PHYSICIAN REFERRAL GUIDE

CANADA HYPERBARICS

# Hyperbaric Oxygen for Necrotizing Soft Tissue Infections

A referral guide for emergency and referring physicians in Canada.

Condition: **Necrotizing Soft Tissue Infections** Open-access studies: **29** Updated **June 2026**
Reviewed **quarterly**

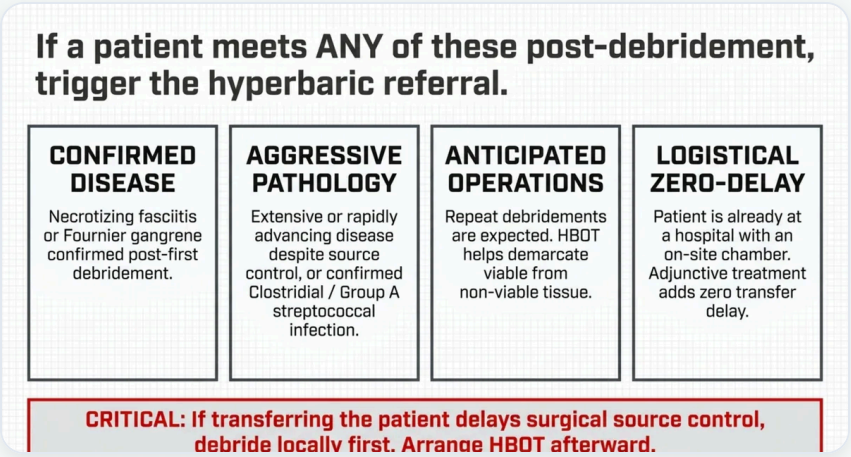
**For referring and emergency physicians in Canada.** Necrotizing soft tissue infections (NSTI), including necrotizing fasciitis and Fournier gangrene, fall under one of the 14 conditions Health Canada recognises for hyperbaric oxygen therapy (HBOT), and HBOT is treated as an emergency adjunct at Canadian hospital-based hyperbaric programmes, covered by provincial health insurance. Hyperbaric oxygen is adjunctive only: it never substitutes for or delays surgical debridement and broad-spectrum antibiotics, which remain the primary, life-saving treatments. This guide summarises when to refer, how to assess the patient before referral, what the evidence supports, the Canadian referral pathway, and contraindications. It closes with the complete list of open-access research published since 2020, each linked to its free full text.

IN THIS GUIDE



## When to refer

Necrotizing soft tissue infection is a surgical emergency. The single most important determinant of survival is the time from presentation to first surgical debridement, so the first action is always to secure source control, not to arrange transfer. Once urgent surgery and antibiotics are under way, refer for hyperbaric assessment when a patient with confirmed or strongly suspected necrotizing infection has any of the following:




FIGURE

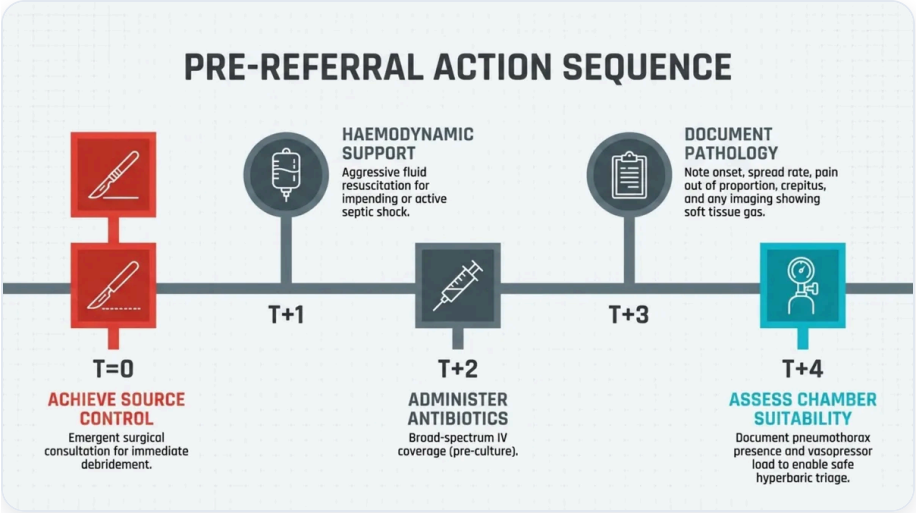
When to refer: once urgent surgery and antibiotics are under way, trigger a hyperbaric referral if the patient has confirmed necrotizing fasciitis or Fournier gangrene after the first debridement, extensive or rapidly advancing disease or a clostridial or Group A streptococcal infection, anticipated repeat debridements, or is already at a hospital with an on-site chamber. If transfer would delay surgical source control, debride locally first and arrange hyperbaric treatment afterward.

- **Confirmed necrotizing fasciitis or Fournier gangrene** after the first debridement, where the hyperbaric team can begin adjunctive treatment within hours of surgery.
- **Extensive or rapidly advancing disease** despite debridement, or a clostridial or Group A streptococcal infection, where toxin suppression and the antibiotic-synergy effect of hyperbaric oxygen are most relevant.
- **Anticipated repeat debridements**, where hyperbaric oxygen may help demarcate viable from non-viable tissue at successive operations.
- **A patient already at a hospital with an on-site chamber**, where adjunctive treatment adds no transfer delay.

Critically, debridement must never be deferred in order to arrange hyperbaric oxygen. If transferring the patient to a hyperbaric facility would delay surgical source control, debride locally first and arrange hyperbaric referral afterward. Hyperbaric oxygen never takes priority over source control.

## Assessing the patient before referral

While arranging surgery and hyperbaric assessment, the receiving emergency department should:




FIGURE

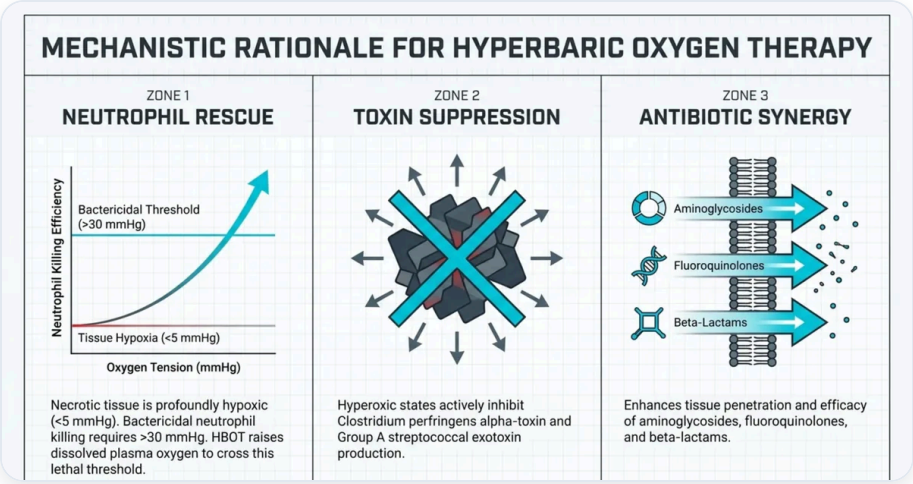
The pre-referral action sequence runs in parallel with the surgical plan. Secure source control first, give aggressive fluid resuscitation and haemodynamic support, start broad-spectrum intravenous antibiotics before culture results, document onset, spread, pain out of proportion to examination, crepitus and any soft-tissue gas, and note factors affecting chamber suitability such as pneumothorax and vasopressor dependence so the hyperbaric team can plan safely around an unstable patient.

- Achieve **source control first**: emergent surgical consultation for debridement is the priority, with hyperbaric referral layered on afterward rather than before.
- Start **broad-spectrum intravenous antibiotics** covering Gram-positive, Gram-negative, and anaerobic organisms without waiting for culture results.
- Provide aggressive **fluid resuscitation and haemodynamic support**, because many patients present in or near septic shock.
- Document the **exposure and progression history**: onset, rate of spread, pain out of proportion to examination findings, crepitus, and any imaging showing gas in soft tissue.
- Note any **factors affecting chamber suitability**, including pneumothorax, the degree of vasopressor dependence, and relevant comorbidities, so the hyperbaric team can plan safely around an unstable patient.

## What the evidence supports

The rationale for hyperbaric oxygen in necrotizing infection is mechanistic and supported by observational data, not by randomised trials, which are ethically infeasible in this rapidly fatal condition. Untreated mortality is high: roughly 20 to

40 percent even with optimal modern care, rising to 50 percent or higher when surgical debridement is delayed beyond 24 hours. This underscores that surgery, not hyperbaric oxygen, drives survival.




**FIGURE**

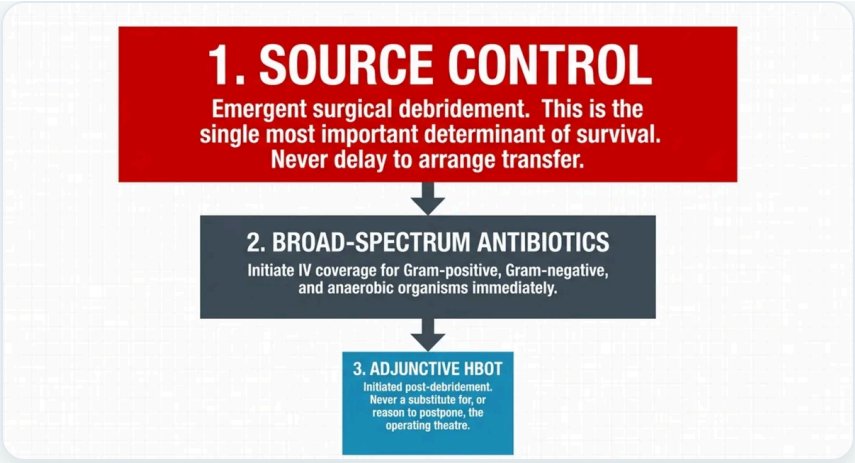
The mechanistic rationale for adjunctive hyperbaric oxygen. Bactericidal neutrophil activity requires a tissue oxygen tension above roughly 30 mmHg, whereas necrotic tissue is profoundly hypoxic, often below 5 mmHg, so raising dissolved plasma oxygen restores oxygen-dependent killing. Hyperbaric oxygen also inhibits clostridial alpha-toxin and Group A streptococcal exotoxin production and enhances the tissue penetration of several antibiotic classes. These are mechanistic and observational findings, not proof from randomised trials, and they position hyperbaric oxygen as an adjunct to prompt surgery and antibiotics.

The mechanistic basis for adjunctive hyperbaric oxygen is well established. Bactericidal neutrophil activity requires a tissue oxygen tension above about 30 mmHg, whereas necrotic tissue is profoundly hypoxic, often below 5 mmHg; raising dissolved plasma oxygen restores oxygen-dependent killing. Hyperbaric oxygen also inhibits Clostridium perfringens alpha-toxin and Group A streptococcal exotoxin production, enhances the tissue penetration of aminoglycosides, fluoroquinolones, and beta-lactams, and helps demarcate viable from non-viable tissue across successive debridements.

Necrotizing infection is recognised as UHMS indication number 9, with a Level B (moderate) evidence rating from controlled studies and clinical data. Observational cohort studies and meta-analyses, including work by Wilkinson and Doolette (2004), Soh (2012), Hedetoft (2021), and Huang (2023), report an association between adjunctive hyperbaric oxygen and reduced mortality and fewer debridement procedures. The observational evidence is not uniform: some cohorts report lower mortality with adjunctive hyperbaric oxygen while others report no difference. Because these are observational data, they show association rather than proof of causation, and they consistently position hyperbaric oxygen as an adjunct to, never a replacement for, prompt surgery and antibiotics.

## ◈ Clinical translation

Debride first, antibiotics second, hyperbaric oxygen third. The benefit of hyperbaric oxygen depends entirely on it being added to timely surgical source control, not on it replacing or postponing surgery. When a patient has had a first debridement and a chamber is reachable without delaying further operative care, the first hyperbaric sessions are typically delivered within hours of surgery at 2.0 to 2.5 ATA on 100 percent oxygen for about 90 minutes, twice daily for the first 24 to 48 hours and then once daily, for a total course of roughly 10 to 30 sessions guided by clinical response. When transfer would delay debridement, source control comes first and hyperbaric oxygen follows.

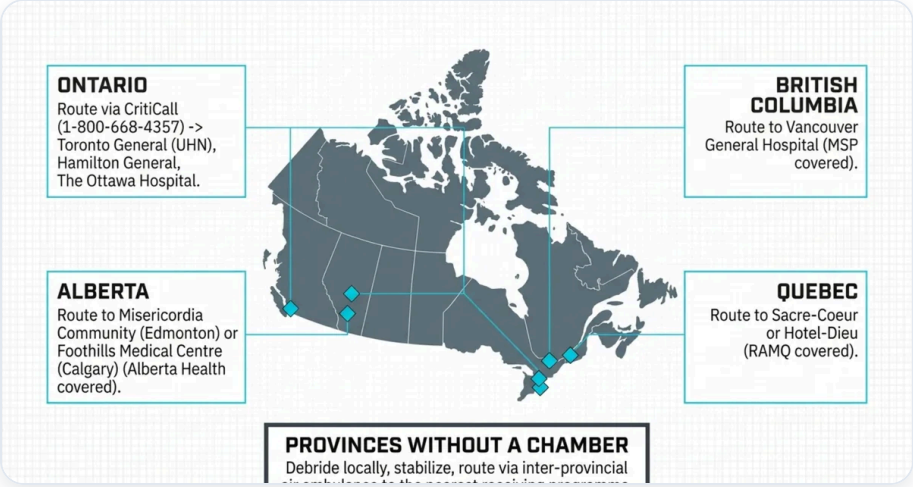



FIGURE

Clinical translation: debride first, antibiotics second, hyperbaric oxygen third. Emergent surgical debridement is the single most important determinant of survival, broad-spectrum intravenous antibiotics follow immediately, and hyperbaric oxygen is added after the first debridement when a chamber is reachable without delaying further operative care. Hyperbaric oxygen is adjunctive and never a substitute for, or a reason to postpone, surgery.

## The Canadian referral pathway

Necrotizing soft tissue infection is treated as an emergency adjunct at Canadian hospital-based hyperbaric programmes and is covered by provincial insurance, with all 11 hospital-based programmes across seven provinces (Ontario, Quebec, British Columbia, Alberta, Nova Scotia, Newfoundland and Labrador, and Saskatchewan) accepting these referrals. Because source control cannot wait, the pathway is physician-to-physician and runs in parallel with the surgical plan.




FIGURE

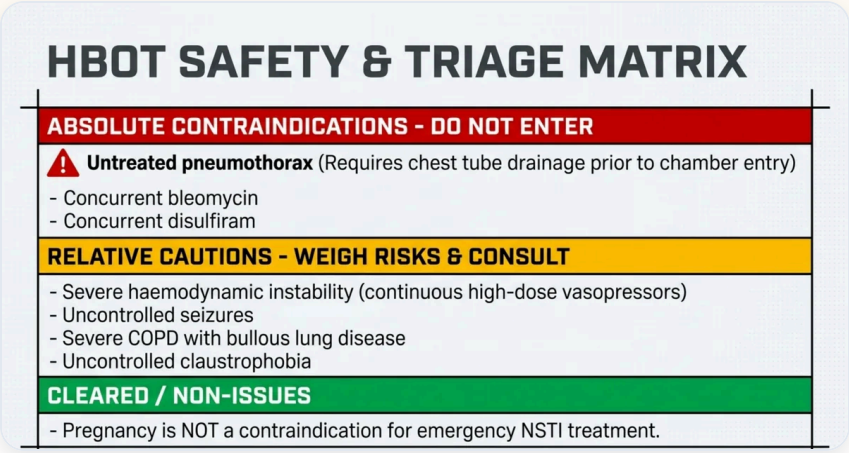
The Canadian referral pathway is physician-to-physician and runs in parallel with surgery, covered by provincial insurance. In Ontario, CritiCall Ontario (1-800-668-4357) connects emergency and surgical teams to the Toronto, Hamilton and Ottawa programmes and arranges transport; British Columbia routes to Vancouver General, Alberta to Misericordia or Foothills, and Quebec to the Montreal or Levis programmes. Provinces without a chamber debride and stabilise locally, then transfer to the nearest receiving programme.

- **Ontario:** call **CritiCall Ontario at 1-800-668-4357**, the 24/7 physician-to-physician coordination line that connects emergency departments and surgical teams to the Toronto General (UHN), Hamilton General, and The Ottawa Hospital programmes and arranges Ornge transport when needed.
- **British Columbia:** route to Vancouver General Hospital (Leon Judah Blackmore Pavilion), the hospital chamber in the province; covered under MSP.
- **Alberta:** route to Misericordia Community Hospital (Edmonton) or Foothills Medical Centre (Calgary); covered by Alberta Health.
- **Quebec:** RAMQ covers the hospital-based programmes, including Hopital du Sacre-Coeur de Montreal and Hotel-Dieu de Levis.
- **Provinces and territories without a chamber:** the patient is debrided and stabilised locally, and hyperbaric referral, where appropriate, routes to the nearest receiving programme by inter-provincial air-ambulance transfer.

For any necrotizing infection, the surgeon and intensivist lead; the hyperbaric team is engaged once the patient is in the operating theatre or recovering from the first debridement, never as a reason to delay it. You can read more background on the necrotizing soft tissue infections condition page.

## Contraindications and cautions

The only absolute contraindication relevant in the emergency setting is an **untreated pneumothorax**, which must be drained with a chest tube before chamber entry. **Concurrent bleomycin** and **concurrent disulfiram** are treated as effectively absolute contraindications by most programmes. Relative cautions that the hyperbaric team will weigh against the severity of the infection include **severe haemodynamic instability requiring continuous high-dose vasopressor titration**, an **uncontrolled seizure disorder**, **severe COPD with bullous lung disease**, and **uncontrolled claustrophobia**. Pregnancy is not a contraindication. In every case the hyperbaric team manages chamber suitability around a critically ill patient; the referring priority remains prompt surgery and antibiotics.




FIGURE

The hyperbaric safety and triage matrix. An untreated pneumothorax must be drained with a chest tube before chamber entry, and concurrent bleomycin or disulfiram are treated as effectively absolute contraindications by most programmes. Relative cautions weighed against the severity of the infection include severe haemodynamic instability on high-dose vasopressors, an uncontrolled seizure disorder, severe COPD with bullous lung disease, and uncontrolled claustrophobia. Pregnancy is not a contraindication, and none of these should delay prompt surgery and antibiotics.

## How to use the research list below

The list contains every necrotizing soft tissue infection study in the Canada Hyperbarics database that was published in 2020 or later **and** has a freely available full-text version, each linked directly to that full text. Paywalled and abstract-only studies are excluded, and retracted studies are removed. This is a reference list, not a set of summaries. Counts and the open-access set refresh each quarter.

## Open-access research, 2020 to present

29 studies with a free full-text version, grouped by year, newest first. Each title links to the full text. Retracted and paywalled studies are excluded; the set refreshes quarterly.

### 2026

1. Tinggaard M et al.. Periorbital infections caused by Group A streptococci: a case series. *BMC infectious diseases.*
2. Patel A et al.. Hyperbaric oxygen therapy and Fournier's gangrene: a systematic review and meta-analysis. *Medical gas research.*

### 2025

1. Azmi YA et al.. The impact of sodium-glucose cotransporter-2 inhibitors on the incidence, therapy, and outcomes of fournier gangrene: insights from a systematic review of case reports. *Systematic reviews.*

2. Vinkel J et al.. Blood from septic patients with necrotising soft tissue infection treated with hyperbaric oxygen reveal different gene expression patterns compared to standard treatment. *BMC Med Genomics*.
3. Gregory TJ et al.. The Role of Hyperbaric Oxygen Therapy in Management of Necrotizing Soft Tissue Infection. *Journal of clinical medicine*.
4. Hyldegaard O et al.. Use of Hyperbaric Oxygen in Patients with Necrotizing Soft Tissue Infections: A Scandinavian Multicenter, Prospective, Observational Cohort. *Infect Dis Ther*.
5. Devaney B et al.. Core outcome set for research in necrotising soft tissue infection patients: an international, multidisciplinary, modified Delphi consensus study. *Diving and hyperbaric medicine*.
6. Shishido A et al.. Hyperbaric Oxygen Therapy for Necrotizing Soft Tissue Infections: A Retrospective Cohort Analysis of Clinical Outcomes. *Surg Infect (Larchmt)*.

## 2024

1. Devaney B. Equipoise: an important ethical consideration when contemplating participation in a randomised controlled trial of hyperbaric oxygen treatment in necrotising soft tissue infections. *Diving and hyperbaric medicine*.
2. Toppen W et al.. Contemporary national outcomes of hyperbaric oxygen therapy in necrotizing soft tissue infections. *PLoS One*.
3. Wackett J et al.. Reported outcome measures in necrotising soft tissue infections: a systematic review. *Diving and hyperbaric medicine*.
4. Mendes J et al.. Toxic Shock Syndrome: Rare but Deadly. *Cureus*.
5. Bion V et al.. Validation of necrotising infection clinical composite endpoint in a retrospective cohort of patients with necrotising soft tissue infections. *Diving Hyperb Med*.
6. Kryeziu K et al.. Efficacity of hyperbaric oxygen therapy for necrotizing fasciitis in the maxillofacial region: The review of the literature. *International wound journal*.

## 2023

1. Vinkel J et al.. Key pathways and genes that are altered during treatment with hyperbaric oxygen in patients with sepsis due to necrotizing soft tissue infection (HBOmic study). *European journal of medical research*.
2. Tramallino J et al.. The Subacute Necrotizing Fasciitis: The Forgotten form of this Life-threatening Infection. A Case Report. *J Orthop Case Rep*.
3. Huang C et al.. The effect of hyperbaric oxygen therapy on the clinical outcomes of necrotizing soft tissue infections: a systematic review and meta-analysis. *World journal of emergency surgery : WJES*.
4. Wójcik B et al.. Advances in Management of Fournier's Gangrene by Coupling Intensive Hospital Treatment With Innovative Post-discharge Hyperbaric Oxygen Therapy Rehabilitation: A Case Report. *Cureus*.

## 2022

1. Tutino R et al.. Which Role for Hyperbaric Oxygen Therapy in the Treatment of Fournier's Gangrene? A Retrospective Study. *Front Surg*.
2. Vinkel J et al.. Investigating the Effects of Hyperbaric Oxygen Treatment in Necrotizing Soft Tissue Infection With Transcriptomics and Machine Learning (the HBOmic Study): Protocol for a Prospective Cohort Study With Data Validation. *JMIR research protocols*.
3. Raizandha MA et al.. The role of hyperbaric oxygen therapy in Fournier's Gangrene: A systematic review and meta-analysis of observational studies. *International braz j urol : official journal of the Brazilian Society of Urology*.

## 2021

1. Schneidewind L et al.. Hyperbaric Oxygenation in the Treatment of Fournier's Gangrene: A Systematic Review. *Urol Int*.
2. Trama F et al.. Multimodal approach in a patient with Fournier's gangrene during the coronavirus pandemic. *Urol Case Rep*.
3. Creta M et al.. Fournier's Gangrene in Patients with Oncohematological Diseases: A Systematic Review of Published Cases. *Healthcare (Basel)*.
4. Feres O et al.. Hyperbaric oxygen therapy decreases mortality due to Fournier's gangrene: a retrospective comparative study. *Medical gas research*.

## 2020

1. Peetermans M et al.. Necrotizing skin and soft-tissue infections in the intensive care unit. *Clinical microbiology and infection : the official publication of the European Society of Clinical Microbiology and Infectious Diseases*.
2. Rubartelli A et al.. Left lower limb fasciitis due to sigmoid colonic perforated diverticulitis: a rare case of colocutaneous fistula. *J Surg Case Rep*.
3. Floether L et al.. Necrotizing fasciitis caused by the treatment of chronic non-specific back pain. *BMC Anesthesiol*.
4. Cetinkaya A et al.. A loxoscelism case received therapeutic apheresis and hyperbaric oxygen therapy. *Saudi Med J*.

---