Implementation of the M.O.I.S.T. concept for the local treatment of chronic wounds into clinical practice

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The M.O.I.S.T. concept was developed in 2017 by an expert group (WundDACH) and is an evolution of the T.I.M.E. clinical decision tool. M.O.I.S.T. is primarily an educational tool which builds on the existing T.I.M.E concept by incorporating new areas of knowledge and local wound therapies and their impact on wound healing – namely Oxygen balance (e.g. therapies to improve wound hypoxia) and Supporting strategies (e.g. therapies including but not limited to biologics, skin substitutes, and protease modulators). T.I.M.E. includes varying concepts of wound bed preparation and re-epithelialisation, whereas M.O.I.S.T. represents the overall concept of local treatment. A broad group of wound care specialists from the Asia-Pacific (APAC) region convened in June 2022 to discuss the M.O.I.S.T. concept. Discussions focused on how M.O.I.S.T. applies to clinical practice, as well as how best to implement and deliver this educational tool to improve local wound management.

While most acute wounds in generally healthy people will proceed through an orderly process to repair the soft tissue and skin, many people with comorbidities, such as diabetes appear to be at a higher risk of impaired wound healing (Xiang et al, 2019). This is reflected in wound healing outcome data, which indicate that only 30% of all diabetes-related foot ulcers (DFUs) and pressure ulcers (PUs) are likely to heal within a 12-week treatment period and only 45% of venous leg ulcers (VLUs) will achieve healing by this time point (Marston et al, 2019). Large data sets also show that these ulcers last on average between 6 and 12 months and that they can reoccur in up to 60% to 70% of patients (Frykberg and Banks, 2015). Importantly, these wounds commonly lead to loss of function and decreased quality of life, and are significant causes of morbidity (Richmond et al, 2013).

These ulcers, usually described as chronic wounds in the literature, have the potential to heal but fail to progress with standard therapy in an orderly and timely manner. Chronic wounds often remain stalled in the inflammatory stage of the healing process, making them particularly challenging to treat and heal. Another challenge is the variability in how wound care is delivered. Inconsistencies in wound care have been attributed to variations in staff involvement and dressing selection, as well as a lack of coherence in treatment plans in many cases (Guest et al, 2020).

Tools, pathways and algorithms can help improve the consistency and quality of care, direct the most appropriate therapy selection, and make care consistent and structured across an organisation or region (World Union of Wound Healing Societies [WUWHS], 2020). These tools are also critical for the education and training of clinicians with diverse competencies and skill sets.

M.O.I.S.T. concept

The acronym M.O.I.S.T. describes a concept for the topical treatment of chronic wounds, but it may also be applicable to other wound phenotypes besides chronic wounds. While there have been recent movements to adopt the term 'hard-to-heal' wounds instead of 'chronic' wounds, we will use the term chronic wounds in this article.

An international and multidisciplinary expert panel created the M.O.I.S.T. concept on behalf of WundDACH, the umbrella organisation of the wound care societies in German-speaking countries (Dissemond et al, 2017). The expert panel identified an opportunity to develop an educational tool that could be applied widely in clinical practice to help healthcare professionals (HCPs) systematically plan and deliver topical management for different types of chronic wounds, using the most recent technological advances. The M.O.I.S.T. concept evolved from the refinement of another concept for the topical management of chronic wounds known as T.I.M.E. and was first published in 2003 (Schultz et al, 2003).

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Box 1. From T.I.M.E. to M.O.I.S.T. (Dissemond et al, 2017).

T: Tissue	M: Moisture balance
I: Infection and inflammation	O: Oxygen balance
M: Moisture balance	I: Infection control
E: Edge of the wound	S: Supporting strategies
	T: Tissue management

The factors of the T.I.M.E. concept designated by 'T', 'I', and 'M' were deemed to be still highly applicable and important. They were, therefore, included, albeit slightly modified, in the M.O.I.S.T. concept.

The letter 'E' of the T.I.M.E. concept originally stood for epidermis and subsequently for edge (wound margins) (Schultz et al, 2003; 2004), and comprised very different concepts aimed at wound-bed preparation and promotion of re-epithelialisation, such as debridement, skin grafts, and biological wound therapies.
In the M.O.I.S.T. concept, 'E' has now been replaced by the letters 'O' for oxygen balance and 'S' for supporting strategies, thus allowing for the inclusion of new treatment options for targeted therapy in a much more differentiated fashion.

M.O.I.S.T. extends beyond the T.I.M.E. concept (Schultz et al, 2003; 2004) by taking into consideration the many novel therapeutic options that have become available since the T.I.M.E. concept was first introduced, specifically therapeutic interventions that help to restore oxygen balance in hypoxic wounds and therapies (supporting strategies) that have a bio-physiological effect on the wound healing process [Box 1].

Each letter of M.O.I.S.T. describes an element of topical chronic wound management (Dissemond et al, 2017):

- **Moisture balance** — Exudate is vital to support wound healing, but too little or too much moisture in the wound can inhibit or delay healing (WUWHS, 2019). Accordingly, dry wounds require the addition of moisture, whereas wounds with excessive exudate will benefit from products that absorb and retain moisture away from the wound bed.
- **Oxygen balance** — Oxygen aids the body's metabolic processes, including wound healing, and hypoxia is known to play a critical role in wound chronicity (Schreml et al, 2010). If measures such as surgical revascularisation fail to adequately address hypoxia, then topical oxygen therapy options, which received Grade 1B recommendation from Gottrup et al (2017) - such as haemoglobin spray, higher cyclical pressure oxygen, low constant pressure oxygen in a contained chamber — to restore oxygen balance can be considered. Hyperbaric oxygen therapy is primarily a systemic therapy rather than a topical therapy. In the absence of topical oxygen therapy or devices, an indirect treatment, such as hyperbaric oxygen therapy may be considered to treat localised chronic hypoxia (Gottrup et al, 2017).
- **Infection control** — Infection of chronic wounds is a common risk with potentially severe complications if not managed and treated sufficiently. It is associated with additional pain, discomfort, delayed healing and hospital admittance. Infection control aims to modulate the signs and symptoms of local, systemic and spreading infection. To prevent or treat local infections, eradicate multi-resistant pathogens (MRPs) and support antimicrobial stewardship practices, the use of topical antimicrobials (e.g. polyhexanide and octenidine) or wound dressings with antimicrobial effects (e.g. those containing silver and, honey) or non-antimicrobials (e.g. dialkyl carbamoyl chloride, Poloxamer 188) are commonly used in the topical treatment of chronic wounds (Dissemond et al, 2014). Likewise, to reduce bioburden in the wound bed, anti-biofilm strategies should be multimodal, including regular cleansing, debridement and antimicrobial dressings (WUWHS, 2016).
- **Supporting strategies** — When chronic wounds do not heal as expected, strategies to rebalance the environment may be beneficial to move the wound to a healing trajectory. A range of local advanced therapeutic choices are available to stimulate healing, e.g. modulating and decreasing excessive metalloproteinases (MMPs; Eming et al, 2014), optimising pH conditions (Schneider et al, 2007), applying (and subsequently protecting) growth factors (Eming et al, 2014), controlling pro-inflammatory mediators (e.g. with collagen dressings; El Masry et al, 2019) and local stem cell therapy (Sharma et al, 2020).
- **Tissue management** — Tissue management describes all measures involved in wound bed preparation. Cleansing (e.g. with solutions

containing hypochlorous acid; Dissemond, 2020) and preparing the wound bed by removing non-viable tissue (e.g. slough, eschar, necrotic tissue) and bacteria can be achieved through different types of debridement (e.g. autolytic, biosurgical, surgical, enzymatic, mechanical; Manna et al, 2022). The use of adjuvant therapies, such as negative pressure wound therapy (NPWT), electrical stimulation and ultrasound can have beneficial effects on debridement and wound cleansing, as well as on granulation tissue formation and re-epithelialisation (Dissemond et al, 2014).

How HEIDI will aid clinicians in understanding the patient and the wound before implementing M.O.I.S.T.

M.O.I.S.T. provides best practice principles for HCPs to feel more confident in their decision-making for the topical management of chronic wounds. In order to provide effective wound management, it is essential that clinicians have a comprehensive understanding of what they're dealing with. Wound assessment is complex and requires a range of clinical skills and knowledge. Wound assessments need to be thorough, systematic and evidence-based.

To facilitate the appropriate application of M.O.I.S.T. the Mölnlycke Asia–Pacific Chronic Wound Management Advisory Board advocates for clinicians to utilise an assessment tool such as the mnemonic HEIDI: History, Examination, Investigation, Diagnosis and Implementation. HEIDI can be used to assist clinicians in taking a systematic and holistic approach to wound assessment. M.O.I.S.T. works well with HEIDI as it can be implemented within the examination section. We provide a brief description of HEIDI, however, a detailed explanation of HEIDI has been published previously (Harding, et al 2007). Of note, another useful resource for wound assessment can be found in the World Union of Wound Healing Societies, Advances in Woundcare: The triangle of wound assessment (WUWHS, 2016).

- **History** — The primary aim of completing a thorough history is to identify and correct the aetiologic factors behind the wound. A comprehensive history of the patient's medical background, previous laboratory tests or consultations regarding the wound, and current or previous medications can all help to build a picture of the individual presenting with a wound. Clinicians can also assist in determining the underlying mechanisms of the wound, such as pressure, trauma, surgical, or idiopathic.
- **Examination** — Examining wounds is essentially a clinical skill that involves the use of senses: touch, feel, palpate, smell, observe and listen. Movement at joints, assessing for deformity, foot and leg pulses, temperature, smelling for malodour, and visual observations of erythema or poor tissue quality (dark, pale) are some examples.
- **Investigations** — Clinical observations frequently necessitate additional evaluations to investigate clinical suspicion and/or rule out differential diagnoses. For example, full blood count, erythrocyte sedimentation rate, autoantibodies, urea and electrolytes, liver function tests, C-reactive protein test, wound swab, tissue biopsy or curettage, radiology imaging (X-ray, magnetic resonance imaging, computerised tomography (CT)), vascular sonography, ankle-brachial index, toe-brachial index, toe pressures, duplex, CT angiography, transcutaneous oximetry ($TcPO_2$) and skin perfusion pressures.
- **Diagnosis** — The combination of history, examination and investigations provide clinicians with the necessary information to provide a diagnosis on the aetiology of the wound. In the lower extremity, for example, common wound aetiologies include (but are not limited to) leg ulcers (venous, arterial and mixed).
- **Implementation** — All the indicators from a systematic assessment are used to implement any required interventions which are not delivered by the local or topical management of wounds = M.O.I.S.T. As an example, a patient history may reveal that the patient suffers from a large vessel or macrovascular problem, such as heart disease. Examination of the wound and peripheral skin identifies features suggestive of poor perfusion, prompting the clinician to request some arterial studies. These studies confirm the presence of peripheral arterial disease and more advanced studies suggest that, as an implementation action, this wound requires revascularisation.

The same process can be used for someone who has been prescribed compression therapy for chronic venous insufficiency, antibiotics for wound infection and offloading to address increased plantar pressure or friction.

To avoid confusion, these factors are implemented as systemic measures under HEIDI, rather than topically as with M.O.I.S.T. We have provided a clinical scenario to aid in the

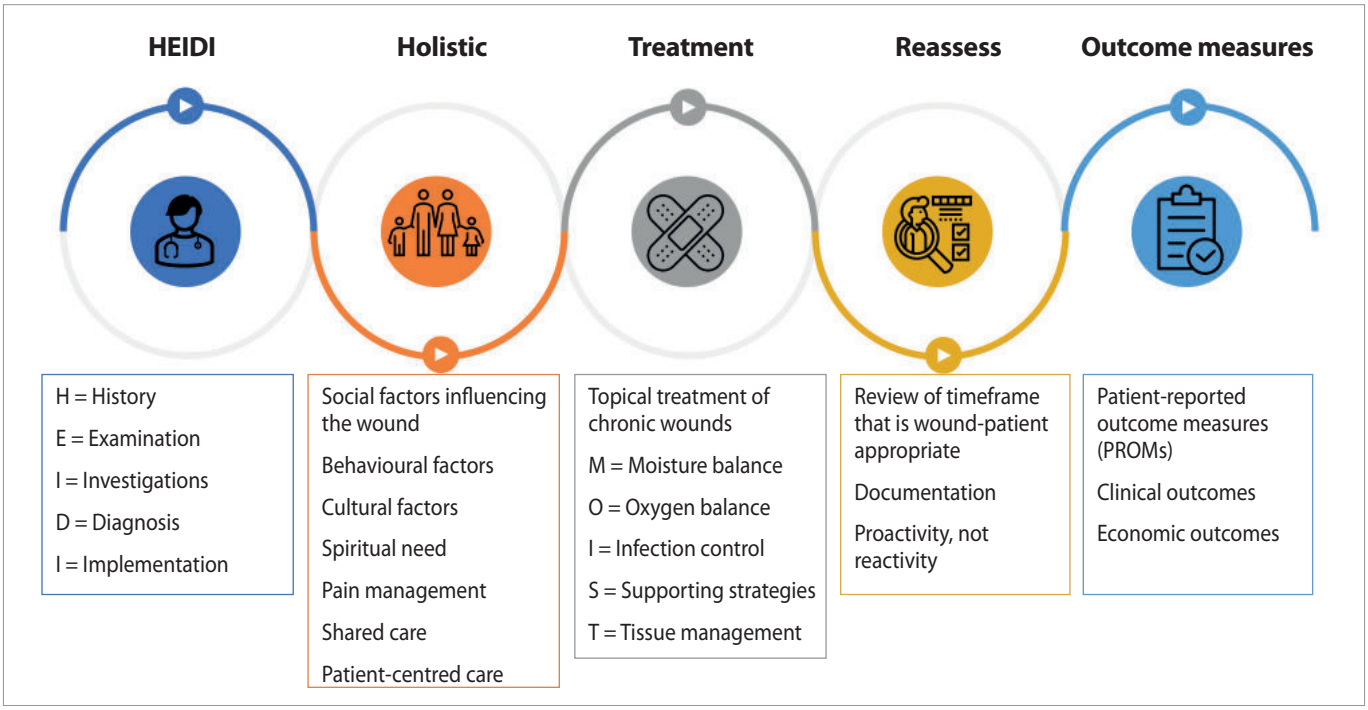

Figure 1. *How local wound therapy (i.e. M.O.I.S.T.) can be integrated into complete holistic wound care (figure courtesy of and adapted from Matthew Malone).*

understanding of HEIDI and how it supports the M.O.I.S.T. concept (Refer to clinical application of HEIDI and M.O.I.S.T. — Case illustration).

M.O.I.S.T. as part of holistic wound management

The M.O.I.S.T concept should be applied after a full patient assessment and in conjunction with other therapeutic interventions to manage underlying wound pathologies, such as compression therapy (for venous leg ulcers) and offloading for DFUs and PUs. M.O.I.S.T. should be embedded as part of a holistic approach to wound management that recognises the importance of patient-centred care, appropriately supported self-management, re-assessment and frequent review of outcome measures. See Figure 1 for how M.O.I.S.T. can be integrated into holistic wound care using the HEIDI holistic wound care approach (Harding et al 2007).

The elements of M.O.I.S.T. are not intended to be reviewed in order, such as first reviewing the moisture balance, then the oxygen balance, and so on; instead, the elements should be considered in the order determined by the HCP to be the most appropriate *[Figure 2]*.

M.O.I.S.T. — based considerations for the topical management of chronic wounds

To apply the M.O.I.S.T. concept in clinical practise, a holistic assessment of the patient is required to diagnose the wound aetiology

Figure 2. *The patient is at the centre of the M.O.I.S.T. concept. The outer circle's 'supporting therapies' are other therapeutic options that are primarily used to treat the cause of the chronic wound, such as compression therapy for venous leg ulcer management and off-loading for diabetic foot ulcers.*

and identify the patient factors impacting the wound. The assessment results will direct the HCP to use evidence-based practice to address the underlying cause of the wound (e.g. diabetes, venous disease, arterial disease) in addition to topical wound management.

The M.O.I.S.T. concept can help HCPs to identify suitable management goals and treatment options for individual patients *[Table 1* and *Figure 3]*. M.O.I.S.T. treatment recommendations should be adaptable to account for local and regional variations in product availability. Treatment strategies

Table 1. Topical wound therapy recommendations in accordance with the M.O.I.S.T. concept.

	Goal and wound assessment considerations	Topical wound therapy options aligned with evidence-based practice[2]	Outcome measurement
M = Moisture balance	**GOAL**: To create a balanced moist and healing environment **Assessment** includes identification of the cause of the low or high moisture level (e.g. venous disease, lymphatic disease); moisture level, type, colour and consistency, and odour; effectiveness of current exudate management dressing/device (WUWHS, 2019) **Resources:** WUWHS Consensus Document: Wound exudate, effective assessment and management (WUWHS, 2019).	Consider a primary dressing based on the wound moisture level[3] (Eriksson et al, 2022): ■ Dry: hydrogel dressings, semi-permeable films ■ Low: hydrogel dressings, semi-permeable films, foams ■ Moderate: foams, alginates, fibres, SAP dressings, ■ High: foams, fibres, SAP dressings, NPWT. A secondary dressing may be required for moisture balance in moderate to highly exuding wounds Consistency of the exudate: ■ Viscous: opaque, discoloured and thick exudate require dressing with large pores or open cells ■ Non-viscous: clear and thin exudate require dressings with smaller pores. If the perforations or cells in the dressing wound contact layer are too small, they become clogged because viscous exudate is unable to pass through them.	Define individual outcomes and expectations at the start of treatment and reassess throughout treatment as expectations may change. **Patient-related outcomes:** ■ e.g. factors that impact the quality of life, such as treatment satisfaction, comfort, pain. **Clinical outcomes:** ■ e.g. maintenance of moist wound bed, wound closure, wound size and/or volume reduction, and increased granulation tissue formation. ■ Use of validated clinical rating tools: e.g. TILI score (Dissemond et al, 2020a; 2020b) for infection (validated for LUs).
O = Oxygen balance	**GOAL**: To improve tissue perfusion and local oxygenation at the wound bed **Assessment** involves assessing the local and limb oxygenation via skin temperature, sensation, colour, pulse, condition, pain, wound condition after debridement. To measure local or limb oxygenation, use pulse palpation or $TcPO_2$ (Gottrup et al, 2017) NOTE: Before considering local therapy, the arterial/vascular condition must be determined. Local oxygen therapy will not be effective if there is underlying arterial disease. Use tests to assess systemic vascular statuses, such as ABI or TBI, to exclude patients who need other specialist vascular diagnostics: - ABI below 0.9 should be referred to a vascular specialist - ABI below 0.5 indicates high risk of CLI **Resources:** Use of Oxygen Therapies in Wound Healing (Gottrup et al, 2017).	Refer for vascular assessment and/or intervention if arterial disease is suspected After the arterial disease is discounted and/or addressed, consider topical oxygen therapy after adequate debridement. Topical oxygen therapy can be delivered to the wound by a range of modalities (Gottrup et al, 2017): ■ Continuous delivery of oxygen ■ Low constant pressure oxygen in a contained chamber ■ Higher cyclical pressure oxygen ■ Oxygen released through dressing or gel ■ Oxygen transfer via haemoglobin ■ Application of oxygen species. Hyperbaric oxygen treatment is primarily a systemic therapy, not a topical therapy. If topical oxygen therapy or devices are not available, indirect treatment, such as hyperbaric oxygen therapy may be considered to restore localised chronic hypoxia (Gottrup et al, 2017).	

may fall into one or more of the categories under the M.O.I.S.T concept (e.g. NPWT may be classified under 'M.' and 'T.'). The recommendations should also be simple for generalists (e.g. doctors, nurses and allied healthcare professionals) to understand. In some circumstances, wounds will not heal no matter what interventions are used, such as gangrenous toes or wounds in people receiving end-of-life care. In this case, some but not all elements of M.O.I.S.T. may still be suitable.

Mölnlycke Asia–Pacific Chronic Wound Management Advisory Board

The Mölnlycke Asia–Pacific Chronic Wound Management Advisory Board is a regional initiative to consolidate expert opinions and resources in chronic wound management, and translate clinical evidence into practice, with the ultimate goal of improving the delivery of care and wound outcomes. The advisory board, which includes countries from the Asia-Pacific region and wound specialists, has the following goals for the future:

Table 1. Topical wound therapy recommendations in accordance with the M.O.I.S.T. concept *(Continued)*.

	Goal and wound assessment considerations	Topical wound therapy options aligned with evidence-based practice[2]	Outcome measurement
I = Infection control	**GOAL**: To avoid wound infection **Assessment of wound infection** ■ Local infection (covert and subtle) ■ Local infection (overt and classic) ■ Spreading infection ■ Systemic infection ■ What type of infection behaviour is evident, acute or chronic? Consider using a validated standardised scoring system for local infection, e.g. TILI score (Dissemond et al, 2020a; 2020b) and DFI Wound Score (Lipsky et al, 2009). **Resources:** IIWI: Wound Infection in Clinical Practice: Principles of best practice (Swanson et al, 2022) Guidelines on the diagnosis and treatment of foot infection in persons with diabetes (IWGDF 2019 update) (Lipsky et al, 2020).	Follow wound hygiene principles, including regular cleansing and debriding, which is essential for overt and covert infection control (Wilcox et al, 2018). Use topical antimicrobial products according to antimicrobial stewardship principles and as per local protocol and official national and international guidelines, e.g. antiseptics, such as honey, iodophors, PHMB and silver, and surfactants, such as DACC, among others (Kramer et al, 2018; IWII, 2022).	Define individual outcomes and expectations at the start of treatment and reassess throughout treatment as expectations may change **Patient-related outcomes:** ■ e.g. factors that impact the quality of life, such as treatment satisfaction, comfort, pain. **Clinical outcomes:** ■ e.g. maintenance of moist wound bed, wound closure, wound size and/or volume reduction, and increased granulation tissue formation ■ Use of validated clinical rating tools: e.g. TILI score (Dissemond et al, 2020a; 2020b) for infection (validated for LUs).
S = Supporting strategies	**GOAL**: To create a supportive wound environment to stimulate healing. **Assessment:** Review wound progression and wound healing assessments, e.g. Pressure Ulcer Scale for Healing (PUSH) (Ratliff and Rodeheaver, 2005)[1]. **Resources:** Challenges in the Treatment of Chronic Wounds (Frykberg and Banks, 2015).	Consider selecting a supporting therapy that might help to modulate the wound bed environment, e.g. control and modulate MMPs, pH, growth factors, and pro-inflammatory mediators. e.g. growth factors, topical wound scaffolds, local stem cell therapy.	
T = Tissue management	**Goal:** To remove devitalised tissue and debris. To form healthy granulation and epithelial tissue. **Assessment:** Visually and objectively assess the wound bed tissue using a tool (e.g. Bates-Jensen wound assessment tool; Harris et al, 2010), or use a photo-analysing tool. **Ressources:** EWMA document: Debridement (Strohal et al, 2013).	Cleanse and debride the wound bed: The method and products used for cleansing and debriding should depend on the clinician's competency, the treatment setting and patient acceptance (Strohal et al, 2013). Methods of debridement include autolytic, biological, mechanical, sharp, surgical and enzymatic debridement. Application of a dressing or device (e.g. NPWT) that supports a wound healing environment.	

ABI: ankle-brachial index; CLI: chronic limb ischaemia; DACC: dialkyl carbamoyl chloride; DFI: diabetic foot infection; LUs: leg ulcers; MMPs: matrix metalloproteinases; NPWT: negative pressure wound therapy; PHMB: polyhexamethylene biguanide; SAP: superabsorbent polymer; TBI: toe-bachial index; TILI: Therapeutic Index for Local Infections.

[1] In some circumstances, wounds will not heal no matter what interventions are used, such as gangrenous toes or wounds in people at end-of-life care. In this case, some but not all elements of M.O.I.S.T. may still be suitable.

[2] Treatment strategies may fall under one or more categories under the M.O.I.S.T. concept (e.g. NPWT may be classified under M and T)

[3] For wound moisture level, refer to WUWHS Consensus Document: Wound Exudate, Effective Assessment and Management (WUWHS, 2019)

[4] Not recommended for wounds when revascularisation is not possible, e.g. dry eschar, diabetic foot with poor arterial supply, among others (Hedger, 2013).

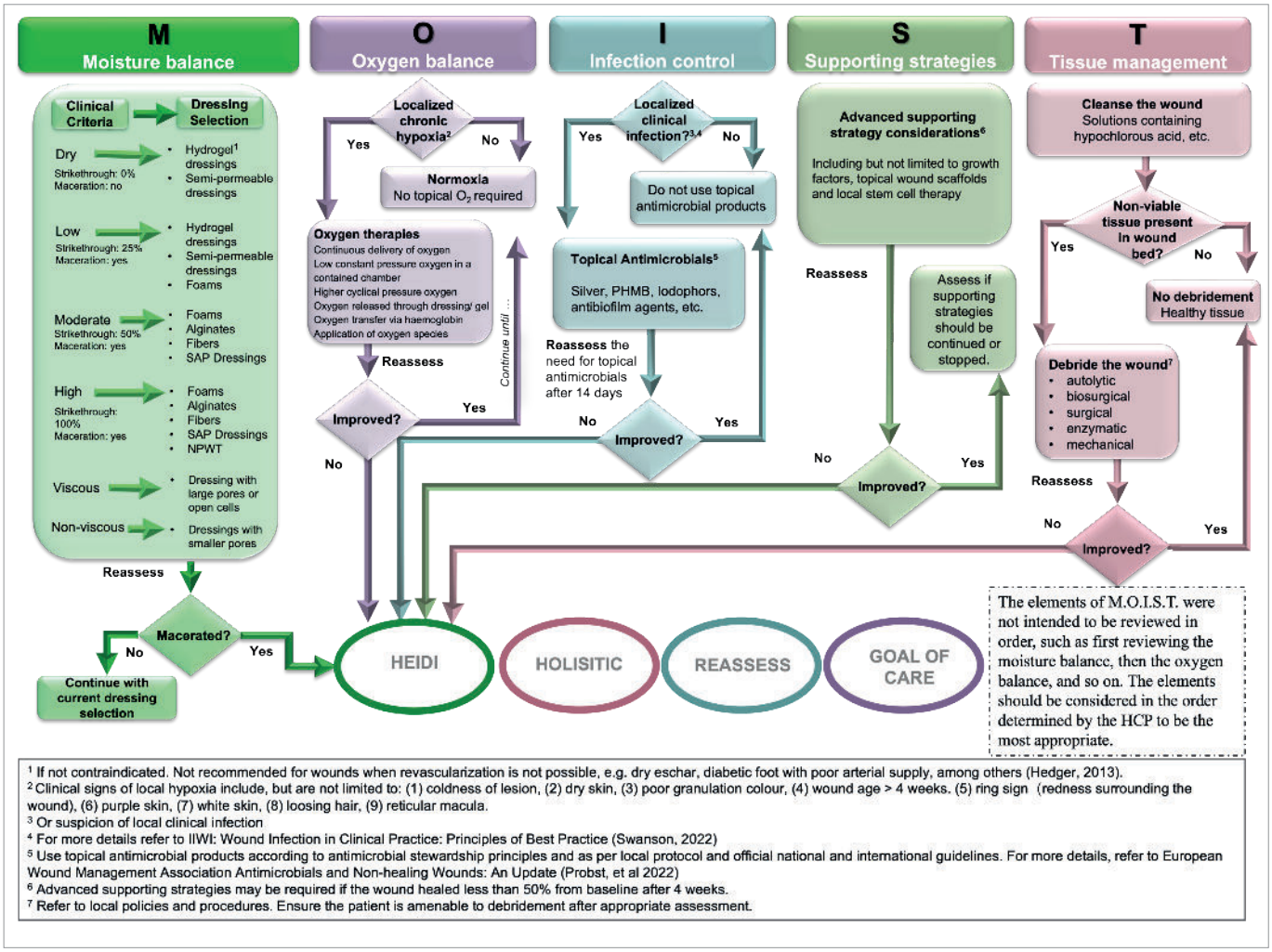

Figure 3. Treatment algorithm in accordance with the M.O.I.S.T. concept

- To identify the gaps and challenges in chronic wound management
- To recognise ways of improving clinical and economic outcomes by implementing treatment guidelines from research and consensus in chronic wound management
- To develop practical, easy-to-use, evidence-based treatment recommendations based on the M.O.I.S.T. educational tool for generalists and wound care specialists.

The advisory board convened online to identify gaps and challenges in chronic wound management and to develop practical, easy-to-use, evidence-based treatment recommendations based on the M.O.I.S.T. educational tool. The meeting was chaired by Professor Joachim Dissemond, and members of the advisory board were invited to share their experiences and expertise in wound care.

Gaps and challenges in chronic wound management in the APAC region

The advisory board identified some of the gaps and challenges they face in wound care as follows:

Research and knowledge challenges:

- Lack of bedside diagnostic tools (e.g. to measure oxygen levels at the wound bed or MMPs)
- Lack of evidence for treatment options to standardise care internationally
- Too much focus on local wound therapy rather than on a holistic approach to wound care
- Insufficient knowledge base of staff and minimal wound care-related training and education.

Patient and wound challenges:

- Patient knowledge and varying tolerance to treatment
- Sensitivity to cultural and spiritual needs
- Shared decision-making and shared care between HCPs and patients/informal caregivers
- Chronic infection.

Environmental challenges:

- Climate, for example, compression can be difficult to encourage and be tolerated by patients
- Patient setting.

Organisational challenges:

- Lack of access to primary care
- Lack of (or delayed) access to wound care specialists in rural and remote areas
- Lack of access to podiatric medicine in most countries in Asia
- Insufficient policies, procedures, and protocols in healthcare organisations
- Reimbursement issues
- Geographical variations in access to certain wound products or products without regulatory approval.

By overcoming these obstacles, it is hoped that health-related quality of life will improve, complications will be minimised, the cost burden of chronic wounds will be reduced and treatment for people with wounds will be optimised.

Next steps

The next steps will involve integrating the M.O.I.S.T. concept into wound care pathways. This can be achieved through a range of approaches, such as educational platforms/tools/webinars, workshops and congresses and seminars, flyers and posters for institutions/patients, product classification/labelling to facilitate product selections, practical implementation/training for HCPs and integration into electronic devices/apps and recording systems.

Evidence of the practical implementation of M.O.I.S.T. will help illustrate the role that the concept can have as part of a holistic wound care approach. This could be obtained by undertaking clinical case studies or multicenter clinical trials. The incorporation of M.O.I.S.T. into clinical case studies/guidelines should also be a key objective.

Conclusion

Wound care can vary according to region based on healthcare systems. The M.O.I.S.T. -based treatment recommendations are a step towards consistent care for local wound therapy that can be implemented alongside existing protocols and guidelines.

Figure 4. Clinical scenario of applying HEIDI and M.O.I.S.T in a patient with a foot ulcer.

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HEIDI and M.O.I.S.T. in clinical practice - A case study

H History

A 69-year-old male presented with a lateral ulcer on his right foot, see Figure 4. The patient recalls it began as a rub from footwear and at the time of referral had been present for 3 weeks. At first, it was a small blister that popped, but the lesion gradually increased in size, became wet and had a malodour. The patient sought treatment from his primary care physician, who prescribed cephalexin 500 mg twice daily, but this had no effect. The patient was then referred to a wound care specialist.

Medical background: Type 2 diabetes mellitus, suboptimal glycemic control ((HbA1C) level of 9.6%), peripheral neuropathy, retinopathy, nephropathy, hypertension, polymyalgia rheumatica, non-smoker and alcohol consumption (3 times weekly, 5 units).

Medications: Rosuvastatin 10 mg once daily, methotrexate 25 mg/week, metformin 1000 mg once daily. No known allergies.

Social: The patient lived in his own home with his wife, was semi-retired. The patient was well-informed about his current medical situation.

E Examination

When compared to the non-affected foot, the foot and extremities were cool to the touch, but the wound periphery was warm. There was hair loss in the distal third of the leg, and the skin was thin and atrophic to the touch. The patient reported no wound pain but did experience cramps in his calves while walking short distances.

The wound was non-stageable, but there was suspicion of deeper involvement due to the presence of dark, non-viable tissue. The wound was malodorous, there was erythema extending from the wound for more than 2 cm, and there was a high suspicion of local infection. A Buerger's test was performed to rule out reactive hyperaemia, and it came back positive. As a result, an increase in blood flow after arterial occlusion could not be excluded.

Foot pulses were palpated and both dorsalis pedis and posterior tibial pulses were absent. A popliteal pulse was palpated.

I Investigations

Clinical suspicion of an arterial component to the wound

At the initial presentation in the outpatient clinic, simple ABIs, TBIs, and toe pressures were performed. ABI was 0.3, TBI was 0.3, and toe pressure was 39 mmHg. Suspicion of arterial/vascular disease with potential limb ischemia warranted urgent vascular studies, and the patient was admitted for a CT angiogram per vascular surgery advice. The CT angiogram revealed moderate to severe atherosclerotic changes in the right below-the-knee arteries, as well as several small stenoses but no occlusions. There were three runoff vessels, but there was poor flow below the knee into the calf and foot.

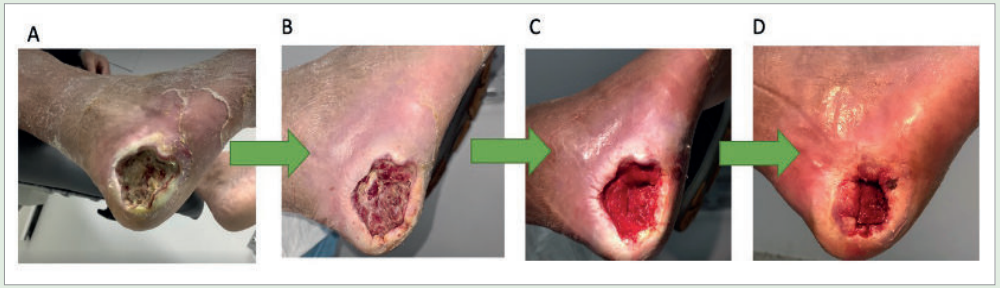

Figure 5. (A) First post-discharge appointment, (B) 4 week post-discharge, (C) 6 weeks after post-discharge and (D) 10 weeks post-discharge.

Clinical suspicion of local wound infection

TThe wound demonstrated features suggestive of wound infection. The investigations included a full blood count to include white cell count and inflammatory markers (C-reactive protein and erythrocyte sedimentation rate, renal profile (urea, electrolytes and creatinine, and liver function tests) and glycaemic control (HbA1C). A baseline X-ray was performed to rule out osseous involvement and a tissue biopsy was obtained and sent for microbiology, culture and sensitivity.

D Diagnosis

A diagnosis of a neuroischemic DFU was made with the initial mechanism of injury being rubbing (frictional force) from a poorly fitting shoe. The patient's ischemic status was further scored according to the Wound, Ischemia, and foot Infection (WIfI) classification as Ischemia Grade 3. The patient was further diagnosed with a presenting skin and soft tissue diabetes foot infection. The infection severity was classified using the perfusion, extent, depth, infection and sensation (PEDIS) classification system by the International Working Group for the Diabetic Foot - Diabetic Foot Infection Guidelines as PEDIS grade 3 (moderate). Imaging did not identify any features suggestive of osteomyelitis.

I Implementation

The patient was admitted for revascularisation and underwent a right lower limb percutaneous transluminal angioplasty with a stent. The patient was commenced on intravenous piperacillin and tazobactam 13.5 g daily and following revascularisation underwent surgical debridement for source control. Tissue cultures identified the presence of Gram-negative rods and Pseudomonas aeruginosa. Upon discharge after 14 days, the patient was de-escalated to oral amoxicillin and clavulanic acid (875/125 mg twice daily) and ciprofloxacin (500 mg twice daily).

Now we understand the aetiology of the wound. How do we apply M.O.I.S.T. work in clinical practice?

Figure 5A represents the patient's first post-discharge appointment.

The M.O.I.S.T. concept was utilised to assist in the systematic planning of the topical treatment of this wound. M.O.I.S.T. was applied in the following order of perceived clinical importance.

- **T Tissue** - Despite surgical debridement, there is significant non-viable pale tissue in the wound cavity, and the presence of malodour. To maintain source control, conservative debridement and the removal of as much non-viable tissue as possible were required. The cavity was then cleaned with a topical hypochlorous acid irrigation solution (Granudaycn®).
- **I Infection** - The infection was healing, but more source control was needed, so the cavity was packed with topical antimicrobial silver gelling fibre (Exufiber® Ag+) to reduce the microbial burden, manage 'dead space,' and control excessive exudate.
- **O Oxygen balance** - The appearance of the wound and the presence of ischemia made it highly likely that the wound was potentially affected by hypoxia. However, it was believed at the time that any topical oxygen would fail until source control was achieved. In picture A, no oxygen was used.
- **M Moisture balance** - The wound has excessive amount of viscous exudate. Within the clinic, the only option was to use a super absorber (Mextra®).
- **S Supporting therapies** - No supporting therapies required.

Picture 5B represents 4 weeks post-discharge.

- **M Moisture balance** - Wound is still highly exuding; continue using super absorber
- **O Oxygen balance** - Wound source control has been achieved but wound size remains significant with minimal healing. Suspicion of wound chronic hypoxia, commence topical oxygen therapy (Granulox®)
- **I Infection** - Infection resolved. Stop all topical antimicrobials
- **S Supporting therapies** - No supporting therapies required
- **T Tissue** - Wound debridement for maintenance via curettage to remove non-viable tissue and wound bed cleansing with topical hypochlorous acid irrigation solution (Granudaycn®).

Picture 5C represents 2 weeks after commencement with topical oxygen therapy.

- **M Moisture balance** - Wound is moderately exuding so downgrade to a flexible 5-layer foam dressing (Mepilex® Border Flex)
- **O Oxygen balance** - No reduction in wound size but much healthier granulation tissue, continue topical oxygen therapy (Granulox®) but review wound metrics in 2 weeks
- **I Infection** - No topical antimicrobials are required
- **S** Supporting therapies - No supporting therapies required
- **T Tissue** - No debridement was required, but wound bed cleansing with topical hypochlorous acid irrigation solution (Granudaycn®) was continued.

Picture 5D represents 12 weeks after commencement with topical oxygen therapy.

- **M Moisture balance** - Wound is moderately exuding; continue flexible 5-layer foam dressing (Mepilex border flex)
- **O Oxygen balance** - 50% reduction in wound size, healthier granulation tissue, slow progress in healing rate, and decision to continue topical oxygen therapy beyond standard timeframes due to known history of severe arterial disease
- **I Infection** - No topical antimicrobials are required
- **S Supporting therapies** - No supporting therapies
- **T Tissue** - Continue with wound bed cleansing with topical hypochlorous acid irrigation solution (Granudaycn®).

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