

# Integrating Near-Infrared Spectroscopy and Bacterial Auto Fluorescence Imaging into the VISTA Pathway for Diabetic Limb Preservation

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BACKGROUND	VISTA FRAMEWORK			DISCUSSION
<p>Diabetic lower extremity wounds (DLEWs) remain a leading healthcare burden globally, with recurrence rates up to 65% and major amputations often being inevitable in cases with chronic ulceration and osteomyelitis. Conventional care emphasizes infection control and wound closure but often neglects vascular insufficiency and biomechanical drivers of ulcer recurrence. The VISTA pathway—Vascular Evaluation, Infection Control, Surgical Correction, Technologies &amp; Therapies, and Amputation Prevention—advances a surgical-first, multidisciplinary approach. This abstract highlights the importance of integrating near-infrared spectroscopy (NIRS) for microvascular assessment and bacterial auto fluorescence (BAF) imaging for infection control within VISTA.</p>	<p><b>V – Vascular Evaluation</b></p> <ol style="list-style-type: none"> <li>1. Non-invasive vascular testing: ABI/TBI, NIRS PEMLE and Plantar Palmar Index (PPI), Skin perfusion pressure (SPP), transcutaneous oxygen measurement (TcPO<sub>2</sub>)</li> <li>2. Imaging modalities: Duplex ultrasonography, CTA/MRA</li> <li>3. Revascularization planning: Early vascular referral when PAD is suspected. Endovascular and open bypass surgeries followed by revascularization before reconstruction/ debridement</li> <li>4. Multidisciplinary collaboration</li> </ol>	<p><b>I – Infection Control</b></p> <ol style="list-style-type: none"> <li>1. Prompt diagnosis and stratification: Clinical infection signs are corroborated with CRP,ESR,WBC, MRI/CT and bone biopsy for suspected osteomyelitis</li> <li>2. Culture-guided antibiotic therapy tailored to sensitivity</li> <li>3. Surgical source control: sharp debridement, drainage of abscesses, removal of necrotic tissue, resection of infected dead bone</li> <li>4. Minimally invasive B-PLAST intervention</li> <li>5. Advanced fluorescence-guided bacterial imaging for precise debridement</li> <li>6. Multidisciplinary collaboration between infectious disease specialists, surgeons and wound clinicians</li> <li>7. Adjunctive local therapies: wound irrigants/washes, NPWTi, localized antibiotic delivery system</li> <li>8. Infection control is integrated into initial assessment</li> </ol>	<p><b>A – Amputation Prevention</b></p> <ol style="list-style-type: none"> <li>1. Durable offloading strategies, including custom therapeutic footwear and orthoses</li> <li>2. Structured gait retraining and physical therapy</li> <li>3. Routine clinical follow-up augmented by advanced imaging</li> <li>4. Patient education empowering self-care and adherence to offloading</li> <li>5. Multidisciplinary collaboration across vascular surgery, infectious disease, endocrinology, podiatry, and rehabilitation disciplines</li> <li>6. In this longitudinal framework, amputation prevention shifts the clinical focus from reactive salvage to proactive, sustained limb preservation</li> </ol>	<p>Evidence supports NIRS as not only a tool for measuring tissue perfusion but also a reliable, non-invasive alternative for microvascular perfusion assessment. BAF imaging enhances infection control by identifying bacterial bioburden beyond clinical visualization, reducing residual contamination and optimizing wound bed preparation. In the VISTA application, these technologies can improve early detection of perfusion deficits and bacterial hotspots, potentially reduce surgical stages and accelerate healing. Combining advanced diagnostics with proactive surgical correction can reduce recurrence and improve limb salvage rates.</p>
<p><b>METHODS</b></p> <p>A narrative synthesis of diabetic foot ulcer literature and VISTA application was performed. Emphasis was placed on technologies that enhance early detection and targeted intervention. NIRS (SnapshotNIR, Kent Imaging, Calgary, Canada) was evaluated as a non-invasive modality for assessing tissue perfusion and microvascular assessment, particularly when ankle-brachial index (ABI) and toe-brachial index (TBI) are unreliable in diabetic patients. BAF imaging (SnapshotGLO, Kent Imaging, Calgary, Canada) was reviewed for its ability to visualize bacterial load (&gt;10<sup>4</sup> CFU/g) and guide precision debridement. Clinical integration points of these technologies within VISTA were mapped to the vascular evaluation and infection control phases.</p>	<p><b>S – Surgical Correction</b></p> <ol style="list-style-type: none"> <li>1. Tendon and tissue procedures: Achilles tendon lengthening or gastrocnemius recession, Digital tenotomies or capsulotomy</li> <li>2. Bony Procedures: Osteotomies and arthrodesis (fusion), Lapidus bunionectomy, Metatarsal head resection or shortening</li> <li>3. External Fixation: Integration of smart devices for complex deformities and Charcot reconstructions</li> <li>4. Soft Tissue Reconstruction: local and free flap coverage, CAMP's, split-thickness and full-thickness skin grafts</li> <li>5. Vascular assessment and needed intervention combined with infection control is prioritized prior to definitive reconstruction</li> </ol>	<p><b>T – Technologies and Therapies</b></p> <ul style="list-style-type: none"> <li>• NPWTi and antimicrobial dressings</li> <li>• Antibiotic-eluting bone void fillers</li> <li>• Smart external fixation systems</li> <li>• Thermal imaging, <u>Near-infrared spectroscopy (NIRS), and BAF-guided bacterial visualization</u></li> <li>• Pressure-mapping technologies, custom 3D-printed orthotics</li> </ul>	<p><b>Example Images</b></p> <p>Figure: RGB, oxygen saturation (StO<sub>2</sub>) and bacterial auto fluorescence image captured by SnapshotNIR and SnapshotGLO (Kent Imaging, Calgary, Canada). Image courtesy: Dr. Tyler Sexton</p>	<p>Incorporating NIRS and BAF imaging into VISTA strengthens its proactive, technology-driven framework. NIRS addresses a critical gap in vascular assessment for diabetic patients with calcified vessels, while BAF imaging elevates infection control through real-time bacterial visualization. These tools align with VISTA's emphasis on precision, multidisciplinary care, and long-term limb preservation. Future prospective studies should evaluate their combined impact on amputation-free survival, cost-effectiveness, and workflow integration.</p>

