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Rippon, Mark, Colegrave, Melanie and Ousey, Karen

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Original Citation

Rippon, Mark, Colegrave, Melanie and Ousey, Karen (2016) Incontinence-associated dermatitis: reducing adverse events. *British journal of nursing*, 25 (18). pp. 1016-1021. ISSN 0966-0461

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Incontinence-Associated Dermatitis: Adverse event sequelae, cost and prevention.

Mark Rippon, Melanie Colegrave, Karen Ousey

Corresponding author: Melanie Colegrave PhD. No current institutional affiliation.

Freelance Medical Writer and Researcher

Molecular Cell Research,

14 The Avenue,

Lincoln,

LN1 1PD

UK

www.molecularcellreaserch.co.uk

Telephone: 01522 530839

Email: molcellres@gmail.com

Mark G. Rippon PhD, Visiting Clinical Research Fellow.

School of Human and Health Sciences,

Institute of Skin Integrity and Infection Prevention.

University of Huddersfield.

Queensgate,

Huddersfield.

HD1 3DH.

Karen Ousey; PhD; RN Professor and Director for the Institute of Skin Integrity and Infection Prevention

University of Huddersfield,

Queensgate,

Huddersfield.

HD1 3DH.

Abstract

Incontinence-associated dermatitis (IAD) is a common problem in patients with faecal and/or urinary incontinence. Urine alters the normal skin flora and increases permeability of the stratum corneum and faecal enzymes on the skin contribute to skin damage. Faecal bacteria can then penetrate the skin, increasing the risk of secondary infection. However, IAD can be prevented and healed with timely and appropriate skin cleansing and skin protection. This includes appropriate use of containment devices. HARTMANN incontinence pads have been developed to absorb the fluids that cause IAD and maintain the skin's acidic pH. The acidic pH of the skin contributes to its barrier function and defence against infection. Therefore, maintaining an acidic pH will help protect the skin from damage.

Key phrases

The incidence of IAD in people in long term care, acute care and the community is high.

Treatment of IAD increases the cost of providing incontinence care and decreases patients' quality of life.

IAD incidence can be significantly reduced by effective preventative measures that involve correct implementation of a structured skin care protocol.

Incontinence pads with curly fibre technology may assist with effective skin care protocols to prevent IAD and effective skin care protocols to prevent IAD and have associated benefits for the patient's quality of life and for healthcare providers.

Key words

Incontinence associated dermatitis; Prevention; Skin care protocol; Acidic pH; Incontinence pads; Curly fibres

Conflict of interest

This review was supported by HARTMANN.

Introduction

Skin moisture is not necessarily damaging. But when moisture that contains irritating substances, such as alkaline urine, contacts the skin for a prolonged period, damage can occur (Ousey et al, 2016). Incontinence-associated dermatitis (IAD) is one of the clinical manifestations of moisture-associated skin damage and is a common problem in patients with faecal and/or urinary incontinence (Voegeli, 2013). Therefore, IAD is often encountered by nursing staff and is an important issue for nurses to be aware of. Incontinence causes disruption of the skin barrier function and leads to superficial skin damage (Figure 1). This occurs because of the effects of urine, faeces, and containment devices on the skin (Gray et al, 2012). The skin's pH contributes to its barrier function and defence against infection; an ideal pH is 5.0 to 5.9 (Boer et al, 2016). Urine pH ranges from 4.5 to 8.0; the higher range is alkaline and contributes to skin damage (Larner et al, 2015).

Nurses should know that IAD can be prevented and healed with timely and appropriate skin cleansing and skin protection (Gray et al, 2012; Beeckman et al, 2015). Prevention and treatment should also focus on a proper use of incontinence containment materials (Fader et al, 2008). Products with fluid handling and removal properties may be considered as an adjunct to a structured skin care regimen to help avoid occlusion and over-hydration of the stratum corneum (Beeckman et al, 2015). HARTMANN incontinence pads have been developed in line with a technology that enables absorption of the fluids that cause IAD and also chemically maintains pH such that tissue damage is very much reduced (Beguin et al, 2010; Bliss et al, 2016).

Incidence/prevalence of incontinence and IAD

It is estimated that in the UK up to half a million adults may experience faecal incontinence (Harari et al, 2014) and between three and six-million people in the UK may have urinary incontinence (Withington et al, 2014). Most detailed studies of incontinence prevalence have been undertaken internationally, and they suggest that up to 79% of residents in nursing homes and 35% of community-dwelling adults have been found to experience incontinence (Newman et al, 2007; Langemo et al, 2011), putting them at risk of IAD. The prevalence of IAD varies dramatically depending on the setting with international surveys suggesting rates between 5.6% and 50%, while the incidence is 3.4% to 25 % (Gray et al, 2012). However, it can be difficult to truly estimate these levels as most studies involve small samples in specific settings. This is in part because IAD is not well defined; until recently there was no international agreement on the name of the condition and IAD does not have a separate code in the International Statistical Classification of Diseases and Related Health Problems 10th version, 2007 (ICD-10) where it is grouped as diaper dermatitis (Beeckman, 2016). Meanwhile, incontinence is not well reported because it is not considered to be a medical diagnosis, but rather a nursing diagnosis or care problem (Halfens et al, 2013).

Details from the National Prevalence Measurement of Care Problems in Austria and the Netherlands suggest that both urinary and faecal incontinence are more prevalent in nursing homes than hospitals with around 10-15% of patients in hospitals and 55-75% in nursing homes experiencing urinary incontinence. The prevalence of faecal incontinence is around 10% in hospital and 30-60% in nursing homes (Halfens et al, 2013). Long et al (2012) presented information on 171 patients admitted to a long-term care facility in Cincinnati, Ohio, USA. 39 had IAD on admission (prevalence of 22.8%). The incidence of IAD in those without IAD at admission was 7.6% at 12 weeks. Junkin and Selekof (2007) in a survey of acute care patients in Lincoln, NE, USA found that the overall prevalence of incontinence was 19.7% in 608 patients, in those who were incontinent 42.5% had

skin injury. Campbell et al (2016) investigated acute care patients in Australia and found a 24% prevalence of incontinence and that IAD occurred in 42% of patients who were incontinent. Hall and Clark (2015) found an incidence of 29.4% IAD in patient with incontinence in neurotrauma intensive care and progressive care units in Virginia, USA. This was reduced to 0% after the implementation of an education programme involving best practice for prevention and treatment for incontinence cleansing.

Incontinence is also a problem for nurses working in the community. Rohwer et al (2013) found that in 189 community-living individuals in Minnesota, USA with faecal incontinence, 52.5% experienced IAD. Bliss et al (2015) found that in 98 community-living individuals with faecal incontinence that did not experience IAD at the beginning of the study, the incidence of IAD was 41% (40 of the 98) over 52 days.

Conditions associated with IAD

The data above shows that there is a high incidence of IAD in people with incontinence but nurses should be aware that there are certain conditions that may be associated with a particularly high risk of IAD (Table 1, Voegeli, 2016). A recent review suggested that there are 27 individual risk factors for IAD but nine were identified as priorities: urinary incontinence, faecal incontinence, double incontinence, perineal environment, toileting ability, tissue tolerance, skin pH, the use of absorbent products and absence of structured skin care (Heywood and Holloway, 2014).

More research is needed in this area as some of the risk factors remain controversial and the level of evidence for many factors is low. Kottner et al (2014) found IAD was more likely to occur in males than females, those individuals with diabetes mellitus, those with a higher BMI, those with faecal incontinence rather than urinary incontinence or those showing a high degree of functional and psychical impairments. Campbell et al (2016) suggested that faecal incontinence was not more likely to be a risk factor for IAD but they did find that patients with semi-formed or liquid stool were more likely to have IAD than those with formed stool, they also found no association with the frequency of incontinence. However, Rohwer et al (2013) support the view that faecal incontinence and frequency of incontinence episodes are risk factors for IAD. Animal models also support this view with increased irritation of the skin being due to digestive enzymes in faecal matter (Gray et al, 2012).

It also remains debatable whether ageing plays a role, and ageing is associated with many of the risk factors of IAD. Kottner et al (2014) and Rohwer et al (2013) found no association between IAD and ageing, but Campbell et al (2016) did. Animal studies suggest that ageing enhances skin maceration and the ultrastructural alteration of the epidermis a major risk factor for impairing skin barrier function and IAD (Minematsu et al, 2011). Aging also increases the pH of the skin, which is in itself a major reason for urine causing skin damage (Hachem et al, 2005; Trojahn et al, 2015). There is a higher reported incidence of IAD in the elderly (Le-Lievre, 2001; Kottner and Beeckman, 2015) but this could be a reflection of the increased levels of incontinence in the population in this study.

The implications of IAD

Patients with IAD experience discomfort and pain that is likely to diminish their quality of life (Jacobson and Wright, 2015). As IAD decreases the skin's protective barrier, this makes the area much more prone to infection. The most common infections involve *Candida* sp. and *Staphylococcus aureus*; with fungal infection being very common (Campbell et al, 2016). Infection means IAD takes

longer to be successfully treated (Bliss et al, 2007). Cases of IAD result in longer hospital stays (Chatham and Carls, 2012; Lewis-Byers and Thayer, 2002). Additionally, pain increases patient morbidity and may cause a lack of adherence to required interventions (Junkin and Selekof, 2008). This may in turn impact upon the effectiveness of treatment, and lead to further complications.

There is some debate over whether IAD increases the risk of pressure ulcer (PU) development but current evidence suggests that this may be the case (Beeckman et al, 2014). Patients who develop PU experience severe pain, restricted activity and prolonged periods of hospitalisation (Gorecki et al, 2009).

Nurses should be aware that PUs and IAD are sometimes misidentified and confused because they may co-exist and present in a similar manner, but they have distinct aetiologies and treatment strategies, so it is important to distinguish between them (Hall et al, 2015; Beeckman 2016). Cases of PUs occur when deeper skin tissue is affected by pressure or shear and the vulnerability of the skin to PU development is increased by moisture (Beeckman et al, 2014). Education is important to assist health professionals with correct identification and treatment of IAD and/or PUs.

Prevention and treatment of IAD

The first step for nurses in preventing IAD should be identification of incontinence and its appropriate management (Voegeli, 2016). Appropriate management can involve improving mobility, medication, use of indwelling catheters and external collection devices (Gray et al, 2016). If incontinence cannot be reversed, then prevention of IAD involves removal of the irritant and moisture and augmentation of the skin's barrier function (Beeckman, 2016) summarised as follows:

- Routinely use a defined skin care regimen
- Timely and gentle cleansing of soiling
- Apply moisturiser especially on dry skin
- Apply protectant to areas that might come into contact with urine or faeces

Therefore, skin cleansing to remove urine or stool and their enzymes and microorganisms is important, alongside application of skin moisturiser and application of a skin barrier to prevent skin breakdown (Kottner et al, 2013). Cleansing should involve a product with a pH as close to that of normal skin as possible and an optimal skin care regimen should be undertaken following each major incontinence event (Beeckman et al, 2009).

Evidence suggests that perineal skin cleansers are most effective for skin cleansing (Beeckman et al, 2009). Then creams, ointments, lotions and films all show efficacy as a protective barrier (Beeckman, 2016). For removal of urine or stool from the skin appropriate use of incontinence containment materials can be effective, including the use of incontinence pads and devices (Macaulay et al, 2015; Nazarko, 2015; Payne, 2015; Fader et al, 2008). However, further research is needed to evaluate which methods and products are most suitable for different patients and situations. Nevertheless, implementation of a structured skin care protocol is the major reason for decreased incidence of IAD in many studies (Hall and Clark, 2015; Bale et al, 2004; Bates-Jensen et al, 2003; Hunter et al, 2003). However, Nix and Ermer-Seltun (2004) found that few skin care protocols were implemented correctly with many omitting the use of a protective skin barrier. This could be because in some cases excess use of barrier products have been found to clog incontinence pads and causing them not to work (Voegeli, 2016). Therefore, it is critical that nurses follow the guidelines for the correct use of barrier creams.

Treatment and prevention strategies for IAD are generally similar but for complex IAD antifungals or antibiotics may be required to treat a secondary infection. This may also involve additional diagnostic tests (Chatham and Carls, 2012).

The costs associated with IAD

To our knowledge there has been no study undertaken to evaluate the true economic cost of IAD in the UK. The high rates of incontinence result in a large economic burden worldwide, estimates range between 0.89 and 1.74 USD per episode of incontinence (Bliss et al, 2007) or skin-assessment scale costs of 28.36 Euro to 98.06 Euro (Baatenburg de Jong & Admiraal, 2004). However, the cost of IAD to healthcare providers and patients can be difficult to measure accurately. This is because prevention and treatment of IAD when they occur can involve similar protocols, the economic benefit of preventing IAD may be considered to be minimal. However, the pain and discomfort encountered by the patient with IAD should not be discounted, as it is likely to require medication and longer hospital stays involve increased use of supplies and nursing care (Chatham and Carls, 2012; Junkin and Selekof, 2008; Lewis-Byers and Thayer, 2002). This suggests that IAD will have a large economic burden in the UK, which may be offset by providing preventative care.

Costs can be lowered by careful choice of an effective care regimen. Studies show that use of a polymer based skin barrier film compared to ointment or cream reduces costs because it is only applied three times a week rather than daily (Bliss et al, 2007; Baatenburg de Jong and Admiraal, 2004).

HARTMANN incontinence briefs with curly fibre

Containment devices, otherwise known as incontinence briefs, are multilayer disposable garments containing a superabsorbent polymer designed to wick and trap moisture. They can form an important part of a carefully controlled IAD prevention strategy but, by trapping heat and moisture, may cause redness and inflammation that can progress to skin erosion (Payne, 2015). Fortunately, newer products with improved fluid handling properties can avoid occlusion and over-hydration of the stratum corneum, and this could complement an effective skin care regimen (Beeckman et al, 2015). Appropriate use of containment devices includes correct fitting and measurement of the appropriate brief size, regular monitoring of incontinence episodes to change the containment device once wetting has occurred and regular assessment of the skin (Beeckman et al, 2015).

In order to address the demands of preventing IAD, HARTMANN have developed incontinence pads that enable absorption of the fluids that result from incontinence and maintain an acidic pH (Beguin et al, 2010; Bliss et al, 2016). Similar to other incontinence pads, they should be changed after each episode of incontinence, but they are designed to reduce skin damage by removing the fluid and maintaining the skin pH immediately when an episode occurs. The curly fibre technology, which is pH 5.5 spiral shaped cellulose fibre contained within the upper layer of the pad material and sits directly next to the skin, buffers the pH of the incontinence voids and also helps draw and distribute fluids into the superabsorbent core (Figure 2). Using these pads significantly lowered the pH of skin exposed to an alkaline solution with pH similar to urine/faeces, while standard briefs did not (Bliss et al, 2016). However, careful monitoring of the skin condition of patients with incontinence is still required (Beeckman et al, 2015).

The acidic pH of the skin surface and the difference in pH between the skin surface and the deeper layers of the skin control the skin's microbiological flora. The growth and density of bacteria and fungi increase as the pH increases (Boer et al, 2016). The correct pH also helps maintain correct hydration of the epidermis and increased pH corresponds with increased transepidermal water loss, an

important indicator of epidermal barrier function (Boer et al, 2016). Skin pH plays an important role in the surface structure and stability of the stratum corneum's extracellular matrix lipids (Plasencia et al, 2007). The benefits of a low pH in protecting the skin have led some studies to consider using an acidic skin cleanser to improve barrier function (Duncan et al, 2013; Blaak et al, 2011).

As maintenance of an acidic pH protects patients from skin damage, incontinence pads with curly fibre may improve skin care protocols that are essential for protecting patients from IAD through management of incontinence and skin health protection. This would reduce the incidence of IAD in at risk patients and reduce the cost of treating IAD. Further research is required to quantify the benefits.

Conclusion

The high prevalence of incontinence in people in long term care, acute care and even in the community suggests that the incidence of IAD is also high. This results in a high cost, in terms of money and quality of life. However, IAD incidence can be significantly reduced by effective preventative measures that involve correct implementation of a structured skin care protocol. The use of HARTMANN incontinence pads with curly fibre technology assists with maintaining an acidic pH. As skin pH is a factor in incidence of IAD, this suggests there are benefits for both the patient and the organisation.

References

- Bale S, Tebble N, Jones V, Price P (2004) The benefits of implementing a new skin care protocol in nursing homes. *J Tissue Viability* 14(2): 44-50.
- Baatenburg de Jong H, Admiraal H (2004) Comparing cost per use of 3M Cavilon No Sting Barrier Film with zinc oxide oil in incontinent patients. *J Wound Care* 13(9): 398-400.
- Bates-Jensen BM, Alessi CA, Al-Samarrai NR, Schnelle JF (2003) The effects of an exercise and incontinence intervention on skin health outcomes in nursing home residents. *J Am Geriatr Soc* 51(3): 348-55.
- Beeckman D (2016) A decade of research on Incontinence-Associated Dermatitis (IAD): Evidence, knowledge gaps and next steps. *J Tissue Viability* pii:S0965-206X(16)00022-X. DOI: 10.1016/j.jtv.2016.02.004. [Epub ahead of print]
- Beeckman D Campbell J, Campbell K, et al (2015) Proceedings of the Global Ied expert Panel. Incontinence associated dermatitis: moving prevention forward. *Wounds International* 2015. available to download from www.woundsinternational.com
- Beeckman D, Schoonhoven L, Verhaeghe S, Heyneman A, Defloor T (2009) Prevention and treatment of incontinence-associated dermatitis: literature review. *J Adv Nurs* 65(6): 1141-54. DOI: 10.1111/j.1365-2648.2009.04986.x.
- Beeckman D, Van Lancker A, Van Hecke A, Verhaeghe S (2014) A systematic review and meta-analysis of incontinence-associated dermatitis, incontinence, and moisture as risk factors for pressure ulcer development. *Res Nurs Health* 37(3): 204-18. DOI: 10.1002/nur.21593.
- Beguin AM, Malaquin-Pavan E, Guihaire C, et al (2010) Improving diaper design to address incontinence associated dermatitis. *BMC Geriatr* 10:86. DOI: 10.1186/1471-2318-10-86.

Blaak J, Wohlfart R, Schürer NY (2011) Treatment of Aged Skin with a pH 4 Skin Care Product Normalizes Increased Skin Surface pH and Improves Barrier Function: Results of a Pilot Study. *J Cosmetics Dermatol Sci Appl* 1(3): 50-58.

Bliss DZ, Funk T, Jacobson M, Savik K (2015) Incidence and Characteristics of Incontinence-Associated Dermatitis in Community-Dwelling Persons With Fecal Incontinence. *J Wound Ostomy Continence Nurs* 42(5):525-30. DOI:10.1097/WON.000000000000159.

Bliss D, Bland P, Wiltzen K, Gannon A, Wilhelms A, Mathiason M, Turnbaugh R (2016) Absorbent Briefs Containing Curly Fiber Lower (Acidify) Skin pH Reducing Risk for Incontinence Associated Skin Damage in Older Nursing Home Residents. Poster presented at WCON society and CAET joint conference in Montreal, Quebec, Canada.

Bliss DZ, Zehrer C, Savik K, Smith G, Hedblom E (2007) An economic evaluation of four skin damage prevention regimens in nursing home residents with incontinence: economics of skin damage prevention. *J Wound Ostomy Continence Nurs* 34(2): 143-52.

Boer M, Duchnik E, Maleszka R, Marchlewicz M (2016) Structural and biophysical characteristics of human skin in maintaining proper epidermal barrier function. *Postepy Dermatol Alergol* 33(1): 1-5. DOI: 10.5114/pdia.2015.48037.

Campbell JL, Coyer FM, Osborne SR (2016) Incontinence-associated dermatitis: a cross-sectional prevalence study in the Australian acute care hospital setting. *Int Wound J* 13(3): 403-11. DOI: 10.1111/iwj.12322.

Chatham N, Carls C (2012) How to manage incontinence-associated dermatitis: Prevention and prompt action are keys to managing this painful and costly complication. *Wound Care Advisor* 1(1): 7-10.

Duncan CN, Riley TV, Carson KC, Budgeon CA, Siffleet J (2013) The effect of an acidic cleanser versus soap on the skin pH and micro-flora of adult patients: a non-randomised two group crossover study in an intensive care unit. *Intensive Crit Care Nurs*. 29(5): 291-6.

Fader M, Cottenden A, Getliffe K, et al (2008) Absorbent products for urinary/faecal incontinence: a comparative evaluation of key product designs. *Health Technol Assess* 12(29):iii-iv, ix-185.

Gorecki C, Brown JM, Nelson EA, et al (2009) European Quality of Life Pressure Ulcer Project group. Impact of pressure ulcers on quality of life in older patients: a systematic review. *J Am Geriatr Soc* 57(7):1175-83. DOI: 10.1111/j.1532-5415.2009.02307.x.

Gray M, Beeckman D, Bliss DZ, et al (2012) Incontinence-associated dermatitis: a comprehensive review and update. *J Wound Ostomy Continence Nurs* 39(1): 61-74. doi:10.1097/WON.0b013e31823fe246.

Gray M, Skinner C, Kaler W (2016) External Collection Devices as an Alternative to the Indwelling Urinary Catheter: Evidence-Based Review and Expert Clinical Panel Deliberations. *J Wound Ostomy Continence Nurs*. 43(3): 301-7.

Hachem JP, Man MQ, Crumrine D, et al (2005) Sustained serine proteases activity by prolonged increase in pH leads to degradation of lipid processing enzymes and profound alterations of barrier function and stratum corneum integrity. *J Invest Dermatol* 125(3): 510-20.

Halfens RJ, Meesterberends E, van Nie-Visser NC, et al (2013) International prevalence measurement of care problems: results. *J Adv Nurs* 69(9): e5-17. DOI: 10.1111/jan.12189.

Hall KD, Clark RC (2015) A Prospective, Descriptive, Quality Improvement Study to Decrease Incontinence-Associated Dermatitis and Hospital-Acquired Pressure Ulcers. *Ostomy Wound Manage* 61(7):26-30.

Harari D, Husk J, Lowe D, Wagg A (2014) National audit of continence care: adherence to National Institute for Health and Clinical Excellence (NICE) guidance in older versus younger adults with faecal incontinence. *Age Ageing* 43(6):785-93. doi: 10.1093/ageing/afu056.

Heywood N, Holloway S (2014) Risk factors for incontinence-associated dermatitis: an evidence-based review. *Wounds UK* 10(4):22-33.

Hunter S, Anderson J, Hanson D, Thompson P, Langemo D, Klug MG (2003) Clinical trial of a prevention and treatment protocol for skin breakdown in two nursing homes. *J Wound Ostomy Continence Nurs* 30(5):250-8.

Jacobson TM, Wright T (2015) Improving quality by taking aim at incontinence-associated dermatitis in hospitalized adults. *Urol Nurs* 35(6): 292-9

Junkin J, Selekof JL (2008) Beyond "diaper rash": Incontinence-associated dermatitis: does it have you seeing red? *Nursing* 38(11 Suppl):56hn1-10. DOI: 10.1097/01.NURSE.0000341725.55531.e2.

Junkin J, Selekof JL (2007) Prevalence of incontinence and associated skin injury in the acute care inpatient. *J Wound Ostomy Continence Nurs* 34(3):260-9.

Kottner J, Blume-Peytavi U, Lohrmann C, Halfens R (2014) Associations between individual characteristics and incontinence-associated dermatitis: a secondary data analysis of a multi-centre prevalence study. *Int J Nurs Stud* 51(10): 1373-80. DOI: 10.1016/j.ijnurstu.2014.02.012.

Kottner J, Lichterfeld A, Blume-Peytavi U (2013) Maintaining skin integrity in the aged: a systematic review. *Br J Dermatol*. 169(3):528-42.

Kottner J, Beeckman D (2015) Incontinence-associated dermatitis and pressure ulcers in geriatric patients. *G Ital Dermatol Venereol* 150(6): 717-29

Langemo D, Hanson D, Hunter S, Thompson P, Oh IE (2011) Incontinence and incontinence-associated dermatitis. *Adv Skin Wound Care* 24(3):126-40. DOI: 10.1097/01.ASW.0000395037.28398.6c.

Larner J, Matar H, Goldman VS, Chilcott RP (2015) Development of a cumulative irritation model for incontinence-associated dermatitis. *Arch Dermatol Res*. 307(1): 39-48. DOI: 10.1007/s00403-014-1526-y.

Le Lievre S (2001) The management and prevention of incontinence dermatitis. *Br J Community Nurs* 6(4): 180-5.

Lewis-Byers K, Thayer D (2002) An evaluation of two incontinence skin care protocols in a long-term care setting. *Ostomy Wound Manage* 48(12):44-51.

Long MA, Reed LA, Dunning K, Ying J (2012) Incontinence-associated dermatitis in a long-term acute care facility. *J Wound Ostomy Continence Nurs* 39(3): 318-27. DOI: 10.1097/WON.0b013e3182486fd7.

Macaulay M, Broadbridge J, Gage H, et al (2015) A trial of devices for urinary incontinence after treatment for prostate cancer. *BJU Int* 116(3):432-42. DOI: 10.1111/bju.13016.

Minematsu T, Yamamoto Y, Nagase T, et al (2011) Aging enhances maceration-induced ultrastructural alteration of the epidermis and impairment of skin barrier function. *J Dermatol Sci* 62(3):160-8. DOI: 10.1016/j.jdermsci.2011.03.005.

Nazarko L (2015) Use of continence pads to manage urinary incontinence in older people. *Br J Community Nurs* 20(8):378-4. DOI: 10.12968/bjcn.2015.20.8.378

Newman D, Preston A, Salazar S (2007) Moisture control, urinary and faecal incontinence, and perineal skin management. In: *Chronic wound care: A clinical source book for healthcare professionals*. Krasner D, Rodeheaver G, Sibbald R eds. 4th edn. HMP communications, Malvern. 159-164.

Nix D, Ermer-Seltun J (2004) A review of perineal skin care protocols and skin barrier product use. *Ostomy Wound Manage* 50(12): 59-67.

Ousey K, Cutting KF, Rogers AA, Rippon MG (2016) The importance of hydration in wound healing: reinvigorating the clinical perspective. *J Wound Care* 25: 122-130. DOI: 10.12968/jowc.2016.25.3.122.

Payne D (2015) Selecting appropriate absorbent products to treat urinary incontinence. *Br J Community Nurs* 20(11):551-8. DOI:10.12968/bjcn.2015.20.11.551.

Plasencia I, Norlén L, Bagatolli LA (2007) Direct visualization of lipid domains in human skin stratum corneum's lipid membranes: effect of pH and temperature. *Biophys J* 93(9): 3142-55.

Rohwer K, Bliss DZ, Savik K (2013) Incontinence-associated dermatitis in community-dwelling individuals with fecal incontinence. *J Wound Ostomy Continence Nurs* 40(2):181-4. DOI: 10.1097/WON.0b013e31827e8b3d.

Trojahn C, Dobos G, Blume-Peytavi U, Kottner J (2015) The skin barrier function: differences between intrinsic and extrinsic aging. *G Ital Dermatol Venereol* 150(6):687-92.

Voegeli D (2013) Moisture-associated skin damage: an overview for community nurses. *Br J Community Nurs* 18(1):6-12.

Voegeli D (2016). Incontinence-associated dermatitis: new insights into an old problem. *Br J Nurs* 25(5):256-262. DOI: 10.12968/bjon.2016.25.5.256.

Withington J, Hirji S, Sahai A (2014) The changing face of urinary continence surgery in England: a perspective from the Hospital Episode Statistics database. *BJU Int* 114(2):268-77. doi: 10.1111/bju.12650.

Figure 1: Example of incontinence associated dermatitis (IAD) that had developed in a patient whose skin was contaminated with urine containing a large amount of sediment that had bypassed her indwelling urinary catheter.

Figure 2: Incontinence briefs with curly fibre technology from HARTMANN. **A:** Curly fibre before incorporation into the brief. **B:** Dignity briefs ① Inner cuff system, ② Hypo-allergenic materials, ③ Air active material, ④ The 3-layer absorbent core, ⑤ Super-absorbent polymer, ⑥ Soft, cloth-like back-sheet. **C:** Three-layer design of the incontinence pads. **D:** Curly fibre method of action.