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CLINICAL INVESTIGATION

Peri-procedural code status for transcatheter aortic valve replacement: Absence of program policies and standard practices

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Abstract

Background: Little is known about policies and practices for patients undergoing Transcatheter Aortic Valve Replacement (TAVR) who have a documented preference for Do Not Resuscitate (DNR) status at time of referral. We investigated how practices across TAVR programs align with goals of care for patients presenting with DNR status.

Methods: Between June and September 2019, we conducted semi-structured interviews with TAVR coordinators from 52/73 invited programs (71%) in Washington and California (TAVR volume > 100/year:34%; 50–99:36%; 1–50:30%); 2 programs reported no TAVR in 2018. TAVR coordinators described peri-procedural code status policies and practices and how they accommodate patients' goals of care. We used data from the Society of Thoracic Surgeons/American College of Cardiology Transcatheter Valve Therapy Registry, stratified by programs' DNR practice, to examine differences in program size, patient characteristics and risk status, and outcomes.

Results: Nearly all TAVR programs (48/50: 96%) addressed peri-procedural code status, yet only 26% had established policies. Temporarily rescinding DNR status until after TAVR was the norm (78%), yet time frames for reinstatement varied (38% <48 h post-TAVR; 44% 48 h-to-discharge; 18% >30 days post-discharge). For patients with fluctuating code status, no routine practices for discharge documentation were well-described. No clinically substantial differences by code status practice were noted in Society of Thoracic Surgeons Predicted Risk of Mortality risk score, peri-procedural or in-hospital cardiac arrest, or hospice disposition. Six programs maintaining DNR status recognized TAVR as a palliative procedure. Among programs categorically reversing patients' DNR status, the rationale for differing lengths of time to reinstatement reflect divergent views on accountability and reporting requirements.

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See related Editorial by Christopher E. Knoepke

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Conclusions: Marked heterogeneity exists in management of peri-procedural code status across TAVR programs, including timeframe for reestablishing DNR status post-procedure. These findings call for standardization of DNR decisions at specific care points (before/during/after TAVR) to ensure consistent alignment with patients' health-related goals and values.

KEYWORDS
do not resuscitate, palliative care, peri-procedural, policy, Transcatheter aortic valve replacement

INTRODUCTION

Transcatheter Aortic Valve Replacement (TAVR) improves the survival of patients with severe aortic stenosis at prohibitive surgical risk and has revolutionized the treatment of valvular heart disease.[1–3] With widespread adoption in the United States for nearly a decade,[4–6] and recent extension to lower risk populations,[7–9] TAVR volumes now exceed surgical aortic valve replacement.[10]

Many patients presenting for evaluation prior to TAVR have Do Not Resuscitate (DNR) orders or other advance directives limiting the use of life-sustaining therapies. Management of DNR status is not addressed in current guidelines[10] or guidance documents for TAVR,[11–13] despite recommendations from professional societies and the Centers for Medicare & Medicaid Services promoting shared decision-making prior to TAVR.[10,11] Little is known about programs' policies and procedures surrounding DNR status in this context.

Approaches to code status before, during, and after TAVR are of particular importance for several reasons. First, the increasing prevalence of older adults in the United States portends higher demand for TAVR in the coming decades with greater documentation of DNR preference.[14,15] Second, most older adults with severe aortic stenosis present for TAVR evaluation to improve quality of life,[16] requiring a nuanced understanding of their treatment goals to assess the appropriateness of peri-procedural cardiopulmonary resuscitation (CPR). Only 7% of octogenarians report prolonged life as the primary reason for undergoing TAVR, with many instead prioritizing improvements in functional status, maintenance of independence, and palliation of severe symptoms.[16] Lastly, older adults with severe aortic stenosis are often considered to be at elevated risk of adverse outcomes due to increased prevalence of frailty and comorbidities.[17–19] Evidence suggests these patients are at risk of adverse outcomes and decreased quality of life not only post-procedurally,[20,21] but also following CPR for in-hospital cardiac arrest.[22–28]

Key points

- Peri-procedural code status was a concern addressed by nearly all Transcatheter Aortic Valve Replacement (TAVR) programs, yet few had established policies in place for those with a documented preference for Do Not Resuscitate (DNR) status at the time of referral.
- Most programs require patients with DNR status revert to full code status at the time of TAVR; one program excluded patients with DNR status from TAVR consideration. Time frames for reinstating DNR status varied and included 48 h post-procedure, total hospital stay, and/or after 30 days. Post-TAVR code status was rarely documented at discharge.
- No consensus exists among TAVR programs about the appropriate timing for reinstating DNR status and assuring that current documentation reflects patients' preferences. Clinicians who refer older adults with DNR status for TAVR can prepare them by setting expectations for possibly suspending DNR status and documenting goals for peri-procedural resuscitation and TAVR.

Why does this paper matter?

Our findings indicate a need for standardization of DNR decisions before, during, and after TAVR to ensure consistent longitudinal alignment with patients' health-related goals and values.

In this study, we interviewed TAVR program coordinators to examine current policies and management practices pertaining to peri-procedural DNR status and their supporting rationales.

METHODS

We conducted a mixed methods study evaluating data from semi-structured interviews with TAVR coordinators in Washington and California hospitals and data from The Society of Thoracic Surgeons (STS) / American College of Cardiology (ACC) Transcatheter Valve Therapy (TVT) Registry. We selected coordinators as key informants given their leading roles in the identification, management and monitoring of TAVR candidates, and in reporting outcomes to mandated registries. Participants were recruited via electronic mail through the ACC. Interested coordinators completed 30–60-min phone interviews between June and September 2019, which were recorded and transcribed for analysis.

We used a set of standardized demographic questions to characterize participants' educational backgrounds and program sizes, then asked open-ended questions about formal policies and informal practices concerning peri-procedural DNR using an interview guide (Data S1). We also asked coordinators to share copies of any formal policies for review. We did not explicitly ask coordinators about their own views of policies and practices surrounding peri-procedural code status. The University of Washington Institutional Review Board approved this protocol.

Study investigators (GMB, AK, JMS) used directed content analysis[29,30] to address the following research questions: (1) how many and what size programs had either 'formal' policies (written documents issued by division, department or hospital) and/or 'informal' practices (unwritten understanding of common practices) addressing peri-procedural code status; (2) how program policies and practices elicited and incorporated patients' goals, values, and preferences; and (3) methods for determining eligibility for patients with DNR status referred for TAVR.

The coding team inductively created a codebook characterizing peri-procedural code status practices. We independently identified and then collaboratively compared coded excerpts to identify patterns across programs. We examined patterns by program size based on the number of TAVRs performed in 2018: large (≥100); mid-size (50–99); or small (1–50), and by their peri-procedural DNR practices. We focused on rationales used for adoption of DNR practices, as well as language used to reconcile discordant views between formal policies and informal practices.

From these analyses, we identified five approaches to managing peri-procedural status: (1) maintaining DNR status, (2) reversing DNR status but reinstating within 48 hours of procedure, (3) reversing DNR status but reinstating prior to discharge, (4) reversing DNR status but reinstating 30 days post-procedure, and (5) no consistent practice with respect to DNR status (Figure 1). We also obtained aggregated, unadjusted patient characteristics,

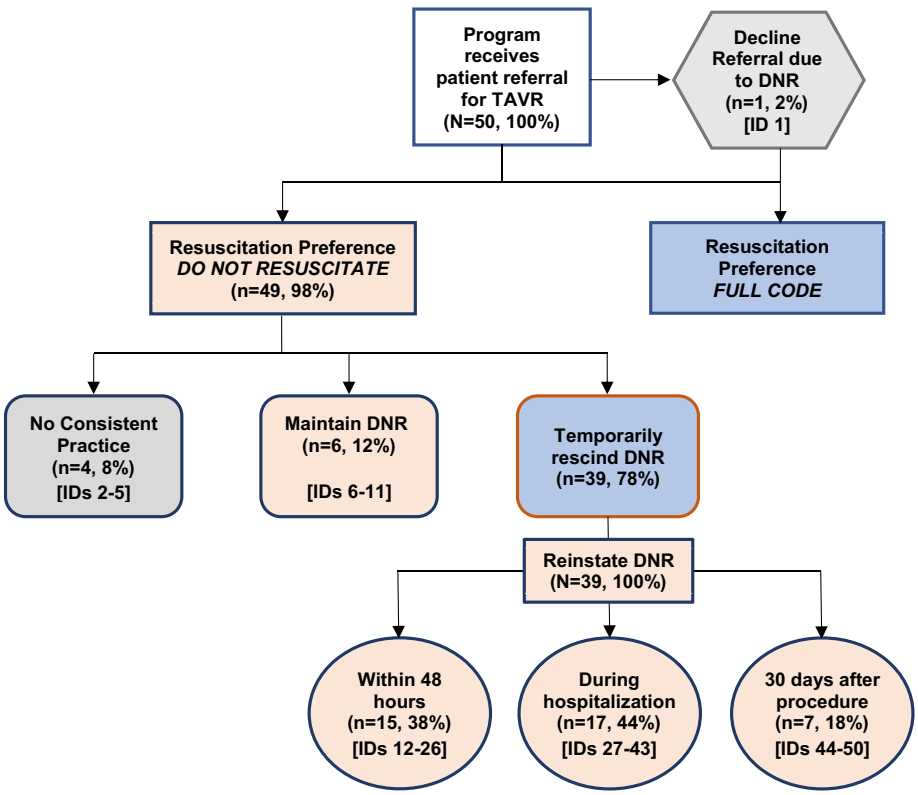

FIGURE 1 Transcatheter aortic valve replacement (TAVR) program peri-procedural code status practices

peri-procedural risk status, and outcomes data across all programs from the TVT Registry, stratified by peri-procedural DNR practice.

RESULTS

Cohort description and code status policies

Of the 73 TAVR coordinators invited, 52 were interviewed (71% response rate) and 50 were included in the analysis (two did not report any TAVRs to the Registry in 2018). Among the coordinators who declined, most stated that their administration would not allow their participation; others cited time as their limiting factor. More than one-third (38%) of participants were nurse practitioners or equivalent, 16% were Masters-level nurses, and 46% were registered nurses. Three (6%) coordinators identified as male. Participants represented programs of all sizes: large (34%), mid-size (36%), and small (30%). Program geographic distribution was 56% urban; 38% suburban; and 6% rural; 50% were associated with academic medical centers.

Nearly all (48/50: 96%) programs reported routinely addressing code status during TAVR eligibility screening. Figure 1 shows the distribution of programs by their approach to peri-procedural code status. Six programs (12%) reported performing TAVR with maintenance of DNR status. One program (2%) declined referral due to DNR status and 4 programs (8%) described no consistent practice. The remaining 39 (78%) participants reported that their programs routinely temporarily reverse or suspend DNR solely for the purpose of performing TAVR. However, time frames for DNR reinstatement varied widely, with 15 (38%) programs reinstating DNR within 48 hours of the procedure, 17 (44%) reinstating DNR between 48 hours and hospital discharge, and 7 (18%) waiting until 30-days post-TAVR.

Roughly one-quarter of participants (13/50:26%) cited formal policies addressing peri-procedural code status. Eight programs shared their policies for review. Seven of the eight policies addressed the importance of providing patients with an updated Physician Orders for Life Sustaining Treatment (POLST) form at the time of discharge to reinstate their DNR preferences, however, this was routinely done by only one program. Only two programs reported practices reflecting their institutions' formal policies. The content of these two policies differed substantially; one maintained the patient's DNR status, and the other automatically suspended it for the procedure.

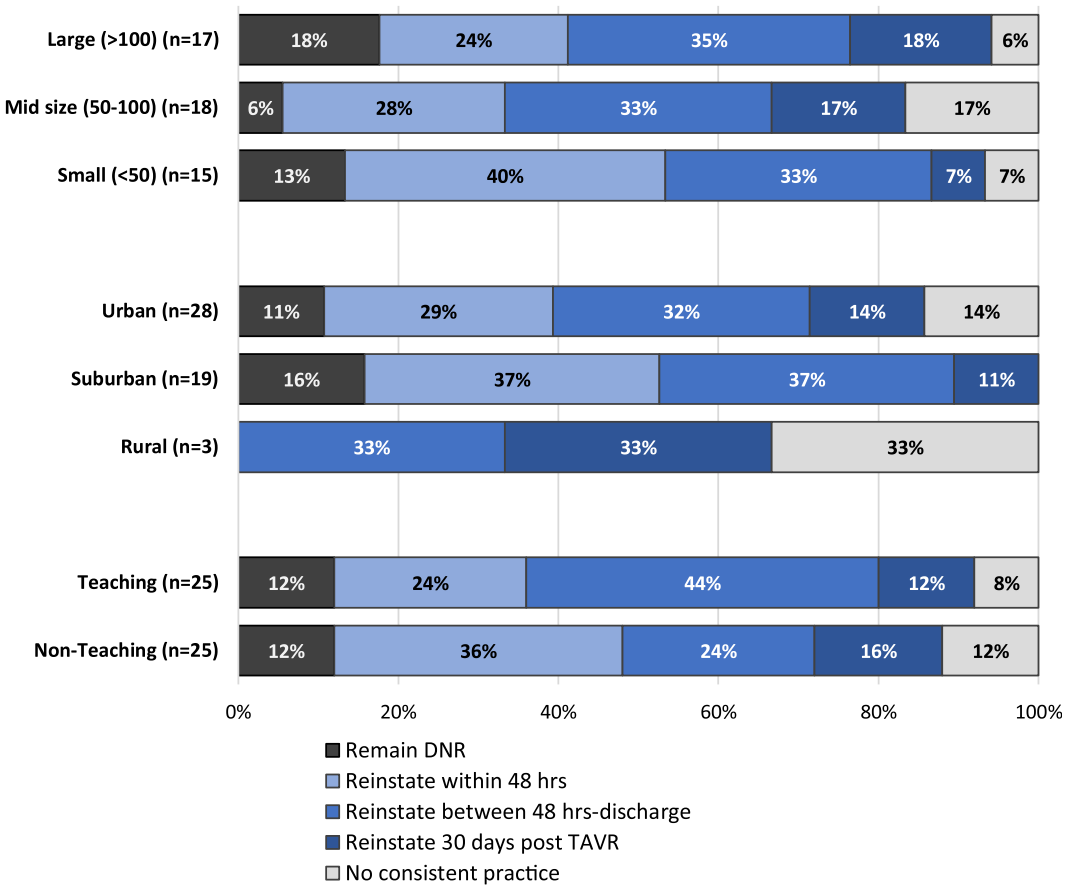

FIGURE 2 DNR peri-procedural code status practice by TAVR program size, location and teaching program

Program and patient characteristics

Figure 2 shows the distribution of DNR practices by program size, geographic location, and teaching affiliation; none of these differences were statistically significant ($p = 0.219$). Registry data (Table 1) show that the patient populations treated are similar across programs despite differences in DNR practices. The mean patient age across TAVR programs was 80.4 ± 9.1 years and 55% were men. Unadjusted pre-procedure risk assessment scores were also similar across groups, with mean STS Predicted Risk Of Mortality (PROM) scores ranging from lowest of 6.1 ± 5.3 for those remaining DNR to highest of 6.8 ± 5.9 for those who reinstate DNR by hospital discharge. Patients' unadjusted outcomes (Table 2) were also similar, with very low rates of in-hospital cardiac arrest (1.5%–2%) and in-hospital death ≤2% across categories of program size. In-cath lab death was low, ranging from 1 to 5 (0.2%–0.5%) patients. Among patients discharged alive, hospice referral was rare, ranging from 0 to 3 (0.0%–0.4%) patients.

Duration and documentation of code status reversal

The qualitative data identify what factors different programs consider in determining how to manage DNR status. Table 3 includes representative quotes across practices (the [ID] numbers indicate different coordinators and peri-procedural code status practice). About three-quarters of coordinators (78%) reported that their programs would not perform TAVR on patients without DNR reversal (prior to, during, or following consultation), though this type of exclusion was typically cited as a rare event (Table 3A). In at least one case, patients were excluded from consideration for TAVR without having DNR reversal prior to consultation. One coordinator justified the program's practice based on effort and expense:

> We do not perform TAVRs on patients who are no-code status. It's not a walk in the park. It's an expense. Why would you have [TAVR] if you did not want to survive? [12]

In contrast, 6 programs (12%) allowed patients to remain DNR during TAVR. Coordinators reported that these patients were referred for TAVR to address symptoms and understood the procedure to be more compatible with comfort-oriented care:

> TAVR is ...more of a way to improve quality of life than quantity, I mean it's great we get the quantity, ...and I think that's the way that a lot of our patients view it as well. Just because you don't want compressions or open-heart surgery doesn't mean you're not open to having a procedure. [6]

With this goal in mind, many described discussing what DNR means to the patient and what interventions they would be willing to undergo in the event of an arrest (Table 3B,C).

Rescind and reinstate DNR

Programs that reinstated DNR within 48 h cited peri-procedural risk and safe transfer to the post-anesthesia care unit (Table 3D). Those that maintained a status of 'full code' until discharge cited the possibility of untoward events in the immediate post-procedural period; however, one commented on the fluidity of code status, especially for older adults with co-morbid conditions:

> It's for the length of their stay. Their code status is their code status unless it gets changed. So, it could be ever-changing, and on some patients, it is ever-changing...[13]

Registry reporting requirements were cited by those waiting until 30 days post-procedure:

> If they are going to invest in it, they have to invest in it for 30 days... for outcomes for TVT and STS registries. [31]

Despite stated practices around reinstating DNR status, no routine practices for documenting code status at the time of discharge were described. Some coordinators cited relying instead on pre-procedural POLST forms (Table 3E).

Limited life expectancy

Despite guideline recommendations to perform TAVR only if life expectancy is greater than 1 year,[8] some coordinators reported otherwise. Ten programs (20%) reported having performed TAVR, and 16 programs (32%) reported a willingness to perform TAVR, for patients with life expectancy less than 1 year. Improved quality of life and symptom relief were the primary reasons offered for pursuing TAVR in this situation; undergoing chemotherapy and other solid organ transplantation were other reasons. Reporting requirements, lack of reimbursement, risk of adverse outcomes, and availability of balloon valvuloplasty were cited as reasons against this practice.

TABLE 1 Patient characteristics and procedural risk of those undergoing TAVR among 50 programs in Washington and California states by designated code status practice in 2018

Patient characteristic	Code status practice[a]					
		Temporarily rescind and reinstate DNR				
	Remain DNR ($n = 1019$)	within 48 h of TAVR ($n = 1148$)	48 h - hospital discharge ($n = 1672$)	after 30 days post TAVR ($n = 783$)	No consistent practice/ only full code ($n = 321$)	Total ($N = 4943$)
Age in years (mean, SD)	80.0 (9.3)	80.5 (8.9)	81.0 (9.0)	78.9 (9.4)	82.1 (8.5)	80.4 (9.1)
Male (*n*, %)	605 (59.4)	597 (52.0)	924 (55.3)	407 (52.0)	179 (55.8)	2712 (54.9)
White, non-Hispanic (*n*, %)	841 (82.5)	891 (77.6)	1303 (77.9)	719 (91.8)	261 (81.3)	4015 (81.2)
Medicare (*n*, %)	887 (87.0)	878 (76.5)	1482 (88.6)	688 (87.9)	257 (80.1)	4192 (84.8)
Comorbid conditions (*n*, %)						
Diabetes	352 (34.5)	437 (38.1)	632 (37.8)	318 (40.6)	107 (33.3)	1846 (37.3)
Currently on dialysis	53 (5.2)	54 (4.7)	84 (5.0)	30 (3.8)	15 (4.7)	236 (4.8)
Home oxygen	46 (4.5)	73 (6.4)	101 (6.0)	51 (6.5)	16 (5.0)	287 (5.8)
Prior stroke or TIA	153 (15.0)	204 (17.8)	296 (17.7)	130 (16.6)	52 (16.2)	835 (16.9)
Prior CABG	162 (15.9)	150 (13.1)	261 (15.6)	125 (16.0)	45 (14.0	743 (15.0)
Prior ICD	23 (2.3)	34 (3.0)	45 (2.7)	30 (3.8)	11 (3.4)	143 (2.9)
Prior permanent pacemaker	143 (14.0)	129 (11.2)	221 (13.2)	88 (11.2)	53 (16.5	634 (12.8)
Hostile chest	30 (2.9)	31 (2.7)	129 (7.7)	47 (6.0)	12 (3.7)	249 (5.0)
Pre-procedure risk status						
STS-PROM score, % (mean, SD)	6.1 (5.3)	6.4 (5.0)	6.8 (5.9)	6.1 (4.8)	6.4 (5.2)	6.4 (5.4)
KCCQ-12 score (mean, SD)[b]	45.5 (25.9)	44.2 (25.5)	50.6 (24.3)	48.7 (23.6)	45.8 (26.1)	47.5 (25.1)
5 m walk test in sec (mean, SD)	7.2 (2.4)	8.3 (4.3)	8.1 (4.1)	7.1 (3.3)	9.5 (23.6)	7.9 (6.9)
Unable to walk[c] (*n*, %)	216 (21.2)	205 (17.9)	211 (12.6)	100 (12.8)	33 (10.3)	765 (15.5)
Heart failure within 2 weeks[d] (*n*, %)	906 (88.9)	846 (73.7)	1362 (81.5)	650 (83.0)	203 (63.2)	3967 (80.3)
NYHA class IV (*n*, %)	133 (13.1)	129 (11.2)	180 (10.8)	116 (14.8)	24 (7.5)	582 (11.8)
Other cardiac procedure within 30 days	45 (4.4)	196 (17.1)	173 (10.3)	96 (12.3)	24 (7.5)	534 (10.8)
Porcelain aorta (*n*, %)	15 (1.5)	60 (5.2)	49 (2.9)	77 (9.8)	4 (1.2)	205 (4.1)
Procedural acuity (*n*, %)						
Non-elective status	149 (14.6)	121 (10.5)	191 (11.4)	107 (13.7)	22 (6.9)	590 (11.9)
Cardiac arrest within 24 h prior	1 (0.1)	6 (0.5)	4 (0.2)	3 (0.4)	0 (0.0)	14 (0.3)

[a]For patients with >1 TAVR in 2018, the first TAVR was used. All denominators include missing (<0.5% of total) unless otherwise specified.
[b]For KCCQ-12 Score, N = 936, 1077, 1635, 619 for columns B-E, respectively.
[c]Among those who tried to complete a 5 Meter Walk Test.
[d]There is physician documentation or report that the patient has been in a state of heart failure within the past 2 weeks.

TABLE 2 Unadjusted procedural risk status and clinical outcomes of patients undergoing TAVR among 50 programs in Washington and California states by designated code status practice in 2018

	Code status Practice[a]					
		Temporarily rescind and reinstate DNR				
Procedural risk & outcome	**Remain DNR ($n = 1019$)**	**Within 48 h of TAVR ($n = 1148$)**	**48 h-hospital discharge ($n = 1672$)**	**after 30 days post TAVR ($n = 783$)**	**No consistent practice/ only full code ($n = 321$)**	**Total ($N = 4943$)**
Procedural risk status (n, %)						
On inotropes during procedure	291 (28.6)	471 (41.0)	433 (25.9)	276 (35.2)	38 (11.8)	1509 (30.5)
Conversion to open heart surgery	5 (0.5)	7 (0.6)	10 (0.6)	5 (0.6)	0 (0.0)	27 (0.5)
Use of cardio-pulmonary bypass	9 (0.9)	6 (0.5)	8 (0.5)	4 (0.5)	1 (0.3)	28 (0.6)
Clinical outcome[b] (n, %)						
In-hospital cardiac arrest	17 (1.7)	17 (1.5)	31 (1.9)	16 (2.0)	5 (1.6)	86 (1.7)
In-cath lab death	5 (0.5)	3 (0.3)	4 (0.2)	2 (0.3)	1 (0.3)	15 (0.3)
In-hospital death	21 (2.1)	16 (1.4)	22 (1.3)	16 (2.0)	2 (0.6)	77 (1.6)
Stroke within 30 days	24 (2.4)	27 (2.4)	49 (2.9)	22 (2.8)	2 (0.6)	124 (2.5)
New requirement for dialysis within 30 days	4 (0.4)	5 (0.5)	6 (0.4)	1 (0.1)	0 (0.0)	16 (0.3)
Reintervention within 30 days	115 (11.3)	157 (13.7)	210 (12.6)	100 (12.8)	36 (11.2)	618 (12.5)
Rehospitalization within 30 days	55 (5.4)	90 (7.8)	144 (8.6)	66 (8.4)	25 (7.8)	380 (7.7)
30-day KCCQ-12 mean (SD)	76.9 (22.1)	76.3 (22.5)	79.0 (21.2)	72.2 (22.8)	73.9 (22.6)	76.7 (22.1)
30-day death (unadjusted)	24 (2.4)	29 (2.5)	42 (2.5)	23 (2.9)	4 (1.2)	122 (2.5)
Hospice referral	2 (0.2)	2 (0.2)	2 (0.1)	3 (0.4)	0 (0.0)	9 (0.2)

[a]For patients with >1 TAVR in 2018, the first TAVR was used. All denominators include missing (<0.5% of total) unless otherwise specified.

[b]Clinical outcomes are unadjusted. Stroke, rehospitalization, reintervention, 30-day death, new requirement for dialysis <5% missing; KCCQ <30% missing; Hospice no missing.

TABLE 3 Participant explanations for variations in policies and practices related to TAVR peri-procedural code status

A. Cancel TAVR

"The expectation is that all patients are 'full codes' for the procedure and hospitalization. If the patient is refusing [to have the DNR removed], there is a discussion with them about it. If we know up front about it, there would be a discussion if the patient should even have the TAVR, and that came up yesterday. The patient then consented to have the DNR removed, and agreed to have CPR, temporary intubation, and medication. Or the TAVR would've been canceled." [Program 27]

B. Maintain DNR

"For the most part, that means that these patients do not want to be converted to 'open' under any circumstances. But a lot of them are OK if maybe they go hypotensive or brady, or they need compression or medication during the procedure... So, I guess we tailor it. "[Program 6]

"There are many older patients that have DNR, but they do not have a terminal diagnosis. We're not going to totally exclude them-it would be a DNR if something happened on the table. ... I think if they have a DNR in place, and express no open chest, resuscitation, anything, then we respect that. We're not going to resuscitate someone with DNR in place." [Program 7]

"No, it is not [reversed]. ...Typically, they go in DNR. ...About 20 patients in the past year." [Program 8]

C. Negotiate meaning/purpose of DNR and code status

"It's not a 'full code, no code' world in our hospital, we have 'no intubation/no meds', ...'meds/no intubation', ...'do intubation/no meds' ...we do everybody full code, and then if anything should happen during the procedure, we come out and speak to the family and ask how they want to proceed." [Program 13]

"I've found that ...their understanding of [their DNR from 2013 is] if they are found down...and they are going to be brain dead, they do not want to be resuscitated. Their biggest fear is being in a vegetative state and being on life support, unable to have quality of life. I do not think they perceive DNR status as when you come in for elective or routine health care—I do not think they think 'it counts.'" [Program 45]

"Because sometimes they are DNR for [an]other underlying condition that they would not want treatment for, separate from their [treatable] valve disorder." [Program 46]

D. Rescind DNR and reinstate after the procedure

Within 24–48 h

"We still move forward ... DNR is held while they are in [procedure] and reactivated after [in PACU]." [Program 14]

"I think [code status does not revert] in PACU, but once they are admitted as an inpatient and up in the unit. ...I'm sure a day goes by without anyone 'hey, you are full code' and 'no, I was DNR'. So, the nurse has to get the doctor to officially change it back." [The patient might go up to the floor as full code if the provider does not readdress it with the patient?] "Yes." [Program 15]

"Yes, [they are asked to change to full code] for the first 24–28 h post-procedure." [What happened for patients who declined to do so?] "Then the goals-of-care discussion continues, and we can refer back to their primary care physician or cardiologist..." [Program 16]

Duration of the hospital stay

"[DNR is] reversible for the procedure. ...What we found is that the patients that are DNR status, but good enough to go through the procedure, they generally have some other issues going on, so we try to address those issues and see if this is actually what they want – or do they feel like a burden to everybody? We discuss the whole psycho-social issues with them. [They remain full code] just during hospital stay." [Program 28]

Often [most] times..., patients remain full code throughout their hospitalization." [Program 29]

After 30 days

"I think it's more financial than anything, and that has to do with the Registry data, anything that has to do within that 30-days scope really is part of 'the program hit'. We try to maintain that 30 days, because after that 30 days, it's not an 'at fault' issue. If a patient gets into a car accident on day 28, that death gets blamed on the procedure. That's the rationale." [Program 47]

"30 days–that's just a number the team decided on..." [Program 46]

E. Documentation of DNR status after reinstatement

"It is not in the computer – we just talk to [the patients] about it." [Program 17]

"I think the majority remain full code after the procedure, but there's not clear documentation of that anywhere. It's just a verbal understanding between the team and patient and family." [Program 31]

"I do not believe it's changed [in the record] ...It's on their record it's DNR when they get out." [Program 14]

"I would say no, [not included in discharge summary] ...No, [not readdressed at 30-day visit.]" [Program 27]

Note: [square brackets] Indicate interviewer comments/edits for clarity; program numbers identify speakers.

DISCUSSION

Nearly all TAVR programs (96%) reported routinely addressing peri-procedural code status through informal practices, yet there was considerable variation among programs regarding how code status is managed, and few programs reported having formal policies in place. More than three quarters of programs require temporary suspension of DNR status prior to TAVR. Among programs that rescind DNR status, the rationales offered for three

time periods for reinstatement reflected different perceptions about external regulatory frameworks and accountability for adverse outcomes.

It is not clear what clinical differences between programs contribute to the observed variability in practice. TVT Registry data do not support the notion that patients with DNR status be excluded from consideration for TAVR, because in-hospital cardiac arrest and mortality within 30 days were similar among peri-procedural code status groups. This contrasts with other studies, where DNR status was strongly associated with mortality,[32] and cardiac arrest emerged from machine learning models as a significant factor in predicting in-hospital mortality following TAVR.[33]

Frailty is common among older adults undergoing TAVR,[17] and a rapidly growing body of evidence suggests a dismal prognosis for frail patients following in-hospital CPR, with survival to discharge ranging from 0% to 4.8% versus 26% to 31% in frail versus non-frail patients, respectively.[24–26] Whether such patients should proceed to TAVR as 'full code' may depend on their specific motivations, circumstances and preferences.[17,18,34] Our findings suggest a need for clinicians to gain a better understanding of how TAVR fits into patients' goals of care and values, and whether symptom relief and palliation can be reasonably achieved through this intervention.[35–37]

Our findings also imply that routine reversal of DNR status prior to TAVR may be partly motivated by considerations unrelated to patient preferences and characteristics, such as requirements to report outcomes like all-cause mortality to the STS/ACC TVT Registry. Such concerns are not unique to TAVR; 'surgical buy-in' has long been seen as a prerequisite to invasive procedures as well as a barrier to treatment limitations in the perioperative setting.[38,39] Lack of 'surgical buy-in' has been thought to contribute to surgeons' unwillingness to operate, hesitancy to pursue comfort care strategies, and shifting of responsibility for outcomes to the patient.[38] Indeed, 54% of surgeons in a prior study would refuse to operate on patients whose advance directives placed limits on postoperative care.[39] However, the targeted focus on 30-day surgical outcomes has come under scrutiny and is giving way to more patient-centered decision-making processes focused on goal-concordant surgical care.[40,41]

Our study indicates significant variability in practices surrounding re-instatement of DNR status following TAVR. The finding that most programs suspend DNR for some time but do not routinely document when DNR is reinstated presents a clear opportunity for improvement. If patients' DNR orders are suspended or modified for TAVR, it is necessary to ensure that their prior code status is re-established in a timely and well-documented manner to avoid unwanted treatment.[42]

Standardization of DNR policies is not addressed in current guidelines[10] or guidance documents for TAVR.[11–13,43] By contrast, the American Society of Anesthesiologists' (ASA) and American College of Surgeons (ACS) guidelines for the care of patients with DNR status have addressed automatic DNR suspension as conflicting with patients' rights to self-determination.[34,42,44] These societies advocate for discussion of the appropriateness of resuscitation based on a patient's specific circumstances and preferences prior to anesthesia and surgery. In 2019, the ACS launched the Geriatric Surgery Verification Quality Improvement Program, which established standards for shared decision-making, assessment of geriatric-specific vulnerabilities, and interdisciplinary care planning.[31] These standards recommend that surgeons discuss code status in all patients 75 years of age or greater and clarify preferences for life-sustaining therapies. Such practices acknowledge frequent overlap and compatibility between palliative care and procedural interventions, of which TAVR is a clear example.[41]

The goal-directed approach articulated in the ASA and ACS guidelines[42,44] derives from accepted ethical precepts supporting patients' rights to self-determination and reflects widespread efforts to deliver care tailored to patients' goals and values. This approach may be especially well-suited to older adults undergoing TAVR, because many are motivated by concerns about their quality of life and also tend to be at higher risk of complications following CPR.[16,27,37] A recent study demonstrates the importance of understanding how patients make sense of apparent contradictions in preferences: Burkle et al. found that 92% of patients with pre-existing DNR orders expected discussions about DNR status to occur prior to operations, but 57% felt that pre-operative DNR orders should be suspended during their elective surgical cases.[45] Excluding patients from consideration for TAVR in this manner, without addressing underlying reasons for DNR status, risks making decisions to pursue TAVR unilateral, rather than shared. Yet, 78% of coordinators in our study said their programs would not perform TAVR on candidates with a standing DNR order.

Clinicians who refer older adults with DNR status for TAVR can prepare them by setting expectations for possibly suspending their DNR and discussing goals for peri-procedural resuscitation, especially for those whose goals of care are palliative. Given the variability in practice and different interpretations of what code status stands for in the context of TAVR, developing standard practices for assessing goals, suspending DNR if appropriate, and clear procedures for reinstatement and documentation are needed. A broader conversation among clinicians who care for patients with aortic stenosis,

including primary care, geriatrics, cardiology, cardiac surgery, anesthesiology, emergency medicine, and palliative care about how TAVR can be palliative, life-prolonging or both among older persons is needed, and should lead to the development of a multi-society expert decision clinical pathway. Multi-disciplinary heart teams responsible for reviewing TAVR candidacy are best positioned to implement any proposed standardization of the peri-procedural approach to code status for patients undergoing TAVR and probably should include representation from geriatrics and palliative medicine.[46]

Our study has several limitations. Resources limited our capacity to interview TAVR coordinators outside of Washington and California, thus we cannot say how wider geographic differences might affect policies and practices. However, given coordinators' demonstrated depth of understanding and range of views represented in this study, we do not believe geography limits generalizability. Most coordinators who declined participation stated that their administrations would not allow their participation in this study; while this creates unavoidable selection bias, it also suggests a need for a broader platform to discuss issues surrounding peri-procedural code status. Finally, the study did not seek patient or family perspectives—a critical area for future research.

Our study suggests current approaches to DNR orders prior to TAVR are frequently in tension with longstanding ethical frameworks supporting shared decision-making and patient-centered approaches to use of life-sustaining therapies in the peri-procedural setting. These findings indicate a need to determine best practices and standardize approaches to code status in patients undergoing TAVR.

AUTHOR CONTRIBUTIONS

Study concept and design – Gwen M Bernacki, Ashok Krishnaswami and James N Kirkpatrick. Acquisition of subjects and/or data – Gwen M Bernacki, Janet Wyman and James N Kirkpatrick. All authors contributed to analysis and interpretation of data and the preparation of the manuscript.

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CONFLICT OF INTEREST

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SUPPORTING INFORMATION

Additional supporting information can be found online in the Supporting Information section at the end of this article.

Data S1. TAVR Peri-Procedural Code Status Interview Guide of Clinical Program Coordinators in Washington and California

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