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Review

# Mepitel film for the prevention of radiation dermatitis: A comprehensive review of its efficacy, side effects, physics measurements, patient- and clinician-reported outcomes

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ABSTRACT

*Objective:* This review aimed to summarize the benefits, side effects, physics measurements, and patient- and clinician-reported outcomes of Mepitel film (MF) in preventing radiation dermatitis (RD) for cancer patients.
*Methods:* The online database PubMed was searched from inception to April 15, 2024 with the search terms "Mepitel film" or "Mepitel." Articles of any study design evaluating MF for the prevention of RD were included. Non-human studies were excluded.
*Results:* The database search identified 119 articles and 13 of them were included in this review. Across these studies, MF was found to be beneficial in reducing RD and improved patient- and clinician-reported outcomes in breast and head and neck cancers. Side effects of MF included itchiness, acne, allergic reaction, tightness, discomfort, and poor film adherence, but patient dropouts were uncommon. MF did not cause a bolus effect or increased skin dose in physics measurements.
*Conclusions:* MF is a safe and effective intervention for preventing acute RD. It should be recommended in breast cancer patients where the data is more robust. Further research is needed to evaluate MF's efficacy on patients with different skin tones, its cost-effectiveness, and identifying patients who most benefit from MF relative to other effective interventions.

## Introduction

Radiation dermatitis (RD) is a common side effect occurring in more than 90% of cancer patients receiving radiotherapy (RT).[1] In the acute phase, it is characterised by erythema, edema and pruritus. In severe cases when treating with high doses, skin breakdown may occur, leading to moist desquamation (MD) or, rarely, ulceration.[1,2] RD begins to appear in patients between 1 and 4 weeks into RT and peaks in severity 2–4 weeks after the completion of RT.[1,3,4] While acute RD can be extremely painful and uncomfortable, most patients recover within 3 months after the completion of RT.[2] However, RD can also persist chronically and may leave patients with permanent changes to their skin, such as dryness, hyperpigmentation, and telangiectasia.[5] These chronic changes may affect patients' mobility, cause disfiguration, and negatively impact patient quality of life in the long term.[5] Therefore, preventing RD is highly important to enhancing patient outcomes, especially in breast, head and

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neck, and pelvic cancer patients who are more susceptible to RD because they receive relatively higher doses of RT to the skin.[6]

Guidelines for the prophylaxis of RD are variable across institutions.[7] Many prophylactic measures for RD have been studied in randomized controlled trials (RCTs), such as moisturizers, barrier films, film-forming gels, topical corticosteroids, photobiomodulation and natural agents.[8] To date, there have not been any studies that demonstrate the relative efficacy of these interventions. Barrier films, such as Mepitel Film (MF) and Hydrofilm, have emerged as promising interventions for the prophylaxis of RD because they firmly adhere to the skin, thereby preventing inflammation and reducing friction with clothing.[9] MF is a silicone-based polyurethane barrier film that uses Safetac technology, which is patented to minimise trauma to the skin when it is removed after use.[10–13] A number of RCTs have investigated the efficacy of MF for the prophylaxis of RD for cancer patients and proven its effectiveness as a preventative measure.[10–12,14,15] These positive results have been confirmed with multiple systematic reviews, including two meta-analyses, reporting on MF as being effective at reducing rates of RD in breast and head and neck cancer patients.[16–18]

Despite the promising results on the efficacy of MF reported in the literature, many international guidelines have not adopted the application of MF. The aim of this review is to comprehensively evaluate the efficacy, side effects, physics measurements, and patient and health care professional experiences using the product, so that clinicians and policy makers can make informed decisions regarding the use of MF.

## Methods

A literature search was conducted in PubMed from database inception to April 15th, 2024 using the keywords "Mepitel" or "Mepitel Film". Articles were included if the study is in the English language and evaluated the role of MF for the prevention of RD, regardless of study design. Non-human studies were excluded. Articles were independently screened by two authors (OK and MD). Any conflicts regarding article eligibility were discussed and resolved by OK, MD, and HW to reach consensus. Data extracted from the relevant articles includes study characteristics, side effects reported by patients using MF, clinician perspectives on the effectiveness and implementation of MF, and the incidence of RD and MD.

## Results

### *Study characteristics*

The literature search identified 119 studies published between 2005 and 2024. Of these studies, 13 were included in full-text screening and met the inclusion criteria. In this review, 1 case series ($n = 1/13$, 7.7%), 1 feasibility trial ($n = 1/13$, 7.7%), 1 retrospective analysis ($n = 1/13$, 7.7%), 6 RCTs ($n = 6/13$, 46.2%), 2 systematic reviews and meta-analyses ($n = 2/13$, 15.4%) and 2 studies on patient and clinician experiences ($n = 2/13$, 15.4%) were analyzed. Nine studies investigated MF in breast cancer and four investigated head and neck cancer patients. Study characteristics for the included RCTs are outlined in Table 1.

### *Efficacy of Mepitel film for the prevention of RD*

#### *Results for breast cancer*

Morgan was the first to report the efficacy of MF in preventing RD in a case series of three breast cancer patients. No MD was observed in all

**Table 1**
Study characteristics of randomized controlled trials.

| First author (Year) | Country | Sample size analyzed | Cancer sites | RT dose-fractionations | Control arm (*n*) | Treatment arm (*n*) | Assessment tools |
|---|---|---|---|---|---|---|---|
| Herst et al. (2014) | New Zealand | 78 analyzed | Post-lumpectomy or mastectomy women and men with breast cancer receiving RT | 50 Gy/25 Fr<br>40 Gy/15 Fr, 45 Gy/20 Fr<br>46 Gy/20 Fr<br>50.4 Gy/25 Fr<br>54 Gy/27 Fr | Aqueous cream (78) | MF (78) | Modified RISRAS<br>RTOG<br>Exit questionnaire |
| Møller et al. (2018) | Denmark | 79 analyzed | Women receiving adjuvant RT for breast cancer | 40 Gy/15 Fr<br>50 Gy/25 Fr | Daily washing and moisturizing lotion or glucocorticoid containing lotion for itching skin (79) | MF (79) | RTOG/EORTC scale<br>Study specific questionnaire comprised of PROM, PREM, and clinician evaluation of RD sections |
| Behroozian et al. (2022) | Canada | 376 analyzed | Post-lumpectomy or mastectomy women and men with breast cancer receiving RT | 50 Gy/25 Fr or 40-42.6 Gy in 15-16 Fr | Aqueous cream (251) | MF (125) | CTCAE v5.0<br>RISRAS<br>SSA |
| Wooding et al. (2018) | New Zealand and China | 33 analyzed | NZ patients receiving RT for mucosal squamous cell carcinoma of the head and neck. CH patients receiving RT for nasopharyngeal carcinoma. | NZ: 66 Gy/30 Fr with or without elective nodal 50 Gy/25 Fr or 54 Gy/30 Fr<br>CH: 74 Gy/37 Fr for primary tumour and 50 Gy/25 Fr for neck node region | NZ: Dermasoft Sorbolene prophylactic cohort (11), management cohort (11)<br>CH: Biafine cream prophylactic cohort (11) | NZ: MF prophylactic cohort (11), management cohort (11)<br>CH: MF prophylactic cohort (11) | Modified RISRAS<br>Expanded RTOG<br>Exit questionnaire |
| Rades et al. (2019) | Germany | 36 analyzed | Patients receiving RT for locally advanced squamous cell carcinoma of the head and neck | 5 × 2.0 Gy per week | Fatty cream with 2%–5% urea and MMF (27) | MF (9) | CTCAE v4.03<br>Self-rating scale from 0 to 10 for RD and pain |
| Yan et al. (2020) | China | 39 analyzed | Patients receiving RT to the bilateral lymph nodes for squamous cell carcinoma of the head and neck | 70-74 Gy in 35-37 Fr<br>The head and neck regions received 50 Gy/25 Fr | Biafine cream (39) | MF (39) | Expanded RTOG scale<br>Modified RISRAS<br>Exit questionnaire |

CH, China; CTCAE, Common Terminology Criteria for Adverse Events; EORTC, European Organization for the Research and Treatment of Cancer; Fr, fractions; MF, Mepitel film; MMF mometasone furoate; NZ, New Zealand; PREM, patient-reported experience measure; PROM, patient-reported outcome measure; RD, radiation dermatitis; RISRAS, Radiation-Induced Skin Reaction Assessment Scale; RT, radiotherapy; RTOG, Radiation Oncology Group; SSA, Skin Symptom Assessment.

three patients, and one patient did not experience any skin toxicities at all during or after RT.[19] Patients also reported no discomfort, pruritus, or burning caused by the film or any pain when the film was removed. All three patients were able to return to normal activities after treatment.[19]

Based on the encouraging results of the case series, Herst et al. performed the first intra-patient RCT investigating the prophylactic use of MF in preventing MD in breast cancer patients ($n = 78$). No MD was experienced in the skin covered by MF. The radiation-induced skin reaction assessment scale (RISRAS) scores, which is a scale that assesses clinician reported and patient reported components, were reduced by 92% in favour of MF across all patients.[11] Møller et al. performed a similar intra-patient RCT ($n = 79$), which showed a lower incidence of grades 2 and 3 RD on the MF applied skin for patients who had a mastectomy and were treated to 50 Gy or more on the last day of RT. Patients also reported significantly less pain, sensitivity, itching, burning sensation and edema two weeks after RT. However, in contrast to the study by Herst et al., there was no difference in the severity of RD in lumpectomy patients and in all patients at 14 days after completion of RT.[12]

Due to the inconsistency between results from the RCTs by Herst et al. and Møller et al., Yee et al. conducted a prospective study to further evaluate MF in breast cancer patients. No grade 3 RD was observed in this study.[13] In patients with grade 2 RD, MD mostly occurred in the axilla region where MF adherence was reported to be poor, or over the nipple skin fold.[13]

Following the promising results of the feasibility study, Behroozian et al. led a randomized open-label phase III trial in breast cancer patients at high risk of RD, defined as mastectomy patients or lumpectomy patients with a band size or breast size greater than or equal to 36 inches or C cup. The incidence of grade 2 or 3 RD was reduced from 45.6% ($n = 57/125$) in the standard arm to 15.5% ($n = 39/251$) in the MF arm.[10] Significantly lower rates of MD, erythema, pain/soreness, blistering and peeling, and pigmentation were observed.[10] Fewer patients in the MF arm were prescribed antibiotics, although there was no difference in topical steroid use.[10] Regarding patient-reported outcomes, lower RISRAS scores were found in tenderness, discomfort or pain, burning sensation, as well as overall scores compared to the standard arm.[10] Patients in the MF arm also had lower Skin Symptom Assessment scores in blistering and peeling, erythema, pigmentation, and edema compared to the standard arm.[10]

A systematic review and meta-analysis by Shariati et al. pooled the results of the 3 RCTs. The meta-analysis indicated that MF was able to reduce the incidence of grade 2 or worse and grade 3 RD by 84% and 85%, respectively.[17] Shariati et al. also found that RISRAS scores reflected a significant reduction in patient and combined mean scores.[17]

*Results for head and neck cancer*

MF has also been evaluated in head and neck cancer following the publication of the RCT by Herst et al. The first study was an intra-patient randomized trial by Wooding et al. ($n = 33$). The trial took place at two centres, one in New Zealand ($n = 22$) and one in China ($n = 11$).[20] MF decreased the skin reaction severity and MD in both cohorts by around 30%.[20] Similarly, in another RCT by Yan et al. ($n = 39$), MF reduced skin reaction severity in head and neck cancer patients by 30% and incidence of MD by 41%.[15] Rades et al. ($n = 57$) subsequently led a RCT, which compared MF to standard skin care. The study was terminated prematurely due to many patients ($n = 13/28$, 46.4%) finding the film intolerable and MF not demonstrating superiority to the standard skin care for the prevention of grade $\geq 2$ RD ($P = 1.00$ for both grades 2 and 3 RD).[14] However, it is important to note that the standard arm involved a topical agent combining fatty cream, 2-5% urea cream and mometasone cream, which has been shown to be effective in preventing RD. Also, median pain scores were found to be lower in the evaluable patients in the MF arm compared to the standard skin care arm (2.0 versus 2.5).[14]

A systematic review and meta-analysis of MF in the prevention of RD in head and neck cancer patients was conducted by Lee et al. A significant reduction in the incidence of grades 2 to 3 RD was found when pooling the data from RCTs of Wooding et al. and Yan et al.[16] No significant reduction in the rates of grade 3 RD were reported, but there was a significantly lower incidence of MD.[16] Pooling the RISRAS scores in the New Zealand patients from Wooding et al. and all patients from Yan et al. demonstrated that MF significantly reduced patient, researcher, and combined mean scores.[16]

*Patient reported experience of using Mepitel film*

Gojsevic et al. conducted a survey ($n = 192$) for breast cancer patients who used MF in the phase III RCT by Behroozian et al. The survey consisted of 34 questions that assessed the impact MF had on daily activities, the overall experience of using MF, and an open response section for patients to provide additional comments.[21] More than half of the patients ($n = 126/189$, 66.7%) agreed that MF was comfortable to wear on their skin, although some agreed that the film caused itchiness.[21] Wearing MF was reported to minimally affect personal image or self-esteem.[21] In the open response section, 48 patients felt that MF successfully prevented severe skin reactions and protected their skin.[21] Some respondents found that they hesitated to exercise or shower to avoid the film from getting wet and peeling.[21] A majority of patients were not impacted by MF during sleep ($n = 163/191$, 85.3%), exercise ($n = 132/185$, 71.4%), or household maintenance ($n = 169/191$, 88.5%) and felt protected ($n = 138/187$, 73.8%) and comfortable ($n = 126/189$, 66.7%). Patients indicated they would recommend MF to a friend ($n = 166/188$, 88.3%) after their positive experience of using MF ($n = 173/189$, 91.5%).[21]

Furthermore, all patients in the trials led by Herst et al. and Yan et al. reported having a positive experience, with most patients in each RCT preferring MF over the standard cream. Patients experienced no discomfort, less redness, less itchiness, less pain, and felt protected by the film in the RCT conducted by Herst et al.[11] In addition, 15 New Zealand patients from the RCT by Wooding et al. viewed the trial as being positive and 13 patients preferred MF over the standard. Specifically, five patients found that the film reduced pain, burning, and stinging while three patients reported it was comfortable on the skin and five remarked it was easy to use.[20] The majority of patients ($n = 66/79$, 83.5%) in the study by Møller et al. believed MF should be a standard offer for breast cancer patients. Regarding treatment preference, 93.8% ($n = 15/16$) and 71.4% ($n = 45/63$) of patients would have preferred to use MF on their entire treatment area for mastectomy and lumpectomy, respectively.[12]

*Side effects and costs of Mepitel film*

*Side effects: results in prospective studies and RCTs*

Table 2 describes the side effects experienced in each study. One of the most highly reported side effects of MF was itchiness. In both RCTs by Rades et al. and Behroozian et al., one patient withdrew from the study due to itchiness. In the RCT conducted by Herst et al., three patients experienced itchiness, but found it to be tolerable and did not remove the film. In the head and neck cancer studies, itchiness was much more prevalent amongst patients. In the study led by Wooding et al., all 11 patients in the Chinese cohort reported some degree of itchiness. Rades et al. reported that two patients removed MF early due to itchiness or MD. Out of 39 patients, Yan et al. commented that 12 patients experienced itchiness caused by MF. Overall, up to 26.5% ($n = 35/132$) of patients reported itchiness, but less than 4.0% ($n = 14/353$) of patients required treatment discontinuation.

Another side effect experienced by both breast and head and neck cancer patients was poor film adherence. Herst et al. and Behroozian et al. observed MF curling at the edges of dressings and not adhering well to the axillary region due to increased perspiration and friction, which resulted in more frequent replacement of MF. For patients with head and neck cancer, poor film adherence was the largest concern in terms of side effects. Wooding et al. reported extremely poor film adherence when film was applied to the necks of men, as overnight facial hair growth would disrupt MF. This phenomenon was seen more so in the New Zealand cohort as men in the Chinese cohort did not have as heavy stubble

**Table 2**
Reported side effects and rate, dropout rate, and incidence of grade 2 or 3 RD and MD.

| First author | Incidence of grade 2 or 3 RD | | Incidence of MD | | Itchiness rate (%) | Poor adherence rate (%) | Acne rate (%) | Skin/ allergic reaction rate (%) | Tightness rate (%) | Discomfort rate (%) | Dropout rate (%) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Control rate (%) | MF rate (%) | Control rate (%) | MF rate (%) | | | | | | | |
| Herst et al. | 56/78 (71.8%) | **6/78 (7.7%)** | 20/78 (25.6%) | **0/78 (0.0%)** | 3/60 (5.0%) | 3/60 (5.0%) | NR | NR | NR | NR | NR |
| Møller et al. | 10/79 (12.7%) | 6/79 (7.6%) | NR | NR | NR | 75/79 (94.9%) | NR | NR | NR | NR | [a]19/79 (24.1%) |
| Behroozian et al. | 57/125 (45.6%) | **39/251 (15.5%)** | 24/125 (19.2%) | 20/251 (8.0%) | NR | NR | NR | NR | NR | NR | [b]3/251 (1.2%) |
| Wooding et al. | NZ: 21/22 (95.5%)<br>CH: 10/11 (90.9%) | NZ: 20/22 (90.9%)<br>CH: 7/11 (63.6%) | NZ: 16/22 (72.7%)<br>CH: 7/11 (63.6%) | NZ: 10/22 (45.5%)<br>CH: 3/11 (27.3%) | NZ: 9/22 (40.9%)<br>CH: 11/11 (100.0%) | NZ: 6/16 (37.5%)<br>CH: 5/11 (45.5%) | NR | NR | CH: 1/11 (9.1%) | CH: 3/11 (27.3%) | NR |
| Rades et al. | 50 Gy: 9/27 (33.3%)<br>60 Gy: 15/26 (57.7%) | 50 Gy: 3/9 (33.3%)<br>60 Gy: 4/7 (57.1%) | NR | NR | NR | 5/23 (21.7%) | NR | NR | NR | NR | [c]14/23 (60.9%) |
| Yan et al. | 33/39 (84.6%) | 21/39 (53.8%) | 24/39 (61.5%) | 8/39 (20.5%) | 12/39 (30.8%) | 11/39 (28.2%) | NR | NR | 3/39 (7.7%) | 16/39 (41.0%) | NR |

CH, China; MD, moist desquamation; MF, Mepitel film; NR, not reported; NZ, New Zealand; RD, radiation dermatitis.
[a] 12 due to itchiness or rash, 2 due to problems handling MF, 3 due to acne, 2 due to discomfort.
[b] 1 due to itchiness, 2 due to skin reaction.
[c] 1 due to itchiness, 5 due to tightness, 8 due to discomfort.

growth.[20] Other than facial hair growth, Yan et al. reported poor film adherence in 11 patients due to hot weather in the study's location and humidity in the shower. MF became intolerable for five patients in the study by Rades et al. due to the film's lack of proper adherence, contributing to the 13 out of 28 patients who discontinued using MF.[14]

Less common side effects contributed to the removal of MF, including acne which caused one patient to withdraw from the study by Yee et al. and another two patients to remove the film early. Skin rashes were observed by Møller et al. and Behroozian et al. with 12 and two patients withdrawing from each study due to dry and flaky skin, an allergy, or spots/pustules in the area covered by MF, respectively. Rades et al. and Yan et al. reported tightness in five and three patients and discomfort in eight and 16 patients, respectively.

*Costs*

Three studies reported on the cost of purchasing MF for breast cancer patients. Herst et al. disclosed an estimated $13.37 USD was spent on an average of 5 strips for each patient, and $20.79 USD per patient for the time spent by radiation therapists applying MF. In the study by Yee et al., the average cost of MF for all patients was $42.76 USD where patients with a smaller breast size had a lower average cost ($37.36 USD) of MF than patients with large breasts ($44.24 USD) and mastectomy ($45.26 USD). Behroozian et al. reported that the average cost of MF for participants with lumpectomy was $72.88 USD and $58.89 USD for participants with mastectomy. Each of these studies reported that the number of films used was estimated to be 5, 21.4 and 23 for each patient, respectively.[10,11,13] The mean frequency of MF touch ups ranged from 6.9 to 9.5 and the average number of full MF replacements ranged from 1.3 to 2 as reported in two studies.[10,13] No RCTs for head and neck cancer patients reported the cost and the amount of MF used for participants.

Studies also reported the significant time burden of applying MF by health care professionals. In the study by Behroozian et al., the application and daily checking of MF took an average of 55.1 and 45.9 minutes in lumpectomy and mastectomy patients, respectively.[10] Wooding et al. reported that daily replacement of MF for males with heavy beard stubble was needed, and commented that implementing MF in routine clinical care would be costly and could disrupt the flow of treatment schedules.[20] For patients with larger breast size, cone beam computed tomography is required to ensure the shape of the breast is not distorted by the film which contributes to additional time spent by HCPs on MF application.[10]

*Perception of health care professionals on using Mepitel film*

As a follow-up to the RCT done by Behroozian et al., Rajeswaran et al. conducted a study on the perceptions of HCPs on the use of MF for RD prophylaxis using a web-based questionnaire. Most respondents indicated that MF is effective in reducing RD, and 90.9% ($n$ = 20/22) indicated that MF is better than the standard of care.[22] Some believed that MF did not increase patient anxiety, was not a financial burden to patients, did not decrease the sexual functioning or desire of patients ($n$ = 18/22, 81.8%), did not decrease wellbeing ($n$ = 17/22, 77.3%), and did not decrease self-esteem ($n$ = 14/22, 63.6%).[22] However, 63.6% ($n$ = 14/22) of respondents reported difficulties with MF in at least one point during treatment.[22] For example, one respondent reported that improper application of MF changes the contour of the breast and makes treatment imaging and matching difficult.[22] More than half of respondents ($n$ = 13/22, 59.1%) also reported issues such as a lack of time for MF application and poor film adherence.[22] Some respondents ($n$ = 3/22, 13.6%) also reported issues with patient flow between RT units and clinics due to MF application.[22] Of HCP's surveyed, 71.4% ($n$ = 15/21) felt that patients who undergo mastectomy without immediate reconstruction are most suitable for MF, and another 61.9% ($n$ = 13/21) would also recommend MF for patients with average breast size who undergo lumpectomy.[22] Most HCPs did not recommend its use for patients with large breast size or patients who undergo mastectomy followed by immediate reconstruction.[22] MF was also not recommended

for patients with decreased mobility, poor health-related quality of life, or smoking status.[22]

Half ($n = 11/22$, 50.0%) of HCPs felt that MF would be difficult to implement into the current flow of clinics and RT units, and that maintaining a schedule would be difficult based on the need for daily checks.[22] Conversely, 45.5% ($n = 10/22$) of HCPs thought that the implementation of MF would be feasible.[22] Other concerns brought up around the implementation of MF included HCPs ($n = 10/22$, 45.5%) believing that application of MF may be difficult due to an increased need in staff and time, and that many HCPs ($n = 15/20$, 75.0%) believed that the majority of their patients would not be able to afford MF if it was priced close to $80 USD per treatment.[22] Many HCPs were open to the idea of training non-HCPs, such as patient family members, on how to apply, check, and remove MF to reduce strain on RT units and clinic staff.[22]

*Physics measurements and properties*

Herst et al. investigated the bolus effect of MF and stated it was 0.12 mm and therefore negligible. Wooding et al. used gafchromic film and thermoluminescence dosimetry (TLD) to measure the skin dose. The average radiation doses found through using gafchromic film for skin treated with MF and Biafine in Chinese patients were 42.9 ± 3.2 Gy and 43.0 ± 3.2 Gy, respectively.[20] When using TLDs, the average radiation doses for patients in the New Zealand group whose skin was treated with MF and Sorbolene were similar.[20] Yan et al. used gafchromic film to measure the skin radiation dose received for all patients, finding an average dose of 45.1 ± 1.2 Gy and 45.2. ± 1.1 Gy for skin treated with MF and Biafine cream, respectively. Skin doses between treatments is similar, and neither treatment was proven to increase skin toxicity.[15] In the study by Behroozian et al., ion chamber measurements and optically stimulated luminescence dosimeter (OSLD) measurements were recorded. MF showed a negligible attenuation effect in ion chamber measurements.[10] However, it is important to note that OSLD measurements indicated there was a small increase in surface dose caused by MF that worsened as more layers of MF were overlapped.[10] The surface dose increased between 3 and 12% when 1 to 2 layers were overlapped and increased 11%-25% when 3 to 4 layers were overlapped.[10] This shows that the effect of MF is clinically insignificant if only one layer is applied to the skin and overlapping of multiple layers is avoided.[10]

Cumming et al. compared patients who received chest wall irradiation with surface-guided radiation therapy (SGRT) while using MF ($n = 8/18$, 44.4%) versus not using it ($n = 10/18$, 55.6%).[23] The analysis of 275 daily image-guided Online Corrections (OLCs) demonstrated that patients applying MF had larger OLCs in the superior–inferior axis and combined translational vector.[23] Furthermore, in patients who applied MF, combined translational systematic error was slightly higher. However, the mean absolute differences between the two groups were around 1mm.[23] Therefore, the study concluded that MF could affect the accuracy of patient-positioning for SGRT in postmastectomy patients, but the effect is considered clinically insignificant.[23]

## Discussion

Our comprehensive review on MF presented the efficacy, side effects, physics measurements, patient and clinician outcomes when using MF. Despite the variability in the assessment tools and frequency of assessment, MF proved to be beneficial in reducing RD and improving patient- and clinician-reported outcomes for breast cancer and head and neck cancer patients in systematic reviews and meta-analyses. Across multiple trials, patients experienced less erythema, discomfort, and pruritus. Additionally, many patients indicated that their experience with MF was so positive that they prefer it over the standard of care and would recommend it to other patients. The benefits demonstrated by MF are particularly evident for breast cancer patients due to the increased improvement in patient-reported outcomes, clinician-reported outcomes, and film adherence when compared to head and neck cancer patients.

Despite its proven benefits, MF did exhibit some limitations. For example, side effects were reported across all trials. The most common side effects caused by MF that made the film intolerable were itchiness, acne, or allergic skin reactions. Furthermore, film adherence to the skin was another limitation, with multiple studies reporting that MF did not adhere well to areas such as the axilla, head, and neck, resulting in the need for more frequent dressing changes.[10,11,14,15,20] Another barrier for the implementation of MF in daily practice is both the cost and time associated with using MF. All trials that reported film cost disclosed that the average cost of MF and HCP application, regardless of surgery type, was approximately $50 USD for the entire course of treatment for breast cancer patients.[10,11,13] The costs may be even greater in head and neck cancer patients as frequent film changes are required. The costs associated with MF may be too high for some patients to afford if they pay out of pocket, especially for patients from lower socioeconomic backgrounds.

Based on these limitations, there are many areas to be explored for further research. Firstly, future studies should evaluate which patients are most suitable for MF. Certain risk factors put patients at a higher risk of developing RD, such as mastectomy, high body mass index, greater RT dose, darker skin tones, and large breast size in lumpectomy patients.[24–26] Many of these factors were not stratified in the published RCTs. Specifically, Black and Hispanic persons experience higher rates of RD, but they were underrepresented in current studies.[26] The published studies also showed variability in how patients tolerated MF. The only predictable pattern of film intolerability was found in head and neck cancer patients who often had poor film adherence, especially for patients applying MF to areas where facial hair is present.[20] An international, multicentre prospective registry would be helpful to continuously evaluate which patients may benefit more from MF and identify predictors for poor tolerance. Clinicians may also evaluate whether there is a need to test MF on an unaffected area of skin before RT begins to ensure they are able to tolerate the film.

In addition, a formal cost effectiveness evaluation should be performed. While MF is expensive and could disrupt the usual workload of HCPs, there is a possibility that the total time and costs of managing severe RD (e.g., wound care and dressing for MD, topical and oral antibiotics for secondary infection) could be significantly more in patients who do not receive MF. Further research on the feasibility of home-application for MF may be beneficial. The Canadian division of the company that produces MF, Mölnlycke, has published an instructional video aimed towards teaching caretakers of patients with breast cancer how to apply MF which may be useful for this research.[27]

To date, most published studies on MF were performed in North America, Europe and New Zealand where climates are generally cool and dry. It is important to have an in-depth assessment of the tolerance of MF in patients living in warm and humid climates, as Wooding et al. reported that sweat interfered with the adherence of MF in the Chinese cohort.

There is currently one ongoing phase III trial (clinicaltrial.gov ID NCT04989504) which assesses MF's efficacy in preventing RD in post-mastectomy patients receiving conventionally fractionated RT in the United States. Results of this large study will shed light on which patient subsets may potentially benefit more from MF. With a planned follow up of up to 2 years, this study will also reveal whether MF is effective in preventing long-term skin toxicities.

Apart from MF, Hydrofilm is a barrier film that has been shown to be effective in preventing radiation dermatitis in breast cancer in RCTs and systematic reviews.[9,28,29] Compared to MF, it has a stronger adhesive, which may have advantages in applying in anatomically complex areas, such as the supraclavicular fossa and skin folds of large breasted or obese patients.[9] Patients who are physically active or those with excessive sweating may also find Hydrofilm less easy to fall off. MF, on the other hand, can be a preferred option in patients with sensitive or fragile skin. Barrier forming gels such as StrataXRT and 3M Cavilon No Sting Barrier

Film, have the advantage of being easily applied to any area of the body, but the evidence for these products in preventing severe RD is less robust and results from RCTs are conflicting.[30–33] The ongoing intra-patient RCT led by Herst et al. in New Zealand comparing StrataXRT to MF will generate more information regarding the comparative efficacy and properties of different barrier films or dressings. Before these results are available, clinicians should take into account the experience of the health care team, patient preference, costs and patient allergies in deciding the most appropriate barrier dressing for patients at high risk of RD.

### *Implications for nursing practice and research*

Oncology nurses play an important role in providing counselling on skin care and management of RD during radiation therapy for breast cancer patients. Our literature review provides an important update for oncology nurses on MF as a modality for the prevention of this potentially debilitating side effect. Raising awareness about MF amongst nurses is timely as more patients may start to ask their health care providers for this intervention following the publication of recent RCTs. Although MF has been shown to be efficacious and safe, it may take up significant nursing time to apply and do touch ups when the films roll off at the edges. Future nursing research should involve developing strategies to empower and educate patients or their family members to apply and check the integrity of the films before radiation therapy. Implementing workflows that streamline the application of the film by nurses and other HCPs will also be crucial to reduce the impact on the nursing manpower.

### *Limitations*

A limitation of our literature review is that we performed the search only on PubMed, therefore there may be a possibility that studies indexed only in other databases were not reviewed. Additionally, we only included articles that had full texts available and published in the English language. Conference abstracts with preliminary data and articles in other languages were thus excluded. Nevertheless, our review included recently published systematic reviews and meta-analyses of RCTs on MF, so the evidence summarised in this review likely encompassed all the largest clinical studies published to date.

## Conclusions

From our comprehensive review of the literature, there is high-level evidence to suggest that MF is a safe and effective intervention for the prevention of RD. Consistent with a recently published Delphi consensus led by the Multinational Association in the Supportive Care in Cancer (MASCC), MF should be recommended for routine clinical use and adopted in international guidelines in breast cancer patients where the data is more robust.[8] Across all trials, MF did not cause a bolus effect as long as care is taken to minimize overlap of the films in the irradiated area. Side effects such as itchiness and tightness were reported by patients, but few had to discontinue it due to intolerance. Most patients reported an overall positive experience applying MF during treatment and would be inclined to recommend it to other patients. Pragmatic, real-world studies to continually evaluate its effectiveness across diverse patient populations will help identify patients who will most benefit from MF and streamline workflow to improve cost-effectiveness.

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Not required.

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## CRediT authorship contribution statement

**Olivia Kuszaj**: Conceptualization, Methodology, Data curation, Formal analysis, Writing. **Marley Day**: Conceptualization, Methodology, Data curation, Formal analysis, Writing. **Matt Wronski:** Formal analysis, Writing – Revised draft preparation **Kimberly Corbin**: Formal analysis, Writing – Revised draft preparation. **Patries Herst:** Formal analysis, Writing – Revised draft preparation. **Rosemary Hill:** Formal analysis, Writing – Revised draft preparation. **Dirk Rades:** Formal analysis, Writing – Revised draft preparation **Cindy Wong:** Formal analysis, Writing – Revised draft preparation. **Irene Karam:** Formal analysis, Writing – Revised draft preparation. **Francois Gallant:** Formal analysis, Writing – Revised draft Preparation. **Shing Fung Lee:** Formal analysis, Writing – Revised draft preparation. **Shirley SW Tse**: Formal analysis, Writing – Revised draft preparation. **Edward Chow:** Conceptualization, Methodology, Data collection, Writing – Original and Revised draft preparation. **Henry Wong**: Conceptualization, Methodology, Data collection, Writing – Original and Revised draft Preparation. All authors had full access to all the data in the study, and the corresponding author had final responsibility for the decision to submit for publication. The corresponding author attests that all listed authors meet authorship criteria and that no others meeting the criteria have been omitted.

## Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

## Data availability statement

Data sharing is not applicable to this article as no new data were created or analyzed in this study.

## Declaration of generative AI and AI-assisted technologies in the writing process

No AI tools/services were used during the preparation of this work.

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