect safe hospital discharge. Another possibility is that this prolonged LOS is a reflection of provider bias, which has been shown to foster patient distrust, poor patient–provider communication, and greater patient stress, all of which could impact a patient's postoperative course.

We also found that Hispanics and API admissions had higher costs of stay. This finding is less likely to be fully

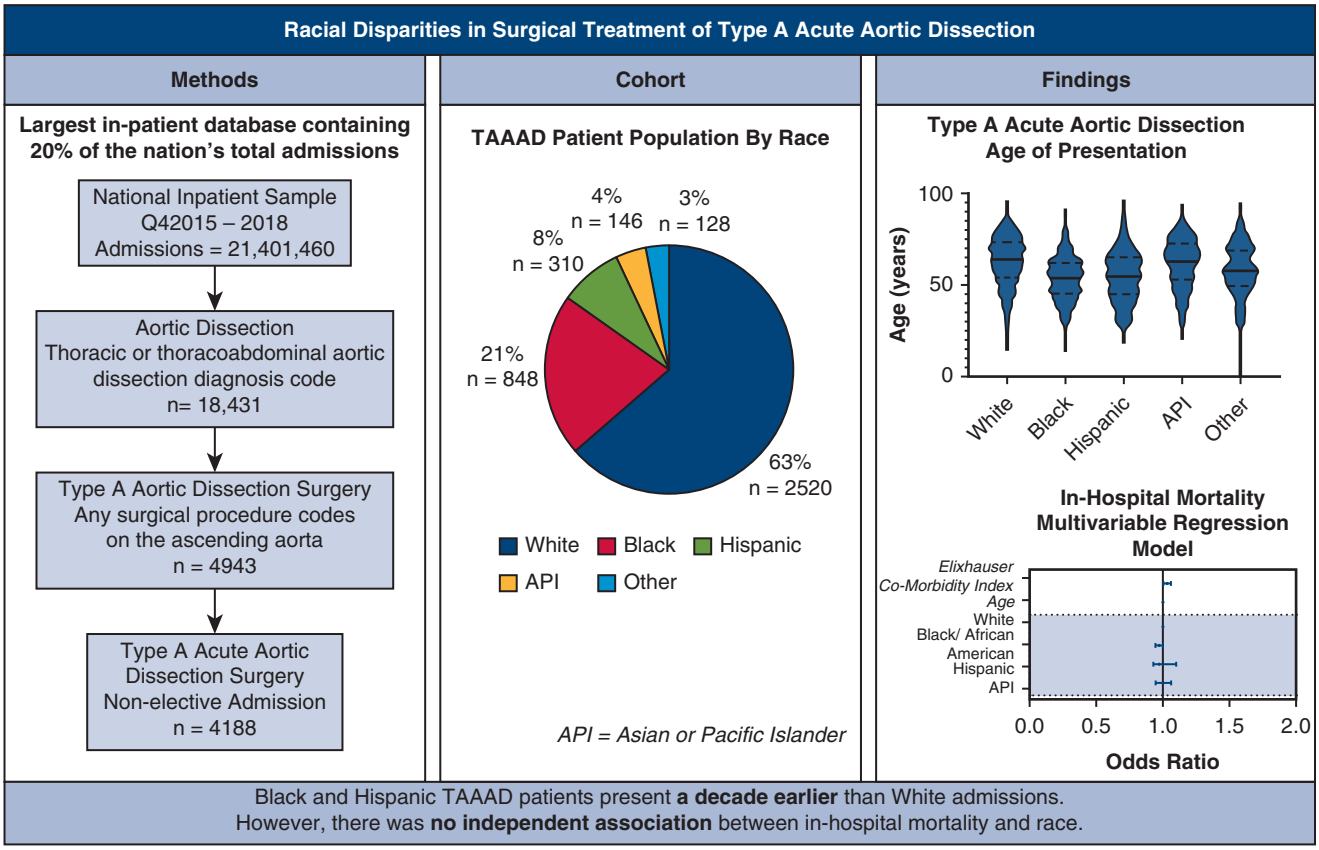

FIGURE 4. Graphic abstract.

attributable to LOS, given that Hispanic admissions were longer by only 1 day, and API admissions were not found to be significantly longer. The higher cost of API admissions may be related to the finding that a higher proportion of API admissions belonged to the highest income quartile. These patients may access specialty care that may lead to higher costs without a corresponding increase in LOS.

TABLE 4. Median household income interaction analysis on independent association of race and mortality

Race × income interactions	DF	OR	95% CI
Black × quartile 2	1	1.037	0.962-1.116
Black × quartile 3	1	1.038	0.959-1.123
Black × quartile 4	1	0.986	0.907-1.072
Hispanic × quartile 2	1	1.143	0.954-1.281
Hispanic × quartile 3	1	1.047	0.939-1.168
Hispanic × quartile 4	1	0.928	0.824-1.046
API × quartile 2	1	0.859	0.699-1.056
API × quartile 3	1	0.891	0.718-1.106
API × quartile 4	1	0.832	0.692-1.000

DF, Degrees of freedom; *OR*, odds ratio; *CI*, confidence interval; *API*, Asian and Pacific Islander.

However, owing to the heterogeneity of these patient populations, and the lack of data surrounding previous access to healthcare and common complications, further study with a clinically driven descriptive database may be necessary to understand this difference in outcome.

Other studies using self-reporting methods have also pointed to likely racial disparities in aortic dissection. In a small retrospective study looking at a single institution, Black patients with aortic dissection were significantly younger, had poorer hypertension control, and required a greater number of reinterventions than their white counterparts.[8] Owing to the rarity of acute aortic dissection, the study included a cohort of only 126 patients with type B aortic dissections. Another retrospective study investigating all acute hospitals in Maryland observed higher rates of hospitalization for all aortic dissections in non-White patients.[9] Additionally, one nationwide study investigating the different types of aortic dissection in the early 2000s listed race as a significant determinant of mortality but failed to investigate this finding further.[4] Although limited in scope, each of these studies pointed toward existing racial disparities in the development and presentation of aortic dissection, but further investigation is needed to gain a more comprehensive understanding of how this condition

VIDEO 1. Summary of the article's purpose, main findings, and significance. Video available at: https://www.jtcvs.org/article/S2666-2736(23)00028-1/fulltext.

impacts underrepresented patient populations across the entire spectrum of disease.

Our study was subject to several limitations. First, the NIS does not distinguish whether a condition was present on admission or was a postoperative complication. Therefore, even though we did not observe differences in mortality, further investigation is needed to identify any significant differences in complications among racial groups. The NIS contains only deidentified admission data, which prevented longitudinal analysis of any individual patient's care. For instance, we were unable to determine access to medical care prior to the patient's TAAAD admission, nor were we able to study any follow-up care or longitudinal mortality. For instance, we were unable to determine differences in aneurysm burden between racial groups on admission, as the NIS does not provide clear indicators between diagnoses present on admission versus a postoperative complication. Additionally, because the NIS is an administrative database, it provides no diagnostic clinical details of a patient's status that would have been included in a clinical registry. For example, we were not able to distinguish between patients who had well-controlled hypertension and those with poorly controlled hypertension, which would have a significant impact on the development of TAAAD. Finally, because we focused on patients who had undergone surgery, the data did not permit us to identify patients presenting with TAAAD who did not undergo surgery and thus may have masked potential selection bias.

CONCLUSIONS

Black/African American and Hispanic TAAAD admissions have higher rates of Medicaid coverage and hypertension, and lower socioeconomic status compared to their White and API counterparts. Additionally, Black and Hispanic patients present with TAAAD 10 years younger than their White and API counterparts. Despite these disparities, after adjusting for potential confounding variables, there was no association between race and TAAAD surgical mortality, but Hispanic TAAAD admissions were found to have longer LOS and higher costs of stay, and API admissions had higher costs of stay, compared to White admissions. Further investigation is needed to identify any racial disparities in associated postoperative complications in addition to other phases of care (Figure 4).

Conflict of Interest Statement

The authors reported no conflicts of interest.

The *Journal* policy requires editors and reviewers to disclose conflicts of interest and to decline handling or reviewing manuscripts for which they may have a conflict of interest. The editors and reviewers of this article have no conflicts of interest.

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Key Words: aortic dissection, racial disparities, type A aortic dissection

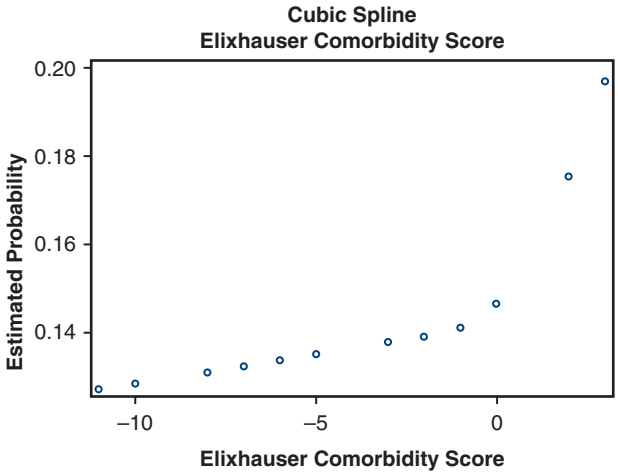

FIGURE E1. Cubic spline of the Elixhauser comorbidity index.

TABLE E1. ICD-10 surgical procedure codes for the ascending aorta

ICD-10 code	Description
02QX0ZZ	Repair thoracic aorta, ascending/arch, open approach
02UX07Z	Supplement thoracic aorta, ascending/arch with autologous tissue substitute, open approach
02UX08Z	Supplement thoracic aorta, ascending/arch with zooplastic tissue, open approach
02UX0JZ	Supplement thoracic aorta, ascending/arch with synthetic substitute, open Approach
02UX0KZ	Supplement thoracic aorta, ascending/arch with nonautologous tissue substitute, open approach
02VX0CZ	Restriction of thoracic aorta, ascending/arch with extraluminal device, open approach
02VX0DZ	Restriction of thoracic aorta, ascending/arch with intraluminal device, open approach
02VX0EZ	Restriction of thoracic aorta, ascending/arch with branched or fenestrated intraluminal device, one or two arteries, open approach
02VX0FZ	Restriction of thoracic aorta, ascending/arch with branched or fenestrated intraluminal device, three or more arteries, open approach
02VX0ZZ	Restriction of thoracic aorta, ascending/arch, open approach
02BX0ZZ	Excision of thoracic aorta, ascending/arch, open approach
02RX07Z	Replacement of thoracic aorta, ascending/arch with autologous tissue substitute, open approach
02RX08Z	Replacement of thoracic aorta, ascending/arch with zooplastic tissue, open approach
02RX0JZ	Replacement of thoracic aorta, ascending/arch with synthetic substitute, open approach
02RX0KZ	Replacement of thoracic aorta, ascending/arch with nonautologous tissue substitute, open approach

ICD-10, International Classification of Diseases, Tenth Revision.

TABLE E2. ICD-10 codes for comorbidities

ICD-10 code	Description
Hypertension	
I10	Essential (primary) hypertension
I11	Hypertensive heart disease
I12	Hypertensive kidney disease
I13	Hypertensive heart and chronic kidney disease
I15	Secondary hypertension
I16	Hypertensive crisis
I110	Hypertensive heart disease with heart failure
I119	Hypertensive heart disease without heart failure
I120	Hypertensive chronic kidney disease with stage 5 chronic kidney disease or end stage renal disease
I129	Hypertensive chronic kidney disease with stage 1 through stage 4 chronic kidney disease, or unspecified chronic kidney disease
I130	Hypertensive heart and chronic kidney disease with heart failure and stage 1 through stage 4 chronic kidney disease or unspecified chronic kidney disease
I1310	Hypertensive heart and chronic kidney disease without heart failure with stage 1 through stage 4 chronic kidney disease, or unspecified chronic kidney disease
I1311	Hypertensive heart and chronic kidney disease without heart failure with stage 5 chronic kidney disease, or end stage renal disease
I132	Hypertensive heart and chronic kidney disease with heart failure with stage 5 chronic kidney disease, or end stage renal disease
I150	Renovascular hypertension
I151	Hypertension secondary to other renal disorders
I152	Hypertension secondary to endocrine disorders
I158	Other secondary hypertension
I159	Secondary hypertension, unspecified
I160	Hypertensive urgency
I161	Hypertensive emergency
I169	Hypertensive crisis, unspecified
Peripheral vascular disease	
I70	Atherosclerosis
I701	Atherosclerosis of renal artery
I702	Atherosclerosis of native arteries of the extremities
I7020	Unspecified atherosclerosis of native arteries of extremities
I70201	Unspecified atherosclerosis of native arteries of extremities right leg
I70202	Unspecified atherosclerosis of native arteries of extremities left leg
I70203	Unspecified atherosclerosis of native arteries of extremities bilateral legs
I70208	Unspecified atherosclerosis of native arteries of extremities other extremity
I70209	Unspecified atherosclerosis of native arteries of extremities unspecified extremity
I7021	Atherosclerosis of native arteries of extremities with intermittent claudication
I70211	Atherosclerosis of native arteries with intermittent claudication right leg
I70212	Atherosclerosis of native arteries with intermittent claudication left leg
I70213	Atherosclerosis of native arteries with intermittent claudication bilateral legs
I70218	Atherosclerosis of native arteries with intermittent claudication other extremity
I70219	Atherosclerosis of native arteries with intermittent claudication unspecified extremity
I7022	Atherosclerosis of native arteries of extremities with rest pain
I70221	Atherosclerosis of native arteries of extremities with rest pain right leg
I70222	Atherosclerosis of native arteries of extremities with rest pain left leg
I70223	Atherosclerosis of native arteries of extremities with rest pain bilateral legs
I70228	Atherosclerosis of native arteries of extremities with rest pain other extremity
I70229	Atherosclerosis of native arteries of extremities with rest pain unspecified extremity
I7023	Atherosclerosis of native arteries of right leg with ulceration
I70231	Atherosclerosis of native arteries of right leg with ulceration of thigh
I70232	Atherosclerosis of native arteries of right leg with ulceration of calf
I70233	Atherosclerosis of native arteries of right leg with ulceration of ankle

(Continued)

TABLE E2. Continued

ICD-10 code	Description
I70234	Atherosclerosis of native arteries of right leg with ulceration of heel and midfoot
I70235	Atherosclerosis of native arteries of right leg with ulceration of other part of foot
I70238	Atherosclerosis of native arteries of right leg with ulceration of other part of lower leg
I70239	Atherosclerosis of native arteries of right leg with ulceration of unspecified site
I7024	Atherosclerosis of native arteries of left leg with ulceration
I70241	Atherosclerosis of native arteries of left leg with ulceration of thigh
I70242	Atherosclerosis of native arteries of left leg with ulceration of calf
I70243	Atherosclerosis of native arteries of left leg with ulceration of ankle
I70244	Atherosclerosis of native arteries of left leg with ulceration of heel and midfoot
I70245	Atherosclerosis of native arteries of left leg with ulceration of other part of foot
I70248	Atherosclerosis of native arteries of left leg with ulceration of other part of lower leg
I70249	Atherosclerosis of native arteries of left leg with ulceration of unspecified site
I7025	Atherosclerosis of native arteries of other extremities with ulceration
I7026	Atherosclerosis of native arteries of extremities with gangrene
I70261	Atherosclerosis of native arteries of extremities with gangrene right leg
I70262	Atherosclerosis of native arteries of extremities with gangrene left leg
I70263	Atherosclerosis of native arteries of extremities with gangrene bilateral legs
I70268	Atherosclerosis of native arteries of extremities with gangrene other extremity
I70269	Atherosclerosis of native arteries of extremities with gangrene unspecified extremity
I7029	Other atherosclerosis of native arteries of extremities
I70291	Other atherosclerosis of native arteries of extremities right leg
I70292	Other atherosclerosis of native arteries of extremities left leg
I70293	Other atherosclerosis of native arteries of extremities bilateral legs
I70298	Other atherosclerosis of native arteries of extremities other extremity
I70299	Other atherosclerosis of native arteries of extremities unspecified extremity
I703	Atherosclerosis of unspecified type of bypass graft(s) of the extremities
I7030	Unspecified atherosclerosis of unspecified type of bypass graft(s) of the extremities
I70301	Unspecified atherosclerosis of unspecified type of bypass graft(s) of the extremities right leg
I70302	Unspecified atherosclerosis of unspecified type of bypass graft(s) of the extremities left leg
I70303	Unspecified atherosclerosis of unspecified type of bypass graft(s) of the extremities bilateral legs
I70308	Unspecified atherosclerosis of unspecified type of bypass graft(s) of the extremities other extremity
I70309	Unspecified atherosclerosis of unspecified type of bypass graft(s) of the extremities unspecified extremity
I7031	Atherosclerosis of unspecified type of bypass graft(s) of the extremities with intermittent claudication
I70311	Atherosclerosis of unspecified type of bypass graft(s) of the extremities with intermittent claudication right leg
I70312	Atherosclerosis of unspecified type of bypass graft(s) of the extremities with intermittent claudication left leg
I70313	Atherosclerosis of unspecified type of bypass graft(s) of the extremities with intermittent claudication bilateral legs
I70318	Atherosclerosis of unspecified type of bypass graft(s) of the extremities with intermittent claudication other extremity
I70319	Atherosclerosis of unspecified type of bypass graft(s) of the extremities with intermittent claudication unspecified extremity
I7032	Atherosclerosis of unspecified type of bypass graft(s) of the extremities with rest pain
I70321	Atherosclerosis of unspecified type of bypass graft(s) of the extremities with rest pain right leg
I70322	Atherosclerosis of unspecified type of bypass graft(s) of the extremities with rest pain left leg
I70323	Atherosclerosis of unspecified type of bypass graft(s) of the extremities with rest pain bilateral legs
I70328	Atherosclerosis of unspecified type of bypass graft(s) of the extremities with rest pain other extremity
I70329	Atherosclerosis of unspecified type of bypass graft(s) of the extremities with rest pain unspecified extremity
I7033	Atherosclerosis of unspecified type of bypass graft(s) of the right leg with ulceration
I70331	Atherosclerosis of unspecified type of bypass graft(s) of the right leg with ulceration of thigh
I70332	Atherosclerosis of unspecified type of bypass graft(s) of the right leg with ulceration of calf
I70333	Atherosclerosis of unspecified type of bypass graft(s) of the right leg with ulceration of ankle
I70334	Atherosclerosis of unspecified type of bypass graft(s) of the right leg with ulceration of heel and midfoot
I70335	Atherosclerosis of unspecified type of bypass graft(s) of the right leg with ulceration of other part of foot
I70338	Atherosclerosis of unspecified type of bypass graft(s) of the right leg with ulceration of other part of lower leg
I70339	Atherosclerosis of unspecified type of bypass graft(s) of the right leg with ulceration of unspecified site

(Continued)

TABLE E2. Continued

ICD-10 code	Description
I7034	Atherosclerosis of unspecified type of bypass graft(s) of the left leg with ulceration
I70341	Atherosclerosis of unspecified type of bypass graft(s) of the left leg with ulceration of thigh
I70342	Atherosclerosis of unspecified type of bypass graft(s) of the left leg with ulceration of calf
I70343	Atherosclerosis of unspecified type of bypass graft(s) of the left leg with ulceration of ankle
I70344	Atherosclerosis of unspecified type of bypass graft(s) of the left leg with ulceration of heel and midfoot
I70345	Atherosclerosis of unspecified type of bypass graft(s) of the left leg with ulceration of other part of foot
I70348	Atherosclerosis of unspecified type of bypass graft(s) of the left leg with ulceration of other part of lower leg
I70349	Atherosclerosis of unspecified type of bypass graft(s) of the left leg with ulceration of unspecified site
I7035	Atherosclerosis of unspecified type of bypass graft(s) of other extremity with ulceration
I7036	Atherosclerosis of unspecified type of bypass graft(s) of the extremities with gangrene
I70361	Atherosclerosis of unspecified type of bypass graft(s) of the extremities with gangrene right leg
I70362	Atherosclerosis of unspecified type of bypass graft(s) of the extremities with gangrene left leg
I70363	Atherosclerosis of unspecified type of bypass graft(s) of the extremities with gangrene bilateral legs
I70368	Atherosclerosis of unspecified type of bypass graft(s) of the extremities with gangrene other extremity
I70369	Atherosclerosis of unspecified type of bypass graft(s) of the extremities with gangrene unspecified extremity
I7039	Other atherosclerosis of unspecified type of bypass graft(s) of the extremities
I70391	Other atherosclerosis of unspecified type of bypass graft(s) of the extremities right leg
I70392	Other atherosclerosis of unspecified type of bypass graft(s) of the extremities left leg
I70393	Other atherosclerosis of unspecified type of bypass graft(s) of the extremities bilateral legs
I70398	Other atherosclerosis of unspecified type of bypass graft(s) of the extremities other extremity
I70399	Other atherosclerosis of unspecified type of bypass graft(s) of the extremities unspecified extremity
I704	Atherosclerosis of autologous vein bypass graft(s) of the extremities
I7040	Unspecified atherosclerosis of autologous vein bypass graft(s) of the extremities
I70401	Unspecified atherosclerosis of autologous vein bypass graft(s) of the extremities right leg
I70402	Unspecified atherosclerosis of autologous vein bypass graft(s) of the extremities left leg
I70403	Unspecified atherosclerosis of autologous vein bypass graft(s) of the extremities bilateral legs
I70408	Unspecified atherosclerosis of autologous vein bypass graft(s) of the extremities other extremity
I70409	Unspecified atherosclerosis of autologous vein bypass graft(s) of the extremities unspecified extremity
I7041	Atherosclerosis of autologous vein bypass graft(s) of the extremities with intermittent claudication
I70411	Atherosclerosis of autologous vein bypass graft(s) of the extremities with intermittent claudication right leg
I70412	Atherosclerosis of autologous vein bypass graft(s) of the extremities with intermittent claudication left leg
I70413	Atherosclerosis of autologous vein bypass graft(s) of the extremities with intermittent claudication bilateral legs
I70418	Atherosclerosis of autologous vein bypass graft(s) of the extremities with intermittent claudication other extremity
I70419	Atherosclerosis of autologous vein bypass graft(s) of the extremities with intermittent claudication unspecified extremity
I7042	Atherosclerosis of autologous vein bypass graft(s) of the extremities with rest pain
I70421	Atherosclerosis of autologous vein bypass graft(s) of the extremities with rest pain right leg
I70422	Atherosclerosis of autologous vein bypass graft(s) of the extremities with rest pain left leg
I70423	Atherosclerosis of autologous vein bypass graft(s) of the extremities with rest pain bilateral legs
I70428	Atherosclerosis of autologous vein bypass graft(s) of the extremities with rest pain other extremity
I70429	Atherosclerosis of autologous vein bypass graft(s) of the extremities with rest pain unspecified extremity
I7043	Atherosclerosis of autologous vein bypass graft(s) of the right leg with ulceration
I70431	Atherosclerosis of autologous vein bypass graft(s) of the right leg with ulceration of thigh
I70432	Atherosclerosis of autologous vein bypass graft(s) of the right leg with ulceration of calf
I70433	Atherosclerosis of autologous vein bypass graft(s) of the right leg with ulceration of ankle
I70434	Atherosclerosis of autologous vein bypass graft(s) of the right leg with ulceration of heel and midfoot
I70435	Atherosclerosis of autologous vein bypass graft(s) of the right leg with ulceration of other part of foot
I70438	Atherosclerosis of autologous vein bypass graft(s) of the right leg with ulceration of other part of lower leg
I70439	Atherosclerosis of autologous vein bypass graft(s) of the right leg with ulceration of unspecified site
I7044	Atherosclerosis of autologous vein bypass graft(s) of the left leg with ulceration
I70441	Atherosclerosis of autologous vein bypass graft(s) of the left leg with ulceration of thigh
I70442	Atherosclerosis of autologous vein bypass graft(s) of the left leg with ulceration of calf
I70443	Atherosclerosis of autologous vein bypass graft(s) of the left leg with ulceration of ankle
I70444	Atherosclerosis of autologous vein bypass graft(s) of the left leg with ulceration of heel and midfoot
I70445	Atherosclerosis of autologous vein bypass graft(s) of the left leg with ulceration of other part of foot

(Continued)

TABLE E2. Continued

ICD-10 code	Description
I70448	Atherosclerosis of autologous vein bypass graft(s) of the left leg with ulceration of other part of lower leg
I70449	Atherosclerosis of autologous vein bypass graft(s) of the left leg with ulceration of unspecified site
I7045	Atherosclerosis of autologous vein bypass graft(s) of other extremity with ulceration
I7046	Atherosclerosis of autologous vein bypass graft(s) of the extremities with gangrene
I70461	Atherosclerosis of autologous vein bypass graft(s) of the extremities with gangrene right leg
I70462	Atherosclerosis of autologous vein bypass graft(s) of the extremities with gangrene left leg
I70463	Atherosclerosis of autologous vein bypass graft(s) of the extremities with gangrene bilateral legs
I70468	Atherosclerosis of autologous vein bypass graft(s) of the extremities with gangrene other extremity
I70469	Atherosclerosis of autologous vein bypass graft(s) of the extremities with gangrene unspecified extremity
I7049	Other atherosclerosis of autologous vein bypass graft(s) of the extremities
I70491	Other atherosclerosis of autologous vein bypass graft(s) of the extremities, right leg
I70492	Other atherosclerosis of autologous vein bypass graft(s) of the extremities, left leg
I70493	Other atherosclerosis of autologous vein bypass graft(s) of the extremities, bilateral legs
I70498	Other atherosclerosis of autologous vein bypass graft(s) of the extremities, other extremity
I70499	Other atherosclerosis of autologous vein bypass graft(s) of the extremities, unspecified extremity
I705A	Atherosclerosis of nonautologous biological bypass graft(s) of the extremities
I7050	Unspecified atherosclerosis of nonautologous biological bypass graft(s) of the extremities
I70501	Unspecified atherosclerosis of nonautologous biological bypass graft(s) of the extremities, right leg
I70502	Unspecified atherosclerosis of nonautologous biological bypass graft(s) of the extremities, left leg
I70503	Unspecified atherosclerosis of nonautologous biological bypass graft(s) of the extremities, bilateral legs
I70508	Unspecified atherosclerosis of nonautologous biological bypass graft(s) of the extremities, other extremity
I70509	Unspecified atherosclerosis of nonautologous biological bypass graft(s) of the extremities, unspecified extremity
I7051	Atherosclerosis of nonautologous biological bypass graft(s) of the extremities, intermittent claudication
I70511	Atherosclerosis of nonautologous biological bypass graft(s) of the extremities with intermittent claudication, right leg
I70512	Atherosclerosis of nonautologous biological bypass graft(s) of the extremities with intermittent claudication, left leg
I70513	Atherosclerosis of nonautologous biological bypass graft(s) of the extremities with intermittent claudication, bilateral legs
I70518	Atherosclerosis of nonautologous biological bypass graft(s) of the extremities with intermittent claudication, other extremity
I70519	Atherosclerosis of nonautologous biological bypass graft(s) of the extremities with intermittent claudication, unspecified extremity
I7052	Atherosclerosis of nonautologous biological bypass graft(s) of the extremities with rest pain
I70521	Atherosclerosis of nonautologous biological bypass graft(s) of the extremities with rest pain, right leg
I70522	Atherosclerosis of nonautologous biological bypass graft(s) of the extremities with rest pain, left leg
I70523	Atherosclerosis of nonautologous biological bypass graft(s) of the extremities with rest pain, bilateral legs
I70528	Atherosclerosis of nonautologous biological bypass graft(s) of the extremities with rest pain, other extremity
I70529	Atherosclerosis of nonautologous biological bypass graft(s) of the extremities with rest pain, unspecified extremity
I7053	Atherosclerosis of nonautologous biological bypass graft(s) of the right leg with ulceration
I70531	Atherosclerosis of nonautologous biological bypass graft(s) of the right leg with ulceration of thigh
I70532	Atherosclerosis of nonautologous biological bypass graft(s) of the right leg with ulceration of calf
I70533	Atherosclerosis of nonautologous biological bypass graft(s) of the right leg with ulceration of ankle
I70534	Atherosclerosis of nonautologous biological bypass graft(s) of the right leg with ulceration of heel and midfoot
I70535	Atherosclerosis of nonautologous biological bypass graft(s) of the right leg with ulceration of other part of foot
I70538	Atherosclerosis of nonautologous biological bypass graft(s) of the right leg with ulceration of other part of lower leg
I70539	Atherosclerosis of nonautologous biological bypass graft(s) of the right leg with ulceration of unspecified site
I7054	Atherosclerosis of nonautologous biological bypass graft(s) of the left leg with ulceration
I70541	Atherosclerosis of nonautologous biological bypass graft(s) of the left leg with ulceration of thigh
I70542	Atherosclerosis of nonautologous biological bypass graft(s) of the left leg with ulceration of calf
I70543	Atherosclerosis of nonautologous biological bypass graft(s) of the left leg with ulceration of ankle
I70544	Atherosclerosis of nonautologous biological bypass graft(s) of the left leg with ulceration of heel and midfoot
I70545	Atherosclerosis of nonautologous biological bypass graft(s) of the left leg with ulceration of other part of foot
I70548	Atherosclerosis of nonautologous biological bypass graft(s) of the left leg with ulceration of other part of lower leg

(Continued)

TABLE E2. Continued

ICD-10 code	Description
I70549	Atherosclerosis of nonautologous biological bypass graft(s) of the left leg with ulceration of unspecified site
I7055	Atherosclerosis of nonautologous biological bypass graft(s) of other extremity with ulceration
I7056	Atherosclerosis of nonautologous biological bypass graft(s) of the extremities with gangrene
I70561	Atherosclerosis of nonautologous biological bypass graft(s) of the extremities with gangrene, right leg
I70562	Atherosclerosis of nonautologous biological bypass graft(s) of the extremities with gangrene, left leg
I70563	Atherosclerosis of nonautologous biological bypass graft(s) of the extremities with gangrene, bilateral legs
I70568	Atherosclerosis of nonautologous biological bypass graft(s) of the extremities with gangrene, other extremity
I70569	Atherosclerosis of nonautologous biological bypass graft(s) of the extremities with gangrene, unspecified extremity
I7059	Other atherosclerosis of nonautologous biological bypass graft(s) of the extremities
I70591	Other atherosclerosis of nonautologous biological bypass graft(s) of the extremities, right leg
I70592	Other atherosclerosis of nonautologous biological bypass graft(s) of the extremities, left leg
I70593	Other atherosclerosis of nonautologous biological bypass graft(s) of the extremities, bilateral legs
I70598	Other atherosclerosis of nonautologous biological bypass graft(s) of the extremities, other extremity
I70599	Other atherosclerosis of nonautologous biological bypass graft(s) of the extremities, unspecified extremity
I706	Atherosclerosis of nonbiological bypass graft(s) of the extremities
I7060	Unspecified atherosclerosis of nonbiological bypass graft(s) of the extremities
I70601	Unspecified atherosclerosis of nonbiological bypass graft(s) of the extremities, right leg
I70602	Unspecified atherosclerosis of nonbiological bypass graft(s) of the extremities, left leg
I70603	Unspecified atherosclerosis of nonbiological bypass graft(s) of the extremities, bilateral legs
I70608	Unspecified atherosclerosis of nonbiological bypass graft(s) of the extremities, other extremity
I70609	Unspecified atherosclerosis of nonbiological bypass graft(s) of the extremities, unspecified extremity
I7061	Atherosclerosis of nonbiological bypass graft(s) of the extremities with intermittent claudication
I70611	Atherosclerosis of nonbiological bypass graft(s) of the extremities with intermittent claudication, right leg
I70612	Atherosclerosis of nonbiological bypass graft(s) of the extremities with intermittent claudication, left leg
I70613	Atherosclerosis of nonbiological bypass graft(s) of the extremities with intermittent claudication, bilateral legs
I70618	Atherosclerosis of nonbiological bypass graft(s) of the extremities with intermittent claudication, other extremity
I70619	Atherosclerosis of nonbiological bypass graft(s) of the extremities with intermittent claudication, unspecified extremity
I7062	Atherosclerosis of nonbiological bypass graft(s) of the extremities with rest pain
I70621	Atherosclerosis of nonbiological bypass graft(s) of the extremities with rest pain, right leg
I70622	Atherosclerosis of nonbiological bypass graft(s) of the extremities with rest pain, left leg
I70623	Atherosclerosis of nonbiological bypass graft(s) of the extremities with rest pain, bilateral legs
I70628	Atherosclerosis of nonbiological bypass graft(s) of the extremities with rest pain, other extremity
I70629	Atherosclerosis of nonbiological bypass graft(s) of the extremities with rest pain, unspecified extremity
I7063	Atherosclerosis of nonbiological bypass graft(s) of the right leg with ulceration
I70631	Atherosclerosis of nonbiological bypass graft(s) of the right leg with ulceration of thigh
I70632	Atherosclerosis of nonbiological bypass graft(s) of the right leg with ulceration of calf
I70633	Atherosclerosis of nonbiological bypass graft(s) of the right leg with ulceration of ankle
I70634	Atherosclerosis of nonbiological bypass graft(s) of the right leg with ulceration of heel and midfoot
I70635	Atherosclerosis of nonbiological bypass graft(s) of the right leg with ulceration of other part of foot
I70638	Atherosclerosis of nonbiological bypass graft(s) of the right leg with ulceration of other part of lower leg
I70639	Atherosclerosis of nonbiological bypass graft(s) of the right leg with ulceration of unspecified site
I7064	Atherosclerosis of nonbiological bypass graft(s) of the left leg with ulceration
I70641	Atherosclerosis of nonbiological bypass graft(s) of the left leg with ulceration of thigh
I70642	Atherosclerosis of nonbiological bypass graft(s) of the left leg with ulceration of calf
I70643	Atherosclerosis of nonbiological bypass graft(s) of the left leg with ulceration of ankle
I70644	Atherosclerosis of nonbiological bypass graft(s) of the left leg with ulceration of heel and midfoot
I70645	Atherosclerosis of nonbiological bypass graft(s) of the left leg with ulceration of other part of foot
I70648	Atherosclerosis of nonbiological bypass graft(s) of the left leg with ulceration of other part of lower leg
I70649	Atherosclerosis of nonbiological bypass graft(s) of the left leg with ulceration of unspecified site
I7065	Atherosclerosis of nonbiological bypass graft(s) of other extremity with ulceration
I7066	Atherosclerosis of nonbiological bypass graft(s) of the extremities with gangrene
I70661	Atherosclerosis of nonbiological bypass graft(s) of the extremities with gangrene, right leg
I70662	Atherosclerosis of nonbiological bypass graft(s) of the extremities with gangrene, left leg

(Continued)

TABLE E2. Continued

ICD-10 code	Description
I70663	Atherosclerosis of nonbiological bypass graft(s) of the extremities with gangrene, bilateral legs
I70668	Atherosclerosis of nonbiological bypass graft(s) of the extremities with gangrene, other extremity
I70669	Atherosclerosis of nonbiological bypass graft(s) of the extremities with gangrene, unspecified extremity
I7069	Other atherosclerosis of nonbiological bypass graft(s) of the extremities
I70691	Other atherosclerosis of nonbiological bypass graft(s) of the extremities, right leg
I70692	Other atherosclerosis of nonbiological bypass graft(s) of the extremities, left leg
I70693	Other atherosclerosis of nonbiological bypass graft(s) of the extremities, bilateral legs
I70698	Other atherosclerosis of nonbiological bypass graft(s) of the extremities, other extremity
I70699	Other atherosclerosis of nonbiological bypass graft(s) of the extremities, unspecified extremity
I707	Atherosclerosis of other type of bypass graft(s) of the extremities
I7070	Unspecified atherosclerosis of other type of bypass graft(s) of the extremities
I70701	Unspecified atherosclerosis of other type of bypass graft(s) of the extremities, right leg
I70702	Unspecified atherosclerosis of other type of bypass graft(s) of the extremities, left leg
I70703	Unspecified atherosclerosis of other type of bypass graft(s) of the extremities, bilateral legs
I70708	Unspecified atherosclerosis of other type of bypass graft(s) of the extremities, other extremity
I70709	Unspecified atherosclerosis of other type of bypass graft(s) of the extremities, unspecified extremity
I7071	Atherosclerosis of other type of bypass graft(s) of the extremities with intermittent claudication
I70711	Atherosclerosis of other type of bypass graft(s) of the extremities with intermittent claudication, right leg
I70712	Atherosclerosis of other type of bypass graft(s) of the extremities with intermittent claudication, left leg
I70713	Atherosclerosis of other type of bypass graft(s) of the extremities with intermittent claudication, bilateral legs
I70718	Atherosclerosis of other type of bypass graft(s) of the extremities with intermittent claudication, other extremity
I70719	Atherosclerosis of other type of bypass graft(s) of the extremities with intermittent claudication, unspecified extremity
I7072	Atherosclerosis of other type of bypass graft(s) of the extremities with rest pain
I70721	Atherosclerosis of other type of bypass graft(s) of the extremities with rest pain, right leg
I70722	Atherosclerosis of other type of bypass graft(s) of the extremities with rest pain, left leg
I70723	Atherosclerosis of other type of bypass graft(s) of the extremities with rest pain, bilateral legs
I70728	Atherosclerosis of other type of bypass graft(s) of the extremities with rest pain, other extremity
I70729	Atherosclerosis of other type of bypass graft(s) of the extremities with rest pain, unspecified extremity
I7073	Atherosclerosis of other type of bypass graft(s) of the right leg with ulceration
I70731	Atherosclerosis of other type of bypass graft(s) of the right leg with ulceration of thigh
I70732	Atherosclerosis of other type of bypass graft(s) of the right leg with ulceration of calf
I70733	Atherosclerosis of other type of bypass graft(s) of the right leg with ulceration of ankle
I70734	Atherosclerosis of other type of bypass graft(s) of the right leg with ulceration of heel and midfoot
I70735	Atherosclerosis of other type of bypass graft(s) of the right leg with ulceration of other part of foot
I70738	Atherosclerosis of other type of bypass graft(s) of the right leg with ulceration of other part of lower leg
I70739	Atherosclerosis of other type of bypass graft(s) of the right leg with ulceration of unspecified site
I7074	Atherosclerosis of other type of bypass graft(s) of the left leg with ulceration
I70741	Atherosclerosis of other type of bypass graft(s) of the left leg with ulceration of thigh
I70742	Atherosclerosis of other type of bypass graft(s) of the left leg with ulceration of calf
I70743	Atherosclerosis of other type of bypass graft(s) of the left leg with ulceration of ankle
I70744	Atherosclerosis of other type of bypass graft(s) of the left leg with ulceration of heel and midfoot
I70745	Atherosclerosis of other type of bypass graft(s) of the left leg with ulceration of other part of foot
I70748	Atherosclerosis of other type of bypass graft(s) of the left leg with ulceration of other part of lower leg
I70749	Atherosclerosis of other type of bypass graft(s) of the left leg with ulceration of unspecified site
I7075	Atherosclerosis of other type of bypass graft(s) of other extremity with ulceration
I7076	Atherosclerosis of other type of bypass graft(s) of the extremities with gangrene
I70761	Atherosclerosis of other type of bypass graft(s) of the extremities with gangrene, right leg
I70762	Atherosclerosis of other type of bypass graft(s) of the extremities with gangrene, left leg
I70763	Atherosclerosis of other type of bypass graft(s) of the extremities with gangrene, bilateral legs
I70768	Atherosclerosis of other type of bypass graft(s) of the extremities with gangrene, other extremity
I70769	Atherosclerosis of other type of bypass graft(s) of the extremities with gangrene, unspecified extremity
I7079	Other atherosclerosis of other type of bypass graft(s) of the extremities
I70791	Other atherosclerosis of other type of bypass graft(s) of the extremities, right leg
I70792	Other atherosclerosis of other type of bypass graft(s) of the extremities, left leg

(Continued)

TABLE E2. Continued

ICD-10 code	Description
I70793	Other atherosclerosis of other type of bypass graft(s) of the extremities, bilateral legs
I70798	Other atherosclerosis of other type of bypass graft(s) of the extremities, other extremity
I70799	Other atherosclerosis of other type of bypass graft(s) of the extremities, unspecified extremity
I708	Atherosclerosis of other arteries
I709	Other and unspecified atherosclerosis
I7090	Unspecified atherosclerosis
I7091	Generalized atherosclerosis
I7092	Chronic total occlusion of artery of the extremities
Z8679	Personal history of other diseases of the circulatory system
COPD	
J43	Emphysema
J430	Unilateral pulmonary emphysema
J431	Panlobular emphysema
J432	Centrilobular emphysema
J438	Other emphysema
J439	Emphysema, unspecified
J449	Chronic obstructive pulmonary disease, unspecified
J44	Other chronic obstructive pulmonary disease
J440	Chronic obstructive pulmonary disease with (acute) lower respiratory infection
J441	Chronic obstructive pulmonary disease with (acute) exacerbation
J442	Chronic obstructive pulmonary disease, unspecified
Marfan syndrome	
Q8740	Marfan syndrome unspecified
Q8741	Marfan syndrome with cardiovascular manifestations
Q87410	Marfan syndrome with aortic dilation
Q87418	Marfan syndrome with other cardiovascular manifestations
Q8742	Marfan syndrome with ocular manifestations
Q8743	Marfan syndrome with skeletal manifestations
Q874	Marfan syndrome
Ehlers-Danlos syndrome	
Q7960	Ehlers-Danlos syndrome, unspecified
Q7961	Classical Ehlers-Danlos syndrome
Q7962	Hypermobile Ehlers-Danlos syndrome
Q7963	Vascular Ehlers-Danlos syndrome
Q7969	Other Ehlers-Danlos syndrome
Q796	Ehlers-Danlos syndrome
Turner syndrome	
Q960	Turner syndrome karyotype 45, X
Q961	Turner syndrome karyotype 46, X iso (Xq)
Q962	Turner syndrome karyotype 46, X with abnormal sex chromosome, except iso (Xq)
Q963	Turner syndrome mosaicism, 45, X/46, XX or XY
Q964	Turner syndrome mosaicism, 45, X/other cell line(s) with abnormal sex chromosome
Q968	Turner syndrome, other variants of Turner syndrome
Q969	Turner syndrome, unspecified
Q96	Turner syndrome
Diabetes	
E101	Type 1 diabetes mellitus with ketoacidosis
E1010	Type 1 diabetes mellitus with ketoacidosis without coma
E1011	Type 1 diabetes mellitus with ketoacidosis with coma
E102	Type 1 diabetes mellitus with kidney complications
E1021	Type 1 diabetes mellitus with diabetic nephropathy
E1022	Type 1 diabetes mellitus with diabetic chronic kidney disease
E1029	Type 1 diabetes mellitus with other diabetic kidney complication
E103	Type 1 diabetes mellitus with ophthalmic complications

(Continued)

TABLE E2. Continued

ICD-10 code	Description
E1031	Type 1 diabetes mellitus with unspecified diabetic retinopathy
E10311	Type 1 diabetes mellitus with unspecified diabetic retinopathy with macular edema
E10319	Type 1 diabetes mellitus with unspecified diabetic retinopathy without macular edema
E1032	Type 1 diabetes mellitus with mild nonproliferative diabetic retinopathy
E10321	Type 1 diabetes mellitus with mild nonproliferative diabetic retinopathy with macular edema
E103211	Type 1 diabetes mellitus with mild nonproliferative diabetic retinopathy with macular edema right eye
E103212	Type 1 diabetes mellitus with mild nonproliferative diabetic retinopathy with macular edema left eye
E103213	Type 1 diabetes mellitus with mild nonproliferative diabetic retinopathy with macular edema bilateral
E103219	Type 1 diabetes mellitus with mild nonproliferative diabetic retinopathy with macular edema unspecified eye
E10329	Type 1 diabetes mellitus with mild nonproliferative diabetic retinopathy without macular edema
E103291	Type 1 diabetes mellitus with mild nonproliferative diabetic retinopathy without macular edema right eye
E103292	Type 1 diabetes mellitus with mild nonproliferative diabetic retinopathy without macular edema left eye
E103293	Type 1 diabetes mellitus with mild nonproliferative diabetic retinopathy without macular edema bilateral
E103299	Type 1 diabetes mellitus with mild nonproliferative diabetic retinopathy without macular edema unspecified eye
E1033	Type 1 diabetes mellitus with moderate nonproliferative diabetic retinopathy
E10331	Type 1 diabetes mellitus with moderate nonproliferative diabetic retinopathy with macular edema
E103311	Type 1 diabetes mellitus with moderate nonproliferative diabetic retinopathy with macular edema right eye
E103312	Type 1 diabetes mellitus with moderate nonproliferative diabetic retinopathy with macular edema left eye
E103313	Type 1 diabetes mellitus with moderate nonproliferative diabetic retinopathy with macular edema bilateral
E103319	Type 1 diabetes mellitus with moderate nonproliferative diabetic retinopathy with macular edema unspecified eye
E10339	Type 1 diabetes mellitus with moderate nonproliferative diabetic retinopathy without macular edema
E103391	Type 1 diabetes mellitus with moderate nonproliferative diabetic retinopathy without macular edema right eye
E103392	Type 1 diabetes mellitus with moderate nonproliferative diabetic retinopathy without macular edema left eye
E103393	Type 1 diabetes mellitus with moderate nonproliferative diabetic retinopathy without macular edema bilateral
E103399	Type 1 diabetes mellitus with moderate nonproliferative diabetic retinopathy without macular edema unspecified eye
E1034	Type 1 diabetes mellitus with severe nonproliferative diabetic retinopathy
E10341	Type 1 diabetes mellitus with severe nonproliferative diabetic retinopathy with macular edema
E103411	Type 1 diabetes mellitus with severe nonproliferative diabetic retinopathy with macular edema right eye
E103412	Type 1 diabetes mellitus with severe nonproliferative diabetic retinopathy with macular edema left eye
E103413	Type 1 diabetes mellitus with severe nonproliferative diabetic retinopathy with macular edema bilateral
E103419	Type 1 diabetes mellitus with severe nonproliferative diabetic retinopathy with macular edema unspecified eye
E10349	Type 1 diabetes mellitus with severe nonproliferative diabetic retinopathy without macular edema
E103491	Type 1 diabetes mellitus with severe nonproliferative diabetic retinopathy without macular edema right eye
E103492	Type 1 diabetes mellitus with severe nonproliferative diabetic retinopathy without macular edema left eye
E103493	Type 1 diabetes mellitus with severe nonproliferative diabetic retinopathy without macular edema bilateral
E103499	Type 1 diabetes mellitus with severe nonproliferative diabetic retinopathy without macular edema unspecified eye
E1035	Type 1 diabetes mellitus with proliferative diabetic retinopathy
E10351	Type 1 diabetes mellitus with proliferative diabetic retinopathy with macular edema
E103511	Type 1 diabetes mellitus with proliferative diabetic retinopathy with macular edema right eye
E103512	Type 1 diabetes mellitus with proliferative diabetic retinopathy with macular edema left eye
E103513	Type 1 diabetes mellitus with proliferative diabetic retinopathy with macular edema bilateral
E103519	Type 1 diabetes mellitus with proliferative diabetic retinopathy with macular edema unspecified eye
E10352	Type 1 diabetes mellitus with proliferative diabetic retinopathy with traction retinal detachment involving the macula
E103521	Type 1 diabetes mellitus with proliferative diabetic retinopathy with traction retinal detachment involving the macula right eye
E103522	Type 1 diabetes mellitus with proliferative diabetic retinopathy with traction retinal detachment involving the macula left eye
E103523	Type 1 diabetes mellitus with proliferative diabetic retinopathy with traction retinal detachment involving the macula bilateral
E103529	Type 1 diabetes mellitus with proliferative diabetic retinopathy with traction retinal detachment involving the macula unspecified eye
E10353	Type 1 diabetes mellitus with proliferative diabetic retinopathy with traction retinal detachment not involving the macula

(Continued)

TABLE E2. Continued

ICD-10 code	Description
E103531	Type 1 diabetes mellitus with proliferative diabetic retinopathy with traction retinal detachment not involving the macula
E103532	Type 1 diabetes mellitus with proliferative diabetic retinopathy with traction retinal detachment not involving the macula left eye
E103533	Type 1 diabetes mellitus with proliferative diabetic retinopathy with traction retinal detachment not involving macula bilateral
E103539	Type 1 diabetes mellitus with proliferative diabetic retinopathy with traction retinal detachment not involving macula unspecified eye
E10354	Type 1 diabetes mellitus with proliferative diabetic retinopathy with combined traction retinal detachment and rhegmatogenous retinal detachment
E103541	Type 1 diabetes mellitus with proliferative diabetic retinopathy with combined traction retinal detachment and rhegmatogenous retinal detachment right eye
E103542	Type 1 diabetes mellitus with proliferative diabetic retinopathy with combined traction retinal detachment and rhegmatogenous retinal detachment left eye
E103543	Type 1 diabetes mellitus with proliferative diabetic retinopathy with combined traction retinal detachment and rhegmatogenous retinal detachment bilateral
E103549	Type 1 diabetes mellitus with proliferative diabetic retinopathy with combined traction retinal detachment and rhegmatogenous retinal detachment unspecified eye
E10355	Type 1 diabetes mellitus with stable proliferative diabetic retinopathy
E103551	Type 1 diabetes mellitus with stable proliferative diabetic retinopathy right eye
E103552	Type 1 diabetes mellitus with stable proliferative diabetic retinopathy left eye
E103553	Type 1 diabetes mellitus with stable proliferative diabetic retinopathy bilateral
E103559	Type 1 diabetes mellitus with stable proliferative diabetic retinopathy unspecified eye
E10359	Type 1 diabetes mellitus with proliferative diabetic retinopathy without macular edema
E103591	Type 1 diabetes mellitus with proliferative diabetic retinopathy without macular edema right eye
E103592	Type 1 diabetes mellitus with proliferative diabetic retinopathy without macular edema left eye
E103593	Type 1 diabetes mellitus with proliferative diabetic retinopathy without macular edema bilateral
E103599	Type 1 diabetes mellitus with proliferative diabetic retinopathy without macular edema unspecified eye
E1036	Type 1 diabetes mellitus with diabetic cataract
E1037	Type 1 diabetes mellitus with diabetic macular edema, resolved following treatment
E1037X1	Type 1 diabetes mellitus with diabetic macular edema, resolved following treatment right eye
E1037X2	Type 1 diabetes mellitus with diabetic macular edema, resolved following treatment left eye
E1037X3	Type 1 diabetes mellitus with diabetic macular edema, resolved following treatment bilateral
E1037X9	Type 1 diabetes mellitus with diabetic macular edema, resolved following treatment unspecified eye
E1039	Type 1 diabetes mellitus with other diabetic ophthalmic complication
E104	Type 1 diabetes mellitus with neurological complications
E1040	Type 1 diabetes mellitus with diabetic neuropathy, unspecified
E1041	Type 1 diabetes mellitus with diabetic mononeuropathy
E1042	Type 1 diabetes mellitus with diabetic polyneuropathy
E1043	Type 1 diabetes mellitus with diabetic autonomic (poly)neuropathy
E1044	Type 1 diabetes mellitus with diabetic amyotrophy
E1049	Type 1 diabetes mellitus with other diabetic neurologic complication
E105	Type 1 diabetes mellitus with circulatory complications
E1051	Type 1 diabetes mellitus with diabetic peripheral angiopathy without gangrene
E1052	Type 1 diabetes mellitus with diabetic peripheral angiopathy with gangrene
E1059	Type 1 diabetes mellitus with other circulatory complications
E106	Type 1 diabetes mellitus with other specified complications
E1061	Type 1 diabetes mellitus with diabetic arthropathy
E10610	Type 1 diabetes mellitus with diabetic neuropathic arthropathy
E10618	Type 1 diabetes mellitus with other diabetic arthropathy
E1062	Type 1 diabetes mellitus with skin complications
E10620	Type 1 diabetes mellitus with diabetic dermatitis
E10621	Type 1 diabetes mellitus with foot ulcer
E10622	Type 1 diabetes mellitus with other skin ulcer
E10628	Type 1 diabetes mellitus with other skin complications

(Continued)

TABLE E2. Continued

ICD-10 code	Description
E1063	Type 1 diabetes mellitus with oral complications
E10630	Type 1 diabetes mellitus with periodontal disease
E10638	Type 1 diabetes mellitus with other oral complications
E1064	Type 1 diabetes mellitus with hypoglycemia
E10641	Type 1 diabetes mellitus with hypoglycemia with coma
E10649	Type 1 diabetes mellitus with hypoglycemia without coma
E1065	Type 1 diabetes mellitus with hyperglycemia
E1069	Type 1 diabetes mellitus with other specified complication
E108	Type 1 diabetes mellitus with unspecified complications
E109	Type 1 diabetes mellitus without complications
E110	Type 2 diabetes mellitus with hyperosmolarity
E1100	Type 2 diabetes mellitus with hyperosmolarity without nonketotic hyperglycemic-hyperosmolar coma (NKHHC)
E1101	Type 2 diabetes mellitus with hyperosmolarity with coma
E111	Type 2 diabetes mellitus with ketoacidosis
E1110	Type 2 diabetes mellitus with ketoacidosis without coma
E1111	Type 2 diabetes mellitus with ketoacidosis with coma
E112	Type 2 diabetes mellitus with kidney complications
E1121	Type 2 diabetes mellitus with diabetic nephropathy
E1122	Type 2 diabetes mellitus with diabetic chronic kidney disease
E1129	Type 2 diabetes mellitus with other diabetic kidney complication
E113	Type 2 diabetes mellitus with ophthalmic complications
E1131	Type 2 diabetes mellitus with unspecified diabetic retinopathy
E11311	Type 2 diabetes mellitus with unspecified diabetic retinopathy with macular edema
E11319	Type 2 diabetes mellitus with unspecified diabetic retinopathy without macular edema
E1132	Type 2 diabetes mellitus with mild nonproliferative diabetic retinopathy
E11321	Type 2 diabetes mellitus with mild nonproliferative diabetic retinopathy with macular edema
E113211	Type 2 diabetes mellitus with mild nonproliferative diabetic retinopathy with macular edema right eye
E113212	Type 2 diabetes mellitus with mild nonproliferative diabetic retinopathy with macular edema left eye
E113213	Type 2 diabetes mellitus with mild nonproliferative diabetic retinopathy with macular edema bilateral
E113219	Type 2 diabetes mellitus with mild nonproliferative diabetic retinopathy with macular edema unspecified eye
E11329	Type 2 diabetes mellitus with mild nonproliferative diabetic retinopathy without macular edema
E113291	Type 2 diabetes mellitus with mild nonproliferative diabetic retinopathy without macular edema right eye
E113292	Type 2 diabetes mellitus with mild nonproliferative diabetic retinopathy without macular edema left eye
E113293	Type 2 diabetes mellitus with mild nonproliferative diabetic retinopathy without macular edema bilateral
E113299	Type 2 diabetes mellitus with mild nonproliferative diabetic retinopathy without macular edema unspecified eye
E1133	Type 2 diabetes mellitus with moderate nonproliferative diabetic retinopathy
E11331	Type 2 diabetes mellitus with moderate nonproliferative diabetic retinopathy with macular edema
E113311	Type 2 diabetes mellitus with moderate nonproliferative diabetic retinopathy with macular edema right eye
E113312	Type 2 diabetes mellitus with moderate nonproliferative diabetic retinopathy with macular edema left eye
E113313	Type 2 diabetes mellitus with moderate nonproliferative diabetic retinopathy with macular edema bilateral
E113319	Type 2 diabetes mellitus with moderate nonproliferative diabetic retinopathy with macular edema unspecified eye
E11339	Type 2 diabetes mellitus with moderate nonproliferative diabetic retinopathy without macular edema
E113391	Type 2 diabetes mellitus with moderate nonproliferative diabetic retinopathy without macular edema right eye
E113392	Type 2 diabetes mellitus with moderate nonproliferative diabetic retinopathy without macular edema left eye
E113393	Type 2 diabetes mellitus with moderate nonproliferative diabetic retinopathy without macular edema bilateral
E113399	Type 2 diabetes mellitus with moderate nonproliferative diabetic retinopathy without macular edema unspecified eye
E1134	Type 2 diabetes mellitus with severe nonproliferative diabetic retinopathy
E11341	Type 2 diabetes mellitus with severe nonproliferative diabetic retinopathy with macular edema
E113411	Type 2 diabetes mellitus with severe nonproliferative diabetic retinopathy with macular edema right eye
E113412	Type 2 diabetes mellitus with severe nonproliferative diabetic retinopathy with macular edema left eye
E113413	Type 2 diabetes mellitus with severe nonproliferative diabetic retinopathy with macular edema bilateral
E113419	Type 2 diabetes mellitus with severe nonproliferative diabetic retinopathy with macular edema unspecified eye
E11349	Type 2 diabetes mellitus with severe nonproliferative diabetic retinopathy without macular edema
E113491	Type 2 diabetes mellitus with severe nonproliferative diabetic retinopathy without macular edema right eye

(Continued)

TABLE E2. Continued

ICD-10 code	Description
E113492	Type 2 diabetes mellitus with severe nonproliferative diabetic retinopathy without macular edema left eye
E113493	Type 2 diabetes mellitus with severe nonproliferative diabetic retinopathy without macular edema bilateral
E113499	Type 2 diabetes mellitus with severe nonproliferative diabetic retinopathy without macular edema unspecified eye
E1135	Type 2 diabetes mellitus with proliferative diabetic retinopathy
E11351	Type 2 diabetes mellitus with proliferative diabetic retinopathy with macular edema
E113511	Type 2 diabetes mellitus with proliferative diabetic retinopathy with macular edema right eye
E113512	Type 2 diabetes mellitus with proliferative diabetic retinopathy with macular edema left eye
E113513	Type 2 diabetes mellitus with proliferative diabetic retinopathy with macular edema bilateral
E113519	Type 2 diabetes mellitus with proliferative diabetic retinopathy with macular edema unspecified eye
E11352	Type 2 diabetes mellitus with proliferative diabetic retinopathy with traction retinal detachment involving the macula
E113521	Type 2 diabetes mellitus with proliferative diabetic retinopathy with traction retinal detachment involving the macula right eye
E113522	Type 2 diabetes mellitus with proliferative diabetic retinopathy with traction retinal detachment involving the macula left eye
E113523	Type 2 diabetes mellitus with proliferative diabetic retinopathy with traction retinal detachment involving the macula bilateral
E113529	Type 2 diabetes mellitus with proliferative diabetic retinopathy with traction retinal detachment involving the macula unspecified eye
E11353	Type 2 diabetes mellitus with proliferative diabetic retinopathy with traction retinal detachment not involving macula
E113531	Type 2 diabetes mellitus with proliferative diabetic retinopathy with traction retinal detachment not involving macula right eye
E113532	Type 2 diabetes mellitus with proliferative diabetic retinopathy with traction retinal detachment not involving macula left eye
E113533	Type 2 diabetes mellitus with proliferative diabetic retinopathy with traction retinal detachment not involving macula bilateral
E113539	Type 2 diabetes mellitus with proliferative diabetic retinopathy with traction retinal detachment not involving macula unspecified eye
E11354	Type 2 diabetes mellitus with proliferative diabetic retinopathy with combined traction retinal detachment and rhegmatogenous retinal detachment
E113541	Type 2 diabetes mellitus with proliferative diabetic retinopathy with combined traction retinal detachment and rhegmatogenous retinal detachment right eye
E113542	Type 2 diabetes mellitus with proliferative diabetic retinopathy with combined traction retinal detachment and rhegmatogenous retinal detachment left eye
E113543	Type 2 diabetes mellitus with proliferative diabetic retinopathy with combined traction retinal detachment and rhegmatogenous retinal detachment bilateral
E113549	Type 2 diabetes mellitus with proliferative diabetic retinopathy with combined traction retinal detachment and rhegmatogenous retinal detachment unspecified eye
E11355	Type 2 diabetes mellitus with stable proliferative diabetic retinopathy
E113551	Type 2 diabetes mellitus with stable proliferative diabetic retinopathy right eye
E113552	Type 2 diabetes mellitus with stable proliferative diabetic retinopathy left eye
E113553	Type 2 diabetes mellitus with stable proliferative diabetic retinopathy bilateral
E113559	Type 2 diabetes mellitus with stable proliferative diabetic retinopathy unspecified eye
E11359	Type 2 diabetes mellitus with proliferative diabetic retinopathy without macular edema
E113591	Type 2 diabetes mellitus with proliferative diabetic retinopathy without macular edema right eye
E113592	Type 2 diabetes mellitus with proliferative diabetic retinopathy without macular edema left eye
E113593	Type 2 diabetes mellitus with proliferative diabetic retinopathy without macular edema bilateral
E113599	Type 2 diabetes mellitus with proliferative diabetic retinopathy without macular edema unspecified eye
E1136	Type 2 diabetes mellitus with diabetic cataract
E1137	Type 2 diabetes mellitus with diabetic macular edema, resolved following treatment
E1137X1	Type 2 diabetes mellitus with diabetic macular edema, resolved following treatment right eye
E1137X2	Type 2 diabetes mellitus with diabetic macular edema, resolved following treatment left eye
E1137X3	Type 2 diabetes mellitus with diabetic macular edema, resolved following treatment bilateral
E1137X9	Type 2 diabetes mellitus with diabetic macular edema, resolved following treatment unspecified eye

(Continued)

TABLE E2. Continued

ICD-10 code	Description
E1139	Type 2 diabetes mellitus with other diabetic ophthalmic complication
E114	Type 2 diabetes mellitus with neurological complications
E1140	Type 2 diabetes mellitus with diabetic neuropathy, unspecified
E1141	Type 2 diabetes mellitus with diabetic mononeuropathy
E1142	Type 2 diabetes mellitus with diabetic polyneuropathy
E1143	Type 2 diabetes mellitus with diabetic autonomic (poly)neuropathy
E1144	Type 2 diabetes mellitus with diabetic amyotrophy
E1149	Type 2 diabetes mellitus with other diabetic neurological complication
E115	Type 2 diabetes mellitus with circulatory complications
E1151	Type 2 diabetes mellitus with diabetic peripheral angiopathy without gangrene
E1152	Type 2 diabetes mellitus with diabetic peripheral angiopathy with gangrene
E1159	Type 2 diabetes mellitus with other circulatory complications
E116	Type 2 diabetes mellitus with other specified complications
E1161	Type 2 diabetes mellitus with diabetic arthropathy
E11610	Type 2 diabetes mellitus with diabetic neuropathic arthropathy
E11618	Type 2 diabetes mellitus with other diabetic arthropathy
E1162	Type 2 diabetes mellitus with skin complications
E11620	Type 2 diabetes mellitus with diabetic dermatitis
E11621	Type 2 diabetes mellitus with foot ulcer
E11622	Type 2 diabetes mellitus with other skin ulcer
E11628	Type 2 diabetes mellitus with other skin complications
E1163	Type 2 diabetes mellitus with oral complications
E11630	Type 2 diabetes mellitus with periodontal disease
E11638	Type 2 diabetes mellitus with other oral complications
E1164	Type 2 diabetes mellitus with hypoglycemia
E11641	Type 2 diabetes mellitus with hypoglycemia with coma
E11649	Type 2 diabetes mellitus with hypoglycemia without coma
E1165	Type 2 diabetes mellitus with hyperglycemia
E10	Type I diabetes
E11	Type II diabetes
Prior cardiac surgery	
Z951	Presence of aortocoronary bypass graft
Z952	Presence of prosthetic heart valve
Z953	Presence of xenogenic heart valve
Z954	Presence of other heart valve replacement
Z955	Presence of coronary angioplasty implant and graft
Z958	Presence of other cardiac and vascular implants and grafts
Z95810	Presence of automatic (implantable) cardiac defibrillator
Z95811	Presence of heart assist device
Z95812	Presence of fully implantable artificial heart
Z95818	Presence of other cardiac implants and grafts
Z9582	Presence of other vascular implants and grafts
Z95820	Peripheral vascular angioplasty status with implants and grafts
Z95828	Presence of other vascular implants and grafts
Z959	Presence of cardiac and vascular implant and graft, unspecified
Z95	Presence of vascular implants and grafts on presentation
Chronic heart disease	
I25	Chronic ischemic heart disease
I251	Atherosclerotic heart disease of native coronary artery
I2510	Atherosclerotic heart disease of native coronary artery without angina pectoris
I2511	Atherosclerotic heart disease of native coronary artery with angina pectoris
I25110	Atherosclerotic heart disease of native coronary artery with unstable angina pectoris
I25111	Atherosclerotic heart disease of native coronary artery with unstable angina pectoris with documented spasm
I25118	Atherosclerotic heart disease of native coronary artery with other forms of angina pectoris

(Continued)

TABLE E2. Continued

ICD-10 code	Description
I25119	Atherosclerotic heart disease of native coronary artery with unspecified angina pectoris
I252	Old myocardial infarction
I253	Aneurysm of heart
I254	Coronary artery aneurysm and dissection
I2541	Coronary artery aneurysm
I2542	Coronary artery dissection
I255	Ischemic cardiomyopathy
I256	Silent myocardial ischemia
I257	Atherosclerosis of coronary artery bypass graft(s) and coronary artery of transplanted heart with angina pectoris
I2570	Atherosclerosis of coronary artery bypass graft(s), unspecified, with angina pectoris
I25700	Atherosclerosis of coronary artery bypass graft(s), unspecified, with unstable angina pectoris
I25701	Atherosclerosis of coronary artery bypass graft(s), unspecified, with unstable angina pectoris with documented spasm
I25708	Atherosclerosis of coronary artery bypass graft(s), unspecified, with other forms of angina pectoris
I25709	Atherosclerosis of coronary artery bypass graft(s), unspecified, with unspecified angina pectoris
I2571	Atherosclerosis of autologous vein coronary artery bypass graft(s) with angina pectoris
I25710	Atherosclerosis of autologous vein coronary artery bypass graft(s) with unstable angina pectoris
I25711	Atherosclerosis of autologous vein coronary artery bypass graft(s) with unstable angina pectoris with documented spasm
I25718	Atherosclerosis of autologous vein coronary artery bypass graft(s) with other forms of angina pectoris
I25719	Atherosclerosis of autologous vein coronary artery bypass graft(s) with unspecified angina pectoris
I2572	Atherosclerosis of autologous artery coronary artery bypass graft(s) with angina pectoris
I25720	Atherosclerosis of autologous artery coronary artery bypass graft(s) with unstable angina pectoris
I25721	Atherosclerosis of autologous artery coronary artery bypass graft(s) with unstable angina pectoris with documented spasm
I25728	Atherosclerosis of autologous artery coronary artery bypass graft(s) with other forms of angina pectoris
I25729	Atherosclerosis of autologous artery coronary artery bypass graft(s) with unspecified angina pectoris
I2573	Atherosclerosis of nonautologous biological coronary artery bypass graft(s) with angina pectoris
I25730	Atherosclerosis of nonautologous biological coronary artery bypass graft(s) with unstable angina pectoris
I25731	Atherosclerosis of nonautologous biological coronary artery bypass graft(s) with unstable angina pectoris with documented spasm
I25738	Atherosclerosis of nonautologous biological coronary artery bypass graft(s) with other forms of angina pectoris
I25739	Atherosclerosis of nonautologous biological coronary artery bypass graft(s) with unspecified angina pectoris
I2575	Atherosclerosis of native coronary artery of transplanted heart with angina pectoris
I25750	Atherosclerosis of native coronary artery of transplanted heart with unstable angina
I25751	Atherosclerosis of native coronary artery of transplanted heart with unstable angina with documented spasm
I25758	Atherosclerosis of native coronary artery of transplanted heart with other forms of angina pectoris
I25759	Atherosclerosis of native coronary artery of transplanted heart with unspecified angina pectoris
I2576	Atherosclerosis of bypass graft of coronary artery of transplanted heart with angina pectoris
I25760	Atherosclerosis of bypass graft of coronary artery of transplanted heart with unstable angina
I25761	Atherosclerosis of bypass graft of coronary artery of transplanted heart with unstable angina with documented spasm
I25768	Atherosclerosis of bypass graft of coronary artery of transplanted heart with other forms of angina pectoris
I25769	Atherosclerosis of bypass graft of coronary artery of transplanted heart with unspecified angina pectoris
I2579	Atherosclerosis of other coronary artery bypass graft(s) with angina pectoris
I25790	Atherosclerosis of other coronary artery bypass graft(s) with unstable angina pectoris
I25791	Atherosclerosis of other coronary artery bypass graft(s) with unstable angina pectoris with documented spasm
I25798	Atherosclerosis of other coronary artery bypass graft(s) with other forms of angina pectoris
I25799	Atherosclerosis of other coronary artery bypass graft(s) with unspecified angina pectoris
I258	Other forms of chronic ischemic heart disease
I2581	Atherosclerosis of other coronary vessels without angina pectoris
I25810	Atherosclerosis of coronary artery bypass graft(s) without angina pectoris
I25811	Atherosclerosis of native coronary artery of transplanted heart without angina pectoris
I25812	Atherosclerosis of bypass graft of coronary artery of transplanted heart without angina pectoris
I2582	Chronic total occlusion of coronary artery

(Continued)

TABLE E2. Continued

ICD-10 code	Description
I2583	Coronary atherosclerosis due to lipid rich plaque
I2584	Coronary atherosclerosis due to calcified coronary lesion
I2589	Other forms of chronic ischemic heart disease
I259	Chronic ischemic heart disease, unspecified
Chronic kidney disease	
N18	Chronic kidney disease (CKD)
N18.1	Chronic kidney disease, stage 1
N18.2	Chronic kidney disease, stage 2 (mild)
N18.3	Chronic kidney disease, stage 3 (moderate)
N18.30	Chronic kidney disease, stage 3 unspecified
N18.31	Chronic kidney disease, stage 3a
N18.32	Chronic kidney disease, stage 3b
N18.4	Chronic kidney disease, stage 4 (severe)
N18.5	Chronic kidney disease, stage 5
N18.6	End-stage renal disease
N18.9	Chronic kidney disease, unspecified
Aortic aneurysm	
I71.1	Thoracic aortic aneurysm, ruptured
I71.2	Thoracic aortic aneurysm, without rupture
I71.3	Abdominal aortic aneurysm, ruptured
I71.4	Abdominal aortic aneurysm, without rupture
I71.5	Thoracoabdominal aortic aneurysm, ruptured
I71.6	Thoracoabdominal aortic aneurysm, without rupture
I71.8	Aortic aneurysm of unspecified site, ruptured
I71.9	Aortic aneurysm of unspecified site, without rupture
Obesity	
Z6843	Body mass index 50-59.9
E669	Obesity
Cardiac inflammation	
M314	Takayasu (aortic arch syndrome)
M315	Giant cell arteritis with polymyalgia rheumatica
M316	Other giant cell arteritis
A5200	Cardiovascular syphilis, unspecified
A5201	Syphilitic aneurysm of aorta
A5202	Syphilitic aortitis
A5203	Syphilitic endocarditis
A5206	Other syphilitic heart involvement
A5209	Other cardiovascular syphilis
A1884	Tuberculosis of heart
Z950	Presence of cardiac pacemaker
Q231	Congenital insufficiency of aortic valve
Z8673	Personal history of transient ischemic attack (TIA), and cerebral infarction without residual deficits
Preoperative shock	
R57.0	Cardiogenic shock
R57.1	Hypovolemic shock
R57.8	Other shock
R57.9	Shock, unspecified

ICD-10, International Classification of Diseases, Tenth Revision.

TABLE E3. ICD-10 codes for complications

ICD-10 code	Description
Postprocedural shock/cardiac failure	
T8110XA	Postprocedural shock unspecified, initial encounter
T8111XA	Postprocedural cardiogenic shock, initial encounter
T8112XA	Postprocedural septic shock, initial encounter
T8119XA	Other postprocedural shock
T882	Shock due to anesthesia
T882XXA	Shock due to anesthesia initial encounter
I970	Postcardiotomy syndrome
I97110	Postprocedural cardiac insufficiency following cardiac surgery
I97120	Postprocedural cardiac arrest following cardiac surgery
I97130	Postprocedural heart failure following cardiac surgery
I97190	Other postprocedural cardiac functional disturbances following cardiac surgery
I97710	Intraoperative cardiac arrest during cardiac surgery
I97790	Other intraoperative cardiac functional disturbances during cardiac surgery
I977	Intraoperative cardiac functional disturbances
I97711	Intraoperative cardiac arrest during other surgery
I97791	Other intraoperative cardiac functional disturbances during other surgery
I971	Other postprocedural cardiac functional disturbances
I97121	Postprocedural cardiac arrest following other surgery
I97131	Postprocedural heart failure following other surgery
I97191	Other postprocedural cardiac functional disturbances following other surgery
I9788	Other intraoperative complications of the circulatory system, not elsewhere classified
I9789	Other procedural complications and disorders of the circulatory system, not elsewhere classified
Pulmonary complications	
Z9911	Dependence on a ventilator
Z930	Tracheostomy status
0B110D6	Bypass trachea to esophagus with intraluminal device, open approach
0B110F4	Bypass trachea to cutaneous with tracheostomy device, open approach
0B110Z4	Bypass trachea to cutaneous, open approach
0B113F4	Bypass trachea to cutaneous with tracheostomy device, percutaneous approach
0B113Z4	Bypass trachea to cutaneous, percutaneous approach
0B114F4	Bypass trachea to cutaneous with tracheostomy device, percutaneous endoscopic approach
0B114Z4	Bypass trachea to cutaneous, percutaneous endoscopic approach
J952	Acute pulmonary insufficiency following nonthoracic surgery
J95821	Acute postprocedural respiratory failure
J951	Acute pulmonary insufficiency following thoracic surgery
J95822	Acute and chronic postprocedural respiratory failure
J95851	Ventilator-associated pneumonia
J95859	Other complication of respirator
J9588	Chronic pulmonary insufficiency following surgery
T8282XA	Emphysema (subcutaneous) resulting from a procedure, initial encounter
J950	Tracheostomy complications
J9500	Unspecified tracheostomy complication
J9501	Hemorrhage from tracheostomy stoma
J9502	Infection of tracheostomy stoma
J9503	Malfunction of tracheostomy stoma
J9504	Tracheoesophageal fistula following tracheostomy
J9509	Other tracheostomy complication
J951	Acute pulmonary insufficiency following thoracic surgery
J952	Acute pulmonary insufficiency following nonthoracic surgery
J953	Chronic pulmonary insufficiency following surgery
J954	Chemical pneumonitis due to anesthesia
J955	Postprocedural subglottic stenosis
J956	Intraoperative hemorrhage and hematoma of a respiratory system organ or structure complicating a procedure

(Continued)

TABLE E3. Continued

ICD-10 code	Description
J9561	Intraoperative hemorrhage and hematoma of a respiratory system organ or structure complicating a respiratory system procedure
J9562	Intraoperative hemorrhage and hematoma of a respiratory system organ or structure complicating other procedure
J957	Accidental puncture and laceration of a respiratory system organ or structure during a procedure
J9571	Accidental puncture and laceration of a respiratory system organ or structure during a respiratory system procedure
J9572	Accidental puncture and laceration of a respiratory system organ or structure during other procedure
J958	Other intraoperative and postprocedural complications and disorders of respiratory system, not elsewhere classified
J9581	Postprocedural pneumothorax and air leak
J95811	Postprocedural pneumothorax
J95812	Postprocedural air leak
J9582	Postprocedural respiratory failure
J95821	Acute postprocedural respiratory failure
J95822	Acute and chronic postprocedural respiratory failure
J9583	Postprocedural hemorrhage of a respiratory system organ or structure following a procedure
J95830	Postprocedural hemorrhage of a respiratory system organ or structure following a respiratory system procedure
J95831	Postprocedural hemorrhage of a respiratory system organ or structure following other procedure
J9584	Transfusion-related acute lung injury (TRALI)
J9585	Complication of respirator [ventilator]
J95850	Mechanical complication of respirator
J95851	Ventilator-associated pneumonia
J95859	Other complication of respirator [ventilator]
J9586	Postprocedural hematoma and seroma of a respiratory system organ or structure following a procedure
J95860	Postprocedural hematoma of a respiratory system organ or structure following a respiratory system procedure
J95861	Postprocedural hematoma of a respiratory system organ or structure following other procedure
J95862	Postprocedural seroma of a respiratory system organ or structure following a respiratory system procedure
J95863	Postprocedural seroma of a respiratory system organ or structure following other procedure
J9588	Other intraoperative complications of respiratory system, not elsewhere classified
J9589	Other postprocedural complications and disorders of respiratory system, not elsewhere classified
Z990	Dependence on aspirator
Z991	Dependence on respirator
Z9912	Encounter for respirator [ventilator] dependence during power failure
Z9981	Dependence on supplemental oxygen
0B110D6	Bypass trachea to esophagus with intraluminal device, open approach
0B110F4	Bypass trachea to cutaneous with tracheostomy device, open approach
0B110Z4	Bypass trachea to cutaneous, open approach
0B113F4	Bypass trachea to cutaneous with tracheostomy device, percutaneous approach
0B113Z4	Bypass trachea to cutaneous, percutaneous approach
0B114F4	Bypass trachea to cutaneous with tracheostomy device, percutaneous endoscopic approach
0B114Z4	Bypass trachea to cutaneous, percutaneous endoscopic approach
Hemorrhage/hematoma/seroma	
I97410	Intraoperative hemorrhage and hematoma of a circulatory system organ or structure complicating a cardiac catheterization
I97411	Intraoperative hemorrhage and hematoma of a circulatory system organ or structure complicating a cardiac bypass
I97418	Intraoperative hemorrhage and hematoma of a circulatory system organ or structure complicating other circulatory system procedure
I9742	Intraoperative hemorrhage and hematoma of a circulatory system organ or structure complicating other procedure
I97610	Postprocedural hemorrhage of a circulatory system organ or structure following cardiac catheterization
I97611	Postprocedural hemorrhage of a circulatory system organ or structure following cardiac bypass
I97618	Postprocedural hemorrhage of a circulatory system organ or structure following other circulatory system procedure
I97620	Postprocedural hemorrhage of a circulatory system organ or structure following other procedure
I97621	Postprocedural hematoma of a circulatory system organ or structure following other procedure
I97630	Postprocedural hematoma of a circulatory system organ or structure following cardiac catheterization

(Continued)

TABLE E3. Continued

ICD-10 code	Description
I97631	Postprocedural hematoma of a circulatory system organ or structure following cardiac bypass
I97638	Postprocedural hematoma of a circulatory system organ or structure following other circulatory system procedure
I97622	Postprocedural seroma of a circulatory system organ or structure following other procedure
I97640	Postprocedural seroma of a circulatory system organ or structure following a cardiac catheterization
I97641	Postprocedural seroma of a circulatory system organ or structure following cardiac bypass
I97648	Postprocedural seroma of a circulatory system organ or structure following other circulatory system procedure
I9761	Postprocedural hemorrhage of a circulatory system organ or structure following a circulatory system procedure
I9762	Postprocedural hemorrhage, hematoma, and seroma of a circulatory system organ or structure following other procedure
I9763	Postprocedural hematoma of a circulatory system organ or structure following a circulatory system procedure
I9764	Postprocedural seroma of a circulatory system organ or structure following a circulatory system procedure
Stroke	
I97810	Intraoperative cerebrovascular infarction during cardiac surgery
I97820	Postprocedural cerebrovascular infarction following cardiac surgery
Adverse reaction	
T886	Anaphylactic reaction due to adverse effect of correct drug or medicament properly administered
T886XXA	Anaphylactic reaction due to adverse effect of correct drug or medicament properly administered, initial encounter
T887	Unspecified adverse effect of drug or medicament
T887XXA	Unspecified adverse effect of drug or medicament, initial encounter
Y83	Surgical operation and other surgical procedures as the cause of abnormal reaction of the patient, or of later complication, without mention of misadventure at the time of the procedure
Y830	Surgical operation with transplant of whole organ as the cause of abnormal reaction of the patient, or of later complication, without mention of misadventure at the time of the procedure
Y831	Surgical operation with implant of artificial internal device as the cause of abnormal reaction of the patient, or of later complication, without mention of misadventure at the time of the procedure
Y832	Surgical operation with anastomosis, bypass or graft as the cause of abnormal reaction of the patient, or of later complication, without mention of misadventure at the time of the procedure
Y833	Surgical operation with formation of external stoma as the cause of abnormal reaction of the patient, or of later complication, without mention of misadventure at the time of the procedure
Y834	Other reconstructive surgery as the cause of abnormal reaction of the patient, or of later complication, without mention of misadventure at the time of the procedure
Y835	Amputation of limb(s) as the cause of abnormal reaction of the patient, or of later complication, without mention of misadventure at the time of the procedure
Y836	Removal of other organ (partial) (total) as the cause of abnormal reaction of the patient, or of later complication, without mention of misadventure at the time of the procedure
Y838	Other surgical procedures as the cause of abnormal reaction of the patient, or of later complication, without mention of misadventure at the time of the procedure
Y839	Surgical procedure, unspecified as the cause of abnormal reaction of the patient, or of later complication, without mention of misadventure at the time of the procedure
T886	Anaphylactic reaction due to adverse effect of correct drug or medicament properly administered
T886XXA	Anaphylactic reaction due to adverse effect of correct drug or medicament properly administered, initial encounter
T887	Unspecified adverse effect of drug or medicament
T887XXA	Unspecified adverse effect of drug or medicament, initial encounter
Y832	Surgical operation with anastomosis, bypass, or graft as the cause of abnormal reaction
Y839	Surgical procedure, unspecified as the cause of abnormal reaction of the patient, or of later complication, without mention of misadventure at the time of the procedure
Catheter-related complication	
T801XXA	Vascular complications following infusion, transfusion and therapeutic injection, initial encounter
T80219A	Unspecified infection due to central venous catheter, initial encounter
T80211A	Bloodstream infection due to central venous catheter, initial encounter
T80212A	Local infection due to central venous catheter, initial encounter
T8022XA	Acute infection following transfusion, infusion, or injection of blood or blood products, initial encounter
T8029XA	Infection following other infusion, transfusion, and therapeutic injection, initial encounter
T800	Air embolism following infusion, transfusion, and therapeutic injection

(Continued)

TABLE E3. Continued

ICD-10 code	Description
T801	Vascular complications following infusion, transfusion and therapeutic injection
T801XXA	Vascular complications following infusion, transfusion and therapeutic injection, initial encounter
T802	Infections following infusion, transfusion and therapeutic injection
T8021	Infection due to central venous catheter
T80211	Bloodstream infection due to central venous catheter
T80211A	Bloodstream infection due to central venous catheter, initial encounter
T80212	Local infection due to central venous catheter
T80212A	Local infection due to central venous catheter, initial encounter
T80218	Other infection due to central venous catheter
T80 218A	Other infection due to central venous catheter, initial encounter
T80219	Unspecified infection due to central venous catheter
T80219A	Unspecified infection due to central venous catheter, initial encounter
T8022	Acute infection following transfusion, infusion, or injection of blood and blood products
T8022XA	Acute infection following transfusion, infusion, or injection of blood and blood products, initial encounter
T8029	Acute infection following other transfusion, infusion, or injection of blood and blood products, initial encounter
T8029XA	Acute infection following transfusion, infusion, or injection of blood and blood products, initial encounter, initial encounter
Postprocedural hypertension	
I973	Postprocedural hypertension
Other unspecified complications	
T888	Other specified complications of surgical and medical care, not elsewhere classified
T889	Complication of surgical and medical care, unspecified
T889XXA	Complication of surgical and medical care, unspecified initial encounter
Z99	Dependence on enabling machines and devices, not elsewhere classified
Z998	Dependence on other enabling machines and devices
Z9989	Dependence on other enabling machines and devices
T888XXA	Other specified complications of surgical and medical care, not elsewhere classified, initial encounter
T8132XA	Disruption of internal operation (surgical) wound, not elsewhere classified, initial encounter
K6811	Postprocedural retroperitoneal abscess

ICD-10, International Classification of Diseases, Tenth Revision.