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Evidence-Based Skin Care: A Systematic Literature Review and the Development of a Basic Skin Care Algorithm

Lichterfeld, Andrea ; Hauss, Armin ; Surber, Christian ; Peters, Tina ; Blume-Peytavi, Ulrike ; Kottner, Jan

Abstract: Patients in acute and long-term care settings receive daily routine skin care, including washing, bathing, and showering, often followed by application of lotions, creams, and/or ointments. These personal hygiene and skin care activities are integral parts of nursing practice, but little is known about their benefits or clinical efficacy. The aim of this article was to summarize the empirical evidence supporting basic skin care procedures and interventions and to develop a clinical algorithm for basic skin care. Electronic databases MEDLINE, EMBASE, and CINAHL were searched and afterward a forward search was conducted using Scopus and Web of Science. In order to evaluate a broad range of basic skin care interventions systematic reviews, intervention studies, and guidelines, consensus statements and best practice standards also were included in the analysis. One hundred twenty-one articles were read in full text; 41 documents were included in this report about skin care for prevention of dry skin, prevention of incontinence-associated dermatitis and prevention of skin injuries. The methodological quality of the included publications was variable. Review results and expert input were used to create a clinical algorithm for basic skin care. A 2-step approach is proposed including general and special skin care. Interventions focus primarily on skin that is either too dry or too moist. The target groups for the algorithm are adult patients or residents with intact or preclinical damaged skin in care settings. The goal of the skin care algorithm is a first attempt to provide guidance for practitioners to improve basic skin care in clinical settings in order to maintain or increase skin health.

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Evidence-Based Skin Care

A Systematic Literature Review and the Development of a Basic Skin Care Algorithm

Andrea Lichterfeld ■ Armin Hauss ■ Christian Surber ■ Tina Peters ■ Ulrike Blume-Peytavi ■ Jan Kottner

ABSTRACT

Patients in acute and long-term care settings receive daily routine skin care, including washing, bathing, and showering, often followed by application of lotions, creams, and/or ointments. These personal hygiene and skin care activities are integral parts of nursing practice, but little is known about their benefits or clinical efficacy. The aim of this article was to summarize the empirical evidence supporting basic skin care procedures and interventions and to develop a clinical algorithm for basic skin care. Electronic databases MEDLINE, EMBASE, and CINAHL were searched and afterward a forward search was conducted using Scopus and Web of Science. In order to evaluate a broad range of basic skin care interventions systematic reviews, intervention studies, and guidelines, consensus statements and best practice standards also were included in the analysis. One hundred twenty-one articles were read in full text; 41 documents were included in this report about skin care for prevention of dry skin, prevention of incontinence-associated dermatitis and prevention of skin injuries. The methodological quality of the included publications was variable. Review results and expert input were used to create a clinical algorithm for basic skin care. A 2-step approach is proposed including general and special skin care. Interventions focus primarily on skin that is either too dry or too moist. The target groups for the algorithm are adult patients or residents with intact or preclinical damaged skin in care settings. The goal of the skin care algorithm is a first attempt to provide guidance for practitioners to improve basic skin care in clinical settings in order to maintain or increase skin health.

KEY WORDS: Baths, Cosmetics, Dermatology, Hospital, Long-term care, Nursing, Prevention, Skin, Skin care.

Introduction

Maintaining and improving skin health and integrity are major goals in acute and long-term care. Skin integrity is regarded as a quality indicator¹ and maintaining skin

integrity is widely accepted as being more cost-effective compared to wound treatment.²⁻⁴ Patients who are critically and chronically ill and those with immobility or incontinence are at risk for developing a broad range of adverse skin conditions such as pressure ulcers (PUs), incontinence-associated dermatitis (IAD), skin tears, or intertriginous dermatitis (intertrigo).^{5,6} Due to continuous changes in skin and underlying soft tissue structure and function,⁷ advancing age can also be regarded as an independent risk factor for developing skin problems. Dry skin (xerosis), fungal infections, and several forms of dermatitis are most prevalent in aged populations in care settings.⁸⁻¹²

Thousands of patients receive daily routine skin care, including washing, showering, and bathing with or without the use of skin cleansers. Cleansing is often followed by application of lotions, creams, and ointments. These personal hygiene and skin care activities are integral parts of nursing practice, but little is known about the benefits and clinical efficacy of these practices.^{5,13}

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The authors declare no conflicts of interest.

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We practice in a similar situation at the Charité-Universitätsmedizin Berlin, one of the largest university hospitals in central Europe. Multiple skin care products are used, and skin care routines are based on personal beliefs, preferences, and local care policies rather than current best evidence or consistent best practices. In order to reduce practice variations, we developed a basic skin care algorithm based on current best evidence and best practices. A quality improvement project was launched. This article reports results of a systematic literature review about the current best evidence regarding basic skin care. Review results and expert input were then used to create a clinical algorithm for basic skin care in care settings, which is introduced in the second part of this article.

Basic skin care was defined as skin cleansing and application of topical products in order to maintain and improve the skin's barrier function and integrity. Common practices include washing, bathing, showering with or without cleansing products, and application of leave-on products such as lotions, creams or ointments. We placed special emphasis on a preventive approach to skin care.¹⁴ Application of administration of prescriptive agents was excluded from this project.

■ Methods

A systematic literature search was conducted to evaluate the empirical evidence supporting basic skin care interventions. The electronic databases MEDLINE, EMBASE, and CINAHL were searched ranging from 1995 to 2013. We also completed reference (ancestry) searches of selected publications. After inclusion of publications from the database and reference list searches, a forward search was conducted using Scopus and Web of Science. This technique allowed us to search forward in time of publication of key articles to ensure a more thorough review. There were no language restrictions.

We decided to cover a broad range of basic skin care interventions in our literature review. We therefore deemed the following article types eligible for inclusion: (1) systematic reviews; (2) intervention studies; and (3) clinical practice guidelines, consensus statements, and best practice standards. Many intervention studies have been included in previous systematic reviews already. If studies had already been included in a previous review, they were not included as a single study again. Instead we limited our review to randomized controlled trials (RCTs) reporting basic skin care treatment effects that were not included in previous systematic reviews. Editorials, comments, case-control studies, and studies focusing on the treatment of persons with IAD, skin tears, or PUs were excluded.

Study Selection and Data Extraction

Two reviewers (A.L. and A.H.) independently screened the results of the database search based on title and abstract. Potentially relevant articles were read in full text

independently by the same 2 reviewers; disagreements were resolved by consensus. The results were methodologically clustered into (1) systematic reviews, (2) RCTs, and (3) clinical practice guidelines, consensus statements, and recommendations. The following characteristics were extracted: (1) Systematic reviews: authors, review topic, main inclusion criteria, summary of results, and included studies (Table 1); (2) RCTs identified during reference reviews: authors, topic/research question, sample, intervention, and main results (Table 2); and (3) Clinical practice guidelines, consensus statements, and recommendations: source, topic, conclusion, and recommendations about skin care (Table 3). Besides the different publication types identified, content was then iteratively classified into related topics.

The methodological quality of all systematic reviews and the RCTs included in our review was independently rated by 2 reviewers (A.L. and A.H.); disagreements in quality were resolved by consensus. We used a validated instrument to evaluate systematic review quality (AMSTAR, Assessing the Methodological Quality of Systematic Reviews).¹⁵ This instrument consists of 11 items covering the design and the conduct of each systematic review, for example, whether a research question and inclusion criteria were stated a priori, or if a list of inclusion and exclusion criteria was provided. Other questions address, for example, the characteristics, the scientific quality of the included studies, or whether publication bias was assessed. All questions were answered with "Yes," "No," "Can't answer," or "Not applicable." Every "Yes-answer" was assigned one point, indicating that this quality criterion was met.

Randomized controlled trials included in this review were rated using the Cochrane Collaboration's tool for assessing risk of bias.¹⁶ Six possible bias categories (sequence generation, allocation concealment, blinding, incomplete outcome data, selective outcome reporting, and other potential threats to validity) were ranked using "Yes" for low risk of bias, "No" for high risk of bias, or "Unclear." Because of their heterogeneous nature, the methodological quality of the guidelines, consensus statements, and recommendations was not formally assessed.

Development of the Skin Care Algorithm

After evaluation and summary of empirical evidence, recommendations for care, along with consensus statements and a clinical algorithm for basic skin care in an institutional care setting, were developed. At first, review results were clustered into similar interventions and activities. These interventions were then ordered according to the general care process logic.¹⁷ The first draft of our algorithm was sent to colleagues with expertise in dermatology (U.B.P.), skin pharmacology/pharmacy (C.S.), nursing science, and basic skin care research (J.K., A.L.), clinical quality and risk management (A.H.). Based on feedback from these expert colleagues, the algorithm was

TABLE 1.
Systematic Reviews

	Hodgkinson et al (2006, 2007) ²²	Beeckman et al (2009) ²	Haslinger-Baumann and Burns (2009) ²¹	Cowdell et al (2015) ¹³	Kottner et al (2013) ⁵	Moore and Webster (2013) ³	Flanagan et al (2014) ⁴
Review topic	Effectiveness of topical skin care interventions for residents of aged care facilities	Effectiveness of interventions for prevention and treatment of incontinence-associated dermatitis (IAD)	Skin care for healthy skin in older people	Skin cleansing practices for older people	Prevention of dry skin and skin injuries in aged skin	Prevention of pressure ulcers using dressings and local applications	Management of incontinence and continence promotion in older people in care homes
Main inclusion criteria	(1) Systematic reviews, randomized or nonrandomized studies; (2) evaluation of nonmedical intervention or program for improvement of skin integrity; (3) age 65 years and over; (4) aged care facility, hospital, or long-term care	(1) Adults; (2) studies describing interventions for prevention and treatment of IAD	(1) Skin care and assessment tools; (2) aged humans; (3) healthy skin	(1) Older than 65 years; (2) quantitative or qualitative research; (3) skin cleansing interventions; and (4) skin health measures	(1) Primary intervention studies, reporting treatment effect (bathing/cleansing procedure/application of leave-on/rinse-off products/cosmetic products); (2) experimental and observational design; (3) In vivo; and (4) age range lower limit 50 years	(1) Risk of PU; (2) randomized controlled trials comparing the use of dressings, topical agents, or both	(1) Older than 65 years or majority with mean age of 65 years; (2) home care facilities; (3) descriptive/observational or intervention studies with focus of management, promotion and maintenance of continence as outcome measures; and (4) type of condition
Summary of results	(1) Use of disposable bodyworms in incontinent patients to protect skin; (2) avoidance of soap, only use of emollient soap; (3) use of no rinse cleanser with ingredients like CLINISAN(Synergy Health, UK) reduces risk of pressure ulcer formation; (4) use of bag bath leads to reduction in skin dryness; and (5) zinc cream and SUDOCREM (Kyberg Phar. Vert. GmbH, Germany) reduce skin redness	(1) Use of soap and water not appropriate; (2) use of structured perineal skin care; (3) use of products with pH near to normal skin; and (4) use of skin protectant	(1) Avoidance of frequent washing; (2) use of mild soaps; (3) washing/bathing with lukewarm water; (4) pat skin dry instead of rubbing; (5) use of emollients with low pH directly after lanolin-free products; (7) skin protection with products including silicones; and (8) application of no-rinse cleansers reduces skin tears	(1) Regular bathing with warm water (not hot); (2) Not too long soaking (avoidance of dehydration); (3) Avoidance of soap, use of gently products like emollients; (4) Soap can damage the skin (alter pH of skin surface, disturb skin flora); (5) Use soft cloth	(1) Syndet (liquid) soaps, bag bath reduced skin dryness; (2) moisturizers containing humectants (eg, urea, glycerin) reduced dry skin conditions and strengthened skin barrier; (3) emollients combined with humectants reduce xerosis; (4) use of special soaps, nondetergent cleansers reduces risk for skin injuries; and (5) additionally applied emollients or barrier products promote skin protection	(1) Insufficient evidence about the use of topical agents for PU prevention; and (2) 79% PU risk reduction when dressings applied over bony prominences	(1) Use of skin care regimens in incontinence instead of soap and water; (2) soap and water less effective and more time consuming than "pH cleanser" and barrier cream; and (3) good skin care important for prevention or improving IAD
Included studies	Byers et al (1995) Dealey (1995) Hardy (1996) Mason (1997)	X X ... X	... ... ... ...	... ... X X	X ... X X	... ... ... ...	3 2 2 3

(continues)

TABLE 1.

Systematic Reviews (Continued)

Methodological quality with AMSTAR (max. 11)	Hodgkinson et al (2006, 2007) ²²	Beeckman et al (2009) ²	Haslinger-Baumann and Burns (2009) ²¹	Cowdell et al (2015) ¹³	Kottner et al (2013) ⁵	Moore and Webster (2013) ³	Flanagan et al (2014) ⁴	Total (n)
	7/11	5/11	3/11	4/11	6/11	10/11	7/11	
Whittingham and May (1998)	X	X	...	...	...	...	...	2
Schölermann et al (1999)	...	...	...	...	X	...	...	1
Draelos (2000)	...	X	...	...	...	...	...	1
Sheppard and Brenner (2000)	X	...	...	X	X	...	...	3
Dawson et al (2001)	...	...	...	X	...	...	...	1
Cooper and Gray (2001)	X	X	...	...	X	...	X	4
Clever et al (2002)	X	X	...	...	X	...	...	3
Kuzmina et al (2002)	...	...	...	...	X	...	...	1
Lewis-Byers et al (2002)	...	...	...	...	X	...	X	2
Pham et al (2002)	...	...	...	...	X	...	...	1
Warshaw et al (2002)	...	X	...	...	X	...	...	2
Birch and Coggins (2003)	X	...	X	X	X	...	...	4
Hunter et al (2003)	...	...	...	...	X	...	...	1
Baatenburg de Jong and Admiral (2004)	...	X	...	...	...	...	...	1
Bates-Jensen et al (2003)	...	X	...	...	...	...	...	1
Bale et al (2004)	...	...	...	...	...	...	X	1
Zehrer et al (2004a, 2004b)	...	X	...	...	X	...	...	2
Hoggarth et al (2005)	...	...	X	...	...	...	...	1
Thompson et al (2005)	...	...	...	...	X	...	...	1
Torra I Bou et al (2005)	...	...	...	...	X	X	...	2
Wilson and Nix (2005)	...	...	X	...	X	...	...	2

(continues)

TABLE 1.
Systematic Reviews (Continued)

	Hodgkinson et al (2006, 2007) ²²	Beeckman et al (2009) ²	Haslinger-Baumann and Burns (2009) ²¹	Cowdell et al (2015) ¹³	Kottner et al (2013) ⁵	Moore and Webster (2013) ³	Flanagan et al (2014) ⁴	Total (n)
Methodological quality with AMSTAR (max. 11)	7/11	5/11	3/11	4/11	6/11	10/11	7/11	Total (n)
Bliss et al (2006, 2007)	...	X	...	...	X	...	...	2
Dieter et al (2006)	...	X	...	...	...	...	...	1
Okada et al (2006)	X	...	...	1
Welzel et al (2006)	X	...	...	1
Nakagami (2007)	X	...	1
Sloane et al (2007)	X	...	...	1
Cooper et al (2008)	X	...	...	1
Houwing (2008)	X	...	1
Quatresooz et al (2009)	X	...	...	1
Groom et al (2010)	X	...	...	1
Qiuli (2010)	X	...	1
Beeckmann et al (2011)	X	...	...	1
Han (2011)	X	...	1
Papanas et al (2011)	X	...	...	1
Elewa et al (2012)	X	...	...	1
Kalowes (2012)	X	...	1
Roure et al (2012)	X	...	...	1
Total	8	12	3	5	29	6	3	63

TABLE 2.

Additional Randomized Controlled Trials Not Included in Systematic Reviews

Source	Topic	Sample/Intervention	Main Results	Risk of Bias							
				Sequence	Allocation	Blinding Participants/Personnel	Blinding Outcome	Completeness	Selection	Other	Interpretation
Jennings et al (1998) ³⁶	Efficacy of 5% salicylic acid and 10% urea vs 12% ammonium lactate for treatment of foot xerosis	N = 70 Loss of follow-up: n = 31 Mean age = 48 y Duration: 4 wks Intervention: Twice-daily application of 5% salicylic acid and 10% urea and 12% ammonium lactate on left or right foot Outcomes: (1) Xerosis severity score	(1) Decrease in xerosis severity score after 4 weeks (week 0: 2.4, week 4: 1.0; P = .15), no differences between groups	Yes	Yes	Yes	Unclear	Yes	Yes	Yes	Twice-daily application of either cream reduces skin dryness on feet.
Uy et al (1999) ⁴⁰	Efficacy of ammonium lactate 12% lotion vs liposome based moisturizing lotion for plantar xerosis	N = 57 Loss of follow-up: n = 14 Mean age: 42 y Duration: 6 wks Intervention: Twice-daily application of ammonium lactate 12% lotion and liposome-based moisturizing lotion on left or right foot Outcomes: (1) xerotic grade, (2) clinical evaluation (1 = worse to 6 = clear)	(1) Decrease in mean xerotic grade of ammonium lactate lotion and liposome moisturizing lotion (baseline: 2.3 to week 4: 0.80; P < .001); (2) Clinical evaluation: Mean 4.7 (ammonium) and 4.6 (liposome) week 4; mean 3.7 (ammonium) and 3.5 (liposome) week 6; no differences between groups	Unclear	Yes	Yes	Unclear	Yes	Yes	Unclear	Twice-daily application of either lotion reduces xerosis and hyperkeratosis on feet.

(continues)

TABLE 2. Additional Randomized Controlled Trials Not Included in Systematic Reviews (Continued)

		Risk of Bias									
Source	Topic	Sample/Intervention	Main Results	Sequence	Allocation	Blinding Participants/ Personnel	Blinding Outcome	Completeness	Selection	Other	Interpretation
Gehring and Gloor 2000 ²⁶	Effect of topical dexpanthenol on epidermal barrier function and stratum corneum hydration (1) Drug-free vehicle (placebo), (2) vehicle and 6% borage oil, (3) vehicle + 6% borage oil and 2.5% dexpanthenol, (4) vehicle and 2.5% dexpanthenol, (5) vehicle and 1% dexpanthenol	N = 60 Loss of follow-up: n = 0 Mean age: 37.8 y Duration: 1 wk Intervention: Twice-daily application of 200- μ l study product on volar forearm vs placebo Outcomes: (1) Stratum corneum hydration, (2) TEWL	(1) Improvement of stratum corneum hydration ($P < .001$) with vehicle alone; additional improvement with dexpanthenol ($P < .01$ vs untreated; $P < .05$ vs vehicle) (2) Decrease of TEWL ($P < .05$) for formulation with dexpanthenol compared to placebo group	Unclear	Unclear	Unclear	Unclear	Yes	Yes	Unclear	Twice-daily applications of dexpanthenol maintain epidermal barrier function.
Gehring and Gloor (2001) ²⁷	Effect of 2.5% dexpanthenol on experimentally damaged skin	N = 40 Loss of follow-up: n. r. Mean age: 34.6 y Duration: 5 d Intervention: Application of 50- μ l study product 5 times daily 30 min after washing test Outcomes: (1) stratum corneum hydration; (2) TEWL; and (3) anti-inflammatory effect	(1) Increase in SCH for placebo and dexpanthenol vs untreated skin ($P < .01$) (2) Decrease on TEWL in dexpanthenol vs vehicle and untreated skin ($P < .05$) (3) Decrease of inflammation for dexpanthenol vs vehicle ($P < .01$) and untreated skin ($P < .05$)	Unclear	Unclear	Unclear	Unclear	Yes	Yes	Unclear	Application of 2.5% dexpanthenol-stabilized epidermal barrier function and has hydrating and anti-inflammatory effects.

(continues)

TABLE 2.

Additional Randomized Controlled Trials Not Included in Systematic Reviews (Continued)

Source	Topic	Sample/Intervention	Main Results	Risk of Bias							
				Sequence	Allocation	Blinding Participants/ Personnel	Blinding Outcome	Completeness	Selection	Other	Interpretation
Ademola et al (2002) ²³	Effectiveness of 40% urea and 12% ammonium lactate in the treatment of xerosis	N = 25 Loss of follow-up: n = 7 Age: range 18-65 y Duration: 28 d Intervention: Twice-daily application of test products Outcomes: (1) TEWL, (2) scaliness, (3) roughness, and (4) SCH	(1) Mean TEWL of 40% urea was lower than in ammonium lactate ($P < .05$) at day 28 (2 and 3) Improvement of 40% urea cream in skin roughness, fissures, thickness, dryness ($P < .05$) compared to 12% ammonium lactate (4) Increase in SCH for both groups	Unclear	Unclear	Unclear	Unclear	Yes	Yes	Unclear	Twice-daily application of either cream reduces xerosis, but 40% urea was superior to 12% ammonium lactate.
Hill and Edwards 2002 ⁴⁴	Effects of 3 bath additives (BALMANDOL (Spirig Pharma GmbH (Switzerland), EUCERIN (Bayersdorf AG (Germany), EUCERIN (Bayersdorf AG (Germany), BALNEUM (Almirall Hermal GmbH (Germany)), on skin barrier function	N = 20 Loss of follow-up: n. r. Mean age: 42.8 y Duration: 2 d Intervention: Application of randomized test products on the right and left arm on 2 days Outcomes: (1) TEWL	(1) Mean TEWL: 24 (BALMANDOL (Spirig Pharma GmbH (Switzerland)), 22 (EUCERIN (Bayersdorf AG (Germany))), 21.5 (BALNEUM (Almirall Hermal GmbH (Germany))) 17 (Water) at baseline; 18 (BALMANDOL (Spirig Pharma GmbH (Switzerland))), 22 (EUCERIN (Bayersdorf AG (Germany))), 20 (BALNEUM (Almirall Hermal GmbH (Germany))) 18 (Water) after 120 min Greater effect of BALMANDOL (Spirig Pharma GmbH (Switzerland), on barrier function ($P < .05$) AUC TEWL vs Time	Unclear	Unclear	Unclear	Unclear	Yes	Yes	Unclear	BALMANDOL (Spirig Pharma GmbH, Switzerland) had a greater effect on skin barrier function than BALNEUM (Almirall Hermal GmbH, Germany) and EUCERIN (Bayersdorf AG, Germany).

(continues)

TABLE 2.
Additional Randomized Controlled Trials Not Included in Systematic Reviews (Continued)

Source	Topic	Sample/Intervention	Main Results	Risk of Bias							Interpretation
				Sequence	Allocation	Blinding Participants/Personnel	Blinding Outcome	Completeness	Selection	Other	
Jennings et al (2002) ⁶²	Effect of LACTINOL (Pedinol Pharmacal, Inc. (USA)) vs LAC HYDRIN (Bristol-Myers Squibb Co. (Germany)) 12% in mild to moderate foot xerosis	N = 53 Loss of follow-up: n = 18 Mean age: 50 y Duration: 4 wks Intervention: Treatment of test products on left or right foot Outcomes: (1) xerosis severity score, (2) tenderness, (3) pruritus, (4) adverse events, and (5) overall evaluation of treatment (score: 5 = worse, 4 = no improvement, 3 = slight improvement, 2 = moderate improvement, 1 = good improvement, 0 = clear)	(1) Decrease in mean xerosis severity score in both groups (baseline: 2.5; week 4: 0.8); "both show reduction in skin dryness" (p, 148), (2) n. r., (3) n. r. (4) Lactinol-group: heat (n = 0), burning (n = 2), pruritus (n = 3), erythema (n = 3); Lac-Hydrin-group: heat (n = 1), burning (n = 3), pruritus (n = 1), erythema (n = 1), (5) no differences in both groups (mean overall evaluation: both groups = 0.8)	Unclear	Unclear	Unclear	Unclear	Yes	No	Unclear	Treatment of either lotion reduces foot xerosis.

(continues)

TABLE 2. Additional Randomized Controlled Trials Not Included in Systematic Reviews (Continued)

Source	Topic	Sample/Intervention	Main Results	Risk of Bias							Interpretation
				Sequence	Allocation	Blinding Participants/ Personnel	Blinding Outcome	Completeness	Selection	Other	
Biro et al (2003) ⁹⁹	Efficacy of 5% dexpanthenol in skin protection	N = 25 Loss of follow-up: n = 4 Age range: 18-45 y Duration: 26 days Intervention: Twice-daily application of test products on left and right forearms Outcomes: (1) Sebum, (2) SCH, (3) pH	(1) 3 µg/cm ² (dexpanthenol and vehicle) day 0; 12 µg/cm ² (dexpanthenol), 11 µg/cm ² (vehicle) day 22; 4 µg/cm ² (dexpanthenol), 3.5 µg/cm ² (vehicle) day 2 (2) 70 (dexpanthenol), 75 (vehicle) day 0; 58 (dexpanthol), 70 (vehicle) day 26 (3) 5.1 (dexpanthenol), 5.0 (vehicle) day 0; 4.8 (dexpanthenol), 4.9 (vehicle) day 26	Unclear	Unclear	Unclear	Unclear	Yes	Yes	Unclear	Twice-daily application of 5% dexpanthenol exhibits protective effects against skin irritation.
Agero and Verallo-Rowell 2004 ²⁴	Efficacy of virgin coconut oil compared with mineral oil for treatment of mild to moderate xerosis	N = 34 Loss of follow-up: n = 0 Age range: 16-70 y Duration: 2 wks Intervention: Twice-daily application of coconut oil (CO) or mineral oil (MO) on legs Outcomes: (1) Skin hydration, (2) skin lipids, (3) pH, (4) TEWL, (5) skin symptoms (dryness, scaling, roughness, pruritus, grade of xerosis)	Mean changes in values: (1) 8 (mineral oil, MO), 10 (coconut oil CO), (2) 75.22 (MO), 96.88 (CO), (3) -0.11 (MO), 0.39 (CO), (4) -8.47 (MO), -3.98 (CO), (5) dryness: 15 (MO), 19.13 (CO), Scaling: 15.94 (MO), 17.33 (CO), Roughness: 14.33 (MO), 19.94 (CO), Pruritus: 17.61 (MO), 17.43 (CO), Grade of xerosis: 0.78 (MO), 0.94 (CO) Improvement in skin hydration in both groups	Yes	Yes	Yes	Yes	Yes	No	Twice-daily application of either oils improved skin hydration and skin surface lipid levels. Subjective grading patients favor coconut oil.	

(continues)

TABLE 2. Additional Randomized Controlled Trials Not Included in Systematic Reviews (Continued)

Source	Topic	Sample/Intervention	Main Results	Risk of Bias						
				Sequence	Allocation	Blinding Participants/ Personnel	Blinding Outcome	Completeness	Selection	Other	Interpretation
Loden et al (2004) ⁴⁵	Differences in the irritation potential of 8 shower or bath oils (1) E45 EMOLLIENT BATH OIL (Reckitt Benckiser (UK) Ltd), (2) ACO SHOWER&BATH OIL (ACO Hud AB (Sweden)), (3) ACO INTIMATE WASH OIL (ACO Hud AB (Sweden)), (4) CERIDAL BATH OIL (Stiefel Laboratories Ireland Ltd (Ireland)), (5) BALNEUM HERMAL (Almirall Hermal GmbH (Germany)), (6) SEBAMED, SHOWER OIL (Sebapharma GmbH & Co. Boppard (Germany)) (7) NIVEA SHOWER OIL (Nivea (Germany)), (8) PH 5 EUCERIN SHOWER OIL (Beiersdorf (Germany)).	N = 15 Loss of follow-up: n = 0 Age range: 23-57 y Duration: 2 d Intervention: Application of test products on volar forearm with chambers over 24 h Outcomes: (1) TEWL, (2) skin blood flow, (3) visual scoring	(1) and (2) SEBAMED, SHOWER OIL (Sebapharma GmbH & Co. Boppard (Germany)), NIVEA SHOWER OIL (Nivea (Germany)) and PH 5 EUCERIN SHOWER OIL (Beiersdorf (Germany)) increased TEWL and blood flow, BALNEUM HERMAL (Almirall Hermal GmbH (Germany)) showed higher TEWL compared to water; E45 EMOLLIENT BATH OIL (Reckitt Benckiser (UK) Ltd), ACO SHOWER&BATH OIL (ACO Hud AB (Sweden)) and ACO INTIMATE WASH OIL (ACO Hud AB (Sweden)) showed not higher values than water; (3) Water induced very weak erythema, no significant differences between test products	Unclear	Unclear	Unclear	Yes	Yes	Unclear	Results showed a large difference in irritation potential between products.

(continues)

TABLE 2.
Additional Randomized Controlled Trials Not Included in Systematic Reviews (Continued)

		Risk of Bias									
Source	Topic	Sample/Intervention	Main Results	Sequence	Allocation	Blinding Participants/ Personnel	Blinding Outcome	Completeness	Selection	Other	Interpretation
Buraczewska et al (2007) ⁴²	Effect of long-term treatment with moisturizers on barrier function of normal skin (1) Ordinary cream, (2) cream with hydrocarbons isohexadecane and paraffin, (3) vegetable triglyceride oil, canola oil (4) Vegetable triglyceride oil, canola oil with urea, (5) lipid-free gel with polymer	N = 78 Loss of follow-up: n. r. Age range: 25-60 y Duration: 7 wks Intervention: Twice-daily application of test products on volar forearm Outcomes: (1) TEWL, (2) blood flow, (3) skin capacitance (only undamaged skin)	(1) Cream with hydrocarbons isohexadecane and paraffin, vegetable triglyceride oil, canola oil and canola oil with urea, and lipid-free gel with polymer increased TEWL, complex cream decreased TEWL; (2) unchanged to baseline; (3) cream with hydrocarbons isohexadecane and paraffin decreased skin capacitance, unchanged in the other preparations	Unclear	Unclear	Unclear	Unclear	Yes	Yes	Unclear	Twice-daily application of moisturizers influences skin barrier function, but the influence depends on the composition of the moisturizer.

(continues)

TABLE 2. Additional Randomized Controlled Trials Not Included in Systematic Reviews (Continued)

		Risk of Bias									
Source	Topic	Sample/Intervention	Main Results	Sequence	Allocation	Blinding Participants/Personnel	Blinding Outcome	Completeness	Selection	Other	Interpretation
Williams et al (2010) ⁴⁶	Effect of 5 different moisturizers on skin barrier function	N = 132 Loss of follow-up: n = 22 Age range: 16-65 y Duration: 2 wks Intervention: Hand washing 15 times a day with antiseptic hand soap and then application of moisturizers ("five commercial products" (p. 1089)) Outcomes: (1) TEWL, (2) Epidermal hydration, (3) Hand Eczema Severity Index (HECSI)	(1) Soap only no differences in TEWL from baseline to day 14; one product use decrease TEWL from baseline to day 14; (2) three products show an increase in skin hydration, (3) soap only had a worse effect on HECSI from baseline to day 14; one product showed worse effect on HECSI from baseline to day 7	Unclear	Unclear	Unclear	Unclear	Unclear	Yes	Unclear	Regular application of moisturizers to normal skin offers a protective effect against exposure to irritants.
Baalham et al (2011) ³⁷	Effectiveness of 2 moisturizer (AQUEOUS CREAM; Pinewood Laboratories Ltd, Ireland) and CCS FOOT CARE CREAM (EC De Witt & Co Ltd, England) on xerosis of the feet	N = 15 females with xerosis of the feet Loss of follow-up: n. r. Mean age: n. r. (adult) Duration: 14 d Intervention: Twice-daily application of 2 moisturizers (left and right foot) Outcomes: (1) Skin hydration	(1) Mean baseline: 19.02 (left feet), 19.13 (right feet) (P < .001); after treatment: 32.61 (left feet), 27.53 (right feet), increase in skin hydration in both feet (P < .05)	Unclear	Yes	Yes	Unclear	Unclear	Yes	No	Twice-daily applications of either moisturizer increase skin hydration.

(continues)

TABLE 2.

Additional Randomized Controlled Trials Not Included in Systematic Reviews (Continued)

Source	Topic	Sample/Intervention	Main Results	Risk of Bias							
				Sequence	Allocation	Blinding Participants/Personnel	Blinding Outcome	Completeness	Selection	Other	Interpretation
Garrigue et al (2011) ³⁹	Effect of PEDIMED CREAM (Pierre Fabre Médicament, France) vs placebo on foot xerosis in diabetic patients	N = 55 Loss of follow-up: n = 1 Mean age: 57 y Duration: 4 wks Intervention: Twice-daily application of test products on the feet Outcomes: (1) Xerosis assessment scale (XAS), (2) overall clinical cutaneous score (OCCS), (3) SCH, (4) desquamation parameters, (5) adverse events	(1) 4.2 day 0, 1.7 day 28 (PEDIMED), 4.3 day 0, 2.8 day 28 (placebo); (2) 6.0 day 0, 2.2 day 28 (PEDIMED), 6.0 day 0, 3.8 day 28 (placebo); (3) 13 day 0, 20.5 day 28 (PEDIMED), 12 day 0, 17 day 28 (placebo); (4) All D-Squame parameters = greater improvement with PEDIMED, (5) 5 adverse events (bullous dermatitis, sciatica, pyrexia, shoulder surgery, mild burning sensation)	Unclear	Unclear	Unclear	Unclear	Yes	Yes	Unclear	Twice-daily application of PEDIMED CREAM (Pierre Fabre Médicament, France) improves foot xerosis and reduced fissures of the feet in diabetics.
Christman et al (2012) ⁴³	Comparison between 2 cosmetic niacinamide/glycerin body moisturizers vs conventional body moisturizers	N = 121 (n = 63 study 1, n = 58 study 2) Loss of follow-up: n = 11 Age range: 18-65 y Duration: 35 d per study Intervention: Twice-daily application on test products on the lower legs (Saturday and Sunday one time application), same in both studies Outcomes: (1) Visual dryness (6-point scale), (2) skin hydration, (3) TEWL	(1) Mean visual dryness grades: range 2.3-2.6 study 1; range 2.4-2.6 study 2, (2) decrease in skin dryness for niacinamide in both studies ($P \leq .02$) after 1 wk, ($P \leq .01$) after 2 wks, (2) Decrease in skin hydration for niacinamide in both studies ($P \leq .01$), (3) improvement in skin integrity in both studies ($P \leq .01$) after 1 wk for niacinamide vs control	Unclear	Unclear	Unclear	Unclear	Yes	Yes	Unclear	Twice-daily application of a niacinamide/glycerin body moisturizer improved the integrity of the stratum corneum.

(continues)

TABLE 2. Additional Randomized Controlled Trials Not Included in Systematic Reviews (Continued)

Source	Topic	Sample/Intervention	Main Results	Risk of Bias							
				Sequence	Allocation	Blinding Participants/ Personnel	Blinding Outcome	Completeness	Selection	Other	Interpretation
Domoto et al (2012) ²⁵ (study 1)	Effect of orange roughy (<i>Hostethus atlanticus</i>) oil vs petrolatum on skin dryness	N = 24 (female) Loss of follow-up: n. r. Age range: 21-62 y Duration: 42 d Intervention: Twice-daily application of test products on areas of the leg after washing/bathing Outcomes: (1) TEWL, (2) skin dryness (changes)	(1) 13.5 (orange oil), 13.0 (petrolatum), 12.6 (untreated) day 0; 12.5 (orange oil), 11.3 (petrolatum), 11.9 (untreated) day 42 (2) Dryness score: 2.7 (orange oil), 2.6 (petrolatum), 2.7 (untreated) day 0; 2.2 (orange oil), 2.0 (petrolatum), 2.35 (untreated) day 42	Unclear	Unclear	Unclear	Unclear	Unclear	Yes	Unclear	Twice-daily application of orange roughy oil improved skin dryness.
Domoto et al (2012) ²⁵ (study 2)	Effect of orange roughy (<i>Hostethus atlanticus</i>) oil vs petrolatum on skin dryness	N = 22 (female) Loss of follow-up: n. r. Age range: 20-48 y Duration: 6 wks Intervention: Twice-daily application of test products on the face and areas of the forearm after washing/bathing Outcomes: (1) skin hydration	(1) 50 μs (orange oil) week 0, 85 μs (orange oil) after 6 wks	Unclear	Unclear	Unclear	Unclear	Unclear	Yes	Unclear	Twice-daily application of orange roughy oil improved skin dryness.

(continues)

TABLE 2. Additional Randomized Controlled Trials Not Included in Systematic Reviews (Continued)

Source	Topic	Sample/Intervention	Main Results	Risk of Bias							
				Sequence	Allocation	Blinding Participants/ Personnel	Blinding Outcome	Completeness	Selection	Other	Interpretation
Federici et al (2012) ³⁸	Efficacy of an urea 5%, arginine and carnosine-based cream vs a glycerol-based emollient cream in the treatment of foot xerosis in type 2 diabetic patients	N = 40 (type II diabetic patients) Loss of follow-up: n = 0 Age range: 40-75 y Duration: 28 d Intervention: Twice-daily application of test products on the feet Outcomes: (1) Dryness Area Severity Index (DASI), (2) Visual Analogue Score (VAS)	(1) DASI: 1.7 (intervention), 1.9 (control) baseline; 0.2 (intervention), 1.0 (control) wk 4 (2) VAS: 6.0 (intervention), 7.2 (control) baseline; 9.8 (intervention), 8.5 (control) week 4	Yes	Unclear	Unclear	Unclear	Yes	Yes	Unclear	Twice-daily application of urea 5%, arginine and carnosine cream increases skin hydration and improves skin dryness in type 2 diabetics.
Verdun and Soldevilla (2012) ³⁷	Comparison between IPARZINE (Laboratoire Larima (Monaco)) vs placebo in prevention of pressure ulcers	N = 194 (patient with high PU risk) Loss of follow-up: n. r. Mean age: 78.16 y (intervention-group), 78.51 y (placebo-group) Duration: 2 wks Intervention: Application of test products every 12 h on sacrum, trochanters and heels administered with gentle massage Outcomes: (1) PU incidence and (2) adverse events	(1) n = 6 developed PU in the intervention-group; n = 7 PU in the control-group. (2) not reported	Yes	Yes	Yes	Yes	Yes	Unclear	Unclear	There is no difference between intervention and placebo group in the effect of prevention of PU.

TABLE 3.

Clinical Practice Guidelines, Consensus Statements and Recommendations

Guidelines/Consensus Statements/Recommendations	Topic	Conclusions and Recommendations of Skin Care
Apelqvist et al (2000) ³⁵	Consensus and guideline for management and prevention of the diabetic foot	(1) Regular washing of feet; (2) careful drying, especially between the toes; (3) water temperature less than 37°C; and (4) use of oils or creams, but not between the toes
Holden et al (2002) ¹⁹	Best practice for use of emollients in dry skin conditions	(1) Avoid soap and use emollient soap substitutes for showering and bathing; (2) applying of emollients at least twice daily in adequate quantities (500 g or more per week); and (3) Solution: A-avoid soap, B-benefit from emollients, C-control inflammation
Gray et al (2007) ³⁰	Management of incontinence-associated dermatitis	(1) Gently daily perineal skin cleansing and after each major incontinence episode; (2) avoid scrubbing the skin; (3) at least once daily moisturization; and (4) application of a skin protectant or moisture barrier
Apelqvist et al (2008) ³⁶	Guideline for management and prevention of the diabetic foot	(1) Regular washing of feet; (2) careful drying, especially between the toes; (3) water temperature less than 37°C; and (4) use of oils or creams, but not between the toes
EPUAP (2009) ³³	Clinical practice guideline for prevention and treatment of PU	(1) Use of skin emollients to hydrate dry skin; (2) use of moisture barrier to protect skin from exposure to excessive moisture; and (3) avoidance of vigorously rubbing the skin
Deutsches Netzwerk für Qualitätsentwicklung in der Pflege (2010) ⁶⁰	Expert standard for pressure ulcer prevention	(1) Moisturizing skin care for sacral region
Black et al (2011) ²⁸	Consensus for prevention and management of IAD and intertriginous dermatitis	(1) Clean skin after each episode of incontinence and daily with no-rinse cleanser (pH 5.5); (2) no scrubbing of the skin; (3) use products to remove prior applications of skin protectants; (4) application of skin protectant (zinc oxide, petrolatum, dimethicone, or skin sealant (copolymer)); (5) after cleansing moisturize using products with humectants and emollients but avoid products with strong concentration of humectants
LeBlanc and Baranowski (2011) ³⁴	Consensus for the prevention of skin tears	(1) Use of warm/tepid water (not hot); (2) soapless or pH-neutral cleanser/soaps; (3) skin lubrication with hypoallergenic moisturizer twice per day; (4) application of moisturizers after showering while skin is still damp but not wet; and (5) limit baths
Australian Wound Management Association (2012) ³¹	Guideline for prevention and management of pressure injury	(1) Use of pH appropriate skin cleanser; (2) dry the skin thoroughly for protection of moisture; (3) use of water-based skin emollients; and (4) avoidance of vigorously rubbing the skin
Ayello and Sibbald (2012) ³²	Guideline for prevention of pressure ulcer and skin tears	<i>PU:</i> (1) Clean only soiling skin and avoid hot water and irritating cleaning agents like soaps; (2) use emollients on dry skin; (3) use of barrier products for skin protection; (4) use lotion after bathing; and (5) avoidance of vigorously rubbing the skin <i>Skin tears:</i> (1) Use lotion, especially on dry skin on arm and legs twice a day; (2) use of skin-protective products; (3) use no-rinse soapless bathing products; (4) application of moisturizers; and (5) use of nonadherent dressings on frail skin
Bakker et al (2012) ⁶¹	Management and prevention of diabetic foot	(1) Regular washing of feet; (2) careful drying, especially between the toes; (3) water temperature less than 37°C; and (4) use of lubricating oils or creams, but not between the toes
Guenther et al (2012) ¹⁸	Prevention and treatment of dry skin	(1) 5 min of bathing; (2) no body washes, no bubble baths; (3) limit soap, cleansers, and shampoo; (4) wear loose linen or cotton clothing; (5) limit sun exposure; (6) use of botanical- and fragrance- free cleanser; (7) apply emollients and/or moisturizers; (8) use of barrier cream for hands and feet; and (9) patting the skin dry (better than rubbing or harsh toweling)

(continues)

TABLE 3.

Clinical Practice Guidelines, Consensus Statements and Recommendations (*Continued*)

Guidelines/Consensus Statements/Recommendations	Topic	Conclusions and Recommendations of Skin Care
Doughty et al (2012) ²⁹	Prevention and treatment of IAD	(1) Gently cleansing with no-rinse cleanser with pH range similar to normal skin; (2) moisturization, but high concentrations are contraindicated for hyperhydrated skin; (3) application of moisture barrier products (eg, petrolatum-based, dimethicone-based, zinc-oxide based); and (4) use of a disposable cloth impregnated with acidic no-rinse cleanser and a protectant like dimethicone
Ananthapadmanabhan et al (2013) ⁴¹	Effect of daily cleansing—caring for healthy stratum corneum	(1) Use of cleanser with milder anionic detergents include acyl phosphates, acyl sarosinates, acyl taurates, sulphoacetates and isethionates; (2) application of anionic surfactants with amphoteric and nonionic surfactants reduce irritation potential; and (3) use of products with pH 6.5
Moncrieff et al (2013) ²⁰	Consensus statement for the use of emollients in dry skin conditions	(1) Use of emollients including leave-on products, washing products and bath emollients according to skin condition; (2) aqueous cream is damaging the skin barrier; (3) emollients have anti-inflammatory properties; (4) all products used on skin should be emollient based; (5) use of soaps and detergents should be avoided; (6) application of emollient several times a day; and (7) humectant-containing products lead to greater barrier repair

revised and discussed in a subsequent face-to-face meeting. A second revision was reviewed again and finally approved.

■ Outcomes

Searches of the EMBASE, MEDLINE, CINAHL, Scopus, and other electronic databases retrieved 1007 records. A title search narrowed this number to 121 articles that were read in full text by 2 reviewers (A.L. and A.H.). Ultimately, 41 documents reporting 7 systematic reviews, 19 RCTs, and 15 guidelines/consensus statements were included in the data synthesis (Figure 1).

We retrieved 3 clinical practice guidelines based on consensus statements,¹⁸⁻²⁰ 4 systematic reviews,^{5,13,21,22} and 6 RCTs not included in systematic reviews²³⁻²⁷ that we used to generate recommendations and interventions for prevention of dry skin. We retrieved 3 clinical practice guidelines/consensus statements²⁸⁻³⁰ and 2 systematic reviews^{2,4} that were used to generate recommendations and interventions for prevention of IAD. We used 4 clinical practice guidelines/consensus statements³¹⁻³⁴ and 1 systematic review⁵ to generate recommendations and interventions for prevention of skin injuries. Finally, we used 2 clinical practice guidelines^{35,36} and 6 RCTs³⁷⁻⁴⁰ to generate recommendations and interventions for prevention of the diabetic foot and foot xerosis. One expert symposium⁴¹ and 5 RCTs⁴²⁻⁴⁶ were extracted, which reported recommendations and results about basic skin care. Forty-three single studies covering the time period 1995 to 2012 were included in the 7 systematic reviews. Some studies were

included 3 to 4 times,⁴⁷⁻⁵² whereas others⁵³⁻⁵⁵ were included only once.

Methodological Quality

The methodological quality of the included publications varied. Four^{3-5,22} of 7 systematic reviews showed good methodological quality; they met 6 or more out of 11 quality criteria according AMSTAR. The most common reasons for the poor ratings were: (1) no protocol was published a priori,^{2,4,5,13,21} (2) excluded studies were not listed,^{2,4,5,13,21,22} or (3) a conflict of interest was not specified for the systematic review and for each of the included studies^{2-5,13,21,22} (Table 1).

Most of RCTs showed low methodological quality. Four^{24,40,56,57} of the 19 RCTs were deemed of high methodological quality. The main criteria associated with lower methodological quality were missing or inappropriate allocation concealment, no blinding of participants, personnel and outcome assessors, or sequence generation processes (Table 2). The main results of clinical practice, the guidelines/ recommendations, and consensus statements are reported in Table 3. As noted earlier, their methodological quality was not assessed.

Main Findings

Findings from our review were clustered into 3 topics: (1) skin care for prevention of dry skin; (2) skin care for prevention of IAD; and (3) skin care for prevention of skin injuries, including PUs, skin tears, and diabetic foot syndrome. This concept incorporates the various clinical pictures resulting from diabetic neuropathy, ischemia,

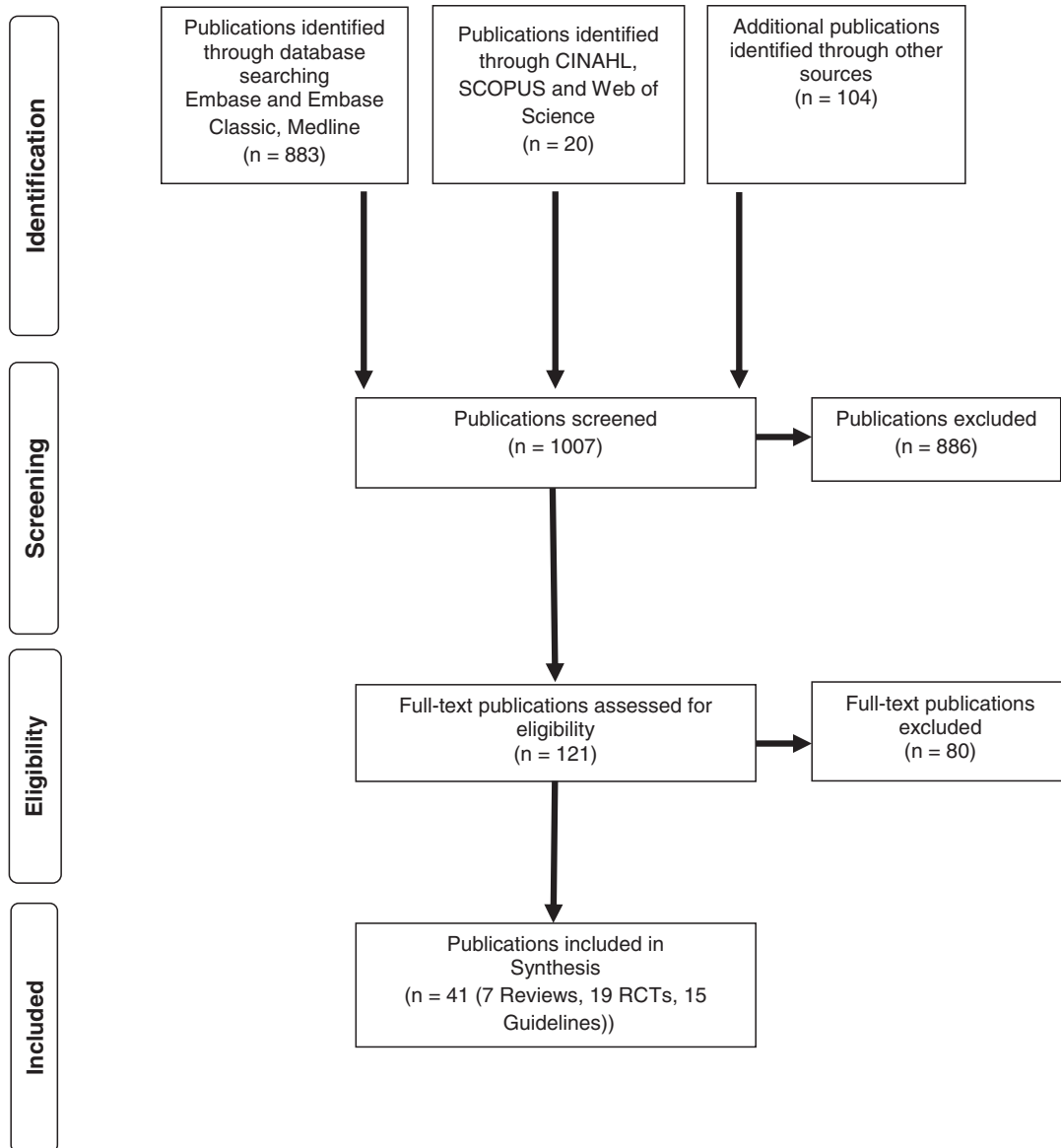


FIGURE 1. Flow diagram of the search and selection process.

and infection, leading to wounds and potential amputation.⁵⁸

Skin Care for Prevention of Dry Skin

Recommendations for prevention of dry skin were based on a single report from an expert dermatology symposium,⁴¹ 3 clinical practice guidelines and consensus statements,¹⁸⁻²⁰ 4 systematic reviews,^{5,13,21,22} and 6 RCTs not included in the systematic reviews.²³⁻²⁷ Because the pH of the surface of the skin is slightly acidic (pH 4.5-5.7), the use of mild cleansers with pH close to skin pH is recommended. Skin cleansing with natural soap is not recommended because the alkaline pH of these products (7-12) has the potential to damage the skin barrier. Key ingredients of cleansers are surfactants (surface active agents). These are molecules consisting of hydrophilic (water-soluble) and

lipophilic (oil-soluble) parts. Therefore, they are able to dissolve in both phases, making them miscible. According to the charge of the hydrophilic head group of the molecule "amphoteric," "nonionic" or "anionic" surfactants are distinguished. Based on the available evidence, amphoteric and nonionic surfactants instead of anionic surfactants lower the irritation potential and should be preferred. In any case, mild cleansers are preferred.⁴¹

Evidence retrieved from our review revealed that topically applied dexpanthenol 2.5% and 5% demonstrated protective effects against skin irritation.^{26,27,59} Twice-daily application of moisturizers has the potential to improve the skin's barrier function, but the effectiveness depends on the composition of the moisturizers and emollients.⁴² The 2010 study by Williams and colleagues⁴⁶ revealed that the application of moisturizers to healthy skin offers

protective effects against exposure to irritants. Another study investigated cosmetic body moisturizers, including niacinamide and glycerin versus moisturizers containing only glycerin or glycerin with petrolatum or glycerin with mineral oil. The twice-daily application of a cosmetic body moisturizer with niacinamide and glycerin improved the integrity of the stratum corneum by diminishing skin dryness and transepidermal water loss.⁴³

Frequent bathing or showering should be avoided and bathing time should be shortened when skin is dry. At least twice-daily application of emollients and moisturizers containing humectants such as urea or glycerin is recommended for prevention of dry skin.^{5,13,18,20}

Skin Care for Prevention of IAD

Recommendations for prevention of IAD were based on 3 clinical practice guidelines/consensus statements and 2 systematic reviews.^{2,4,28-30} Gentle daily cleansing with no-rinse cleansers (pH 5.5) and cleansing after each incontinence episode is recommended for prevention of IAD. Soap and water were found to be less effective and more time consuming than non-rinse cleansers (eg, wipes) and barrier creams.⁴ The skin should be dried carefully and thoroughly, and scrubbing should be avoided because of its deleterious effects on the skin's moisture barrier. After cleansing, a skin protectant product should be applied. Products, including zinc oxide, petrolatum, dimethicone, or other skin sealant, may be used.²⁸⁻³⁰

Skin Care for Prevention of PUs, Skin Tears, and Diabetic Foot Syndrome

Recommendations for prevention of PUs, skin tears, and diabetic foot syndrome were drawn from multiple sources. Recommendations for the contribution of skin care to the prevention of PU were drawn from 4 of the 15 clinical practice guidelines, best practice, or consensus statements^{31-33,60} along with 1 systematic review³ and 1 additional RCT.⁵⁷ One consensus statement was found with recommendations for skin tear prevention³⁴ and one systematic review focused on skin injury prevention.⁵ Recommendations related to basic skin care for prevention of diabetic foot syndrome were drawn from 3 consensus statements,^{35,36,61} and 6 RCTs.^{37-40,56,62}

The skin should be washed with lukewarm water and dried carefully but thoroughly, especially the toes and other areas where skin-to-skin contact is present (eg, submammary, inguinal, axilla). Irritating cleaning agents such as soap should be avoided. A clinical practice guideline from the Australian Wound Management Association recommended the use of pH appropriate skin cleansers and the application of emollients.³¹ The use of oils or creams is recommended for skin care in persons with diabetic foot syndrome, but the skin between the toes should be avoided.⁶³ The application of emollients or a moisture barrier for skin protection in terms of PU prevention is

also recommended.^{5,33} A best practice document for prevention of PUs and skin tears by Ayello and Sibbald³² suggested application of hypoallergenic moisturizers twice daily especially on arms and legs, combined with avoidance of rubbing the skin.

Algorithm for Basic Skin Care

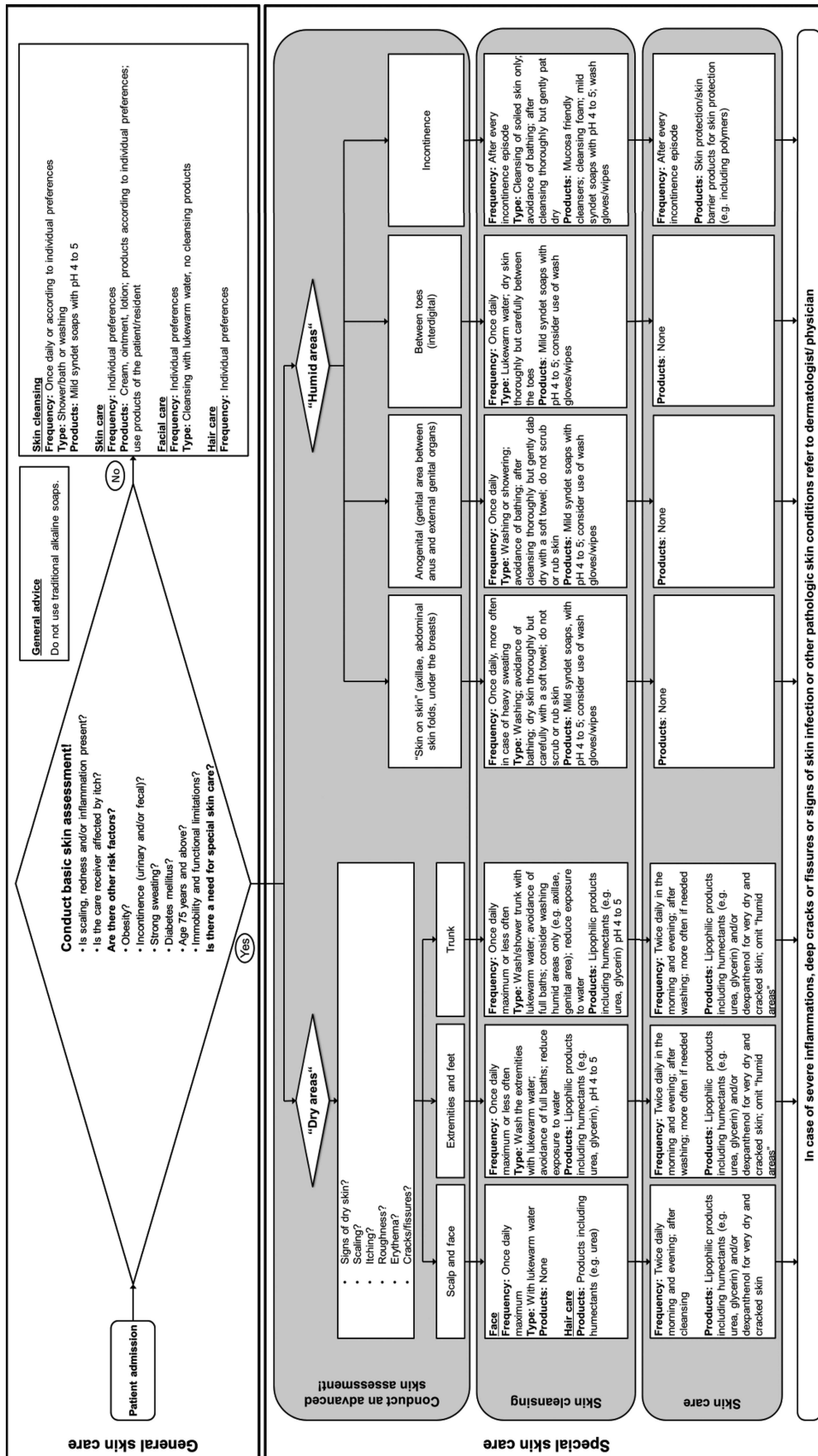
We developed our algorithm for basic skin care based on universal care process logic (assessment, diagnoses, interventions¹⁷), findings from our literature review, and expert review as described previously (Figure 2). The target groups for the algorithm are adult patients or residents in institutional and home care settings. The algorithm is intended for persons with intact skin that may exhibit signs of dryness such as scaling or hyperhydration such as maceration or other moisture-related changes. The algorithm is not intended to address severe inflammation, cutaneous lesions, infections, or wounds. The algorithm is not intended for persons with common dermatoses such as eczema, psoriasis, and candidiasis. Similarly, it is not intended for use in persons with atopic, contact, or seborrheic dermatitis.

The algorithm distinguishes between general and special basic skin care. General skin care is defined as all interventions and activities that patients or residents should receive. An assessment helps decide whether special skin care is needed or not. Skin care interventions always include cleansing followed by skin care. Skin cleansing usually includes the application of rinse-off products to remove unwanted substances on the skin (eg, dirt, bacteria, sweat, debris). Skin care is the application of leave-on products (eg, moisturizers, emollients) to protect and/or to enhance/restore the skin barrier.

General Assessment and Care

A thorough skin assessment is completed after patient admission as soon as possible. The clinician should assess the skin for integrity, scaling, redness, or cutaneous signs of pruritus. The assessment should take into account a history of comorbid conditions affecting the skin such as obesity, urinary or fecal incontinence, diaphoresis, diabetes mellitus, age 75 years or greater, immobility, or functional limitations. In case of the presence of skin problems or risk factors, special skin care is needed.

The skin should be cleansed once daily. Traditional alkaline soaps should be avoided when providing basic skin care. We recommend the use of a syndet cleansing product. Syndets, synthetic soap like products, should contain a milder synthetic surfactant when compared to traditional soaps and possess a pH of 4 to 5 that is compatible with the acid mantle of healthy skin. However, cleansing and the other caring procedures may follow individual preferences as long as no skin problems occur.



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FIGURE 2. Clinical algorithm for basic skin care in care settings.

Special Skin Care

The skin of patients requiring special skin care is classified based on “dry” and “humid” skin areas. Dry areas include surfaces that are directly exposed to air and/or clothes such as the face, scalp, and back. Humid areas include areas where skin folds occur such as axillae, abdominal skin folds, under the breasts, groin, and skin between the toes. We acknowledge that this dichotomous division may not reflect subtle differences between various skin areas, but we believe it aids thinking and clinical decision making in relation to the 2 key challenges in basic skin care: enhancing the moisture barrier when the skin is “too dry” or “too moist.”

Dry skin areas should be regularly assessed for the presence of scaling, roughness, redness, and cracks. Documentation and follow-up of these signs are especially important when evaluating the effectiveness of preventive interventions. In general, cleansing of dry skin areas should occur daily using lukewarm water. Severely dry skin should not be cleaned with soap and water; instead, mild lipid containing cleansers (syndets) with a pH near 4 to 5 should be used. Cleansers containing humectants (eg, urea, lactic acid, glycerin) are preferred. Lipid and humectant containing leave-on products should be applied to dry skin areas at least twice daily. In the case of severe dryness, products must be applied more often. The drier the skin, the more lipophilic the product should be.

Humid skin areas should be cleansed once daily and, if necessary, more frequently; these areas should be dried thoroughly but carefully. Full-body immersion should be avoided in order to limit exposure to additional moisture. For cleansing, mild syndet soaps should be used. Leave-on products should be avoided. If the patient has urinary or fecal incontinence, cleansing should be conducted after every incontinent episode to reduce exposure to urine and/or stool. A skin protectant should be applied after and before exposures to protect the skin.

The skin care algorithm provides general guidance for basic skin cleansing and caring and broad functional product categories. Nevertheless, we acknowledge that it does not address all possible special conditions and risks. Furthermore, we recognize a continuum between intact healthy and severely damaged skin. Targeted basic skin care is effective in managing dry scaly, (mildly) inflamed or even macerated skin. In case of severe deterioration of the skin condition and in case of infection or apparent wounds, a specialist (eg, a wound specialist, dermatologist) should be consulted.

Discussion

Skin care is an integral part of nursing practice in every care setting. The majority of skin care guidance addresses specific problems such as PU prevention,^{3,31-33} diabetic foot care,^{35,36} and management of dry (xerotic) skin.^{5,18-20} Nevertheless, a comprehensive guide addressing multiple

skin care needs is not available. Our contribution is designed to fill this gap.

This work is based on a comprehensive appraisal and summary of existing literature. While previous reviews focused on special skin care areas, we provided a broad summary of available evidence. The systematic reviews we used for generating recommendations and designing our basic skin care algorithm incorporated approximately 40 studies (Table 1). In addition, we identified another 20 RCTs not incorporated into the systematic reviews (Table 2). We found that the methodological quality of most RCTs was poor, and interventions and outcomes are generally not comparable. In order to capture best practices where evidence was missing or lower quality, we also summarized recent guidelines and recommendations about diabetic foot care, dry skin, PU, and skin tear management.

Variability in the terms used to describe skin care provided a significant challenge for interpreting results. For instance, one resource recommended “mild”⁴¹ but failed to define what this term actually means. Another problem is the mixing of product functions (eg, moisturizing) and ingredient function (eg, glycerin as humectant, petrolatum as skin protectant). These difficulties are also observed for procedures. For instance, cleansing or application frequencies and durations are often not well described. Irrespective of these conceptual inconsistencies and different clinical areas, skin care recommendations and guideline statements were broadly similar. This suggests that there is a kind common state-of-the-art agreement, which is reflected in our algorithm.

The main therapeutic goal of the proposed skin care algorithm is the maintenance of a healthy and intact cutaneous barrier. In certain conditions such as mild inflammation or dryness, the proposed algorithm is also expected to improve barrier function. Applying a 2-step approach is considered useful to identify special skin care needs early. As long as the skin is intact and there are no other risk factors, “General skin care” interventions are considered appropriate. We acknowledge that personal hygiene and skin care procedures rely on tradition, personal beliefs, and preferences, but found no evidence signaling a need to change these behaviors as long as the integrity or barrier function of the skin is not compromised. On the other hand, patients with certain risk factors such as advanced age or incontinence will be led to the “special skin care” of the algorithm section that provides interventions to counteract the increased vulnerability to inflammation, maceration, and infection.

Product selection remains a major challenge in the field of basic skin care. For example, variable labeling of cleansing and skin care products renders it difficult to determine product performance.^{64,65} In addition, existence of a specific ingredient does not determine product performance; instead, performance must be determined based on the cumulative formulation and its proper application.⁶⁶

Because of these difficulties, we provided general advice about what each product category should look like. For instance, we propose lipophilic leave-on products for dry skin conditions. This might include high lipid-containing creams or lotions.

■ Conclusions

This is the first clinical algorithm created for basic skin care in nursing care settings published internationally. It will be implemented at the Charité-Universitätsmedizin in Berlin and revised as indicated based on feedback from clinicians. During implementation, the number of skin cleansing and caring products will be reduced and the skin care approach standardized.

KEY POINTS

- ✓ A comprehensive basic skin care algorithm for use in clinical settings is proposed.
- ✓ In dry skin, frequent bathing or showering should be avoided and exposure to water should be reduced to a minimum.
- ✓ Lipophilic products including humectants should be used for treating dry skin.
- ✓ Skin should be protected against exposures to urine and/or feces.
- ✓ Skin care product selection is difficult due to heterogeneous labeling and claimed performance.

■ ACKNOWLEDGMENT

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