

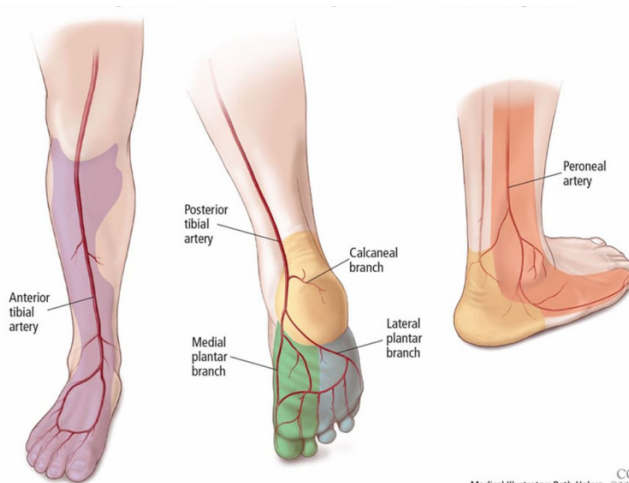
MIMOSA Diagnostics Sponsored Learning:

Shining a Light on Tissue Health: Canadian Leadership

Presenters: Dr. Karen Cross MD PhD FRCSC, Tracey Rickards BN RN MN PhD, Dr. Jordan Tarshis MD FRCPC DRCPC and Ronni Bellefontaine CCRN

The Concept Of Angiosomes

An angiosome is defined as a block of tissue (i.e., skin, muscle, tendon, and/or bone) supplied by a particular course of arteries.¹ There are connections between angiosomes known as choke arteries.¹ These connections provide safety conduits to enable blood flow between border zones if the source artery in a particular angiosome is injured.¹ There are six angiosomes in the foot and ankle supplied by three main arteries (i.e., posterior tibial artery, anterior tibial artery and peroneal artery). Understanding of angiosome is crucial in surgical planning, particularly in revascularization and patient outcomes. Fifteen percent of ischemic lower extremity wounds fail to heal despite adequate arterial bypass surgeries.² A direct revascularization approach is preferred over an indirect approach. Direct revascularization is when the bypassed vessel directly feed the source artery of the angiosome where the wound is.² The failure rate and amputation rate are much lower when the revascularization is direct.²

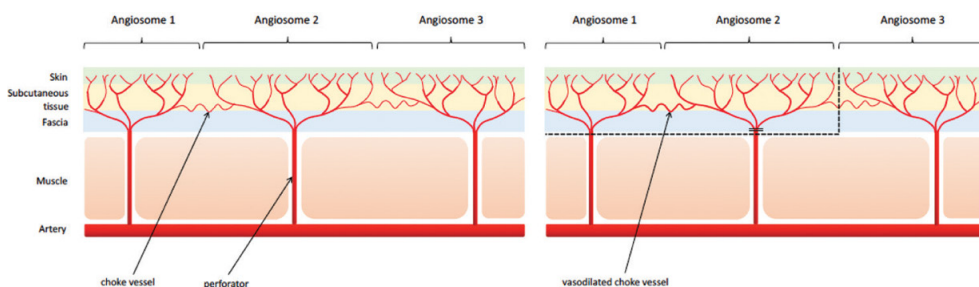


Source: Shishehbor and Reed (2014). *Circ Cardiovasc Interv.*³ Medical Illustrator: Beth Halasz ©2014 CCF

Macrocirculation, Microcirculation And Wound Healing:

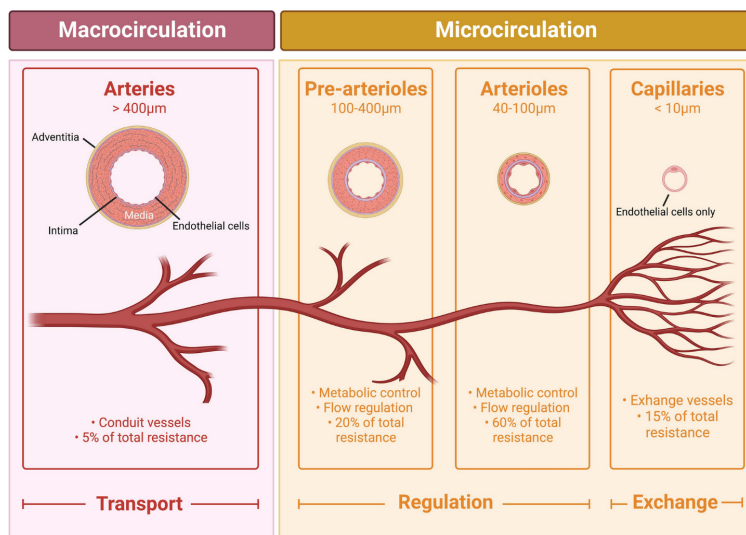
Adequate perfusion is crucial for proper and timely wound healing. The macrocirculation (i.e., arteries) are responsible for bringing oxygenated blood from the heart to the microcirculation. The microcirculation (e.g., pre-arterioles, arterioles and capillaries) then deliver oxygenated blood

to the skin and the wound bed. Compromised macro- and micro-circulation delay wound healing, rendering them chronic or non-healable. Over the past 20 years, advances in research have recognized and emphasized the importance of



Source: Eccles et al. (2020). *Standards for the Management of Open Fractures*¹

not just microcirculation, but microcirculation in wound healing.



Source: Merdji H et al. (2023). *Ann Intensive Care*.⁴

Macro- and microcirculation can be assessed by two broad categories of vascular imaging – optical and non-optical. Optical imaging involves light-based technologies, whereas non-optical imaging does not. Table 1 summarizes the common optical and non-optical imaging techniques for the assessment of macro- and microcirculation.

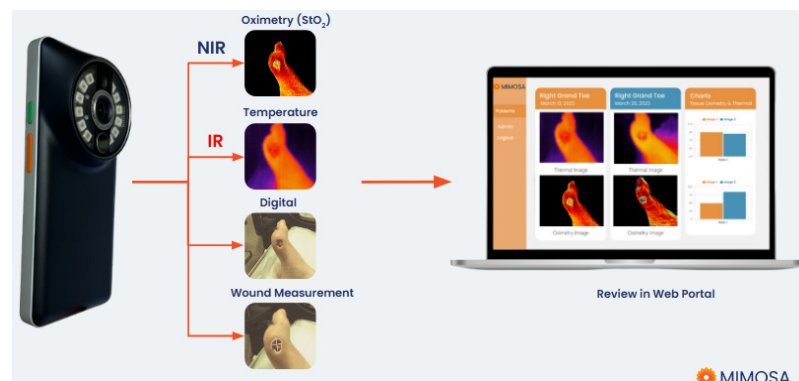
Table 1. Imaging Techniques for the Assessment of Macro- and Microcirculation

		Microcirculation
Optical Imaging	Doppler (Duplex)	Laser Doppler Flowmetry (LDF)
	Ultrasound	Near-Infrared Spectroscopy (NIRS)
	Angiography	
Non-Optical Imaging	Ankle-Brachial Index (ABI)	Transcutaneous Oximetry (TcPO ₂)
	Pulse Volume Recording (PVR)	Skin Perfusion Pressure (SPP)

MIMOSA Pro

The MIMOSA Pro is an FDA-approved (and recently Health Canada-approved) pocket-sized medical device that enhances clinical decision-making in wound care. MIMOSA Pro provides four key

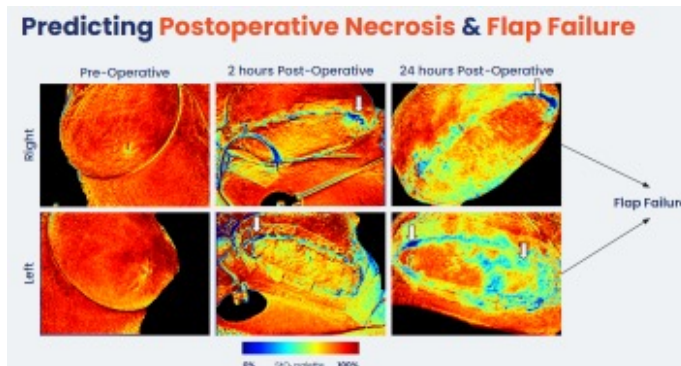
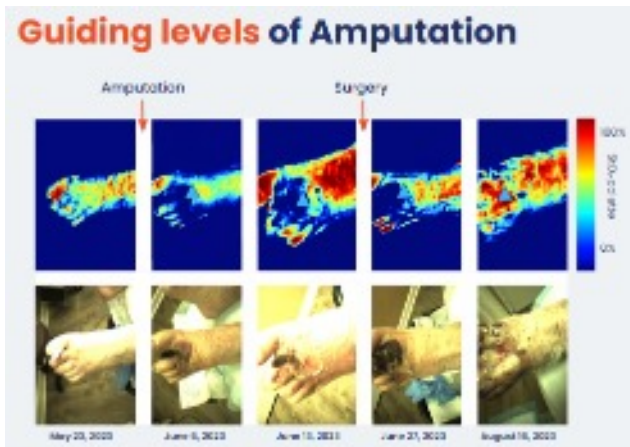
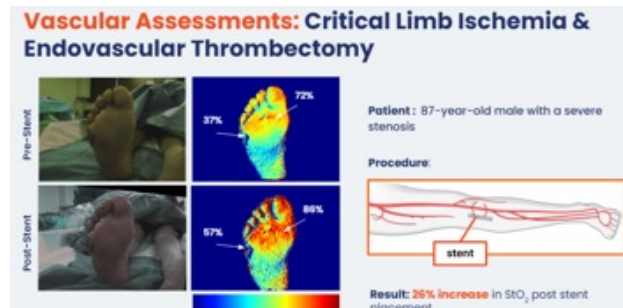
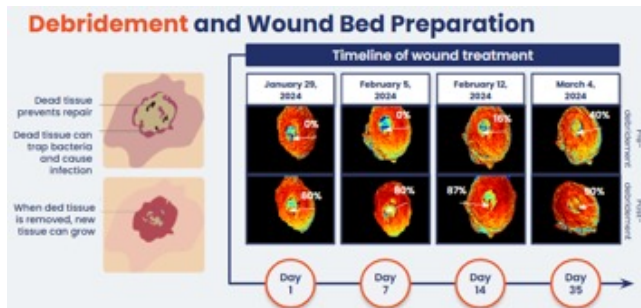
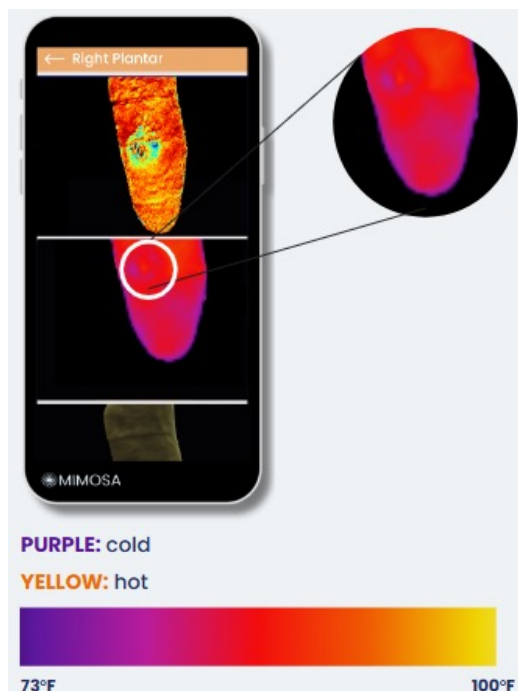
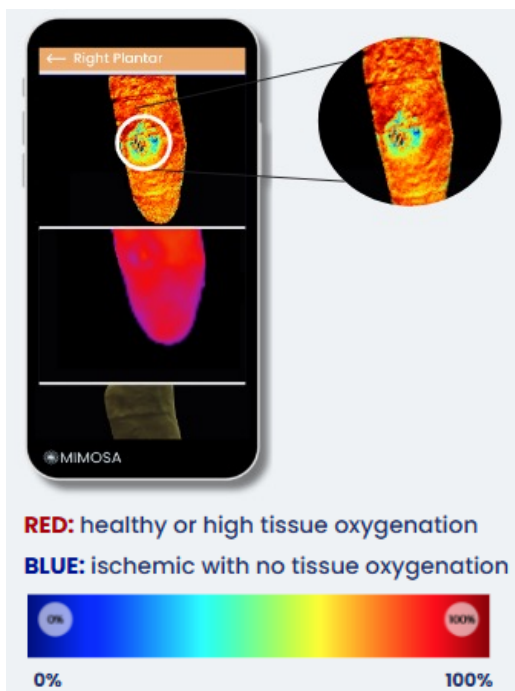
functionalities available at the point of care: near infrared spectroscopy (NIRS), infrared spectroscopy (IR), digital wound photography and wound measurement. MIMOSA Pro is smart and agile – wound images and data are stored and can be viewed on a web portal.



NIRS a fibre-based technology that is commonly used in health care (e.g., pulse oximeter) and provides information beyond what the naked eye can see. The light emitted by the MIMOSA Pro goes below the surface of the skin and is absorbed by the hemoglobin in red blood cells. The light that is not absorbed will bounce back and the signals are detected by the camera system. This creates a digital fingerprint – a surrogate marker for tissue oxygenation (StO₂). Clinicians can visualize wound and peri-wound tissue oxygenation at the point of care. It provides information on healing trajectories and enables clinical decision-making (e.g., debridement, pre- and post-intervention evaluation). Skin temperature is an important clinical indicator for wound infection and inflammatory conditions (e.g., Charcot neuroarthropathy). Through the integrated infrared spectroscopy (IR), clinicians can assess temperature variations in and around the wound. Clinicians can also capture digital images of the wound at point of care. MIMOSA Pro can also provide wound measurements. These features simplify and improve the accuracy of documentation. This also enables clinicians to track wound healing progression.

Clinicians can utilize MIMOSA Pro to guide wound bed preparation. For example, NIRS imaging provides real-time feedback and offers insights to the efficacy of debridement. Clinicians can also use MIMOSA Pro to instantly assess the

effectiveness of invasive vascular procedures at the bedside. Surgeons can utilize MIMOSA Pro to guide surgical decision (e.g., level of amputation) and predict post-operative necrosis and flap failure.

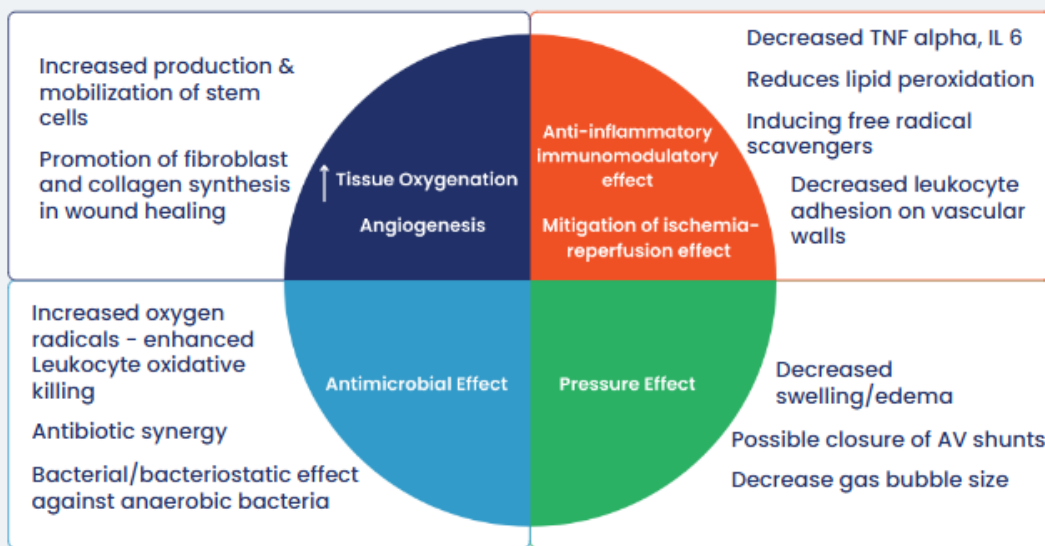


The Value Of Imaging In Hyperbaric Oxygen Therapy (HBOT)

Hyperbaric oxygen therapy (HBOT) is the delivery of high concentrations of oxygen at pressures significantly higher than ambient air. HBOT is indicated for deep infections (i.e., osteomyelitis, acute ischemia, compromised surgical flaps and grafts, and complex non-healing wounds). While it is an adjunctive therapy, HBOT does not replace good wound care. There are, however, many benefits to HBOT in wound healing, some of which are highlighted in Figure 1

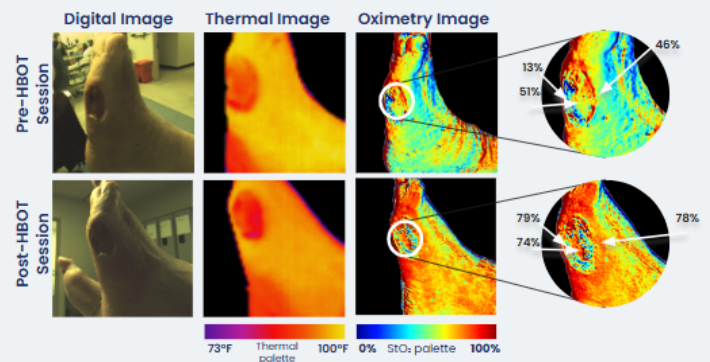
A common misconception about HBOT is that the effects are temporary (i.e., only when the patient is in the hyperbaric chamber). The human body responds to hypoxia by producing hypoxia-inducible factor-1-alpha (HIF-1-alpha). When the patient steps out of the hyperbaric chamber and breathes ambient air, the body is 'tricked' by thinking it is in a hypoxic state and subsequently releases HIF-1-alpha. This is how HBOT provides the short-term and prolonged effects beneficial to wound healing stated above.

Figure 1. The Benefits of Hyperbaric Oxygen Therapy



The following is an example of a patient with a diabetic foot ulcer (DFU) receiving HBOT to enhance healing. Wound images were taken pre and post-HBOT using the MIMOSA Pro.

The use of MIMOSA Pro not only provided a digital image of the wound, but valuable infor-



Tissue oxygenation increased by 23% in wound, 66% in the periwound & 34% in surrounding tissue following HBOT. The patient is responding well to treatment and is on a healing trajectory.

mation such as real-time qualitative validation of HBOT as evidenced by increased in wound and peri-wound oxygenation. These types of objective visualizations may enhance patient adherence and allows for more accurate documentation. They also allow clinicians to track progression and project healing, especially pre- and post-intervention. They can also aid in streamlining clinical decision making, including when to discontinue a particular treatment (e.g., HBOT).

Innovative Approaches to Wound Care Across Canada

New Brunswick – The Healthy Seniors Pilot Project

The median age in New Brunswick is 45.7 years, the second highest in Canada. Approximately 22.8% New Brunswickers are 65 years or old – 27% of them live alone and 10% are living in poverty. Forty-seven percent of those who are 65 years or older live in a rural/remote area. Individuals living in rural/remote areas have a three to four times higher chance of amputation due to delayed access to care. Diabetes contributes to 70% of non-trau-

matic leg and foot amputations. Approximately 85% of these were preceded by a diabetic foot ulcer (DFU). More importantly, 80% of lower extremity amputations (LEA) related to diabetic foot complications can be prevented with the integration of prevention and interdisciplinary

care.

The *Healthy Seniors Pilot Project* was a partnership between the University of New Brunswick and the Horizon Health Network. The project aimed to gain a better understanding of the needs of seniors wanting to age in place/at home; improve diabetic foot health among isolated seniors; and reduce self-reported loneliness and social isolation. The project included six foot risk assessment and foot care visits (every four to six weeks) by registered nurses (RNs). MIMOSA Pro was used for foot and wound monitoring and to aid clinical decision-making. Registered social worker (RSWs) provided baseline and periodic patient assessments and information about accessing health care resources. The interdisciplinary team also included, but not limited to, dietitians and occupational therapists.

A total of 313 seniors completed all of the foot assessment and care visits – 53.8% of them were at a high or urgent risk based on diabetic foot risk scores and 6% had an active ulcer.⁵ On average, the foot risk scores decreased after three visits compared to baseline.⁵ The patients' mental health also improved – anxiety and depression scores decreased significantly after 3 months compared to baseline.⁵ This pilot project demonstrated the importance of early intervention and patient engagement. It also highlighted the importance of collaborative efforts to achieve better patient outcomes.

Nova Scotia – The Wound Innovation Collaborative

The Nova Scotia Health Innovation Hub is part of the Nova Scotia Health Authority. They bring technology and solutions into the health-care system through industry partnerships. They also support clinicians in search of health technology solutions or are on a quest to create their own. The *Wound Innovation Collaborative (WIC)* aims to improve patient outcomes by empowering communities with the tools and knowledge to deliver equitable wound care. Their projects are founded on four strategic pillars embedded in its vision: 1) Annotated meaningful data; 2) Impactful products and partnerships; 3) Knowledge translation

and integration; 4) Community connection.

One of WIC's projects is to create a provincial wound registry. This will serve as a data collection platform for wounds across Nova Scotia. The goal of this project is for clinicians to have access to this database, leading to better patient outcomes (e.g., more personalized care, faster rate of healing). The WIC also creates partnerships with companies like MIMOSA Diagnostics to bring the latest wound care innovations to Nova Scotians and ensure optimal care for all. Clinicians (i.e., NSWOCs) in the Central Zone of the Nova Scotian Health Authority will be the first to be trained to utilize and implement MIMOSA Pro in the management of complex wounds.

The WIC strives to support clinical nurse educators in wound care. They ensure alignment and collaboration on initiatives with Interprofessional Practice & Learning (IPP&L) colleagues within the provincial wound care program. They also support the implementation of new roles in wound care, including the wound care clinical nurse educators and pressure injury support nurses. These roles are integral to knowledge translation and integration in the front lines within the health system. Lastly, WIC aims to bridge the gap between hospital and community wound care to ensure a seamless transition of care to achieve better patient outcomes. This is accomplished through building new and strengthening existing community partnerships. After all, majority of wound care is practiced in the community and collaboration is the key to achieving optimal patient outcomes.

Dr. Karen Cross MD PhD FRCS is a Plastic & Reconstructive Surgeon and PhD Scientist. Dr. Cross leads the *Wound Innovation Collaborative*, a centre of excellence in wound innovation and the data registry for the province of Nova Scotia. As an Innovator in Residence at the Nova Scotia Innovation Hub. She was recently named one of Atlantic Canada's Top 50 CEOs of the Year, Innovator of the Year in 2024, and one of Canada's Top 14 Entrepreneurs to Watch in 2023.

Tracey Rickards BN RN MN PhD was an Assistant Professor in the Faculty of Nursing at

the University of New Brunswick in Fredericton. She completed her Bachelor of Nursing at UNB in 1986, her Master of Nursing at UNB in 2005, and her PhD in Nursing at Dalhousie University in 2013.

Dr. Jordan Tarshis MD FRCPC DRCPC obtained his Doctor of Medicine degree at McMaster University and completed his residency in anaesthesiology at the University of Toronto. He is on staff at Sunnybrook Health Sciences Centre. Dr. Tarshis is a Diplomate of the Royal College of Physicians and Surgeons of Canada after completing the Area of Focused Competence in Hyperbaric Medicine at the University of Toronto. He currently practices hyperbaric medicine at Restore Hyperbaric Oxygen and Medical Centre in Mississauga, Ontario when not practicing clinical anaesthesia.

Ronni Bellefontaine CCRN is the Clinical Manager, Innovation at Nova Scotia Health. She started out her career in cardiac care nursing, before transitioning to the Health Innovation Hub to use her skills and education to impact patients in another way.

References

1. Eccles, Simon, and others (eds), Standards for the Management of Open Fractures (Oxford, 2020; online edn, Oxford Academic, 1 Aug. 2020), <https://doi.org/10.1093/med/9780198849360.001.0001>
2. Attinger CE, Evans KK, Bulan E, Blume P, Cooper P. Angiosomes of the foot and ankle and clinical implications for limb salvage: reconstruction, incisions, and revascularization. *Plast Reconstr Surg*. 2006 Jun;117(7 Suppl):261S-293S. doi: 10.1097/01.prs.0000222582.84385.54. PMID: 16799395.
3. Shishehbor MH, Reed GW. Personalized approach to revascularization of critical limb ischemia. *Circ Cardiovasc Interv*. 2014 Oct;7(5):642-4. doi: 10.1161/CIRCINTERVENTIONS.114.001923. PMID: 25336603.
4. Merdji H, Levy B, Jung C, Ince C, Siegemund M, Meziani F. Microcirculatory dysfunction in cardiogenic shock. *Ann Intensive Care*. 2023 May 6;13(1):38. doi: 10.1186/s13613-023-01130-z. PMID: 37148451; PMCID: PMC10164225.
5. Rickards T, Roberts C, Smith T, Shittu S, Boodoo C, Cross K. Using Near-Infrared Spectroscopy and Education to Support Older Adults with Diabetic Foot Ulcers to Age-in-Place: A Case Series. *Adv Skin Wound Care*. 2024 Aug 1;37(8):422-428. doi: 10.1097/ASW.000000000000146. PMID: 39037096.



Presentation Digest is a production of Wounds Canada. The views expressed in this report are those of the presenter and do not necessarily reflect those of Wounds Canada, which has neither reviewed nor endorsed this report. © 2024 Wounds Canada. All Rights Reserved.