

A Practical Approach to the Prevention and Management of Intertrigo, **or Moisture-associated Skin Damage, due to Perspiration: Expert Consensus on Best Practice**

Consensus panel

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Introduction

Moisture-associated skin damage and intertrigo

Moisture is an important risk factor contributing to the development of chronic wounds.¹ Excessive moisture on the skin for a prolonged period of time may result in a spectrum of reversible and preventable skin damage that ranges from erythema to maceration (increased stratum corneum moisture content) and erosion (loss of surface epidermis with an epidermal base). Erythema is the initial observable change in moisture-associated skin damage (MASD). Prolonged exposure to moisture may result in more pronounced inflammation or erosion, which may include both epidermal and dermal loss (dermal or deeper base in ulcers), creating a partial-thickness wound and a risk of secondary infection. MASD is distinct from damage due to pressure, vascular insufficiency, neuropathy, or other factors, but the development of a wound may be associated with several risk factors.

Consensus Statements

- 1. Moisture-associated skin damage:** Moisture is a risk factor for the development of chronic wounds that is distinct from other risk factors, including pressure, arterial insufficiency, venous stasis, and neuropathy.
- 2. Definition of intertrigo:** Intertrigo, or intertriginous dermatitis, may be defined as inflammation resulting from moisture trapped in skin folds subjected to friction.
- 3. Disease classification of intertrigo:** A disease code for intertrigo could improve diagnosis of the condition and support research efforts.
- 4. Epidemiology of intertrigo:** The true incidence and prevalence of intertrigo is currently unknown.
- 5. Risk factors for intertrigo:** The major documented risk factors for intertrigo include hyperhidrosis; obesity, especially with pendulous breasts; deep skin folds; immobility and diabetes mellitus; all risk factors are aggravated by hot and humid conditions.
- 6. Complications of intertrigo:** Secondary bacterial infection is a common complication of intertrigo that must be treated effectively to prevent deep and surrounding invasive infection.

- 7. Diagnosis of intertrigo:** The diagnosis of intertrigo is based on the history and characteristic physical findings supplemented with laboratory testing to rule out secondary infection.
- 8. Evidence for intertrigo treatment:** No well-designed clinical trials are available to support therapies commonly used to treat or prevent intertrigo.
- 9. Principles of management of intertrigo:** Prevention and treatment of intertrigo should maximize the intrinsic moisture barrier function of the skin by focusing on at least one of the following goals:
 - a. Minimize skin-on-skin contact and friction.
 - b. Remove irritants from the skin, and protect the skin from additional exposure to irritants.
 - c. Wick moisture away from affected and at-risk skin.
 - d. Control or divert the moisture source.
 - e. Prevent secondary infection.
- 10. Prevention of intertrigo:** The following strategies may help prevent intertrigo from developing or recurring:
 - a. Cleanse skin folds gently, dry gently but thoroughly (pat, do not rub), and educate patients about proper skin-fold hygiene.
- 11. Treatment of intertrigo:** The following approaches may help treat intertrigo:
 - a. Follow recommended preventive strategies to keep skin folds dry and prevent or treat secondary infection.
 - b. Consider using a moisture-wicking textile with silver between affected skin folds.
 - c. Continue treatment until intertriginous dermatitis has been controlled.
 - d. Treat secondary infection with appropriate systemic and topical agents.
 - e. Revisit the diagnosis in cases that do not respond to usual therapy.
 - f. Initiate a prevention program that can include weight loss, a skin-fold hygiene program, and early detection and treatment of recurrences.

CONSENSUS STATEMENT #1:

Moisture-associated skin damage

Moisture is a risk factor for the development of chronic wounds that is distinct from other risk factors, including pressure, arterial insufficiency, venous stasis and neuropathy.

MASD can be defined as "inflammation and erosion of the skin caused by prolonged exposure to various sources of moisture, including urine or stool, perspiration, wound exudate, mucus, or saliva."² This type of skin damage includes intertriginous (skin-fold) dermatitis, incontinence-associated dermatitis, periwound moisture-associated dermatitis, and peristomal moisture-associated dermatitis.²

This consensus document focuses on intertriginous dermatitis, which is due to perspiration trapped in skin folds plus the effect of friction. Intertriginous dermatitis has been defined as "an inflammatory dermatosis [dermatitis] involving the body folds, notably those of the sub-mammary [under the breasts] and genitocrural regions,"³ and as "an inflammatory dermatosis [dermatitis] of opposing skin surfaces caused by moisture."⁴

CONSENSUS STATEMENT #2:

Definition of intertrigo

Intertrigo, or intertriginous dermatitis, may be defined as inflammation resulting from moisture trapped in skin folds subjected to friction.

There is no uniform nomenclature or assigned code in the International Classification of Diseases-10 for intertriginous dermatitis.⁴ Intertrigo is usually listed under "miscellaneous" or "other" dermatologic codes, especially once the condition is secondarily infected.⁵ This hampers both the diagnosis of the condition and systematic research into intertrigo.

CONSENSUS STATEMENT #3:

Disease classification of intertrigo

A disease code for intertrigo could improve diagnosis of the condition and support research efforts.

Methodology: Literature Search

A MEDLINE search was performed using the key word "intertrigo." The only limits placed on the search were English language and human studies. The search returned 375 citations. Abstracts were reviewed and 47 articles were obtained for complete review. The articles included 15 case reports, 7 cases series, 1 survey, 11 studies, 10 review or overview articles, 2 consensus documents, and 1 symposium summary. Additional references were identified from the reference lists of reviewed articles. Overall, little evidence is available on the topic of intertrigo.

Epidemiology

Intertrigo may be found in patients in acute care, rehabilitation, extended-care facilities, hospices and in home care.⁶ European studies have found the prevalence of intertrigo to be 17% in a group of nursing home patients and 20% in home care patients.⁷ Overall, little evidence quantifies the incidence and prevalence of intertrigo.

CONSENSUS STATEMENT #4:

Epidemiology of intertrigo

The true incidence and prevalence of intertrigo is currently unknown.

Risk Factors for Intertrigo

No formal risk assessment tool exists for intertriginous dermatitis.⁴

Risk factors for intertrigo are numerous, with the most important including hyperhidrosis, obesity and diabetes mellitus.⁸ Immunocompromise and increased skin surface bacterial burden may also be risk factors, as may poor hygiene, malnutrition, tight and closed shoes, and large, prominent skin folds. In fact, any patients with skin folds have a risk of intertriginous dermatitis. A hot and humid climate promotes the development of intertrigo, although this has not been studied in detail.

Skin folds

Skin folds that may develop intertrigo include those in the

neck; in the axilla; under the breasts, especially if they are pendulous; in the lateral flank area; between the buttocks (gluteal cleft, intergluteal cleft); in the groin; in the creases of the knees or elbows; and between the fingers and toes. Intertriginous dermatitis may be seen in lean individuals and in the neck region of infants.

Patients with lymphedema may develop skin folds in the affected limb. Patients who are bedridden or incontinent are prone to intertrigo, especially in the groin and perianal region, and they may have co-existing incontinence-associated dermatitis.⁹

Obese patients also develop multiple additional skin folds, including lateral folds above the waist, folds across the back just below the scapulae (sometimes called angel wings), abdominal folds, pannus, and folds in the legs and arms. "Angel wings" develop both in overweight individuals, even with a body mass index (BMI) less than 30 kg/m², and in the elderly who have lost height. In patients with a BMI above 40 kg/m², skin also folds over at the waist laterally and then centrally as weight increases. Lateral flank folds are prone to trauma and to developing chronic low-grade infection. Pannus (abdominal fold) is graded from 1 to 5, with a grade 1 pannus apron reaching the hairline and mons pubis but not the genitals, and a grade 5 pannus apron reaching to the knees.

Perspiration

Sweat is composed of water containing urea, glucose, and electrolytes, including sodium and chloride.² On most parts of the body, perspiration is not linked to MASD, as sweat usually evaporates readily. However, chronic perspiration that accumulates in a skin fold, especially in an obese individual with deep skin folds, may result in MASD.

Obesity

Brown et al. performed a self-report survey to identify skin problems in 100 patients with obesity and to determine whether they sought professional help.¹⁰ At least one skin problem was identified in 75% of patients, especially itchiness and dry skin, and 63% reported more than one problem. The most prevalent locations for problems were the groin, limbs, beneath the breasts, and the abdomen. The major perceived causes were perspiration and friction. Although 25% of survey respondents had sought no help, 59% had seen a physician and 16% had consulted other health-care professionals.

Several authors have evaluated skin conditions associated with obesity. Mathur et al. described intertrigo as a skin problem in adolescents with obesity.¹¹ Al-Mutairi performed a study of 437 overweight or obese adults to identify the spectrum of skin diseases in the obese population.¹² Among the diseases identified in this population, intertrigo was present in 97 individuals, or 22%. Diabetes mellitus

was diagnosed in 87 patients, and of these, 33 patients had intertrigo. Boza et al. compared the prevalence of skin conditions in 76 obese patients with those seen in 73 normal-weight controls.¹³ Among the skin problems with a statistically significant relationship with obesity was intertrigo, which was found in 45% of the obese group. In a discussion of the dermatological complications of obesity, Garcia-Hidalgo found a linear relation between intertrigo and the degree of obesity.¹⁴

Inframammary intertrigo: Predisposing factors

McMahon et al. performed a point prevalence study of inframammary (below the breasts) skin problems found among inpatients in a district health authority in England.¹⁵ The survey included 131 wards with 1,116 female patients. Among these individuals, 5.8% had active inframammary lesions and 5.4% had a lesion that had healed during their hospital stay, for a total of 11.2% of female patients. The prevalence was highest in wards with elderly patients and those with patients with acute mental illness. Patients with active or healed lesions had a higher than average body weight, and patients with active lesions had significantly higher body weight than those with healed lesions.

CONSENSUS STATEMENT #5:

Risk factors for intertrigo

The major documented risk factors for intertrigo include hyperhidrosis; obesity, especially with pendulous breasts; deep skin folds; immobility and diabetes mellitus; all risk factors are exacerbated by hot and humid conditions.

Pathophysiology of Intertrigo: Moisture Barrier of the Skin

Although much remains to be elucidated about the pathophysiology of intertrigo, or intertriginous dermatitis, exposure to moisture alone is insufficient to produce skin damage.² Both moisture and friction in skin folds are required. These two promoting factors may result in erosions and secondary infection, if potentially pathogenic microorganisms are present.⁸ Although erosion is a common manifestation of intertrigo, the mechanisms leading to erosion are not fully elucidated,² but a combination of moisture and friction is most likely.

The clinical course of intertrigo² usually starts with erythema and inflammation, with the occurrence of erosions in the presence of moisture due to macerated keratin and wet edema. Some or all of these features may present concurrently or individually.

The skin's moisture barrier functions to maintain bodily homeostasis by slowing water

movement out of the body and preventing excessive environmental water absorption.² The moisture barrier consists of hygroscopic (water-attracting) molecules and lipids within the stratum corneum. The hygroscopic molecules are humectants (molecules that bind water in the stratum corneum) that maintain 20% water content within the stratum corneum and comprise natural moisturizing factor. The lipids act as emollients, enhancing the effect of natural moisturizing factor.

The pH of healthy skin is between 5.5 and 5.9.² Skin alka-

with those of normal controls. The authors found a significantly increased skin pH in three areas in persons with diabetes; the inguinal and axillary regions ($p < .0001$) and the inframammary area ($p < .01$) of female participants. Increased skin surface pH also predisposes the skin to invasion by bacteria, yeasts and other microorganisms. As would be predicted with increased pH and diabetes, six persons in this study had intertriginous candidal infections. The pH of the skin varies in different locations.

"Although much remains to be elucidated about the pathophysiology of intertrigo, or intertriginous dermatitis, exposure to moisture alone is insufficient to produce skin damage. Both moisture and friction in skin folds are required."

linity, or increased skin pH, negatively affects the skin's moisture barrier, along with other factors that disturb the barrier function, such as increasing age, obesity, and atopy.

Increased pH

Increased stratum corneum pH prevents lipids from assuming their normal structure,² interfering with the skin's barrier function. A study by Yosipovitch et al. of skin pH and moisture included 50 patients with type 2 diabetes and 40 healthy controls.¹⁶ The study compared the pH of persons with type 2 diabetes

Aging

The efficiency of the moisture barrier slowly declines with age, until the stratum corneum water content drops to less than 10% in the elderly.¹⁷ This leads to dry skin, or winter itch, compromising the normal barrier function; in this situation, the skin has a very fine reticulate scale (crackled eczema, or eczema craquele).

Obesity

Moisture barrier function is also impaired in obesity, with increased sweating after overheating among obese compared

with lean individuals.¹⁸ Obese individuals are less efficient than lean comparators in regulating body temperature by sweating. This inefficiency increases the duration of sweating and the exposure of the skin to moisture. Sweating is most pronounced in skin folds, where moisture is prevented from evaporating. Obese individuals also have more alkaline skin pH than lean individuals.

A study by Nino et al. of 65 overweight children and 30 normal-weight controls included a clinical evaluation and calculation of transepidermal water loss.¹⁹ The study discovered a significantly higher transepidermal water loss in obese than in normal weight children, suggesting that obese children sweat more because of overheating, due to the thick layers of subcutaneous fat and the lower skin surface area relative to body mass.

Atopy

In atopy, the genetic predisposition to develop allergic reactions may be related to mutations in one of the proteins involved in natural moisturizing factor; this may result in compromised moisture barrier function, increasing skin susceptibility to irritants, including excessive moisture.²⁰ Atopic individuals in many studies have demonstrated a decreased skin barrier function that is further compromised by the common use of topical steroids; topical immune response modifiers, such as tacrolimus and pimecro-

limus, may actually improve moisture barrier function.

Location-specific Intertrigo: Clinical Features

Inframammary and pannus intertrigo

Intertrigo in the inframammary area is often due to large or pendulous breasts; abdominal crease intertrigo occurs with abdominal pannus formation. In both situations a hot and moist environment predisposes to intertrigo. The most common symptom is itch, but symptoms can vary from nothing to burning or stinging with severe irritant contact dermatitis. The presence of satellite papules or pustules with a bright red colour or confluent inframammary erythema is often indicative of a secondary candidal infection.

Groin and perianal intertrigo

Intertrigo due to irritant contact dermatitis from sweat and friction is common in the groin region. In females, older or obese individuals and persons with diabetes, intertrigo of this region is often complicated by candidal intertrigo with the characteristic bright red appearance and satellite (small lesions near the main one) papules and pustules that are usually, but not always present. Candidal infection of the groin is also more common in individuals with vaginal yeast infections and in those receiving

systemic antibiotics or immuno-suppressive therapy.

In males, tinea infection is more common in the groin region. There is often an active red border to the eruption, where the hair follicles may be involved in advance of the border. A fine surface scale is often associated with the proximal margin of the eruption on the inner thighs. Central clearing towards the inguinal crease is often associated with sparing of the scrotum.

Toeweb and fingerweb intertrigo

Intertrigo of the toewebs often starts in the webspace between the fourth and fifth toe and spreads proximally. Erythema and scale are often replaced by maceration of the webspace keratin as the eruption spreads proximally. The moisture-associated damage is often complicated by tinea infection.

Fingerweb intertrigo is most common in individuals with substantial water exposure, including cooks, bartenders and health-care workers. Moisture accumulating in the middle finger webspaces along with friction leads to intertrigo that can become secondarily infected, most commonly with *Candida*.

Common Differential Diagnoses of Intertrigo

Common differential diagnoses of intertrigo include inflammatory conditions, such as psoriasis, atopic dermatitis and, less commonly, lichen planus. Atopic

individuals may also develop dermatitis in the flexural areas due to a combination of factors.^{4,21} Contact dermatitis is more commonly irritant than allergic and may be confused with intertrigo. Incontinence-associated dermatitis in skin folds exposed to urine or feces can also be confused with intertrigo. Infections due to fungi, yeasts and bacteria, such as erythrasma, can exist with and without intertrigo, which is characterized by increased local perspiration and moisture. Some rare flexural disorders are summarized in Table 1.

Psoriasis

Psoriasis can occur in many forms, including plaque, pustular, erythrodermic and intertriginous psoriasis. The intertriginous form of psoriasis is symmetrically distributed and bright red in colour with a sharp margin.²¹ It is distinguished from other forms of psoriasis by the absence of a silvery scale even in untreated cases. Intertriginous psoriasis is most common in the groin, under the breasts, in the axillae and in the perianal area, but it can occur in other locations. There is usually an absence of satellite papules or pustules. Involvement of other areas may help to establish the diagnosis.

Seborrheic dermatitis of the flexural areas

Seborrhea of the flexural areas is common in otherwise healthy, young infants. Seborrhea presents as yellow-pink erythema, sometimes with a peripheral

greasy scale. As infants become older, it gradually improves. This condition is rare in older children or adults except in association with immunosuppression or immunodeficiency.

Contact dermatitis of the flexural regions

Eighty per cent of contact dermatitis is due to irritants and 20% is allergic in nature. Irritant contact dermatitis is often diffuse, whereas many contact allergies produce bright red erythema with discrete margins. Irritant contact dermatitis is common, due to irritants in soaps, detergents, fabric softener residue in clothes, deodorants, antiperspirants and antimicrobial preparations.

Common contact allergens in the flexural areas include perfumes; preservatives such as formaldehyde and formaldehyde releasers, including quaternium-15; topical antimicrobials, such as neomycin, bacitracin, polymyxin and others; and occasionally topical steroids. The allergic reaction can be reproduced by the repeat open application test. Products can be screened by applying them twice a day for two or three days to a coin-shaped circle on normal forearm skin. Allergic reactions to irritants or sensitizing agents can be confirmed by patch testing.²¹

Kranke et al. performed a prospective study of 126 patients with a presumptive diagnosis of anal eczema.²² The clinical diagnosis was intertrigo/candidiasis in 43%, atopic dermatitis in 6%,

pruritus ani in 6%, psoriasis in 3%, contact eczema in 26%, and no diagnosis (presumed contact eczema) in 20%. Some patients had more than one diagnosis.

Incontinence-associated dermatitis

Incontinence of feces or urine can result in incontinence-associated dermatitis.⁴ This dermatitis may occur in the perineum, labial folds, groin, buttocks, scrotum and perianal and intergluteal cleft. This condition is also commonly associated with candidal infection. In the presence of pain and local tenderness, secondary cellulitis should be suspected. Staphylococcal or streptococcal infection may need to be treated with systemic antimicrobial therapy. Perianal cellulitis is more common than cellulitis of the anterior groin area. All anterior groin eruptions may extend around the perineum into the perianal area and onto the buttocks. Perianal eruptions are more common with hemorrhoids or loose, watery stools.

Atopic dermatitis of the flexural areas

Atopic individuals often have a decreased ability to sweat, altered immunity and susceptibility to eczema in the body folds. Atopic flexural eczema is most common in the ante-cubital and popliteal fossae, starting once individuals can walk with an upright posture, and is less common as they reach adulthood.²¹ Itch often leads to scratching and rubbing

the involved areas, which can produce increased skin surface markings (lichen simplex chronicus).

Complications of Intertrigo

Secondary skin infection can occur in the presence of intertrigo or may occur independently of any evidence of MASD.

Secondary skin infection

Overhydration of the stratum corneum, due to an inability to evaporate or translocate moisture from a skin fold, can disrupt the moisture barrier, allowing irritants to pass into the skin and produce dermatitis.⁵ Saturated skin is also more susceptible to friction damage, resulting in further inflammation, which then allows the penetration of organisms to cause secondary bacterial or fungal infection, the most common complication of intertrigo. The warm, damp environment in skin folds with associated skin damage provides an ideal environment for organisms to proliferate. Infections due to *Candida albicans* and dermatophytes, such as *Trichophyton rubrum*, are common, and many bacterial species can also be seen, including staphylococci, streptococci, Gram-negative species, and antibiotic-resistant strains.

ORGANISMS IN INTERTRIGO

Edwards et al. conducted a small single-hospital study to identify common microorganisms in intertrigo by culturing 15 sites of

Table 1. Rare Forms of Flexural Disorders

Disease Process	Comments
Lichen planus	Violaceous papules or plaques that leave behind post-inflammatory pigmentation
Fox Fordyce disease	Rare disorder with extremely itchy perifollicular papules in the axilla, groin and around the nipples
Hailey-Hailey disease (Benign familial pemphigus)	Intertriginous fragile blisters that are often worse in the hot months or when secondarily infected
Unusual drug reactions	Chemotherapy drug reactions Toxic epidermal necrolysis: most common with anticonvulsants, antibiotics, and non-steroidal anti-inflammatory drugs

Table 2. Organisms Cultured from 15 Sites from 9 Patients with Intertrigo

Organism	Times Cultured
<i>Staphylococcus</i> species coagulase negative	12
<i>Proteus mirabilis</i>	8
Diphtheroids	5
<i>Enterococcus faecalis</i>	5
<i>Candida albicans</i>	4
Vancomycin-resistant <i>Enterococcus faecium</i>	3
<i>Escherichia coli</i>	2
<i>Streptococcus viridans</i> group	1
Group D <i>Enterococcus</i>	1
<i>Acinetobacter baumannii/haemolyticus</i>	1

intertrigo from nine hospitalized patients (Table 2).²³

In this sample, there was no relation between the type or quantity of microorganism cultured and the severity of erythema. At four sites with satellite lesions, the satellites did not all contain the same organism. In addition, only two contained *Candida albicans*, suggesting that antifungals should not be prescribed based on the presence of satellite lesions alone.

Limitations of this study include the small size, the single site, and the lack of a control group.

Specific types of infection

Although Kugelman²¹ and others classify pyoderma, candidiasis, dermatophytosis and erythrasma as differential diagnoses for intertrigo, this document considers them to be secondary infections, or complications of intertrigo, when chronic exposure to moisture in skin folds is present.

Because infections require a portal of entry and develop on skin that has already been compromised, it is more rational to consider them as secondary rather than primary conditions.

CANDIDIASIS

Candidal infection is intensely itchy, with plaques with sharp margins and frequent satellite lesions beyond the area of friction. Whitish exudate may be present.²¹ As candidal organisms are frequently present, positive culture alone is insufficient for a diagnosis; the invasive mycelial phase of the organism must be present on microscopic examination of lesion scrapings. Candidal intertrigo may often respond to a topical antifungal preparation.⁹ Resistant or extensive cutaneous infections may require systemic antifungal agents, with diflucanazole the most commonly used agent.

A study by Gloor et al. of the biochemical and physiological parameters of areas of healthy skin in 20 patients with candidal intertrigo found a significant decrease in the amount of squalene and an increase in wax and cholesterol esters in the skin surface lipids in these patients compared with 39 healthy controls.²⁴ These alterations may point to a predisposing factor for candidal infection.

DERMATOPHYTOSIS

Intertriginous infection with dermatophytes (fungi that cause skin disease), which may be caused by *T. rubrum*, *T. mentagrophytes*, or *Epidermophyton floccosum*, is most frequently

seen in adult males.²¹ Itchy, red, scaling plaques on the upper medial thighs characterize tinea cruris. Lesions tend to grow with a circular border, and central clearing may be seen. The macerated keratin compromises the cutaneous barrier and acts as a portal of entry for secondary bacterial infection leading to lymphangitis and cellulitis.

Tinea of the interdigital spaces of the toe webs is usually accompanied by tinea pedis, characterized by a dry, white powdery scale. This scale accentuates the skin surface markings and extends around the side of the feet in a distribution that would be covered by a moccasin (moccasin foot tinea pedis). The moccasin changes of tinea pedis need to be distinguished from the dry skin that occurs as a result of the autonomic component of the neuropathy associated with diabetes and other etiologies. The nails may also be involved with a distal streaking and eventual whole nail plate involvement. Involvement often starts asymmetrically and then spreads to the other foot and, in susceptible individuals, to the hands. **A secondary bacterial infection, often from the toe webs in a person with diabetes, can be life or limb threatening.**

The diagnosis can be confirmed by examining fungal scrapings of the skin surface keratin for the presence of septate hyphae in potassium hydroxide preparations. A positive culture on Sabouraud's agar can identify the specific organ-

ism, but culture can take up to a month. About 20% of fungal infections are negative on a potassium hydroxide test and on culture. With a high index of suspicion clinically, it is important to obtain three negative cultures before considering another diagnosis. Dermatophyte infection generally responds well to topical antifungal creams.⁹

Gloor et al. performed a study of the healthy skin of 27 patients with tinea cruris and 27 healthy patients to assess biochemical and physiological parameters.²⁴ The study found that significantly more amino acids could be extracted from the skin surface of patients with tinea cruris than from the healthy controls. The authors hypothesized that the increase in amino acids may be related to excessive perspiration, and this finding may indicate a factor predisposing to dermatophyte infection.

BACTERIAL INFECTIONS: PYODERMAS

Most pyodermas are caused by coagulase-positive staphylococci and β-hemolytic streptococci, and systemic antibiotics are the usual therapy.²¹ Staphylococci may cause folliculitis (superficial hair follicle infection) or furunculosis (deep hair follicle infection) in the axilla or groin, which must also be differentiated from hidradenitis suppurativa, an inflammatory condition of the apocrine glands. Staphylococci and streptococci may also cause cellulitis. Superficial, honey-coloured intertriginous lesions may be the presenting sign of impetigo.

STREPTOCOCCAL INTERTRIGO

Streptococcal intertrigo is caused by group A β -hemolytic streptococci and presents as a fiery red or beefy-red, shiny, exudative lesion with well-defined borders without satellite lesions and with a foul smell.²⁵ Microscopic examination and culture provide the diagnosis. This complication of intertrigo most commonly occurs in infants, where it affects mainly the neck, but axillary, inguinal and anal folds may also be involved.²⁶⁻²⁸ Infants have a predisposition to cervical infection due to their relatively short necks, deep skin folds in chubby infants and saliva from drooling, which collects in the neck folds.

ERYTHRASMA

Erythrasma is caused by *Corynebacterium minutissimum*, producing dull red scaling plaques with a sharp margin on the medial thighs, the axillae, toewebs and perianal area. The diagnosis is made by finding coral-red fluorescence, which is due to an excreted porphyrin, under a Wood's light. Erythrasma responds to topical imidazole antifungal agents (such as clotrimazole and miconazole), erythromycin or clindamycin.⁹ Treatment with oral erythromycin or clarithromycin may be necessary.²⁹ In patients with interdigital erythrasma, a combination of oral and topical therapy may be necessary.

INTERDIGITAL INTERTRIGO

Interdigital foot intertrigo is commonly infected with dermatophytes, but it can also

be infected with bacteria or molds. Lin et al. reported on a case series of interdigital foot intertrigo with a poor response to antifungal therapy that included 32 episodes in 17 patients.³⁰ Clinically, the toewebs were macerated. Most bacterial cultures (93%) grew a mixture of pathogens, with the most common being *Pseudomonas aeruginosa*, *Enterococcus faecalis* and *Staphylococcus aureus*.

Deeper infection

Secondary infection of the skin is a clinically relevant complication of intertriginous dermatitis that can develop into deeper, clinically important infections.²

Dupuy et al. performed a case-control study to assess risk factors for erysipelas of the leg, or cellulitis.³¹ The analysis included 167 patients with erysipelas and 294 controls. Multivariate analysis found an odds ratio (OR) for lymphedema of 71.2 (95% confidence interval [CI] 5.6 to 908) and an OR for site of entry of 23.8 (95% CI 10.7 to 52.5). The site of entry was defined as disruption of the cutaneous barrier and included leg ulcer, wound, fissurated toe-web intertrigo, pressure ulcer and leg dermatosis. Other risk factors were leg edema (OR 2.5, 95% CI 1.2 to 5.1), venous insufficiency (OR 2.9, 95% CI 1.0 to 8.7) and overweight (OR 2, 95% CI 1.1 to 3.7).

Studer-Sachsenberg et al. reported on seven cases of buttock cellulitis at varying times after hip replacement surgery.³² In assessing these cases, the authors identified the presumed

portals of entry of the infection as intergluteal intertrigo in three patients, tinea pedis in one patient, a psoriatic plaque in one patient and a carbuncle of the buttock in one patient. No portal of entry was found for the seventh patient.

CONSENSUS STATEMENT #6:

Complications of intertrigo

Secondary bacterial infection is a common complication of intertrigo that must be treated effectively to prevent deep and surrounding invasive infection.

Assessment of Intertrigo

A full history and examination of the entire body surface can help to differentiate intertrigo from conditions that may appear similar.

History

Clues to the diagnosis of intertrigo may often be found in the patient's medical history.⁹ Patients with diabetes or immunosuppression may have a greater incidence of intertrigo. In addition, patients who are obese, bedridden or incontinent are prone to intertrigo. It is also important to identify previous therapies, such as topical or systemic corticosteroids, as they may affect the appearance of the lesion.

Physical examination

To assess a patient with possible intertrigo, it is important to inspect the entire body, including all skin folds, right to their base. It may be useful to measure the depth of skin folds, as the deeper the fold, the more likely is the development of intertrigo. Full body examination is best accomplished with the patient lying flat. With some obese patients, assistance may be necessary to lift large skin folds without exacerbating existing skin damage. Intertrigo appears as mirror-image ery-

inflammatory signs, such as local increased temperature, cellulitis, exudate and smell, often alter the appearance of the primary disease process.⁹

Diagnosis

The diagnosis is often clear-cut and is generally based on the clinical presentation of characteristic intertriginous dermatitis: mirror-image erythema, inflammation or erosion within skin folds.⁸ The presence of other types of lesions, such as pustules, deep papules, nodules or

infections or pseudohyphae in candidiasis.

CONSENSUS STATEMENT #7:

Diagnosis of intertrigo

The diagnosis of intertrigo is based on the history and characteristic physical findings supplemented with laboratory testing to rule out secondary infection.

Management of Intertrigo

Evidence

Mistiaen et al. performed two systematic literature reviews of prevention and treatment of intertrigo in large skin folds of adults, published in 2004 and 2010.^{7,33} Only the more recent review is discussed here. The review used a search of 13 databases followed by reference tracking and forward citation searches.⁷ Of 316 articles included for full-text assessment, only 68 studies met the inclusion criteria, and only four of these were randomized controlled trials. Most of the studies lacked scientific rigour for a variety of serious methodological reasons. No study addressed prevention of intertrigo. In the studies of treatment, secondarily infected intertrigo was generally the condition treated, and a large variety of therapies was evaluated, primarily topical therapies, such as antifungal and antibacterial creams. In addition, 15 studies addressed reduction mammo-

"Every effort must be made to restore a normal environment that will encourage the natural regenerative capacity of the skin."²¹
— TP. Kugelman

thema, inflammation or erosion within skin folds. Other signs and symptoms include itch, burning, pain and odour. Itch often requires sedating H₁ antihistamines, such as diphenhydramine or hydroxyzine, which are taken at night and have a carryover effect the following day. Pain with intertrigo may be severe and sometimes requires pain medication. The burning associated with intertrigo may approximate severe sunburn symptoms and may respond to a combination of pain and antihistamine medication. Pain may also indicate secondary infection. In this situation, superimposed infection-associated

vesicles may offer a clue to the diagnosis. If secondary infection is likely, it is appropriate to perform a culture and sensitivity. Biopsy may be uninformative in uncomplicated intertrigo, but in atypical clinical presentations or lesions without a positive bacterial or fungal laboratory test that are nonresponsive to treatment, biopsy may serve a useful function. Examination under a Wood's light may identify secondary infections, such as erythrasma (coral-red fluorescence) or pseudomonas (green fluorescence). Potassium hydroxide examination may demonstrate hyphae in dermatophyte

plasty. The review was also hampered by differing descriptions of intertrigo, diagnostic criteria and measurements of treatment success. Overall, no rigorous randomized controlled trial evidence exists for the prevention or treatment of intertrigo of the large skin folds.

CONSENSUS STATEMENT #8:

Evidence for intertrigo treatment

No well-designed clinical trials are available to support therapies commonly used to treat or prevent intertrigo.

Management principles

A previous expert panel agreed that a preventive or treatment approach for MASD should be based on at least one of the following goals:²

1. an interventional skin care program that removes irritants from the skin, maximizes its intrinsic moisture barrier function, and protects the skin from further exposure to irritants
2. use of devices or products that wick moisture away from affected or at-risk skin
3. prevention of secondary cutaneous infection
4. control or diversion of the moisture source"

The panel also agreed that a preventive or treatment regimen should be consistent and include gentle cleansing, moisturization if indicated and application of a protective device or product when additional expos-

"...intertrigo deserves more serious attention from the dermatology field on all aspects from defining to diagnosing, pathophysiology, prevention, treatment and evaluation."⁷

— P. Mistiaen

ure to moisture was anticipated. Furthermore, measures to reduce or eliminate skin-on-skin contact and friction are important.

CONSENSUS STATEMENT #9:

Principles of management of intertrigo

Prevention and treatment of intertrigo should maximize the intrinsic moisture barrier function of the skin by focusing on at least one of the following goals:

1. Minimize skin-on-skin contact and friction.
2. Remove irritants from the skin and protect the skin from additional exposure to irritants.
3. Wick moisture away from affected and at-risk skin.
4. Control or divert the moisture source.
5. Prevent secondary infection.

Prevention

No randomized controlled trial, evidence-based literature supports strategies to prevent intertrigo, but common-sense approaches are effective.⁸ It is important that skin folds be kept as clean and dry as possible to minimize friction. Gentle cleansing with a pH-balanced,

rinseless cleanser is recommended. Irritated skin folds should be patted dry, rather than wiped or rubbed.⁴ Loose-fitting, lightweight clothing of natural fabrics or athletic clothing that wicks moisture away from the skin are good choices. Open-toed shoes may be bene-

Notes on Skin Care for Obese Individuals

Obese patients have a large skin surface and more and deeper skin folds compared with lean individuals.³⁴ Meticulous skin care is necessary but difficult to achieve in obese individuals. Skin folds in obese individuals are often moist and predisposed to developing intertrigo and to secondary infection. Due to the potential itch or pain associated with intertrigo, it is helpful to use rinseless cleansers when cleansing skin folds in obese individuals. It is also important to dry skin folds by patting rather than wiping to prevent causing more pain, much as you would for a patient with sunburn—pat gently, do not wipe.

Moisture-wicking Textile with Silver

This polyurethane-coated polyester textile is impregnated with a silver compound. The coating is specifically designed to assist in the absorption and wicking away, or translocation, of moisture. The moisture-wicking textile with silver translocates excess moisture from the skin fold to keep skin dry, the silver-impregnated formulation provides effective antimicrobial action for five days, and the soft knitted textile provides a friction-reducing surface that reduces the risk of skin tears. The textile is effective for signs and symptoms of intertriginous dermatitis, such as maceration, denudement, inflammation, pruritus, erythema and satellite lesions. Overall, the moisture-wicking textile with silver treats intertriginous dermatitis by managing moisture, friction, bacteria and odour. In addition to intertriginous dermatitis, other uses of the moisture-wicking textile with silver in MASD include placement under

- blood pressure cuffs in intensive care unit patients
- immobilizers and medical devices
- compression bandages in patients with limb edema

ficial in preventing toe-web intertrigo.⁸ However, closed-toe shoes would be recommended for patients with diabetes, and a moisture-wicking textile with silver could be woven between the toes to help translocate moisture. (See Moisture-wicking Textile with Silver, above.) Proper supportive garments, such as brassieres, can reduce apposition of skin surfaces. In addition, placing moisture-wicking textile with silver within large skin folds to translocate excessive moisture may be helpful.⁴ Ensuring that 4 cm of the fabric hangs out of the fold allows translocation of moisture. Patient education should include the importance of showering after exercise and carefully drying skin folds; awareness of the risk of intertrigo associated with sweating, such as in hot and humid weather, should be stressed.

CONSENSUS STATEMENT #10:

Prevention of intertrigo

The following strategies may help to prevent intertrigo from developing or recurring:

1. Cleanse skin folds gently, dry gently but thoroughly (pat, do not rub) and educate patients about proper skin fold hygiene.
2. Counsel patients to wear open-toed shoes and loose-fitting, lightweight clothing of natural fabrics or athletic clothing that wicks moisture away from the skin.
3. Advise patients to wear proper supportive garments, such as brassieres, to reduce skin-on-skin contact.
4. Consider using a moisture-wicking textile with silver within large skin folds to translocate excessive moisture.

Treatment

A follow-up survey by McMahon et al. of nurses' knowledge about the management of inframammary intertrigo found they had a broad variety of recommendations, many of which were contradictory. An example of a contradictory recommendation included the use of talcum powder (16.5%), and its avoidance (15.7%).³ Talcum (zinc oxide powder) can be useful, but this product may be confused or substituted with corn starch, which can support the growth of bacterial organisms. Another alternative is short-chain fatty acid powders, such as undecylic acid, which can decrease organism growth and facilitate local drying.

The consensus recommendations included:

- hygiene-related suggestions: washing thoroughly and drying well

- clothing-related approaches: natural fibres and wearing a brassiere
- occlusive dressings and various powders, especially short-chain fatty acid powders
- protective barriers: zinc oxide or petrolatum, film-forming liquid acrylates and silicone- or dimethicone-based creams

The survey identified a lack of coherence in the management of inframammary intertrigo.

INEFFECTIVE THERAPIES

A previous expert panel identified several therapies that were ineffective or harmful to prevent or treat intertriginous dermatitis.⁴ Powders, such as cornstarch, have no proven benefit and may encourage fungal growth, as cornstarch is a substrate for growth of yeasts.⁹ Textiles, such as gauze, various fabrics or paper towels, placed between skin folds, are usually ineffective as they absorb moisture but do not allow it to evaporate, promoting skin damage.⁴ Home remedies, such as diluted vinegar and wet tea bags, have never been evaluated in clinical research.

HYPERHIDROSIS

Intertrigo due to hyperhidrosis, or increased perspiration, can be treated using several modalities. The first-line treatment is aluminum chloride hexahydrate 20% in anhydrous ethanol. Second-line therapies include oral and topical anticholinergics and botulinum toxin A. Intertrigo prevention in this population is most commonly addressed with

aluminum chloride hexahydrate, systemic β -blockers, or anti-cholinergic drugs.

Botulinum toxin A has been evaluated in a multicentre trial in 145 patients with axillary hyperhidrosis.³⁵ Botulinum toxin A blocks the release of acetylcholine, the sympathetic neurotransmitter in the sweat glands, to stop excessive sweating. In each patient, botulinum toxin A 200 U was injected into one axilla and placebo into the other. Two weeks later, botulinum toxin A 100 U was injected into the axilla that had previously received placebo. Patients were followed for 26 weeks, and the rate of sweat production measured. At two weeks, average sweat production had decreased by 87.5%. At 26 weeks, sweat production, which was similar in both axillae, was still 65.6% lower than at baseline. Virtually all (98%) patients reported they would recommend the therapy to others.

INTERTRIGO AND MOISTURE-WICKING TEXTILE WITH SILVER

Various standard treatments for intertrigo, such as drying agents, barrier creams, topical antifungals and absorptive materials, may be ineffective in some patients. Kennedy-Evans et al. performed a clinical study

to determine the efficacy of the moisture-wicking textile with silver instead of standard therapy in patients with refractory intertrigo.³⁶ Study participants were 21 patients with intertriginous dermatitis from two long-term-care centres. Mean patient age was 53.8 years and mean body mass index was 54.75. The intertrigo had been present for a varying number of weeks and in most cases other products had been tried without a response. Skin assessment was performed on Day 1, Day 3 and Day 5 for itching/burning, maceration, denudement, satellite lesions, erythema and odour (Table 3).

In this study, moisture-wicking textile with silver relieved the patients' symptoms and signs of intertrigo within a five-day period. The moisture-wicking textile with silver is also cost-effective, as it reduces nursing time substantially. (See Cost-effective Treatment of Intertrigo, page 18.)

COMMON-SENSE APPROACHES

Intertrigo treatment relies on common-sense approaches because little evidence sup-

Table 3. Signs and Symptoms in Study Patients

Sign or Symptom	Day 1	Day 3	Day 5
Itching/burning	15	1	0
Maceration	10	1*	1*
Denudement	7	3	1
Satellite lesions	5	1	1
Erythema	21	↓†	↓†
Odour	12	↓†	2*

* One patient had maceration and odour due to urine soiling of textile that was not removed immediately

† Statistically significant decrease

Cost-effective Treatment of Intertrigo

A comparison of potential retail costs for each treatment and potential nursing time are listed below. In general this type of treatment may be offered in chronic care institutions, but it is unlikely that twice daily nursing visits would be authorized through home care.

Table 4. Cost Comparison for Intertrigo Treatment

Agent	Associated Costs
Clotrimazole antifungal cream, 30g, twice daily for 2 weeks, 7.5 applications per tube	
Cost per tube	\$12.99
Cost per day	\$3.46
Cost for 2 weeks' treatment with clotrimazole	\$48.44
Nursing time	28 applications over 14 days
Nystatin antifungal cream, 30g, twice daily for 2 weeks, 7.5 applications per tube	
Cost per tube	\$4.99
Cost per day	\$1.33
Cost for 2 weeks' treatment with nystatin	\$18.63
Nursing time	28 applications over 14 days
Moisture-wicking textile with silver , 10" x 12", applied every 5 days	
Cost per roll (10" x 12')*	\$107.64
Cost per day	\$1.78
Resolution in 5 days with the moisture-wicking textile with silver	\$8.97
Nursing time	5 visits
Resolution in 10 days with the moisture-wicking textile with silver	\$17.94
Nursing time	10 visits

* Retail cost; institutional cost lower

Source: Retail pharmacy costs

ports various commonly used therapies. Most importantly, it is necessary to establish or continue a skin-care regimen that focuses on keeping the skin folds dry and prevents or treats secondary infection.⁴ The mois-

ture-wicking textile with silver has been shown to be effective in treating intertrigo. Treatment of secondary infection may require topical and possibly oral therapy. Treatment should continue until the intertrigin-

ous dermatitis has resolved.¹ It is also important to recognize that eroded intertrigo skin is not completely healed until the normal skin thickness is re-established and the barrier function restored. The diagnosis should

be revisited in cases of intertriginous dermatitis that do not respond to usual therapy.

Weight loss is always an appropriate preventive and treatment strategy, but it is notoriously difficult to achieve. Although intertrigo is not an indication for reduction mammoplasty, a meta-analysis of reduction mammoplasty outcomes in 4,173 patients found intertrigo decreased from 50.3% to 4.4% after surgery.³⁷

CONSENSUS STATEMENT #11:

Treatment of intertrigo

The following approaches may help treat intertrigo:

1. Follow recommended preventive strategies to keep skin folds dry and prevent or treat secondary infection.
2. Consider using a moisture-wicking textile with silver between affected skin folds.
3. Continue treatment until intertriginous dermatitis has been controlled.
4. Treat secondary infection with appropriate systemic and topical agents.
5. Revisit the diagnosis in cases that do not respond to usual therapy.
6. Initiate a prevention program that can include weight loss, a skin-fold hygiene program and early detection and treatment of recurrence.

A Case of Axillary Intertrigo

A 60-year-old woman with a history of right-sided mastectomy presented with denuded and erythematous skin at the right axillary fold (Figure 1). The lesion was very painful, and a foul odour and drainage were present. The condition had been present for two weeks. Nystatin powder had been ineffective in improving the problem. At presentation, the lesion was cleaned gently and patted dry. A piece of moisture-wicking textile with silver was placed within the axillary fold and secured at the shoulder, leaving adequate textile exposed for translocation. The textile was replaced after five days. At seven days, there was significantly less drainage and redness and the denuded skin was almost healed (Figure 2).



Figures 1 and 2. Axillary intertrigo before and after seven days with moisture-wicking textile with silver

Conclusion

Intertrigo is a common condition associated with MASD. Intertrigo may be found in a variety of clinical settings, including acute, chronic, long-term and home care. Overall, the limited information about intertrigo currently available is a cause for concern. The incidence and prevalence of intertrigo are unknown, and little evidence supports the use of commonly used therapies. The information in this consensus document has been synthesized for educational purposes for clinicians and as a stimulus for more research into this common condition.

A Case of Inframammary Intertrigo

A 92-year-old female presenting for care of venous stasis ulceration complained of a persistent, painful rash underneath her breasts that had been unresponsive to treatment with a variety of oral and topical therapies. Candida intertrigo was present with erythematous papules, satellite lesions, denudement, weeping and a musty odour. Initial treatment was with an oral prescription antifungal for five days. When this was ineffective, a topical anti-fungal powder was prescribed twice daily for two weeks. The rash persisted and was then treated with an antifungal cream twice daily for two weeks.

At the next visit, the intertrigo was gently cleaned and patted dry. A piece of moisture-wicking textile with silver was then placed beneath each breast, leaving 4 cm exposed for translocation and secured in place using a sports bra. Substantial improvement was noted by 14 days with complete resolution by 21 days.



Figures 3 and 4. Inframammary intertrigo before and after moisture-wicking textile with silver

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