



Long-Term Left Ventricular Assist Device Support as Destination Therapy: Caregiver Burden as an Outcome Measure

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Introduction

Left ventricular assist devices (LVADs) were developed as a bridge to heart transplantation, but a growing majority of implants are now destination therapy: intended as a patient's final circulatory support rather than a step toward transplant [1]. That shift was made possible by two decades of steadily improving survival and adverse-event outcomes, from the original REMATCH trial's 52% one-year survival through the fully magnetically levitated HeartMate 3's 58% five-year survival in MOMENTUM 3 [1,2]. It was also made possible, less visibly, by an assumption built into nearly every implant protocol: that a family member or friend will be identified before surgery and will take on an open-ended, often years-long role managing a driveline exit site, battery and controller changes, alarm response, and emergency recognition at home.

This review reads the well-established survival and device-safety literature for destination-therapy LVAD support alongside the comparatively smaller and less systematic literature on family caregiver burden, to ask a specific question: when a therapy's success depends on an unpaid caregiver's sustained performance, should that caregiver's own wellbeing count as a trial outcome, and if so, what has actually been measured so far.

The honest complication this review foregrounds is a mismatch in measurement effort. Survival, stroke, bleeding, and device thrombosis are primary or co-primary endpoints in every pivotal LVAD trial, adjudicated by independent

committees and reported with precise rates and confidence intervals. Caregiver depression, anxiety, time burden, and financial strain are, at best, secondary or exploratory outcomes in a handful of smaller, largely separate studies -- and in the pivotal trials that set device policy, they are not measured at all.

Material and Methods

This is a narrative review drawing on the primary publication of the REMATCH trial, the 5-year report of the MOMENTUM 3 trial, the Society of Thoracic Surgeons Intermacs 2020 annual report, the 2020 American Heart Association scientific statement on family caregiving in heart failure, the DECIDE-LVAD shared decision-making trial's caregiver outcomes, dyad-level and qualitative studies of LVAD caregiver strain and psychological distress, a 2026 systematic review and thematic synthesis of LVAD caregiving, a 2026 nationwide multicenter survey of home LVAD management burden, and a 2026 cardiovascular nursing statement proposing standardized caregiver-reported outcome domains, identified through the sources cited here and citation tracking between them, without a pre-registered protocol or systematic search string. All percentages, rates, and p-values reported here are taken directly from the cited sources; none has been invented, estimated, or extrapolated.

Results

Survival and safety: a well-measured, steadily improving device story

REMATCH, the trial that established destination therapy as a Medicare-approved option, randomized 129 patients with end-stage heart failure ineligible for transplant to a first-generation pulsatile LVAD or optimal medical therapy [1]. One-year survival was 52% with the LVAD versus 25% with medical therapy ($p=0.002$), and 2-year survival was 23% versus 8% ($p=0.09$) [1]. Figure 1 sets this result beside the most recent pivotal-trial survival data. That survival benefit came with a substantially higher adverse-event burden: relative to medical therapy, LVAD patients had roughly 9-fold higher rates of non-neurological bleeding, over 4-fold higher rates of serious neurological events, and roughly double the rate of serious infection [1].

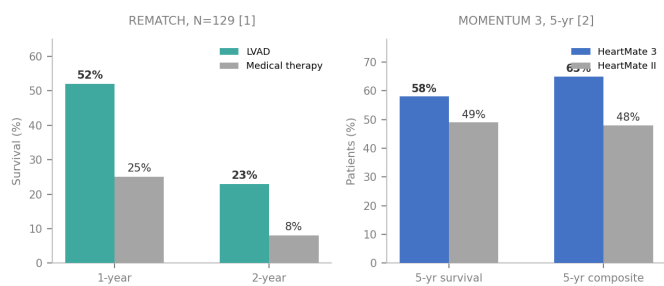


Figure 1: Survival with LVAD/destination-therapy device versus comparator arm: REMATCH at 1 and 2 years, and MOMENTUM 3 at 5 years [1,2].

This improving survival record is the direct reason destination therapy has grown from a minority indication into the dominant one: the Society of Thoracic Surgeons' Intermacs registry reports that destination therapy accounted for 49.5% of continuous-flow LVAD implants in 2017, an average of 56.1% across 2016-2020, and 78% of implants in 2020 alone, a shift also driven by the 2018 heart-transplant allocation policy change that reduced transplant access for stable LVAD patients [3]. Figure 2 shows this rise.

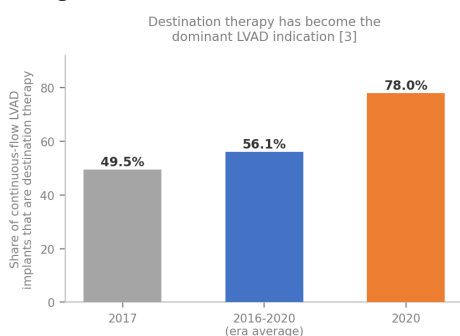


Figure 2: Destination therapy as a share of continuous-flow LVAD implants, Intermacs registry [3].

Device technology has moved from pulsatile, to axial-flow, to fully magnetically levitated centrifugal-flow pumps over this same period, and the survival gains have tracked that progression. In the MOMENTUM 3 trial's 5-year report,

patients randomized to the fully magnetically levitated HeartMate 3 had 58% survival versus 49% for the older axial-flow HeartMate II ($p=0.003$), and 65% versus 48% achieved the composite outcome of survival free of disabling stroke or reoperation for pump malfunction ($p<0.001$) [2]. Figure 3 sets out why: hemocompatibility-related adverse events fell sharply with the newer pump, from 0.108 to 0.01 device-thrombosis events per patient-year, from 0.136 to 0.05 for stroke, and from 0.765 to 0.43 for bleeding, while infection, arrhythmia, and right ventricular failure rates were similar between the two devices [2]. Every one of these figures -- survival, stroke, bleeding, thrombosis, and the growing denominator of patients now living for years on device support -- is measured consistently, adjudicated centrally, and reported in the primary trial or registry publication.

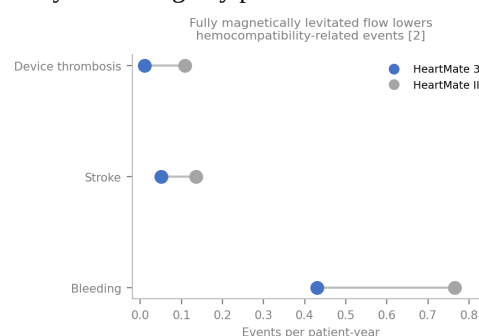


Figure 3: Hemocompatibility-related adverse event rates, HeartMate 3 versus HeartMate II, MOMENTUM 3 5-year report [2].

The caregiver behind the device: an assumption built into every protocol

Destination-therapy LVAD implantation is not offered to patients living alone: essentially every implanting program requires an identified family caregiver before surgery, because outpatient safety depends on that person's ability to change a driveline dressing, replace batteries and manage the external controller, recognize and respond to device alarms, and activate emergency care when something goes wrong, often for years and often around the clock in the early months [7,8]. Figure 4 sets this dyad relationship out schematically. This is a structural, not incidental, dependency: the therapy's real-world safety record rests in part on an unpaid, unmeasured caregiver's sustained performance, which makes that caregiver's own wellbeing directly relevant to the therapy's true outcome, not merely an adjacent concern.

The requirement is explicit rather than implied in most program protocols, and it is not a brief commitment: because destination therapy is by definition open-ended, the caregiving role it creates has no planned end date the way a bridge-to-transplant caregiver's role does once a donor organ becomes available. A caregiver who accepts this role at implant is agreeing, in effect, to an unspecified number of years of the tasks Figure 4 sets out, on top of whatever employment, family, or health circumstances already occupied their time before the implant [7,8].

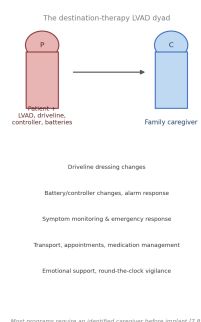


Figure 4: The destination-therapy LVAD caregiver-patient dyad: device-management tasks that typically fall to a family caregiver at home [7,8].

Caregiver burden: real, measurable, and comparatively under-reported

Where the caregiver-outcomes literature does exist, it finds burden that is substantial and quantifiable. In a 50-dyad single-center study, the Multidimensional Caregiver Strain Index (18-90 scale) rose from 37.0 before implant to 40.6 at 1 month and remained elevated at 40.5 at 3 months before easing to 37.0 by 6 months, with caregivers citing time constraints, compromised social life, and physical strain as the leading sources of stress -- and this peak in caregiver strain coincided with the patients' own greatest quality-of-life gains, measured by a Kansas City Cardiomyopathy Questionnaire rise from 29.6 to 51.3 over the same first month [5]. In a separate cohort of LVAD patients and their partners, partner depression prevalence was 39% at 3-4 weeks post-implant, still 33% at 3 months, and 19% at 6 months; partner anxiety followed a similar course, from 48% to 44% to 22%; and partner PTSD symptoms were present in 12% at 1 month and 14% at 6 months, essentially unchanged [6]. Figure 5 tracks this trajectory. None of these figures approaches zero even at 6 months, and the study design in each case captured only one, or a few, of many centers performing these implants.

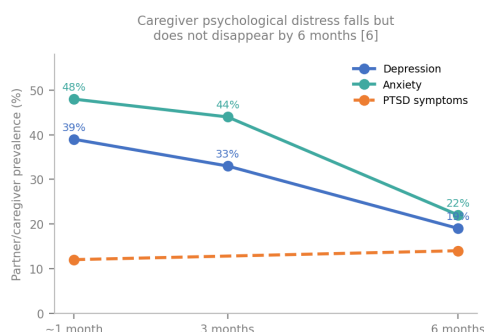


Figure 5: Caregiver/partner depression, anxiety, and PTSD-symptom prevalence over the first 6 months after LVAD implantation [6].

The single trial designed specifically around destination-therapy LVAD caregivers, DECIDE-LVAD, offers the clearest illustration of both the possibility and the current limits of caregiver-inclusive measurement. Run as a stepped-wedge trial of a shared decision-making intervention across six mechanical circulatory support programs, it enrolled 182 caregivers alongside 248 patients and prospectively

measured caregiver decisional conflict, decision regret, perceived stress, preparedness for caregiving, depression, and care satisfaction -- a caregiver-outcomes panel considerably broader than anything in REMATCH, MOMENTUM 3, or the Intermacs registry [7]. Yet the intervention produced no significant improvement on any of these secondary caregiver outcomes; decisional conflict actually decreased more in the usual -care control arm (a 9.3-point reduction) than in the decision-aid intervention arm (2.6 points, $p=0.009$), and knowledge gains did not differ significantly between arms ($p=0.08$) [7]. A companion mixed-methods study of the same population identified persistent themes of role strain, vigilance, and financial worry among caregivers of destination-therapy LVAD patients, describing coping as an ongoing adaptation rather than a problem resolved by education alone [8]. A 2026 nationwide multicenter questionnaire survey extended this picture to socioeconomic impact directly, documenting that long-term home LVAD management can require both patients and their caregivers to reduce working hours, adding a financial dimension to the psychological burden already described [10].

A 2026 systematic review and thematic synthesis pooling 17 qualitative studies and 238 caregivers organized this literature into four temporal phases of caregiving -- from the pre-implant decision period through long-term maintenance -- and identified a recurring theme the authors termed caregiver invisibility: clinical encounters and follow-up visits focus almost exclusively on the patient, despite caregiving's substantial and continuing impact on the caregiver's own health and daily life [9]. Table 1 sets out the survival and safety literature reviewed here, Table 2 sets out the caregiver-burden literature side by side, and Figure 6 makes the resulting asymmetry explicit: the outcome domains that are reliably measured across the major destination-therapy evidence base are survival and device adverse events; caregiver burden, quality of life, and financial strain appear only in a smaller set of dedicated caregiver studies run largely in parallel to, rather than inside, the trials and registries that actually set device policy.

Survival and device safety are consistently measured; caregiver burden rarely is [1,2,3,5,6,7,8,9]

	Survival	Device AEs	Caregiver burden/QoL	Financial strain
REMATCH [1]	✓	✓	–	–
MOMENTUM 3 [2]	✓	✓	–	–
Intermacs report [3]	✓	–	–	–
DECIDE-LVAD [7]	–	–	✓	–
Caregiver studies [5,6,8,9]	–	–	✓	✓

Figure 6: Which outcome domains are actually reported across the survival/registry evidence versus the dedicated caregiver studies reviewed here [1,2,3,5,6,7,8,9].

Study	N	Design	Headline survival/safety result
REMATCH [1]	129	RCT, LVAD vs medical therapy	1-yr survival 52% vs 25% (p=0.002)
MOMENTUM 3, 5-yr [2]	1,028 (RCT cohort)	RCT, HeartMate 3 vs HeartMate II	5-yr survival 58% vs 49% (p=0.003)
Intermacs 2020 report [3]	Registry, national	Annual registry report	DT share of implants 49.5%(2017) -> 78%(2020)

Table 1: Design and headline result of the survival/registry evidence reviewed here [1,2,3].

Study	N (caregivers)	Design	Headline caregiver-burden result
Bidwell et al [5]	50 dyads	Single-center longitudinal	Strain index 37.0 (pre) -> 40.6 (1mo) -> 37.0 (6mo)
Brouwers et al [6]	Not a registry study	Longitudinal cohort	Partner depression 39% (1mo) -> 19% (6mo)
DECIDE-LVAD [7]	182	Stepped-wedge RCT	No sig. benefit on stress, depression, or regret
Eriksson-Liebson et al [9]	238 (17 studies)	Systematic review, thematic synthesis	Caregiver "invisibility" in clinical encounters

Table 2: Design and headline result of the dedicated caregiver-burden studies reviewed here [5,6,7,9].

Discussion

The device-outcomes story told here is genuinely a success story: destination-therapy LVAD survival has improved across three device generations, adverse-event rates have fallen substantially with fully magnetically levitated pumps, and these improvements are precisely quantified because survival and device safety are primary or co-primary endpoints, adjudicated centrally, in every pivotal trial [1,2]. That same rigor has not been extended to the caregiver whose sustained, unpaid labor the therapy structurally depends on. REMATCH, MOMENTUM 3, and the Intermacs registry -- the three data sources that most directly shape clinical and payer decisions about destination therapy -- report no caregiver outcome of any kind [1,2,3]. Where caregiver burden has been measured, it has been in smaller, largely separate studies: single- or few-center cohorts of 50 to about 240 caregivers, run by investigators whose focus is caregiving specifically rather than device performance [5,6,8,9].

This is not merely an academic gap. A caregiver whose own depression, anxiety, or financial strain is unaddressed is plausibly less able to sustain the vigilance that destination therapy depends on, which means caregiver wellbeing is arguably a mediator of the very device-safety outcomes that are so carefully measured, not a separate concern to be traded

off against them [4,9]. The 2020 American Heart Association scientific statement on family caregiving in heart failure makes a version of this same point at a specialty-wide level, concluding that caregiver-directed interventions in heart failure have generally been of low quality, inconsistently measured, and that effective strategies for improving both caregiver and patient outcomes together remain unknown [4]. DECIDE-LVAD is the clearest existing counter-example -- a trial that measured caregiver decisional conflict, stress, preparedness, and depression prospectively in 182 caregivers -- but its own null result on every one of those measures shows that simply adding caregiver outcomes to a trial does not by itself solve the underlying problem; it only makes the problem visible enough to be studied further [7].

What would a caregiver-inclusive outcome framework for destination-therapy LVAD trials actually look like? A recent multi-society cardiovascular nursing statement proposes four measurement domains that map reasonably well onto the gaps identified here: the direct impact of caregiving (burden, strain, time cost); caregiver skills and preparedness (competence and self-efficacy at the specific tasks destination therapy requires); the emotional and psychological impact on the caregiver, including quality of life; and the adequacy of formal and informal support systems available to that caregiver [11]. None of these domains requires abandoning the survival and device-safety endpoints that have driven genuine progress in this field; the proposal is additive, not substitutive. A pragmatic first step within existing destination-therapy trial infrastructure would be routine, standardized caregiver-reported outcome collection at the same visit intervals already used for device follow-up, using instruments already validated in the smaller caregiver studies reviewed here -- the Multidimensional Caregiver Strain Index and standard depression/anxiety screens among them -- rather than waiting for a caregiver-specific trial to be separately funded and designed each time [5,6,11].

The contrast with how thoroughly device performance itself is tracked is instructive. Intermacs collects detailed, adjudicated, patient-level data on every implant performed in the United States, refreshed annually and used directly to inform guideline and payer policy [3]. No equivalent national infrastructure exists for the caregiver side of the same implant: there is no registry field for caregiver strain, no adjudicated caregiver adverse-event category, and no routine mechanism by which a caregiver's declining wellbeing during year two or three of destination therapy would be captured anywhere a clinician, program, or regulator could see it in aggregate [3,4,9]. That asymmetry, more than any single number in this review, is the honest complication a caregiver-inclusive outcome framework would need to address.

Study limitations

This is a narrative review, not a systematic review with a pre-registered protocol, and its device-outcomes section rests on two headline trials plus a national registry report rather than an exhaustive search of the LVAD survival literature. The caregiver-burden studies cited here vary considerably in design, sample size, and instrument choice -- a 50-dyad single-center longitudinal study, a stepped-wedge multicenter trial, and a qualitative thematic synthesis are not directly comparable, and this review reports their findings side by side for descriptive purposes rather than pooling them into a single quantitative estimate [5,6,7,9]. The claim that caregiver outcomes are comparatively under-measured rests on their absence from three specific, high-visibility sources -- REMATCH, MOMENTUM 3, and the Intermacs registry -- rather than a systematic audit of every destination-therapy LVAD publication, so smaller or more recent trials not captured in this review's search may report caregiver outcomes the three flagship sources do not [1,2,3].

The caregiver-specific studies reviewed here also carry their own generalizability limits worth stating plainly. The 50-dyad strain-index study and the partner psychological-distress cohort were each conducted at a small number of centers with caregiver populations predominantly composed of spouses, which may not represent adult children, other relatives, or paid caregivers who fill this role in other households [5,6]. DECIDE-LVAD's null result on caregiver secondary outcomes could reflect a genuinely ineffective intervention, an underpowered secondary analysis, or outcome measures that did not capture the specific burdens destination-therapy caregiving imposes -- the trial itself cannot distinguish between these explanations, and this review does not attempt to adjudicate which is correct [7]. The proposed caregiver-reported outcome domains discussed here come from a recent multi-society statement rather than from a validated, prospectively tested measurement instrument specific to destination-therapy LVAD caregiving, so they should be read as a starting framework for future trial design rather than a ready-made outcome set that could be dropped into an ongoing device trial today [11]. Finally, none of the caregiver studies reviewed here was designed or powered to test whether improving caregiver wellbeing changes a patient's own device-related adverse-event rate, so the mediation hypothesis raised in the Discussion -- that caregiver strain may itself degrade device safety outcomes -- remains a plausible, testable hypothesis rather than a demonstrated finding [4,9].

A further point worth stating for practice: the improvements in survival and device safety documented here occurred over more than two decades and across three distinct device generations, from REMATCH's pulsatile pump to MOMENTUM 3's fully magnetically levitated centrifugal pump, while the caregiver-burden literature reviewed here

spans a comparatively narrow and more recent window and has not obviously benefited from an equivalent, sustained programmatic investment [1,2,5,6,7]. If destination therapy continues to grow toward the 78% implant share already reported for 2020, the absolute number of family caregivers taking on this role will keep rising even without any change in per-patient burden, which strengthens rather than weakens the case for building caregiver-reported outcomes into whatever the next generation of destination-therapy device trials turns out to be [3,11].

Conclusion

Destination-therapy LVAD support has become both more effective and safer across three device generations, a genuine achievement documented in precise, centrally adjudicated survival and adverse-event data. The family caregiver whose sustained, largely unpaid work makes safe outpatient management possible has not received the same measurement attention: caregiver depression, anxiety, strain, and financial burden are real and quantifiable where anyone has looked, but that looking has happened in small, separate studies rather than inside the trials and registries that actually govern destination-therapy practice. A caregiver-inclusive outcome framework -- built on existing, validated caregiver instruments and collected at the same intervals as routine device follow-up -- would not require abandoning the device-outcomes rigor that has served this field well; it would simply extend that same rigor to the person the therapy has quietly depended on all along.

Two concrete implications follow directly from the evidence assembled here. First, the financial dimension of caregiver burden deserves the same explicit accounting that device cost already receives in destination-therapy programs: the 2026 nationwide survey found that long-term home management can force both patients and caregivers to cut working hours, a socioeconomic cost that sits entirely outside the survival and adverse-event ledger that REMATCH, MOMENTUM 3, and the Intermacs registry report [3,10]. Second, the four domains proposed by the 2026 cardiovascular nursing statement -- caregiving impact, skills and preparedness, emotional and psychological wellbeing, and support-system adequacy -- read less like a new research agenda than like a checklist against which every destination-therapy program could already audit its own current practice, using instruments many programs already have access to through the caregiver studies reviewed here [5,6,11]. Neither implication requires new device technology or a new pivotal trial; both require only that the caregiver already present at every destination-therapy consent conversation be measured with the same seriousness as the pump.

It is worth being precise about what this review does and does not claim. It does not argue that destination-therapy LVAD

support is a poor choice for patients or families, nor that its documented survival benefit is anything less than genuine and clinically meaningful -- REMATCH's near-doubling of 1-year survival and MOMENTUM 3's continued gains at 5 years stand on their own [1,2]. The argument is narrower and, the authors think, harder to dispute: a therapy whose safe delivery structurally depends on a family caregiver's sustained performance should measure that caregiver's wellbeing as a matter of course, in the same trials and registries that already measure everything else about the therapy, rather than leaving that measurement to a separate and smaller research tradition that the pivotal device literature does not cite, fund, or build upon [4,9]. Closing that gap is a matter of trial design and registry field addition, not new device science, which is precisely why it is reasonable to expect it could happen well before the next device generation arrives.

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1. Rose EA, Gelijns AC, Moskowitz AJ, et al. "Long-term use of a left ventricular assist device for end-stage heart failure". *N Engl J Med* 345(2001):1435-1443.
2. Mehra MR, Goldstein DJ, Cleveland JC, et al. "Five-Year Outcomes in Patients With Fully Magnetically Levitated vs Axial-Flow Left Ventricular Assist Devices in the MOMENTUM 3 Randomized Trial". *JAMA* 328(2022):1233-1242.
3. Molina EJ, Shah P, Kiernan MS, et al. "The Society of Thoracic Surgeons Intermacs 2020 Annual Report". *Ann Thorac Surg* 111(2021):778-792.
4. Kitko L, McIlvennan CK, Bidwell JT, et al. "Family Caregiving for Individuals With Heart Failure: A Scientific Statement From the American Heart Association". *Circulation* 141(2020):e864-e878.
5. Bidwell JT, Lyons KS, Mudd JO, et al. "Patient and Caregiver Determinants of Patient Quality of Life and Caregiver Strain in Left Ventricular Assist Device Therapy". *J Am Heart Assoc* 7(2018):e008080.
6. Brouwers C, Denollet J, Caliskan K, et al. "Psychological distress in patients with a left ventricular assist device and their partners: an exploratory study". *Eur J Cardiovasc Nurs* 14(2015):53-62.
7. McIlvennan CK, Matlock DD, Thompson JS, et al. "Caregivers of Patients Considering a Destination Therapy Left Ventricular Assist Device and a Shared Decision-Making Intervention: The DECIDE-LVAD Trial". *JACC Heart Fail* 6(2018):904-913.
8. McIlvennan CK, Jones J, Makic MBF, et al. "Stress and Coping Among Family Caregivers of Patients With a Destination Therapy Left Ventricular Assist Device: A Multicenter Mixed Methods Study". *Circ Heart Fail* 14(2021):e008243.
9. Eriksson-Liebon M, Kato NP, Ben Avraham B, et al. "The Dynamic Nature of Caregiving in Advanced Heart Failure With Left Ventricular Assist Device Support: A Systematic Review and Thematic Synthesis". *Curr Heart Fail Rep* 23(2026):19.
10. Watanabe M, Matsumiya G, Kohno H, Kinugawa K. "Psychological and socioeconomic impact of long-term home management on patients with left ventricular assist devices and their caregivers: a nationwide multicenter questionnaire survey". *J Artif Organs* 29(2026), Epub ahead of print.
11. Lie I, Borregaard B, Fredericks S, et al. "Perspectives on caregiver-reported outcomes in cardiovascular diseases today and in future healthcare services". *Eur J Cardiovasc Nurs* 25(2026):646-664.