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Sensors and cannulas:

keys to preventing skin lesions and ensuring continued use of diabetes technology

When a person with type 1 diabetes uses glucose sensors or insulin pumps, the skin ceases to be merely a surface and becomes an active part of treatment. If the skin becomes irritated or macerated, is painful, heals poorly, or develops an allergy, continuity of technology use and, at times, clinical effectiveness may be compromised. (1).

THE SKIN IS ALSO PART OF TREATMENT

The success of diabetes technology does not depend solely on the system, sensor accuracy, or type of cannula. It also requires the device to be applied to healthy skin, tolerated for the intended period, and removed without causing lesions that make subsequent use difficult. Cutaneous and subcutaneous complications include contact dermatitis, lipodystrophy, inflammatory lesions, wounds, scars, erythema, pruritus, and infections, and they may reduce tolerance, adherence, and glycemic control. For this reason, the 2024 *International Society for Pediatric and Adolescent Diabetes* (ISPAD) guidelines recommend assessing site selection and rotation, cutaneous and subcutaneous signs, insertion technique, and the use of adhesives or adhesive removers from the outset, whenever needed (2).

This explains why skin care should not be regarded as a secondary issue during consultations. In an international survey of professionals experienced in pediatric diabetes, contact dermatitis was the most frequently reported skin complication, and the authors concluded that considerable variability still exists in the prevention and day-to-day management of these problems. In other words, **the problem is common, important, and still managed inconsistently across centers** (3, 4).

Moreover, there is an emotional dimension. Recent studies show that device-related skin reactions increase mental burden, frustration, and distress among young users and their families, particularly when they force users to shorten the intended wear time or discontinue use because of repeated pain or pruritus. Therefore, caring for the skin is not merely a matter of "preventing marks"; it is also essential for protecting treatment continuity (5).

WHAT PROBLEMS OCCUR?

The most common problems are readily recognizable in both clinical practice and daily life: pruritus, redness, stinging, eczema, superficial wounds, scars, discomfort during adhesive removal, and lipohypertrophy at sites used repeatedly for insulin administration (6). In the 2025 multinational SKIN-PEDIC study, which included a total of 1,719 children and adolescents from 22 centers, skin problems were observed in 52% of insulin-pump users and 30% of sensor users. Eczema occurred in approximately 9% of users of both technologies, whereas scars, wounds, and lipodystrophy were more frequent at pump-catheter application sites (7).

This pattern is consistent with smaller studies that more closely reflect routine clinical practice. In a European observational study, no clear association was ever found with HbA1c or time in range, reminding us that skin lesions may go unnoticed without affecting glycemic control and that damage may accumulate even when glucose appears to be well controlled (5).

In adults, the 2023 CUTADIAB study provided data on symptoms that should raise suspicion of adhesive-related skin problems: 28% of sensor users and 29% of pump users experienced skin reactions. Among those affected, redness and pruritus occurred in 75%, pain in 25%, and vesicles or desquamation in 12% to 15%. In addition, although the reaction could begin within the first 24 hours, it could first appear after several months of use. This is an essential point, because a problem should not be ruled out merely because the person had "always tolerated" the device well (7).

IRRITATION OR ALLERGY

In practice, the key question is usually whether the reaction represents simple irritation or an allergy. The brief answer is that both occur, they may appear very similar, and they may even coexist (8). Irritation, or irritant dermatitis, results from the direct effects of accumulated moisture, persistent friction, macerated skin beneath the patch, or products that damage the skin barrier. Prior sensitization is not required; skin damage alone is sufficient. Allergy, by contrast, usually reflects an immune-system reaction to components of the adhesive or device, particularly acrylates and related compounds (6).

A simple distinction that can be explained to patients is as follows. When the skin reacts because it is excessively dry or damaged, improvement usually occurs after preparation of the area is modified, exposure to irritants is reduced, and the specific skin region is allowed to rest (4, 5). »

CUTANEOUS AND SUBCUTANEOUS COMPLICATIONS CAUSED BY SENSORS AND CANNULAS MAY REDUCE TOLERANCE AND ADHERENCE AND WORSEN GLYCEMIC CONTROL

ANATOMICAL AREAS EXPOSED TO CONTINUOUS FRICTION OR PRESSURE FROM CLOTHING SHOULD BE AVOIDED, BECAUSE REPEATED FRICTION AND PRESSURE PROMOTE BOTH ADHESION FAILURE AND SKIN INJURY

» When an allergy is present, the reaction may appear only after weeks or months of initial exposure—the period required for sensitization and development of an immune response—and may then recur more rapidly and with greater intensity after subsequent applications (6, 8). In a 2025 review of allergy to sensors and pumps, allergic dermatitis typically began after approximately 5 to 7 months of use of the causative device. Once sensitization had developed, flares after each new application usually appeared within 1 or 2 days. Clinically, allergic dermatitis usually presents as intensely pruritic eczema with borders that reproduce the shape of the adhesive. More severe cases may involve edema, vesicles, exudation, erosions, pain, secondary infection, or permanent skin marks (8).

This does not mean that all pruritus is caused by allergy. In fact, scientific studies emphasize that many lesions are irritant reactions and that a substantial proportion of patients with skin reactions have negative patch-test results, either because the problem is irritative or because the chemical composition of the device has not been fully disclosed by the manufacturer (4-8). Patch tests are non-invasive skin tests used to identify substances responsible for a possible contact allergy by applying patches containing allergens to the skin. This is one of the major current difficulties: manufacturers »

» do not always provide sufficient information to guide an accurate diagnosis, thereby delaying or complicating the assessment. When allergy is strongly suspected, referral to dermatology for patch testing remains the most useful standard approach (8).

HOW TO PREPARE THE SKIN BEFORE APPLYING A DEVICE

The best prevention begins before the adhesive backing is removed. The first rule is to select healthy skin. This means completely avoiding areas with wounds, scabs, cuts, pre-existing irritation, active eczema, ongoing healing, or severely damaged skin. Anatomical areas exposed to continuous friction or pressure from clothing should also be avoided, because repeated friction and shear forces promote both adhesion failure and skin injury. In practice, the insertion site, technique, and signs of skin problems should be assessed before each new device is applied (4).

The second rule is to clean without causing irritation. A Danish study published in 2023 is particularly relevant because it evaluated a basic skin-care program that included a repairing cream, careful removal, and avoidance of routine disinfection. The intervention reduced skin lesions without increasing infections, despite recommending that routine disinfection be omitted in the usual home setting. This does not mean that the skin should never be disinfected. Rather, when the skin is clean and the technique is correct, use of a disinfectant at home does not always provide greater safety and may increase dryness and irritation. In practice, washing with water and a syndet cleanser, removing grease or lotion residues, and drying the area completely usually provides gentler care of the skin barrier than repeated use of alcohol on skin that is already dry or sensitive (9). A syndet is a cleanser that does not contain traditional soap. It is formulated to cleanse the skin while better preserving its pH and natural barrier and is therefore widely recommended for sensitive, dry, atopic, or irritated skin.

The third rule is to adapt preparation to the skin type. When there is abundant hair, trimming it may improve adhesion and reduce pain during removal. When sweating is excessive or the adhesive tends to detach, »

» supportive products may be reasonable, but only after the skin has dried completely. In people who have already experienced mild reactions or have highly reactive skin, some guidelines allow the use of barrier films, intermediate dressings, supplementary adhesives, and adhesive-removal products in selected cases (4).

Barrier dressings may help prevent further skin reactions, and some studies have shown partial improvement, but they should not be recommended universally. In sensitized patients, certain hydrocolloid dressings containing rosin-related compounds may worsen the reaction. Their effectiveness is also limited: in the pediatric cohort reported by Passanisi et al., only 52.4% achieved complete resolution, whereas 38.1% discontinued the insulin pump and/or continuous monitoring. They should therefore be used judiciously, with careful monitoring of the skin response and referral when the reaction persists (8-10).

ROTATION, REMOVAL, AND CARE AFTER USE

Rotation is more than a logistical detail; it is a skin-protection measure. Rotating sites prevents repeated trauma to the same area, reduces the risk of scarring, limits the accumulation of tissue damage, and helps prevent lipodystrophy. Recent reports recommend using as many application sites as possible and positioning each new device several centimeters away from the previous site. Rotation is considered one of the cornerstones of education in glucose monitoring (4,5).

Moreover, its important to respect the intended wear time of each device. Sensors and insulin-pump infusion sets have wear times defined by the model and manufacturer. Extending their use may appear harmless, but it increases moisture, friction, loss of adhesion, and the risk of skin injury. Similarly, when signs of local inflammation, bleeding, or unexpected hyperglycemia occur despite a theoretically appropriate dose, the set should be replaced immediately rather than waiting until the scheduled wear time has elapsed (4, 5).

Removal deserves as much attention as insertion. The 2024 ISPAD guidelines recommend providing specific adhesive-removal products, particularly natural oils such as olive or coconut oil. The key is to avoid rapid pulling. The more fragile or dry the skin, the more important it is to peel the adhesive away slowly and progressively with the aid of an appropriate product. Afterward, adhesive residue should be removed with water and soap and/or vegetable oil, the area should be inspected visually, and a recovery period should be allowed before the same site is used again. If the skin is dry, moisturizing may help; if it is irritated, resting the site is the treatment (4-9).

WHEN TO SEEK MEDICAL ADVICE AND WHAT REMAINS UNCERTAIN?

There are situations in which self-care should give way to clinical assessment. The health care team should be consulted when the reaction recurs after every cannula or sensor replacement, worsens progressively, or causes intense pruritus. Furthermore, assessment is required for signs of severe dermatitis, including a clearly imprinted adhesive pattern, vesicles, exudation, erosions, ulcers, or scars, as well as increasing pain, redness, local warmth, pus, fever, persistent induration, marked lipohypertrophy, nodules, or repeated sensor or infusion failures without an apparent technical cause. When allergy is suspected, collaboration with dermatology and patch testing are the most appropriate means of identifying safe alternatives (8).

Current evidence strongly supports several clinical recommendations for maintaining skin integrity: nonirritating cleansing, thorough drying, rotation, avoidance of friction during dressing removal, and early referral when atypical reactions occur. Nevertheless, relevant uncertainties remain. Much of the available evidence is observational, and preventive measures are heterogeneous and difficult to standardize. In addition, certain empirical strategies—such as combining barrier products or using intranasal corticosteroids topically on the skin for an *off-label* indication—have shown promising preliminary results but lack sufficient evidence to support a universal clinical recommendation. A further structural barrier is the lack of transparency regarding the chemical composition of many adhesives and materials, which makes it difficult to establish the exact etiologic diagnosis and select a genuinely alternative therapeutic device (4, 6, 8). D

MUCH OF THE AVAILABLE EVIDENCE REMAINS OBSERVATIONAL; PREVENTIVE MEASURES ARE HETEROGENEOUS AND DIFFICULT TO STANDARDIZE

Image 1.

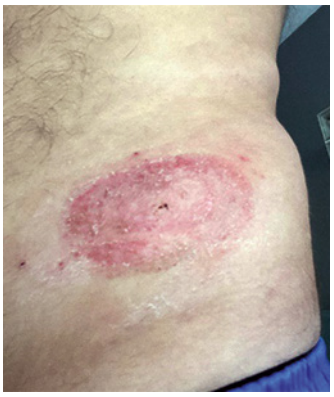

Image 2.

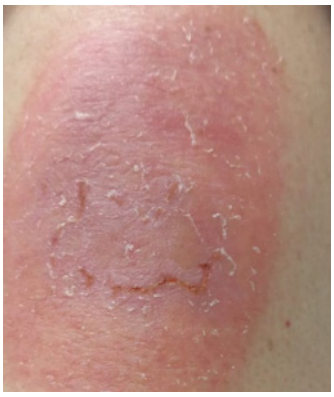

Image 3.

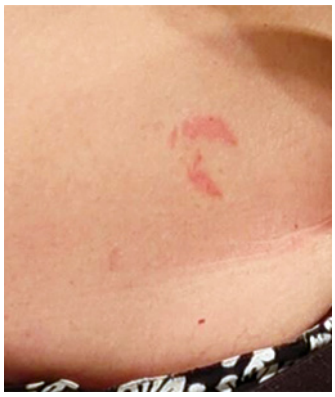

Image 4.

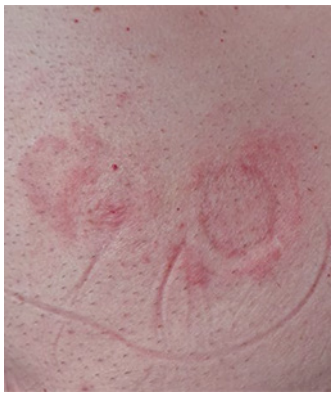

Image 1. Local skin reaction after use of a glucose sensor, with a well-demarcated oval erythematous plaque and signs of superficial irritation at the application site.
Image 2. Localized dermatitis at the device application site, with a well-demarcated erythematous plaque, superficial desquamation, and small central fissures/excoriations, compatible with irritant or allergic contact dermatitis.
Image 3. Localized erythema at a previous adhesive-device application site, compatible with superficial skin irritation associated with traumatic removal.
Image 4. Mild residual erythema at 2 insulin-pump infusion-set application sites, with a circular pattern compatible with a superficial local skin reaction.

CONCLUSIONS

The conclusion is practical rather than alarmist: most people do not need to discontinue the technology if they learn to care for and assess their skin with the same attention they devote to reviewing sensor trends. This helps improve tolerance to adhesives, promote skin repair, reduce wounds, and plan effective rotation. In diabetes, this translates into greater continuity of device use, fewer treatment interruptions, and improved sustainability of technologies that facilitate glycemic control.

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