# Wound care in the dermatology office: Where are we in 2011?

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Dermatologists perform several minor surgical procedures in their offices on a daily basis that result in superficial cutaneous wounds. Conventionally, the approach to postoperative care for these superficial wounds has been the application of a topical antibiotic ointment. In reality, this practice is based more on perception and habit, and not on sound scientific evidence, especially regarding reduction in postoperative infection rates and risk of adverse reactions. In addition, the routine use of a topical antibiotic in this scenario may contribute to the emergence of antibiotic-resistant bacterial strains, and has been shown to increase the risk of allergic contact dermatitis. With few new antibiotics in development and several worldwide initiatives to curb the increase in antibiotic resistance in progress, it is important that clinicians reevaluate the standard postoperative wound care that is used after superficial office-based dermatologic procedures. (J Am Acad Dermatol 2011;64:S1-7.)

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It has been estimated that 50 million elective surgical incisions are made each year in the United States.[1] Dermatologists perform in excess of 25 million minor surgical procedures annually, with this number increasing every year.[2,3] Commonly performed dermatologic procedures, including curettage, shave or saucerization procedures, biopsies, and cryosurgery are performed multiple times each day in essentially all dermatology offices. Many dermatology practices regularly incorporate cosmetic procedures such as laser resurfacing and skin peels. All of these procedures create superficial cutaneous wounds, which require rational postoperative care to ensure a satisfactory outcome for the patient (Table I).

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The care of superficial wounds created by health care providers under aseptic conditions has typically involved the use of a topical antibiotic.[4,5] In fact, the routine use of topical antibiotics after a superficial dermatologic procedure is thought to be both unnecessary and not recommended, based on more recent evidence that takes into account the vast number of superficial dermatologic procedures performed in ambulatory practice, the very low risk of postoperative infection, the lack of evidence demonstrating prevention of infection, and the relatively common occurrence of allergic contact dermatitis with the use of bacitracin and neomycin.[6-9] Resistance to topical antibiotics is a continually emerging issue in the dermatology community.[10] Despite growing concerns regarding the increase in antibiotic resistance, current wound care practices used by many practitioners are based on habit rather than evidence-based medicine. Given this, it may be time we step back and review how we got to our current standard of care, and examine more closely why and how we should modify our approach to topical wound care.

## ORIGINS OF WOUND CARE

The care of wounds has evolved over the centuries as new discoveries have been made. These include advances in the understanding of the mechanisms of wound repair and the causes of wound complications and the development of new treatments and procedures for wound care.

During the Renaissance, wound care was predominantly left to the "barber-surgeons," considered lower-class practitioners compared with physicians

and surgeons. Wound care practices were frequently based on superstition, anecdotal advice, and personal experience.[11] Advances in wound management came predominantly from the treatment of battlefield wounds. The standard of care at the time was to treat gunshot wounds with boiling oil, thought to cure the patient of the alleged poison contained in gunpowder. Because of a dwindling supply of oil in one battlefield "hospital," Ambroise Paré, often considered one of the fathers of surgery, used an ancient Roman remedy containing turpentine, egg yolks, and oil of roses to treat firearm wounds. The mixture both relieved the pain and sealed the wounds, with the turpentine providing antiseptic properties, whereas those treated with boiling oil remained in agony. Realizing that the boiling oil not only was of no benefit, but was actually harmful, Paré put an end to this tortuous practice.[11]

Before the mid-19th century, surgical wounds frequently became infected, resulting in sepsis and often death.[12] Over the years, the relationship between micro-organisms and infections was elucidated and various measures were introduced to reduce the risk of infection. In the 19th century, Ignaz Philipp Semmelweiss developed the first sterile surgical techniques, observing that infectious diseases could be passed between patients through contaminations on the physicians' hands, and washing them in chlorinated lime could dramatically reduce death rates.[13] Although micro-organisms were first visualized under a microscope during the Renaissance period, they were not linked to the cause of infections and disease until the time of Louis Pasteur and Robert Koch whose work convinced the medical community of the credibility of the germ theory.[14] Joseph Lister took the findings of both Pasteur and Semmelweiss and pioneered the aseptic techniques used in surgery today. These techniques included sterilizing equipment, surgical instruments, and the operating room; wearing gloves; and washing hands before and after surgery.[15,16]

The mechanism of wound healing was further elucidated in 1910 when the Nobel Prize winner Alexis Carrel divided acute wound healing into 4 sequential, yet overlapping, phases: (1) hemostatic, (2) inflammatory, (3) proliferative, and (4) remodeling.[1] Once it was realized that infection impairs the normal mechanism of wound healing, prophylactic antibiotics were introduced as part of normal wound care.[17]

Several experiments conducted in the 1960s and 1970s investigated the use of topical antibiotics at reducing infection rates. One study looked at 6419 surgical wounds created during a 4-year period. These were incisional wounds, of at least 3 inches in length, created during predominantly clean, elective surgery. Using a pressurized powder spray of neomycin-bacitracin-polymyxin sprayed periodically into the wound during the course of surgery, infection rates were reduced from 5% to 10% down to an average of 3.3%, with annual infection rates continuing to decrease, and reaching just 1.8% in the final year of the investigation.[18] In 1969, Heisterkamp et al[19] compared tetracycline spray, neomycin-bacitracin-polymyxin spray, and vehicle for the treatment of 255 wounds in a war zone where conditions prevented wound debridement. Antibiotic treatment significantly reduced the incidence of infections compared with vehicle (16% vs 39%, respectively). During the 1970s, several groups reported a similar reduction in infections of surgical wounds treated with various antimicrobial sprays.[20,21] The findings from these studies led to the adoption of prophylactic topical antibiotics as part of the standard of care for surgical procedures.

A relatively recent advance in the care of wounds was the finding that keeping the wound moist promotes re-epithelialization and accelerates healing.[22,23] When applied to superficial wounds, moisture-retentive dressings and ointments have been shown to heal an average of 3 to 4 days faster than wounds that were either exposed to air[22,23] or dressed with conventional gauze.[24] The use of occlusive dressings has also been shown to speed re-epithelialization in superficial wounds such as those caused by shave biopsies.[25]

Today, the principles of topical wound therapy involve elimination of necrotic tissue, control of bacterial loads, management of wound exudate, maintenance of open proliferative wound edges, and provision of a moist and protected wound surface (Table II).[26,27] In the dermatology office, the standard of care for the vast majority of minor superficial wounds resulting from removal of benign neoplasms includes cleaning the wound with either a cleanser or irrigation, applying a topical antibiotic ointment, and covering the wound with a dressing.[4,28]

There are a few procedures such as laser resurfacing for which there is no well-established standard of care for the treatment of wounds,[29] and treatment is directed by individual circumstances. For example, occlusive dressings might be used for ablative resurfacing procedures, whereas for nonablative procedures, open wound care with an occlusive topical agent is far more convenient and appears to be sufficient to achieve rapid, safe healing with a good cosmetic outcome. Medical device emulsions and topical ointments are commonly used for such cases. Typically, the area of the

**Table I.** Common procedures that result in superficial wound

| |
|---|
| Curettage |
| Shave, saucerization, or punch biopsy |
| Electrodessication |
| Laser resurfacing |
| Cryosurgery |
| Skin peels |

**Table II.** Principles of wound care[26]

| |
|---|
| Remove impediments to repair |
| Debride necrotic tissue |
| Identify and treat infection |
| Wick and absorb exudate |
| Eliminate trauma to wound bed |
| Maintain an environment conducive to repair |
| Maintain moist wound surface |
| Maintain open wound edges |
| Insulate wound |

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wound is quite large and nasal bacterial carriage is a concern; therefore it is perceived the risk of infection is high. However, topical antibiotics are not generally used because of the large treatment area and concerns of allergic contact dermatitis. Therefore, a systemic antibiotic and an oral antiviral (particularly for patients with a history of herpes labialis) are frequently given to these patients.

## ANTIBIOTIC RESISTANCE IS INCREASING

Overuse and misuse of antibiotics have increased the incidence of bacterial strains that are less sensitive to many antibiotics (antibiotic resistance). As early as 1945, Sir Alexander Fleming stated during his Nobel Prize lecture, "It is not difficult to make microbes resistant to penicillin in the laboratory by exposing them to a concentration not sufficient to kill them."[30] Currently, no antibiotics exist to which bacteria have not developed resistance.

Antibiotic resistance has increased alongside the increase in antibiotic use in the general population. The emergence of antibiotic-resistant strains such as methicillin-resistant *Staphylococcus aureus* (MRSA) is a significant cause of mortality in many developed nations. Systemic MRSA infections have been estimated to cause 700 to 1500 deaths per year in Germany.[31] From 2004 through 2008, deaths caused by MRSA were between 1138 and 1652 each year in England and Wales, United Kingdom.[32] In the United States, the estimated number of MRSA-related hospitalizations between 1999 and 2005 more than doubled, from 127,036 to 278,203, and the number of MRSA-related deaths averaged approximately 5500 per year.[33]

As new antibiotics are introduced, resistance progressively develops, and in some cases emerges rapidly. For example, one surveillance study showed that the percentage of MRSA isolates that were resistant to mupirocin increased from 1.6% between 1995 and 1999 to 7.0% between 2000 and 2004.[34] As resistance develops, health care providers have logically and predictably moved on to the next available antibiotic that promises to be even more effective than the previous; however, there is currently a conspicuous absence of new antibiotics coming forth to replace the old ones.

Widespread concerns about the emergence of resistant strains of bacteria have led to several public health initiatives to reduce the use of antibiotics. In 1999, the Food and Drug Administration, along with the Centers for Disease Control and Prevention (CDC) and the National Institutes of Health, formed the US Interagency Task Force on Antimicrobial Resistance. In 2001, this task force published the "Public Health Action Plan to Combat Antimicrobial Resistance." Part of this campaign is to educate consumers and health care professionals on the appropriate use of antibiotics and measures to reduce the incidence of infection in the first place.[35]

The CDC guiding principles for maximizing the safety and effectiveness of surgical antimicrobial prophylaxis state that antimicrobial prophylaxis should be used for procedures that carry a risk of infection and have evidence to support that administration of antimicrobial prophylaxis reduces the risk of infection.[12,36]

In 2001, the World Health Organization launched the Global Strategy for Containment of Antimicrobial Resistance. This initiative depicts several strategies to help stem the growing problem of antibiotic resistance. Specific recommendations included using alternatives to antibiotics to reduce infection, appropriate selection and use of antibiotics, and education of patients on the importance of compliance when using antibiotics.[37] Campaigns that have targeted the public and physicians simultaneously have been effective in reducing the use of antibiotics.[38] In Slovenia, restrictions placed on antibiotic use reduced consumption by 20% between 2000 and 2007.[39] France has launched campaigns to preserve the efficacy of antibiotics and to counteract the spread of MRSA and *Streptococcus pneumoniae*.[40] These educational campaigns aimed at the public and practitioners have successfully reduced the levels of resistant bacteria, although there is still a long way to go. The outcome of many of these

initiatives in terms of increasing antibiotic-susceptible strains of bacteria is still unknown. What is known is that antibiotic overuse and misuse leads to a marked increase in resistant strains of bacteria, and these practices need to be modified before the problem can be resolved.

According to antibiotic prescribing data from 2003, dermatologists prescribe 8 to 9 million oral antibiotics and 3 to 4 million topical antibiotics annually.[41] Some of these prescriptions are for prophylactic purposes, given to patients after minor surgical procedures to prevent infections, rather than to treat existing infections. To conserve the efficacy of currently available antibiotics, it needs to be determined if these wounds carry a risk of infection and if prophylactic antibiotic use can substantially reduce this risk, especially in the setting of outpatient dermatology practice.[42]

## INFECTION RATES VERSUS STANDARD OF CARE

The most common source of surgical site infections is micro-organisms on patient skin,[43] an estimated 50% of which are caused by the skin bacterium *Staphylococcus aureus*.[44] Infection is caused by an imbalance in the level of bacteria present in the wound. Bacterial colonization greater than $10^5$ organisms per gram of tissue is generally considered to tip the balance toward infection.[1] The goal of prophylactic antibiotic administration is to decrease the risk of contamination of the wound from the existing skin flora.[36] However, is the overall risk of such contamination high enough after performance of superficial dermatologic procedures to warrant routine use of postoperative antibiotic therapy, including with a topical agent?

The ensuing obvious question is, "So, what is the risk of wound infection after performance of dermatologic procedures that produce a superficial wound?" The risk of developing surgical site infection depends on the type of surgical wound, its location, the health status of the patient, and the duration of the operation.[45] According to the 1985 CDC guidelines for prevention of surgical wound infections, wounds created in a dermatology office would be graded as class I wounds, ie, these are wounds on clean, noncontaminated skin, made under aseptic conditions.[7] Postoperative infection rates for these dermatologic procedures have been reported to be approximately 1.3%.[46-49] One of the primary causes of postoperative infections is suboptimal skin antisepsis both before and after procedures,[43,44] indicating that adherence to aseptic techniques is key in reducing infection rates. Careful preparation of the skin with an appropriate antiseptic is essential.[44]

The risk of postoperative infection has been shown to correlate with increasing length of the surgical procedure.[45] The types of commonly performed superficial procedures carried out in dermatology offices are typically performed over a duration time of a few to several minutes. Laser resurfacing of the perioral area typically takes around 10 minutes, whereas a full facial resurfacing treatment would take 20 to 30 minutes. Thus, the risk of infection for most in-office surgical procedures is very low. Mohs micrographic surgery may be an exception in that this procedure requires the wound to be left open during histologic confirmatory testing that may need to be repeated until all cancerous cells have been removed. This procedure may take up to several hours depending on the number of stages needed; however, postoperative infection rates for Mohs micrographic surgery have been reported as 1.1 to 2.45%.[48,50]

Modern preoperative aseptic procedures such as surgical site preparation and hand washing have reduced infection rates to the extent that prophylactic antibiotics are no longer necessary, and may do more harm than good.[1] This observation is clinically relevant especially in regard to most commonly performed office-based dermatologic procedures. In addition to the potential for increasing antibiotic resistance, some topical antibiotics are well-recognized causes of allergic contact dermatitis, particularly when used on compromised skin. The incidence of allergic contact dermatitis to neomycin and bacitracin has been reported as 7.2% to 13.1% and 1.5% to 9.1%, respectively.[51] The North American Contact Dermatitis Group has reported both of these antibiotics as consistently being in the top 10 contact allergens over the last 10 years.[52,53] A comparison of 1249 superficial wounds in 922 patients treated with either bacitracin ointment or white petrolatum showed statistically equivalent infection rates between groups (4 [0.9%] vs 9 [2.0%], respectively).[54] Notably, the exact same number of patients treated with bacitracin who developed an infection developed allergic contact dermatitis (0.9%), whereas no patients treated with petrolatum developed allergic contact dermatitis.[54] In addition, wound infections occurring at sites treated with bacitracin ointment were commonly infected with gram-negative pathogens, a finding that supports antibiotic selection pressure and that may require more complicated forms of treatment. This evidence challenges the routine use of prophylactic antibiotics as the standard for postoperative care for superficial wounds occurring after

commonly performed office-based dermatology procedures.

Numerous guidelines and reviews have stated that antibiotic prophylaxis of class I wounds is not necessary.[6-9] Clean wounds with negligible bacterial bioburden do not benefit from use of prophylactic antibiotics.[8] Despite the evidence, the guidelines, and the recommendations, many dermatologists continue to use and recommend topical antibiotics for the treatment of these minor superficial wounds.

## THE FUTURE OF WOUND CARE: 2011 AND BEYOND

In 2005, the National Surgical Infection Prevention Program was initiated to decrease the incidence of infections in major surgical procedures. The success of this program was based on improved timing of antibiotic administration, appropriate drug selection, and the reduction in the needless use of antibiotics postoperatively.[55] Although this program was directed at higher-risk surgical procedures, all wound care could benefit from adopting these measures.

In 2011 it is appropriate to re-examine standard postoperative wound care after commonly performed office-based dermatologic procedures based on the best current evidence that is relevant to this setting. To complete this task, specific objectives must be kept in mind. These objectives are to: (1) provide effective wound healing; (2) avoid adverse sequelae (ie, side effects such as contact dermatitis); and (3) rationally incorporate use of antibiotics when they are needed. The latter objective requires acceptance of 3 important observations. First, routine postoperative topical antibiotic use has not been scientifically shown to reduce the risk of infection. Secondly, many topical antibiotics used postoperatively increase the risk of allergic contact dermatitis, especially with neomycin and bacitracin. Third, avoiding routine prophylactic topical antibiotic use for superficial postoperative skin wounds may reduce the emergence of antibiotic-resistant bacterial strains. With regard to reducing antibiotic resistance, it has been shown in many countries that educating the public and health care communities can be effective at reducing antibiotic use.[38] Evidence has shown that rational reduction in antibiotic use can lead to a rebalancing and re-emergence of more antibiotic-sensitive strains of bacteria coupled with reductions in resistant strains.[56]

There are some wounds for which prophylactic antibiotic use may be appropriate and should be considered. Certain anatomic locations such as the distal lower extremity or the groin and reconstructive surgical procedures appear to be associated with a higher risk of postoperative infection.[7] For wounds that have a higher infection risk, topical antibiotic use may be limited to a few days (depending on the size and rate of re-epithelialization) before switching to an antibiotic-free topical agent that provides moist wound care. It has been demonstrated that prophylactic antibiotic regimens exceeding 48 hours provide no additional benefit as compared with a shorter course of prophylaxis.[10]

The majority of superficial wounds caused by office-based dermatologic procedures can be appropriately treated simply by providing a moist healing environment. Comparative wound-healing studies have demonstrated that petrolatum-based or paraffin-based products produce equivalent healing compared with topical antibiotics, are associated with a low rate of postoperative infection, and do not induce allergic contact dermatitis.[54,57] New topical medical device emulsions are coming onto the market with claims to improve re-epithelialization and to speed healing. Although these products are gaining approval as medical devices based on current device approval standards, data are needed to demonstrate whether there is superior efficacy and safety in the management of specific wound types relative to existing and less expensive options.

It is important that dermatologists keep an open mind and be willing to rethink "recycled dogma" when emerging evidence effectively challenges why certain approaches to treatment are chosen. In the case of topical wound management after performance of superficial office-based dermatologic procedures, there are several valid reasons to reconsider our approach. Routine application of topical antibiotics to superficial postoperative wounds has not been shown to markedly impact the potential for wound infection. Moreover, this practice increases the risk of allergic contact dermatitis and may contribute to the emergence of antibiotic-resistant bacterial strains. Simple wound care using nonantibiotic topical agents that maintain a moist wound environment has been shown to effectively promote wound healing without causing adverse sequelae such as allergic contact dermatitis and antibiotic resistance.

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