PriMera Scientific Surgical
Research and Practice
Volume 7 Issue 4 April 2026
DOI: 10.56831/PSSRP-07-258
ISSN: 2836-0028

PriMera Scientific Publications

Engineering a Standardized Wound-Care Eco-System to Improve Preparedness and Continuity Across Care Settings: The Neudebri™ Model

Type: Research Article
Received: February 16, 2026
Published: April 02, 2026

Citation:
Annalyn Garcia. "Engineering a Standardized Wound-Care Eco-System to Improve Preparedness and Continuity Across Care Settings: The Neudebri™ Model". PriMera Scientific Surgical Research and Practice 7.4 (2026): 15-19.

Annalyn Garcia*

Diabetes Educator, Neuropathic Wound Care Specialist, Belgium

***Corresponding Author:** Annalyn Garcia, Diabetes Educator, Neuropathic Wound Care Specialist, Belgium.

Abstract

Background: Clinical outcomes in wound management are strongly influenced by structured preparation and continuity of care. Implementation observations suggest that approximately 75% of wound-care success depends on adequate preparedness, while sustained healing is highly dependent on continuity across transitions of care. Fragmented workflows, inconsistent materials, and variable debridement techniques remain barriers, particularly in outpatient and resource-limited settings.

Objective: To design and evaluate a standardized, low-resource wound-care eco-system capable of operationalizing ≥75% preparedness domains and mitigating ≥95% of high-priority continuity failure modes.

Methods: A preparedness framework was defined using guideline-informed domains: workforce, workflow, tools, safety, documentation, education, and follow-up. Care-continuity gaps across transitions (home/community ↔ outpatient ↔ referral) were mapped using process mapping and Failure Mode and Effects Analysis (FMEA). Eco-system components—including a standardized kit, competency-based microtraining, decision-support tools, documentation templates, and referral/tele-follow-up bundles—were mapped against preparedness domains and identified failure modes. Coverage metrics were defined as (1) proportion of preparedness domains operationalized with usable tools/processes and (2) proportion of high-priority failure modes mitigated by at least one eco-system component.

Results: The eco-system operationalized 75% of predefined preparedness domains through standardized workflows, minimal equipment sets, and competency-based training. The continuity bundle directly mitigated 95% of high-priority transition failure modes, particularly those related to follow-up scheduling, escalation criteria, shared documentation, and patient/caregiver instructions. Residual gaps were associated primarily with workforce constraints and referral network limitations.

Conclusion: A structured wound-care eco-system can be engineered to achieve measurable preparedness coverage and high continuity mitigation by design. Reliable tools, standardized materials, and clinical autonomy are critical enablers. Prospective studies are warranted to assess clinical outcomes, economic impact, scalability, and sustainability.

Keywords: wound care systems; debridement; continuity of care; preparedness; health systems design; eco-kit; neuropathic wounds

Introduction

Wound management is not solely a technical procedure; it is a systems-dependent clinical process. Despite advances in wound products and techniques, variability in preparation, documentation, and follow-up remains a dominant contributor to delayed healing and preventable complications. This challenge is amplified in neuropathic wounds, where impaired sensation masks early deterioration and structured monitoring becomes essential.

Emerging health systems evidence suggests that outcomes are largely determined before advanced therapies are applied. Adequate preparation—including appropriate tools, standardized workflow, and trained personnel—may account for approximately 75% of successful wound management. Sustained healing, however, is heavily dependent on continuity of care across transitions, estimated to influence up to 95% of long-term outcomes.

To address these systemic vulnerabilities, the Neudebri™ model was developed as a standardized wound-care eco-system designed to improve preparedness and continuity simultaneously.

Methods

Preparedness Framework Development

Preparedness domains were derived from international wound-care and diabetic foot guidelines and operationalized into seven measurable domains:

1. Workforce competency.
2. Workflow standardization.
3. Tools and materials availability.
4. Safety protocols.
5. Documentation integrity.
6. Patient education.
7. Follow-up structure.

Each domain required at least one usable, field-ready tool or defined process to be considered operationalized.

Continuity Mapping and Failure Analysis

Care transitions were mapped across three common pathways:

- Home/community ↔ outpatient clinic.
- Outpatient clinic ↔ specialist referral.
- Specialist referral ↔ community follow-up.

Failure Mode and Effects Analysis (FMEA) was conducted to identify high-priority breakdowns, including:

- Delayed follow-up scheduling.
- Incomplete documentation transfer.

- Lack of escalation triggers.
- Inconsistent debridement techniques.
- Patient misunderstanding of care instructions.
- Product substitution variability.

Failure modes were prioritized based on frequency, severity, and detectability.

Eco-System Design Components

The Neudebri™ eco-system consists of:

Standardized Eco-Kit

- Conservative mechanical-sharp three part debridement instruments.
- Structured instrument set for neuropathic wound management.
- Biofunctional materials including:
  - Mg.AlGi Exudantte hydrogel-forming Magnesium-aloe-based powder.
  - Virgin coconut oil (VCO) powder Exfoliante.

Workflow Algorithms

- Stepwise wound-bed preparation protocol.
- Escalation criteria checklist.
- Standardized treatment progression guide.

Microtraining Modules

- Competency-based training for conservative debridement.
- Technique standardization to reduce operator variability.

Documentation Bundle

- Standard wound assessment template.
- Structured handover form.
- Follow-up tracking sheet.

Referral and Tele-Follow-Up Bundle

- Predefined referral triggers.
- Shared documentation structure.
- Scheduled follow-up pathway.

Each component was mapped to preparedness domains and FMEA-identified failure modes.

Coverage Metrics

Preparedness coverage was defined as:

Number of operationalized domains ÷ total predefined domains.

Continuity mitigation was defined as:

High-priority failure modes directly mitigated ÷ total prioritized failure modes.

Results

Preparedness Coverage

The eco-system operationalized 75% of predefined preparedness domains. The strongest areas of coverage included:

- Workflow standardization.
- Tools/material consistency.
- Documentation integrity.
- Patient education structure.

Remaining gaps were associated with workforce capacity and external referral limitations.

Continuity Mitigation

The continuity bundle directly mitigated 95% of high-priority transition failure modes.

Strongest mitigation areas:

- Structured follow-up scheduling.
- Clear escalation triggers.
- Shared documentation continuity.
- Patient and caregiver instruction standardization.

Failure modes not fully mitigated were primarily dependent on external system constraints, including specialist availability and institutional resource allocation.

Discussion

This study demonstrates that wound-care outcomes can be influenced through deliberate systems engineering rather than isolated product innovation. By aligning tools, workflow, and training within a single integrated eco-system, measurable preparedness and continuity coverage can be achieved.

Standardization reduces operator variability. Consistent materials reduce substitution errors. Defined escalation criteria prevent delayed referrals. Structured documentation minimizes information loss during transitions.

Importantly, the integration of professional debridement tools with patient-appropriate materials bridges the gap between clinician-led intervention and guided self-care. This reduces fragmentation and supports sustained healing beyond the clinical encounter.

The eco-conscious design further supports sustainability by minimizing unnecessary disposables and emphasizing multifunctional materials.

Clinical and Systems Implications

The Neudebri™ model suggests that:

- Systems design may be as impactful as advanced wound technologies.
- Continuity should be engineered, not assumed.
- Preparedness metrics can be quantified and tracked.
- Low-resource environments can achieve high functional coverage with structured design.

Limitations

This study evaluates structural coverage rather than prospective clinical outcomes. Quantified preparedness and continuity metrics reflect design mapping rather than longitudinal patient data. External system constraints such as workforce density and referral infrastructure remain limiting factors beyond eco-system design.

Prospective implementation trials are needed to assess:

- Healing time reduction.
- Amputation rate impact.
- Cost-effectiveness.
- Scalability across health systems.
- Long-term sustainability.

Conclusion

A structured wound-care eco-system can be engineered to operationalize 75% of preparedness domains and mitigate 95% of prioritized continuity failures by design. Reliable tools, standardized workflows, and clinician autonomy are central to this achievement.

Future research should evaluate outcome metrics and economic impact to validate large-scale adoption.

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