



PRISM: Incorporating Advanced Imaging Technologies into a Comprehensive Strategy for Chronic Wound Assessment and Management



Near-Infrared Spectroscopy & Bacterial Autofluorescence as the Physiologic Foundation of the PRISM Framework for Chronic Wound Management and Limb Preservation

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P Perfusion Imaging **R** Regional Bacterial Status **I** Infection Staging **S** Structural Correction **M** Maintenance & Monitoring

Background · Introduction

Chronic wounds — especially diabetic lower-extremity wounds — are among the most resource-intensive problems in healthcare, with five-year recurrence rates of **40–65%** and a frequent trajectory toward amputation.

Three silent, modifiable failures drive limb loss:

- Inadequate tissue perfusion
- Unrecognized bacterial burden
- Unaddressed biomechanical deformity

Each can stall healing without producing classic clinical signs, and each has traditionally been judged subjectively — perfusion from pulses, bioburden from wound appearance, deformity only after recurrence.

Two point-of-care optical technologies now measure the dominant modifiable barriers **directly and in real time**: near-infrared spectroscopy (NIRS) for tissue oxygenation and bacterial autofluorescence (BAF) for bacterial load.

PRISM is a structured, imaging-first algorithm that organizes these technologies into a single sequential pathway — anchoring every decision in measured physiology rather than clinical impression.

NIRS & BAF Technology · SnapshotNIR / SnapshotGLO

Near-Infrared Spectroscopy (NIRS) · SnapshotNIR

Near-infrared light (700–1000 nm) and the differential absorption of oxygenated vs. deoxygenated hemoglobin map tissue oxygen saturation (StO₂) to ~2–3 mm depth, producing RGB, StO₂, HbO₂, and DeOxyHb maps of wound bed and periwound.

- StO₂ > 70% supports healing; < 40% signals significant hypoxia
- Non-contact; works over open wounds where ABI / TCOM fail

Bacterial Autofluorescence (BAF) · SnapshotGLO

Violet/UV illumination (~405 nm) excites endogenous bacterial porphyrins to emit red fluorescence (~635 nm), detecting clinically significant burden (**≥ 10⁴ CFU/g**) in real time — without contact or culture delay.

- Red = general bacteria; Cyan = Pseudomonas aeruginosa
- Reveals occult burden, guides debridement, supports antimicrobial stewardship

PRISM Algorithm · At Each Encounter

Imaging-first: *objective perfusion and bacterial data are captured before any wound manipulation, so every downstream decision rests on measured physiology.*

Encounter Flow: Clinical evaluation → NIRS (P) → BAF (R) → Infection Staging (I) → Structural Correction (S, if indicated) → Maintenance & Monitoring (M). *Post-debridement BAF confirms bacterial clearance.*

Components of PRISM

Like a prism resolving light into its wavelengths, PRISM separates the complex wound into five discrete, individually addressable barriers:

P Perfusion Imaging — NIRS maps tissue oxygenation (StO₂), detects hypoxia, and evaluates vascular status via the PPI and a provocative elevation maneuver.

R Regional Bacterial Status — BAF detects, localizes, and grades bacterial burden in real time, distinguishing red (general) from cyan (Pseudomonas) signal.

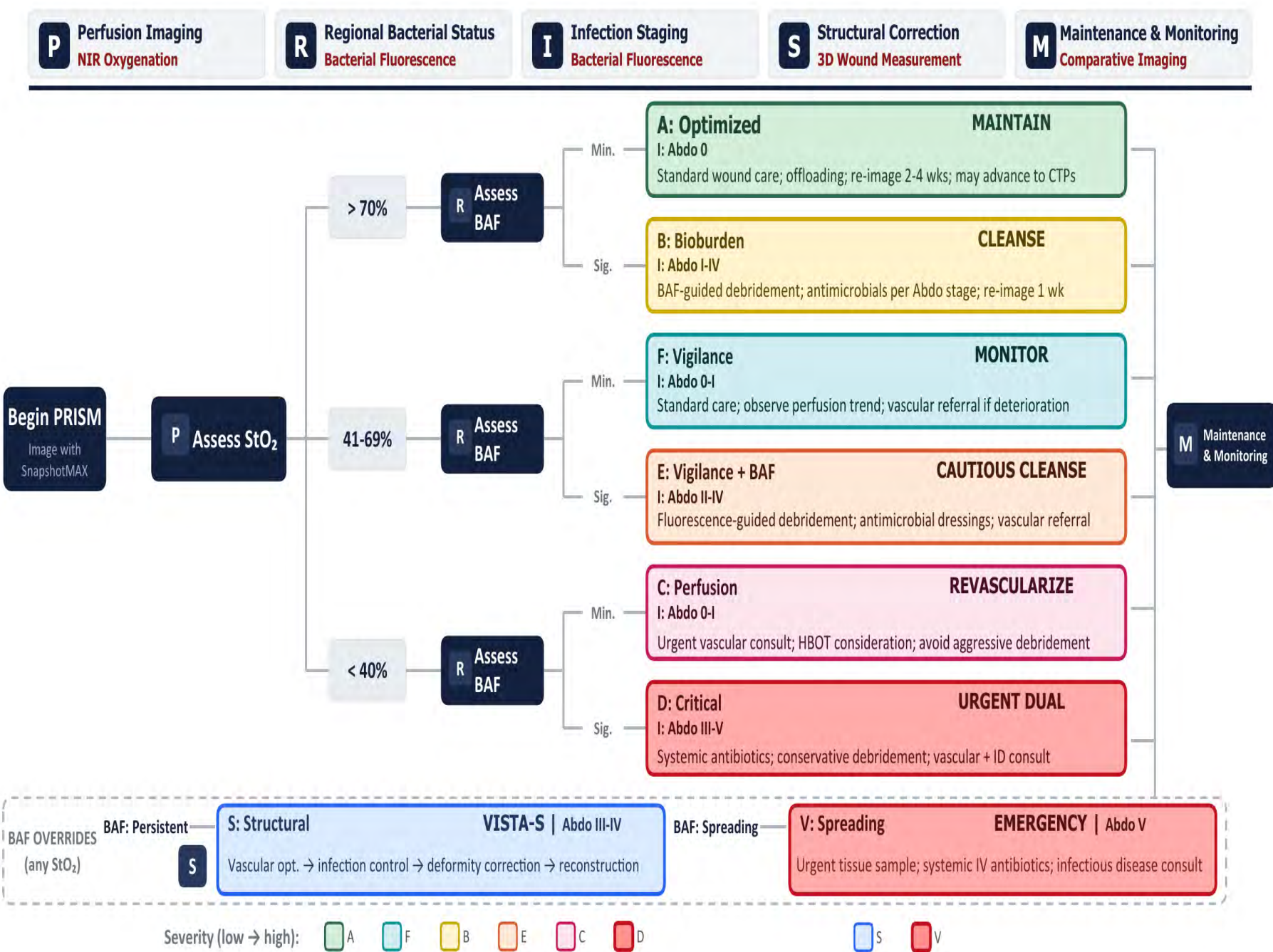
I Infection Staging — A fluorescence-based staging system (Stages 0–V) guides stepwise, evidence-informed antimicrobial intervention.

S Structural Correction — Surgical and biomechanical correction of deformities that drive recurrence — tendon procedures, osteotomy, external fixation, reconstruction.

M Maintenance & Monitoring — Longitudinal serial NIRS/BAF imaging, offloading, glycemic control, education, and multidisciplinary follow-up.

P, R, and I are performed at every encounter; **S and M** are activated and tailored by imaging findings.

Decision Tree Matrix



PRISM Clinical Decision Algorithm

Combined StO₂ × BAF findings resolve into eight point-of-care scenarios:

A > 70% / minimal → Maintain: moist care + offloading; re-image 2–4 wks

B > 70% / significant → Cleanse: fluorescence-guided debridement; stage-matched antimicrobials

F 41–69% / minimal → Monitor: standard care; vascular referral if deterioration

E 41–69% / significant → Cautious cleanse + antimicrobial dressings; refer if no progress

C < 40% / minimal → Revascularize: urgent vascular consult; consider HBO; avoid aggressive debridement

D < 40% / significant → Urgent dual intervention: systemic antibiotics + conservative debridement; vascular + ID consult

S any / persistent → Structural pathway: vascular → infection → surgery → closure

V any / spreading → Systemic emergency: IV antibiotics, tissue sample, ID/vascular consult, imaging

Benefits of PRISM Algorithm

- Replaces clinical impression with **objective measurement** at the two decision points — perfusion and bioburden — where care most often derails.
- Couples perfusion and infection: avoids escalating antimicrobials in a hypoxic field, and avoids mistaking good perfusion for license to ignore occult burden.
- Advances **antimicrobial stewardship** by directing therapy to documented, imaged bacterial presence.
- Reproducible, point-of-care pathway usable across wound, podiatric, vascular, and limb-preservation teams.
- Enables earlier identification of healing barriers, objective longitudinal monitoring, and **limb preservation**.

Conclusion

PRISM provides a unified, imaging-anchored pathway for chronic wound management. It begins with objective measurement of the wound’s two most critical physiologic parameters — **tissue oxygenation and bacterial burden** — stages antimicrobial intervention through a structured fluorescence-based classification, activates surgical correction when structural drivers are identified, and sustains gains through longitudinal monitoring.

By centering each decision on real-time imaging rather than impression alone, PRISM separates the complex wound into discrete, addressable barriers and directs targeted care at each — offering a reproducible route toward **durable healing and long-term limb preservation**.

KEY REFERENCES

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Perfusion-first Wound Assessment Using Near-Infrared Spectroscopy: The “P” Component of the PRISM Imaging Framework

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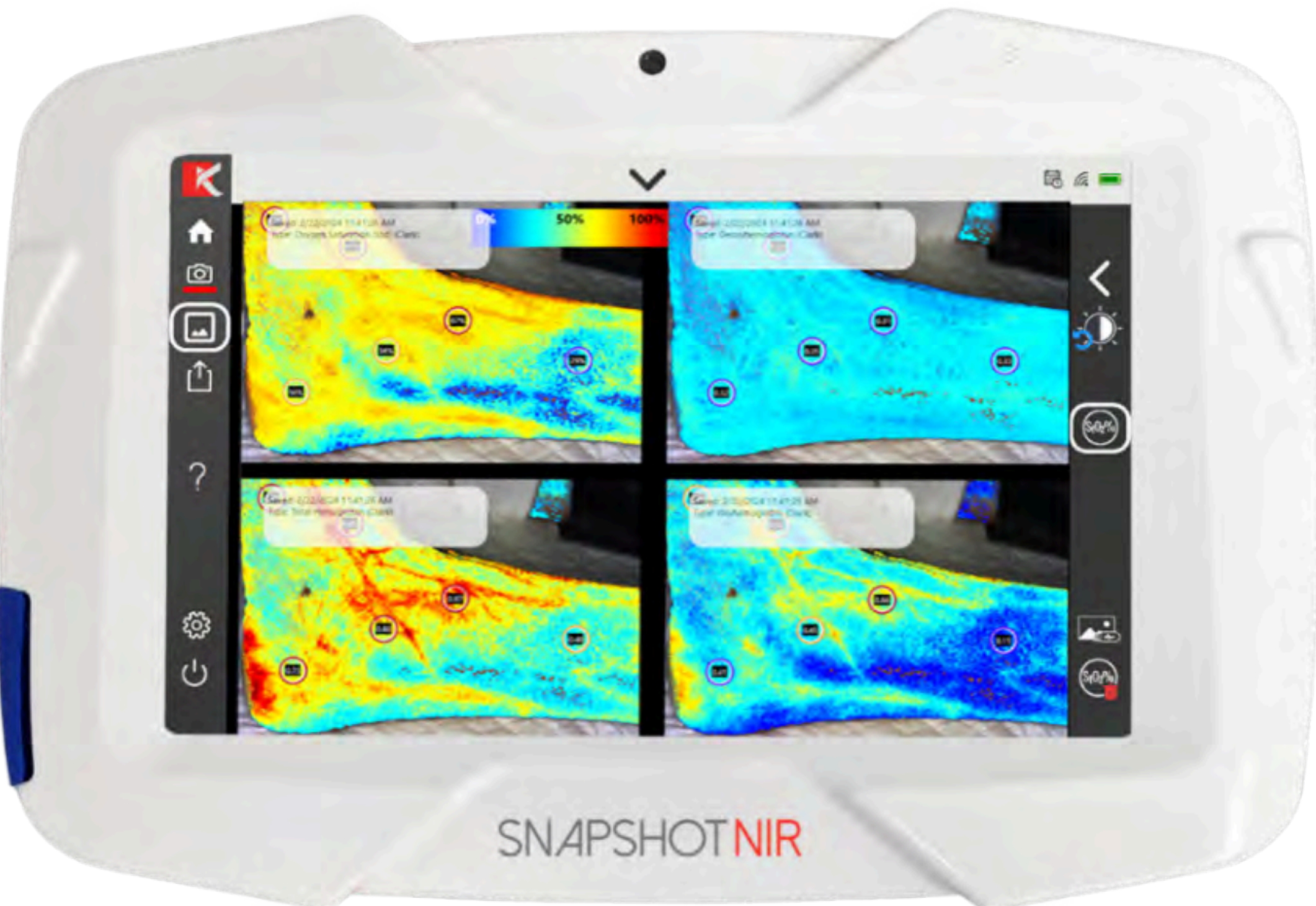


BACKGROUND

Inadequate tissue perfusion in wounds, particularly diabetic lower-extremity ulcers, often contributes to progressing them from chronicity to limb loss and has recurrence rates ranging from 40% to 65%.

Inferring perfusion from pulses or a single ankle-brachial index (ABI) measurement offer limited insight into the dynamic microvascular environment of the wound bed and unreliable results in patients with vascular calcification. Advanced point-of-care optical imaging, however, enables direct, real-time quantification of tissue perfusion, thereby helping clinicians make inform clinical decision-making and guide actionable, point-of-care interventions.

PRISM (Perfusion Imaging, Regional Bacterial Status, Infection Staging, Structural Correction, and Maintenance & Monitoring) is a structured, imaging-first algorithm that organizes these technologies into a unified, sequential pathway for chronic wound assessment and management. This article reviews the first component of the PRISM framework, perfusion imaging (“P”).



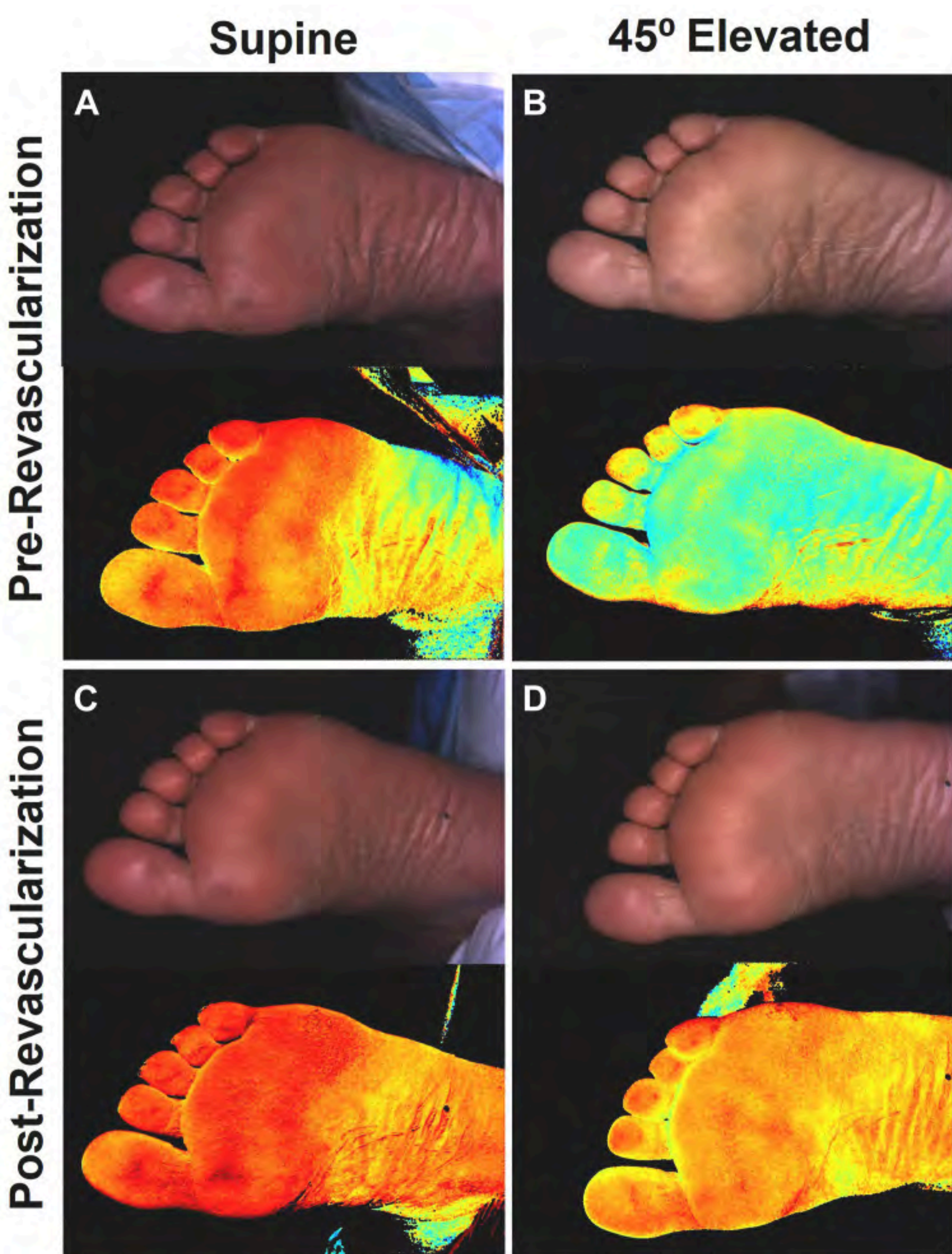
SnapshotNIR, Kent Imaging Inc., Calgary, Canada

METHODS

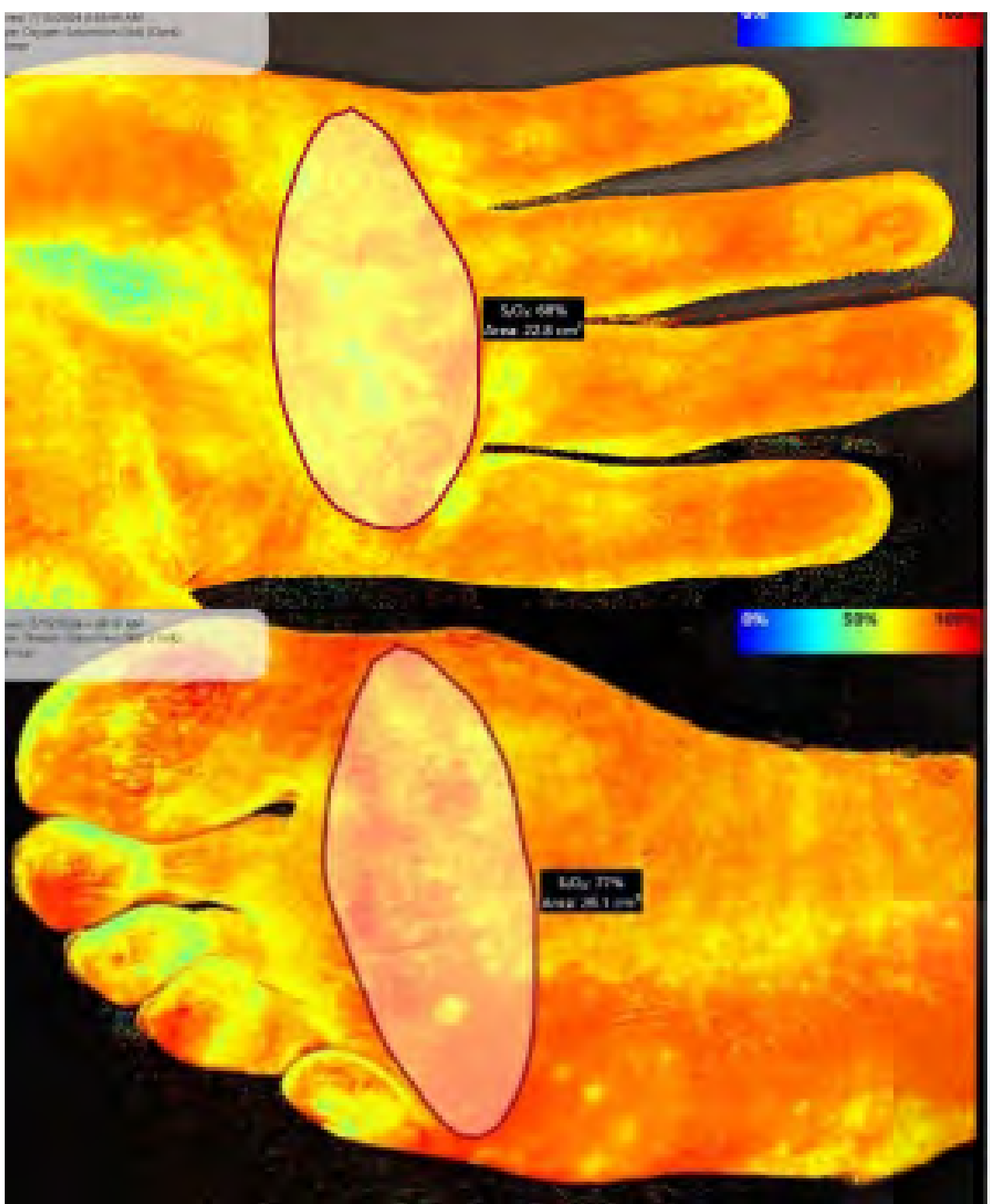
- The PRISM framework positions NIRS to quantify tissue oxygen saturation (StO₂) by exploiting the differential absorption spectra of oxy- and deoxyhemoglobin within the 700–1000 nm wavelength range
- A commercially available NIRS platform (SnapshotNIR, Kent Imaging Inc., Calgary, Canada) acquires RGB images alongside StO₂, oxyhemoglobin (HbO₂), and deoxyhemoglobin (DeOxyHb) maps, enabling comparative analysis across the wound bed, periwound tissue, and contralateral reference sites.
- For suspected peripheral arterial disease or indetermindate vascular status, the plantar-palmar index (PPI) is calculated to screen for arterial insufficiency, and a lower-extremity elevation maneuver is performed to assess dynamic changes in tissue oxygen saturation (ΔStO₂)

RESULTS

NIRS Finding	Interpretation and Action
StO ₂ > 70%	Adequate perfusion — a healing environment is supported.
StO ₂ 41–69%	Intermediate “vascular vigilance” zone — close monitoring required; reassess perfusion trend.
StO ₂ < 40%	Significant hypoxia — vascular referral for formal assessment and possible intervention indicated; avoid aggressive debridement until perfusion is optimized.
Plantar-Palmar Index (PPI)	NIRS-derived ratio of plantar to palmar StO ₂ ; a validated, non-contact alternative to the ABI for PAD screening, especially in calcified diabetic vessels.
Provocative elevation maneuver	Modified Buerger test with serial NIRS; ΔStO ₂ between supine and elevated positions differentiates PAD severity classes.



Clinical example for provocative leg maneuver. Image courtesy Reiter et al. (2023)



Region of Interest for Plantar-palmar index (PPI): PPI = Plantar StO₂ / Palmar StO₂. Image courtesy Niezgoda et al. (2025)

DISCUSSION AND CONCLUSION

- Integration of NIRS into wound assessment provides objective, reproducible perfusion data that informs clinical-decision making and reduces reliance on subjective evaluation
- This is followed by assessing Regional Bacterial Status (“R”) via BAF imaging followed by Infection (“I”) staging that grades persistent bacterial load and links each stage to a defined, escalating set of point-of-care interventions.
- The five PRISM components converge in a single point-of-care decision framework

Objective Detection of Regional Bacterial Status Using Bacterial Autofluorescence Imaging: The “R” Component of The PRISM Framework

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BACKGROUND

Chronic wounds frequently harbor clinically significant bacterial burden (>10⁴ CFU/g) without overt clinical signs of infection, contributing to impaired healing and variability in treatment decisions based on visual assessment alone.

PRISM (Perfusion Imaging, Regional Bacterial Status, Infection Staging, Structural Correction, and Maintenance & Monitoring) is a structured, imaging-first algorithm that organizes these technologies into a unified, sequential pathway for chronic wound assessment and management. This article reviews the second component of the PRISM framework, regional bacterial status (“R”).

METHODS

- The PRISM framework incorporates the objective detection of Regional Bacterial Status (R) using bacterial autofluorescence (BAF) imaging
- Under 405nm ultraviolet excitation, endogenous bacterial porphyrins emit red fluorescence (~635nm), while *Pseudomonas aeruginosa* produces cyan fluorescence through pyoverdine emission.
- Imaging is performed in a darkened environment at a standardized distance of 8–12cm to capture baseline bacterial distribution. Fluorescence is mapped by ROI (wound bed, peri-wound, beyond peri-wound), pattern (asymmetric or diffuse), and intensity as a surrogate of bacterial burden.
- SnapshotGLO (Kent Imaging Inc., Calgary, Canada) is technology that is able to detect bacterial fluorescence from tissue that has been exposed to ultraviolet excitation light. Pre-intervention imaging establishes baseline bioburden, and repeat imaging following debridement assesses adequacy of bacterial clearance.



RESULTS

Fluorescence Finding	Interpretation and Action
Red fluorescence	General bacterial presence — most porphyrin-producing organisms (<i>S. aureus</i> , <i>E. coli</i> , and others).
Cyan fluorescence	<i>Pseudomonas aeruginosa</i> (pyoverdine emission) — a highly specific signal enabling targeted therapy.
No wound-bed fluorescence	Bacterial load below the 10 ⁴ CFU/g threshold — proceed to standard care.
Periwound fluorescence	Signals spreading infection; asymmetric patterns may suggest cellulitis and uniform patterns diffuse infiltration.
Imaging timing	Always capture before wound hygiene for an accurate baseline; re-image after cleansing and debridement to confirm bacterial clearance.

DISCUSSION AND CONCLUSION

- BAF enables visualization of bacterial distribution not evident clinically and supports medical decision making for targeted debridement and antimicrobial selection, as well as documentation of treatment response.
- Integration of SnapshotGLO within the PRISM framework enhances sensitivity of detection and supports precise, imaging-guided intervention and antimicrobial stewardship.



Figure 1: SnapshotGLO device displaying RGB image (L) with wound measurement alongside BAF image (R) side by side.



Figure 2: Sample RGB and corresponding BAF images from the dataset of two different wounds. Image courtesy: Dr. Tyler Sexton

Image-Guided Infection Staging In Chronic Wounds: Integrating Bacterial Autofluorescence Imaging Into The “I” Component of PRISM

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BACKGROUND

Bacterial autofluorescence (BAF) imaging such as SnapshotGLO (Kent Imaging Inc., Calgary, Canada) enables detection of clinically significant bacterial burden in chronic wounds; however, imaging findings alone do not define treatment. A structured framework is required to translate these findings into consistent, proportional clinical interventions.

PRISM (Perfusion Imaging, Regional Bacterial Status, Infection Staging, Structural Correction, and Maintenance & Monitoring) is a structured, imaging-first algorithm that organizes these technologies into a unified, sequential pathway for chronic wound assessment and management. This article reviews the third component of the PRISM framework, Infection Staging (“I”).

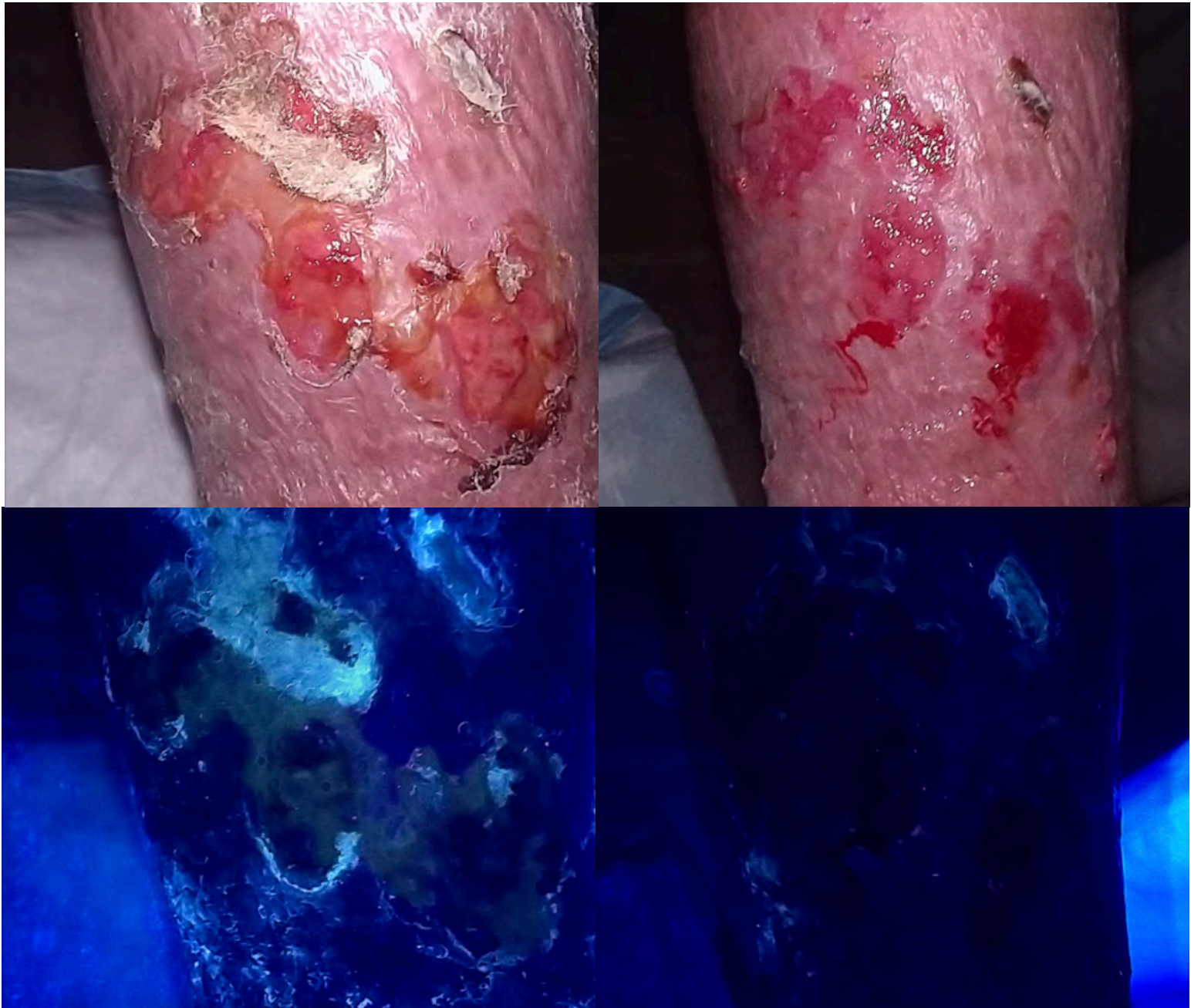
METHODS

The PRISM framework incorporates a bacterial auto fluorescence imaging-based Infection Staging (I) system. BAF imaging is performed prior to intervention to establish baseline distribution and repeated after debridement to confirm bacterial clearance.

Stage	Fluorescence / Clinical Finding	Representative Interventions
0	No bacterial burden on imaging or clinical assessment.	Standard care and basic hygiene; consider readiness for advanced products (e.g., cellular and/or tissue-based products).
I	Burden present but eliminated by hygiene or selective debridement.	Basic hygiene, cleansing, or selective debridement; standard dressings; re-image at next visit; reinforce at-home hygiene.
II	Burden persists in the wound bed after cleansing or selective debridement.	Add antiseptic cleanser; consider topical antimicrobial therapy; re-image at next visit.
III	Burden persists in the peri-wound after cleansing or selective debridement.	Stronger antiseptics; obtain tissue sample (quantitative and/or qualitative culture); topical antimicrobial; consider oral antibiotics if persistent; follow up within one week.
IV	Burden persists in wound bed and/or periwound after aggressive excisional debridement.	Escalate antiseptic; tissue sample; continue topical antimicrobial; consider oral or systemic antibiotics if local signs of infection; follow up within one week.
V	Burden spreading beyond periwound with signs of local or deep infection.	Urgent tissue sample; systemic (IV) antibiotics plus local treatment; infectious-disease consultation; additional imaging (radiograph, CT, or MRI); increase visit frequency.



RESULTS



PRE Debridement POST Debridement
Diabetic foot ulcer treated with ultrasonic debridement guided by imaging. Image courtesy: Dr. Tyler Sexton



PRE Debridement POST Debridement
Chronic right ankle ulcer complicated by lymphedema, CHF, and varicose veins; plasma jet debridement was used guided by imaging. Image courtesy: Dr. Tyler Sexton

In both cases, fluorescence imaging revealed bacterial hotspots not apparent on visual assessment, enabling precise removal and reducing bioburden

DISCUSSION AND CONCLUSION

- This fluorescence-based staging system standardizes antimicrobial decision-making by aligning treatment intensity with objective imaging findings
- Staging is interpreted alongside NIRS perfusion assessment (with SnapshotNIR, Kent Imaging Inc., Calgary, Canada); in cases of compromised perfusion ($StO_2 < 40\%$), infection management and vascular optimization are pursued concurrently due to reduced treatment efficacy in hypoxic tissue.
- Integration within the PRISM framework enables reproducible, imaging-guided care that addresses subclinical bacterial burden and supports appropriate therapeutic escalation.

IMAGING-INFORMED STRUCTURAL INTERVENTION IN CHRONIC WOUNDS: THE “S” COMPONENT OF THE PRISM FRAMEWORK

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BACKGROUND

- Recurrent diabetic lower-extremity wounds remain a major clinical challenge, with reported recurrence rates of 40–65% despite successful wound closure.
- A principal driver of recurrence is the persistence of underlying biomechanical or structural abnormalities, including deformity, pressure redistribution, and osteomyelitis, which are often addressed only after repeated treatment failure.

METHODS

- PRISM leverages the VISTA strategy incorporating structural correction as the “S” component
- The intervention sequence follows a staged pathway: vascular optimization, infection control, structural correction, soft-tissue reconstruction, and definitive closure.

RESULTS

Integration of imaging supports surgical planning and real-time decision-making. Near-infrared spectroscopy such as SnapshotNIR (Kent Imaging Inc., Calgary, Canada) confirms perfusion adequacy prior to intervention, while bacterial autofluorescence imaging such as SnapshotGLO (Kent Imaging Inc., Calgary, Canada) guides debridement margins and confirms bacterial clearance intraoperatively. Early surgical intervention with structural correction addresses the mechanical drivers of tissue breakdown, enabling redistribution of pressure and reduction of recurrent injury at the same anatomical site.

DISCUSSION AND CONCLUSION

Early, imaging-informed structural intervention shifts management from reactive to proactive care. By addressing the underlying biomechanical cause rather than repeated surface manifestations, the PRISM-S component provides a systematic approach to interrupt the cycle of recurrence and supports durable limb preservation.



SURGICAL TRIGGERS — BIOMECHANICAL CONTRIBUTORS

1 Failed Healing Trajectories

Wound fails to achieve expected area reduction over time despite standard-of-care treatment

2 Recurrent Ulceration

Ulceration recurring at the same site despite adequate infection management

3 Bony Deformity Beneath Wound

Visible or imaging-confirmed deformity: Charcot collapse, prominent MT head, hallux valgus, or hammertoe

4 Probe-to-Bone Osteomyelitis

Wound probing to bone with confirmed osteomyelitis on MRI or CT

5 Persistent Bacterial Burden

Intermediate-to-high-stage bacterial burden persisting despite aggressive local treatment

6 Persistent Periwound Fluorescence

Periwound fluorescence that persists despite systemic antimicrobial therapy



STAGED SURGICAL OPTIONS

Tailored to the Underlying Pathology

1 Tendon & Soft Tissue

PROCEDURES

- Achilles tendon lengthening
- Gastrocnemius recession
- Digital tenotomies
- Capsulotomy

2 Bony Procedures

PROCEDURES

- Osteotomy
- Arthrodesis (Lapidus, 1st TMT, ankle)
- Metatarsal head resection / shortening
- Exostectomy

3 External Fixation

PROCEDURES

- Multiplanar circular frames
- Charcot reconstruction
- Midfoot realignment
- Offloading

4 Soft-Tissue Reconstruction

PROCEDURES

- Local or free flap coverage
- Coverage over exposed bone / hardware
- Split-thickness skin grafting
- Full-thickness skin grafting

5 Infection-Targeted Adjuncts

PROCEDURES

- Antibiotic-eluting bone void fillers
- Antibiotic-impregnated cement beads
- Resection of non-viable infected bone



LONGITUDINAL WOUND SURVEILLANCE USING NEAR-INFRARED AND BACTERIAL AUTOFLUORESCENCE IMAGING: THE “M” COMPONENT OF PRISM

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BACKGROUND

Wound closure does not represent cure in chronic wounds, particularly diabetic lower-extremity wounds, which recur in 40–65% of patients within five years. Durable limb preservation requires ongoing surveillance to detect early physiologic deterioration prior to clinical manifestation.

METHODS

- The PRISM framework defines the “M” component as an imaging-driven longitudinal monitoring strategy incorporating serial near-infrared spectroscopy (NIRS) and bacterial autofluorescence (BAF).
- Imaging cadence is stratified by clinical status: wounds progressing appropriately are reassessed every 2–4 weeks; stalled or deteriorating wounds undergo weekly imaging; and post-surgical flaps are monitored with NIRS (SnapshotNIR, Kent Imaging Inc., Calgary, Canada) every 24–48 hours during the early postoperative phase.
- BAF imaging (SnapshotGLO, Kent Imaging Inc., Calgary, Canada) is performed before definitive closure to confirm bacterial clearance, and periodic imaging continues after closure, with re-evaluation triggered by clinical warning signs. Imaging findings are reintegrated into earlier PRISM components (perfusion, bacterial status, infection staging, and structural correction) to guide ongoing care.



RESULTS

- Serial NIRS enables detection of declining tissue oxygenation
- BAF identifies re-emergent bacterial burden before visible clinical signs
- This combined approach facilitates early reactivation of targeted interventions, including vascular evaluation, antimicrobial therapy, or structural reassessment
- Integration with standard care measures—including offloading, glycemic optimization, compression therapy where indicated, and patient education—supports comprehensive wound management



Figure 1: SnapshotGLO device displaying RGB image (L) with wound measurement alongside BAF image (R) side by side.



Figure 2: SnapshotNIR device displaying RGB image (L) alongside NIR enabled StO₂ image (R) side by side.

DISCUSSION AND CONCLUSION

The PRISM-M component reframes wound care as a continuous, imaging-guided process rather than a discrete episode ending with closure. By enabling early detection of recurrence risk and guiding timely intervention, this approach supports sustained remission and long-term limb preservation within a structured, multidisciplinary care model.



Figure 3: Sample RGB and corresponding BAF images from the dataset of two different wounds