

Supplementary Online Content

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This supplementary material has been provided by the authors to give readers additional information about their work.

eTable 1. Hospital Characteristics	
All facilities	N=438
Region (N/%)	
Northeast	86(19.6%)
Midwest	102(23.3%)
South	161(36.8%)
West	89(20.3%)
Teaching facility (N/%)	167(38.1%)
Total number of TAVR performed (Median/IQR)	83(34-182)
TAVR/SAVR volume (N/%)	
Low TAVR volume	
Low SAVR volume	280(63.9%)
High SAVR volume	62(14.2%)
High TAVR volume	
Low SAVR volume	51(11.6%)
High SAVR volume	45(10.3%)

eTable 2. Patient Characteristics (N/%) by Hospital SAVR and TAVR Volume					
	Hospital volume category				P value
	Low SAVR Low TAVR (N=21113)	High SAVR Low TAVR (N=10703)	Low SAVR High TAVR (N=8341)	High SAVR High TAVR (N=20381)	
Age (Mean/SD)	82.2(8.0)	82.7(8.0)	81.8(8.1)	82.4(8.1)	<.001
Female	10210(48.4%)	5226(48.8%)	3957(47.4%)	9780(48.0%)	.24
White race	19456(92.5%)	10080(94.4%)	7674(92.3%)	18991(93.4%)	<.001
Comorbidities (1 year)					
Coronary Artery Disease	16732(79.3%)	8398(78.5%)	6647(79.7%)	16450(80.7%)	<.001
Hypertension	19418(92.0%)	9813(91.7%)	7712(92.5%)	18916(92.8%)	<.001
Chronic Heart Failure	16609(78.7%)	8399(78.5%)	6615(79.3%)	17086(83.8%)	<.001
Diabetes	8539(40.4%)	4274(39.9%)	3430(41.1%)	8049(39.5%)	.05
Chronic Pulmonary Disease	8268(39.2%)	4257(39.8%)	3512(42.1%)	8204(40.3%)	<.001
Obesity	4118(19.5%)	1981(18.5%)	1620(19.4%)	3915(19.2%)	.19
Cerebro-vascular Disease	1720(8.2%)	896(8.4%)	674(8.1%)	1718(8.4%)	.65
Peripheral Artery Disease	5846(27.7%)	2870(26.8%)	2467(29.6%)	6009(29.5%)	<.001
Recent conditions (90 day)					
Cardiovascular events*	3365(15.9%)	1702(15.9%)	1290(15.5%)	3088(15.2%)	.12
Atrial Fibrillation/flutter	8758(41.5%)	4742(44.3%)	3504(42.0%)	8811(43.2%)	<.001
Renal Failure	2008(9.5%)	1070(10.0%)	822(9.9%)	2132(10.5%)	.01
Previous Valve Intervention	2482(11.8%)	1034(9.7%)	1061(12.7%)	2902(14.2%)	<.001
Previous CABG or Septal Defect Repair	2557(12.1%)	1311(12.3%)	967(11.6%)	2437(12.0%)	.53
Previous PCI	4669(22.1%)	2347(21.9%)	1919(23.0%)	4542(22.3%)	.30
Approach					<.001
Trans-femoral	17811(84.4%)	9288(86.8%)	6993(83.4%)	17869(87.7%)	
Trans-apical	3302(15.6%)	1415(13.2%)	1348(16.6%)	2512(12.3%)	
Elective Admission	17405(82.4%)	8707(81.4%)	6366(76.3%)	14723(72.2%)	<.001
Concurrent PCI	683(3.2%)	340(3.2%)	321(3.9%)	707(3.5%)	.03
Teaching Facility	7309(34.6%)	7078(66.1%)	6004(72.0%)	16308(80.0%)	<.001
Facility Region					<.001
Northeast	3235(15.3%)	3644(34.1%)	1673(20.1%)	7543(37.0%)	
Midwest	5292(25.1%)	1910(17.9%)	1325(15.9%)	5442(26.7%)	
South	8248(39.1%)	3490(32.6%)	3273(39.2%)	4655(22.8%)	
West	4338(20.6%)	1659(15.5%)	2070(24.8%)	2741(13.6%)	
PCI Volume above Median	6587(31.2%)	7014(65.5%)	2890(34.7%)	13812(67.8%)	<.001
*Recent cardiovascular conditions included acute myocardial infarction, carotid stenosis, and endocarditis.					
Abbreviations: TAVR=Transcatheter Aortic Valve Replacement, SAVR=Surgical Aortic Valve Replacement, CABG=Coronary Artery Bypass Graft, PCI=Percutaneous Coronary Intervention					

eTable 3. Unadjusted 30-day, 1-Year, and 2-Year Outcomes Among Medicare Beneficiaries Undergoing TAVR Procedures at Hospitals With Low and High SAVR Volume			
	Procedures performed in the first year	Procedures performed in the first two years	Procedures performed in all years
	Events (N/%)	Events (N/%)	Events (N/%)
<i>N patients</i>	10962	24442	58337
30-day mortality			
Low SAVR/Low TAVR	270(6.7%)	754(6.4%)	1153(5.7%)
High SAVR/Low TAVR	99(7.2%)	578(6.2%)	562(5.4%)
Low SAVR/High TAVR	180(7.2%)	112(5.1%)	396(4.9%)
High SAVR/High TAVR	195(6.4%)	57(5.0%)	885(4.5%)
30-day mortality/stroke			
Low SAVR/Low TAVR	384(9.6%)	1040(8.9%)	1644(8.1%)
High SAVR/Low TAVR	129(9.4%)	824(8.8%)	826(8.0%)
Low SAVR/High TAVR	242(9.6%)	155(7.0%)	559(7.0%)
High SAVR/High TAVR	284(9.3%)	81(7.1%)	1380(7.0%)
30-day readmission			
Low SAVR/Low TAVR	1017(25.4%)	2923(24.9%)	4766(23.6%)
High SAVR/Low TAVR	359(26.1%)	2370(25.3%)	2409(23.3%)
Low SAVR/High TAVR	673(26.8%)	547(24.8%)	1756(21.9%)
High SAVR/High TAVR	832(27.2%)	298(26.0%)	4156(21.1%)
	Estimated risk	Estimated risk	Estimated risk
<i>N patients</i>	11098	24751	60538
1-year mortality			
Low SAVR/Low TAVR	23.1%	22.4%	20.6%
High SAVR/Low TAVR	25.0%	22.4%	21.0%
Low SAVR/High TAVR	23.1%	18.9%	19.6%
High SAVR/High TAVR	24.0%	19.1%	18.4%
2-year mortality			
Low SAVR/Low TAVR	34.7%	34.5%	32.5%
High SAVR/Low TAVR	36.2%	33.5%	32.7%
Low SAVR/High TAVR	34.8%	30.1%	31.6%
High SAVR/High TAVR	35.6%	31.9%	30.0%

eTable 4. Sensitivity Analysis of 30-Day, 1-Year, and 2-Year Outcomes Among Medicare Beneficiaries Undergoing Transfemoral TAVR Procedures at Hospitals with Low and High SAVR Volume

	Procedures performed in the first year		Procedures performed in the first two years		Procedures performed in all years	
	Events (N/%)	Adjusted OR (95% CI)	Events (N/%)	Adjusted OR (95% CI)	Events (N/%)	Adjusted OR (95% CI)
<i>N patients</i>	9498		19781		49852	
30-day mortality						
Low SAVR volume	369(6.4%)	Ref	657(5.7%)	Ref	1186(5.0%)	Ref
High SAVR volume	233(6.2%)	0.98(0.78-1.22)	460(5.5%)	0.95(0.80-1.12)	1143(4.4%)	0.98(0.78-1.00)
30-day mortality/stroke						
Low SAVR volume	511(8.9%)	Ref	911(8.0%)	Ref	1706(7.2%)	Ref
High SAVR volume	344(9.1%)	1.03(0.86-1.24)	678(8.1%)	1.01(0.88-1.15)	1803(6.9%)	0.96(0.87-1.05)
30-day readmission						
Low SAVR volume	1412(24.6%)	Ref	2692(23.5%)	Ref	5152(21.8%)	Ref
High SAVR volume	975(25.9%)	1.04(0.92-1.19)	1959(23.5%)	0.99(0.89-1.10)	5387(20.6%)	0.96(0.89-1.04)
	Estimated risk	Adjusted HR (95% CI)	Estimated risk	Adjusted HR (95% CI)	Estimated risk	Adjusted HR (95% CI)
<i>N patients</i>	9633		20087		51961	
1-year mortality						
Low SAVR volume	22.4%	Ref	21.2%	Ref	19.5%	Ref
High SAVR volume	24.0%	1.00(0.87-1.14)	21.4%	0.97(0.89-1.07)	18.6%	0.95(0.89-1.02)
2-year mortality						
Low SAVR volume	34.4%	Ref	33.4%	Ref	31.7%	Ref
High SAVR volume	35.7%	1.00(0.90-1.11)	32.8%	0.95(0.88-1.02)	30.2%	0.95(0.89-1.02)

Analyses for 30-day outcomes excluded patients undergoing procedure in December 2015. Time-to-event analyses were used to examine 1-year and 2-year mortality.

eTable 5. Sensitivity Analysis of 30-Day, 1-Year, and 2-Year Outcomes Among Medicare Beneficiaries Undergoing Transfemoral TAVR Procedures at Hospitals With Low and High SAVR/TAVR Volumes						
	Procedures performed in the first year		Procedures performed in the first two years		Procedures performed in all years	
	Events (N/%)	Adjusted OR (95% CI)	Events (N/%)	Adjusted OR (95% CI)	Events (N/%)	Adjusted OR (95% CI)
<i>N patients</i>	9498		19781		49852	
30-day mortality						
Low SAVR/ Low TAVR	225(6.5%)	Ref	565(5.9%)	Ref	874(5.2%)	Ref
High SAVR/ Low TAVR	71(6.8%)	1.04 (0.76-1.42)	425(5.7%)	0.99 (0.83-1.18)	508(4.9%)	0.95 (0.82-1.10)
Low SAVR/ High TAVR	144(6.4%)	0.98 (0.77-1.26)	92(4.8%)	0.89 (0.69-1.15)	312(4.7%)	0.89 (0.75-1.06)
High SAVR/ High TAVR	162(5.9%)	0.93 (0.69-1.24)	35(4.2%)	0.66 (0.44-0.98)	635(4.0%)	0.72 (0.61-0.85)
30-day mortality/stroke						
Low SAVR/ Low TAVR	326(9.4%)	Ref	791(8.3%)	Ref	1261(7.4%)	Ref
High SAVR/ Low TAVR	99(9.5%)	1.01 (0.78-1.31)	627(8.4%)	1.04 (0.90-1.19)	780(7.6%)	1.00 (0.89-1.12)
Low SAVR/ High TAVR	185(8.2%)	0.87 (0.71-1.07)	120(6.3%)	0.84 (0.68-1.04)	445(6.7%)	0.86 (0.75-0.99)
High SAVR/ High TAVR	245(9.0%)	0.95 (0.75-1.20)	51(6.1%)	0.70 (0.51-0.96)	1023(6.4%)	0.79 (0.70-0.91)
30-day readmission						
Low SAVR/ Low TAVR	857(24.7%)	Ref	2262(23.7%)	Ref	3775(22.3%)	Ref
High SAVR/ Low TAVR	268(25.8%)	0.99 (0.82-1.19)	1753(23.4%)	0.98 (0.87-1.10)	2247(21.9%)	0.98 (0.90-1.07)
Low SAVR/ High TAVR	555(24.5%)	0.98 (0.85-1.12)	430(22.5%)	0.97 (0.83-1.13)	1377(20.6%)	0.91 (0.82-1.02)
High SAVR/ High TAVR	707(25.9%)	1.06 (0.90-1.25)	206(24.8%)	1.03 (0.81-1.30)	3140(19.7%)	0.87 (0.78-0.97)

eTable 5 (continued). Sensitivity Analysis of 30-Day, 1-Year, and 2-Year Outcomes Among Medicare Beneficiaries Undergoing Transfemoral TAVR Procedures at Hospitals With Low and High SAVR/TAVR Volumes

	Estimated risk	Adjusted HR (95% CI)		Estimated risk	Adjusted HR (95% CI)		Estimated risk	Adjusted HR (95% CI)
<i>N patients</i>	9633			20087			51961	
1-year mortality								
Low SAVR/ Low TAVR	23.2%	Ref		21.7%	Ref		19.9%	Ref
High SAVR/ Low TAVR	24.9%	0.96 (0.82-1.14)		21.7%	0.99 (0.89-1.10)		19.9%	1.00 (0.93-1.08)
Low SAVR/ High TAVR	21.0%	0.90 (0.78-1.03)		17.8%	0.87 (0.76-1.00)		18.6%	0.93 (0.84-1.03)
High SAVR/ High TAVR	23.7%	0.94 (0.80-1.12)		18.4%	0.77 (0.66-0.91)		17.7%	0.84 (0.76-0.93)
2-year mortality								
Low SAVR/ Low TAVR	35.1%	Ref		33.9%	Ref		32.2%	Ref
High SAVR/ Low TAVR	36.4%	0.97 (0.84-1.11)		33.0%	0.95 (0.87-1.04)		31.9%	1.00 (0.94-1.07)
Low SAVR/ High TAVR	33.3%	0.92 (0.82-1.04)		30.4%	0.88 (0.80-0.98)		30.7%	0.94 (0.86-1.03)
High SAVR/ High TAVR	35.4%	0.96 (0.84-1.09)		31.7%	0.83 (0.75-0.92)		29.1%	0.85 (0.78-0.94)
Analyses for 30-day outcomes excluded patients undergoing procedure in December 2015. Time-to-event analyses were used to examine 1-year and 2-year mortality.								

eTable 6. Sensitivity Analysis of 30-Day, 1-Year, and 2-Year Outcomes Among Medicare Beneficiaries Undergoing TAVR Procedures at Hospitals, Using Different Volume Thresholds

	By SAVR or TAVR volume		By combined SAVR/TAVR volume				
	High SAVR vs. Low SAVR	High TAVR vs. Low TAVR	HS/LT vs. LS/LT	LS/HT vs. LS/LT	HS/HT vs. LS/LT	HS/HT vs. LS/HT	HS/HT vs. HS/LT
Main analysis							
30-day mortality	0.93(0.83-1.04)	0.83(0.74-0.93)	0.94(0.82-1.08)	0.85(0.72-0.99)	0.77(0.66-0.89)	0.91(0.76-1.08)	0.81(0.69-0.95)
30-day mortality/stroke	0.98(0.89-1.07)	0.84(0.77-0.93)	0.97(0.87-1.08)	0.83(0.73-0.95)	0.83(0.73-0.94)	1.00(0.86-1.15)	0.86(0.75-0.97)
30-day readmission	0.98(0.91-1.06)	0.91(0.84-0.98)	1.00(0.91-1.10)	0.93(0.83-1.03)	0.88(0.79-0.98)	0.95(0.84-1.08)	0.89(0.79-0.99)
1-year mortality	0.97(0.91-1.04)	0.87(0.81-0.94)	1.01(0.94-1.09)	0.92(0.84-1.00)	0.85(0.77-0.93)	0.92(0.83-1.02)	0.84(0.76-0.92)
2-year mortality	0.97(0.92-1.03)	0.89(0.84-0.95)	1.01(0.94-1.07)	0.93(0.86-1.01)	0.86(0.79-0.94)	0.93(0.84-1.01)	0.86(0.79-0.93)
High SAVR ≥ 97/y High TAVR ≥ 50/y or 100/2y for majority of years							
30-day mortality	0.94(0.83-1.05)	0.86(0.75-0.98)	0.97(0.84-1.11)	0.90(0.75-1.07)	0.80(0.69-0.93)	0.89(0.74-1.07)	0.83(0.70-0.97)
30-day mortality/stroke	0.98(0.89-1.08)	0.88(0.79-0.98)	0.95(0.85-1.07)	0.85(0.73-0.98)	0.87(0.77-0.98)	1.02(0.88-1.19)	0.91(0.80-1.04)
30-day readmission	0.99(0.91-1.08)	0.91(0.83-0.99)	1.00(0.91-1.11)	0.92(0.81-1.05)	0.89(0.81-0.99)	0.97(0.85-1.11)	0.89(0.80-1.00)
1-year mortality	0.97(0.91-1.04)	0.92(0.85-0.99)	1.02(0.94-1.10)	0.97(0.88-1.06)	0.89(0.81-0.98)	0.93(0.83-1.03)	0.88(0.80-0.98)
2-year mortality	0.97(0.91-1.03)	0.93(0.87-0.97)	1.00(0.93-1.07)	0.96(0.88-1.04)	0.90(0.83-0.97)	0.94(0.86-1.03)	0.90(0.82-0.98)
High SAVR ≥ 84/y High TAVR ≥ Median for majority of years							
30-day mortality	0.91(0.81-1.01)	0.83(0.74-0.93)	0.92(0.81-1.04)	0.86(0.72-1.02)	0.75(0.64-0.87)	0.87(0.72-1.05)	0.81(0.70-0.93)
30-day mortality/stroke	0.95(0.86-1.03)	0.85(0.77-0.93)	0.94(0.85-1.05)	0.84(0.73-0.98)	0.80(0.71-0.90)	0.95(0.81-1.10)	0.85(0.75-0.95)
30-day readmission	0.97(0.90-1.05)	0.91(0.84-0.98)	0.99(0.91-1.08)	0.94(0.83-1.06)	0.88(0.79-0.97)	0.93(0.82-1.07)	0.89(0.80-0.98)
1-year mortality	0.94(0.89-1.00)	0.88(0.82-0.94)	0.98(0.92-1.05)	0.94(0.87-1.02)	0.83(0.75-0.91)	0.88(0.81-0.96)	0.84(0.77-0.92)
2-year mortality	0.95(0.90-1.00)	0.89(0.84-0.95)	0.99(0.93-1.05)	0.96(0.89-1.03)	0.85(0.78-0.92)	0.88(0.82-0.96)	0.86(0.80-0.92)
High SAVR ≥ 84/y High TAVR ≥ 50/y or 100/2y for majority of years							
30-day mortality	0.91(0.82-1.02)	0.86(0.76-0.98)	0.94(0.83-1.08)	0.93(0.76-1.15)	0.79(0.68-0.91)	0.84(0.69-1.03)	0.83(0.72-0.96)
30-day mortality/stroke	0.95(0.86-1.04)	0.89(0.80-0.99)	0.95(0.85-1.06)	0.88(0.74-1.05)	0.85(0.75-0.96)	0.96(0.81-1.13)	0.89(0.79-1.01)
30-day readmission	0.98(0.91-1.06)	0.91(0.83-0.99)	0.99(0.90-1.08)	0.92(0.79-1.07)	0.89(0.80-0.99)	0.97(0.83-1.13)	0.90(0.81-1.00)

1-year mortality	0.94(0.89-1.00)	0.93(0.86-1.00)		0.99(0.92-1.06)	1.00(0.91-1.10)	0.88(0.80-0.96)	0.88(0.80-0.97)	0.89(0.81-0.98)
2-year mortality	0.95(0.90-1.00)	0.93(0.87-0.99)		0.99(0.93-1.05)	0.99(0.92-1.08)	0.89(0.82-0.96)	0.89(0.82-0.97)	0.90(0.83-0.97)
eTable 6 (continued). Sensitivity Analysis of 30-Day, 1-Year, and 2-Year Outcomes Among Medicare Beneficiaries Undergoing TAVR Procedures at Hospitals, Using Different Volume Thresholds								
High SAVR \geq 97/y High TAVR \geq 3rd tertile for majority of years								
30-day mortality	0.90(0.81-1.01)	0.89(0.77-1.02)		0.91(0.81-1.03)	0.91(0.73-1.13)	0.80(0.66-0.96)	0.88(0.68-1.13)	0.87(0.73-1.04)
30-day mortality/stroke	0.95(0.87-1.04)	0.91(0.81-1.02)		0.95(0.86-1.05)	0.88(0.74-1.06)	0.87(0.74-1.02)	0.98(0.80-1.21)	0.92(0.80-1.06)
30-day readmission	0.97(0.90-1.05)	0.95(0.86-1.05)		0.98(0.90-1.06)	0.98(0.84-1.15)	0.91(0.79-1.04)	0.93(0.77-1.12)	0.93(0.82-1.06)
1-year mortality	0.95(0.89-1.02)	0.98(0.90-1.07)		0.96(0.89-1.04)	1.01(0.90-1.13)	0.94(0.84-1.05)	0.93(0.81-1.06)	0.97(0.87-1.08)
2-year mortality	0.95(0.90-1.01)	0.98(0.91-1.06)		0.95(0.89-1.02)	0.99(0.89-1.09)	0.93(0.85-1.03)	0.95(0.84-1.07)	0.98(0.89-1.07)
High SAVR \geq 97/y High TAVR \geq 1st tertile for majority of years								
30-day mortality	0.92(0.82-1.03)	0.93(0.83-1.04)		1.03(0.88-1.21)	1.01(0.88-1.15)	0.84(0.73-0.97)	0.83(0.72-0.97)	0.81(0.69-0.96)
30-day mortality/stroke	0.97(0.88-1.06)	0.94(0.86-1.03)		1.01(0.88-1.15)	0.97(0.86-1.08)	0.90(0.80-1.01)	0.93(0.82-1.06)	0.89(0.78-1.03)
30-day readmission	0.98(0.91-1.07)	0.93(0.86-1.00)		1.00(0.89-1.11)	0.94(0.85-1.02)	0.91(0.82-1.00)	0.97(0.87-1.08)	0.91(0.81-1.03)
1-year mortality	0.97(0.91-1.04)	0.92(0.86-0.98)		1.06(0.97-1.16)	0.97(0.90-1.05)	0.89(0.82-0.98)	0.92(0.84-1.00)	0.84(0.76-0.93)
2-year mortality	0.97(0.92-1.03)	0.92(0.87-0.97)		1.04(0.96-1.12)	0.96(0.90-1.03)	0.90(0.83-0.97)	0.93(0.86-1.00)	0.86(0.79-0.94)
Analyses for 30-day outcomes excluded patients undergoing procedure in December 2015. Time-to-event analyses were used to examine 1-year and 2-year mortality.								

Analyses included data from all years.