Since January 2020 Elsevier has created a COVID-19 resource centre with free information in English and Mandarin on the novel coronavirus COVID-19. The COVID-19 resource centre is hosted on Elsevier Connect, the company's public news and information website.

Elsevier hereby grants permission to make all its COVID-19-related research that is available on the COVID-19 resource centre - including this research content - immediately available in PubMed Central and other publicly funded repositories, such as the WHO COVID database with rights for unrestricted research re-use and analyses in any form or by any means with acknowledgement of the original source. These permissions are granted for free by Elsevier for as long as the COVID-19 resource centre remains active.
Never Let a Crisis Go to Waste: What Have We Learned About Clinical Pathways for Transcatheter Structural Heart Interventions?

Elizabeth M. Perpetua, DNP, ACNP-BC, FACC\(^a\,b\) and Mark J. Russo, MD, MS\(^c\,d\)

\(^a\)Empath Health Services, Seattle, Washington, USA; \(^b\)School of Nursing, Seattle Pacific University, Seattle, Washington, USA; \(^c\)Rutgers–Robert Wood Johnson Medical School, New Brunswick, New Jersey, USA; \(^d\)Robert Wood Johnson Barnabas Health, New Brunswick, New Jersey, USA

The COVID-19 pandemic forced structural heart programs to adapt processes of care in unprecedented ways. Clinical pathways for transcatheter structural heart interventions and the associated outcomes for different patient cohorts are described in two articles in this issue of Structural Heart. Tuttle and colleagues\(^1\) describe their experience early in the COVID-19 crisis (March through June 2020) when resources were significantly restricted. This cohort comprised mostly inpatients with refractory heart failure who underwent transcatheter aortic valve replacement (TAVR, \(n = 22\)) or percutaneous mitral valve intervention (PMVI, unspecified, \(n = 4\)) and had a higher risk of post procedure complications and high resource utilization. Conversely, Pop and colleagues\(^c\) describe their experience applying a same-day discharge (SDD) protocol for TAVR (\(n = 29\)) later in the COVID-19 pandemic (July to December 2020). These patients were selected based on their low complication risk and limited resource consumption. Though each series represents outliers on opposite ends of the risk spectrum—Tuttle et al higher risk and Alum et al low risk—neither study found significant differences in outcomes when compared to a standard population of like patients.

### Resource allocation based on benefit and capacity

Fair and just systematic use of resources is based on the assessment of the patient’s potential benefits versus the risks of the procedure.\(^3\,4\) Following the ACC/SCAI statement on triage for patients requiring structural heart intervention,\(^5\) Tuttle et al treated the most acute patients, who would generally be expected to have high resource utilization depending on definitions and metrics. Efforts to decrease resource use included telehealth and limiting the number of procedural staff members. New practices included completion angiography, vascular ultrasound, and post-discharge ambulatory telemetry monitoring. Significantly lower rates of vascular complications, permanent pacemaker implantation, and postprocedure discharge on day 1 were reported. Patients may have received benefit from the additional diagnostic imaging or surveillance, practices that become sustained changes to their clinical pathway. In addition, it is notable that Tuttle et al grouped the TAVR and PMVI patients; the latter typically do not require contrast or have vascular complications. Further inquiry into the outcome benefit and cost-effectiveness of resource intensive practices is of growing interest. It could also be surmised that outcomes were favorable because patients who did not present for treatment were appropriately triaged and monitored by their nurse coordinators or did not present to their hospital.

While SDD appears safe and feasible, the benefits have yet to be established. Pop et al triaged patients based on hospital capacity, an operating principle of the Canadian Cardiovascular Society guidelines for structural interventions.\(^6\) Founded on the Vancouver 3M\(^6\) and Benchmark\(^c\) pathway, their protocol is described in detail and aims to improve outcomes while minimizing resource utilization along the continuum of care. Four series\(^8\,10\) have demonstrated safety of SDD in select patients; Krishnaswamy et al presented the largest series of SDD in 444 patients at Transcatheter Cardiovascular Therapeutics on November 5, 2021.\(^11\) These single-center studies beg several questions. Where do we go from here? Is SDD better than next-day discharge for TAVR, and if so, in whom and under what conditions? What is the patient’s experience of SDD? Pop et al allude to the multicenter PROTECT-TAVR study for further validation. For now, capacity principles as highlighted in the crisis literature\(^12\) and best practice recommendations for optimizing care in structural heart programs\(^13\) offer foundational guidance for adapting clinical pathways in site-specific ways. Until there is evidence of demonstrable benefit, SDD would be considered for select patients when a hospital is at restricted capacity, and may not be warranted at reduced or conventional capacity.

### The critical staffing shortage

Constraints on space, supplies, and staff have varied widely through the pandemic, but the dire reality is COVID-19 created a critical shortage of our most valuable resource: health care workers. Up to 12% of physicians are considering leaving medicine.\(^14\) Three in 10 health care workers have already resigned.\(^15\) After more than 18 months of pandemic uncertainty, one’s personal surge capacity (ie, health, internal resources, and ability to cope with stress) may be maximized or reached.

The multidisciplinary and multimodality aspects to provide standard care or be thoughtfully minimalist are in fact labor intensive. In other words, considerable time, effort, knowledge, skill, and routine oversight are necessary even with the most standard protocols to make the complex simple. The
triage, surveillance, and care coordination described in these two articles involve highly trained clinicians and coordinators. Preventing fragmentation of care relies upon a team-based approach heavily dependent upon nursing and allied health care professionals who are resigning in droves and are not readily replaced. A survey of more than 22,000 nurses found that nearly 20% plan to leave their jobs in the next 6 months due to burnout.10 Canada required several years to replenish the nursing staff that left the profession after a 2003 SARS epidemic. In Toronto, this outbreak lasted several months and was localized to 17 SARS cases. The COVID pandemic is global and has spanned parts of three years.17 The consequences of the "Great Resignation" are already constraining healthcare supply chain and service lines. Recovery, retention, and recruitment must be prioritized with resources and actions beyond the Triple Aim to the Quadruple Aim: clinician/staff satisfaction, experience, and well-being.

Dynamic innovation in care

Tuttle et al and Pop et al offer early insight on safe albeit distinct clinical pathways at different time points in the pandemic. Early on, the Center for Medicare Services (CMS) issued a series of COVID-19 waivers to ensure access to care in the United States. A current procedure terminology (CPT) code for complex percutaneous coronary intervention (PCI) was also issued for ambulatory surgical centers. As clinicians shaping structural heart clinical pathways, we anticipated a similar trajectory for structural heart therapy, launched SDD,8 and crafted frameworks for program optimization and systems of care.13 We envisioned a not-too-distant future of ambulatory surgical centers for transcatheter structural heart intervention, provided that emergency care protocols and U.S. reimbursement concerns could be thoughtfully mitigated. These strategies may be more favorable for transcatheter mitral edge to edge repair,18,19 left atrial appendage occlusion, and transcatheter closure of patent foramen ovale or interatrial septal defects, which have decreased risk of conduction disorder/permanent pacemaker or vascular complications as compared to TAVR. There will be more, not less, reevaluation of clinical pathways; the COVID-19 pandemic has forever changed health care and the health care workforce. The overarching lesson learned is that innovation in technology must be matched with dynamic innovation in self-care, care for each other, and care delivery.

Funding

The authors report no funding in support of this article.

Disclosure statement

Dr Perpetua reports the following conflicts of interest: Edwards Lifesciences: consulting, speakers bureau/honoraria. Abbott: consulting, speakers bureau/honoraria. Dr Russo reports the following conflicts of interest: Edwards Lifesciences: principal investigator, speakers bureau/honoraria, Abbott: principal investigator, speakers bureau/honoraria.

References

1. Tuttle M, Poulin M-F, Sharma R, et al. Lessons for treating structural heart patients during the COVID-19 pandemic and beyond. Struct Heart. 2021. doi:10.1080/24748706.2021.1981561.
2. Pop A, Barker M, Hickman L, et al. Same day discharge during the COVID-19 pandemic in highly selected transcatheter aortic valve replacement patients. Struct Heart. 2021. doi:10.1080/24748706.2021.19898780.
3. Emanuel EJ, Persad G, Upshur R, et al. Fair allocation of scarce medical resources in the time of Covid-19. N Engl J Med. 2020;382(21):2049–2055. doi:10.1056/NEJMsb2005114.
4. Wood DA, Sathananthan J, Gin K, et al. Precautions and procedures for coronary and structural cardiac interventions during the COVID-19 pandemic: guidance from Canadian association of interventional cardiology. Can J Cardiol. 2020;36(5):780–783. doi:10.1016/j.cjca.2020.03.027.
5. Walsh MN. Social media and cardiology. J Am Coll Cardiol. 2018;71(9):1044–1047. doi:10.1016/j.jacc.2018.01.037.
6. Wood DA, Lauck SB, Cairns JA, et al. The Vancouver 3M (Multidisciplinary, Multimodality, But Minimalist) clinical pathway facilitates safe next-day discharge home at low-, medium-, and high-volume transfemoral transcatheter aortic valve replacement centers. 3M TAVR Study. 2019;12(5):459–469. doi:10.1016/j.jcic.2018.12.020.
7. McCalmont G, Durand E, Lauck S, et al. Setting a benchmark for resource utilization and quality of care in patients undergoing transcatheter aortic valve implantation in Europe-Rationale and design of the international BENCHMARK registry. Clin Cardiol. 2021;44(10):1344–1353. doi:10.1002/clc23711.
8. Russo MJ, Okoh AK, Stump K, et al. Safety and feasibility of same day discharge after transcatheter aortic valve replacement post COVID-19. Struct Heart. 2021 Mar 4;5(2):182–185. doi:10.1080/24748706.2020.1853861.
9. Perdoncin E, Greenbaum AB, Grubb KJ, et al. Safety of same-day discharge after uncomplicated, minimalista transcatheter aortic valve replacement in the COVID-19 era. Catheter Cardiovasc Interv. 2021 Apr 19;75(5):940–947. doi:10.1002/ccd.29453.
10. Rai D, Tahir MW, Chowdhury M, et al. Transcatheter aortic valve replacement same-day discharge for selected patients: a case series. Eur Heart J Case Rep. 2021 Feb;5(2):ytaa556. doi:10.1093/ehjcv/ejaa556.
11. Krishnaswamy A. Early discharge after TAVR. 2021 Nov 5.
12. Hick JL, Einav S, Hanfling D, et al. Surge capacity principles: care of the critically ill and injured during pandemics and disasters: CHEST consensus statement. Chest. 2014 Oct;146(4):e15–e165. doi:10.1378/ chest.14-0733.
13. Perpetua EM, Guibone KA, Keegan PA, et al. Best practice recommendations for optimizing care in structural heart programs: planning efficient and resource leveraging systems (PEARLS). Struct Heart. 2021 Mar 4;5(2):168–179. doi:10.1080/24748706.2021.1877858.
14. Vaidya A. 12% of physicians are considering leaving medicine and 7 other findings about the US physician COVID19 experience. Beckers Hospital Review. https://www.beckershospitalreview.com/hospital-physician-relationships/12-of-physicians-are-considering-leaving-medicine-and-7-other-findings-about-the-us-physician-covid-19-experience.html. Accessed October 30, 2021.
15. Washington Post Frontline Healthcare Workers Survey. 2021. https://www.washingtonpost.com/context/washington-post-kff-frontline-health-care-workers-survey-feb-11-march-7-2021/b152a233-9495-47a9-9cdd-e7a15785b1ca?itid=lnk_inline_manual_7. Accessed October 30, 2021.
16. American Nurses Foundation. COVID19 impact assessment survey - the first year. 2021. https://www.nursingworld.org/practice-policy/ work-environment/health-safety/disaster-preparedness/coronavirus/what-you-need-to-know/year-one-covid-19-impact-assessment-survey/
17. Baumann AO, Blythe JM, Underwood JM. Surge capacity and casu- 
ality: human resource issues in the Post-SARS health system. Can 
J Public Health. 2006;97(3):230–232. doi:10.1007/BF03405592.
18. Nagaraja V, Krishnaswamy A, Yun J, Kapadia Samir R. Same- 
day discharge after transcatheter native aortic and mitral 
valve-in-valve replacement. JACC Case Rep. 2020 Nov 18;2 
(14):2199–2201. doi:10.1016/j.jaccas.2020.09.036.
19. Chen C, Okoh AK, Stump K, et al. Expedited MitraClip: rapid evalua- 
tion, treatment, and discharge in the COVID-19 era. Cardiovasc 
Revasc Med. 2021 Jul;28:54–56. doi:10.1016/j.carrev.2020.11.012.