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Wound Care™

Your independent guide to wound management

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Inside

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New silver dressings may serve critical role in your wound kit

Products provide more reliable methods of silver delivery to injured tissue

Silver has long been associated with the forces of good. Silver weapons were once believed to kill evil creatures. The Lone Ranger rode a horse named Silver and shot silver bullets at outlaws. And if a dark cloud holds hidden blessings, it is said to have a silver lining.

Many cultures around the world recognized the healing properties of silver centuries before the postulation of the germ theory and the identification of bacteria as a cause of infection. Today's intractable infections have caused health care professionals to look once again toward silver to combat topical infections. The metal has proved itself a powerful bactericidal agent for burns, incisions, chronic wounds, and other diagnoses in which skin integrity has been violated.

For the past 2,500 years, silver has been a popular material for making drinking vessels, eating utensils, and surgical instruments, says **Bart Flick**, MD, an orthopedic surgeon in Lakemont, GA, who has investigated the use of silver in wound care for more than a decade. Once the nature and role of bacterial pathogens were accepted in the 19th century, silver's stature in medicine grew when physicians discovered that the metal held bactericidal qualities. Silver nitrate was used successfully to treat skin ulcers, compound fractures, and suppurating wounds. In 1852, an Alabama surgeon pioneered the use of silver sutures during a procedure to repair a vesicovaginal fistula — an operation almost always accompanied by post-surgical infection in those days. In 1881, dilute silver nitrate was first dropped in the eyes of newborns to prevent gonorrheal ophthalmia.

Early in this century, a physician at Johns Hopkins Hospital reported the use of silver foil for dressing wounds, and even oral silver preparations were in vogue. But as highly effective antibiotics entered the medical armamentarium with a flourish, silver usage dropped precipitously.

But the ability of a growing number of bacteria to resist antibiotic therapy has led to an escalating battle between drug-resistant microorganisms and microbiologists attempting to develop new formulations to stop them. The antibiotic defense arsenal, once thought to be impenetrable, has been breached — and with potentially deadly consequences.

Microorganisms such as methicillin-resistant *Staphylococcus aureus* (MRSA), candida, and *Escherichia coli* frequently colonize wound sites. MRSA has been blamed by the Centers for Disease Control and Prevention for approximately 13% of the nation's 2 million annual hospital-acquired infections.

Research has shown that silver's antimicrobial endowment has been traced to silver ions that dissociate from the metal itself. So far, no bacterial pathogens have demonstrated a talent for surviving contact with ionized silver. In addition, no allergies to silver ions or metallic silver have been reported.

"If small amounts of ionic silver can be constantly made available at the wound interface, then the efficacy of the antimicrobial action can be maintained."

David Mitchell, PhD, director of research and development at Maersk Medical UK, writes: "Recent research has shown that silver in ionic dissociation is more effective than the silver itself, but this again suffers from rapid elimination. If small amounts of ionic silver can be constantly made available at the wound interface, then the efficacy of the antimicrobial action can be maintained. In addition, the amount of ionic silver required is very small indeed."[1]

Silver won't cure but may prevent

Why not universally substitute silver for antibiotics? One reason is that there is no way to deliver silver ions systemically and nontoxically to infection sites; thus its application must be topical. Just as importantly, silver cannot be used to cure an existing infection, but it can prevent an incipient one or create an environment that greatly reduces the chances of infection. Another challenge of using silver, until recently, had been to find a way to deliver adequate levels of silver ions to tissue uniformly over extended periods.

Since the early 1970s, the common method of silver use for wound and burn care was via topical silver sulfadiazine cream. This product still provides clinicians with a straightforward modality for applying silver to burns and various types of wounds and is held in high esteem by many who use it regularly. Nowadays, clinicians often refer to silver sulfadiazine as Silvadene, regardless of the manufacturer, though Silvadene is actually a brand name. Several companies produce similar versions of the product.

Some users of silver sulfadiazine claim they have witnessed stunning wound-healing results after applying the cream to chronic wounds that were in danger of infection. Numerous studies of its use for a wide variety of diagnoses can be found in the literature, though specific investigations into its use on chronic wounds are scarce.

Yet even proponents of silver sulfadiazine admit it has some noteworthy drawbacks. Once applied to a wound, silver sulfadiazine actively discharges silver ions for a relatively short period of time, and those ions are quickly neutralized when they come into contact with body fluids. Therefore, the cream must be wiped away and replaced with a fresh batch two to three times daily in order to be effective. Secondary dressing changes must accompany the silver sulfadiazine reapplications, making the undertaking labor-intensive. The fact that reapplication is a messy job doesn't add to its attractiveness. In addition, there is no way to measure the actual amount of silver ions that reach infected tissue.

Clinicians also should note that silver becomes toxic to the liver when present in high quantities, and because of the manner in which the cream is applied, it is impractical to expect consistent and accurate dosing. Because of the threat of toxicity, experts recommend that continuous application of silver sulfadiazine cease after two weeks. By that time, the silver should have killed the pathogens anyway.

A more reliable form of delivery

In recent years, a newer, more reliable method of delivering silver to burns, chronic wounds, surgical incisions, and other skin breaks (such as catheter insertion points) to prevent or decrease bacterial infections has been developed.

Several manufacturers have bonded silver to various dressing materials, with the result that silver ions are released steadily and for relatively long periods of time. This important development decreases the need for frequent dressing changes and the risk of silver toxicity and simultaneously guarantees that a therapeutic dose of silver reaches the wound and effectively reduces the bioburden. Theoretically, faster healing should follow.

Two silver-impregnated dressings are currently on the market: Arglaes, manufactured by Maersk Medical UK and distributed in the United States by Medline Industries of Mundelein, IL, and Acticoat, manufactured by Westaim Corp., Fort Saskatchewan, Canada. A third silver dressing, Silverlon, manufactured by Argentum International LLC of Providence, RI, has

received Food and Drug Administration marketing approval and is expected to enter the market this winter.

Before its approval in the United States, Arglaes had been used in Great Britain for several years. Acticoat, while initially developed for the burn market, is being used more frequently for chronic wound patients.

Reference

1. Mitchell D. Wound care beyond 2000 (abstract). Presented at the Symposium on Advanced Wound Care & 8th Annual Medical Research Forum on Wound Repair. Miami Beach, FL; April 18-22, 1997. ■

Arglaes leads way among silver dressings

Prevents infections, reduces risk of transmission

Dressings impregnated or coated with some form of silver are garnering a lot of attention these days, primarily because of their antimicrobial and antifungal properties. A slew of positive anecdotal reports aren't hurting the reputation of such products. One of the chief applications for silver dressings has been burn care, but they've increasingly found favor for treating chronic wound patients as well.

For wound care, the more prominent of the two silver dressings currently on the market is Arglaes, manufactured by Maersk Medical UK and distributed in the United States by Medline Industries of Mundelein, IL. The other silver dressing available commercially is Acticoat, manufactured by Westaim Corp., Fort Saskatchewan, Canada. Silverlon, an emerging silver dressing manufactured by Argentum International LLC of Providence, RI, has received Food and Drug Administration marketing approval and is expected on the market this winter.

Though some attributes of these three dressings differ, they all are based on the same principle: They deliver silver ions to tissue at a steady rate for extended periods and are designed to prevent bacterial colonization in infection-prone areas.

"The physical characteristics of the dressings vary, but that's not important to practitioners. They want to know how effective they are, how safe they are, and how much they cost," says **Bart Flick**, MD, an orthopedic surgeon who developed Silverlon and began investigating silver as an antimicrobial for wound care more than a decade ago.

Acticoat has been on the market for about a year. It was initially designed for preventing infection in burn patients and is still strongly identified with that niche. A company consultant told *Wound Care* that Westaim has begun to examine a larger role for Acticoat in chronic wound treatment.

Westaim focused first on burn care because it is "probably the most demanding area for high-performance infection control," according to company president **Michael Raymont**, whose office is in Exeter, NH. "Silver ions can wipe out any type of pathogenic bacteria considerably faster and at lower concentrations than conventional silver antimicrobials," he says.

Acticoat is described as a barrier dressing consisting of flexible, abrasion-resistant soluble silver films. Raymont says plans are under way for clinical trials to examine the use of Acticoat for donor sites, chronic wounds, and immunocompromised patients.

Silverlon consists of nylon fabric coated with a thin layer of 99% pure, 1% silver oxide.

"Silver has the capacity to reduce surface contamination," says Flick. "In many cases, that's all that's needed to enhance wound healing." He cautions that silver dressings may help reduce the bioburden of a seriously infected wound, but they will not eliminate an existing infection. "Appropriate medical treatment and surgery are needed for infected wounds," he explains. "There's a lot of confusion over this. It's a great mistake to think that silver alone can entirely rid the infection."

Arglaes more common in wound care

Silver dressings are easier to use than silver sulfadiazine cream. The cream, while easy to apply and less expensive than the newer silver-impregnated dressings, is messy and requires frequent applications and concurrent dressing changes because the silver in the cream is quickly neutralized after it comes into contact with bodily fluids. Dosing of silver sulfadiazine cream also is inexact, and depends greatly on how thickly the cream is applied; there is bound to be inter-clinician (and even intra-clinician) variability between applications.

Arglaes has seen substantially more clinical use in wound care than the other two products. Arglaes is available in two forms: a barrier film dressing designed for dry to lightly draining wounds, and an "island" dressing comprised of an alginate pad for moderately to heavily draining wounds.

The Arglaes film dressing releases silver ions at a relatively constant rate for as long as seven days, while the alginate pad does so for about five days, according to users who related their experiences to *Wound Care*. When water vapor from a wound reaches the silver-impregnated dressing, the material releases silver ions. According to Maersk, the discharge rate of silver ions remains the same regardless of the amount of liquid exuded by a wound. Arglaes can be applied in place of topical antibiotics for at-risk individuals, such as elderly patients, intensive care patients, diabetic patients, and immunosuppressed patients, Maersk researchers say. Many wound care professionals find the product extremely effective for treating patients with chronic wounds.

In one non-randomized study conducted at the Overton Brooks Veterans Administration Medical Center in Shreveport, LA, Arglaes was found to be 100% effective for suppressing bacteria at central line access sites. Common wound dressings demonstrated far less effectiveness.

High price, but reduced costs

The manufacturer claims that Arglaes, while relatively expensive (one user told *Wound Care* a 2" x 2" square of Arglaes cost more than $20), ultimately saves money by reliably preventing infections and reducing the risk of transferring infections to staff members or other patients — events that easily could result in costs greatly exceeding the price of several weeks' worth of dressings and the concomitant staff time.

Stephen Colvin, MD, a cardiothoracic surgeon at the New York University School of Medicine, says the treatment leads to better outcomes for patients and shortens hospital stays. "They need fewer antibiotics and they are able to recover more quickly and completely," Colvin says. He uses Arglaes at the incision sites of his patients to reduce the risk of infection.

At Children's Mercy Hospital in Kansas City, MO, clinicians have used Arglaes to help control infections in patients when prior measures failed. At a Florida hospital, clinicians report that a patient who developed a deep abscess on her buttock after a trauma could not be healed after antibiotic therapy and extensive operations and debridement. The wound became infected with methicillin-resistant *Staphylococcus aureus* and vancomycin-resistant enterococci. Arglaes eventually was applied to the wound, and in one week wound depth had decreased by 50%.

John Macdonald, MD, medical director of the Wound Healing—Lymphedema Center in Fort Lauderdale, FL, has used Arglaes to treat about 50 chronic wound patients. "The basic premise for using silver is very good because it's bactericidal and fungicidal, nothing is really resistant to it, and allergic reactions are rare," he says. Macdonald recalls during his residency a surgeon who used silver ointment on wounds long before silver had become a regular part of wound care.

"If all that the manufacturer is saying is correct, [silver] will be a great alternative to topical antibiotics, which many clinicians stay away from because of the risk of colonization and infection, allergy, and dermatitis," Macdonald adds.

He says he's still getting used to Arglaes and is searching for the best methods of application. "We're doing a lot of trial and error, and a lot of it is working."

He adds that the "jury is still out on some aspects" of Arglaes for chronic wounds.

Giving healing a jump-start

"One question is how much penetration of the skin there is with silver," says Macdonald. "How deep does it go and how much is absorbed? We're seeing the effect, but we'd like to know more about how it works. One problem is that there's not yet a lot of American literature on the use of [Arglaes].

"Where I've seen good results is when I see a wound that needs a quick jump-start of antibacterial or antifungal activity. We've had good luck clearing up periinflammation around wounds. In the very early stages of wound care, when we would often have used a topical antibiotic, Arglaes can be used to take care of a local infection." He says he often leaves the dressing in place for five or six days and has used it under an Unna Boot for treating venous stasis ulcers. Arglaes film is not appropriate for highly exudative wounds because the dressing acts as a barrier to exudate, Macdonald notes.

One nurse reports overcoming that limitation by actually cutting slits in the film dressing and placing an absorbent material over the Arglaes layer to absorb exudate that seeps through. The antimicrobial aspects of the dressing compensate for compromising the barrier, while the dressing combination still maintains a moist wound environment.

Macdonald predicts that over the next year, clinicians will define more "dos and don'ts" for the use of Arglaes. More clinical experience with silver dressings and consistent methods for measuring outcomes are still needed. As more dressings are used and information on their performance is gathered, judgments on the effectiveness of Arglaes under varying circumstances will grow clearer and show if the dressing — and others like it — can fulfill the promises of their manufacturers and marketers. ■

Odor-absorbing dressings differ in lab studies

Dressings use activated charcoal to absorb odors

Odors produced by chronic wounds present a real problem for wound care professionals, patients, and family members. At times, odors can become so severe as to cause a patient to withdraw completely from social interactions, even with family and close friends.

Within the category of nonmalignant chronic wounds, leg ulcers are most commonly associated with noxious odors. The smell results from an amalgam of volatile chemicals including short-chain organic acids produced by anaerobic bacteria and by-products of proteolytic bacteria, according to **Stephen Thomas**, PhD, director of the Surgical Materials Testing Laboratory in Bridgend, Wales, UK. Thomas has conducted research on the properties of odor-absorbing dressings. Some research even suggests that a particular wound odor can be used to identify the specific bacteria present, which can be confirmed through lab testing, he notes.

Ways to reduce wound odor

Thomas says the best way to handle odoriferous wounds is to prevent or eliminate the infection causing the smell. This, of course, may involve systemic antibiotics or antimicrobial agents. These measures are not always successful due to the nature of the wound, particularly when large amounts of necrotic tissue are present.

One potentially successful option for reducing wound odor is to use a hydrogel that contains metronidazole (about 0.8%). Thomas says this combination has been found to have an effect on a range of aerobic organisms. However, the usefulness of this approach has been questioned.

Other, less conventional approaches to reducing wound odor include the use of honey and sugar, which are thought to produce an environment that inhibits bacterial growth and therefore prevents odor formation. Even live yogurt cultures have been applied to fetid wounds to encourage an exaggerated growth of pathogenic organisms by lactic acid bacteria. Larval therapy (maggots) also has been used to mitigate wound infection and decrease necrotic wound odors.

Historically, wound odors were masked by burning incense, and in more recent times, by the use of aerosol sprays or air fresheners. Although these do not resolve the underlying problem, they may make life a little more bearable for patients and families.

Wound odor cannot always be prevented, and most dressings are not designed to absorb the molecules responsible for creating the smell. But within the past couple of decades, special odor-reducing dressings have been developed, all of which contain some form of activated charcoal, a material well-known for its ability to absorb odors. It is believed that the molecules responsible for production of the odor are attracted to the surface of the carbon and are held there by electrical forces. Most of these molecules are small and can be detected by the nose in low concentrations in the air. A single dressing, by virtue of the large surface area of the carbon, is capable of absorbing a very large number of molecules and should therefore be able to eliminate wound odor for extended periods.

Several odor-absorbing wound dressings are currently on the market. The first, Actisorb, arrived in the mid-1970s. Thomas says lab studies showed that bacteria attached firmly to its charcoal fabric and were removed from solution in the wound exudate; the bacteria, however, remained viable. A second-generation dressing, Actisorb Plus, contains 0.15% silver chemically bound to the carbon. Silver is an antimicrobial capable of killing bacteria absorbed by the dressing. **(See related stories on silver dressings, pp. 13-16.)**

Odor-reducing dressings can be placed directly on wounds and may be held in place by secondary dressings placed over the primary layers. Sometimes a retaining bandage is used to hold the assemblage in place.

Information lacking on odor-absorption capabilities

Thomas conducted a laboratory study comparing the odor-absorbing capabilities of four such dressings.[1] The results, he suggests, may have clinical as well as esthetic implications for wound care.

Thomas sought to determine whether these dressings varied in their abilities to handle wound fluids and to control exudate odor. He notes that "despite the relatively widespread use of odor absorbing dressings . . . little objective comparative data is available on their odor and fluid handling characteristics."

Several investigators have tested the efficacy of odor-absorbing dressings of both chemical and biological materials. Chemical techniques often are favored because the efficiency of the dressing can be determined using standard analytical techniques such as gas liquid chromatography. Determination of dressing performance using biological materials is restricted to

more subjective methods of assessment, such as the use of a human test panel. In one example of a biological assessment, researchers compared the odor-absorbing properties of five dressings containing activated charcoal with that of a cotton gauze swab as a control. A panel of volunteers was asked to assess the odor liberated from test samples after the addition of cultures of bacteria isolated from malodorous wounds.

The aim of Thomas' study was "to develop a more objective test system that could be used to compare the ability of different dressings to prevent the passage of a volatile amine when applied to a wound model under simulated 'in-use' conditions."

In the study, Thomas selected odor-absorbing dressings that also are intended as primary wound dressings: Actisorb Plus (Johnson & Johnson), CarboFlex (ConvaTec), Carbonet (Smith & Nephew), and Lyofoam C (Seton Healthcare).

Following is a brief description of each:

• **Actisorb Plus** is made of a charcoal cloth comprising mostly carbon that is integrated into a rayon fabric. The dressing is designed for direct placement on a wound surface and to be covered by an absorbent second dressing. The manufacturer asserts that the proximity of the charcoal to the wound not only reduces the odor but also removes toxins present in the wound fluid, says Thomas. Silver ions contained in the dressing may reduce the risk of infection.

• **CarboFlex** is a multicomponent dressing that consists of alginate and cellulose fibers bonded to a plastic film that allows liquid to travel only in one direction. Charcoal cloth and an absorbent layer are behind the film, followed by a second layer of perforated plastic. The dressing can be placed directly on the wound surface.

• **Carbonet** boasts both fluid- and odor-absorbing properties. It contains a layer of activated charcoal cloth sandwiched between two polyethylene net layers and may be placed directly on a wound surface.

• **Lyofoam C** consists of two pieces of polyurethane foam that enclose a fabric impregnated with activated carbon granules. It also may be placed directly on a wound.

A fifth dressing, Release, which contains no charcoal and is not intended as an odor absorber, was used as a control.

During the test, each dressing was mounted in a specially designed airtight apparatus and exposed to a test solution consisting of sodium/calcium chloride containing sodium and calcium ions at levels commensurate with those found in wound exudate. The mixture was completed with 2% diethylamine and 10% newborn bovine serum.

The test solution was applied to each dressing at a rate of 30 ml/hour, and the concentration was monitored and recorded constantly. Testing of a dressing ended when the concentration of diethylamine present in the air above the dressing rose to approximately 15 ppm, but test results were based on the endpoint of 10 ppm. Each dressing was tested six times.

The following is a summary of the results. The greater the volume of test solution introduced to the chamber before the endpoint of 10 ppm was reached, the greater was the dressing's ability to absorb odors:

Dressing	Mean Volume of Solution in Chamber at Endpoint (ml)
Lyofoam	3.48
Carbonet	2.95
Carboflex	1.95
Actisorb Plus	1.36
Release	0.53

The time taken for the concentration of diethylamine to increase by 10 ppm above baseline values was obtained for each dressing, and the volume of fluid that had been applied to each dressing was calculated.

Clear differences are demonstrated

Thomas writes: "The results of this study demonstrate clear differences in the ability of the products to contain the test solution and prevent the loss of the volatile diethylamine into the surrounding air. Release, an absorbent dressing which contains no activated charcoal, is able to delay the passage of the diethylamine through the dressing but is less effective in this regard than Actisorb Plus, which has limited absorbency. This suggests that the odor absorbing properties of the dressing are determined by at least two factors, the physical absorbency — a function of the presence of some form of absorbent layer, and the activity of the charcoal cloth itself. Products which combine a physical absorbent with a charcoal component show enhanced performance, as might be anticipated."

The results, he adds, do not show if odor absorption of a dressing is most effective when the dressing is applied directly to the surface of a wound or when it is incorporated into the structure of the pad or used as a secondary dressing. Further study is required to determine if the performance of a particular product is impaired once the dressing is saturated with wound fluid, says Thomas.

Based on the test results, the dressings should be expected to provide some degree of odor control from 12 hours to three days, depending on the amount of wound exudate.

Thomas notes that the rate at which the test solution was applied during the test was "considerably in excess of that encountered clinically." This may effect the performance of the dressings, though the variation probably wouldn't affect the rank order of the products because the test is comparative.

Thomas concludes that despite some of his own criticisms of the methods and procedures he used during the investigation, the results provide, "possibly for the first time, an objective method for comparing the performance of different odor absorbing dressings when challenged with a test solution containing an odiferous volatile amine under simulated conditions of use."

References

1. Thomas S. Odor absorbing dressings: A comparative laboratory study. *World Wide Wounds* 1998; http://www.smtl.co.uk/World-Wide-Wounds/. ■

Preceptorships expand sales reps' knowledge

Courses explain product applications

Preceptorships are certainly not a new notion in the medical community. It makes perfect sense for medical professionals to learn new or advanced skills through supervision by more experienced colleagues, and this phenomenon is growing ever more common in wound care.

But the wound care program at Emory University in Atlanta has given preceptorships a little twist. The school offers preceptorial programs not only to clinicians, but also to people who work in the nonclinical side of the wound care industry, such as sales and marketing representatives.

"We started the program so that [industry representatives] could get a better understanding of how their products fit into wound care programs and how they could position their products when they discuss them with wound care clinicians," says **JoAnn Waldrop**, MN, RN, CWOCN, assistant program director at Emory's Wound, Ostomy Continence Nursing Education Center.

Waldrop says many industry representatives are experts on their own products, but often do not understand how their products fit into the larger wound care picture and how they might affect outcomes in light of other variables.

For example, a sales representative who sells topical wound therapy products may get calls from users who didn't like the product because it didn't help the wound heal, explains Waldrop. "Often, the product didn't work because the wound etiology wasn't addressed adequately," she says. "There may have been a nutritional deficiency that slowed the healing process."

After completing the Emory program, the salesperson will have a better understanding of why (and when) that product might not be effective for wound healing, Waldrop adds. "They can ask questions about nutrition, whether there is an infection, if the wound is under compression, etc. They can quiz the nurses about other problems that might interfere with the action of their product."

Occurrences of skin breakdown

A typical course outline includes an overview of skin breakdown problems, anatomy and physiology of healthy skin, the nursing implications of wound healing physiology, nutritional support for wound healing, partial-thickness lesions, pressure-shear injuries, establishing prevention protocols, appropriate use of support surfaces, staging and management of chronic wounds, arterial and venous ulcers, neuropathic ulcers, and principles and products of topical therapy. The longer programs also might cover surgical options in wound care and adjunctive therapies.

Waldrop stresses that the industry preceptorship can be tailored to the needs of the participants by adding or deleting subjects from the course outline. The course sometimes evolves while it progresses as new areas of interest or concern emerge among the participants. "We try to focus on how their products fit into the overall wound care mixture," she says.

Typically, the program works best for small groups. For preceptorships that contain a clinical component, class size is limited to a maximum of eight participants. Otherwise, up to 20 participants can be accommodated. The school provides all class materials.

For obvious reasons of competitive conflicts, courses are held for one company at a time. "It wouldn't be as open a forum if we had people from different companies present," Waldrop says.

Emory offers three industry preceptor program options:

- a two-day program that is entirely didactic;
- a three-day program that includes two days of didactic instruction and two half-days of clinical observation;

• a four-day program that includes two and a half days of didactic instruction and one and a half days of clinical observation.

The cost of the two-day program is a flat $2,500 for a group. Costs for the didactic/clinical programs run about $150 a day per attendee.

According to Waldrop, companies such as Smith & Nephew, Coloplast, Convatec, and Kimberly-Clark have sent representatives to Emory's industry preceptorial programs. ■

Product POINTERS

Planimetry is best way to measure wounds

By **Liza G. Ovington**, PhD, CWS
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Wound healing often is expressed as a change in area over time. Ongoing measurement of the dimensions of a wound is critical in order to gauge healing progress in response to treatment or to compare healing effects of two different treatments. Payers and regulators also are interested in wound measurements as indicators of treatment efficacy.

Wound measurement also is inherently difficult. Wounds are three-dimensional; they possess area and volume. The most accurate way to assess these dimensions often is not the most convenient for clinical usage. Many of the measurement methods commonly used are not entirely accurate and may not capture the full extent of the healing response.

For example, it is common to measure a wound's length, its width, and its depth. However, wounds — especially chronic wounds — very rarely have uniform length, width and depth; they have irregular borders and may be shallow in one area and deep in another. They may even possess shelves and tunnels. So where should the measurement be taken for each of three irregular dimensions? General practice is to measure the longest length, widest width, and deepest depth. The location of these sites is rarely marked in any way to allow subsequent measurements to be taken in the same locations.

Tracing wound margins

Even if the measurements were taken in the same place each time, multiplying length and width to determine wound area overestimates the size of the wound unless it is a square or rectangle. A mathematical correction factor can be applied to the area to better approximate wounds that are oval or round.

A more accurate method of determining wound area is tracing of the wound margins onto a clear plastic film. The tracing can then be measured by planimetry to derive the area. If the tracing is made onto a material of uniform density, it also may be cut out and weighed to give an indication of wound area. Finally, the tracing can be superimposed over a grid or graph paper and the squares encompassed by the tracing counted to reflect the area. All of these steps subsequent to the actual tracing of the wound edges require time. Frequently, a tracing is simply compared to its predecessor for a qualitative indication of healing.

Performing and retaining the wound tracing present sterility issues. There are several tracing devices that consist of a double layer of clear, sterile material. Once the material has been placed on the wound for tracing, the layer that contacted the wound can be removed and disposed of, while the top layer containing the tracing is retained for subsequent analysis or placed in the chart. A nonsterile, low-tech version of a tracing device is a plastic sandwich bag, where the side of the bag that touched the wound is simply cut away after the tracing.

Photographs also may be used to determine wound area if the focal distance is uniform from one photo to the next or if a standard area reference unit is included in the photograph. After the wound is photographed, the image can be digitized to reflect the wound area. This method has an advantage in that it requires no wound contact and may show promise as digital cameras and software become more affordable.

Making wound impressions

Wound area is only part of the story in wound measurement. Full-thickness wounds have appreciable depth, and that dimension also must be followed. Also, wounds occur on sites that have surface curvature, such as lower extremities, and this affects volume measurements.

Multiplying length times width times depth to estimate wound volume is problematic. Wounds are more often bowl-shaped as opposed to having walls that are

Commercially Available Products for Wound Measurement

Product	Company	Information Line
Carrington Rule	Carrington Labs	(800) 358-5205
Dermassist Wound Measuring Guide	Assistec Medical	(800) 224-4488
Disposable Measuring Guide	Trademark Medical	(800) 325-9044
E-Z Graph Wound Assessment System	EZGraph of Victoria	(800) 975-9528
Measure-it	Dumex Medical	(800) 463-0106
MediRule, MediRule II	Briggs Corp.	(800) 247-2343

perpendicular to their base. It is possible to get a more exact assessment of wound volume by filling the wound with a material that hardens and can be removed — such as dental impression material (vinyl polysiloxane, alginate gels). Once the mold of the wound is removed, it can then be weighed or used to displace a measured amount of water in a calibrated container to indicate an accurate wound volume. However, such molds are time-consuming to make and may be considered to be invasive. Alginate volume molds are a popular wound measurement method for use in clinical trials, but rarely are used in daily practice.

Wound volumes also can be measured accurately with devices that utilize laser light and cameras to image the wound. Such devices are not yet in mainstream use, but show promise for the future in terms of their potential accuracy and the fact that they require no wound contact.

None of the methods of wound measurement mentioned here adequately address wound undermining or tunneling. Such features must be assessed using gentle, cautious probing of the wound and a linear measuring device. Whatever method of wound measurement is utilized, it is important to maintain consistency from one assessment period to the next. ■

Future dressings will test the limits of functionality

Using liquid materials to prevent trauma

What will wound dressings of the future look like? How will they enhance wound care or decrease costs of treatment? Will they be significant improvements over currently available options?

Ben Peirce, RN, CCN, clinical manager of the wound program at Columbia Homecare Resource Center in Ft. Lauderdale, FL, offered *Wound Care* a few historical perspectives and some predictions about the future of wound dressings.

Until the 1950s, researchers had not figured out that the micro-environment of a wound — or what you put on it or in it — measurably affected healing rates, Peirce says. Prior to that period, wound dressings were little more than adaptations of natural materials used to absorb fluid and to protect the wound from contaminants.

In a landmark 1962 article in the journal *Nature*, researchers found that if the micro-environment of a wound was controlled (e.g., kept moist), the healing rate increased. This finding led to what turned out to be an explosion in the types and formulation of dressings that are designed to control local environmental factors of a wound. These dressings now make up the bulk of "standard" wound dressings.

For the future, Peirce predicts several trends and directions that dressings for chronic wounds will take. Some are truly cutting-edge developments, while others are just combinations of existing materials that result in an improved product.

• There will be an increasing number of sophisticated composite dressings that combine properties of films, colloids, hydrogels, and alginates.

"The common thread is functionality: extending wear time and allowing for simpler dressing application," says Peirce. "Manufacturers are attempting to use these combinations, and many are coming up with combination dressings that defy categorization, but the bottom line is to increase ease of use and to extend wear time, thus cutting down on the frequency of dressing changes." The attractiveness of those qualities is, of course, to reduce personnel cost associated with dressing changes.

• Peirce predicts that the wound care community will see more utilization of liquid materials that dry into the top layers of skin, such as liquid polymers applied to intact skin to prevent trauma caused by

adhesives. Other liquid applications will protect skin from chemical exposure from wound drainage, urine, and feces.

"I think [liquids] will become more and more effective. Often, they'll be used around stage I wounds and on intact skin where the surface has suffered some injury," Peirce says. "The idea is to stop the problem before it begins or to stop a wound's progress early."

Clinicians also should expect such liquids to become available more often in the form of sprays and wipes, which are easy to apply and whose application is easy to teach to students.

Do growth factors accelerate healing?

• **One trend headed for expansion is dressings that are able to deliver chemicals, such as silver or iodine, to wounds.** Even more advanced will be delivery of growth factors or cytokines via wound dressings to stimulate the healing process in wounds, Peirce says. Curative Inc., which runs a nationwide system of wound care clinics, already uses autologous growth factors aggressively for its chronic wound patients.

"We'll see more of these kinds of products," says Peirce. Products such as Regranax (an altered form of yeast that produces platelet-derived growth factor and is applied topically) grew out of oncology research in the 1980s in which neo-angiogenesis was found in some tumors that stimulated the formation of new blood vessels.

Some clinicians say there is a normal healing rate that cannot be exceeded, regardless of what chemical aids are used. But others claim growth factors do accelerate healing. "This is a very controversial area," Peirce says.

• **Skin equivalents will play an ever-more important role in wound care.** These compounds are grown on matrices or lattices and seeded with fibroblasts and other cells found to be important in wound healing. Some could be thought of as "growth factor factories."

Because skin equivalents are grown in sheets, surgeons who are adept at using skin grafts already are technically prepared to apply them. Skin equivalents often can be applied in an outpatient setting without the need to harvest skin grafts.

• **Other types of dressings to keep an eye out for are "smart dressings" that are designed to adjust the amount of fluid they allow to pass through them to accommodate a wound's tendency to change the amount of exudate it produces.**

• **From a marketing perspective, wound care dressings are entering an "adult" phase, with more consolidation not only of dressing types but of dressing manufacturers as well.** "The big motivating factor is the change in reimbursement, so you have to choose wound dressings based on clinical trials that show them to be more cost-effective," says Peirce. Effectiveness may mean ease, minimal staff time required, or superior outcome, and may not be based solely on cost. An expensive dressing may be the best choice from a clinical and economic standpoint if it doesn't require much attention from skilled health care professionals to apply, maintain, or change.

"The least expensive dressing may not be the most cost-effective," says Peirce. "We're trying to 'de-skill' the use of these dressings, and I think that's going to be good for society." ■

Topical skin adhesive excels in cosmetics trial

FDA approves product to replace sutures, staples

A study appearing in *Plastic and Reconstructive Surgery* highlights findings from a one-year period that show patients treated with Dermabond, a topical skin adhesive, experience superior cosmetic outcomes compared to patients treated with sutures.

Dermabond adhesive, according to its manufacturer, is designed to replace sutures, staples, and adhesive strips for closing certain topical incisions and lacerations. It is the first such product to be approved by the Food and Drug Administration for the U.S. market.

Dermabond is licensed by Closure Medical, which gave marketing and distribution rights to Ethicon Inc.

One hundred eleven patients participated in the trial, which was conducted in a facial plastic and reconstructive surgery setting. Patients were assigned to two groups: those with wounds requiring subcutaneous sutures or wounds without subcutaneous sutures. The two groups were then randomized to receive treatment with either Dermabond or sutures.

Surgeons rate one-year post-op photos

At one year after surgery, photos of the healed wounds were given to two independent facial plastic surgeons who were unfamiliar with the study design. They were asked to rate the appearance of the healed incisions.

Each surgeon was asked to rate the cosmetic result using a visual analog scale, which is more specific than the scale used at 90 days during a clinical study submitted to the Food and Drug Administration. At

one year post-treatment, the two plastic surgeons, after evaluating the photos, concluded that the group treated with the adhesive had better cosmetic outcomes than the group treated with sutures. In addition, there were no instances of wound dehiscence, hematoma, or infection among the group treated with the adhesive.

"The advantages of tissue adhesive in skin closure are significant to both patients and physicians, providing faster, relatively painless closure as compared to sutures," says lead author **Dean M. Toriumi**, MD, associate professor in the Division of Facial Plastic and Reconstructive Surgery at the University of Illinois in Chicago. "Our study finds that in certain applications and with proper wound management, tissue adhesive also provides a better cosmetic result than sutures. This is particularly important for use in surgical procedures on the head or face, where scarring is an important consideration."

Dermabond is intended for topical application to close easily approximated skin edges of wounds from surgical incisions, including punctures from minimally invasive surgery, and simple, thoroughly cleansed trauma-induced lacerations. The manufacturer warns that the product should be used in conjunction with, but not in place of, subcuticular sutures when they are required.

The company also stresses that the adhesive must not get into the wound or be used beneath the skin. It should not be used across areas of skin tension, such as knuckles, elbows or knees, unless the joint will be immobilized during the wound healing process. Dermabond adhesive should not be used on patients with a known hypersensitivity to cyanoacrylate or formaldehyde, or on any wounds with visual evidence of active infection, gangrenous wounds, or wounds from decubitus ulcers. It also should not be used on mucosal surfaces or internally.

Ethicon estimates that skin closure products could be used in approximately 90 million procedures, and that annual suture and staple sales total $2.6 billion. ■

CE objectives

After reading this issue of *Wound Care*, wound care professionals will be able to:

- cite the drawbacks of silver sulfadiazine cream for wound care;
- identify particular management, clinical, educational, and financial issues relevant to wound care;
- explain how those issues affect wound care providers and patients;
- describe practical ways to solve problems that wound care providers commonly encounter in their daily activities. ■

The Wound Calendar

The Sixth NPUAP National Consensus Conference will be held Feb. 26-27, 1999, in Orlando, FL. For more information, contact Sharon Baranoski at the NPUAP. Telephone: (815) 740-1078.

If you have a conference, seminar, or other wound care-related event you would like listed in the Calendar, please send the information to: Wound Care, P.O. Box 740056, Atlanta, GA 30374. ■

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70% of octogenarians suffer dual chronic illness

Roughly 70% of Americans over 80 have at least two coexisting chronic conditions, such as arthritis and diabetes, according to **John Wasson**, MD, of Dartmouth (NJ) Medical School.[1] All too often, these patients' needs are not adequately being met.

The 80+ Project, which Wasson heads, gathers information on this growing segment of the population to give providers and case managers the information necessary to improve quality of care for the elderly.

Researchers with the 80+ Project examined the extent to which health system encounters addressed patients' needs. They conducted a telephone survey of 834 randomly selected members of a New England health system. Respondents reported frequent contact with the health care system. Researchers found:

- 93% had seen a doctor in the last six months.
- Roughly 20% had been hospitalized in the preceding six months.
- 97% of respondents had a primary care physician who was a generalist.
- 10% reported trouble getting care or delays in care due to cost barriers.
- 22% reported structural barriers to care, such as difficulty in getting an appointment.
- Of the 25% of respondents who reported having at least one of nine common geriatric problems, such as diabetes, 23% reported that they had not received treatment for those problems.
- 24% reported financial difficulties.
- 25% reported problems with activities of daily living.

The researchers found that insurance, a regular source of care, and a generalist primary care physician were not enough to ensure access to effective health care in the elderly.

Reference

1. Bierman A, Magari ES, Jette AM, et al. Assessing access as a first step towards improving the quality of care for the very old. *J Ambulatory Care Management* 1998; 21:17-26. ■

Coming in Future Issues

- Therapy for burn victims makes tremendous strides
- New antibiotics targeted for wound infections
- Wound infection: Can you recognize the signs?
- Do magnets heal wounds, or is it just a hoax?