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Nursing Interventions for Preventing Skin Complications Associated with Noninvasive Ventilation Masks

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ABSTRACT: Preventing skin complications from noninvasive ventilation (NIV) masks begins with systematic, proactive assessment before and throughout therapy. Nurses should conduct a baseline skin assessment focusing on high-risk areas—the nasal bridge,

cheeks, chin, forehead, and the mastoid region behind the ears—documenting skin integrity, color, temperature, and any pre-existing fragility or pressure injury risk using validated tools such as the Braden Scale or the Norton Scale. Identifying individual risk factors is equally important: advanced age, malnutrition, low body mass index, diabetes, edema, diaphoresis, impaired sensory perception, and prolonged NIV duration all elevate susceptibility to device-related pressure injury. Nurses should inspect the skin at each shift change and more frequently during the initial 24 hours of therapy, when risk is highest, and reassess whenever the mask is removed. Early detection of non-blanchable erythema, persistent redness, or moisture-associated breakdown allows prompt intervention before lesions progress. Equally important is patient education—teaching patients to report discomfort, burning, or numbness under the mask empowers them to signal problems early, and gentle massage of pressure points and skin emollients should be encouraged only under clinician guidance. Preventive Strategies, Device Selection, and Ongoing Care A cornerstone of prevention involves selecting an appropriately sized, properly fitted mask and rotating among interface types—nasal, oronasal, and helmet—to redistribute pressure points and minimize localized insult. Nurses should apply protective dressings such as hydrocolloid or thin foam barriers over the nasal bridge and other high-pressure areas, ensuring the material does not compromise the mask seal. Correct strap tension is critical: masks should be secured firmly enough to prevent air leak but not so tightly that excessive pressure is generated, and nurses should verify the fit with a low-pressure leak check. Ventilator parameters such as inspiratory pressure and humidification should also be optimized, as inadequate humidification contributes to dryness and mucosal injury. Regular repositioning of the mask and scheduled "mask-free" breaks allow skin recovery and relieve sustained pressure. Moisture management is essential—frequent assessment for skin maceration from humidity or condensation, gentle cleansing with pH-balanced products, and prompt drying must be incorporated into routine care. Nurses should coordinate with respiratory therapists and wound care specialists when skin changes occur, escalate persistent erythema to the care team, and document interventions and outcomes thoroughly to refine prevention protocols and benchmark quality.

INTRODUCTION

Noninvasive ventilation (NIV) has become an essential component of modern respiratory care in critical care units, acute medical wards, and home settings. By delivering positive pressure without an artificial airway, NIV reduces many of the risks associated with invasive mechanical ventilation, preserves airway defenses, and supports earlier mobilization and weaning. However, the interface that makes NIV possible—the mask—creates a distinct and often underestimated vulnerability at the skin level. The mask must maintain a seal against the face to deliver effective ventilation, and the mechanical forces required to achieve that seal, together with the microclimate created beneath the cushion, place patients at risk for facial pressure injuries, friction lesions, moisture-associated skin damage, and device-related skin breakdown. A systematic review of mask-related pressure injury prevention associated with NIV confirms that these complications are common and that preventive nursing strategies are central to safe NIV practice [1].

The clinical importance of mask-related skin complications extends well beyond cosmetic concern. Facial pressure injuries cause pain, interfere with communication and oral intake, increase infection risk, prolong hospital stay, and may force premature discontinuation of NIV or a change to a less effective interface. When NIV is interrupted because of skin breakdown, the patient may lose the respiratory support that was preventing intubation, producing a cascade of adverse outcomes that the original therapy was intended to avoid. An interprofessional quality improvement project in a pediatric intensive care unit demonstrated that structured nursing and team-based prevention can reduce NIV mask–related pressure injuries and improve staff knowledge and preventive behaviors [2].

The skin beneath an NIV mask is exposed to pressure, friction, shear, and moisture, and these forces interact to impair tissue perfusion and barrier function. Skin hydration is significantly higher at erythematous sites than at unaffected sites, and excess

hydration softens the stratum corneum, increases friction, and makes the skin more vulnerable to mechanical damage [3]. Expert recommendations for the prevention and treatment of skin lesions associated with noninvasive mechanical ventilation emphasize systematic assessment, appropriate interface selection, prophylactic skin protection, and regular repositioning [4]. Interface problems are among the most frequent challenges in acute NIV, and poor fit, excessive strap tension, and prolonged uninterrupted contact are major contributors to skin injury [5].

Epidemiology and Clinical Burden of Mask-Related Skin Complications

The reported incidence of skin complications associated with NIV masks varies across populations and care settings, but the available evidence consistently indicates that the problem is common and clinically meaningful. A systematic review and meta-analysis of studies involving adult patients receiving NIV reported that the incidence of facial pressure injuries associated with NIV equipment was approximately 25% [1]. Other syntheses have described a prevalence of device-related pressure injuries of around 25%, with reported incidences of NIV-related facial pressure ulcers ranging from approximately 10% to 31% [1]. These figures are important because they indicate that skin complications are not rare events but predictable consequences of interface use that require systematic prevention.

The burden is particularly pronounced in pediatric and neonatal populations. In a pediatric intensive care unit, 66% of stage 2 or greater health care–associated pressure injuries were facial injuries related to NIV masks, and a structured interprofessional prevention program reduced NIV mask–related pressure injuries from six in 2021 to zero in 2022 [2]. Among children receiving long-term NIV, pressure ulcers occur mainly over the nasal bridge, followed by the nose and forehead, reflecting the anatomical vulnerability of the pediatric face and the difficulty of achieving a stable seal without excessive pressure [2]. The smaller facial features, thinner skin, limited subcutaneous tissue, and proportionally larger head of the child mean that standard adult mask designs and fitting strategies are often inadequate, and the consequences of poor fit are magnified.

The time course of injury is also instructive. Tissue damage and necrosis can occur after as little as two hours of pressure-induced ischemia at a pressure of 4.6 kPa, a level that can be generated by some oronasal masks when straps are tightened to achieve a seal [3]. The rate of facial pressure injury has been reported to be approximately 50% within the first few hours of NIV mask use and to increase to nearly 100% after 48 hours in some series [3]. These observations underscore a fundamental principle: the risk of skin breakdown begins with the first mask application and accumulates with every hour of uninterrupted interface contact. Prevention cannot be deferred until erythema appears; it must be built into the initiation and ongoing management of NIV from the outset [3].

Pathophysiology and Mechanisms of Mask-Related Skin Damage

The skin damage produced by NIV masks is not the result of a single insult but of multiple interacting mechanical and environmental forces. Pressure is the primary mechanism. The mask cushion and headgear compress the skin against underlying bony prominences, particularly the nasal bridge, the malar region, the forehead, and the chin. When external pressure exceeds the capillary closing pressure, perfusion to the skin and underlying tissues is compromised, leading to ischemia, cellular injury, and, if the pressure is sustained, tissue necrosis. The nasal bridge is especially vulnerable because the skin is thin, the subcutaneous padding is minimal, and the bone lies immediately beneath the dermis, leaving little capacity for pressure redistribution [3].

Friction and shear compound the effects of pressure. Friction arises when the mask or straps move across the skin surface, particularly during patient movement, repositioning, or adjustments to the ventilator circuit. Shear occurs when the mask displaces the skin tangentially relative to the underlying tissues. Both forces can damage the stratum corneum and superficial dermis even when the applied pressure alone would be tolerable, and they are often most severe in patients who are agitated, diaphoretic, or unable to cooperate with mask positioning [4]. The interface must therefore be managed not only as a pressure-delivery device but also as a potential source of mechanical trauma [4].

The microclimate beneath the mask is a third critical factor. The interface creates an enclosed space in which temperature and humidity rise, and moisture from perspiration and exhaled air accumulates on the skin. Excessive skin hydration softens the stratum corneum, increases friction, and impairs the skin's barrier function, making it more susceptible to mechanical damage. A prospective cohort study using skin hydration measurements found that skin hydration was significantly higher at sites with erythema than at sites without erythema, and that strategies to maintain normal skin hydration were important for protecting tissue integrity [3]. Humidification of the inspired gas, while often necessary for comfort and mucosal health, may further alter

the skin microclimate; one crossover study in healthy volunteers found that humidified CPAP significantly increased transepidermal water loss and skin humidity compared with non-humidified CPAP, suggesting a potential disrupting effect on the facial skin barrier [6].

Finally, the duration and continuity of interface contact determine the cumulative dose of these harmful forces. Unlike other pressure injuries, which can be relieved by routine repositioning of the whole body, mask-related pressure is concentrated on the face and is difficult to offload without interrupting ventilation. The concept of dose is therefore central: the longer the mask remains in place without relief, the greater the probability and severity of injury [5]. This is why interventions that interrupt contact—mask rotation, scheduled skin breaks, and interface alternation—are not optional comforts but essential components of prevention [5].

Assessment and Classification of Mask-Related Skin Complications

Systematic, standardized assessment is the foundation of prevention because it allows clinicians to detect tissue compromise before irreversible damage occurs and to escalate interventions in a timely manner. The assessment of skin beneath an NIV mask requires a structured approach that includes inspection, palpation, and, where available, instrumental evaluation. A commonly used classification framework for mask-related pressure injury describes six stages: Stage 0, intact skin; Stage 1, suspected injury with a reddish or brown area on intact skin; Stage 2, persistent erythema on intact skin lasting more than one hour after mask removal; Stage 3, partial-thickness skin loss with a superficial ulcer or intact or ruptured serous blister; Stage 4, full-thickness skin loss with exposure of subcutaneous fat but not bone, tendon, or muscle; Stage 5, full-thickness tissue loss with exposure of bone, tendon, or muscle; and Stage 6, necrosis [7].

Pain or discomfort should be recorded using a 0–10 Visual Analog Scale, and NIV tolerance can be rated as absent, poor, moderate, or good. This dual assessment of tissue status and patient experience is important because pain may be the earliest indicator of excessive interface pressure, even before visible erythema appears [7]. Assessment should include the nasal bridge, malar areas, forehead, chin, and any other site of mask or strap contact, and it should document the location, stage, size, and appearance of any lesion, as well as the presence of moisture, erythema, or pain. Expert recommendations emphasize that skin assessment should be performed regularly and that any persistent erythema or break in the skin should prompt reassessment of mask fit and preventive strategies [4].

Instrumental assessment methods are emerging as adjuncts to clinical examination. Skin thermography, which uses infrared imaging to evaluate the thermal effects of NIV on the skin in contact with the interface, has been studied as a tool for monitoring the interface between the mask and the skin [7]. Three-dimensional surface imaging and skin hydration measurement have been used in research settings to identify early skin compromise and to evaluate the effects of different dressings and mask designs [3]. While these technologies are not yet routine in most clinical settings, they underscore the importance of objective, early detection and point toward future directions in preventive nursing assessment [7].

Risk Factors and Vulnerable Populations

The risk of mask-related skin complications is not uniformly distributed. A range of patient-, device-, and care-related factors interact to determine individual vulnerability, and nursing assessment must incorporate these factors to target preventive resources appropriately. Patient-related risk factors include extremes of age, malnutrition and dehydration, sensory impairment, low level of consciousness, acute or chronic illness, hypoxia or hypotension, vascular disease, chronic skin conditions, and a history of previous pressure damage. Aging and poor nutrition lead to thinning of the skin and loss of subcutaneous fat, allowing bony prominences to protrude and reducing the tissue's capacity to absorb pressure. Facial skin edema, diabetes, fever, and a lower Glasgow Coma Scale score have been identified as independent risk factors for facial pressure injuries related to adult NIV equipment [8].

Device-related risk factors are equally important. Prolonged use of NIV, use of a non-rotating single mask, and excessive mask tightness applied to prevent air leaks are consistently identified as contributors to mask-associated pressure injury [8]. The type of interface matters: one study found that 20% of patients using nasal-oral masks developed pressure injuries, compared with 2% of those using full-face masks, although comfort perceptions and leakage profiles differ among interfaces [5]. In neonates, the evidence is more nuanced: some studies show no difference between nasal masks and nasal prongs in the occurrence of nasal ulcers, while others report significantly lower nasal trauma with masks, and three-armed studies suggest that alternating interfaces may produce the lowest injury rates [8].

Care-related factors include inadequate skin assessment, failure to use prophylactic dressings in high-risk patients, poorly timed or absent interface rotation, excessive strap tension, and insufficient staff education regarding mask fitting and skin surveillance. These factors are particularly important because they are modifiable. The presence of a non-invasive ventilation protocol, fever, and the cumulative time of equipment use have been identified among the factors associated with facial pressure injury development, suggesting that structured care processes can influence outcomes [8]. Nursing assessment should therefore combine patient characteristics, device characteristics, and care processes to identify patients who require more frequent skin inspection, earlier prophylactic dressing use, and more aggressive interface rotation [8].

Prophylactic Dressings and Skin Barriers

Prophylactic dressings create a physical barrier between the mask and the skin, redistributing pressure, reducing friction and shear, and managing moisture at the interface. They are among the most extensively studied preventive interventions for mask-related skin damage, and the evidence supports their use in patients at risk. Hydrocolloid dressings are the most commonly used protective interface during NIV. A pre- and post-observational study of 161 patients evaluated the effectiveness of hydrocolloid dressings in preventing pressure injuries on the nasal bridge; grade 2 pressure injuries occurred in nine patients in the control group, while none of the 134 patients who received hydrocolloid dressings developed grade 2 ulcers, and no specific adverse events were attributed to the dressing [9]. A meta-analysis has similarly concluded that hydrocolloid dressings are effective measures for preventing NIV-related facial pressure injuries and that they outperform other approaches, although the authors called for high-quality prospective validation [9].

Silicone foam dressings have emerged as an important alternative, particularly for patients who require prolonged NIV or who are at high risk of moisture-associated damage. Silicone foam dressings offer pressure redistribution, moisture management, and friction reduction, all of which are critical for mitigating the forces that lead to device-related pressure injuries. In a randomized study of protective solutions for prevention of facial pressure injuries during NIV, protective dressings were associated with reduced skin damage compared with standard care, supporting the use of structured skin protection in high-risk patients [10]. The choice among hydrocolloid, foam, and other dressing types should be individualized. Hydrocolloid dressings are appropriate when friction and shear are the predominant concerns and when the skin is intact or only superficially damaged. Foam dressings are preferable when pressure redistribution and moisture management are priorities, and silicone-faced foam dressings are particularly useful when repeated dressing changes are required because they are gentle on fragile skin [10].

Transparent film dressings may be used when visual inspection of the skin is necessary, although their pressure-redistribution capacity is limited. Gel pads and padding materials can supplement dressings in areas of high bony prominence. A critical caveat is that dressings do not prevent damage indefinitely: in patients with more than twelve hours of continuous exposure to the interface, dressings alone are insufficient, and different interfaces should be alternated to rotate the pressure points, particularly if the interface is oronasal [10]. Dressings should therefore be embedded within a broader preventive bundle that includes fit optimization, rotation, and regular skin assessment [10].

Table 1. Summary of Preventive Nursing Interventions for NIV Mask–Related Skin Complications

Intervention Domain	Key Nursing Actions	Evidence and Rationale
Interface selection and fitting	Use manufacturer sizing guides; select interface based on facial anatomy and duration of NIV; secure straps with minimal tension; reassess fit regularly	Poor fit and excessive strap tension are major contributors to pressure injury; strap tension significantly affects nasal pressure
Prophylactic dressings	Apply hydrocolloid or silicone foam dressings to high-risk areas such as the nasal bridge, malar region, and forehead before mask application	Hydrocolloid dressings reduce grade 2 pressure injuries; silicone foam dressings redistribute pressure and manage moisture
Interface rotation and skin breaks	Alternate between mask and nasal prongs every 2–4 hours when feasible; remove mask briefly for	Rotation distributes pressure across different sites and reduces cumulative load; dressings

	skin inspection and pressure relief; assess need for rotation at 24 hours	alone are insufficient after prolonged continuous interface exposure
Skin care and microclimate management	Keep skin clean and dry; cleanse face once per shift; manage secretions and perspiration; avoid excessive skin hydration; consider barrier creams for erythema or rash	Excess hydration impairs barrier function and increases friction; humidification may alter skin microclimate
Humidification	Use humidification judiciously; monitor skin for moisture accumulation; balance mucosal benefits against skin risks	Humidified NIV increases transepidermal water loss and skin humidity, potentially disrupting the facial skin barrier
Nutritional support	Screen for malnutrition; ensure adequate protein and calorie intake in at-risk patients; monitor serum albumin	Malnutrition and low albumin are associated with increased pressure injury risk and impaired healing
Skin assessment and monitoring	Inspect skin under mask every 3–4 hours and at least once per shift; document stage, location, size, and pain; use a visual analog scale for discomfort	Regular assessment enables early detection and timely escalation
Education and bundle implementation	Train staff in mask fitting, skin assessment, and dressing application; implement an interprofessional NIV skincare bundle; audit outcomes	Bundle implementation has reduced NIV mask–related pressure injuries in pediatric intensive care

Interface Selection and Mask Fitting as Primary Prevention

The single most effective preventive intervention is the selection of an appropriate interface and the achievement of an optimal fit. A mask that is the wrong size, the wrong shape, or incorrectly positioned will require excessive strap tension to maintain a seal, and that excessive tension is transmitted directly to the skin. Conversely, a well-fitted mask distributes pressure more evenly, reduces leakage, and minimizes the need for tight straps. Comparative studies of interface type and pressure distribution in noninvasive ventilation show that different masks produce different pressure profiles on the face, and the choice of interface should therefore be guided by the patient's anatomy and the anticipated duration of NIV rather than by convenience alone [11].

Interface selection should be guided by the patient's facial anatomy, the required ventilatory parameters, the anticipated duration of NIV, and the patient's tolerance and comfort. Nasal masks, oronasal masks, full-face masks, nasal pillows, and helmets each have distinct pressure distribution profiles and clinical indications. A prototype face mask designed to reduce skin pressure has been compared with conventional interfaces and has highlighted the importance of cushion design and contact area in reducing facial pressure [12]. In adults, full-face masks have been associated with a lower incidence of pressure injury than nasal-oral masks in some studies, although nasal masks may be perceived as more comfortable [5]. In neonates, the evidence supports the preferential use of nasal masks over nasal prongs in some contexts, while alternating between masks and prongs every two to four hours is recommended when conditions permit, because rotation between interfaces distributes pressure across different anatomical sites and reduces the cumulative load on any single area [11].

Mask fitting is a skill that requires both training and ongoing reassessment. Manufacturer sizing guides should be used rather than estimation, and the mask should be positioned according to the manufacturer's instructions, with the headgear straps adjusted symmetrically. A widely used clinical rule is that approximately two fingers should be able to pass beneath the headgear straps, indicating that the mask is secure without being overtightened. Strap tension has a significant effect on the pressure exerted on the nose, and small increments in tension can produce disproportionate increases in interface pressure [12]. The mask should be secured with the minimal tension required to obtain an adequate seal or minimal air leak, and the fit should be reassessed regularly because patient movement, sweating, changes in fluid status, and the gradual loosening of Velcro straps can all alter fit over time [12].

Patient positioning also influences interface pressure. The supine position has been associated with reduced mask-induced pressure on the nasal bridge compared with the seated position, and this should be considered when positioning patients for comfort and skin protection [12]. However, positioning decisions must balance skin protection against respiratory mechanics,

aspiration risk, and patient preference. Nurses should document the interface type, size, strap tension, and fit assessment so that subsequent caregivers can reproduce optimal positioning and recognize deterioration in fit [12].

Repositioning, Interface Rotation, and Scheduled Skin Breaks

Because mask-related pressure is concentrated on the face and cannot be relieved by whole-body repositioning alone, strategies that periodically interrupt interface contact are essential. The concept of mask rotation—the planned sequential use of different interfaces—reduces pressure effects by alternating the points of highest pressure and is also useful for improving tolerance and efficacy of NIV. Giving the skin regular breaks from interface pressure, ideally every two to four hours, allows for inspection of the skin beneath the mask and reduces the cumulative ischemic dose. If the mask is not removed for prolonged periods, severe skin and tissue damage can occur; a case report described a patient in whom the mask was not removed for more than ninety consecutive hours and who developed severe damage [13].

The practical implementation of rotation depends on the clinical context. In adults, alternating an oronasal mask and a full-face mask allows regular pressure relief of the nasal bridge, while interfaces without contact with the nasal bridge—such as masks with a cut-out over the nasal bridge or nasal prongs—can also be tried. In neonates, high-quality evidence supports systemic rotation between mask and nasal prongs, combined with a hydrocolloid protective barrier, as a priority preventive intervention. When conditions permit, alternating between nasal prongs and masks every two to four hours is advisable, particularly for preterm infants who are at high risk of nasal injury [13]. Helmets have also been compared with face masks in infants with respiratory syncytial virus bronchiolitis, and the choice of interface must balance ventilation efficacy, tolerance, and skin protection [14].

Scheduled skin breaks should be coordinated with other aspects of care, such as oral hygiene, repositioning, and assessment of vital signs, to minimize disruption to ventilation. During the break, the skin should be inspected, cleansed if necessary, and allowed to dry completely before the mask is reapplied. The mask and straps should be checked for debris, moisture, or damage, and the fit should be reassessed before reapplication. The decision to rotate the interface should be documented, along with the condition of the skin at each assessment. In patients at high risk of pressure ulcers, mask rotation should be started from the beginning of NIV rather than deferred until erythema appears [14].

Skin Care and Microclimate Management

The skin beneath an NIV mask exists in a microenvironment that is warmer and more humid than exposed skin, and this microenvironment can be further altered by perspiration, secretions, and humidification of the inspired gas. Maintaining skin integrity requires active management of this microclimate, including keeping the skin clean and dry, reducing excess moisture, and protecting the skin barrier. The skin and mask should be kept clean and dry throughout treatment to reduce the risk of irritation [3]. Washing and cleaning of the face once per shift is a component of several preventive bundles, and it should be performed with a gentle cleanser that does not strip the skin of its natural oils. After cleansing, the skin should be thoroughly dried before the mask is reapplied, because residual moisture can increase friction and promote maceration [3].

If redness, rash, or blistering occur, a change to a silicone- and latex-free mask cushion, application of a barrier cream, and covering the damaged skin to protect it when the mask is in place can all be tried. If an allergic rash occurs, the mask cushion should be changed to a different material, and a steroid cream may be considered under medical guidance [4]. Microclimate management also involves attention to the humidity and temperature of the inspired gas. While humidification is often necessary to prevent mucosal dryness and to maintain comfort, it may increase skin hydration and impair the barrier function of the facial skin [6]. Nurses should monitor the skin for signs of excessive moisture, such as maceration, pallor, or increased friction, and should adjust humidification settings in collaboration with the respiratory therapy team to balance mucosal and skin needs [6].

The use of a well-fitting mask that minimizes leakage can also reduce the accumulation of moisture beneath the interface, because leaked air can carry moisture onto the skin and contribute to a humid microenvironment [6]. Skin care should be documented at each assessment, including cleansing, drying, dressing changes, and any observed changes in color, temperature, or integrity. These observations provide the basis for early escalation and for evaluating the effectiveness of preventive interventions over time [6].

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Humidification and the Balance Between Mucosal and Skin Health

Humidification of NIV is a double-edged sword. On one hand, adequate humidification is important for maintaining the integrity of the respiratory mucosa, preventing dryness, and improving comfort; inspired air should ideally be delivered at 37°C and 100% relative humidity to preserve mucociliary function [6]. On the other hand, humidification can alter the skin microclimate beneath the mask and may contribute to facial skin breakdown. A crossover cohort study in healthy volunteers found that humidified CPAP significantly increased transepidermal water loss and skin humidity compared with non-humidified CPAP, and there was a trend toward increased interleukin-1α concentrations, suggesting a potential inflammatory response. The authors concluded that humidification had a potential disrupting effect on the barrier function of facial skin, associated with changes in skin microclimate and function [6].

For nurses, the implication is not that humidification should be avoided, but that it should be managed thoughtfully. Humidification settings should be tailored to the patient's needs, and the skin beneath the mask should be monitored for signs of excessive hydration. If skin maceration or moisture-associated damage develops, the humidification level should be reviewed, and strategies to reduce skin moisture—such as more frequent skin breaks, absorbent dressings, or adjustments to mask fit—should be implemented [6]. The goal is to achieve a balance in which the respiratory mucosa is protected without compromising the skin barrier. This balance requires ongoing communication among nurses, respiratory therapists, and physicians, because humidification decisions affect both respiratory comfort and skin integrity [6].

Table 2. Comparison of Prophylactic Dressing Types for NIV Mask–Related Skin Protection

Dressing Type	Primary Mechanism	Advantages	Limitations and Considerations
Hydrocolloid dressing	Creates a barrier; reduces friction and shear; absorbs minimal exudate	Most commonly used; evidence supports reduction in grade 2 pressure injuries; available in shaped forms for nasal bridge	May increase mask leakage in some settings; requires sufficient pressure to secure mask; not ideal for heavily exuding wounds
Silicone foam dressing	Redistributes pressure; manages moisture; reduces friction; gentle on fragile skin	Effective in reducing device-related pressure ulcer prevalence; suitable for prolonged use; customizable	Higher cost than some alternatives; may require shaping for facial contours; evidence base is growing
Transparent film dressing	Provides a protective barrier; allows visual inspection of skin	Useful when continuous visualization is needed; low profile	Limited pressure-redistribution capacity; may not reduce friction as effectively as foam or hydrocolloid
Gel pad or padding	Distributes pressure over a larger area; cushions bony prominences	Can supplement other dressings in high-risk areas; reusable in some forms	May slip or displace; requires secure positioning; not a substitute for proper mask fit and rotation

Education, Interprofessional Collaboration, and Bundle Implementation

No preventive strategy is effective unless it is implemented reliably, and reliability depends on education, teamwork, and system-level support. Nurses require ongoing training in mask selection and fitting, skin assessment, dressing application, interface rotation, and the recognition of early skin damage. Brief training on the prevention of nasal pressure injury caused by NIV has been shown to increase nurses' knowledge, and nursing care is essential in preventing NIV-induced pressure injuries. A nurse-led prevention bundle for respiratory device-related pressure injuries has been associated with improved preventive practices and reduced device-related pressure injury rates [15]. Educational programs should include both theoretical content and hands-on practice with mask fitting and dressing application, and they should be reinforced through competency assessments and periodic refresher training [15].

Interprofessional collaboration is equally important. Respiratory therapists, physicians, dietitians, wound care specialists, and nurses each contribute unique expertise to the prevention and management of mask-related skin complications. The development of an evidence-based NIV skincare bundle through interprofessional collaboration has been shown to reduce health care–associated pressure injuries related to NIV masks [2]. In one pediatric intensive care unit, the number of NIV

mask–related pressure injuries decreased from six in 2021 to zero in 2022 after bundle implementation, and postimplementation survey data showed that staff knowledge and preventive behaviors improved [2]. The bundle included prophylactic dressings, routine skin assessments, interface repositioning, alternative interfaces, and standardized documentation, and its success demonstrates that a structured, multifaceted approach can produce meaningful improvements in patient outcomes [2].

Standardized documentation is a critical component of bundle implementation. Documentation should include the type and size of the interface, the strap tension or fit assessment, the condition of the skin at each assessment, the presence of pain or discomfort, the interventions implemented, and the patient's tolerance of NIV [15]. Audit and feedback on these metrics can identify gaps in practice and drive continuous improvement. Education and bundle implementation should be adapted to the local context, because staffing patterns, patient populations, and available interfaces vary across units. Nevertheless, the core principles—systematic assessment, prophylactic protection, fit optimization, rotation, and documentation—are transferable across settings [15].

Monitoring, Early Detection, and Escalation

Prevention of mask-related skin complications depends on the ability to detect early signs of tissue compromise and to respond before irreversible damage occurs. Monitoring should be systematic, documented, and integrated into the routine care of every patient receiving NIV. Skin assessment under the mask should be performed at regular intervals, with the frequency determined by the patient's risk profile and the intensity of NIV support. A scoping review of skin assessment frequency during noninvasive ventilation indicates that reported frequencies vary, but regular scheduled assessment is consistently recommended to enable early detection and timely escalation [16]. Many protocols recommend assessment every three to four hours and at least once per shift, with more frequent assessment in high-risk patients [16].

The assessment should include inspection of the nasal bridge, malar eminences, forehead, chin, and areas under the headgear, as well as palpation for warmth, induration, or tenderness. Erythema that does not blanch on pressure, persistent redness lasting more than one hour after mask removal, and any break in the skin should be documented and reported. The international clinical practice guideline for prevention and treatment of pressure ulcers and injuries provides a framework for staging, risk assessment, and preventive interventions that can be applied to mask-related pressure injuries [17]. Pain is an important early indicator of excessive interface pressure and should be assessed using a validated scale, such as the 0–10 Visual Analog Scale, at each skin assessment [7].

Escalation pathways should be established so that nurses can promptly communicate findings and initiate appropriate interventions. If erythema or stage 1 injury is detected, the frequency of skin assessment should be increased, the mask fit should be reassessed, a prophylactic dressing should be applied if not already in place, and interface rotation should be considered [17]. If a stage 2 or deeper injury develops, a wound care consultation should be obtained, and the feasibility of continuing NIV with an alternative interface or a protective dressing should be evaluated in collaboration with the respiratory team. Documentation of the lesion, the interventions implemented, and the patient's response is essential for continuity of care and for quality improvement [17].

Further Evidence on Dressings, Devices, and Special Populations

Additional evidence supports the use of customized silicone foam dressings in high-risk populations. A customized silicone foam dressing used as part of an NIV skincare bundle has been associated with a decrease in hospital-acquired pressure injuries in neonates without an increase in CPAP failure [18]. Silicone foam dressings offer pressure redistribution, moisture management, and friction reduction, and their use is recommended in high-risk settings. A retrospective evaluation of silicone foam dressings for the prevention of device-related pressure ulcers on the head reported reductions in device-related pressure ulcer prevalence after implementation, supporting the role of silicone foam in preventive programs [19]. These findings are particularly relevant for patients who require prolonged NIV or who have fragile skin, moisture accumulation, or limited ability to report discomfort [19].

Device-related guidance from hospital and professional organizations emphasizes the importance of selecting the correct device size, checking fit and skin at regular intervals, using prophylactic dressings for high-risk patients, and rotating devices when possible. The Minnesota Hospital Association's recommendations for respiratory device-related pressure injury prevention provide practical guidance that aligns with the nursing interventions described in this article [20]. Retrospective data on NIV device-related pressure skin injuries have reported an incidence of 15.4%, with the majority of lesions developing over the nasal

bridge, forehead, and ear; more than 80% of these injuries were classified as stage 1 and approximately 17% as stage 2 [21]. These data reinforce the need for early detection and for preventive strategies that begin at the initiation of NIV [21].

Pediatric populations require particular attention. Among children receiving long-term NIV, pressure ulcers occur mainly over the nasal bridge, followed by the nose and forehead, and the anatomical characteristics of the pediatric face increase the risk of mask-related injury [22]. A multicenter randomized controlled trial protocol comparing three devices for preventing skin damage during facial mask ventilation in acute respiratory failure—the 3PROSNIV trial—illustrates the ongoing effort to identify interfaces and preventive strategies that reduce facial skin injury while maintaining ventilation efficacy [23]. A scoping review of non-invasive ventilation interventions for skin injury prevention further supports a multifaceted approach that combines interface selection, prophylactic dressings, rotation, and systematic assessment [24]. Together, these sources indicate that prevention is most effective when device choice, skin protection, and nursing surveillance are integrated rather than applied in isolation [24].

Nutritional Considerations in Prevention and Healing

Nutrition is a modifiable risk factor for pressure injury development and a critical determinant of tissue repair capacity. Malnutrition and dehydration contribute to thinning of the skin, loss of subcutaneous fat, impaired immune function, and delayed wound healing, all of which increase the vulnerability of the face to mask-related damage. Low serum albumin, low body mass index, and poor nutritional intake have been associated with an increased risk of pressure ulcer development, and nutritional monitoring is a component of evidence-based prevention bundles [25]. Nurses play a key role in screening for malnutrition, coordinating with dietitians, monitoring oral intake, and ensuring that patients receiving NIV—who may have dysphagia, fatigue, or mask-related interference with eating—receive adequate nutrition through appropriate routes [25].

For adults with pressure injuries who are malnourished or at risk of malnutrition, clinical practice guidelines recommend providing approximately 30–35 kcal/kg of body weight per day and 1.25–1.5 g of protein per kg of body weight per day [25]. For patients with chronic obstructive pulmonary disease, a protein intake of 1.2–1.5 g/kg/day has been suggested, and nutritional support should be adjusted to the patient's underlying condition and metabolic status [25]. Nutritional support is not a substitute for mechanical pressure relief, but it strengthens the tissue's resilience and supports healing when damage does occur. Nutritional assessment should therefore be integrated into the preventive plan for every patient receiving NIV, particularly those with prolonged ventilation, poor oral intake, or pre-existing malnutrition [25].

Treatment of Established Skin Damage

When prevention fails and skin damage develops, nursing care shifts to wound management, protection of the damaged area, and, where possible, continuation of NIV with an alternative interface or protective strategy. The treatment of mask-related skin damage begins with accurate classification and assessment of the lesion, including its location, stage, size, type of tissue, presence of exudate, signs of infection, and associated pain [7]. The wound and surrounding skin should be cleaned at each dressing change with drinking water or medical saline solution, and debridement of devitalized tissue should be performed when indicated and when perfusion is adequate [17].

For superficial lesions, daily disinfection followed by application of a topical cream containing hyaluronic acid sodium salt has been used to support healing, and careful cleansing with diluted sodium hypochlorite solution followed by normal saline has been described in case reports [10]. The damaged area should be protected from further pressure and friction, and a change to a different mask cushion material—such as silicone or latex-free—may be necessary if contact dermatitis or allergy is suspected [4]. If the lesion is severe or if NIV cannot be continued without compromising the damaged skin, alternative respiratory support strategies should be considered in collaboration with the medical team. Pain management is an integral component of treatment; pain from the wound or from dressing changes should be assessed and treated appropriately, and the patient's comfort should be considered in every aspect of mask selection, fitting, and repositioning [17]. Psychosocial support may also be needed, because facial skin damage can affect body image, communication, and emotional well-being [17].

CONCLUSION

Skin complications associated with NIV masks are common, clinically significant, and largely preventable. The forces that produce these injuries—pressure, friction, shear, and microclimate disturbance—are inherent to the interface, but their effects can be modulated through skilled nursing care. The evidence supports a multifaceted preventive approach that begins with the selection of an appropriate interface and the achievement of an optimal fit, continues with the application of prophylactic

dressings in at-risk patients, and is sustained through scheduled skin assessment, interface rotation, microclimate management, nutritional support, and interprofessional collaboration. No single intervention is sufficient on its own; the most successful programs are those that bundle these strategies into a standardized, auditable care process and that empower nurses to recognize early signs of tissue compromise and to act on them promptly. As NIV continues to expand across care settings and patient populations, the prevention of mask-related skin complications must remain a central nursing priority—not merely to protect the skin, but to preserve the respiratory support that the skin enables.

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