The potential fire risk of emollients when dried-on viscose bandages

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Abstract

Background: the potential fire risk of fabrics impregnated with emollients has been described within the health service, including ignition of bandages. The role of emollients in fire fatalities have also been included in coroner reports, as accelerating fires when present. **Aims:** although changes in burning behaviour is known, no standard tests have been carried out on bandages which are often used in conjunction with emollients. **Method:** using a standard vertical flammability test, the flammability of viscose bandage was compared to when impregnated with nine dried on emollients with low to high and non-paraffin content. **Findings:** the time to ignition was significantly reduced with an emollient present and the glowing time was longer. **Conclusions:** the same safety advice applies to viscose bandages as other fabrics with emollients; do not expose them to naked flames or high heat sources or allow emollients to build up on bandages.

Keywords: Fire risk • viscose bandages • emollients • flammability of bandages

Emollients are a widely prescribed treatment for a range of dermatological conditions such as eczema, psoriasis and xerosis dermatitis, which are characterised by pruritic, bumpy or scaly skin (Croney, 2016). The term emollients and moisturisers are often used synchronously by healthcare professionals and can be defined as a medical treatment that restores and promotes hydration to the skin (Oxford University Hospitals, 2012). Conditions can range from mild to severe, with some individuals experiencing flare-ups and inflammation that can be managed by routinely applying emollients to the affected areas (Casha, 2022). In the UK, the NHS annually spends around £83 million on prescribing emollients and barrier creams to patients (Greener, 2018). Emollients are available in several formulations, such as creams, lotions, gels, sprays and ointments, which can be prescribed for both day- and night-time use.

When applied to the skin, an emollient will form an oily layer on the stratum corneum, which is composed of dead skill cells, to restore moisture to the skin barrier (Moncrieff et al., 2013). Some emollients can contain high amounts of substances called humectants, such as hyaluronic acid or glycerin, which attract and bind to water (Draelos, 2015). In some circumstances, the use of humectants can increase the rate of transepidermal water loss (Casha, 2022), which can be defined as the evaporation of water as it passes through the dermis to the epidermis (Honari and Maibach, 2014). To prevent excessive transepidermal water loss and provide protection to the affected area, emollients can be used in conjunction with medical dressings such as viscose stockinettes (He, 2020). In healthcare settings, viscose garments made of medical-grade viscose are commonly prescribed to be used with emollients, as they are stretchy, comfortable to wear and breathable. The garments can be applied over the affected areas as either a wet (soaked in water) or dry wrap. Research has shown that viscose garments are an effective aid to the treatment of dry-skin conditions as they provide a physical barrier to protect the skin from damage through, for example, scratching, as well as increasing the strength of the emollient to aid short-term treatment (National Eczema Society, 2021). Viscose garments are also effective as they can be washed to remove some of the emollient build-up and can therefore be reused multiple times (NHS, 2021).

In isolation, emollients are not flammable when applied to the skin; however, emollients can be transferred onto textiles such as bedding, clothing or dressings, soaking into the material. When it has dried, it can leave behind a flammable residue (Blackburn et al, 2022). There have been some reports on ignition of emollients and dressings during surgical procedures (Allen and Tinder, 2001; Arefiev et al, 2012), and some advice (Health and Safety Laboratory, 2007) and commentary on the risk (Shokrollahi, 2017) within the healthcare profession. While fire risks of emollients are communicated to patients when being prescribed by healthcare professionals, emollients can also be purchased over the counter, in pharmacies or in stores, leaving users unaware of the potential risk factors. Organisations such as the Medicines and Healthcare products Regulatory Agency (MHRA) have continuously updated their guidance on the safe use of emollients, with the latest research, including this guidance, to help spread awareness of this risk (MHRA, 2018).

The Fire and Rescue Services report that there have been 50 fire incidents between 2000 and 2018 (49 fatal incidents) involving victims who were either known to be using an emollient, or emollients were at the premises where fires were reported, although the numbers are believed to be higher owing to underreporting and lack of awareness (MHRA, 2018). Campaigns run by organisations such as the MHRA and National Fire Chiefs Council (NFCC) aim to make healthcare providers and users of emollients aware of the fire risks by continually evaluating the latest research and statistics. In January 2008, the MHRA first communicated in the Drug Safety Update that emollients with a paraffin content of over 50% posed a risk of severe and fatal burns. However, in subsequent years, the MHRA have reviewed and updated the guidance to show that emollients with a paraffin content of below 50%, as well as paraffin-free emollients can pose a flammability risk. This update came after flammability tests found that a build-up of emollient residue on textiles had an accelerant effect when ignited (Hall, 2019; MHRA, 2021).

Objectives

The objective of this study was to determine the flammability and fire behaviour of viscose bandages when they have been impregnated with emollient products. In the flammability tests, the bandages were tested when they were 'blanks' (not contaminated with emollient products) and when contaminated with nine different emollient products. Vertical flammability tests were used to determine the bandage's time to ignition, flame time and glow time. The time to ignition was measured, as this could impact on someone's time to react quick enough on accidental ignition of bandages. Flame and glowing time were also measured with a dried-on emollient present, as longer times could cause more severe skin burns.

Methods

The vertical flammability tests were based on a previously reported method (Hall, 2019) adapted from those published by the US Federal Aviation Administration (Horner, 2000). The tests were initially carried out in a fume cabinet with no extraction until the burn progressed independently to reduce the movement of the flame before and at the point of ignition. A bespoke heatproof tile (Eurocell plc) with a drilled circular indent (0.5cm) was used as a stand for the Bunsen burner to allow it to be placed in the same position under the fabric specimen holder. The viscose bandage used was a Comfinette Size '78' Tubular Viscose Stockinette Dressing Bandage (manufactured by Vernacare) and cut to 34 cm x 8.5 cm strips. Each strip was weighed, then an emollient (1.25 mL) was spread evenly up the strip using a fingerprint roller (WA products Ltd.), where it was weighed again before being left to dry for a week and then reweighed before each test.

The bandage samples were sandwiched between two stainless steel specimen holders (fabricated by Mackays Metals, Cambridge) and then held in place using retort stands with only the bottom edge exposed to the indirect flame (8 cm distance from the tip of the flame to the bottom edge of the bandage) (*Figure 1*).

Time to ignition was measured, which was the time from when the Bunsen burner is placed under the lower edge of the textile (*Figure 1*) to when it held an independent flame. Flame and glowing combustion time were also measured, which is the time the flame is present on the surface of the textile and the time after the flame has self-extinguished and 'glowing' can be seen within the remaining fabric, respectively. All tests were repeated 5 times, with a range of nine emollients (*Table 1*) varying from paraffin-free to 100% paraffin content. Emollient has been adopted as the term used to explain the skin care products used including lotions, creams, non-paraffin creams and ointments (Croney, 2018).

Figure 1. Vertical flammability test of viscose bandage.

Table 1. Emollients used and ingredients in flammability testing

Emollient	Manufacturer	Ingredients
Non-paraffin cream 1	Fontus Health Limited	Avena sativa kernel flour 1%, purified water, apricot kernel oil, glycerin, sucrose stearate, cetearyl alcohol, glyceryl stearate SE, dimethicone, phenoxyethanol, vitamin F, ethyl ester, ethylhexylglycerin, xanthan gum, disodium EDTA, vitamin E
Non-paraffin cream 2	Fenton Pharmaceuticals	Aqua, glyceryl stearate SE, glycerin, lanolin alcohol, benzyl alcohol, cetearyl alcohol, oleic acid, triethanolamine, stearic acid, p-Chloro-m-Cresol, parfum, linalool, limonene, citronellol, coumarin, geraniol, anise alcohol, benzyl cinnamate
Lotion 1	Bayer plc	6% white soft paraffin, aqua, petrolatum, glycerin, methyl glucose sesquistearate, dimethicone, PEG-20 methyl glucose sesquistearate, benzyl alcohol, cyclomethicone, glyceryl monostearate, stearic acid, palmitic acid, cetyl alcohol, xanthan gum, magnesium aluminium silicate, carbomer, sodium hydroxide
Lotion 2	Reckitt Benckiser Healthcare	10% white soft paraffin, 4% light liquid paraffin, aqua, petrolatum, isopropyl palmitate, paraffinum liquidum, glyceryl stearate, ceteareth-20, lanolin, phenoxyethanol, ethylparaben, methylparaben, hydroxyethylcellulose, carbomer, ethylhexylglycerin, sodium hydroxide, BHT
Cream 1	Genus Pharmaceuticals	13.2% white soft paraffin, 10.5 % light liquid paraffin, emulsifying wax (SLS free), cetostearyl alcohol, glycerol, phenoxyethanol, citric acid monohydrate, trisodium citrate dihydrate, purified water
Cream 2	Bayer plc	15% white soft paraffin, 6 % liquid paraffin, cetostearyl alcohol, macrogol cetostearyl ether, chlorocresol, sodium dihydrogen phosphate, sodium hydroxide, phosphoric acid, and purified water
Cream 3	Dermal Laboratories	15% liquid paraffin, isopropyl myristate, glycerol, carbomer, sorbitan laurate, trolamine, phenoxyethanol, purified water
Cream 4	Reckitt Benckiser Healthcare	14.5% white soft paraffin, 12.6% light liquid paraffin, lanolin, cetyl alcohol, methyl parahydroxybenzoate, propyl parahydroxybenzoate, empilan GMS, sodium cetostearyl sulphate, carbomer, sodium hydroxide, citric acid monohydrate, purified water
Ointment 1	Bayer plc	95% white soft paraffin, 5% liquid paraffin

Data Analysis

The aim of this research was to compare the viscose blank fabric burning behaviour to when it had been impregnated with a dried-on emollient. Statistical analysis was carried out on the time to ignition, flame time and glowing time using SPSS software (IBM SPSS statistics version 28) and the ANOVA post-hoc Tukey test method. Differences between the means and variance were deemed to be significantly different when $p<0.05$ (95% confidence intervals) was adopted.

Findings of flammability testing

Time to ignition

When comparing the mean time to ignition of the blank bandage to the ignition times of the bandage strips that are impregnated with dried emollients, the time to ignition is slower when there is no emollient present. All tests with emollient products exhibited faster times to ignition (*Figure 2*). All but one emollient times to ignition were significantly quicker ($p<0.05$) to the blank time to ignition. Statistically, ointment 1 was not significantly different to the blank bandage owing to large variation of the ointment test results (non-paraffin cream 1, p=0.047; non-paraffin cream 2, p=<0.001; lotion 1, p=<0.001; lotion 2, p=0.039; cream 1, p=<0.001; cream 2, p=0.003; cream 3, p=0.004; cream 4, p=0.003 and ointment 1, p=0.163).

Flame time

The mean blank bandage flame time (*Figure 3*) is slightly quicker than tests when a dried-on emollient is present. However, all of the tests with emollients present were not significantly different to the blank bandage ($p>0.05$) in flame time, apart from ointment 1, which was significantly longer (non-paraffin cream 1, p=0.999; non-paraffin cream 2, p=0.980; lotion 1, p=0.964; lotion 2, p=0.986; cream 1, p=0.306; cream 2, p=0.994; cream 3, p=0.347; cream 4, p=0.134 and ointment 1, p=<0.001).

Glowing time

The mean glow times exhibited from the tests show that the viscose bandages with dried-on emollients have a longer glow time than the blank viscose bandage (*Figure 4*). Statistical tests found lotion 1, lotion 2 and ointment 1 ($p<0.05$) to be significantly longer in mean glow times when compared to the blank. Creams 1 to 4 and both non-paraffin creams' glow times were found to not be significantly different from the blank bandage glow time ($p>0.05$). (non-paraffin cream 1, p=0.652; non-paraffin cream 2, p=0.076; lotion 1, p=0.045; lotion 2, p=0.023; cream 1, p=0.630; cream 2, p=0.999; cream 3, p=0.825; cream 4, p=0.986 and ointment 1, p=0.050).

Discussion

Time to ignition

The blank viscose bandage mean ignition time of 24.1s is shortened to 4.6 to 14.6s when an emollient is dried onto the bandage. The reason for the significant reduction in the time to ignite is because the emollient acts as a fuel, with the fabric behaving as a wick to increase the volatility of the emollient and to sustain a flame (Croney, 2016; He, 2020). This reduced

Table 2: Comparisons of time to ignition, flame and glow times of blank viscose bandage to bandages when impregnated with dried emollients

Textile test and emollient α	Mean time to ignition ± stdev (s)	%CV	Mean Flame time ± stdev (s)	%CV	Mean Glow time ± stdev (s)	%CV
Blank bandage	24.1 ± 11.9	49.3	9.1 ± 3.6	38.9	29.5 ± 5.2	17.7
Non-paraffin cream 1	12.7 ± 1.2	9.2	10.3 ± 1.9	18.1	46.6 ± 18.1	38.8
Non-paraffin cream 2	6.4 ± 2.1	33.4	10.9 ± 2.3	21.2	57.8 ± 6.0	10.4
Lotion 1	4.6 ± 1.0	21.1	11.1 ± 2.0	18.1	57.3 ± 9.2	16.0
Lotion 2[b]	11.7 ± 3.3	28.3	10.9 ± 1.9	17.4	64.1 ± 32.4	50.5
Cream 1	6.0 ± 2.4	39.3	13.1 ± 2.4	18.6	46.9 ± 8.5	18.1
Cream 2	9.4 ± 2.3	24.1	10.6 ± 2.3	21.7	36.4 ± 15.2	41.7
Cream 3	9.6 ± 2.8	28.6	13.0 ± 1.0	7.8	44.0 ± 5.6	12.8
Cream 4[b]	8.4 ± 3.2	37.6	14.0 ± 4.4	31.4	39.5 ± 7.4	20.1
Ointment	14.6 ± 9.3	63.7	21.6 ± 2.1	9.7	58.1 ± 15.1	26.1

Note: [a]n=5; [b]n=4.

ignition is similar to previous findings on flammability testing of emollients when impregnated on cotton fabrics (Hall, 2019). The emollients chosen for this research contain varying quantities of paraffin or vegetable/nut oils, that when they are dried onto fabric, all become flammable. As shown in *Figure 2*, ointment 1 has a reduced time to ignition, but is not statistically different. This is likely to be due to the large variability of the 5 tests (63.7 %) exhibited by ointment 1. This variability around the mean could be explained by the viscosity of the ointment, emulating the challenges of applying such an emollient on skin (Croney, 2018), as well as an even layer on the fabric. This significant lower time to ignition, could pose a risk to patients who use both emollients and viscose bandages for treatment, if they expose the bandages to a source of flame or high heat, as they have less time to react with this quicker ignition.

Flame time

The mean flame time of the blank viscose bandage was 9.1s, but when emollients had been dried onto the bandage, it slightly increased to a mean flame time of 10.3s to 21.6s. The statistical analysis found no difference in flame time of the bandage when compared to an emollient present, apart from ointment 1, which was found to be statistically different. While it would be expected that the bandage would burn longer with the additional 'emollient' fuel, it does not do so significantly. Therefore, to burn this fuel at the same time recorded for just the bandage alone, the burn must be more intense and mirrors observations during the tests with emollients having larger flame heights and increased temperatures. The only emollient found to significantly increase the flame time was the ointment. This could be due to the slower time for the ointment to become volatile, with the heavier components of the paraffinic content evaporating less quickly (Bapp, 2017). Therefore, the ointment would be available to burn longer as a vapour. The ointment also had a much lower mean mass loss on drying (5%) compared to the other emollients having higher percent mass losses on drying (lotions: 74 to 84 %; non paraffin creams: 70 to 74 %; and creams 1 to 4: 61 to 68 % loss on drying), so more ointment was left on the fabric after drying.

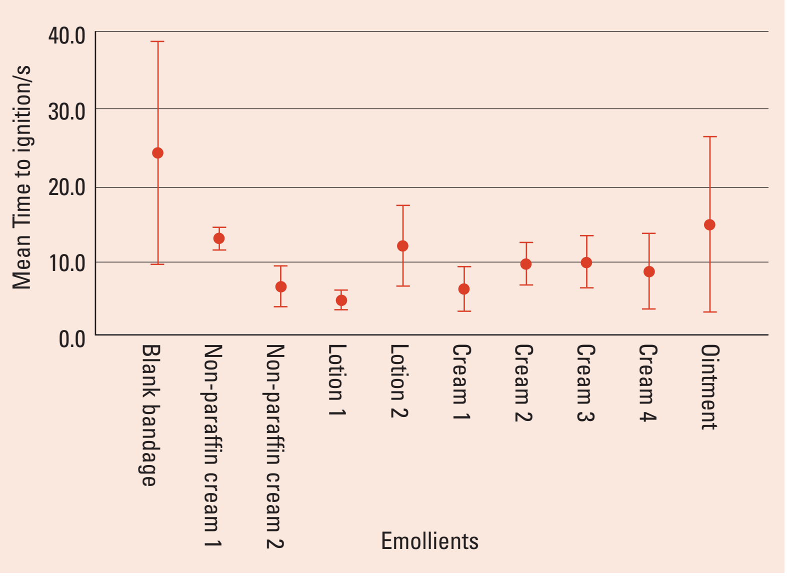

FIGURE 2. Comparison of time to ignition of blank viscose bandage with viscose bandage contaminated with emollient products

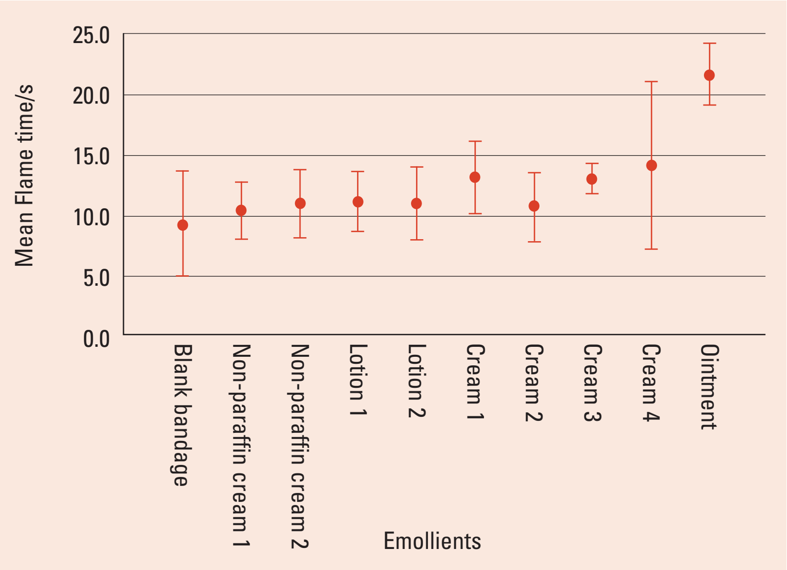

FIGURE 3. Comparison of flame times of blank viscose bandage with the same bandage when impregnated with different emollients.

Glowing time

The blank viscose bandage glowed for 29.5s and the bandages with dried-on emollient glowed for 36.4 to 64.1s. Some of the tests with emollients present did burn longer compared to the bandage on its own, although *Figure 4* does show the large variation in some of the tests. However, if a bandage impregnated with a dried-on emollient was accidentally ignited, after burning with a flame, it could continue to burn via a glowing burn next to the skin and cause a more severe burn (Udayraj, 2014).

Limitations

Although the laboratory flammability test method is used in similar research, previous tests were carried out on denser and tighter weave fabrics. There were challenges in the way the test specimens were prepared, with the edges of the viscose 'curling up' when cutting the strips and applying the emollients. Attempts were made to remove any loose fabric threads at the edge of the bandage that were exposed to the indirect flame. During the flammability tests, the blank viscose bandage moved when being heated up above the flame and this explains the large variation in results. However, it moved less when a dried-on emollient was present as this was observed to 'weigh' down the fabric and reduce the movement above the flame.

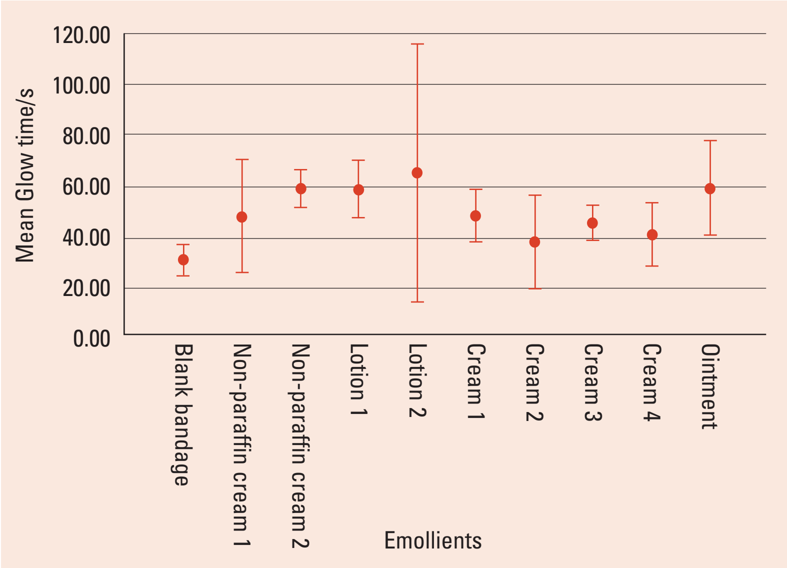

FIGURE 4. Comparison of glow times of blank viscose bandage with the same bandage when impregnated with different emollients.

Key points

- With much quicker ignition times of the viscose fabric with a dried-on emollient it could reduce reaction time on accidental ignition of bandages
- A more intense burn is produced when an emollient is present on viscose bandage
- Viscose bandages with dried on emollients have the potential to burn even without a flame causing more severe burn injury.

CPD reflective questions

- How has reading this article improved your awareness of the fire risks that emollients may potentially pose in your patient population?
- Have you reviewed the MHRA toolkit on fire safety and emollient use, and in what way has this changed your practice because of this?
- With the introduction of warning labels on products, do you feel patients are more aware of the risks? Would you feel more confident now pointing out the risks to patients who bring this up in consultations?
- How can we make sure that all healthcare professionals are properly informed of the fire risk of emollients when dried onto viscose bandages and other fabrics? And pass on advice to patients
- Before reading this article were you aware of how to refer into your local Fire Service for home safety advice and what they can offer patients at high risk?

Strengths

Despite these challenges, these tests still show the differences in burn behaviour of the viscose bandage when the emollient was present and therefore, the same safety advice should be given as outlined by the MHRA on using emollients safely. The guidance published by the MHRA and fire and rescue services does not aim to discourage people from using emollients but to be aware of the flammability risk and take the necessary precautions. The recommended precautions include avoiding open ignition sources, such as naked flames, not smoking in bed and washing textiles at the highest recommended temperature to try to remove some of the emollient residue (Hall et al, 2021; Care Quality Commission, 2022; The National Fire Chief's Council, 2022).

Conclusions

The flammability tests show the differences in burn behaviour of viscose bandages changing with the presence of a dried-on emollient. The most notable was the significant decrease in time to ignition and thus, could impact on a patient's time to react on accidental ignition of the bandage material.

Currently, the risk and preventive measures taken are described in the context of clothing and bedding; however, these tests also show that bandages burn differently with an emollient. The MHRA context of safety is also focused on adults at risk, but viscose bandages and emollients are common practice for children with eczema. This area needs a future focus as a potential area for research. Nonetheless, the prescribing of emollients for treatment should never be changed, as they have significant medical benefits for patients. When prescribed, a conversation with patients or parents about using them safely should be had. Therefore, healthcare practitioners need to advise those wearing bandages in combination with emollients to keep away from a flame and high heat source, but also to make sure their bandages are changed regularly and not allow build up of applications of emollients.

Community teams caring for patients are in the unique position to be seeing these patients in their home setting, where the risks are more obvious compared to those presented to healthcare professionals in hospital settings. They can see open fires, smoking and other hazards such as hoarding. They can stress the importance of replacing or washing viscose bandages heavily contaminated with emollients, if they are to be reused, as while this may not completely remove the risk, it will most definitely reduce it. They can liaise with local fire brigade fire safety teams as they have specialists in this area, for advice in the home, referring patients into the service.

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Allan SJ, Tidman MJ. Dermatology dressings: an incendiary potential. Br J Dermatol. 2001;144(3):649-650. https://doi.org/10.1046/j.1365-2133.2001.04118.x

Arefiev K, Warycha M, Whiting DArefiev K, Warycha M, Whiting D, Alam M. Flammability of topical preparations and surgical dressings in cutaneous and laser surgery: a controlled simulation study. J Am Acad Dermatol. 2012;67(4):700-705. https://doi.org/10.1016/j.jaad.2012.04.026

Bapp G. Volatility vs. flash point; what we should know. 2017. https://www.machinerylubrication.com/Read/30945/volatility-flash-point (accessed 31 October 2022).

Blackburn K, Morrissey J, Tabert C, Hall S. Evaluating the communication within fire and rescue services and the NHS on the fire risk of emollients in accordance of the MHRA safety update. Fire Mater. 2022;46:277–286. https://doi.org/10.1002/fam.2975

Care Quality Commission. Issue 3: fire risk use emollient creams. 2022. https://www.cqc.org.uk/guidance-providers/learning-safety-incidents/issue-3-fire-risk-use-emollient-creams. (accessed 20 September 2022).

Casha E. Six habits to introduce for eczema management: a guide for community nurses. Br J Community Nurs. 2022;27(2):63-64. https://doi.org/10.12968/bjcn.2022.27.2.63

Croney S. Choosing an emollient. Br. J. Nurs. 2018; 27 (11): 697-698. https://doi.org/10.12968/bjon.2018.27.11.597

Croney S. Treating skin conditions in the community: know your emollients. Br. J. Community Nurs. 2016; 21(9): 452-456. https://doi.org/10.12968/bjcn.2016.21.9.452

Draelos Z. Cosmetic dermatology : products and procedures. Chapter 1: epidermal barrier. Wiley and Blackwell, 2015

Draelos ZD. Active agents in common skin care products. Plast Reconstr Surg. 2010;125(2):719-724. https://doi.org/10.1097/prs.0b013e3181c83192

Greener M. Emollient expenditure: time to scratch a budgetary itch. Br. J. Health Care Manag. 2018; 24(6): 274-277. https://doi.org/10.12968/bjhc.2018.24.6.274

Hall S, Franklin L, Bull J, Beard A, Phillips G, Morrissey J. The flammability of textiles when contaminated with paraffin base products. Fir. Safe. J. 2019; 104:109-116. https://doi.org/10.1016/j.firesaf.2019.01.003

Hall SW, Blackburn KJ, Ferguson L, Pugh P. Assessing the potential fire risk of laundered fabrics after contamination with emollients using ATR-FTIR spectroscopy and chemometrics. Sci. Justice. 2021; 61(6): 799-788. https://doi.org/10.1016/j.scijus.2021.09.004

He H, Koh MJ, Lee HY, Ang SB. Pilot study of a customized nanotextile wet garment treatment on moderate and severe atopic dermatitis: A randomized clinical trial. Pediatr Dermatol. 2020;37(1):52-57.

He H, Yu Z. Evaluation of transfer wicking behaviour of fibrous material ensembles used by wildland firefighters. Key Eng. Materials. 2017; 730: 595-600. https://doi.org/10.4028/www.scientific.net/KEM.730.595

Health and Safety Laboratory. Fire Hazards associated with contamination of dressings and clothing by paraffin based ointments. 2007. https://webarchive.nationalarchives.gov.uk/ukgwa/20171030131014/http://www.nrls.npsa.nhs.uk/resources/type/alerts/?entryid45=59876&p=3 (accessed 10 January 2023)

Honari G, Maibach H. Chapter 1 - skin structure and function. Applied Dermatoxicology. Boston: Academic Press; 2014

Horner A. Aircraft Materials Fire Test Handbook. 2000. http://www.tc.faa.gov/its/worldpac/techrpt/ar00-12.pdf (accessed 10 January 2023)

https://doi.org/10.1111%2Fpde.13981

Medicines and Healthcare products Regulatory Agency. Emollients and risk of severe and fatal burns: new resources available. 2018. https://www.gov.uk/drug-safety-update/emollients-and-risk-of-severe-and- fatal-burns-new-resources-available#full-publication-update-history. (accessed 10 January 2023)

Medicines and Healthcare products Regulatory Agency. Emollients and risk of severe and fatal burns: new resources available. 2021. https://www.gov.uk/drug-safety-update/emollients-new-information-about-risk-of-severe-and-fatal-burns-with-paraffin-containing-and-paraffin-free-emollients. (accessed 10 January 2023)

Moncrieff G, Cork M, Lawton S, Kokiet S, Daly C, Clark C. Use of emollients in dry-skin conditions: consensus statement. Clin. Exp. Dermatol. 2013; 38(3):231-238. https://doi.org/10.1111/ced.12104

National Eczema Society. Paste bandages and wet wraps: a practical guide to their use in the management of eczema. 2021. https://eczema.org/wp-content/uploads/NES-Bandages-Booklet-2021-1.pdf. (accessed 10 January 2023)

National Fire Chiefs Council. NFCC warns of fire risk when using emollients. 2020. https://www.nationalfirechiefs.org.uk/News/nfcc-warns-of-fire-risk-when-using-emollients (accessed 10 January 2023)

NHS. Elasticated Viscose Stockinette ('Viscose') Garments. 2021. https://www.panmerseyapc.nhs.uk/media/2221/viscose.pdf (accessed 10 January 2023)

Oxford University Hospitals. Emollients: Information for patients. 2012. https://www.ouh.nhs.uk/patient-guide/leaflets/files/120521emollients.pdf (accessed 10 January 2023)

Shokrollahi K. Paraffin-based ointments and fire hazard: understanding the problem, navigating the media and currently available downloadable patient information. Scars, Burns & Heal. 2017;3:1-2. https://doi.org/10.1177/2059513117704932

Udayraj. Talukdar P, Alagirusamy R, Das A. Heat transfer analysis and second degree burn prediction in human skin exposed to flame and radiant heat using dual phase lag phenomenon. Inter. J. Heat and Mass Transf. 2014;78:1068-1079. https://doi.org/10.1016/j.ijheatmasstransfer.2014.07.073