Improving outcomes with noncontact low-frequency ultrasound

This tool can enhance clinical outcomes and reduce costs in acute-care settings.

By Ronnel Alumia, BSN, RN, WCC, CWCN, OMS

Achieving excellent wound care outcomes can be challenging, given the growing number of high-risk patients admitted to healthcare facilities today. Many of these patients have comorbidities, such as obesity, diabetes, renal disease, smoking, chronic obstructive pulmonary disease, and poor nutritional status. These conditions reduce wound-healing ability.

At the same time patient acuity has been rising, reimbursement for some types of care has been declining. For certain hospital-acquired conditions, such as stage III or IV pressure ulcers and certain surgical-site infections, reimbursement has been eliminated. Thus, clinicians can't choose products based solely on their proven ability to obtain a good clinical outcome; they also must consider economic factors. Noncontact low-frequency ultrasound (NLFU) can help improve clinical outcomes and provide cost savings.

Ultrasound: Simple but effective

NLFU delivers sound waves to tissues through a saline mist. Unlike most wound care treatments, whose effects are limited to the surface, NLFU penetrates into and below the wound bed to reach previously inaccessible tissues. (See *A glimpse of NLFU in action*.)

Ultrasound energy produces biophysical effects from mechanical stimulation of cells, promoting wound healing. A mechanical vibration, ultrasound is transmitted at a frequency above the upper limit of human hearing—20 kHz. The most common form of therapeutic ultrasound

View: See how NLFU works

A glimpse of NLFU in action

This image shows noncontact low-frequency ultrasound (NLFU) being used on a patient. The device shown is the MIST Ultrasound Healing Therapy®.

Photo courtesy of Celleration Inc, Eden Prairie, MN. © 2013.

uses devices that operate in the 1- to 3-MHz range to treat various musculoskeletal disorders with a thermal effect. Diagnostic ultrasound, in contrast, operates in a high-frequency (20 to 40 MHz) range. It has a wide number of uses, from fetal monitoring to echocardiography.

In contrast, NLFU delivers low-frequency (40 kHz), low-intensity (0.2 to 0.6 W/cm2) ultrasound energy to the wound bed with no thermal effect. With most ultrasound therapy, a gel serves as a conduit to deliver sound waves to tissues. However, NLFU uses a saline mist, which eliminates contact with tissue and thus is painless.

NLFU can be performed by nurses with special training. The patient usually undergoes the procedure at the bedside three to five times per week, with the machine preset to a certain number of minutes based on wound measurement (length × width). Typically, the course of therapy ends when the desired outcome is achieved or the patient is discharged or transferred out of the facility.

The science of NLFU

The micromechanical forces produced by ultrasound energy at a cellular and molecular level have a wide range of effects on the wound-healing process, including reduction of bacteria within and below the wound bed. Unlike other body cells, bacteria have a rigid cell membrane; repeated pressing of sound waves can disrupt the bacterial membrane, causing cell death. (See *NLFU: The science behind the solution.*)

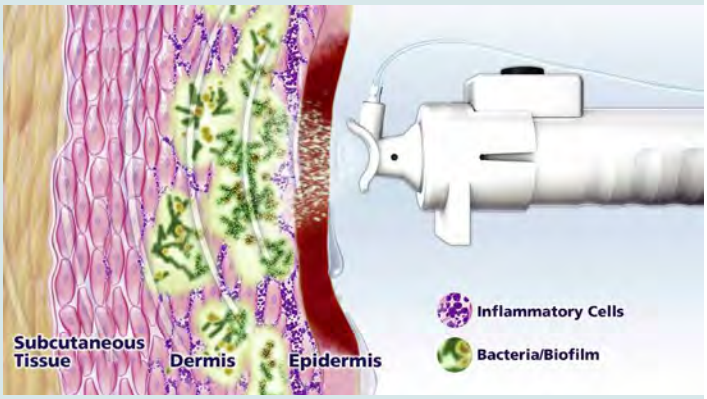
Laboratory tests show NLFU reduces a wide range of bacteria, including some of the hardest to treat, such as methicillin-resistant *Staphylococcus aureus* (MRSA), vancomycin-resistant enterococci (VRE), and *Acinetobacter baumannii*. In a clinical study of patients who had stage III pressure ulcers with high levels of bacteria, punch biopsies were used to determine baseline and posttreatment bacterial counts. Results showed significant reduction in *S. aureus* (93.9%), *A. baumannii* (94%), and *Escherichia coli* (100%) after six NLFU treatments over a 2-week period. In live animal studies, NLFU disrupted the bacterial biofilm after just three treatments. (See *NLFU and the healing process.*)

Sustained inflammation is a common barrier to healing. NLFU reduced pro-inflammatory cytokines in two studies—one involving patients with chronic diabetic foot ulcers and the other involving patients with nonhealing venous leg ulcers. This reduction correlated to reduced wound areas in these previously nonhealing wounds. In one of these studies, researchers reported a decrease in MMP-9, a matrix metalloproteinase that breaks down new granulation tissue and delays healing.

Studies also show NLFU increases va-

The science behind the solution

This illustration shows the action of noncontact low-frequency ultrasound (NLFU) on the skin and tissue layers. NLFU penetrates deep below the wound surface.



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NLFU and the healing process

This chart lists the effects of noncontact low-frequency ultrasound (NLFU) on the three stages of the normal healing process.

Healing stage	NLFU effects
Inflammation	Reduces bacteria Disrupts biofilm Decreases sustained inflammation Reduces matrix metalloproteinase-9
Proliferation	Stimulates vascular endothelial growth factor and angiogenesis Stimulates early release of growth factors (including transforming growth factor beta-1) Increases vasodilation
Remodeling	Promotes increased quantity and quality of collagen

sodilation, stimulates vascular endothelial growth factor and angiogenesis, promotes early release of growth factors, and provides greater amounts of high-quality collagen. The overall result of these cellular effects is accelerated healing.

Clinical outcomes

Use of NLFU is supported by clinical data, including a meta-analysis, three randomized-control trials, 11 peer-reviewed studies, and multiple case series. A 2011 meta-analysis compiled data from eight published studies reporting the effect of NLFU on wound size and healing rates in 444 patients with various chronic wounds. It found 85% wound-area reduction in a mean of 7 weeks, wound-volume reduction of 80% at a mean of 12 weeks, and 42% complete wound closure at 12 weeks. By comparison, a meta-analysis of standard-of-care treatment found only 24% complete wound closure at 12 weeks. Thus, NLFU achieves almost twice the healing of the standard treatment.

Besides consistently speeding healing

Clinical outcomes and cost savings from NLFU

Noncontact low-frequency ultrasound (NLFU) can achieve accelerated healing, bacterial reduction, and early intervention for suspected deep-tissue injuries. These results can bring significant cost savings.

At Acuity Specialty Hospital of New Jersey (a long-term acute-care hospital), we reviewed clinical and economic outcomes for medically compromised patients when NLFU was added to the standard-of-care wound care protocol. We found NLFU yielded improved clinical outcomes—better tissue quality, wound reduction, and hastened wound healing. It also brought a significant cost benefit; the total cost savings potential for these patients was nearly $25,000, with an individual range of $141 to $14,273. Here are two examples.

Patient: 72-year-old man with Fournier's gangrene, sepsis, diabetes mellitus type 2, severe neuropathy, chronic obstructive pulmonary disease, acute kidney injury, normocytic anemia, and severe aortic stenosis
Treatment: NLFU three times a week for 4 weeks, plus negative-pressure wound therapy for 4 weeks
Outcome: 50% increase in granulation tissue; noticeable epithelial tissue on wound edges
Benefits of NLFU: Patient was able to avoid debridement and, possibly, a longer stay.
Savings: $8,606

Patient: 44-year-old woman with a dehisced abdominal wound
Treatment: NLFU three times a week for 3 weeks, plus negative-pressure wound therapy for 4 weeks
Outcome: Wound was placed on healing trajectory.
Benefits of NLFU: Patient was able to stop advanced treatment 11 days before discharge.
Savings: $141; 11 treatment days

NLFU can help healthcare providers meet both clinical and economic outcome goals.

of open wounds, NLFU is an effective early treatment for suspected deep-tissue injuries (sDTI). In a study of 127 sDTIs treated with standard of care alone (63) or standard of care with NLFU (64), only 22% of standard-of-care-alone sDTIs resolved without opening or progressed only to a stage II pressure ulcer, compared to 80% in the NLFU arm. At my hospital, we found similar results in our patient population using NLFU to resolve sDTIs before they became full-thickness wounds. (See *Clinical outcomes and cost savings from NLFU.*)

NLFU has been used in wound care settings across the country for several years. Increasingly, it's being used in acute-care settings as clinicians are grasping its substantial clinical and economic benefits. This technology can help healthcare providers meet both clinical and economic outcome goals. NLFU is rapidly becoming the new standard for early sDTI intervention. ■

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