

# GUIDELINES FOR THE USE OF TOPICAL OXYGEN THERAPY IN THE TREATMENT OF HARD-TO-HEAL WOUNDS BASED ON A DELPHI CONSENSUS

**A** growing body of evidence supports the use of topical oxygen therapy (TOT) in the treatment of diabetic foot ulcers (DFUs). Anecdotal evidence suggests that topical oxygen may be effective in the treatment of other wound types. In May 2021, leaders in the field of wound healing from across the US assembled in New Orleans. In one of the interactive sessions, several physicians reviewed and discussed the evidence for TOT, and attendees shared their experiences in treating patients with TOT. The conference highlighted the need for a consensus document for the use of topical oxygen in patients with hard-to-heal wounds. Subsequently, a Delphi method was employed to establish consensus guidelines for prescribing TOT. A multidisciplinary panel of 23 wound experts (15 wound specialists, six vascular surgeons, one plastic surgeon, one critical care provider and one PhD researcher) participated in two rounds of questionnaires. The Delphi survey questions focused on the indications for topical oxygen, when to prescribe the therapy, pretreatment work-up, visit frequency and length of therapy. A clinical workflow algorithm was also included as part of the Delphi. After two rounds, the Delphi participants were able to reach a consensus of >77% on when to prescribe topical oxygen, the wound types that may benefit from the therapy, pretreatment wound preparation, work-up and length of therapy. The goal of the guidelines is to standardise the use of topical oxygen and inform further research efforts.

Millions worldwide suffer for weeks, months or years with hard-to-heal wounds that fail to heal despite advances in wound care.<sup>1</sup> The US Wound

Registry reports that less than 50% of wounds are healed at 12 weeks.<sup>2</sup> The annual cost of caring for the rising numbers of patients afflicted with wounds approaches 100 billion dollars in the US.<sup>3</sup> The search for technology that promotes wound healing continues.

In the last four years, three randomised controlled clinical trials (RCTs) have demonstrated the efficacy of TOT in promoting wound healing in hard-to-heal DFUs.<sup>4-6</sup> In addition, a 2021 systemic review and meta-analysis of these RCTs, involving 530 participants, concluded that 'TOT significantly increased the likelihood of ulcer healing compared to controls.'<sup>7</sup> This evidence was discussed and debated at a recent Leaders in Wound Healing conference (May 2021, as reported in the current issue of the *Journal of Wound Care*). The wound experts recommended that clinicians consider this technology in the treatment of DFUs. Anticipating the increased interest in the use of TOT, it was suggested that a group of experts draft a consensus document to guide its use, including an algorithm for clinicians to follow when prescribing TOT.

## Methods

The Delphi method is an accepted technique for establishing expert consensus on a given topic. The iterative process entails several rounds of anonymous questionnaires aimed at reaching agreement of greater than 70% among a group of experts.<sup>8</sup> Previous use of the Delphi technique in wound healing included negative pressure wound therapy (NPWT)<sup>9</sup> and clinical trial design.<sup>10</sup> The Delphi process allows a diverse group of clinicians to express their opinions anonymously.

The Delphi expert panel consisted of attendees of the Leadership in Wound Healing conference held in person in New Orleans in May 2021. Thirty-five wound care experts, who attended the conference, were invited to participate in the Delphi. Twenty-three chose to do so. The consensus was sponsored by the Cambridge, US-based, not-for-profit SerenaGroup Research Foundation—an organisation dedicated to advancing the science of wound healing. Participants were present during the TOT educational session; therefore, they were familiar with TOT technology and the evidence supporting its use. In addition, they understood the goals of the Delphi. The authors developed the consensus statements and created the clinical algorithm. All the authors have had extensive experience with TOT.

Round one of the Delphi consisted of 49 questions and statements drafted by the authors and based on published evidence for TOT as well as the authors' experience with the technology. In round one, the experts provided basic information on licensure, years in the practice of wound care and experience with TOT. Specific questions focused on prescribing TOT: what patient comorbidities increase the need for TOT; what wound types benefit from TOT; the work-up and procedures required prior to prescribing TOT; the stage of healing at which TOT should be ordered; the frequency of patient visits for patients receiving TOT; and the length of treatment. Experts answered using a 4-point Likert scale ranging from 'strongly agree' to 'strongly disagree'. In addition, the respondents were invited to comment on the questions during round one. Experts were also asked to comment on a TOT clinical algorithm. Responses with less than 70% consensus were eliminated or restated prior to inclusion in round two.

Eighteen of the original 23 respondents (78%) participated in round two of the Delphi. The second round consisted of 14 statements and a second review of the clinical algorithm. Only statements with greater than 70% agreement were included in the final consensus statement.

## Results

Twenty-three experts in the field of wound healing, chosen at a conference for key opinion leaders, participated in round one of the expert consensus on TOT. Eighteen experts participated in round two. This group contained six vascular surgeons, one plastic surgeon and one critical care physician. Fifteen of the participants identified as wound specialists,

including six podiatric surgeons. One PhD wound healing research scientist also participated.

In round one, ten statements reached consensus with agreement greater than 70%. An additional eight statements reached consensus following the second round. Several portions of the clinical algorithm failed to achieve consensus in round one. Modifications of the algorithm led to a strong consensus in round two.

### Consensus statements

The following work-up and procedures should be performed and documented prior to ordering TOT:

- Assessment of limb perfusion (e.g., ABI/TBI): consensus 91%
- Clinical assessment of bacterial load: consensus 75%
- Nutritional assessment: consensus 78%
- Debridement: consensus 87%
- Oedema management: consensus 75%
- Offloading (diabetic and pressure ulcers): consensus 96%.

TOT should be considered in the following circumstances:

- Delayed wound healing: consensus 100%
- Failure of prior therapies: consensus 94%
- Ischaemic ulcers (following all efforts to revascularise the affected area): consensus 88%.

Wound types likely to benefit from TOT:

- Diabetic foot ulcers: consensus 94%
- Venous leg ulcers: consensus 77%
- Ischaemic ulcers: consensus 77%
- Patients receiving TOT should be seen at least weekly in the wound clinic: consensus 70%.

How long should patients receive topical oxygen therapy?

- Reassess the wound every 4 weeks and continue TOT as long as the wound is improving: consensus 84%.

### Algorithm

Is this a hard-to-heal wound of 4 weeks' duration that has: healed by less than 40% in 4 weeks; or is refractory to other therapies?

**No:** Continue with present care.

**Yes:** Perform the following before instituting TOT: assess perfusion (e.g., ABI/TBI); assess bacterial burden; assess nutritional status; debride the wound; treat oedema; offload the ulcer; assess pain.

Reevaluate wound healing at 4 weeks: is the wound improving?

**No:** Reassess the reasons for poor wound healing.  
**Yes:** Continue TOT until the wound has healed or goals are achieved.

**Discussion**

Expert consensus documents assist in guiding the use of novel technologies and directing further research. The Delphi approach used in this consensus is a proven method for achieving agreement among

experts. The growing body of clinical trial and real-world evidence demonstrating the effectiveness of TOT in diabetic foot and other wounds supports its incorporation into clinical practice. The expert wound specialists participating in this Delphi have provided guidance for clinicians interested in using TOT in their practice. ■

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