SYSTEMATIC REVIEW

What is the evidence that there is antimicrobial resistance associated with the use of topical antimicrobial preparations?

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Abstract

Aims This review aimed to examine the effect of using topical antimicrobial preparations on antimicrobial resistance (AMR) by critically evaluating the currently available evidence.

Method Using systematic review methodology, we considered original research studies employing a prospective design and written in English. The search was conducted in July 2022 using Ovid MEDLINE, Ovid EMBASE Medline and CINAHL databases. Data were extracted using a pre-designed extraction tool and all included studies were quality appraised using the Evidence Based Literature (EBL) appraisal checklist.

Results A total of 375 studies were identified, with 25 meeting the inclusion criteria. Studies were conducted between 1998 and 2021. Half of the studies included explored the use of silver in dressings as an antimicrobial. Two studies were performed in a hospital setting, one study employed an in vitro and in vivo design, with all remaining studies employing an in vitro approach.

Conclusion There was limited evidence of the effect of topical antimicrobial preparations on AMR, with most included studies exploring the effectiveness of topical antimicrobials on infection and wound healing. AMR remains an important issue for exploration and understanding to clearly determine whether topical antimicrobials contribute to AMR.

Keywords AMR, infection, wound healing, wound care, topical antimicrobials

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Introduction

Antimicrobial resistance (AMR) refers to a process in which microorganisms undertake genetic adaptations and become resistant to treatment as a consequence of an overexposure to antimicrobial medications[1]. AMR infections, often transmitted through poor sanitation and inadequate infection control, are a major global problem to population health[1]. Further, AMR infections are responsible for approximately 700,000 deaths each year[2], with a trajectory to increase to an estimated 10 million deaths each year by 2050[3].

Managing the problem of AMR

Such is the magnitude of AMR that several national, international and global collaborative efforts have been established to manage and limit the future impact. The Tackling Antimicrobial Resistance 2019–2024 action plan[4] has a national strategic objective to tackle AMR and is focused on reducing the need for antibiotics, optimising the use of antimicrobials, reducing the number of healthcare-associated Gram-negative bloodstream infections, and reducing the number of specific drug-resistant infections in people by 10% by 2025. The Global Action Plan on AMR (GAP)[1] has a strategic approach on the appropriate use of antibiotics (including antibiotics and antifungals) in healthcare, and the ambition to reduce antimicrobial use in the UK by 15% by 2024 represents a key focus and challenge in healthcare[4].

In Australia, the *National Antimicrobial Resistance Strategy – 2020 and beyond* presents a 20-year national vision for managing the problem of AMR[5]. A core focus of the strategy is encompassing a holistic approach incorporating how AMR can be managed in humans, animals, food and the environment. Indeed, Australia's fourth report on antimicrobial use[6] projects that AMR will be responsible for over 10,000 deaths in Australia between 2015 and 2050. Furthermore, over 40% of people in Australia were prescribed an antimicrobial in 2019, with over 80% of people with acute bronchitis or acute sinusitis being prescribed antimicrobials inappropriately[6].

The problem of AMR can be demonstrated through evidence showing that a significant proportion of prescribed primary care antibiotics are unnecessary[7], perhaps driven by uncertainties around appropriate use[8]. Despite a recent fall in antibiotic-resistant bloodstream infections between 2019–2020 (from 65,583 in 2019, to 55,384), the UK Health Security Agency[9] report states that it is likely to be a reflection of behavioural societal changes, such as social isolation and increased hand hygiene as a consequence of the COVID-19 pandemic, rather than a reduction in infections per se, and infections still remain higher than 6 years previous. The World Health Organization (WHO)[10] further emphasise the financial burden associated with AMR and the urgent need to change antibiotic usage in order to prevent future treatments of infection and diseases being ineffective.

Topical antimicrobials

Antimicrobials include antibiotics, antiseptics and disinfectants and are substances that act to reduce or stop the development of microorganisms[11]. Topical antimicrobials are those substances that act directly on the skin to kill a microbe and are one of the most commonly prescribed antimicrobial treatments. Antimicrobials provide many advantages over other forms of antibiotic treatments, including ease of application, increased adherence to treatment, and reduced likelihood of side effects[12]. However, the evidence regarding the effectiveness in infection prevention of topical antimicrobial preparations has been inconclusive, and there is growing concern around AMR associated with topical preparations for infection prevention. For example, in a systematic review and meta-analysis of the available evidence on the prevention of uncomplicated wound infections by prophylactic topical antibiotics, Tong et al[13] concluded that topical antibiotics were only slightly more effective in reducing wound infections after surgical procedures than antiseptics – defined by the International Wound Infection Institute (IWII)[14] as "Non-selective agents that are applied topically in order to inhibit multiplication of or kill microorganisms. Prophylactic topical antibiotics may have a toxic effect on human cells. Development of resistance to antiseptics is uncommon". The authors further suggest that the latter should be encouraged as an alternative to topical antibiotics in preventing infection.

Another systematic review and meta-analysis examining the efficacy of topical antibiotics in preventing postsurgical wound infections in a dermatology outpatient setting found no difference between infection rates when using either topical antibiotics, or petrolatum or paraffin[15]. In addition, Heal et al[16] reported limited evidence that topical antibiotics prevent surgical site infection (SSI) compared to no antibiotic treatment, equating to 20 fewer SSIs per 1000 patients treated.

Evidence from comparative studies on topical antimicrobials have also reported mixed findings; in a study comparing the wound healing process when applying either a protectant Aquaphor Healing Ointment and Polysporin first-aid ointment after removal of *Dermatosis papulosa nigra* (DPN) lesions, Taylor et al[17] found no difference in wound healing rates and suggested that topical antibiotics are not essential for effective wound healing of such wounds.

The evidence surrounding the effectiveness and impact of topical antimicrobial wound dressings is lacking, and several studies have focused on the existence of antimicrobial resistant bacteria in silver wound dressings. For example, Panáček et al[18] found evidence that Gram-negative bacteria can become resistant to silver nanoparticles with repeated exposure. Hosny et al[19] found the existence of silver-resistant bacteria in a sample of 150 clinical isolates from burns and wounds, suggesting that effective wound healing does not need to be reliant on topical antimicrobial preparations.

Conversely, a systematic review of the literature found no evidence for the presence of bacterial resistance of silver-based wound dressings[20]. Wang et al[21] found no significant evidence to suggest that silver dressings promote wound healing and limited infection in chronic wounds any more than other types of wound dressings. Other evidence focusing on topical antimicrobials involving polyherbal formulations have demonstrated the positive impact on wound healing rates in healing diabetic wounds after repeated application and follow-up[22]. Mandrika et al[23] also found that the anti-inflammatory plant extracts consisting of

13 herbal ingredients with copper sulfate fortified in oil were most active against clinical strains of multidrug resistant bacteria, and suggested the evidence provides support for the use of various herbs in the use of polyherbal formulations for non-healing wounds. In a randomised controlled trial (RCT) of the effectiveness of honey in treating venous leg ulceration (VLU), Jull et al[24] found that at 12 weeks of being treated with either a honey-impregnated wound dressing (n=187) or standard care (n=181), there was no significant difference between groups.

Despite the problem of AMR, the currently available evidence pertaining the use of topical antimicrobial preparations on AMR is mixed. This systematic review with meta-analysis aimed to examine the effect of using topical antimicrobial preparations on AMR.

Methods

Criteria for considering studies for this review

This systematic review included original research studies employing a prospective design, written in English, which assessed the effect of using topical antimicrobial preparations on AMR. We excluded studies of a retrospective design, conference papers, opinion papers and qualitative methodology. There were no date of publication or study setting restrictions applied.

Outcomes

The primary outcome of interest was the incidence of AMR as a result of using topical antimicrobial preparations.

Electronic searches

The following electronic databases were searched to identify relevant literature:

- Cochrane Central Register of Controlled Trials (CENTRAL) (The Cochrane Library) (latest issue).
- Ovid MEDLINE (1946 to April 2022).
- Ovid MEDLINE (In-Process & Other Non-Indexed Citations) (latest issue).
- Ovid EMBASE (1974 to April 2022).
- EBSCO CINAHL Plus (1937 to search April 2022).
- PubMed.
- Scopus.

To identify further published, unpublished and ongoing studies, this systematic review:

- Scanned reference lists of all identified studies and reviews.
- Searched grey literature using OpenGrey (www.opengrey.eu).
- Searched research reports and dissertations.

The keywords used in the search included:

- Antimicrobial resistance OR
- AMR OR
- Topical antimicrobial OR
- Topical antimicrobial preparations OR
- Drug resistance

Study selection

The article titles were assessed by two authors (JB, PA) independently, and their abstracts (when available) were screened for their eligibility according to the criteria for considering studies for this review. The full-text version of potentially relevant studies was obtained and two authors independently screened these against the inclusion criteria. Where discrepancies were identified, a consensus between the two authors was reached through discussion.

Data extraction

Data from the retrieved articles were extracted and inserted into a data extraction table using the following headings – author, date of the study, setting and sample, intervention and results.

Data analysis and quality appraisal

Any meta-analysis was considered inappropriate due to the variation in study design and heterogeneity in the sample populations. Accordingly, the data were narratively summarised giving an overview of geographical location, study settings, sample sizes and results. This was followed by a structured narrative synthesis of each of the included studies based on the outcome measures. Each was then quality appraised using the Evidence Based Literature (EBL) appraisal checklist. This quality appraisal tool assesses the validity, applicability and appropriateness of each study based on four main steps of the research process: population; data collection; study design; results. According to this checklist, if the overall validity of the study (Yes/Total) is ≥75%, or (No + Unclear)/Total) is ≤25% then the study is considered valid.

Results

Overview of all included studies

Figure 1 depicts a PRISMA flow diagram of the results following the search and the subsequent removal of studies prior to synthesis[25]. Following reviews of a total of 375 hits, 342 were excluded. Following extraction of full texts, four of the remaining articles were rejected for not having relevant outcomes (Table 1). Finally, 25 articles were deemed to meet the inclusion criteria (Table 2).

Characteristics of studies

Geographical setting: The geographical location of the studies varied between the UK[30–35,50,51], the USA[36–44], Algeria[45], Eygpt[19], Slovakia[46], Iran[47], Sweden[48], India[23], the Czech Republic[18] and Australia[49].

Study settings: Two studies[32,41] were performed in a hospital setting. All other studies were laboratory-based.

Participants and sample size: Two studies used human participants in their design. Jørgensen et al[41] had a sample size of 129 patients and Michaels et al[32] had a sample of 213 patients.

Study design: Two studies[32,41] were performed in a hospital setting and utilised an RCT study design. One study employed an in vitro and in vivo design[44], with all remaining studies employing an in vitro approach

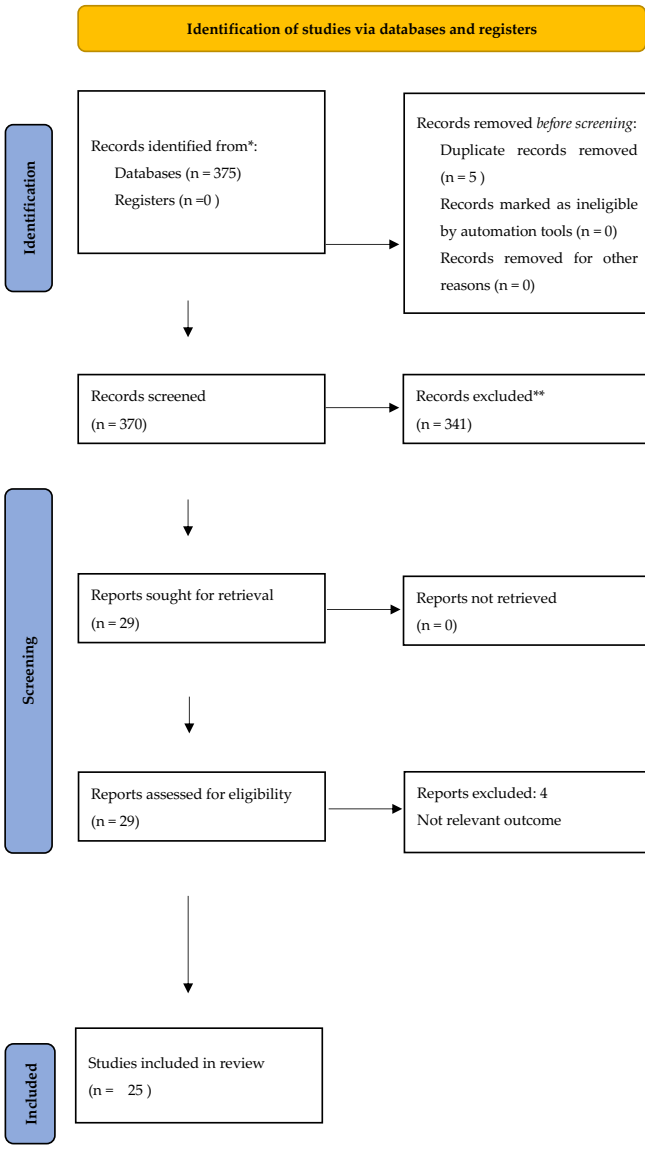

Figure 1. PRISMA 2020 flow diagram for study selection[25]

Primary outcome

Most of the included studies (50%) explored the use of silver in dressings as an antimicrobial[18,19,30,33,36,37,42–44,49,50,51]. From the papers explored, the use of silver as an antimicrobial were all in vitro. One study used both in vivo and in vitro[44].

One study found that there was not a correlate with the antibacterial activity (Parsons et al[30]). Exploration of the in vitro efficacy of previously identified silver-resistant clinical bacteria (*Klebsiella pneumoniae* and *Enterobacter cloacae*) against a variety of commercially available silver-based wound dressings was further investigated in one study. The authors found both silver-resistant strains were largely unaffected and exhibited phenotypic resistance, even when exposed to the high silver concentrations normally found in commercially available wound dressings. In another study, Castellano et al[43] reported that all silver dressings and topical antimicrobials displayed antimicrobial activity, and silver-containing dressings with the highest concentrations of silver exhibited the strongest bacterial inhibitive properties. In vitro tissue contact and antimicrobial activity was shown with a silver-containing Hydrofiber® dressing (HF-Ag) over a 48-hour contact period in the Bowler et al[50] study. In contrast, silver-containing foam dressings tested demonstrated areas of non-conformability which were associated with reduced antimicrobial activity. These in vitro studies confirm that both dressing conformability and silver availability to bacteria at the wound surface are critical to the optimum functioning of silver-containing dressings[30,43,50].

Loh et al[33] explored the prevalence of silver-resistance (sil) genes in methicillin-resistant *Staphylococcus aureus* (MRSA) and methicillin-resistant coagulase-negative Staphylococci (MR-CNS) isolated from wounds and nasal cavities of humans and animals, and also to determine the susceptibility of sil-positive and sil-negative MRSA isolates to a silver-containing Hydrofiber (SCH) wound dressing on planktonic silE-positive and silE-negative MRSA. Results confirmed that the SCH dressing was effective in killing all MRSA strains with and without the silE gene. In the Wright et al[42] study, silver was demonstrated to be effective at killing the antibiotic-resistant strains tested. The silver-coated dressing was particularly rapid at killing the tested bacteria and was effective against a broader range of bacteria.

Table 1. Excluded studies with reasons for exclusion

Author	Study title	Reason for exclusion
Percival et al[26]	Antimicrobial activity of silver-containing dressings on wound microorganisms using an in vitro biofilm model	Not relevant outcome
Chuangsuwanich et al[27]	Cost-effectiveness analysis in comparing alginate silver dressing with silver zinc sulfadiazine cream in the treatment of pressure ulcers	Not relevant outcome
Roth et al[28]	Effect of antiseptic irrigation on infection rates of traumatic soft tissue wounds: a longitudinal cohort study	Not relevant outcome
Morilla-Herrera et al[29]	Effectiveness of a hydrophobic dressing for microorganisms' colonization of vascular ulcers: protocol for a randomized controlled trial (CUCO-UV study)	Not relevant outcome

Table 2. Characteristics of included studies

Author / country	Setting	Sample size and study group	Study design
Parsons et al[30] • UK	Non-applicable	Silver and antibacterial activity in a simulated wound fluid model against in seven wound dressings.	In vitro
Bowler et al[31] • UK	Non-applicable	Analysis of the antimicrobial effect that silver-containing dressings has on a wound microbial model.	In vitro
Michaels et al[32] • UK	Hospital	213 patients: analysis of silver-donating versus non-silver dressings for VLU.	RCT
Loh et al[33] • UK	Non-applicable	Prevalence of silver-resistant genes in 33 MRSA and eight methicillin-resistant staphylococci (MR-CNS) samples	In vitro
Wesgate et al[34] • UK	Non-applicable	Susceptibility of biocide exposure and antimicrobial resistance in bacteria.	In vitro
Rippon et al[35] • UK	Non-applicable	Antimicrobial performance of a hydro-responsive wound dressing.	In vitro
Stoffel et al[36] • USA	Non-applicable	Five vitro biofilm models: comparison of commercial products containing topical antimicrobials.	In vitro
Norton & Finley[37] • USA	Non-applicable	Nine wound dressings: investigation of the efficacy of silver-resistant clinical bacteria against commercially available silver-based wound dressings.	In vitro
Tran et al[38] • USA	Non-applicable	Examination of effectiveness of a polyurethane foam wound dressing on bacterial activity in a mouse wound model.	In vitro
Percival et al[39] • USA	Non-applicable	49 antibiotic-resistant bacteria samples.	In vitro
Barillo et al[40] • USA	Non-applicable	Pure strains of 15 common burn pathogens efficacy of petrolatum-based gauze against burn pathogens using zone-of-inhibition.	In vitro
Jørgensen et al[41] • USA	Hospital	129 patients: effect of silver-release foam dressing with a foam dressing in VLU.	Multi-centre RCT
Wright et al[42] • USA	Non-applicable	Three types of topical silver applications.	In vitro
Castellano et al[43] • USA	Non-applicable	Comparison of the in vitro and in vivo effects of silver products on wound healing. Eight silver-containing dressings against three commercially available topical antimicrobial creams, a non-treatment control, and a topical silver-containing antimicrobial gel.	In vitro
Hiro et al[44] • USA	Non-applicable	Eight silver products were compared to determine fibroblast function and fibroblast mitochondrial activity. In vivo effects of nine silver products were evaluated utilising a rat model of contaminated wounds.	In vitro and in vivo
Ait Abderrahim et al[45] • Algeria	Non-applicable	Assessment of antimicrobial activity of Euphorbia honey and *Allium sativum* against pathogenic microbial strains in wounds in Wistar rats.	In vitro
Hosny et al[19] • Egypt	Non-applicable	150 clinical isolates from burns and wounds.	In vitro
Hajská et al[46] • Slovakia	Non-applicable	Growth of six multiple drug-resistant bacterial strains.	In vitro
Gholipourmalekabadi et al[47] • Iran	Non-applicable	Silver and fluoride bioactive glasses against drug-resistant bacteria from burns.	In vitro
Ronner et al[48] • Sweden	Non-applicable	Eleven strains of *Staphylococcus aureus.* Assessment of the binding capacity of multiple methicillin-resistant and methicillin-sensitive *S. aureus* (MRSA / MSSA).	In vitro
Mandrika et al[23] • India	Non-applicable	Investigation of the antibacterial and anti-inflammatory properties of crude hexane and ethanol extracts of JT formulations.	In vitro

Author / country	Setting	Sample size and study group	Study design
Panáček et al[18] • Czech Republic	Non-applicable	Non-applicable	In vitro
Malone et al[49] • Australia	Non-applicable	17 participants: comparison of cadexomer iodine against microbial activity from chronic non-healing diabetic foot ulcers (DFUs).	In vitro
Bowler et al[50] • UK	Non-applicable	Four in v itro wound models. Investigation of the antimicrobial activity of a silver-containing fibre dressing against bacteria.	In vitro
Cooper et al[51] • UK	Non-applicable	Investigation of topical honey resistance in two cultures of bacteria from *S. aureus* NCTC 10017 and *Pseudomonas aeruginosa* ATCC 27853 and four cultures from wounds.	In vitro

Two of the included studies explored the use of iodine. Malone et al[49] reported that the ability of cadexomer iodine to reduce the microbial load of chronic non-healing diabetic foot ulcers (DFUs) was complicated by biofilm. Stoffel et al[36] directly compared commercial products containing the commonly used topical antimicrobial agents iodine, silver, polyhexamethylene biguanide, octenidine, hypochlorous acid, benzalkonium chloride, and a surfactant-based topical containing poloxamer 188. The authors reported that the iodine and benzalkonium chloride-containing products were overall the most effective in vitro and were then selected for in vivo evaluation in an infected immunocompromised murine model. One paper explored the use of honey as an antimicrobial but did not explore the risk of AMR[45]. Two studies reported that there was no evidence to suggest topical antimicrobial is more effective than an antiseptic in infection prevention[42,47].

Quality appraisal of studies

The EBL appraisal checklist was used to assess the methodological quality of the included studies in this systematic review by focusing on the four main domains: population, data collection, study designs and results. The assessment of these domains is summarised in Table 3, where validity figures can be found as well as any not reported, or unclear issues identified in each domain[52]. The mean validity score for all studies was 92% (SD±0.02%). The minimum score was 89% whilst the highest overall validity was 95%. As can be seen in Table 3, all of the studies scored ≥75%, indicating that these studies were considered valid.

Discussion

This review has synthesised the findings of 25 studies exploring the use of topical antimicrobial preparations against AMR. The majority of studies focused on the effectiveness of such preparations in wound healing and infection prevention; there was limited evidence that the use of topical antimicrobials increase the risk of AMR. Half of the studies included explored the use of silver as an antimicrobial and examined comparisons between commercially available silver wound dressings or the presence of antimicrobial activity. The majority of studies utilised an in vitro design, with only two studies being performed in a hospital setting using an RCT study design with human participants; these had inconclusive findings. These two studies exploring the effectiveness of antimicrobial silver dressings in VLU[30,40] were inconclusive in their findings that antimicrobials were more effective than standard wound dressings.

The study by Wright et al[42] specifically explored the effectiveness of topical silver applications in eliminating antimicrobial resistant bacteria and found that all the products investigated were effective in reducing bacteria. However, it was also reported that antiseptics were effective in infection prevention, suggesting that topical antimicrobials may not be the most cost effective or beneficial method of infection prevention in wound healing. Gholipourmalekabadi et al[47] reported similar findings, also suggesting that the use of topical antiseptics in chronic wound care should be considered before antibiotics to limit their overuse and the risk of future resistance.

The study by Michaels et al[32] explored the use of silver-donating versus non-silver low-adherence dressings in the treatment of VLU in a sample of 213 patients using an RCT design and found no significant group differences between patients randomised to receive a silver donating wound dressing (n=107) or a non-adherent wound dressing (n=106). However, the study suffered from several methodological flaws that limit the validity of the research findings, including several patients being lost to follow-up, patients not receiving the correct allocated study group dressing, and some patients receiving different products to those originally included in the study protocol. Despite these limitations, Michaels et al[32] stated how increased cost associated with antimicrobial wound dressings and the lack of an obvious benefit in wound healing means there is limited benefit to their use. In contrast, Jørgensen et al[41] explored the effect of a silver-release foam dressing and a non-silver dressing for wound healing of VLU in a sample of 129 patients and found that patients receiving the silver-release foam dressing (n=65) healed significantly better than those who did not.

Other studies included in this review explored the bacterial properties of honey, iodine and plant extracts in effective wound healing[36,45,49] but specifically focused on the effectiveness of these topical antimicrobials in wound healing rather than if their use results in an increased risk of AMR. The limited evidence that there is AMR around the use of topical

Table 3. Analysis of EBL appraisal checklist domains

Author	Validity (%) of not reported/unclear issues identified in each domain				Overall validity (%) of study
	Population	Data collection	Study design	Results	
Parsons et al[30]	100%	88%: statistics free from subjectivity	100%	80%: future research recommendation	89%
Bowler et al[31]	100%	88%: statistics free from subjectivity	100%	80%: future research recommendation	89%
Michaels et al[32]	83%: low response rate	88%: instrument not included	100%	80%: future research recommendation	88%
Loh et al[33]	83%: informed consent obtained	100%	100%	80%: future research recommendation	91%
Wesgate et al[34]	100%	88%: statistics free from subjectivity	100%	80%: future research recommendation	89%
Rippon et al[35]	100%	88%: statistics free from subjectivity	100%	80%: future research recommendation	89%
Stoffel et al[36]	100%	100%	100%	80%: future research recommendation	95%
Norton & Finley[37]	100%	88%: statistics free from subjectivity	100%	100%	97%
Tran et al[38]	100%	88%: statistics free from subjectivity	100%	80%: future research recommendation	89%
Percival et al[39]	100%	100%	100%	80%: future research recommendation	95%
Barillo et al[40]	100%	88%: statistics free from subjectivity	100%	80%: future research recommendation	89%
Jørgensen et al[41]	83%: low response rate	100%	100%	80%: future research recommendation	91%
Wright et al[42]	100%	88%: statistics free from subjectivity	100%	80%: future research recommendation	89%
Castellano et al[43]	100%	88%: statistics free from subjectivity	100%	80%: future research recommendation	89%
Hiro et al[44]	100%	100%	100%	80%: future research recommendation	95%
Ait Abderrahim et al[45]	100%	100%	100%	80%: future research recommendation	95%
Hosny et al[19]	100%	100%	100%	80%: future research recommendation	95%
Hajská et al[46]	100%	88%: statistics free from subjectivity	100%	80%: future research recommendation	89%
Gholipourmalekabadi et al[47]	100%	100%	100%	80%: future research recommendation	95%
Ronner et al[48]	100%	100%	100%	80%: future research recommendation	95%
Mandrika et al[23]	100%	100%	100%	80%: future research recommendation	95%
Panáček et al[18]	100%	88%: statistics free from subjectivity	100%	80%: future research recommendation	89%
Malone et al[49]	83%: informed consent obtained	100%	100%	80%: future research recommendation	91%
Cooper et al[51]	100%	100%	100%	80%: future research recommendation	95%

antimicrobials is an important finding, particularly given the emphasis on tackling AMR and its potential impact[1].

Discussion of the methodological quality of the included studies

All studies presented with methodological issues in terms of the EBL appraisal checklist. In the population domain, the main areas of concern that arose in all studies were a lack of informed consent and poor response rate. In the data collection domain, the main aspects of concern were failure to use regularly collected statistics and to include the instrument. In the study design domain, all studies clearly describe this domain's elements. Finally, in the results domain, the main areas of concern related to future research recommendation. Despite these failings, the review has identified all studies as valid.

Limitations

A number of important limitations need to be considered. Firstly, only studies published in English were used to search for evidence. Secondly, the broad methodological heterogeneity of the studies prevented the comparison between studies. This heterogeneity meant that meta-analysis could not be completed for all of the outcomes of interest. Furthermore, six studies had funding/conflict of interest[29,32–34,38,47] whilst ten studies did not report whether they have funding[42] or a conflict of interest[28,31,36,37,39,41,42,46,48,51].

Conclusions

This review found limited evidence to suggest that topical antimicrobial preparations are associated with an increased risk of AMR. However, methodological differences between the studies and a focus on the effectiveness of topical antimicrobials in killing bacteria means that there was limited focus on cause and effect. AMR remains an important issue and, with the potential threat of AMR, understanding if, and how, topical antimicrobials may contribute to the problem of AMR is an essential area for exploration.

Key messages

- There is limited evidence that the use of topical antimicrobials increases the risk of AMR.
- This finding could be attributable to a focus on the effectiveness of topical antimicrobial preparations in wound healing and infection prevention.
- The majority of evidence surrounding the use of topical antimicrobials explores the use of silver in dressings as an antimicrobial.
- AMR and topical antimicrobials remains an important area of exploration.

Author contribution

All authors made significant contributions to the manuscript. All authors approved the final version prior to submission.

Conflict of interest

The authors declare no conflicts of interest.

Ethics statement

An ethics statement is not applicable.

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