LVAD INFECTION PREVENTION TOOLKIT

# Infection Prevention Following Durable LVAD Implantation

## A Toolkit

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LVAD INFECTION PREVENTION TOOLKIT

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August 2024

# Section A

# Goals of the Toolkit

# Goals of this Toolkit

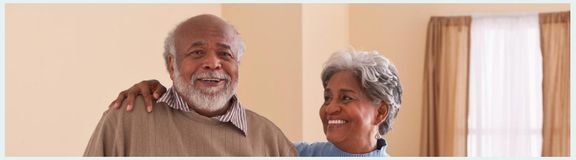
This toolkit provides the necessary foundational support for centers to advance infection prevention activities in the setting of durable left ventricular assist device (LVAD) implantation.

This toolkit includes infection prevention recommendations and accompanying implementation materials (e.g., guides, data collection worksheets).

This toolkit groups recommendations into the following four categories based on their foci and unique set of resource documents and implementation strategies:


**LVAD PROGRAM**

**CLINICIANS**



**PATIENTS & CAREGIVERS**

**LVAD LEADERSHIP**

# How to Use this Toolkit

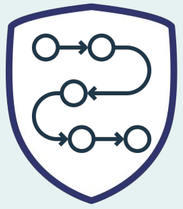
The toolkit includes an eight-step process for advancing infection prevention activities at your center. We anticipate centers will initiate a number of these cycles over the course of their work to advance infection prevention activities.

## STEPS 1-3

focus on reviewing your team's strengths and weaknesses regarding infection prevention, identifying potential recommendations to implement, and prioritizing recommendations for initial areas of focus.

## STEPS 4-6

focus on developing the necessary infrastructure to prepare your team to successfully implement the recommendations you have chosen.



## STEPS 7-8

focus on undertaking your action plan and assessing its associated impact.

# LVAD INFECTION PREVENTION TOOLKIT

01
**Identify areas**
to prevent post-implant infections (e.g., improve patient/caregiver education)

02
**Identify candidate**
recommendations for areas of focus (using the recommendation lookup guide)

03
**Prioritize recommendations**
Use recommendation prioritization table.

04
**Identify team member roles**
to implement recommendations.
Use LVADS ASsignment List

05
**Develop an action plan**
and desired outcomes with LVAD team.

06
**Collect additional data**
elements outside of STS Intermacs as needed (e.g. sterile driveline dressing change techniques).

07
**Set the action plan in motion**

08
**Monitor and report back outcomes**

## Section B

# Identify Areas for Infection Prevention

# Step 1: Identify areas to prevent infections post-implant.

See Appendix B for data collection worksheets to guide your assessment of your team's strengths and weaknesses.


Use your existing LVAD multidisciplinary team meetings to review your team's strengths and weaknesses regarding infection prevention

Your team's strengths and weaknesses can be assessed by reviewing your STS Intermacs reports, existing protocols (e.g., patient/caregiver education, management of driveline infections). Sources can be documented in the Data Collection Worksheet.

Your team will use these data and a summary of your discussions to review the recommendation lookup guide (see next slide).

# Step 2: Identify candidate recommendations.

The Recommendation Lookup Guide is designed to help your team identify recommendations relative to your infection prevention strengths and weaknesses

- This interactive online guide (click here), which can be filtered by your team, contains:
  - Numerical sequencing of each recommendation
  - Groupings of each recommendation into the four categories (LVAD Program, Clinicians, Patients and caregivers, LVAD leadership)
  - List of recommendations
  - Areas of focus (e.g., technology, patient/caregiver education, care bundles)

# Screenshot of Recommendation Lookup Guide

| | Reco... | Recommendation | Audience | Tags |
|---|---|---|---|---|
| 1 | 1 | **Infection Prevention Data Access**<br><br>Up-to-date unit and service line level infection prevention data should be provided to members of the VAD team, including consulting services, to advance evidence-based care and outcomes. | Program Directed | Team Communication<br>Protocol Updates<br>Outcome Assessment and Improve... |
| 2 | 2 | **Patient Image-Sharing Platform**<br><br>Consistent usage of a HIPAA-compliant patient portal can support post-discharge HAI surveillance (e.g., transmission of driveline exit site images to the patient's care team). | Program Directed | Technology<br>Protocol Updates<br>Outcome Assessment and Improve... |
| 3 | 3 | **Advancing Supply Availability**<br><br>Adherence to evidence-based HAI prevention bundles may be advanced by ensuring patients have equitable access to infection prevention items (e.g., driveline dressing kits). | Program Directed | Protocol Updates<br>Care Bundles<br>Outcome Assessment and Improve... |
| 4 | 4 | **Standardized Provider Education**<br><br>Efforts to enhance clinician onboarding and continuing education may benefit from standardized curricula. | Program Directed | Staffing<br>Provider Education |

Section C

# Prioritize Recommendations

# Step 3: Prioritize recommendations.

This toolkit supports your team in prioritizing infection prevention recommendations (See Appendix A)

The toolkit includes a Recommendation Prioritization Table to guide institutional decision-making regarding:

- The choice of recommendation(s) to focus on
- The type of support needed to advance the chosen set of recommendations
- The anticipated timeline for implementing infection prevention recommendations

See **Appendix A** for more in-depth examples and worksheets.

# Considerations for Applying Recommendations

This toolkit and the recommendations contained therein are not comprehensive, and thus may not include all necessary actions to improve healthcare delivery and outcomes at your center.

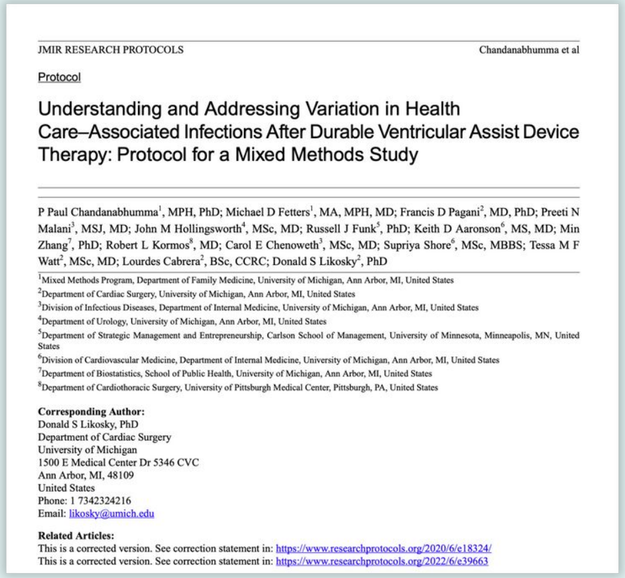
Please consult with your center's multidisciplinary working group and other collaborators to determine your implementation plan (see Section D).

LVAD INFECTION PREVENTION TOOLKIT

The recommendations:

- Were developed in part based on the analysis of qualitative interviews conducted across low and high-performing centers, and
- May be contextualized for a center's resources, staffing, location, academic affiliation status, and external factors (see Appendix E for study information).

Chandanabhumma PP, Fetters MD, Pagani FD, Malani PN, Hollingsworth JM, Funk RJ, Aaronson KD, Zhang M, Kormos RL, Chenoweth CE, Shore S, Watt TMF, Cabrera L, Likosky DS **Understanding and Addressing Variation in Health Care–Associated Infections After Durable Ventricular Assist Device Therapy: Protocol for a Mixed Methods Study**
JMIR Res Protoc 2020;9(1):e14701
doi: 10.2196/14701PMID: 31909721PMCID: 6996720



JMIR RESEARCH PROTOCOLS Chandanabhumma et al

Protocol

Understanding and Addressing Variation in Health Care–Associated Infections After Durable Ventricular Assist Device Therapy: Protocol for a Mixed Methods Study

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**Related Articles:**
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# Section D

# Team Roles and Responsibilities: LVADS

# Step 4: Identify team member roles to implement recommendations.

Your team has now prioritized the infection prevention recommendations that you will implement.

We have developed the acronym L-V-A-D-S to help your team identify the necessary roles and responsibilities to implement each recommendation.

The next slide describes each of these roles in more detail.

See **Appendix D** for more in-depth examples and worksheets.

STEPS

4

# L-V-A-D-S

## Team Member Role and Responsibilities in Implementing and Evaluating Infection Prevention Recommendations


### Leader

Someone assigning strategic direction. The Leader works closely with the Delegator. The Leader sets the team member roles (**Step 4**)


### Validator

Someone who helps provide external review and/or data support. (**Steps 1, 6, and 8**)


### Actor

Someone who performs a task (do-er, taking action in the real-world). (**Step 8**)


### Delegator

Someone who facilitates and helps delegate tasks (often called a Project Manager). The Delegator will develop the action plan (**Step 5**) and monitoring/feedback (Steps 7-8) in coordination with the Leader.


### Supporter

Someone who provides data support to the team. The Supporter will be relied on for **Step 6**.

# Step 5: Develop an action plan and desired outcomes with LVAD team.

- Your team has now assigned roles and responsibilities to advance your prioritized infection prevention recommendations.
- Many teams will use a Plan-Do-Study-Act (PDSA) approach to guide their approach for Steps 5-8.
- The first part of the PDSA cycle is to plan your intervention and identify how you will assess whether your intervention worked.
- The following AHRQ website provides more information about the PDSA approach.

https://www.ahrq.gov/evidencenow/tools/pdsa-form.html

# Step 6:  Collect additional data elements outside of STS Intermacs as needed.

- The next step is to identify any data elements your team might need to collect to successfully undertake your intervention.

- Appendix B includes sample data collection worksheets that your team might consider. We envision some interventions may require primary data collection, while others may solely require STS Intermacs, institutional nursing and/or infection surveillance data.

- For each data element, please specify a definition, primary/secondary data sources and validated ranges (in the case of continuous variables).

# Step 7:  Set the action plan in motion.

- Your team has now assigned roles and responsibilities to advance your prioritized infection prevention recommendations, as well as identified the data elements needed to move forward with your study.

- We encourage you to start with small tests of change, and incrementally move forward thereafter.

# Step 8: Monitor and report back outcomes.

- Your team has now begun the task of monitoring progress on your intervention.
- Successful teams often have a project-specific dashboard that includes process measures and outcomes. These teams share updated dashboards with their team members on a frequent basis.
- During this step, your team will likely identify barriers that impede your progress (e.g., challenges with data collection, finding time to meet as a team).
- Anticipate several PDSA change cycles as your team advances its workflow and engagement with frontline clinical staff.

# Appendix A

# Detailed List of Recommendations


# Program Directed Recommendations

# Program Directed Recommendations (1 of 6)

**Infection Data Access**

Up-to-date unit and service-line level infection data (e.g., rates, prevention practices) should be provided to members of the LVAD team, including consulting services, to advance evidence-based care and outcomes.

**Standardized Provider Education**

Efforts to enhance clinician onboarding and continuing education may benefit from standardized curricula.

# Program Directed Recommendations (2 of 6)

**Real-Time Provider Communication**

Longitudinal infection surveillance may be advanced through HIPAA-compliant electronic communication between patients and their clinical team members. The patient's electronic medical record should be updated to reflect the content of any correspondence.

**Standardizing Infection Prevention Practices**

Efforts should be made to raise awareness of and disseminate evidence-based infection prevention practices across clinicians in varied care settings.

# Program Directed Recommendations (3 of 6)

**Advancing Supply Availability**

Adherence to evidence-based infection prevention bundles may be advanced by ensuring patients have equitable access to infection prevention items (e.g., driveline dressing kits).

**Tailoring Ongoing Caregiver Education**

Tailored (e.g., assessing patient and caregiver surveys), evidence-based infection prevention practices should be designed in conjunction with LVAD team members (e.g., HF cardiologists, surgeons, LVAD Coordinators, nurse educators).

# Program Directed Recommendations (4 of 6)

**Patient Image-Sharing Platform**

Consistent usage of a HIPAA-compliant patient portal can support post-discharge infection surveillance (e.g., transmission of driveline exit site images to the patient's care team).

**Clinical Practice Guideline Changes**

Infection prevention strategies should be routinely reassessed per institutional protocol (e.g., yearly) in addition to more frequently as needed (e.g., as new data emerge).

# Program Directed Recommendations (5 of 6)

**Access to Customizable Care Bundles**

Efforts to enhance adherence to evidence-based infection prevention practices may benefit from: (1) standardization through order sets and (2) availability of LVAD-specific supplies (e.g., driveline dressing kits) for clinicians and patients.

**Engaging Physical and Occupational Therapy in Care Delivery**

Patient and caregiver level care capacities may be effectively addressed during the pre- and post-implant settings by physical and occupational therapists.

# Program Directed Recommendations (6 of 6)

**Offering a Reference for Standards of Care**

Efforts to implement standards of care may benefit from an accessible, up-to-date repository of HAI-prevention resources, policies, and procedures (e.g., hand hygiene program, line replacement protocol, patient and caregiver education tips).

# Patient and Caregiver Directed Recommendations

# Patient and Caregiver Directed Recommendations (1 of 3)

**Multiple committed caregivers**

Adherence to evidence-based infection prevention practices is advanced through a pool of long-term, engaged patient caregivers.

**Personalized education program**

A patient and caregiver-centered education program (e.g., customized to their health literacy level and preferred language, addressing caregiver concerns) and support (e.g., interpreters available during office visits, discussing options for transportation to implanting hospital with patient & caregiver with social work) can advance their long-term commitment to evidence-based infection prevention practices.

# Patient and Caregiver Directed Recommendations (2 of 3)

**Lifestyle change expectation education**

Adherence to infection prevention practices may be advanced through achieving longitudinal patient and caregiver commitment (e.g., Lifestyle Contract).

**Engaging patient advisors in patient education**

Patient advisors (e.g., patients on long-term durable LVADs) may be used to inform the design and implementation of effective tailored patient education curricula and as peer mentors for patients who are newly implanted or being evaluated for durable LVAD implantation.

# Patient and Caregiver Directed Recommendations (3 of 3)

**Documentation of health behavior counseling**

Documented counseling for patients/caregivers to promote health behavior changes (e.g., quitting smoking, changing diet, self-limiting exertion) to minimize the risk of post-implantation infection.

# Clinician Directed Recommendations

# Clinician Directed Recommendations (1 of 6)

**Well-rounded provider education**

Teaching of evidence-based HAI-prevention practices should balance device-related concerns with patient quality of life, such as their ability to participate safely in pre-implant hobbies and to engage in functional activities pre- and post-implant.

**Multidisciplinary protocol development**

Multidisciplinary data-driven discussions support the advancement and implementation of evidence-based LVAD practices and protocols.

# Clinician Directed Recommendations (2 of 6)

**Regular line replacement**

Early removal of invasive devices (e.g., urinary catheter, central line) may support the prevention of infection.

**Outpatient infection education reinforcement**

Post-discharge outpatient visits, including through telehealth modalities, may be used to advance patient and caregiver education and adherence to evidence-based infection prevention practices (e.g., video visit to reinforce optimal driveline dressing changes).

# Clinician Directed Recommendations (3 of 6)

**Anchor and binder usage**

Use of safety devices to secure the percutaneous driveline (e.g., anchors) may prevent inadvertent trauma to the interface between the driveline and subcutaneous tissue and increase the risk of subsequent infections.

**Care bundle adherence**

Adherence to evidence-based nursing care bundles may reduce post-implant infections.

# Clinician Directed Recommendations (4 of 6)

**Health equity considerations**

In order to effectively advance the delivery of patient and caregiver education, clinicians should be aware of potential barriers (e.g., educational, socioeconomic, resource limitations) and other disparities experienced by their patients.

**Communicating positive patient outcomes**

Team member well-being may be enhanced through the development and dissemination of positive patient outcomes (e.g., including stories of patient successes in an LVAD newsletter).

# Clinician Directed Recommendations (5 of 6)

**Patient centered framing during meetings**

Patient and caregiver confidence in executing HAI-prevention practices may be enhanced through patient-centered communication practices during their appointments with LVAD team members.

**Suture color selection**

High contrast suture colors may advance early post-implant infection identification among diverse patient populations.

# Clinician Directed Recommendations (6 of 6)

**Standardizing LVAD Care in Ancillary Departments**

The utilization of evidence-based infection prevention and management practices may be enhanced through specific LVAD management protocol for clinical staff working across diverse settings (e.g., emergency department nurses, emergency medical technicians, rehabilitation facilities).

**Early extubation plan**

Developing an early extubation plan, including effective postoperative pain control, pulmonary hygiene, repeated ventilator wean assessments, and appropriate sedation, may minimize infection risk.

# Leadership Directed Recommendations

# Leadership Directed Recommendations (1 of 6)

**Engaging Infection Control/Prevention and Antimicrobial Stewardship**

In-hospital infection prevention and management may be advanced through a multidisciplinary team rounding approach (e.g., heart failure cardiology, surgery, nursing, anesthesia, pharmacy) that addresses antimicrobial stewardship and infection prevention.

**Peer-to-Peer Accountability Measures**

Consistent nurse-physician dyads, which increase accountability and team familiarity, advance evidence-based HAI-prevention practices.

# Leadership Directed Recommendations (2 of 6)

**Multipronged Infection Prevention Approach**

Efforts aimed at reducing in-hospital infection rates should leverage both existing inpatient infection prevention initiatives (e.g., invasive line management, ERAS, hand hygiene) as well as institutional resources (e.g., Environmental Services, Facilities, Maintenance).

**Documenting Impacts of Protocol Changes**

Extensive documentation of successful interventions (e.g., hand hygiene program, "scrub the hub") and the effect of protocol changes are key to maintaining low infection rates.

# Leadership Directed Recommendations (3 of 6)

**Surveillance and Performance Data**

Ensuring accurate and reliable surveillance and performance data via auditing are foundational for advancing evidence-based HAI-prevention strategies.

**Real-Time OR Infection Tracking**

A longitudinal, robust and up-to-date infection tracking system including OR surveillance may be used to support an LVAD program's infection prevention strategy.

# Leadership Directed Recommendations (4 of 6)

**Unit and Service Level Data Reporting**

Infection surveillance data should be reported at the unit and service level to support local quality improvement efforts.

**Patient-Reported Outcomes and Care Practices**·Developing a reporting system for post-implant patient-reported outcomes can promote improved post-implant patient care and inform interventions that mitigate inconsistent execution of protocol.

# Leadership Directed Recommendations (5 of 6)

**Operating Room (OR) Optimization**

OR size and layout should be optimized for complex cardiac surgery to advance efficiency and mitigate infection risk, including evaluating if there is adequate and well-coordinated use of space.

**Dedicated LVAD/SOT Data Analysts**

Institutional quality assurance and improvement initiatives may be advanced through dedicated team members (e.g., database programmer, biostatistical analyst, quality improvement coordinator).

# Leadership Directed Recommendations (6 of 6)

**LVAD Quality Champions**

Encourage engagement with infection prevention initiatives from physicians, nurses, and/or LVAD Coordinators by nominating quality champions.

**Expand Real-Time Comparison via INTERMACS Dashboard**

Advocate for the expansion of available functions of the INTERMACS dashboard to advance real-time comparisons with aggregate INTERMACs data. These comparisons may improve: (1) the evaluation of an intervention’s efficacy and (2) tracking of institutional data more effectively.

# Appendix B

# Data Collection Worksheets

# Data Collection Worksheet

- Each of our institutions collect a variety of data concerning infections (e.g., nursing care bundles, unit-level infection rates), although these data are often not widely shared.
- Some pertinent data (e.g., patient and/or caregiver adherence to driveline dressing change protocols) are often not collected in a systematic fashion.
- These realities make the evaluation of your LVAD program’s strengths and weaknesses more challenging
- We have developed the following data collection guide to support your team’s evaluation process. Some data may be readily available, while others may require primary data collection.

# How to Complete the Data Collection Worksheet (example)

| Data Type | Specifics | Data Source(s) | Data Custodian(s) |
|---|---|---|---|
| Infection Rates | Type of infection and date of occurrence | STS Intermacs | LVAD Coordinator |
| Infection Rates | Unit-level C. DIFF rate | Nursing documentation and laboratory | Infection Prevention |
| Adherence to driveline dressing recommendations | Bundle adherence rate | Chart review | LVAD Coordinator |

# How to Complete the Data Collection Worksheet (example)

| Data Type | Specifics | Data Source(s) | Data Custodian(s) |
|---|---|---|---|
| | | | |
| | | | |
| | | | |
| | | | |

# Appendix C

# Recommendation Prioritization Tables

# How to Complete the Recommendation Prioritization Tables

- There are a number of potential infection prevention recommendations for your team to consider.
- When completing the recommendation prioritization tables, we suggest that your team consider each recommendation focal area as a whole and prioritize the individual recommendations within each area by rating the “Anticipated Patient Impact” and “Anticipated Center Impact” (high to low) as well as the “Ease of Implementation” (high to low).
- Next, we suggest that your team complete the “Actions Needed” column that will be used to document the individual(s) who will lead specific actions, as well as steps and resources needed to implement the recommendation.
- This appendix provides a set of tables that your team may used to prioritize which recommendations to focus on as a team.

# How To Complete The Table (Example)

| Rank | Anticipated Patient Impact | Anticipated Center Impact | Ease of Implementation | Recommendation | Actions Needed | Timeline |
|---|---|---|---|---|---|---|
| **1** | 10 | | 5 | Efforts should be made to raise awareness of and disseminate evidence-based infection prevention practices across clinicians in varied care settings. | Charlie Johnson:<br>- Create workgroup<br>- Research protocols at other sites | Sep - Oct 2023 |
| **2** | 10 | | 1 | Developing an early extubation plan, including effective postoperative pain control, pulmonary hygiene, repeated ventilator wean assessments, and appropriate sedation, may minimize infection risk. | Dr. Brown:<br>• Create an early extubation protocol<br>• Develop a training and dissemination plan for all LVAD providers involved | Sep 2023 – May 2024 |

Scoring Guide
Anticipated Impact: Low (1) ---- Medium (5) ---- High (10)
Ease of Implementation: Difficult (1) ---- Medium (5) ---- Easy (10)

# Program Directed Recommendations (1/6)

| Rank | Anticipated Patient Impact | Anticipated Center Impact | Ease of Implementation | Recommendation | Actions Needed | Timeline |
|---|---|---|---|---|---|---|
| | | | | Up-to-date unit and service line level infection prevention data should be provided to members of the VAD team, including consulting services, to advance evidence-based care and outcomes. | | |
| | | | | Efforts to enhance clinician onboarding and continuing education may benefit from standardized curricula. | | |

Scoring Guide
Anticipated Impact: Low (1) ---- Medium (5) ---- High (10)
Ease of Implementation: Difficult (1) ---- Medium (5) ---- Easy (10)

# Program Directed Recommendations (2/6)

| Rank | Anticipated Patient Impact | Anticipated Center Impact | Ease of Implementation | Recommendation | Actions Needed | Timeline |
|---|---|---|---|---|---|---|
| | | | | Tailored (e.g., assessing patient and caregiver surveys), evidence-based HAI prevention practices should be designed in conjunction with VAD team members (e.g., HF cardiologists, surgeons, VAD Coordinators, nurse educators). | | |
| | | | | Efforts should be made to raise awareness of and disseminate evidence-based HAI prevention practices across clinicians in varied care settings. | | |

Scoring Guide
Anticipated Impact: Low (1) ---- Medium (5) ---- High (10)
Ease of Implementation: Difficult (1) ---- Medium (5) ---- Easy (10)

# Program Directed Recommendations (3/6)

| Rank | Anticipated Patient Impact | Anticipated Center Impact | Ease of Implementation | Recommendation | Actions Needed | Timeline |
|---|---|---|---|---|---|---|
| | | | | Adherence to evidence-based HAI prevention bundles may be advanced by ensuring patients have equitable access to infection prevention items (e.g., driveline dressing kits). | | |
| | | | | Tailored (e.g., assessing patient and caregiver surveys), evidence-based HAI prevention practices should be designed in conjunction with VAD team members (e.g., HF cardiologists, surgeons, VAD Coordinators, nurse educators). | | |

Scoring Guide
Anticipated Impact: Low (1) ---- Medium (5) ---- High (10)
Ease of Implementation: Difficult (1) ---- Medium (5) ---- Easy (10)

# Program Directed Recommendations (4/6)

| Rank | Anticipated Patient Impact | Anticipated Center Impact | Ease of Implementation | Recommendation | Actions Needed | Timeline |
|---|---|---|---|---|---|---|
| | | | | Consistent usage of a HIPAA-compliant patient portal can support post-discharge HAI surveillance (e.g., transmission of driveline exit site images to the patient's care team). | | |
| | | | | HAI prevention strategies should be routinely reassessed per institutional protocol (e.g., yearly) in addition to more frequently as needed (e.g., as new data emerge). | | |

Scoring Guide

Anticipated Impact: Low (1) ---- Medium (5) ---- High (10)

Ease of Implementation: Difficult (1) ---- Medium (5) ---- Easy (10)

# Program Directed Recommendations (5/6)

| Rank | Anticipated Patient Impact | Anticipated Center Impact | Ease of Implementation | Recommendation | Actions Needed | Timeline |
|---|---|---|---|---|---|---|
| | | | | Efforts to enhance adherence to evidence-based HAI prevention practices may benefit from (1) standardization through order sets and (2) availability of VAD-specific supplies (e.g., driveline dressing kits) for clinicians and patients. | | |
| | | | | Patient and caregiver-level care capacities may be effectively addressed during the pre-and post-implant settings by physical and occupational therapists. | | |

Scoring Guide

Anticipated Impact: Low (1) ---- Medium (5) ---- High (10)

Ease of Implementation: Difficult (1) ---- Medium (5) ---- Easy (10)

# Program Directed Recommendations (6/6)

| Rank | Anticipated Patient Impact | Anticipated Center Impact | Ease of Implementation | Recommendation | Actions Needed | Timeline |
|---|---|---|---|---|---|---|
| | | | | Efforts to implement standards of care may benefit from an accessible, up-to-date repository of HAI-prevention resources, policies, and procedures (e.g., hand hygiene program, line replacement protocol, patient and caregiver education tips). | | |

Scoring Guide

Anticipated Impact: Low (1) ---- Medium (5) ---- High (10)

Ease of Implementation: Difficult (1) ---- Medium (5) ---- Easy (10)

# Patient and Caregiver Directed Recommendations (1/3)

| Rank | Anticipated Patient Impact | Anticipated Center Impact | Ease of Implementation | Recommendation | Actions Needed | Timeline |
|---|---|---|---|---|---|---|
| | | | | Adherence to evidence-based HAI prevention practices is advanced through a pool of long-term, engaged patient caregivers. | | |
| | | | | A patient and caregiver-centered education program (e.g., customized to their health literacy level and preferred language, addressing caregiver concerns) and support (e.g., interpreters available during office visits, discussing options for transportation to implanting hospital with patient & caregiver with social work) can advance their long-term commitment to evidence-based HAI prevention practices. | | |

Scoring Guide

Anticipated Impact: Low (1) ---- Medium (5) ---- High (10)

Ease of Implementation: Difficult (1) ---- Medium (5) ---- Easy (10)

# Patient and Caregiver Directed Recommendations (2/3)

| Rank | Anticipated Patient Impact | Anticipated Center Impact | Ease of Implementation | Recommendation | Actions Needed | Timeline |
|---|---|---|---|---|---|---|
| | | | | Adherence to infection prevention practices may be advanced through achieving longitudinal patient and caregiver commitment (e.g., Lifestyle Contract). | | |
| | | | | Patient advisors (e.g., patients on long-term durable LVADs) may be used to inform the design and implementation of effective tailored patient education curricula and as peer mentors for patients who are newly implanted or being evaluated for durable LVAD implantation. | | |

Scoring Guide

Anticipated Impact: Low (1) ---- Medium (5) ---- High (10)

Ease of Implementation: Difficult (1) ---- Medium (5) ---- Easy (10)

# Patient and Caregiver Directed Recommendations (3/3)

| Rank | Anticipated Patient Impact | Anticipated Center Impact | Ease of Implementation | Recommendation | Actions Needed | Timeline |
|---|---|---|---|---|---|---|
| | | | | Documented counseling for patients/caregivers to promote health behavior changes (e.g., quitting smoking, changing diet, self-limiting exertion) to minimize the risk of post-implantation infection. | | |

Scoring Guide

Anticipated Impact: Low (1) ---- Medium (5) ---- High (10)

Ease of Implementation: Difficult (1) ---- Medium (5) ---- Easy (10)

# Clinician Directed Recommendations (1/6)

| Rank | Anticipated Patient Impact | Anticipated Center Impact | Ease of Implementation | Recommendation | Actions Needed | Timeline |
|---|---|---|---|---|---|---|
| | | | | Teaching of evidence-based HAI-prevention practices should balance device-related concerns with patient quality of life, such as their ability to participate safely in pre-implant hobbies and to engage in functional activities pre- and post-implant. | | |
| | | | | Multidisciplinary data-driven discussions support the advancement and implementation of evidence-based LVAD practices and protocols. | | |

Scoring Guide

Anticipated Impact: Low (1) ---- Medium (5) ---- High (10)

Ease of Implementation: Difficult (1) ---- Medium (5) ---- Easy (10)

# Clinician Directed Recommendations (2/6)

| Rank | Anticipated Patient Impact | Anticipated Center Impact | Ease of Implementation | Recommendation | Actions Needed | Timeline |
|---|---|---|---|---|---|---|
| | | | | Early removal of invasive devices (e.g., urinary catheter, central line) may support the prevention of HAI. | | |
| | | | | Post-discharge outpatient visits, including through telehealth modalities, may be used to advance patient and caregiver education and adherence to evidence-based HAI prevention practices (e.g., video visits to reinforce optimal driveline dressing changes). | | |

Scoring Guide

Anticipated Impact: Low (1) ---- Medium (5) ---- High (10)

Ease of Implementation: Difficult (1) ---- Medium (5) ---- Easy (10)

# Clinician Directed Recommendations (3/6)

| Rank | Anticipated Patient Impact | Anticipated Center Impact | Ease of Implementation | Recommendation | Actions Needed | Timeline |
|---|---|---|---|---|---|---|
| | | | | Use of safety devices to secure the percutaneous driveline (e.g., anchors) may prevent inadvertent trauma to the interface between the driveline and subcutaneous tissue and increase the risk of subsequent HAIs. | | |
| | | | | Adherence to evidence-based nursing care bundles may reduce post-implant HAIs. | | |

Scoring Guide

Anticipated Impact: Low (1) ---- Medium (5) ---- High (10)

Ease of Implementation: Difficult (1) ---- Medium (5) ---- Easy (10)

# Clinician Directed Recommendations (4/6)

| Rank | Anticipated Patient Impact | Anticipated Center Impact | Ease of Implementation | Recommendation | Actions Needed | Timeline |
|---|---|---|---|---|---|---|
| | | | | In order to effectively advance the delivery of patient and caregiver education, clinicians should be aware of potential barriers (e.g., educational, socioeconomic, resource limitations) and other disparities experienced by their patients. | | |
| | | | | Team member well-being may be enhanced through the development and dissemination of positive patient outcomes (e.g., including stories of patient successes in a VAD newsletter). | | |

Scoring Guide

Anticipated Impact: Low (1) ---- Medium (5) ---- High (10)

Ease of Implementation: Difficult (1) ---- Medium (5) ---- Easy (10)

# Clinician Directed Recommendations (5/6)

| Rank | Anticipated Patient Impact | Anticipated Center Impact | Ease of Implementation | Recommendation | Actions Needed | Timeline |
|---|---|---|---|---|---|---|
| | | | | Patient and caregiver confidence in executing HAI-prevention practices may be enhanced through patient-centered communication practices during their appointments with VAD team members. | | |
| | | | | High contrast suture colors may advance early post-implant HAI identification among diverse patient populations. | | |

Scoring Guide

Anticipated Impact: Low (1) ---- Medium (5) ---- High (10)

Ease of Implementation: Difficult (1) ---- Medium (5) ---- Easy (10)

# Clinician Directed Recommendations (6/6)

| Rank | Anticipated Patient Impact | Anticipated Center Impact | Ease of Implementation | Recommendation | Actions Needed | Timeline |
|---|---|---|---|---|---|---|
| | | | | The utilization of evidence-based HAI prevention and management practices may be enhanced through specific VAD management protocol for clinical staff working across diverse settings (e.g., emergency department nurses, emergency medical technicians, and rehabilitation facilities). | | |
| | | | | Developing an early extubation plan, including effective postoperative pain control, pulmonary hygiene, repeated ventilator wean assessments, and appropriate sedation, may minimize HAI risk. | | |

Scoring Guide

Anticipated Impact: Low (1) ---- Medium (5) ---- High (10)

Ease of Implementation: Difficult (1) ---- Medium (5) ---- Easy (10)

# Leadership Directed Recommendations (1/6)

| Rank | Anticipated Patient Impact | Anticipated Center Impact | Ease of Implementation | Recommendation | Actions Needed | Timeline |
|---|---|---|---|---|---|---|
| | | | | In-hospital infection prevention and management may be advanced through a multidisciplinary team rounding approach (e.g., heart failure cardiology, surgery, nursing, anesthesia, pharmacy) that addresses antimicrobial stewardship and infection prevention. | | |
| | | | | Consistent nurse-physician dyads, which increase accountability and team familiarity, advance evidence-based HAI-prevention practices. | | |

Scoring Guide

Anticipated Impact: Low (1) ---- Medium (5) ---- High (10)

Ease of Implementation: Difficult (1) ---- Medium (5) ---- Easy (10)

# Leadership Directed Recommendations (2/6)

| Rank | Anticipated Patient Impact | Anticipated Center Impact | Ease of Implementation | Recommendation | Actions Needed | Timeline |
|---|---|---|---|---|---|---|
| | | | | Efforts aimed at reducing in-hospital HAI rates should leverage both existing inpatient HAI prevention initiatives (e.g., invasive line management, ERAS, hand hygiene) as well as institutional resources (e.g., Environmental Services, Facilities, Maintenance). | | |
| | | | | Extensive documentation of successful interventions (e.g., hand hygiene program, "scrub the hub") and the effect of protocol changes are key to maintaining low HAI rates. | | |

Scoring Guide

Anticipated Impact: Low (1) ---- Medium (5) ---- High (10)

Ease of Implementation: Difficult (1) ---- Medium (5) ---- Easy (10)

# Leadership Directed Recommendations (3/6)

| Rank | Anticipated Patient Impact | Anticipated Center Impact | Ease of Implementation | Recommendation | Actions Needed | Timeline |
|---|---|---|---|---|---|---|
| | | | | Ensuring accurate and reliable surveillance and performance data via auditing are foundational for advancing evidence-based HAI-prevention strategies. | | |
| | | | | A longitudinal, robust, and up-to-date HAI tracking system including OR surveillance may be used to support an LVAD program's HAI prevention strategy. | | |
| | | | | Infection surveillance data should be reported at the unit and service level to support local quality improvement efforts. | | |

Scoring Guide

Anticipated Impact: Low (1) ---- Medium (5) ---- High (10)

Ease of Implementation: Difficult (1) ---- Medium (5) ---- Easy (10)

# Leadership Directed Recommendations (4/6)

| Rank | Anticipated Patient Impact | Anticipated Center Impact | Ease of Implementation | Recommendation | Actions Needed | Timeline |
|---|---|---|---|---|---|---|
| | | | | Developing a reporting system for post-implant patient-reported outcomes can promote improved post-implant patient care and inform interventions that mitigate inconsistent execution of protocol. | | |
| | | | | OR size and layout should be optimized for complex cardiac surgery to advance efficiency and mitigate infection risk, including evaluating if there is adequate and well-coordinated use of space. | | |

Scoring Guide

Anticipated Impact: Low (1) ---- Medium (5) ---- High (10)

Ease of Implementation: Difficult (1) ---- Medium (5) ---- Easy (10)

# Leadership Directed Recommendations (5/6)

| Rank | Anticipated Patient Impact | Anticipated Center Impact | Ease of Implementation | Recommendation | Actions Needed | Timeline |
|---|---|---|---|---|---|---|
| | | | | Institutional quality assurance and improvement initiatives may be advanced through dedicated team members (e.g., database programmer, biostatistical analyst, quality improvement coordinator). | | |
| | | | | Encourage engagement with infection prevention initiatives from physicians, nurses, and/or LVAD Coordinators by nominating quality champions. | | |

Scoring Guide

Anticipated Impact: Low (1) ---- Medium (5) ---- High (10)

Ease of Implementation: Difficult (1) ---- Medium (5) ---- Easy (10)

# Leadership Directed Recommendations (6/6)

| Rank | Anticipated Patient Impact | Anticipated Center Impact | Ease of Implementation | Recommendation | Actions Needed | Timeline |
|---|---|---|---|---|---|---|
| | | | | Advocate for the expansion of available functions of the INTERMACS dashboard to advance real-time comparisons with aggregate INTERMACs data. These comparisons may improve (1) the evaluation of an intervention's efficacy and (2) tracking of institutional data more effectively. | | |

Scoring Guide

Anticipated Impact: Low (1) ---- Medium (5) ---- High (10)

Ease of Implementation: Difficult (1) ---- Medium (5) ---- Easy (10)

# Appendix D

# Team Roles and Responsibilities: LVADS

# Implementation Analysis
## How to Complete the L-V-A-D-S Assignment of Tasks Matrix

Guidance: For each of the recommendation groups, please assign members from your institution's LVAD multidisciplinary working group to each the above roles. Please specify the assigned names for each role, as well as any specific needs they might have to successfully execute the implementation of the infection prevention recommendations. The above table may serve as an example. Worksheets for each of the recommendation groups are provided in the accompanying slides.

| Role | Name | Needs Assessment (e.g., administrative support, institutional buy-in) |
|---|---|---|
| L: Leader | Jane Desai | Administrative support, financial resources to fund |
| V: Validator | James Garcia | Further training on how to navigate large data sets |
| A: Actor | John Smith | Educational materials and access to training |
| D: Delegator | Noah Chen | Implicit and explicit authority to delegate tasks to team members |
| S: Supporter | River Jones | Resources necessary to gather required data (e.g., programming time, institutional authority) with LVAD team |

# Implementation Analysis
# Program Directed

| Role | Name | Needs Assessment (e.g., administrative support, institutional buy-in) |
|---|---|---|
| L: Leader | | |
| V: Validator | | |
| A: Actor | | |
| D: Delegator | | |
| S: Supporter | | |

# Implementation Analysis
# Patient and Caregiver Directed

| Role | Name | Needs Assessment (e.g., administrative support, institutional buy-in) |
|---|---|---|
| L: Leader | | |
| V: Validator | | |
| A: Actor | | |
| D: Delegator | | |
| S: Supporter | | |

# Implementation Analysis
# Clinician Directed

| Role | Name | Needs Assessment (e.g., administrative support, institutional buy-in) |
|---|---|---|
| L: Leader | | |
| V: Validator | | |
| A: Actor | | |
| D: Delegator | | |
| S: Supporter | | |

# Implementation Analysis
# Leadership Directed

| Role | Name | Needs Assessment (e.g., administrative support, institutional buy-in) |
|---|---|---|
| L: Leader | | |
| V: Validator | | |
| A: Actor | | |
| D: Delegator | | |
| S: Supporter | | |

# Appendix E

# Study Information: How Recommendations were Derived

How Recommendations Were Derived

## Impact of Healthcare-Associated Infections After Durable Left Ventricular Assist Device (LVAD) Implantation

- Healthcare-associated infections (HAIs):
  - Among most common & debilitating sequelae of LVAD implantation[1]
  - Vary in rate across hospitals[2]
- HAI prevention initiatives typically one-size—fits all approaches that lack customization.
- The structure, content and delivery of an evidence-based, customizable HAI prevention toolkit should be informed by key LVAD stakeholders.

## Integration of Quantitative & Qualitative Findings

- Identify low- and high- performance outliers based on national evaluation of of 90-day HAIs for patients undergoing durable LVAD.[2, 3-9]
- Conduct 72 semi-structured interviews with clinical and operational team members at each of 3 low and 5 high performance centers.[3, 10]
- Conduct thematic analysis of de-identified interview transcripts

## Development of a Customizable and Deployable HAI Prevention Toolkit

- Structure of toolkit designed based on prior AHRQ-led tookits[11]
- Content informed by mixed methods analyses and input from focus groups involving external experts
- Toolkit designed to facilitate
  - Self-assessment of existing performance
  - Ranking of priorities
  - Tracking of toolkit adoption


**Citations:**

1. Rates and Types of Infections in Left Ventricular Assist Device Recipients: A Scoping Review. doi: 10.1016/j.xjon.2021.08.005
2. Interhospital variability in health care-associated infections and payments after durable ventricular assist device implant among Medicare beneficiaries. doi: 10.1016/j.jtcvs.2021.04.074
3. Understanding and Addressing Variation in Health Care-Associated Infections After Durable Ventricular Assist Device Therapy: Protocol for a Mixed Methods Study. doi: 10.2196/14701
4. Mortality following durable left ventricular assist device implantation by timing and type of first infection. doi: 10.1016/j.jtcvs.2021.10.056
5. Non-patient factors associated with infections in LVAD recipients: A scoping review. doi: 10.1016/j.healun.2021.10.006
7. Mortality following Durable Left Ventricular Assist Device Implant by Timing and Type of First Infection. doi: 10.1016/j.jtcvs.2021.10.056
8. Association Between Care Fragmentation and Total Spending After Durable Left Ventricular Device Implant: A Mediation Analysis of Health Care-Associated Infections Within a National Medicare-Society of Thoracic Surgeons Intermacs Linked Dataset. doi: 10.1161/CIRCOUTCOMES.121.008592
9. Care fragmentation predicts 90-day durable ventricular assist device outcomes. doi: 10.37765/ajmc.2022.89280
10. Expanding Our Methodological Toolbox to Improve Quality: The Role of Mixed-Methods Evaluations. doi: 10.1161/CIRCOUTCOMES.122.009629
11. Agency for Healthcare Research and Quality. https://qualityindicators.ahrq.gov/resources/toolkits. Accessed May 23,

# Study Methodology

Complex mixed methods (integrating quantitative & qualitative findings) study design to develop a customizable and deployable infection prevention toolkit of expert guided recommendations

**Key study phases**:

- Quantitatively analyze associated impact of infections after durable LVAD implantation
  - Analyze national Medicare claims merged with Intermacs (FDA-approved devices)
  - Identify patient, clinician, and hospital-level determinants of interhospital variability in infections (based on national data analyses and scoping reviews of published articles)
  - Findings inform low and high-performing centers for the qualitative phase
- Qualitatively explore contexts and perspectives on infections after durable LVAD implantation
  - Conduct 72 semi-structured interviews with clinicians and operational team members at 3 low and 5 high-performing centers (based on 90-day infection rates)
  - Interviews focused on individuals' perceived practices, barriers and facilitators contributing to infections
  - Analyses of the interview transcripts, field notes, and interview debriefs informed content and structure of an infection prevention toolkit
- Integrate quantitative and qualitative findings by comparing two data sources and synthesizing recommendations through team discussions and team input
- External advisory team of content experts (database coordinators, cardiac surgeons/heart failure cardiologists, infectious disease/nursing/intensive care) provided quantitative and qualitative feedback on draft toolkit's content and implementation
- Iteratively enhance toolkit content and structure based on advisory team feedback

# Data Coordinating Center Team

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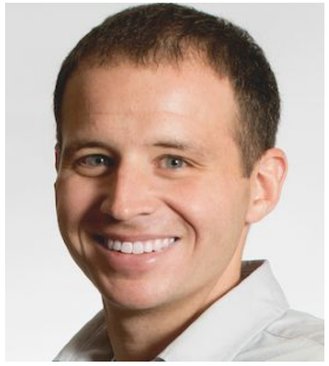
Carol Chenoweth, M.D.

Paul Chandanabhumma, Ph.D.

Michael Fetters, M.D[†].



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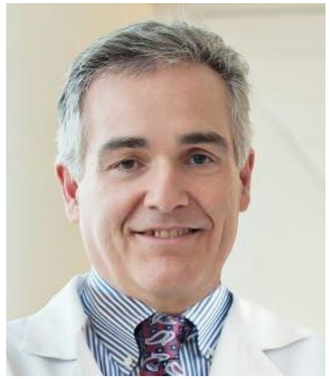

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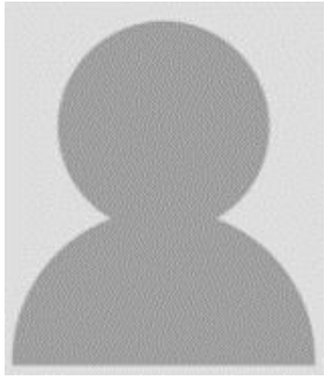
James Stewart, M.D.



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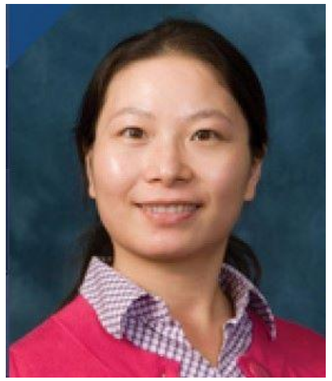
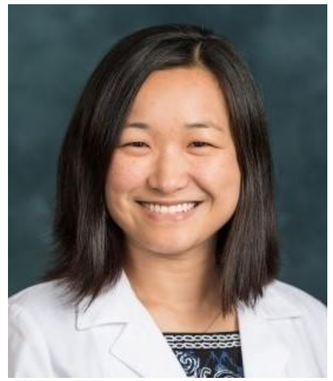


Min Zhang, Ph.D.



Shiwei Zhou, M.D.

# Appendix F

# Fact Sheet: Infections after Durable LVADs

# Fact Sheet about Infections after Durable LVAD Implantation

## Overall and interhospital rate of short- and long-term infections

| Reference | DOI Number | Design | Sample Size | Methods | Main findings |
|---|---|---|---|---|---|
| Likosky et al. | 10.1016/j.jtcvs.2021.04.074 | Cohort study | 8,688 | Secondary analyses of 2 data sources: (1) Medicare claims, and (2) Intermacs data | • There were 3982 infections identified among 27.8% (2417/8688) of patients developing an infection. The median (25th, 75th percentile) adjusted incidence of infections (per 100 patient-months) across hospitals was 14.3 (9.3, 19.5) and varied according to hospital (range, 0.0-35.6).<br>• Total Medicare payments from implantation to 90 days were 9.0% (absolute difference: $13,652) greater in high versus low infection tercile hospitals (P<.0001).<br>• The period between implantation to discharge accounted for 73.1% of the difference in payments during the implantation to 90-day period across terciles. |

# Associated Impact of Infections on Provider Networks, Spending and Health-Related Quality of Life

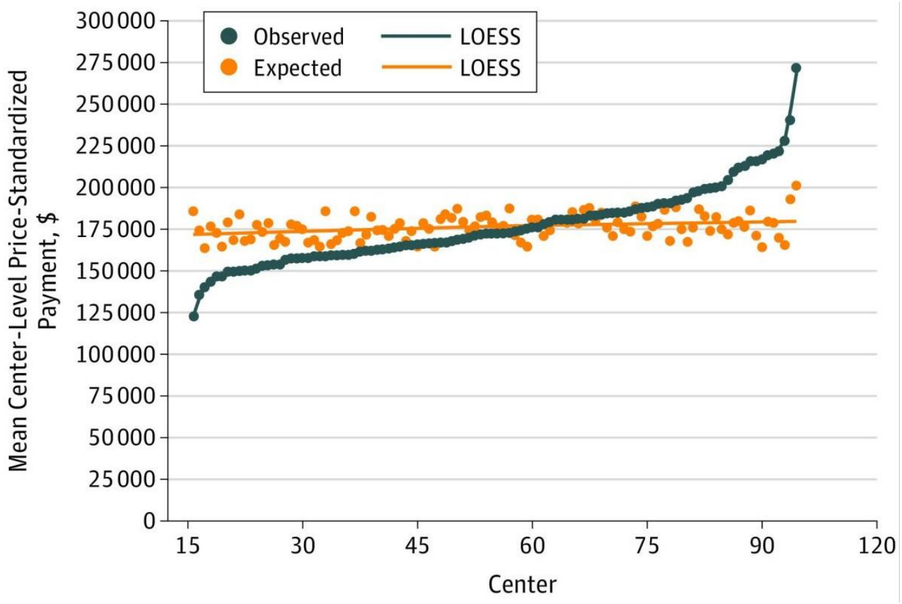
| Reference | DOI Number | Design | Sample Size | Methods | Main findings |
|---|---|---|---|---|---|
| Zhou et al. | 10.1016/j.healun.2023.05.006 | Cohort Study | 11,618 patients | Secondary analyses of 2 data sources: (1) Medicare claims, and (2) Intermacs data | 4,768 (41.0%) patients developed an infection during the one-year post-implantation follow-up period; with 2,282 (19.6%) patients having> 1 infection. Adjusting for covariates, each additional infection was significantly associated with a 22% increased odds of the primary composite adverse outcome (i.e., not thriving or death). This significant effect was observed across all infection types. Among patients surviving to 1-year, the occurrence of any infection was associated with more impairment in HRQOL dimensions compared to patients without infection. |
| Funk et al. | 10.37765/ajmc.2022.89280 | Cohort Study | 5,159 patients | Secondary analyses of 2 data sources: (1) Medicare claims, and (2) Intermacs data | 11.2% patients died and 27.6% experiencing an infection within 90 days after implant. After adjustment, a 1-unit increase in network fragmentation was associated with an increase of 0.179 in the probability of in-hospital infection and an increase of 0.183 in the probability of 90-day infection (both $P < .05$). Similar results were observed in models of the numbers of in-hospital and 90-day infections. Network fragmentation was predictive of the probability of 90-day mortality, although this relationship was not significant after adjustment. |
| Kim et al. | 10.1161/CIRCOUTCOMES.121.008592 | Cohorts Study | 4,897 patients | Secondary analysis of (1) Medicare claims and (2) STS Intermacs data | The patient cohort was 81% male, 73% white, 11% Intermacs Profile 1 with mean (SD) age of 63.1 years (11.1). The mean (SD) level of care fragmentation in provider networks was 1.7 (0.2) and mean (SD) payment from admission to 180 days post-discharge was $246,905 ($109,872). Mean (SD) total payments at the lower, middle, and upper terciles of care fragmentation were $250,135 ($111,924), $243,288 ($109,376), and $247,290 ($108,241), respectively. In mediation analysis, the indirect effect of care fragmentation on total payments, through infections, was positive and statistically significant ($\beta$=16032.5, p=0.008). |
| Yang et al. | 10.1016/j.healun.2022.07.001 | Cohort Study | 14,063 patients | Secondary analyses of 2 data sources: (1) Medicare claims, and (2) Intermacs data | HRQOL incompleteness at high-rate hospitals was more often due to administrative reasons (risk difference, EQ-5D: 10.1%; KCCQ-12: 11.6%) and less likely due to patient reasons (risk difference, EQ-5D: -8.9%; KCCQ-12: -11.4%). A 10% increase in the adjusted pre-implant EQ-5D incompleteness rate was significantly associated with higher risk of infection-related mortality (HR: 1.09), infection (HR: 1.05), and renal dysfunction (HR: 1.03). A 10% increase in the adjusted pre-implant KCCQ-12 incompleteness rate was significantly associated with higher risk of infection (HR: 1.04). |

# Determinants of Infections (overall and by subtype)

| Reference | DOI number | Design | Sample Size | Methods | Main findings |
|---|---|---|---|---|---|
| Pienta et al. | | Scoping review | 132 studies | Synthesis of published evidence related to rates of different types of infections in LVAD recipients. | Most studies of infections in LVAD recipients did not utilize standardized infection definitions and did not complete information on infection locations and types. |
| Shore et al. | 10.1016/j.healun.2021.10.006 | Scoping review | 43 studies | Synthesis of non-patient factors associated with infections among durable LVAD recipients | Only two non-patient related factors were consistently associated with lower infection risk in LVAD recipients: increasing center experience and establishing a silicone-skin interface at driveline exit site. The large variability in reporting across multiple studied interventions limited the ability to discern their effectiveness. |
| Pienta et al. | 10.1016/j.healun.2022.01.011 | Scoping review | 31 studies | Systematically summarize all existing studies examining patient-related factors associated with infections after LVAD implantation. | Studies were frequently single-center with heterogeneity in definition of infectious outcomes as well as exposure variables. Patient race and sex did not correlate with infection risk. There was no consistent association noted between obesity, diabetes, or psychosocial/socio-economic factors and infections in LVAD recipients. Two studies reported a significant association between malnutrition and hypoalbuminemia and post implant infections. |

# Center Variation in Medicare Spending for Durable Left Ventricular Assist Device Implant Hospitalizations

Rank-Ordered Center-Level Mean Observed Price-Standardized Payments for Durable Left Ventricular Assist Device (LVAD) Implant Hospitalizations and Expected Payments Accounting for Patient Case Mix




Variation in Observed, Price-Standardized, and Price-Standardized and Risk-Standardized Payments for Durable Left Ventricular Assist Device Hospitalizations

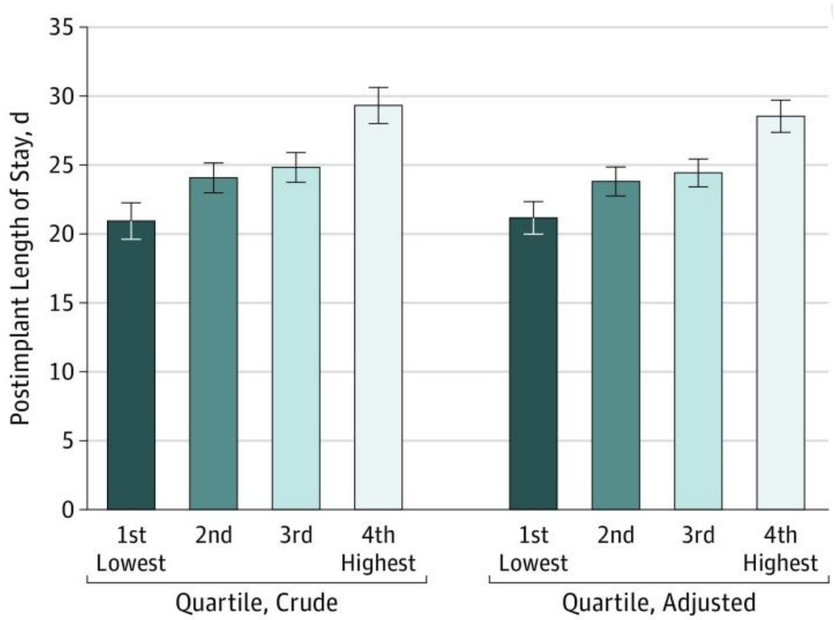
| Payments | Payment Quartile, Mean (SD), $ | | Difference Between First and Fourth Quartile | | | Attributed to Payment Category, % |
|---|---|---|---|---|---|---|
| | First (Lowest) | Fourth (Highest) | Absolute (95% CI) | Relative, % | P Value | |
| Observed | 153 266 (110 913) | 260 086 (138 183) | 106 820 (96 053-117 586) | 70 | <.001 | 100 |
| DRG | 129 591 (88 854) | 218 481 (114 410) | 88 890 (80 247-97 534) | 69 | <.001 | 83 |
| Outlier | 16 898 (38 601) | 30 349 (56 143) | 13 451 (9108-17 794) | 80 | <.001 | 13 |
| Physician services | 6777 (7054) | 11 256 (9088) | 4479 (3734-5223) | 66 | <.001 | 4 |
| Price standardized | 152 714 (36 465) | 208 160 (77 920) | 55 446 (50 250-60 641) | 36 | <.001 | 100 |
| DRG | 137 703 (25 435) | 144 632 (18 228) | 6929 (4917-8940) | 5 | <.001 | 13 |
| Outlier | 8209 (24 477) | 50 951 (68 452) | 42 742 (38 354-47 132) | 521 | <.001 | 77 |
| Physician services | 6803 (6354) | 12 577 (10 993) | 5774 (4995-6553) | 85 | <.001 | 10 |
| Price and risk standardized | 154 110 (7025) | 207 331 (12 417) | 53 221 (52 653-53 789) | 35 | <.001 | 100 |
| DRG | 139 516 (4703) | 143 939 (3333) | 4423 (3996-4850) | 3 | <.001 | 8 |
| Outlier | 6515 (21 714) | 51 479 (38 437) | 44 964 (42 460-47 468) | 690 | <.001 | 84 |
| Physician services | 8079 (2383) | 11 913 (3125) | 3834 (3633-4035) | 47 | <.001 | 7 |

Abbreviation: DRG, diagnosis-related group.

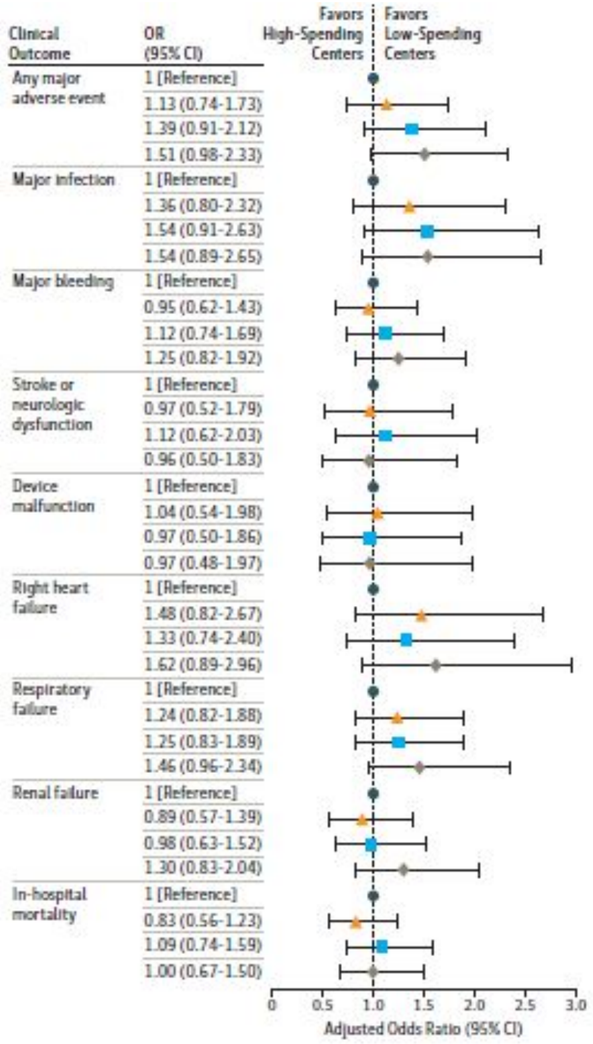
Thompson MP, Pagani FD, Liang Q, Franko LR, Zhang M, McCullough JS, Strobel RJ, Aaronson KD, Kormos RL, Likosky DS; Michigan Congestive Heart Failure Investigators. Center Variation in Medicare Spending for Durable Left Ventricular Assist Device Implant Hospitalizations. JAMA Cardiol. 2019 Feb 1;4(2):153-160. doi: 10.1001/jamacardio.2018.4717. PMID: 30698605; PMCID: PMC6439617.

# Center Variation in Medicare Spending for Durable Left Ventricular Assist Device Implant Hospitalizations

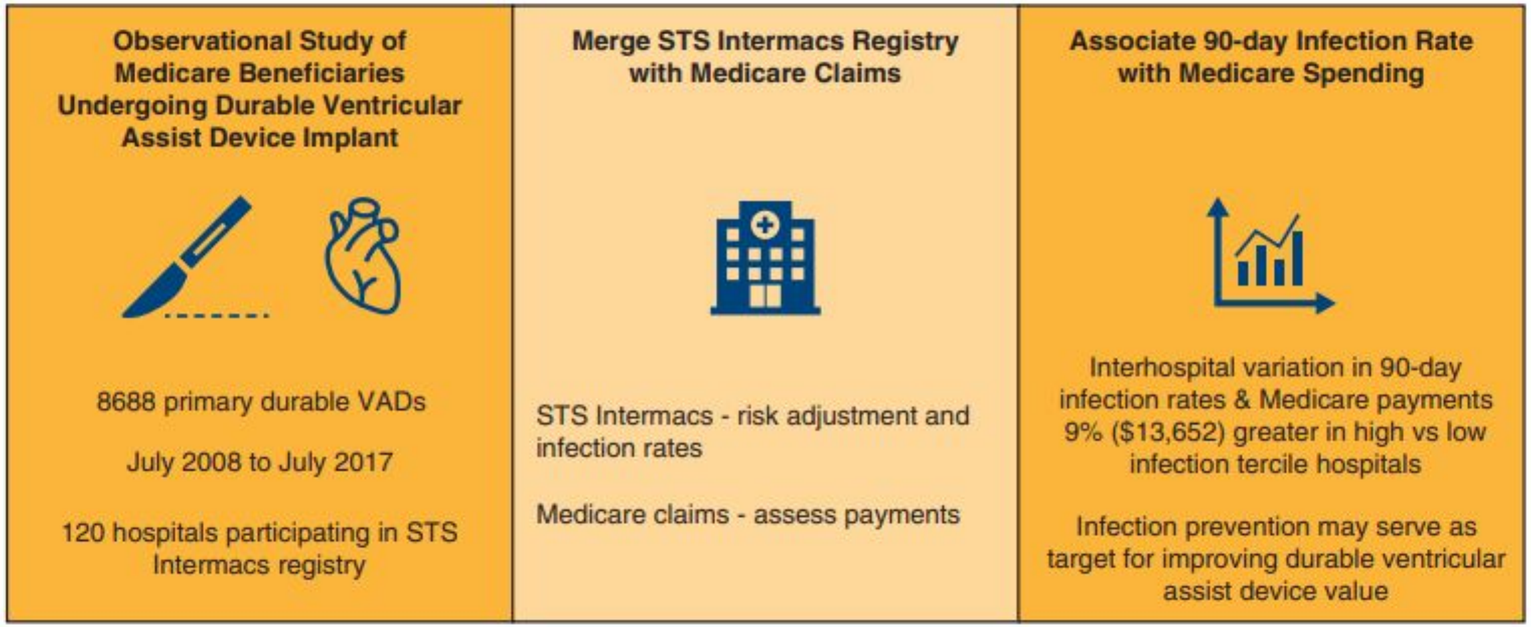
Crude and Adjusted Mean Postimplant Length of Stay (and 95%CI) by Price-Standardized Payment Quartile




Risk-Adjusted Adverse Events for Durable Left Ventricular Assist Device (LVAD) Implant Hospitalizations by Price-Standardized Payment Quartile (Compared With Lowest Spending Quartile)



# Interhospital variability in healthcare-associated infections and payments after durable ventricular assist device implant among Medicare beneficiaries




Likosky DS, Yang G, Zhang M, Malani PN, Fetters MD, Strobel RJ, Chenoweth CE, Hou H, Pagani FD; Michigan Congestive Heart Failure Investigators. Interhospital variability in healthcare-associated infections and payments after durable ventricular assist device implant among Medicare beneficiaries. J Thorac Cardiovasc Surg. 2022 Nov;164(5):1561-1568. doi: 10.1016/j.jtcvs.2021.04.074. Epub 2021 May 4. PMID: 34099272; PMCID: PMC10150658.

# Additional Resources

- Society of Thoracic Surgeons Intermacs Registry (STS Intermacs)
  - National, longitudinal registry of FDA-approved LVADs
  - Website - https://www.sts.org/sts-national-database

- International Society for Heart and Lung Transplantation
  - Multidisciplinary community representing individuals caring and treating patients with mechanical circulatory support devices and/or heart transplantation.
  - Has a professional community focusing on infectious disease
  - Website: https://www.ishlt.org/