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Patients' experiences with the application of medical adhesives to the skin: a qualitative systematic review

Hannelore Hofman ,[1] Tanja Duljic ,[2,3] Sara Johansson,[4] Jan Kottner ,[5] Lise-Marie Kinnaer,[1] Dimitri Beeckman,[1,3] Mats Eriksson [2]

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For numbered affiliations see end of article.

Correspondence to
Dr Mats Eriksson;
mats.h.eriksson@oru.se

ABSTRACT

Objectives Medical adhesives provide securement of medical devices, facilitate skin protection and allow non-invasive monitoring. Application and removal of medical adhesives can result in pain, dermatitis, trauma or other skin lesions. Understanding patients' experiences when subjected to medical adhesives will contribute to the improvement of clinical routines and the development and improvement of new adhesive technologies. A qualitative systematic review was conducted to identify patients' experiences with the application of medical adhesives to the skin.

Design Qualitative systematic review.

Data sources CINAHL, EMBASE, MEDLINE and PsycINFO were systematically searched for records published between January 2012 and March 2024. Reference lists of systematic reviews and included articles were reviewed.

Eligibility criteria Studies published in Danish, Dutch, English, German, Norwegian and Swedish that collected qualitative data on the experience of patients with the application of medical adhesives to the skin were considered. There were no restrictions regarding age, gender or setting.

Data extraction and synthesis Study selection, data extraction and quality appraisal were independently conducted by two reviewers. The methodological quality of the studies under consideration was assessed using the Joanna Briggs Institute Critical Appraisal Tool for Qualitative Research. The extracted data were synthesised using meta-aggregation.

Results Nine studies describing patients' experiences were included. The included studies only reflected experiences with wound dressings. Meta-aggregation of the extracted findings resulted in seven categories that were further synthesised into two synthesised findings: 'strategies to alleviate pain during dressing changes' and 'dressing construction and characteristics'. The synthesised findings illustrate that patients experience pain during dressing change and removal and employ various strategies to alleviate this pain.

Conclusions Patients experience pain and discomfort when dressings are changed or removed. Future research should focus on enhancing both routines and technologies, with a particular emphasis on advancing skin-friendly adhesives to reduce unwanted side effects.

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STRENGTHS AND LIMITATIONS OF THIS STUDY

⇒ Using meta-aggregation as a method for qualitative data synthesis ensures a comprehensive, systematic approach to summarising patients' experiences.
⇒ Though only four databases—MEDLINE, CINAHL, EMBASE and PsycINFO—were systematically searched, potentially limiting the comprehensiveness of this review, these are the largest and most relevant databases to the field.
⇒ This systematic review considered studies published in Danish, Dutch, English, German, Norwegian and Swedish, enhancing the comprehensiveness of this review and reducing the risk of language bias.
⇒ The study selection, data extraction and quality appraisal were performed in duplicate, which strengthens the reliability and minimises potential bias.

INTRODUCTION

Medical adhesives are defined as adhesives used in medical devices to establish and maintain contact with the body over a period of time (usually by application to the skin). They are a component of a variety of products, including bandages and dressings for wound care, ostomy supplies and patches, adhesive film or tape to secure various catheters, tubes and electronic devices (eg, adhesives used for securing ECG and EEG electrodes to the skin).[1 2] Medical adhesives are frequently used in an array of healthcare settings in all patient groups. From premature babies, who often require medical adhesives to secure nasogastric and ventilation tubes, to patients with an ostomy who frequently have to reapply the adhesive stoma products to their skin. In an acute care facility in the USA, a median of 3.00–6.25 adhesive products was used on the skin per patient per day.[3]

Patients may experience pain when changing the medical adhesive.[4 5] The patient's perception of pain is influenced by several factors such as mental and physical health conditions, previous negative experiences and types of medical adhesive used.[6]

Therefore, it has been recommended to perform a pain assessment at every dressing change.[7] Pain and discomfort can cause chronic stress, which might result in impaired wound healing.[8 9] Especially in children, pain can lead to emotional trauma and even post-traumatic stress,[10 11] which potentially results in avoidance of trauma reminders and negative moods or cognitions.[12] Pain is defined as 'an unpleasant sensory and emotional experience associated with, or resembling that associated with, actual or potential tissue damage'.[13] Activation of nociceptors in the epidermis sends signals about potential or actual tissue damage, which causes the experience of pain.[14] This starts an autonomic stress response, which includes heart rate elevation and metabolic changes. Stress exacerbates the pain experience.[14]

Skin damage can cause pain and discomfort in patients.[9 15–17] Application and removal of medical adhesives to the skin can lead to skin stripping, contact dermatitis, or allergic reactions that may manifest as inflammation associated with itching or pain. Adhesive-related skin injury can lead to infection, delayed wound healing and an increased risk of scarring.[2] Medical adhesive-related skin injury (MARSI) occurs when the adhesive material's adhesion to the skin is stronger than the adhesion between the skin's cells on removal. This leads to the separation of epidermal layers or the complete detachment of the epidermis from the dermis, observed as erythema, cuts and blisters.[7] Medical adhesive-related skin injuries can occur in any patient, but elderly patients and newborns are particularly susceptible.[18–20]

Despite the frequent use, medical adhesive-related injuries are rarely reported[7]. Previous studies have shown that nurses did not take action to prevent pain and skin tearing when carrying out dressing change.[17] Understanding the patient's experience with medical adhesives is crucial to determine the focus of further research, to establish policies and to raise awareness among healthcare professionals with the aim of minimising adverse effects and enhancing patient outcomes during the use of medical adhesives.

Therefore, this systematic review aimed to answer the following research question: 'What are patients' experiences with the application of medical adhesives to the skin?'

METHODS

This systematic review is reported according to the Enhancing Transparency in Reporting the Synthesis of Qualitative Research statement criteria.[21] Meta-aggregation was used to synthesise the results based on the guideline from the Joanna Briggs Institute (JBI).[22] This review is registered with the PROSPERO International Prospective Register of Systematic Reviews. The protocol of this review has been published previously.[23]

Search strategy and information sources

A two-step strategy was used to identify relevant studies. First, a systematic search in four electronic databases was conducted: CINAHL (accessed through the EBSCO interface), EMBASE (accessed through Elsevier), MEDLINE (accessed through the Ovid interface) and PsycINFO (accessed through the EBSCO interface). For the initial searches in MEDLINE, the concepts 'experience' (keywords include 'pain', 'dermatitis', 'itching', 'pruritus' and 'discomfort') and 'removal of dressings' (keywords include 'adhesive', 'bandage', 'dressing', 'adverse event', 'device deficiency', 'removal', 'change' and 'application') were used. The initial search strategy was customised for each electronic database (see online supplemental file 1). Second, the reference lists of relevant systematic reviews and included articles in this review were screened to identify additional studies that were not retrieved through the first strategy.

Eligibility criteria

Population and context

This review focused on patients who currently or in the past had medical adhesives applied to their skin. There were no restrictions regarding sex or age.

Phenomena of interest and study design

Studies were included in the review if they collected qualitative data on the experience of patients with the application of medical adhesives to the skin. Both qualitative studies and qualitative data from mixed method studies were considered.

Setting, language and time frame

There were no restrictions regarding settings. Articles published in Danish, Dutch, English, German, Norwegian and Swedish were considered. Due to continuous technological advances in the field of medical adhesives,[24–26] this review tried to focus on medical adhesives that are currently still being used in clinical practice by restricting the search period. Therefore, the initial search was conducted to identify records with a publication date between January 2012 and November 2022. The search was repeated in March 2024 to identify any additional studies.

Study selection, data collection and management

All databases underwent individual searches, and the retrieved records were then exported into Covidence software for systematic reviews (Veritas Health Innovation, Melbourne, Australia). Following this, duplicates were identified and subsequently eliminated. The screening of records was conducted independently by two reviewers (HH, TD). In case of disagreement, discussions were held until consensus was reached. If there was no consensus, a third member of the review team was consulted (ME or DB). First, the titles and abstracts of the records were screened against the inclusion criteria. In a second round, the full text of the selected articles was screened.

Table 1 Key concepts and terminology in meta-aggregation.

Key concept	Definition
Finding	A verbatim extract of the author's analytical interpretation of the results or data[22]
Illustration	A direct quotation of a participant's voice, fieldwork observation or other supporting data from the paper[22]
Unequivocal finding	Findings accompanied by an illustration that is beyond reasonable doubt[22 27]
Equivocal finding	Findings accompanied by an illustration lacking clear association with the finding and therefore open to challenge[22 27]
Unsupported finding	Findings that are not supported by the data[22 27]
Category	A brief description of a key concept arising from the aggregation of two or more like findings[22 27]
Synthesised finding	An overarching description of a group of categorised findings[22 27]

Assessment of methodological quality

The methodological quality of the studies under consideration was assessed independently by two reviewers (HH, TD). The JBI Critical Appraisal Tool for Qualitative Research was used.[27] In cases of disagreement, discussions were held among the reviewers to reach consensus about the methodological quality. If necessary, a third reviewer was involved to resolve remaining disagreements (DB).

Data extraction

From the included studies, (a) bibliographic information (lead author, year, title, journal, full citation) (b) study design and sample size, (c) patient demographics, setting and geographical context, (d) description of how the research findings are addressed in the article, (e) method of data collection, (f) method of data analysis, (g) context (product names/brands or type of material of medical adhesives investigated), (h) phenomenon of interest (experience of patients with the application of medical adhesives to the skin) and (i) findings and illustrations were extracted. Definitions of findings and illustrations in meta-aggregation are provided in table 1.

Data extraction was independently conducted by two reviewers (HH and TD), with any ambiguities addressed through discussion within the research team. Final data extraction was accomplished through reviewer discussions, ensuring consensus was reached. Another member of the research team (ME, DB) performed quality control of the extracted data on 20% of the included articles.

Data synthesis

Meta-aggregation was used to summarise the evidence. A level of plausibility was allocated to each extracted finding: unequivocal, equivocal and unsupported. Unsupported findings do not appear in the data synthesis.[22 27]

Meta-aggregation was completed according to the following steps: (a) each article was read repeatedly to extract all findings from the results and discussion section of the included studies, accompanied by an illustration; next, a level of plausibility was allocated to the extracted finding, (b) findings were summarised into categories based on similarity of concepts and (c) synthesised findings were derived from categories.[22 27] Category descriptions and synthesised findings were created by a consensus process among three members of the review team (HH, TD and DB), after repeated reading of the extracted findings.

Patient and public involvement

No patients were involved in the design or conduct of this systematic review.

RESULTS

Screening and search outcome

The literature search identified 5463 records. No additional records were identified through manual search. After removing duplicates, two reviewers (HH and TD) independently screened the title and abstract of 3102 articles using the software tool Covidence. The eligibility of 160 articles was assessed by screening the full texts. After full- text screening, 151 studies were excluded. In total, nine studies were included. The search and selection process is summarised in figure 1.[28]

Description of included studies

The included studies were published between 2013 and 2023. Five studies were conducted in the United Kingdom,[29–33] and one each in Turkey,[34] Brazil,[35] Ireland[36] and China.[37] Four studies adopted a phenomenological approach.[30 34 35 37] Seven studies used semistructured interviews, in-depth interviews or focus groups.

Various methods for data analysis were employed across these studies. Data collection was conducted either directly from patients or through proxies such as parents, healthcare providers or informal caregivers. Sample sizes across the studies varied, ranging from 7 to 150 participants. All medical adhesives used in the included studies were wound dressings. Table 2 provides a detailed overview of the study characteristics.

Assessment of methodological quality

The quality appraisal of the nine studies showed varying quality levels. All studies used suitable methodologies, but none addressed the researchers' cultural or theoretical background, and only one noted the potential influence of researchers on the outcomes.[36] To ensure a comprehensive synthesis of the existing evidence, articles were

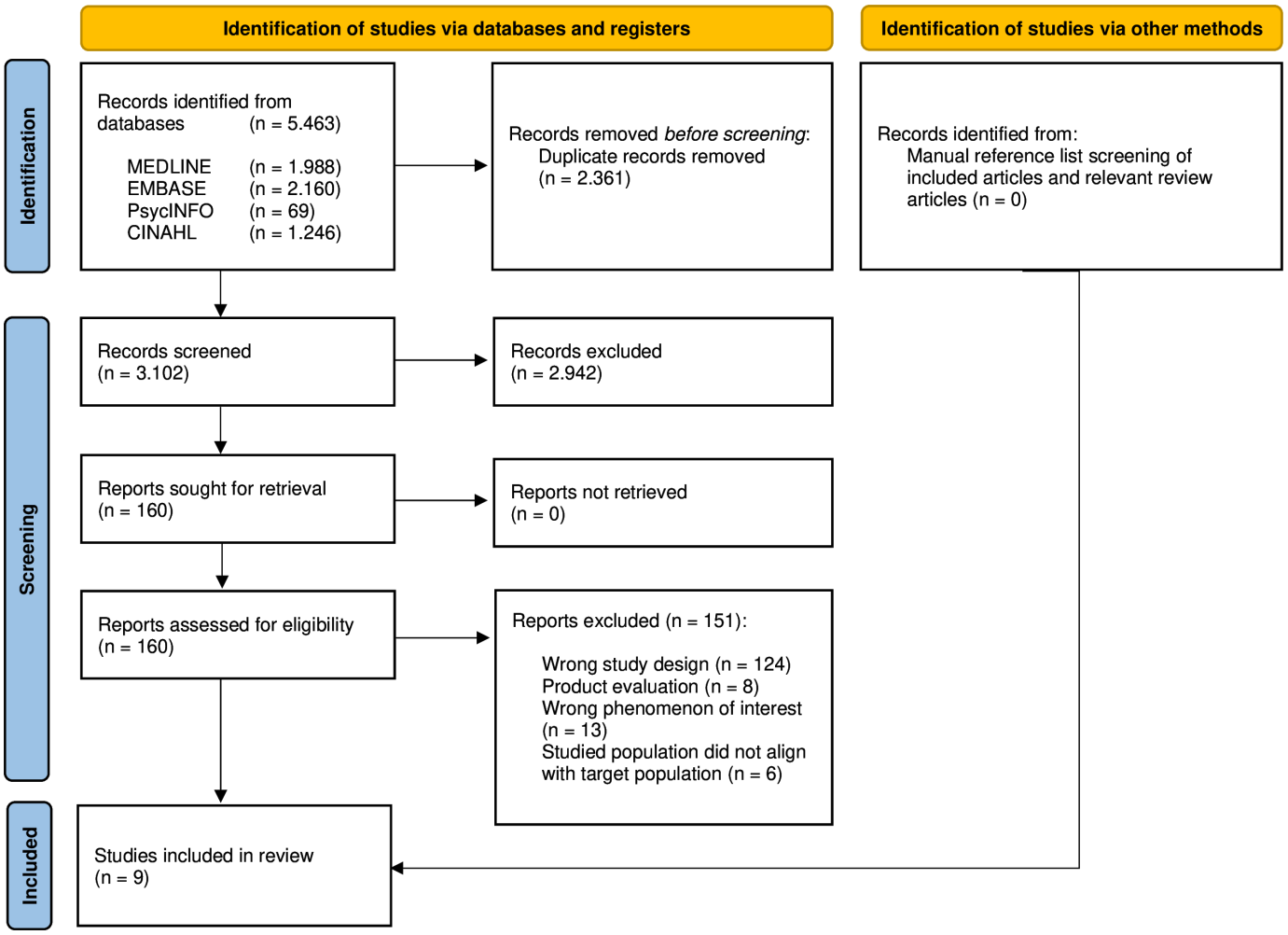

Figure 1 PRISMA flowchart. PRISMA, Preferred Reporting Items for Systematic Review and Meta-Analysis Protocols.

not excluded based on low quality. Online supplemental file 2 provides a detailed overview of the assessment of methodological quality.

Findings

Patients and healthcare providers reported that patients experienced pain during dressing removal and dressing changes.[30 32–34 36 37] From the 9 included studies, 43 findings were extracted after repeated reading of the text. 24 of the 43 extracted findings were supported by an illustration and were, therefore, allocated unequivocal or equivocal as level of plausibility. The supported findings were then aggregated into seven categories, based on similarity in meaning.[27] These categories were clustered further into two synthesised findings based on similarity of concepts: 'strategies to alleviate pain during dressing changes' and 'dressing construction and characteristics'. Table 3 provides an overview of the meta-aggregation of the extracted supported findings.

The category 'emotional response to pain caused by dressing changes' could not be clustered into any synthesised finding, since a synthesised finding has to consist of at least two categories.[22 27] Current or previous experiences of pain during dressing change can trigger an emotional response in patients. Healthcare providers described non-compliance with leg ulcer treatment in patients due to anxiety and anticipated pain based on previous painful experiences. *If you tell them we need to increase their visits they don't like it because obviously they know they're going to get pain … it kind of puts them off and then they become non-compliant.*[30] Patients reported that distraction by use of virtual reality (VR) gave them a sense of control over the situation, which resulted in a decrease in pain during dressing change. *Something as trivial as a video was actually quite empowering for me because I could take myself away.*[32]

Synthesised findings

Strategies to alleviate pain during dressing changes

The synthesised finding *strategies to alleviate pain during dressing changes* emerged from four categories: (a) 'analgesia is a strategy to alleviate pain during dressing changes', (b) 'VR is a strategy to alleviate pain during dressing changes', c) 'strategies to alleviate pain and suffering in children caused by dressing

Table 2 Characteristics of Included Studies

Author (year), country	Methodology/ design	Aim	Method of data collection	Method of data analysis	Participants	Setting	Experience reported by	Medical adhesive used
Bateman (2015), UK[29]	Product evaluation with a qualitative component	To gain insight into the patient's experience, especially in regard to patient choice of product.	Clinicians asking patients one close-ended question and asking them to provide comments to it	No formal data analysis reported (themes were formed from the comments)	Patients who were referred to a wound care service with low to high-exuding wounds (n=150)	Wound care service of an NHS trust	Patient	CutiMed Siltec B(order)—also CutiMed Siltec and CutiMed Siltec Plus were used in this study
Docking *et al*. (2018), UK[30]	No specific study design is mentioned	To explore the feasibility of the use of analgesic dressings in older adults with leg ulcers, including their perception of current pain management, feasibility of an analgesic dressing, and potential challenges.	Focus group interviews (n=2)	Framework analysis	Community nurses at the University of Greenwich, who attended a wound care class (n=15)	Nursing staff within the University of Greenwich	Proxy: nurses	Not reported
Elliott & Bluebelle Study Group (2017), UK[31]	Mixed-methods research; phase 1 included interviews	To produce a comprehensive list of potential issues relating to wound and dressing experience and practical management issues.	Semistructured interviews	Coding + method of constant comparison to derive themes from the data	Patients who had undergone, or were scheduled to undergo, an abdominal surgical procedure or caesarean section (n=39)	Two university-teaching NHS hospitals and three district NHS hospitals in the Southwest and Midlands regions of England	Patient	Varied between adhesive coverings (absorptive or non-absorptive) and tissue adhesive as a dressing (brands were not reported)
Furness *et al*. (2019), UK[32]	Small-scale qualitative usability study using a person-centred approach	To explore patient and staff perceptions of the impact and usability of active and passive virtual reality during painful dressing changes.	Semistructured interviews (patients) and focus groups (staff)	Semantic analysis for developing themes + constant comparative analysis	Adult inpatients at the local Burns Unit—individual interviews (n=5) and qualified nurses – focus group (n=3)	One local UK burns unit	Patient and proxy: nurses	Not reported
Grocott *et al*. (2013), UK[33]	Qualitative participatory research design	To identify unmet needs within the epidermolysis bullosa population in relation to wound dressings and to translate these needs into design concepts and novel products.	Workshop data enhanced by field notes collected during workshops, visits to participants in their homes or in hospital to observe dressing changes	Brainstorming workshop was to begin the creative and analytic process of formulating innovative design concepts. Findings from these sessions were fed back to the user group through subsequent workshops.	Patients with epidermolysis bullosa (A total of 4 workshops were held with numbers of participants ranging from 6 to 20)	Hospital epidermolysis bullosa clinics	Patient and proxy: Informal caregivers and clinical nurse specialists	Participants used a variety of products to hold the dressings in place such as bandages, tapes and elastic hosiery. (brands were not reported)

Continued

Table 2 Continued

Author (year), country	Methodology/ design	Aim	Method of data collection	Method of data analysis	Participants	Setting	Experience reported by	Medical adhesive used
Probst *et al*. (2023), Ireland[36]	Qualitative, descriptive design	To describe individuals' experiences for chronic wound-associated pain	Semistructured interviews (telephone interviews)	Thematic analysis following Braun and Clarke framework	Adults with chronic wounds who experience chronic wound-associated pain (n=13)	Community	Patient	'Dressing' and 'VAC dressing' (brands were not reported)
Roma *et al*. (2021), Brazil[35]	Qualitative, exploratory research	To understand the perception and attitude of parents of newborns admitted to a neonatal unit about their children's pain.	Semistructured interviews	Thematic analysis	Parents of 15 premature newborn babies with a gestational age of 24 to 36 weeks and chronological age of 8 days to 5 months and 3 days (n=20)	Neonatology Service (40 beds) of a university hospital	Proxy: Parents of newborn children	Tape (brands were not reported)
Unver *et al*. (2018), Turkey[34]	Qualitative, descriptive design (phenomenology)	To describe patients' pain experience, pain-coping skills and the effect of negative pressure wound therapy-related pain on daily life activities following abdominal surgery.	Semistructured interviews	Colaizzi's method of phenomenological data analysis	Patients receiving negative pressure wound therapy in the abdominal area for the first time (n=12)	Surgical ward of a university hospital	Patient	'Adhesive wrap' with foam dressing underneath (brands were not reported)
Wang *et al*. (2015), China[37]	Qualitative, exploratory design (phenomenology)	To investigate medical workers' understanding of current pain management during dressing among children with burns and their attitudes toward the application of 50% nitrous oxide in pain management.	Semistructured in-depth interviews	Content analysis and open coding	Doctors and nurses (n=7)	Burn centre of a tertiary hospital in Eastern China	Proxy: doctors and nurses	Not reported

Table 3 Overview of meta-aggregation of the extracted findings

Finding	Category	Synthesised finding
Patients who were provided anaesthesia before debridement and dressing changes reported they did not feel any pain. (UE)[34]	Analgesia is a strategy to alleviate pain during dressing changes	Strategies to alleviate pain during dressing changes
The majority of participants reported that pain is at its worst during dressing removal and changing. Patients therefore require pain relief that will last beyond the point of removal. (UE)[30]		
One of the strategies was to take painkillers as prescribed by the physician, even though they sometimes caused some side effects such as stomachache or illusions. (UE)[36]		
Many tissue viability nurses recommend that patients take additional analgesics prior to appointments for dressing changes. (UE)[30]		
Some participants indicated providing recommendations to their care network about research or dressings on managing wound-associated pain. (E)[36]		
Raising awareness about chronic wound-associated pain was another recommendation. Some participants highlighted the importance of immediately referring the wound patients to a pain manager if they mention having pain. (UE)[36]		
Medical workers agree that 50% nitrous oxide is applicable to dressing analgesia for children with burns. (UE)[37]		
A key factor in reducing pain and increasing tolerance of wound care seemed to be the degree of distraction created by VR. (UE)[32]	VR is a strategy to alleviate pain during dressing changes	
Patients were unanimous that they had achieved good levels of distraction (and no nausea) in the active VR. Some spoke of awareness of pain and of what the nurses were doing. (UE)[32]		
Without this distraction, normal behaviour involved being drawn to and focusing on the wound and wound care, which increased pain. Not watching meant reduced pain. (UE)[32]		
More than 10% of neonates hospitalised in the four units analysed in the survey, in 2011, did not receive any analgesia in the first three postoperative days. Alisson's speech drew attention to other painful stimuli. (UE)[35]	Strategies to alleviate pain and suffering in children caused by dressing changes	
Participants thought there was a large gap between the current situation and their expectations. They expected to perform dressing with children's cooperation under non-invasive analgesia. They expected better measures to reduce the pain during dressing. (UE)[37]		
For the pain suffered by children during dressing of burn wounds, all participants showed sincere sympathy: we provided a score of 0–10 to measure their degree of sympathy. All of them scored 10 (sincere sympathy). (UE)[37]		
The main causes of dressing change pain were swift wrap removal and the resulting traumatised skin. (UE)[34]	Procedures to remove dressings	
Nine participants specified having procedural pain and the pain level was influenced by their activities of daily living. (UE)[36]		
Dressing removal: 'I just completely soaked it [adhesive dressing] in the shower then my husband just took it off for me. But it was, it was really easy. Much easier than I thought.' (Patient, adhesive dressing)'. (UE)[31]		

Continued

Table 3 Continued

Finding	Category	Synthesised finding
Atraumatic application and removal, skin protection, good adherence with product remaining in place, comfort of product in place. (E)[29]	Characteristics of an atraumatic dressing	Dressing construction and characteristics
It is essential that a dressing designed for leg ulcers only impacts on the wounds itself. (UE)[30]		
Wound comfort (UE)[31]	Adverse reactions to the dressing	
Reactions to the dressing (UE)[31]		
Participants noted that the amount of exudate and associated odour and leakage meant dressings required frequent changes, which were painful and time consuming, also evidenced in the way that pain was described was the 'pain' experienced by the carers. (UE)[33]		
One of the key problems reported with treating leg ulcers was noncompliance by the patients, often related to their anxiety around anticipated pain. (E)[30]	Emotional response to pain caused by dressing changes	/
Most spoke of positive emotions in response to the VR. The active VR in particular was 'fun', 'challenging' and 'enjoyable' (various pts). Ns1 expressed surprise at participants' apparently pleasurable engagement with the technology. She spoke about "laughter," an outcome rarely associated with painful dressing changes. (UE)[32]		
Two described feeling they could control part of the otherwise passive and traumatic dressing change experience when using VR. Having control meant retaining one's 'humanity'. The sense of having some control over the situation, along with the distraction and reduced pain, helped some patients manage their own emotional responses to the experience. There was a sense of pride in her achievement of self-control in circumstances which could otherwise be experienced as shameful, humiliating, and disempowering. (UE)[32]		

E, equivocal finding; UE, unequivocal finding; VR, virtual reality.

changes' and (d) 'procedures to remove dressings' (table 3).

a) Analgesia is a strategy to alleviate pain during dressing changes

Analgesia and anaesthesia were described as strategies to alleviate pain during dressing changes.[30 34 36 37] Patients reported that being provided anaesthesia before the dressing changes reduced the experienced pain. *On the first changing, they made me sleepy (with narcotics) and I didn't feel anything then the wraps were taken off the skin. They didn't anaesthetize me the second time, and it was much worse.*[34] Healthcare providers similarly recommended patients to take additional analgesics prior to dressing change appointments in order to reduce pain during dressing,[30 36 37] even though they sometimes triggered side effects.[36] Some patients gave recommendations about research on dressings or pain management to their care network. *Olivia suggested focusing research on pain relieving dressings rather than drugs.* Some also indicated the importance of timely referral to a pain manager.[36]

b) VR is a strategy to alleviate pain during dressing changes

Additionally, utilising VR was described as a strategy to alleviate pain during dressing changes. The use of VR distracted patients from focusing on the wound care and accompanying pain during dressing change. *Before you were thinking, it hurts, because watching them do it makes it worse.*[32]

c) Strategies to alleviate pain and suffering in children caused by dressing changes

Parents and healthcare providers reported pain and suffering in neonates and children during dressing change.[35 37] *The day I most saw her crying in pain was when she removed the tape.*[35] Even though pain during dressing change is a known problem, healthcare providers reported a gap between the current situation and their expectations regarding strategies to alleviate pain during dressing change in children. Patients received too little or even no pain relief.[35 37] *Analgesics available for children are quite few, children with burns cry all the time during the dressing, and we need available drugs or methods to relieve their pain.*[37]

d) Procedures to remove dressings

Specific procedures for removal of dressings were described.[31 34] Unver *et al*[34] reported that swift removal of adhesives and the resulting skin trauma were the main causes of pain during dressing changes. Patients soaked the adhesive dressings in the shower to aid dressing

removal and reduce removal pain. *I just completely soaked it (adhesive dressing) in the shower then my husband just took it off for me. But it was, it was really easy. Much easier than I thought.*[31] Patients experienced procedural pain and indicated that activities of the daily living influenced pain levels. *Maybe sometimes with dressing changes, the worst pain I had was with the VAC dressing (Negative Pressure Wound Therapy).*[36]

Dressing construction and characteristics

The two categories (a) 'characteristics of an atraumatic dressing' and (b) 'adverse reactions to the dressing' have been synthesised on the basis that they both describe the constitution of the dressings used in the studies. This synthesised finding demonstrates that dressings should be designed in a way that facilitates easy removal and minimises discomfort during wear.

a) Characteristics of an atraumatic dressing

Atraumatic application and removal were described as a characteristic of an atraumatic dressing. *Those dressings helped my mum's legs in that they didn't hurt here when the nurse took them off.*[29] Additionally, skin protection of the peri-wound skin, good adherence and comfort during wear of the adhesive dressing were highlighted as features of atraumatic dressings. *Very important not to have them stuck on the area that has just been healed, and it is very difficult to take it off without hurting the wound again, and I think that is terribly important.*[29 30]

b) Adverse reactions to the dressing

To minimise discomfort during dressing wear, potential adverse reactions to dressings must be considered when choosing an adhesive dressing. Frequent dressing changes due to leakages caused by highly exudating wounds, were reported as very painful. *It is excruciating when the dressings keep coming on and off and she is in unbearable pain (reported by carer).*[33] Itching and allergic reactions to the adhesives used were also described as uncomfortable adverse reactions to an adhesive dressing. *I've now got really itchy where the plaster goes. Which is uncomfortable.*[31]

DISCUSSION

This systematic review aimed to synthesise patients' experiences with the application of medical adhesives to the skin. This systematic literature search only retrieved studies that included findings on wound dressings. No records reporting patients' experiences with other types of medical adhesives such as ECG electrodes, intravenous catheter patches, securement for medical devices, ostomy supplies et cetera were identified. All included studies in this review reported experiences with the changing and removal of dressings. No findings described patient experiences with the application and wear of adhesive dressing.

The results imply that patients experience pain and discomfort during dressing change and removal.[30 32–34 37] Awareness among healthcare providers is important since a single painful experience can change nociceptive pathways and induce sensitisation. This is a process that involves a reduction in the threshold of activation and an increased response rate to damaging stimulation.[38 39] Pain is a personal experience, influenced by biological, psychological and social factors to varying degrees.[13] A clinical tool predicting severe pain (Numeric Rating Scale ≥8) during wound dressing changes using clinically available wound and patient factors was developed.[40 41] Expected pain intensity ($p<0.001$; OR=1.50), resting pain intensity ($p<0.001$; OR=1.19) and type of dressing ($p<0.05$; OR 1.19 to 3.62) are significant predictors for experiencing high-intensity pain during wound care procedures (overfitting-corrected AUC=0.826). Sex, age, ethnicity chronic pain, opioid tolerance, anxiety, depression and pain catastrophising were not significant predictors.[41] Pain catastrophising is measured by using 'the pain catastrophising scale' and the term is frequently used since the factors included in the measurements are a comprehensive predictor of pain. However, this term is controversial since people with chronic pain have reacted negatively towards it as the term diminishes the importance of the medical reason behind their pain and focuses too much on psychological factors, which in the end can lead to insufficient care.[42] Through the use of neurological imaging, cortical and subcortical pathways have been identified that are activated when the patient expects pain. This is called anticipatory pain.[43] Patients experiencing anxiety in relation to anticipatory pain can develop a reduced pain tolerance and lead to an increased self-reported pain intensity, resulting in more painful future procedures.[40 43 44]

Along with describing experiences, patients and proxies describe the need for strategies to alleviate the pain and discomfort experienced during the application of dressings to the skin.[30–32 34 35 37] Both pharmacological and non-pharmacological interventions to alleviate dressing-related pain were described. Healthcare professionals describe the lack of an appropriate analgesic regimen for neonates needing their burn wounds dressed.[37] Many infants get too little or no pain relieving interventions despite the existence of validated pain assessment tools and recommended actions for pain management when conducting medical procedures. The recommendation for neonates is both pharmacological measures, such as acetaminophen, opioids and local topical agents, and non-pharmacological measures, such as breast feeding, skin-to-skin contact and sucrose solution together with non-nutritive sucking.[45] In addition, distraction by VR was described as a non-pharmacological intervention to reduce dressing change-related pain.[32] Immersive VR has been demonstrated to alleviate pain across various medical procedures, including dressing changes in patients with hand injuries.[46] For patients to take prescribed analgesics before dressing changes and for nurses to recommend patients to take analgesics before dressing changes was also part of the synthesised finding.[30 36] Recommended

pharmacological strategies for treating pain or breakout pain when changing dressings include increasing the dose of the analgesic already prescribed, adding another fast-acting pain medication or reducing the time in between doses.[47]

Health professionals should improve their communication with patients about the risks related to adhesive wound dressing use. They should try to minimise pain during dressing removal and the occurrence of MARSI.[7] It is important for health professionals to understand the unique characteristics of an adhesive wound dressing for informed decision-making regarding the selection of the dressing.[48] Dressing characteristics for atraumatic dressing removal were described in a few studies.[29–33] Patients with atraumatic dressings using a silicone contact layer applied to their skin report significantly lower pain scores ($p<0.01$) when compared with traditional adhesives (ie, adhesive foams, hydrocolloids and other dressings).[49] It is also important for health professionals to have knowledge about the skin as well as knowledge about application and removal techniques for adhesive wound dressings and medical adhesives in general to prevent unnecessary damage to the patient.[48] The barrier function of the skin can be damaged as a result of single or repeated application of adhesives, despite a reduction in adhesive strength during prolonged dressing wear.[50]

Methodological considerations

This review used meta-aggregation to synthesise the findings. No member of the research team had previous experience with this data synthesis method. Therefore, meta-aggregation was performed independently by two members of the research team (HH and TD). Extracted findings were synthesised to a higher level of abstraction until consensus was reached. When necessary, a third member of the research team (DB) was consulted.

The methodological quality of the included studies was assessed, but no studies were excluded for low quality. However, all studies lacked reflexivity regarding researchers' cultural and theoretical backgrounds, with only one study addressing the potential influence of the researchers on the outcomes. Methodological guidelines for qualitative research recommend that researchers reflect on their own position, biases and assumptions in their writings before and during the research process to minimise bias.[51] The lack of a statement on reflexivity in the primary studies may indicate bias, as readers of these articles are not informed about the authors' perspectives and prejudices regarding the concept of pain before they started the analysis process.

Strengths and limitations

The systematic review only included studies containing qualitative data to explore patients' experiences with the application of medical adhesives to the skin, which resulted in only nine eligible studies. Employing quantitative studies in addition to qualitative articles might have provided interesting insights into pain and discomfort scores of patients while adhesive dressings are being removed. Conducting a mixed-method review has several limitations, including difficulties in comparing results from these different paradigms and extending the time required to complete the review.[52]

For this review, only four databases were systematically searched. MEDLINE, CINAHL and EMBASE are among the largest and most relevant databases in the field of nursing science. PsycINFO primarily covers psychology, behavioural science and mental health. These databases were selected to ensure comprehensive coverage of primary studies containing qualitative data on patients' experiences with the application of medical adhesives to the skin. Their scope makes them the optimal choice for capturing the most relevant studies for the data synthesis.

Only studies published between January 2012 and March 2024 were considered. The initial search for this systematic review was conducted in November 2022, focusing on articles published between January 2012 and November 2022. The search was updated in March 2024 to capture any new publications on the topic of this review. In light of the ongoing advancements in medical adhesives and technological innovations,[24–26] this study aimed to focus on adhesives currently used in clinical practice. Additionally, during the last 10 years, pain research has advanced significantly.[13] Limiting the timeframe from January 2012 to March 2024 enabled incorporation of the latest knowledge and developments in the field.

The study characteristics of the included studies, such as age, setting and country, were heterogeneous. Since only a limited amount of findings could be extracted, it was not possible to identify potential cultural differences in the reported findings.

Studies that were published in languages other than Danish, Dutch, English, German, Norwegian or Swedish were not screened through the search strategy. This may have led to the exclusion of relevant articles published in another language.

Four of the included studies[30 32 34 37] did not specify the used dressing type or brand. No additional information on dressing type or brand was retrieved by contacting the authors. As a result, not all of the published information could be synthesised fully.

This systematic review describes patients' experiences with the application of dressings on various wound types: burn wounds,[32 37] chronic leg ulcers,[30] surgical wounds[31 34] and epidermolysis bullosa.[33] Pain can also be caused by tissue damage.[53] Reported experiences of pain and discomfort with the application of medical adhesives to the skin might consequently be obscured by wound pain.[36 41]

This study did not involve patients or the public in its conceptualisation, design or conduct. This qualitative systematic review is part of a larger research project, the TAPE research project, which consists of four phases. In the subsequent phases of this project, patients will be involved in refining the research objectives to ensure the concerns of patients who use medical adhesives are addressed.

Implications for research and clinical practice

Future research should focus on exploring routines to reduce unwanted side effects with medical adhesive use in clinical practice. This will guide improvement of adhesive technologies, the establishment of policies and raise awareness among healthcare professionals regarding the pain and discomfort related to medical adhesives application to the skin.

Pain and discomfort related to the application, presence and removal of medical adhesives are often overlooked. A lack of established policies and training exacerbates the issue. Pharmacological interventions designed to alleviate pain and discomfort related to the application, use and removal of medical adhesives often result in unwanted side effects. Non-pharmacological interventions offer alternatives but costs of necessary equipment, such as VR materials, may result in a limited availability. Establishing policies and raising awareness among healthcare professionals is needed.[5 17] This can be done through an educational effort as well as raising awareness on a higher level in the healthcare system, for example, questioning the materials being bought for hospital wide use. When cost is the deciding factor, it is important to evaluate whether different brands offer comparable adhesion and skin protection.

Future research should focus on enhancing both routines and technologies, with a particular emphasis on advancing skin-friendly adhesives to reduce unwanted side effects. Interviewing patients about their experiences and doing a narrative description of specific aspects of the dressing change process could be of value. Since medical adhesives are frequently used in all patient groups and the findings of this study indicate that patients experience pain when dressings are being removed, future qualitative research should explore patient experiences with other types of medical adhesives (ECG electrodes, intravenous patches, et cetera).

Future dressing development should focus on material science, cell biology an intelligent technology to develop multipurpose dressings that can further improve wound management.[54] In some cases, there will be a need for medical adhesives that adhere more strongly to the skin to prevent dislocation of life-saving medical devices such as endotracheal tubes and intravenous catheters in an intensive care setting.

CONCLUSION

The meta-aggregation performed in this study implies that patients do experience pain and discomfort when wound dressings are changed or removed. The synthesised findings of this review ‘strategies to alleviate pain during dressing changes’ and ‘dressing construction and characteristics’ can serve as a guide to improve clinical routines for adhesive dressing use, avoid pain and discomfort while changing adhesive dressings[4 5] and prevent emotional trauma and post-traumatic stress in children.[10 11]

Author affiliations
[1]Department of Public Health and Primary Care, University Centre for Nursing and Midwifery, Ghent University Faculty of Medicine and Health Sciences, Ghent, Belgium
[2]Faculty of Medicine and Health Sciences, School of Health Sciences, Orebro universitet, Örebro, Sweden
[3]Faculty of Medicine and Health Sciences, School of Health Sciences, Swedish Centre for Skin and Wound Research, Orebro universitet, Örebro, Sweden
[4]Creative Mammals, Gothenburg, Sweden
[5]Institute of Clinical Nursing Science, Charité Center for Health and Human Sciences, Charite—Universitatsmedizin Berlin, Berlin, Germany

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Contributors HH and TD contributed equally to this paper. All authors contributed to the conception of the research question and the writing of the protocol. HH, DB, SJ, JK, L-MK and ME contributed to the development of search strategies, eligibility criteria and methodology for data synthesis. All authors contributed to the draft protocol and approved the final version of the protocol. HH, TD and ME worked in duplicate to review the titles and abstracts of all materials obtained using the search strategy to exclude articles that do not meet the eligibility criteria. HH and TD evaluated potentially eligible studies through full-text screening and excluded non-eligible studies, documenting the reason for exclusion. HH and TD independently extracted data from the included studies. ME and DB checked the quality on 20% of the extracted data of the included articles. HH and TD synthesised the data and drafted the manuscript. All authors read, provided feedback and approved the final manuscript. ME is responsible for the overall content as guarantor.

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ORCID iDs
Hannelore Hofman http://orcid.org/0000-0001-5750-0346
Tanja Duljic http://orcid.org/0009-0007-8496-5609
Jan Kottner http://orcid.org/0000-0003-0750-3818
Mats Eriksson http://orcid.org/0000-0002-5996-2584

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Updated search date 2024-03-13 (initial search was made in March 2022-11-10)

Searchterms			Results
Pain			
	1	Pain/ or Acute Pain/ or Pain, Procedural/ or Pain Measurement/ or Pain Management/ or Pain Threshold/	
	2	(pain* or ache* or aching or distress* or suffer* or itch* or discomfort* or anxious or anguished or agony or agonising or anxiety).ab,kf,ti.	
	3	1 or 2	
Removal of dressings			
	4	Bandages/ or Bandages, Hydrocolloid/ or Occlusive Dressings/ or Adhesives/	
	5	Device Removal/	
	6	(remov* or redress* or chang* or select* or application* or cho?s* or apply* or "device deficienc*" or "adverse event*").ab,kf,ti.	
	7	5 or 6	
	8	4 and 7	
	9	((fastener* or adhesive* or tape* or taping or bandaid* or bandag* or dressing* or mucilage* or "sticky past*" or gum or latex or adherent* or adhering or seal*) adj4 (remov* or redress* or chang* or select* or application* or cho?s* or apply* or "device deficienc*" or "adverse event*")).ab,kf,ti.	
Combined Sets			
	10	8 or 9	
	11	3 and 10	3,586
	12	limit 11 to (yr="2012-01-01 -2024-03-13" and (danish or dutch or english or norwegian or swedish))	1,988

EMBASE via Elsevier
Updated search date 2024-03-13 (initial search was made in March 2022-11-10)

Searchterms			Results
Pain			
	1	'pain'/de OR 'pain measurement'/exp OR 'procedural pain'/de OR 'analgesia'/de	
	2	pain*:ti,ab,kw OR ache*:ti,ab,kw OR aching:ti,ab,kw OR distress*:ti,ab,kw OR suffer*:ti,ab,kw OR itch*:ti,ab,kw OR discomfort*:ti,ab,kw OR anxious:ti,ab,kw OR anguished:ti,ab,kw OR agony:ti,ab,kw OR agonising:ti,ab,kw OR anxiety:ti,ab,kw	
	3	#1 or # 2	
Removal of dressings			
	4	'bandages and dressings'/de OR 'adhesive tape'/exp OR 'adhesive bandage'/de OR 'crepe bandage'/de OR 'elastic adhesive bandage'/de OR 'tubular bandage'/de OR 'central line dressing'/de OR 'surgical tape'/de OR 'hydrocolloid dressing'/de OR 'occlusive dressing'/de OR 'adhesive agent'/de OR 'sealant'/de	
	5	'device removal'/de	
	6	remov*:ti,ab,kw OR redress*:ti,ab,kw OR chang*:ti,ab,kw OR select*:ti,ab,kw OR application*:ti,ab,kw OR cho$s*:ti,ab,kw OR apply*:ti,ab,kw OR 'device deficienc*':ti,ab,kw OR 'adverse event*':ti,ab,kw	
	7	#5 or #6	
	8	#4 and #7	
	9	(fastener* OR adhesive* OR tape* OR taping OR bandaid* OR bandag* OR dressing* OR mucilage* OR 'sticky past*' OR gum OR latex OR adherent* OR adhering OR seal*) NEAR/4 (remov* OR redress* OR chang* OR select* OR application* OR cho$s* OR apply* OR 'device deficienc*' OR 'adverse event*')	
	10	#8 or #9	
Combined Sets			
	11	#3 and #10	5,298
	12	#11 NOT 'conference abstract'/it AND ([danish]/lim OR [dutch]/lim OR [english]/lim OR [norwegian]/lim OR [swedish]/lim) AND [2012-01-01-2024-03-13]/py	2,160

PsycINFO via EBSCO
Updated search date 2024-03-13 (initial search was made in March 2022-11-10)

Searchterms			Results
Pain			
	S1	DE "Pain" OR DE "Acute Pain" OR DE "Pain Management" OR DE "Pain Measurement" OR DE "Suffering"	
	S2	TI (pain* or ache* or aching or distress* or suffer* or itch* or discomfort* or anxious or anguished or agony or agonising or anxiety) OR AB (pain* or ache* or aching or distress* or suffer* or itch* or discomfort* or anxious or anguished or agony or agonising or anxiety)	
	S3	S1 OR S2	
Removal of dressings			
	S4	TI ((fastener* or adhesive* or tape* or taping or bandaid* or bandage* or bandaging or dressing* or mucilage* or "sticky past*" or gum or latex or adherent* or adhering or seal*) N3 (remov* or redress* or chang* or selection* or application* or cho#s* or apply* or "device deficienc*" or "adverse event*")) OR AB ((fastener* or adhesive* or tape* or taping or bandaid* or bandage* or bandaging or dressing* or mucilage* or "sticky past*" or gum or latex or adherent* or adhering or seal*) N3 (remov* or redress* or chang* or selection* or application* or cho#s* or apply* or "device deficienc*" or "adverse event*"))	
Combined Sets			
	S5	S3 AND S4	131
	S6	S5 Limiters - Published Date: 2012-01-01-2024-03-13; Language: Danish, Dutch, English, Norwegian, Swedish	69

CINAHL via EBSCO
Updated search date 2024-03-13 (initial search was made in March 2022-11-10)

Searchterms			Results
Pain			
	S1	(MH "Pain") OR (MH "Pain, Procedural") OR (MH "Pain Management") OR (MH "Pain Measurement")	
	S2	TI (pain* or ache* or aching or distress* or suffer* or itch* or discomfort* or anxious or anguished or agony or agonising or anxiety) OR AB (pain* or ache* or aching or distress* or suffer* or itch* or discomfort* or anxious or anguished or agony or agonising or anxiety)	
	S3	S1 OR S2	
Removal of dressings			
	S4	(MH "Bandages and Dressings+") OR (MH "Tapes") OR (MH "Transparent Dressings") OR (MH "Adhesives")	
	S5	TI (remov* or redress* or chang* or select* or application* or cho?s* or apply* or "device deficienc*" or "adverse event*") OR AB (remov* or redress* or chang* or select* or application* or cho?s* or apply* or "device deficienc*" or "adverse event*")	
	S6	S4 AND S5	
	S7	TI (((fastener* or adhesive* or tape* or taping or bandaid* or bandag* or dressing* or mucilage* or "sticky past*" or gum or latex or adherent* or adhering OR seal*) N3 (remov* or redress* or chang* or select* or application* or cho#s* or apply* or "device deficienc*" or "adverse event*"))) OR AB (((fastener* or adhesive* or tape* or taping or bandaid* or bandag* or dressing* or mucilage* or "sticky past*" or gum or latex or adherent* or adhering or seal*) N3 (remov* or redress* or chang* or select* or application* or cho#s* or apply* or "device deficienc*" or "adverse event*")))	
	S8	S6 OR S7	
Combined Sets			
	S9	S3 AND S8	2,004
	S10	S9 Limiters - Published Date: 2012-01-01-2024-03-13; Language: Danish, Dutch/Flemish, English, Norwegian, Swedish	1,246

Supplementary Table: Assessment of Methodological Quality (JBI Critical Appraisal Tool: Checklist for Qualitative Research).

	Bateman (2015)	Docking et al. (2018)	Elliott & Bluebelle Study Group (2017)	Furness et al. (2019)	Grocott et al. (2013)	Probst et al. (2023)	Roma et al. (2021)	Unver et al. (2018)	Wang et al. (2015)
1. Is there congruity between the stated philosophical perspective and the research methodology?	NA	N	U	U	Y	Y	U	Y	Y
2. Is there congruity between the research methodology and the research question or objectives?	U	Y	Y	Y	Y	Y	Y	Y	Y
3. Is there congruity between the research methodology and the methods used to collect data?	Y	Y	Y	Y	Y	Y	Y	Y	Y
4. Is there congruity between the research methodology and the representation and analysis of data?	U	Y	Y	Y	Y	Y	Y	Y	Y
5. Is there congruity between the research methodology and the interpretation of results?	Y	Y	Y	Y	Y	Y	Y	Y	Y
6. Is there a statement locating the researcher culturally or theoretically?	N	N	N	N	N	N	N	U	U
7. Is the influence of the researcher on the research, and vice versa, addressed?	N	N	N	N	N	Y	N	N	N
8. Are participants, and their voices, adequately represented?	Y	Y	Y	Y	Y	Y	Y	Y	Y
9. Is the research ethical according to current criteria or, for recent studies, and is there evidence of ethical approval by an appropriate body?	N	Y	Y	Y	Y	Y	U	Y	Y
10. Do the conclusions drawn in the research report flow from the analysis, or interpretation, of the data?	Y	Y	U	Y	Y	Y	Y	Y	Y

Y = Yes; N = No; U = Unclear; NA = Not Applicable