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Review

# Does negative-pressure wound therapy influence subjacent bacterial growth? A systematic review

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Negative-pressure wound therapy;
NPWT;
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Instillation therapy

**Summary** *Background:* Negative-pressure wound therapy is a ubiquitous wound management resource. The influence of NPWT on the bacterial bioburden of the subjacent wound remains unclear. We sought to examine the evidence.
*Datasources:* MEDLINE, Embase, PubMed, the Cochrane Database of Systematic Reviews and the Cochrane Controlled Trials Register were searched for articles quantitatively evaluating bacterial load under NPWT.
*Results:* Twenty-four studies met the inclusion criteria including 4 randomised controlled trials, 8 clinical series and 12 experimental studies. Twenty studies evaluated conventional NPWT, while 4 evaluated infiltration-based NPWT. While 8 studies using conventional NPWT failed to demonstrate an observable effect on bacterial load, 7 studies reported that NPWT was inherently bacteriostatic and 5 others reported species selectivity with suppression of non-fermentative gram-negative bacilli (NFGNB), including *Pseudomonas* spp. Simultaneously, there was some evidence of enhanced proliferation of gram-positive cocci where the niche was cleared of NFGNB. Two of the 4 studies using infiltration-based NPWT also reported selectively impaired proliferation of *Pseudomonas* spp.
*Conclusion:* The assumption that NPWT suppresses bacterial proliferation is oversimplified. There is evidence that NPWT exhibits species selectivity, suppressing the proliferation of NFGNB. However, this may depopulate the niche for exploitation by gram-positive cocci. This,

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in turn, has implications for the use of NPWT where highly virulent strains of gram-positive cocci have been isolated and the duration of NPWT therapy and frequency of dressing changes.


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## Introduction

Since the publication of the seminal papers in 1997 by Argenta and Morykwas,[1,2] negative-pressure wound therapy (NPWT) has found widespread application in almost every type of open wound and, more recently, over closed incisions. Based largely on these papers, the purported mechanisms of action, namely promotion of granulation tissue formation, increased blood flow to adjacent tissue and bacterial clearance at the wound bed, have become accepted and are often repeated despite the emergence of experimental studies that have challenged some of these assertions. More recent work has revealed a complex rationale for the apparent clinical benefits of NPWT based on micromechanical deformation with fibroblast proliferation; VEGF-mediated neo-angiogenesis; and modulation of local and systemic expression of cytokines, growth factors, and matrix metalloproteinases.[3,4]

The influence of NPWT on the microbiological environment of the subjacent wound is shrouded in confusion owing to the plethora of variables in studies designed to answer the question. Acute, chronic and pre-contaminated wounds have all been investigated. Various sampling methods and qualitative outcome measures have been employed. Intermittent surgical debridement and the simultaneous use of systemic antibiotics have also complicated data analysis. This study aimed to systematically analyse the existing experimental and clinical data to establish if NPWT acts in part by improving bacterial clearance of the wound.

## Patients and methods

### Search strategy

PubMed (no date restriction), Ovid Medline (1997 to March 2016), Embase (1997 to March 2016), the Cochrane database of systematic reviews and the Cochrane controlled trials register (searched 24 March, 2016) were searched using medical subject heading terms and free text terms. Articles were searched from 1997 as this year corresponds with the first description of the therapy as it is used in contemporary practice. The search strategy and terms used are shown in Supplemental Table 1. Articles were cross-referenced to identify other articles of interest. Additionally, the online trials registers ClinicalTrials.gov and the national research register were scrutinised for completed, discontinued and ongoing trials relating to NPWT and bacterial growth within the subjacent wound. The search strategy was performed in accordance with the Cochrane Highly Sensitive Search Strategy guideline in the Cochrane Handbook for Systematic reviews of Interventions. The review is reported in line with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses statement.[5] This study was