



A Review of Pharmacist-Led Counselling for the Skin, Hair and Nail Toxicities of Breast Cancer Chemotherapy

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ABSTRACT :

Chemotherapy remains central to the treatment of breast cancer, but it frequently causes dermatological adverse events, including nail toxicity, alopecia, hand-foot syndrome and xerosis. These events are often graded as low severity, yet they can impair hand function, body image and quality of life, and in some patients they contribute to dose delays, dose reductions or early treatment discontinuation. Patients are often not warned about them in advance, and clinicians may under-detect them, in part because the standard grading system captures functional impact poorly. Physical and topical preventive measures have variable evidence. Cryotherapy with frozen gloves and socks and scalp cooling are supported by randomised trials, whereas evidence for topical prophylaxis of hand-foot syndrome is mixed. Because prevention depends heavily on what patients do at home, education is a central intervention. Pharmacist-led counselling has been shown in randomised trials from Malaysia and Nepal, and in observational and quality-improvement studies from several other countries, to improve quality of life and reduce anxiety and depression in patients receiving chemotherapy, but few studies have measured dermatological outcomes directly. This review describes the spectrum and impact of chemotherapy-related skin, hair and nail toxicities in breast cancer, summarises the evidence for preventive measures and for pharmacist-led counselling, briefly considers routinely available inflammatory indices as possible future risk-stratification tools, and proposes a cycle-by-cycle counselling framework suitable for resource-constrained oncology units, with particular attention to Indian practice.

Keywords: breast cancer; chemotherapy; dermatological adverse events; nail toxicity; alopecia; hand-foot syndrome; clinical pharmacist; patient counselling; cryotherapy; supportive care

1. Introduction

Worldwide, breast cancer is diagnosed more often than any other malignancy in women, with GLOBOCAN estimating about 2.3 million new cases and roughly 666,000 deaths in 2022 [1]. In India too it is the commonest cancer in women [1]. Anthracycline-, taxane- and capecitabine-containing regimens remain core options in early and advanced disease. Adding a taxane to an anthracycline-based backbone, or giving paclitaxel weekly, improved outcomes in landmark adjuvant trials [2], and capecitabine improved survival in patients with residual disease after neoadjuvant therapy [3].

These benefits come with toxicities of the skin and its appendages. Nail changes, alopecia and hand-foot syndrome are among the most frequent and are often described as cosmetic or minor. However, they can cause pain, infection, difficulty with fine motor tasks and distress about appearance, and they are recognised reasons for dose modification [4,5,6]. Because breast cancer treatment is usually given with curative intent in early disease, maintaining planned dose intensity is important. The classic dose-response analyses of adjuvant chemotherapy in breast cancer showed that patients who received less than the planned dose fared worse [7].

An important feature of these toxicities is that their severity is partly modifiable by patient behaviour and by simple physical or topical measures, provided that patients know what to expect, what to do, and when to call for help. This creates an opportunity for structured counselling by members of the oncology team. Clinical pharmacists are well placed to provide it, because they see patients at each treatment cycle, understand the pharmacology of the regimen and can reinforce messages consistently [8,9]. Most published pharmacist-counselling studies, however, look at overall quality of life and mood during chemotherapy instead of skin, hair and nail toxicity [10,11].

The aims of this review are to (i) describe the spectrum, incidence and impact of chemotherapy-related dermatological adverse events in breast cancer, (ii) appraise the evidence for preventive and supportive measures, (iii) summarise the evidence for pharmacist-led counselling in oncology, (iv) discuss emerging risk-stratification tools, and (v) propose a practical counselling framework, with attention to resource-limited and Indian settings.

2. Review Approach

This is a narrative review. Sources were identified through targeted searches of PubMed, PubMed Central and Google Scholar for the topics of taxane-induced nail toxicity, chemotherapy-induced alopecia and scalp cooling, capecitabine-associated hand-foot syndrome, pharmacist-led counselling in oncology, patient-reported outcome measures, and the blood-count indices NLR and SII in breast cancer. Priority was given to randomised trials, systematic reviews and meta-analyses, and to studies from low- and middle-income settings. Formal systematic search methods, duplicate screening and quality appraisal were not applied, so the review may not be exhaustive and is subject to selection bias.

3. Dermatological Adverse Events of Breast Cancer Chemotherapy

Table 1 summarises the principal dermatological toxicities, the agents most often responsible, and the measures generally advised.

Table 1. Common dermatological adverse events of chemotherapy used in breast cancer

Adverse event	Typical agents	Features	Preventive and supportive measures
Nail toxicity	Taxanes (paclitaxel, docetaxel); anthracyclines less often	Beau's lines, onycholysis, subungual haemorrhage, paronychia, pigmentation [4,12]	Cryotherapy, nail care, avoidance of trauma, early reporting [13,14]
Alopecia	Anthracyclines, taxanes, cyclophosphamide	Diffuse hair loss beginning 2–4 weeks after the first cycle; usually reversible	Scalp cooling where available; hair care; cosmetic support [15,16]
Hand-foot syndrome	Capecitabine, fluorouracil, pegylated liposomal doxorubicin, docetaxel	Erythema, swelling, pain, fissures and blisters of palms and soles [5]	Moisturisation, trauma avoidance, dose adjustment; topical agents under study [17,18]
Xerosis, pruritus, photosensitivity	Multiple agents	Dry, itchy or fragile skin; sunburn on exposure	Emollients, gentle cleansing, sun protection [4]

Sources: [4,5]. The list is not exhaustive; targeted and endocrine therapies cause additional cutaneous effects.

3.1 Nail toxicity

The nail may show Beau's lines, onycholysis, subungual haemorrhage, pigment change or painful paronychia. These usually become obvious only after several cycles, which fits with the slow outward growth of the nail plate and with damage that accumulates over repeated doses [4,12]. Early reports emphasised onycholysis with weekly taxane schedules [19]. A meta-analysis reported nail changes in about one third of patients on docetaxel and over 40% of those on paclitaxel [20], although incidence varies widely with schedule, cumulative dose and method of assessment [6,12]. In a single-centre experience of 79 patients, paclitaxel was the taxane most often responsible and toenails were prone to trauma-related damage. The authors argued that established onycholysis is hard to reverse, so care should concentrate on prevention and early detection [6]. Dermatology reviews from India likewise describe nail damage from chemotherapy as under-recognised during routine follow-up [21,22]. Suggested explanations are a toxic effect on the fast-turning-over nail matrix, reduced perfusion of the nail bed through antiangiogenic action, and later inflammation or infection [4,6].

3.2 Alopecia

Alopecia is one of the most feared consequences of chemotherapy, and it reflects injury to the rapidly proliferating hair matrix. It is discussed here because it is often the first dermatological concern patients raise and because counselling about it overlaps with nail and skin care. Scalp cooling spares hair in a sizeable share of patients. In the SCALP randomised trial of women with breast cancer, 50.5% of cooled patients lost half or less of their hair, whereas no control patient reached that level [15], and pooled analyses of randomised trials point the same way [16]. A randomised trial from India shows that the approach can be delivered locally [23], and a later randomised trial found persistent alopecia at six months in 13.5% of cooled patients against 52.0% of controls [24].

3.3 Hand-foot syndrome

Hand-foot syndrome is a common toxicity of capecitabine, fluorouracil, pegylated liposomal doxorubicin and docetaxel [5]. In trials of capecitabine, reported incidence ranges widely, and severe (grade 3) disease can limit daily activities and lead to dose modification [17,25]. Patients usually notice tingling, redness and swelling of the palms and soles first, which can progress to painful fissures and blisters [5]. Because capecitabine is used for residual disease after neoadjuvant therapy and in metastatic breast cancer [3], hand-foot syndrome counselling is relevant to many patients who will already have completed anthracycline and taxane treatment.

3.4 Grading and its limitations

Adverse events in oncology are most often graded with the CTCAE [26], but its categories for the nail are coarse and can miss both the range of changes and their effect on daily function. Spazzapan and colleagues argued as early as 2002 that nail toxicity needed a different grading approach [19]. Morrison

and colleagues, finding CTCAE too blunt for the breadth and everyday burden of taxane nail changes, devised their own clinician-rated and quality-of-life instruments (NToX-G12 and NToX-QoL) for their trial [14]. Separately, PRO-CTCAE was created so that patients can report symptomatic toxicities themselves [27,28], and a randomised trial showed that routinely collecting patient-reported symptoms during chemotherapy improved quality of life, among other benefits [29]. Pharmacist assessment should therefore pair clinician grading with structured patient reporting.

4. Clinical and Treatment Impact

The impact of dermatological toxicities extends beyond appearance. Nail toxicity and hand-foot syndrome can impair writing, dressing, walking and household tasks, and they may be accompanied by pain and infection risk [4,5,6]. Hair loss can cause distress, body image concerns and social withdrawal. In the context of breast cancer, where many patients have also undergone or will undergo surgery, these effects may compound existing appearance-related concerns [4]. Severe toxicity may lead to dose delay, dose reduction or discontinuation, which is undesirable if planned dose intensity contributes to outcome [6,7]. Although direct data linking nail toxicity specifically to inferior survival are limited, protecting dose intensity is a sound rationale for prevention. Where patients must travel far for each cycle, a delay caused by an avoidable side effect also carries real travel and financial costs.

5. Evidence for Preventive and Supportive Measures

5.1 Cryotherapy for nail toxicity

Cooling of the hands and feet during infusion is thought to induce vasoconstriction and reduce delivery of the drug to the nail unit. In a multicentre study using a frozen glove on one hand with the other hand as control, the gloved hand had markedly less onycholysis and cutaneous toxicity [30]. A randomised trial in docetaxel-treated patients supported the benefit of cryotherapy for hand and nail toxicity [31], and a nurse-led study of frozen gloves and socks identified predictors of efficacy and reinforced the importance of patient comfort and adherence [32]. Pooling nine studies (three randomised and six prospective, 708 patients in all), a 2019 review found less nail toxicity with cooling than without, although the cooling temperature and duration differed from study to study [13]. Tolerability is a practical limitation, as cold intolerance and discomfort can reduce adherence [13,32].

5.2 Topical and nail-care measures

Morrison and colleagues randomised 105 women receiving taxane chemotherapy for early breast cancer to usual advice alone, usual advice plus dark nail polish, or usual advice plus specialist nail drops. The usual advice covered glove use, hand hygiene, nail care and avoiding harsh products and artificial nails. Women who applied polish fared worse than those in either of the other arms, and most of the study's dropouts came from the polish group [14]. The result argues for tailored advice on nail cosmetics instead of assuming that a protective cover is helpful. Trimming the nails, protecting them from injury and moisturising are commonly advised as well, though these habits rest on less trial evidence [4,6].

5.3 Scalp cooling

Scalp cooling is the only widely used preventive measure for chemotherapy-induced alopecia with randomised evidence of benefit [15,16]. Success depends on the regimen, with lower rates reported for anthracycline-containing schedules than for taxane-only regimens, and on technical factors such as cap fit [15,16]. Indian randomised data support its feasibility [23], and a randomised trial suggests possible benefit for persistent alopecia [24]. Cost and equipment availability remain barriers in many centres.

5.4 Hand-foot syndrome prophylaxis

Evidence for topical prophylaxis of capecitabine-associated hand-foot syndrome is inconsistent. The placebo-controlled N05C5 study of a urea and lactic acid keratolytic did not demonstrate protection against capecitabine-associated hand-foot syndrome [33]. Hofheinz and colleagues compared two preparations in 152 evaluable patients over the first six weeks of capecitabine; 10% urea cream outperformed an antioxidant ointment (hand-foot syndrome in 22.4% versus 39.5%), but with no untreated comparison group this cannot show that urea prevents the syndrome [34]. In a 2025 open-label trial from Thailand, 216 patients on capecitabine were assigned to usual care with or without twice-daily urea cream, and syndrome rates were similar (62.4% and 56%); the cream nonetheless appeared to soften severity in later cycles [17]. Meta-analyses have suggested benefit for urea cream and for celecoxib [18,35], while pyridoxine was not effective in a randomised placebo-controlled trial [36]. Consequently, basic advice on moisturising and avoiding friction, heat and trauma, together with early reporting and dose adjustment by the oncology team, remains the mainstay [5,17]. Table 2 summarises selected evidence.

Table 2. Selected evidence for preventive interventions

Intervention	Study	Design and population	Main finding
Frozen glove	Scotté et al., 2005 [30]	Multicentre split-hand study, docetaxel	Less onycholysis and cutaneous toxicity in the gloved hand
Cryotherapy (gloves and socks)	Huang et al., 2019 [13]	Meta-analysis, 3 RCTs and 6 prospective studies, 708 patients	Lower nail toxicity with cryotherapy; protocol heterogeneity
Nail drops vs nail polish vs standard care	Morrison et al., 2022 [14]	RCT, 105 women, taxane chemotherapy	Nail polish inferior to standard care and nail drops

Intervention	Study	Design and population	Main finding
Scalp cooling	Nangia et al., 2017 [15]	RCT, 182 women with breast cancer	Hair loss $\leq 50\%$ in 50.5% vs 0% of controls
Scalp cooling	Kang et al., 2024 [24]	RCT, breast cancer, curative chemotherapy	Persistent alopecia at 6 months 13.5% vs 52.0%
10% urea cream	Wongkraisri et al., 2025 [17]	RCT, 216 patients on capecitabine	No significant reduction in HFS; possible less severe HFS in later cycles
Urea/lactic acid keratolytic	Wolf et al., 2010 [33]	Placebo-controlled RCT, capecitabine	No demonstrated prevention of HFS

HFS: hand-foot syndrome; RCT: randomised controlled trial. Populations and outcome definitions differ across studies.

6. Pharmacist-Led Counselling in Oncology

6.1 Rationale and scope

Pharmacists in oncology contribute to prescription verification, regimen education, adverse event monitoring, supportive care and adherence [8,9]. Their frequent contact with patients, knowledge of the schedule and pharmacology of the regimen, and role in dispensing supportive medicines make them well suited to delivering education about self-care and early symptom reporting [8,37]. Systematic reviews of pharmacist interventions in patients with cancer have generally reported favourable effects on medication-related problems and patient outcomes, although study designs and outcomes are heterogeneous [8,9,38].

6.2 Randomised and observational evidence

The strongest evidence comes from Malaysian randomised trials. Periasamy and colleagues assigned 162 patients on chemotherapy at a government hospital to usual care or repeated pharmacist counselling built on a dedicated module, and the counselled group reported better quality of life with less anxiety and depression [10]. A follow-up trial in ten government hospitals (2,120 patients) tested the same approach and found gains in self-esteem and psychological well-being [39]. In Nepal, Poudel and colleagues allocated 128 patients to usual care or usual care plus one 20–25 minute pharmacist session and a leaflet on cancer, chemotherapy and lifestyle. Three months later the counselled group scored better on anxiety, depression and health-related quality of life, whereas controls showed no gain in anxiety or quality of life and a slight worsening of depressive symptoms; roughly a quarter of the participants had breast cancer [11]. Observational studies add supportive evidence: in Japanese outpatients with breast cancer, pharmacist counselling was associated with fewer adverse events that affect quality of life [40], and pharmaceutical intervention for adverse events improved quality of life in patients receiving outpatient chemotherapy [41]. Reports from other settings describe improved knowledge, attitudes and quality of life with clinical pharmacy services [37,42]. Table 3 summarises these studies.

Table 3. Selected studies of pharmacist-led counselling or intervention in oncology

Study	Setting and design	Intervention	Main outcomes
Periasamy et al., 2017 [10]	Malaysia; single-blind RCT, 162 patients	Repeated counselling using a chemotherapy module	Improved quality of life; less anxiety and depression
Mohd-Sidik et al., 2018 [39]	Malaysia; RCT, 2,120 patients, 10 hospitals	Repeated counselling using a chemotherapy module	Improved self-esteem and psychological affect
Poudel et al., 2025 [11]	Nepal; RCT, 128 patients	One 20–25 min session plus leaflet	Lower anxiety and depression scores; better quality of life at 3 months
Tanaka et al., 2018 [40]	Japan; outpatients with breast cancer	Pharmacist counselling	Fewer adverse events affecting quality of life
Fujii et al., 2022 [41]	Japan; outpatient chemotherapy	Pharmaceutical intervention for adverse events	Improved quality of life
Colombo et al., 2017 [8]; Fentie et al., 2024 [38]	Systematic reviews	Various pharmacist interventions	Generally favourable effects; heterogeneous designs and outcomes

Only some participants had breast cancer in several of these studies; dermatological outcomes were not the primary endpoint in the trials listed.

6.3 The evidence gap for dermatological toxicity

Despite this supportive general evidence, dermatological toxicity is seldom the primary outcome in pharmacist-counselling studies. The randomised trials

above measured psychological and quality-of-life outcomes, and direct evidence that structured pharmacist counselling reduces the incidence or severity of nail toxicity, hand-foot syndrome or alopecia is limited [10,11,40]. Nail-care advice, cryotherapy and hair-care advice are supported by trial or observational data as interventions, but the added effect of delivering them through structured counselling, as opposed to leaflets or usual advice, has been little tested [14,32]. Studies with pre-specified dermatological endpoints, graded with both CTCAE and patient-reported tools, would fill this gap [14,27].

7. Towards Risk Stratification: Inflammatory Indices

If patients at high risk of severe dermatological toxicity could be identified early, counselling, cryotherapy and monitoring could be intensified for them. Interest has therefore turned to indices derived from the routine complete blood count. Zahorec first described the neutrophil-to-lymphocyte ratio (NLR) as an easily obtained gauge of inflammatory and stress responses in critically ill patients [43], and Hu and colleagues later added platelets to create the systemic immune-inflammation index (SII), which they tested as a prognostic tool in hepatocellular carcinoma [44]. Across solid tumours a high NLR tends to accompany shorter survival [45], and breast cancer meta-analyses report the same for NLR and SII [46,47]. These indices are attractive because they cost nothing beyond a blood count that is already being performed.

However, this evidence relates mainly to prognosis, not to prediction of toxicity. To date, evidence that NLR or SII can predict the onset or severity of taxane-associated nail toxicity or other dermatological adverse events comes mostly from small, single-centre studies that require validation, and these indices are non-specific and are influenced by infection, corticosteroids, tumour burden and myelosuppressive chemotherapy [45,46]. Any proposed threshold would need validation in independent cohorts, with attention to whether marker changes precede clinical toxicity rather than accompany it. At present, these indices should be regarded as hypothesis-generating and should not replace clinical assessment or structured counselling for all patients [45,47].

8. A Practical Counselling Framework

Counselling should start before the first cycle and be reinforced at each subsequent visit, because toxicities such as nail changes are cumulative and typically emerge after several cycles [4,6]. The framework below draws on the evidence reviewed above, and on the structure of pharmacist counselling interventions reported in oncology [10,11].

Table 4. Suggested pharmacist counselling schedule for dermatological toxicity

Timepoint	Key content	Pharmacist actions
Before cycle 1	Expected skin, hair and nail effects for the regimen; when they appear; that most are reversible; option of cryotherapy or scalp cooling where available [13,15]	Baseline nail and skin check; explain with leaflet in local language; teach-back [11]
Each cycle (pre-infusion)	Review of new symptoms; reinforcement of nail care, moisturising and trauma avoidance; adherence to cooling [14,32]	Grade with CTCAE and a patient-reported tool; document [26,27]
Between cycles	Warning signs (pain, swelling, pus, bleeding, fever); whom to call [6]	Reminder call or message; advise early review [17]
Capecitabine cycles	Hand and foot care; avoid friction, heat and trauma; report tingling and redness early [5,17]	Liaise with the oncologist about dose adjustment for grade 2 or higher toxicity
End of treatment	Expected recovery; nails can take months to regrow; when to seek dermatology review [6,24]	Final assessment; referral if persistent

8.1 Core messages

- Nails: trim them short, keep them clean, and avoid biting, cuticle cutting or aggressive manicures; choose well-fitting footwear, use gloves for household work, moisturise the nails and surrounding skin, and do not rely on dark polish as protection [6,14].
- Cooling: where available, offer frozen gloves and socks during paclitaxel or docetaxel infusion, explain that mild discomfort is common, and encourage the patient to report severe cold, pain or numbness [13,32].
- Hair: explain that hair loss depends on the regimen, offer scalp cooling if available and appropriate, and recommend gentle hair care and early planning for wigs or head coverings [15,23].
- Hands and feet (capecitabine): moisturise, avoid heat and friction, report early tingling or redness, and expect dose adjustment if symptoms become severe [5,17].
- Escalation: contact the team promptly for increasing pain, pus, bleeding, fever or extensive nail separation, because infection in a patient with low white cell counts can be serious [4,6].

8.2 Delivery methods

Effective counselling combines verbal explanation with written or pictorial material in the patient's language, teach-back to confirm understanding, and follow-up contact. The Nepalese trial suggests that even one structured session backed by a leaflet can help where pharmacists are seldom involved in oncology [11], while the Malaysian trials favour repeating counselling over several cycles [10,39]. In a Thai trial, patients were reminded by telephone or a messaging application to complete electronic symptom records at each cycle, illustrating a low-cost method of follow-up [17]. Electronic or paper patient-reported symptom tools can help pharmacists to identify toxicity early [28,29].

9. Implementation in Indian and Resource-Limited Settings

Indian tertiary centres treat large numbers of patients with breast cancer, often with limited staff and clinic time [1]. Several features of the literature suggest that structured counselling is feasible. First, a brief structured pharmacist session, supported by a leaflet, produced measurable benefit in a low-resource cancer hospital [11]. Second, cryotherapy can be delivered with commercially available or locally sourced cold packs and gloves under protocol, although effectiveness and tolerability depend on the cooling protocol used [13,32]. Third, indigenous randomised data show that scalp cooling can be delivered in an Indian tertiary centre [23].

Practical barriers include literacy and language, since materials must be accessible to patients who may have limited schooling [11]; workload, which can be reduced by targeting the first cycle and high-risk regimens; and lack of routine documentation of dermatological toxicity, which limits audit and improvement [21,22]. Pharmacist counselling could be built into existing workflows, for example at the time of pre-infusion checks, using a short checklist with graded assessment. Regional-language pictorial leaflets and telephone follow-up may extend reach without large additional resources [11,17]. Local audit of nail and skin toxicity by cycle would also help to identify which regimens and patient groups need the most attention [6,14].

10. Limitations of the Evidence and Future Directions

- Few trials of pharmacist counselling have dermatological toxicity as the primary endpoint; most report psychological and quality-of-life outcomes [10,11,39].
- Nail toxicity is measured inconsistently, and CTCAE may under-detect functional impact, so future trials should combine clinician grading with patient-reported tools such as NToX or PRO-CTCAE [14,27].
- Cryotherapy protocols vary widely in temperature and duration, and optimal, well-tolerated protocols for use in India need definition [13].
- Evidence for hand-foot syndrome prophylaxis is inconsistent, and further well-designed trials are needed [17,18,33].
- Whether NLR and SII can predict dermatological toxicity still needs confirmation in larger prospective cohorts with cycle-wise sampling and adjustment for confounders [45,46,47].
- Trials should measure downstream outcomes, including dose delays, dose reductions and discontinuations, and cost-effectiveness [7,38].

11. Conclusion

Dermatological toxicities of breast cancer chemotherapy are common, are often unheralded, and can affect function, quality of life and treatment delivery. Evidence supports cryotherapy for nail toxicity and scalp cooling for alopecia, while nail-care advice should be tailored and evidence for hand-foot syndrome prophylaxis remains mixed. Because prevention depends on patient behaviour, structured counselling is a logical and low-cost intervention, and pharmacist-led counselling has improved psychological and quality-of-life outcomes in randomised trials from Malaysia and Nepal. Direct evidence on dermatological outcomes is limited, and routinely available inflammatory indices are, at best, hypothesis-generating tools for risk stratification. A cycle-by-cycle counselling framework, combined with standardised grading and clear escalation pathways, offers a practical way to integrate pharmacists into supportive care, and it should be evaluated in prospective studies with dermatological endpoints.

REFERENCES

1. Bray F, Laversanne M, Sung H, et al. Global cancer statistics 2022: GLOBOCAN estimates of incidence and mortality worldwide for 36 cancers in 185 countries. *CA Cancer J Clin.* 2024;74(3):229-263.
2. Sparano JA, Wang M, Martino S, et al. Weekly paclitaxel in the adjuvant treatment of breast cancer. *N Engl J Med.* 2008;358(16):1663-1671.
3. Masuda N, Lee SJ, Ohtani S, et al. Adjuvant capecitabine for breast cancer after preoperative chemotherapy. *N Engl J Med.* 2017;376(22):2147-2159.
4. Robert C, Sibaud V, Mateus C, et al. Nail toxicities induced by systemic anticancer treatments. *Lancet Oncol.* 2015;16(4):e181-e189.
5. Nagore E, Insa A, Sanmartin O. Antineoplastic therapy-induced palmar plantar erythrodysesthesia ('hand-foot') syndrome. Incidence, recognition and management. *Am J Clin Dermatol.* 2000;1(4):225-234.
6. Alessandrini A, Starace M, Cerè G, Brandi N, Piraccini BM. Management and outcome of taxane-induced nail side effects: experience of 79 patients from a single centre. *Skin Appendage Disord.* 2019;5(5):276-282.
7. Bonadonna G, Valagussa P. Dose-response effect of adjuvant chemotherapy in breast cancer. *N Engl J Med.* 1981;304(1):10-15.
8. Colombo LR, Aguiar PM, Lima TM, Storpirtis S. The effects of pharmacist interventions on adult outpatients with cancer: a systematic review. *J Clin Pharm Ther.* 2017;42(4):414-424.
9. Ali HB, Dike UP, Khan MB, Khusrau N. Pharmacotherapy and psychological support: integrating pharmacists into comprehensive cancer

- care – a literature review. *J Oncol Pharm Pract.* 2025;10781552251316827.
10. Periasamy U, Mohd Sidik S, Rampal L, Fadhilah SI, Akhtari-Zavare M, Mahmud R. Effect of chemotherapy counseling by pharmacists on quality of life and psychological outcomes of oncology patients in Malaysia: a randomized control trial. *Health Qual Life Outcomes.* 2017;15:104.
 11. Poudel B, Sankhi S, Pathak N, Basyal B, Paudel S, Marasine NR. Impact of pharmacist-led chemotherapy counseling on health-related quality of life and psychological outcomes of oncology patients in cancer hospital: a single center, open-label, randomized controlled trial. *Explor Res Clin Soc Pharm.* 2025;20:100649.
 12. Minisini AM, Tosti A, Sobrero AF, et al. Taxane-induced nail changes: incidence, clinical presentation and outcome. *Ann Oncol.* 2003;14(2):333-337.
 13. Huang KL, Lin KY, Huang TW, et al. Prophylactic management for taxane-induced nail toxicity: a systematic review and meta-analysis. *Eur J Cancer Care (Engl).* 2019;28(5):e13118.
 14. Morrison A, Marshall-McKenna R, McFadyen AK, et al. A randomised controlled trial of interventions for taxane-induced nail toxicity in women with early breast cancer. *Sci Rep.* 2022;12:11575.
 15. Nangia J, Wang T, Osborne C, et al. Effect of a scalp cooling device on alopecia in women undergoing chemotherapy for breast cancer: the SCALP randomized clinical trial. *JAMA.* 2017;317(6):596-605.
 16. Rugo HS, Voigt J. Scalp hypothermia for preventing alopecia during chemotherapy. A systematic review and meta-analysis of randomized controlled trials. *Clin Breast Cancer.* 2018;18(1):19-28.
 17. Wongkraisri C, Chusuwanrak K, Laocharoenkeat A, et al. Randomized controlled trial on the efficacy of topical urea-based cream in preventing capecitabine-associated hand-foot syndrome. *BMC Cancer.* 2025;25:275.
 18. Pandey JGP, Franco PIG, Li RK. Prophylactic strategies for hand-foot syndrome/skin reaction associated with systemic cancer treatment: a meta-analysis of randomized controlled trials. *Support Care Cancer.* 2022;30(11):8655-8666.
 19. Spazzapan S, Crivellari D, Lombardi D, et al. Nail toxicity related to weekly taxanes: an important issue requiring a change in common toxicity criteria grading. *J Clin Oncol.* 2002;20(21):4404-4405.
 20. Capriotti K, Capriotti J, Lessin S, et al. The risk of nail changes with taxane chemotherapy: a systematic review of the literature and meta-analysis. *Br J Dermatol.* 2015;173(3):842-845.
 21. Gupta A, Parakh A, Dubey AP. Chemotherapy induced nail changes. *Indian J Dermatol.* 2008;53(4):204-205.
 22. Mittal S, Khunger N, Kataria SP. Nail changes with chemotherapeutic agents and targeted therapies. *Indian Dermatol Online J.* 2022;13(1):13-22.
 23. Bajpai J, Kagwade S, Chandrasekharan A, et al. Randomised controlled trial of scalp cooling for the prevention of chemotherapy induced alopecia. *Breast.* 2020;49:187-193.
 24. Kang D, Cho J, Zhao D, et al. Scalp cooling in preventing persistent chemotherapy-induced alopecia: a randomized controlled trial. *J Clin Oncol.* 2024;42(26):3115-3122.
 25. Tebbutt NC, Wilson K, Gebiski VJ, et al. Capecitabine, bevacizumab, and mitomycin in first-line treatment of metastatic colorectal cancer: results of the Australasian Gastrointestinal Trials Group randomized phase III MAX study. *J Clin Oncol.* 2010;28(19):3191-3198.
 26. National Cancer Institute. Common Terminology Criteria for Adverse Events (CTCAE), version 5.0. Bethesda (MD): US Department of Health and Human Services; 2017.
 27. Basch E, Reeve BB, Mitchell SA, et al. Development of the National Cancer Institute's patient-reported outcomes version of the Common Terminology Criteria for Adverse Events (PRO-CTCAE). *J Natl Cancer Inst.* 2014;106(9):dju244.
 28. Kluetz PG, Chingos DT, Basch EM, Mitchell SA. Patient-reported outcomes in cancer clinical trials: measuring symptomatic adverse events with the National Cancer Institute's patient-reported outcomes version of the Common Terminology Criteria for Adverse Events (PRO-CTCAE). *Am Soc Clin Oncol Educ Book.* 2016;35:67-73.
 29. Basch E, Deal AM, Kris MG, et al. Symptom monitoring with patient-reported outcomes during routine cancer treatment: a randomized controlled trial. *J Clin Oncol.* 2016;34(6):557-565.
 30. Scotté F, Tourani JM, Banu E, et al. Multicenter study of a frozen glove to prevent docetaxel-induced onycholysis and cutaneous toxicity of the hand. *J Clin Oncol.* 2005;23(19):4424-4429.
 31. McCarthy AL, Shaban RZ, Gillespie K, Vick J. Cryotherapy for docetaxel-induced hand and nail toxicity: randomised controlled trial. *Support Care Cancer.* 2014;22(5):1375-1383.
 32. Can G, Aydinler A, Cavdar I. Taxane-induced nail changes: predictors and efficacy of the use of frozen gloves and socks in the prevention of nail toxicity. *Eur J Oncol Nurs.* 2012;16(3):270-275.
 33. Wolf SL, Qin R, Menon SP, et al. Placebo-controlled trial to determine the effectiveness of a urea/lactic acid-based topical keratolytic agent for prevention of capecitabine-induced hand-foot syndrome: North Central Cancer Treatment Group study N05C5. *J Clin Oncol.* 2010;28(35):5182-5187.
 34. Hofheinz RD, Gencer D, Schulz H, et al. Mapisal versus urea cream as prophylaxis for capecitabine-associated hand-foot syndrome: a randomized phase III trial of the AIO Quality of Life Working Group. *J Clin Oncol.* 2015;33(22):2444-2449.
 35. Lan TC, Tsou PH, Tam KW, Huang TW. Effect of urea cream on hand-foot syndrome in patients receiving chemotherapy: a meta-analysis. *Cancer Nurs.* 2022;45(5):378-386.
 36. Kang YK, Lee SS, Yoon DH, et al. Pyridoxine is not effective to prevent hand-foot syndrome associated with capecitabine therapy: results of a randomized, double-blind, placebo-controlled study. *J Clin Oncol.* 2010;28(24):3824-3829.
 37. McKee M, Frei BL, Garcia A, Fike D, Soefje SA. Impact of clinical pharmacy services on patients in an outpatient chemotherapy academic clinic. *J Oncol Pharm Pract.* 2011;17(4):387-394.

38. Fentie AM, Huluka SA, Gebremariam GT, et al. Impact of pharmacist-led interventions on medication-related problems among patients treated for cancer: a systematic review and meta-analysis of randomized control trials. *Res Social Adm Pharm*. 2024;20(5):487-497.
39. Mohd-Sidik S, Akhtari-Zavare M, Periasamy U, Rampal L, Fadhilah SI, Mahmud R. Effectiveness of chemotherapy counselling on self-esteem and psychological affects among cancer patients in Malaysia: randomized controlled trial. *Patient Educ Couns*. 2018;101(5):862-871.
40. Tanaka K, Hori A, Tachi T, et al. Impact of pharmacist counseling on reducing instances of adverse events that can affect the quality of life of chemotherapy outpatients with breast cancer. *J Pharm Health Care Sci*. 2018;4:13.
41. Fujii H, Ueda Y, Hirose C, et al. Pharmaceutical intervention for adverse events improves quality of life in patients with cancer undergoing outpatient chemotherapy. *J Pharm Health Care Sci*. 2022;8:8.
42. Wang Y, Wu H, Xu F. Impact of clinical pharmacy services on KAP and QOL in cancer patients: a single-center experience. *Biomed Res Int*. 2015;2015:502431.
43. Zahorec R. Ratio of neutrophil to lymphocyte counts – rapid and simple parameter of systemic inflammation and stress in critically ill. *Bratisl Lek Listy*. 2001;102(1):5-14.
44. Hu B, Yang XR, Xu Y, et al. Systemic immune-inflammation index predicts prognosis of patients after curative resection for hepatocellular carcinoma. *Clin Cancer Res*. 2014;20(23):6212-6222.
45. Templeton AJ, McNamara MG, Šeruga B, et al. Prognostic role of neutrophil-to-lymphocyte ratio in solid tumors: a systematic review and meta-analysis. *J Natl Cancer Inst*. 2014;106(6):dju124.
46. Ethier JL, Desautels DN, Templeton AJ, Shah PS, Amir E. Prognostic role of neutrophil-to-lymphocyte ratio in breast cancer: a systematic review and meta-analysis. *Breast Cancer Res*. 2017;19(1):2.
47. Zhang Y, Sun Y, Zhang Q. Prognostic value of the systemic immune-inflammation index in patients with breast cancer: a meta-analysis. *Cancer Cell Int*. 2020;20:224.