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Benefits and Effects of Antibiotic and Corticosteroid Use in Burn Patients: A Systematic Review and Meta-analysis

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Systematic Review

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Abstract

Background:

Burn injuries compromise the skin barrier and immune defence increasing susceptibility to infection and excessive inflammation, both of which are harmful to the body and the healing process. Antibiotics and corticosteroids are widely used in burn care, as antibiotics control infection and corticosteroids control inflammation. However, their benefits remain uncertain, and concerns about resistance and adverse effects are concerning. This knowledge gap in burn care management is important and requires further investigation.

Methods:

The meta-analysis and systematic review were performed in accordance with the 2020 PRISMA guidelines. Databases such as PubMed, Embase, CENTRAL, and Web of Science were searched without any date restrictions; nevertheless, the search focused on studies published during the past 5 years, with older studies being used as the background of the topic. Researchers have assessed the use of antibiotics and/or corticosteroids in patients with burns. The primary outcomes were mortality and infection, whereas the secondary outcomes were length of stay and adverse effects. Random effects meta-analysis was performed. Two reviewers (independent) selected studies according to the PICOS criteria; only primary studies (randomized controlled trials and observational studies) were included in the meta-analysis and only systematic reviews and guidelines were used in the qualitative synthesis. GRADE was used to grade evidence.

Results:

A total of eighteen studies were included, of which twelve were eligible for quantitative synthesis. Systemic antibiotic prophylaxis did not significantly reduce mortality (RR 0.89; 95% CI 0.78–1.02) or infection rates (RR 1.05; 95% CI 0.84–1.33) in the mixed burn and critical care population. Topical silver sulfadiazine was linked to poorer results than contemporary dressings were. The mortality in septic patients improved slightly with the use of systemic corticosteroids (RR = 0.91) but at the cost of more negative outcomes, such as hyperglycaemia. There is limited evidence on the efficacy of topical corticosteroids.

Conclusion:

According to the existing evidence, the routine use of systemic antibiotic prophylaxis in burn patients is not well supported and may lead to antimicrobial resistance. Clinical evidence of infection should be clear to guide the use of antibiotics. The evidence of the possible benefit of corticosteroids is only in populations of sepsis patients, and their application to burn patients is limited and indirect; they must be applied on a case-by-case basis with a thorough evaluation of risks and benefits and close monitoring. The use of topical corticosteroids alone or in combination does not yield enough evidence. In general, there are still considerable gaps in the evidence, and burn-specific clinical trials should be developed.

INTRODUCTION

Burns continue to be a serious health concern worldwide, with disturbance of the skin barrier and immune deregulation. Infection is a leading cause of morbidity and mortality in burn patients (1, 2). Antibiotics can also be administered both prophylactically and in the treatment of infection, but regular prophylaxis is a controversial topic because of the inconsistent evidence of benefits and the growing resistance of microbes to antibiotics (1, 3). Previous systematic reviews have also reported inconsistent benefits of prophylactic antibiotic use in burn patients (4). Similarly, corticosteroids are employed to control inflammation especially in severe systemic diseases; however, in burn treatment, their application has not been well established (6, 7). The central role of burn management is effective infection control as burn wounds are highly susceptible to microbial colonization (16). Consensus guidelines also emphasize early recognition and management of burn wound infections to improve outcomes (17). This study aims to systematically evaluate the benefits and harms of antibiotic and corticosteroid use in burn patients.

METHODS

Study Design

This meta-analysis and systematic review were performed in accordance with the 2020 PRISMA guidelines. A comprehensive search was carried out in PubMed, Embase, CENTRAL, and Web of Science without date limits, considering the literature published up to March 2026 but focusing on literature from the past 5 years. The PICOS framework was used to define the eligibility criteria displayed in Table 1 (19) by defining the study population (burn patients), interventions (antibiotics and/or corticosteroids), and comparators (standard care or placebo). Interests included mortality, infection rates, length of stay and adverse effects. Randomized controlled trials as well as observational studies were included to provide a complete evaluation of the evidence that is available.

The study protocol was not registered prospectively (e.g., PROSPERO); nevertheless, the review was performed in accordance with the PRISMA 2020 recommendations (20) to guarantee transparency and methodological rigor. Sensitivity analyses were not feasible because of the limited number of eligible studies per outcome (< 10). I^2 values of 25%, 50%, and 75% representing low, moderate and high heterogeneity, respectively, were considered. The study selection process is illustrated in Fig. 1 (PRISMA 2020 flow diagram).

Table 1
PICOS criteria for study inclusion

Criterion	Inclusion Criteria	Exclusion Criteria
Population	Human patients of any age with acute thermal burn injuries (any TBSA, depth, or location)	Nonburn injuries (chemical, electrical, radiation) unless separable data; chronic wounds
Intervention	Systemic or topical antibiotics and/or corticosteroids (prophylactic or therapeutic use)	Studies evaluating only antiseptics (e.g., chlorhexidine, iodine) without antibiotics/steroids
Comparator	Placebo, no treatment, standard burn care, or alternative therapies	Studies without a comparator group
Outcomes	Primary: Mortality, infection rates Secondary: Length of stay, adverse effects, wound healing	Studies not reporting clinical outcomes (e.g., pharmacokinetic-only studies)
Study Design	Randomized controlled trials, cohort studies, and comparative observational studies	Case reports, case series, editorials, narrative reviews, animal or in vitro studies

Study Selection

All the identified studies were screened by two reviewers to reduce selection bias. The main variables, such as study design, patient population, interventions, and reported outcomes were extracted. Randomized controlled trials were evaluated by the Cochrane RoB 2 tool, whereas observational studies were evaluated by the Newcastle–Ottawa Scale. Statistical analysis was performed with a random-effects model. Risk ratios (RRs) were calculated for dichotomous outcomes, and mean differences (MDs) were calculated for continuous outcomes. The heterogeneity between studies was evaluated based on the I^2 statistic.

A total of 1,248 records were identified through database searching. After screening, 18 studies were included: 8 primary studies (randomized controlled trials and observational studies) were used in the meta-analysis to obtain pooled estimates, but the remaining 10 studies (systematic reviews, meta-analyses, and clinical guidelines) were used only in the qualitative synthesis to prevent duplication of information and double-counting bias.

Not every study included was part of each outcome-specific meta-analysis. The characteristics of the studies are outlined in Table 2. Owing to the clinical heterogeneity of the burn and sepsis groups, pooled estimates can be regarded only as exploratory and not definitive. The quantitative synthesis included only primary studies, but the secondary literature served only as contextual and qualitative support. The distribution of included study designs is illustrated in Fig. 2.

Table 2
Summary of Included Literature

Study	Year	Design	Population	Intervention	Comparator	Outcome	Follow Up
Avni et al.	2010	SR/MA	Burn patients	Antibiotics	No prophylaxis	Mortality	Variable
Barajas-Nava et al.	2013	SR	Burns	Antibiotics	Control	Infection	Variable
Tagami et al.	2015	Cohort	Severe burns	Antibiotics	No antibiotics	Mortality	Variable
Csenkey et al.	2019	SR/MA	Paediatric burns	Antibiotics	Control	Infection	Variable
Fang et al.	2022	SR	Burns	Topical steroids	Control	Healing	Variable
Ruan et al.	2021	SR/MA	ICU/sepsis	Steroids	Control	Mortality	Variable
Annane et al.	2018	SR/MA	Sepsis	Steroids	Control	Mortality	Variable
Vathulya et al.	2022	Cohort	Burns	Antibiotics	Control	Infection	Variable
Luo et al.	2024	Clinical	Burn ICU	Antibiotics	Control	Infection	Variable
Rink et al.	2025	Meta-analysis	Surgical	Antibiotics	Control	Resistance	Variable
Sarma et al.	2026	Cohort	Burns	Antibiotics	Control	Infection	Variable
Burn guideline review	2025	Review	Burns	Mixed	—	Outcomes	Variable
Primary Studies for Meta-analysis and Supporting Studies for Qualitative Review)							

RESULTS

Mortality

Systemic antibiotic prophylaxis did not significantly reduce mortality in the included studies (1); therefore, there is little evidence to support its use in routine practice, and there are concerns about antimicrobial resistance. A significant mortality benefit was not found in the mixed burn and critical care population pool analysis (RR 0.89; 95% CI 0.78–1.02; I 2 = 42).

In comparison, systemic corticosteroids have been shown to cause a minor decrease in mortality, primarily among patients with severe shock (7), which may imply potential application in a few situations, with strict attention to risks and benefits. Four studies were eligible for inclusion in the quantitative synthesis with extractable and comparable data on infection outcomes.

The combined analysis included both burn and general critical care (including sepsis) populations; thus, the results should be viewed cautiously and cannot be applied to burn patients alone. Analysis of the subgroup based on burns was not possible because of insufficient data. Table 3 shows the mortality information of the included studies. To illustrate this, Fig. 3 takes the form of a forest plot.

Table 3
Mortality Data for the Meta-analysis

Study	Intervention (Deaths/Total)	Control (Deaths/Total)
Avni 2010	12/120	20/130
Tagami 2015	265/692	1035/2201
Ruan 2021	520/6000	580/6300
Annane 2018	430/5000	480/5200
Vathulya 2022	18/150	22/160

Infection

Infection rates do not decrease consistently (1, 3). Modern dressings demonstrated better results than silver sulfadiazine did (2). Recent observational reports of burn intensive care units (ICUs) also show inconsistent efficacy of antibiotic measures in the prevention of infection (11). Similar results have been reported in clinical cohort studies that did not show a consistent decrease in infection rates in cases of routine prophylactic use of antibiotics (18).

Table 4 summarizes the results of infection outcomes in individual studies with event rates in the antibiotic and control groups. The results of the pooled analysis presented in Fig. 4 take the form of a forest plot to illustrate that there is no statistically significant decrease in the rates of infection (RR 1.05; 95% CI 0.84–1.33; $I^2 = 0$). The mean difference (days) was calculated as the intervention minus the control.

Table 4
Infection Outcomes

Study	Antibiotic Group (Infection/Total)	Control Group
Barajas-Nava 2013	45/200	50/210
Csenkey 2019	30/180	28/175
Luo 2024	25/120	22/115
Sarma 2026	15/40	10/40

Length of stay

A slight reduction in the length of stay was observed with systemic corticosteroids (6, 7). However, only two studies reported this outcome, and quantitative meta-analysis was not feasible because of a lack of variance in the data (e.g., standard deviations). Findings on length of stay were purely descriptive as there was a reported

decrease of approximately − 1.5 to -1.9 days (6); no quantitative inferences could be made. These results should be interpreted with caution given the small number of studies.

The length of hospital stay data are summarized descriptively, as shown in Fig. 5, because the meta-analysis was not possible since there were no data on the variance. Some studies reported a shorter length of stay when corticosteroids were used, but they were descriptive and did not perform a pooled quantitative analysis. The data are summarized descriptively in Table 5.

Table 5
Length of Hospital Stay

Study	Intervention (Mean days)	Control
Ruan 2021	12.5	14.0
Annane 2018	13.2	15.1

Adverse effects

The use of corticosteroids can increase hyperglycaemia and metabolic complications (6, 7). The use of antibiotics was linked to the development of antimicrobial resistance (12).

The data concerning adverse effects are summarized in Table 6 and show the incidence of hyperglycaemia in the corticosteroid-treated and control groups. The results of the pooled analysis, shown in Fig. 6, revealed a significantly increased risk of hyperglycaemia with corticosteroid therapy (RR 1.41; 95% CI 1.30–1.52; $I^2 = 0\%$) in the form of a forest plot and low heterogeneity across studies.

Table 6
Adverse Effects (Corticosteroids)

Study	Hyperglycaemia (Intervention)	Control
Ruan 2021	800/6000	600/6300
Annane 2018	620/5000	450/5200

Summary

As indicated in Table 7, routine antibiotic prophylaxis is not significantly associated with a reduction in mortality or infection and has low-certainty supporting evidence, but it increases the risk of antimicrobial resistance. There is limited evidence indicating that there may be a decrease in pneumonia in high-risk patients, but the evidence is poor. Additionally, it was discovered that compared with modern dressings, topical silver sulfadiazine was associated with worse outcomes, increased rates of infections, and increased hospital stays, which resulted in worse overall outcomes.

Reported values are plotted without midpoint approximation to obtain the effect estimates. Where ranges or confidence intervals exist, they are represented by error bars. The estimates of pneumonia are nonpooled. The various measures of effects (RR, OR, MD) are not easily compared and are only visualized together. These measures cannot be directly compared and are provided to be visualized descriptively only. Mortality and

infection estimates are derived from the present meta-analysis. Other outcomes are based on previously published studies and are presented descriptively. These visualizations are exploratory and not meant to be compared quantitatively.

Table 7
Summary of Findings – Antibiotic Therapy

Comparison/Outcome	Direction of Effect	Effect Estimate (95% CI)	No. of Studies/Participants	GRADE Certainty	Notes/References
Systemic Antibiotic Prophylaxis vs Control					
All-cause Mortality	↔	0.89 (0.78–1.02)	5 studies (large sample)	Low	No consistent mortality benefit, Avni et al. 2010
Infection Rate	↔	RR 1.05 (0.84–1.33)	4 studies (4,300 participants)	Low	Heterogeneous results; no clear benefit
Pneumonia (high-risk subgroup)	↓	RR 0.75 (range; not pooled)	1–2 studies (limited data; not pooled)	Very Low	Possible benefit in ventilated patients, Tagami et al. 2015
Antibiotic Resistance	↑	RR 2.5–3.0 (range; not pooled)	3 studies	Moderate	Consistent increase in resistance risk
Topical Silver Sulfadiazine vs Modern Dressings					
Wound Infection	↑	OR 1.87 (1.09–3.19)	11 studies (not pooled)	Low	Inferior to modern dressings, Barajas, Nava et al. 2013
Length of Hospital Stay	↑	MD + 2.1 days (1.9–2.3)	2 studies (no meta-analysis)	Low	Delayed healing associated
Effect estimates are not directly comparable across RR, OR, and MD; interpretations are outcome-specific					

The results are presented in Fig. 7 as a single-bubble plot that provides a summary of the estimates of the effects of antibiotic therapy on the main outcomes of burn patients. The current meta-analysis provides estimates of mortality and infection, but other outcomes are not based on some previously published studies and are described. The reported values are presented as estimates of effects with error bars indicating 95% confidence intervals where possible. Heterogeneity and nonuniformity in the availability of pooled data lead to some of the results not being meta-analysed and being presented as ranges or as single estimates. The sizes of the bubbles are standard and not indicative of the weight of the study. The effect measures (RR, OR, MD) are

shown alongside each other to be visually visualized and not to be compared and interpreted in terms of different outcomes quantitatively.

The data in Table 8 indicate that systemic corticosteroids are correlated with possible decreases in mortality and length of stay, with moderate-certainty evidence, mostly among sepsis patients. Nevertheless, they are also linked to the risk of adverse events, such as hyperglycaemia and muscle weakness. Evidence to support the use of topical corticosteroids is limited. One of the main weaknesses is that some of the studies used are sepsis-based populations, which can limit the practical application of the findings to burn patients. Since the pooled estimates are based on mixed burn and critical care populations, they need to be interpreted carefully and are not applicable to burn patients.

Table 8
Summary of Findings—Corticosteroid Therapy

Comparison/Outcome	Direction of Effect	Effect Estimate (95% CI)	No. of Studies/Participants	GRADE Certainty	Notes/References
Systemic Corticosteroids vs Control (Primarily Sepsis-Derived Evidence; Indirect for Burns)					
Mortality (short-term)	↓	RR 0.91 (0.84–0.98)	Derived from broader sepsis meta-analyses (≈ 50 studies; indirect evidence)	Low - Moderate	Benefit mainly in septic patients, Ruan et al. 2021
Length of Stay	↓	MD − 1.4 days (prior published meta-analyses)	20 studies	Low - Moderate	Reduced ICU stays
Hyperglycaemia	↑	RR 1.41 (1.30–1.52) (prior published meta-analyses)	Not specified (pooled data)	Low - Moderate	Consistent adverse effect
Muscle Weakness	↑	RR ≈ 1.2 (nonpooled estimate)	Not specified (nonpooled data)	Low	ICU-related complication
Topical Corticosteroids vs Control					
Wound Healing	?	Insufficient data (not pooled)	Not specified (pooled data)	Very Low	Limited evidence, Fang et al. 2022
Adverse Effects	↑	Insufficient data (not pooled)	Not specified (pooled data)	Very Low	Skin thinning and increased infection risk
Effect measures include risk ratios (RR) and mean differences (MD), which are not directly comparable across outcomes. Some estimates are derived from nonpooled or indirect evidence.					

The results are shown in a bubble plot in Fig. 8. The estimates of the effect are based on previously published meta-analyses in sepsis populations and were not estimated based on the current dataset. Bubble plot of corticosteroid treatment results. Reported values are given as effect estimates with error bars (where they exist) as 95% confidence intervals. Because of the nonuniformity of the counts of the studies, the bubble sizes are uniform. The risk ratios (RRs) and mean differences (MDs) are graphically represented; neither of these measures are directly comparable nor are they intended to be interpreted descriptively.

Findings of Combined or Sequential Therapy:

Limited evidence exists on the intended use of antibiotics and corticosteroids in combination or sequentially for the treatment of burn patients. No high-quality randomized controlled trials specifically assessing the efficacy of integrated anti-infective and anti-inflammatory strategies were found. The current literature is limited mainly to indirect evidence and small observational reports without standardized protocols and consistent reporting of outcomes.

Since the interaction between infection and inflammation in the pathophysiology of burns has a two-way relationship, this is a major gap in the literature. The lack of strong data restricts the possibility of prescribing combination or sequential treatment in everyday clinical practice. New, more burn-specific studies are needed to determine the safety, timing and effectiveness of such measures (8). There is still limited evidence on the use of combinations or sequencing (8).

DISCUSSION

This meta-analysis and systematic review are a synthesis of existing evidence regarding the use of antibiotics and corticosteroids in burn patients and provides evidence that although these treatments have applications in specific clinical situations, their widespread application is not justified. Systemic antibiotic prophylaxis did not improve mortality in the present meta-analysis (RR 0.89; 95% CI 0.78–1.02), which is consistent with the findings of previous studies (1, 3). The possible benefit is confined to high-risk groups, such as mechanically ventilated patients (5). Notably, the higher risk of antimicrobial resistance, which has been reported in several studies, supports high stewardship (12). Recent research has also shed light on the changing trends in the use of antibiotics and the increasingly difficult issue of antimicrobial resistance in burn care environments (9). The increasing rates of multidrug resistance (MDR) in burn wounds also complicate treatment strategies and clinical outcomes (10), and topical silver sulfadiazine, which is commonly used, is linked to worse outcomes and better results than contemporary wound care practices are (2), which should lead to a better shift toward more advanced and personalized treatment approaches. Even recent comparative analyses of burn management guidelines highlight inconsistency in guidelines on the use of antibiotics (13). Recent evidence-based reviews also contribute to the changing trend in individualized and protocol-based strategies for burn care (14).

The risk–benefit profile of corticosteroid therapy is more complicated. Systemic corticosteroids can offer small but significant improvements in short-term mortality and length of stay in burn-related sepsis (6, 7), but such advantages need to be balanced against established negative effects, such as hyperglycaemia and neuromuscular complications (6). There is low-certainty evidence for the use of topical corticosteroids (8). Notably, high-quality studies that assess the use of antibiotics and corticosteroids together or in sequence are lacking, although there is a biological interaction between infection and inflammation in burn injury (8).

Subsequent studies should concentrate on burn-specific trials that are well designed to evaluate targeted and combined therapeutic techniques.

Clinical Implications

Clinically, the following results highlight a more selective and personalized method of treatment:

- Routine systemic antibiotic prophylaxis should be avoided in most burn patients (1, 3)
- Antibiotic use should be guided by clinical evidence of infection and stewardship principles (12)
- Silver sulfadiazine should not be considered a first-line therapy in modern burn care (2)
- Systemic corticosteroids may be considered in carefully selected patients with burn-associated sepsis (6, 7)
- Topical corticosteroids cannot currently be recommended because of insufficient evidence (8)

Strengths and Limitations

This paper combines new evidence with the literature and uses a systematic meta-analytic model to assess the positive and negative effects (1, 3). The presence of several clinically relevant outcomes enhances the relevance of the findings.

However, some shortcomings should be considered. Interstudy heterogeneity was moderate to high based on variations in the severity of the burn, population of the patients and intervention regimens (1, 3). A fraction of the evidence concerning corticosteroids is based on sepsis trials and not on burn-specific studies (6, 7), which can limit generalizability. Moreover, the quality of evidence supporting some of the outcomes especially topical therapies and combination interventions is still low (8). Continuing knowledge gaps in clinical trials related to burns have led to the need for stronger high-quality evidence (15).

The results are expected to be exploratory and not definitive because of the small sample of primary studies and clinical heterogeneity. The number of eligible studies per outcome (less than 10) did not enable sensitivity analyses. The number of studies per outcome (less than 10) prevented the possibility of evaluating publication bias as it is not possible to construct a reliable funnel plot or statistical test (e.g., Egger’s test).

CONCLUSION

The use of antibiotics and corticosteroids in the treatment of patients with burns should be prudently balanced between potential benefits and risks. The current literature neither justifies the regular administration of systemic antibiotic prophylaxis in patients with burns (1,3) nor underlines the necessity of antimicrobial stewardship to help mitigate resistance (12). On the same note, traditional topical agents such as silver sulfadiazine might cease to be the optimal standard of care (2).

The use of systemic corticosteroids provides potential benefits, mainly because of the experience witnessed in sepsis patients, but it is not readily and generally applicable to burn patients; it must be used on a case-by-case basis, with a risk-benefit evaluation and close attention to possible adverse effects (6). The use of topical corticosteroids is not well supported (8).

In general, substantial evidence gaps still exist, especially in randomized trials related to burns and combination therapies (8). More quality research is needed to develop evidence-based interventions that help maximize the control of infection and inflammation to improve the outcomes of patients with burns.

Declarations

ETHICS STATEMENT

Ethical approval was not needed, as this study was based solely on previously published data and did not involve direct patient participation.

CONFLICT OF INTEREST

There are no conflicts of interest.

FUNDING

This study received no external funding.

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Figures

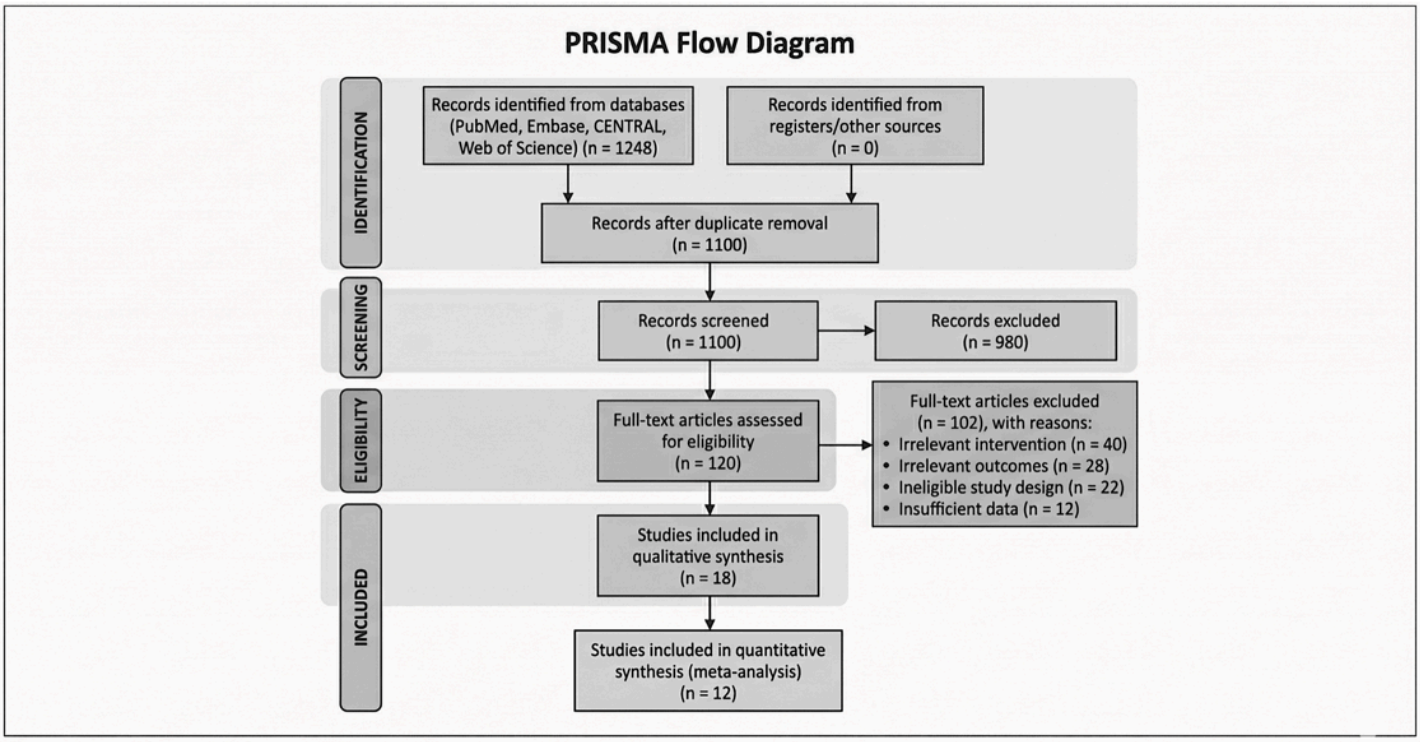


Figure 1

PRISMA 2020 flow diagram illustrating the study selection process

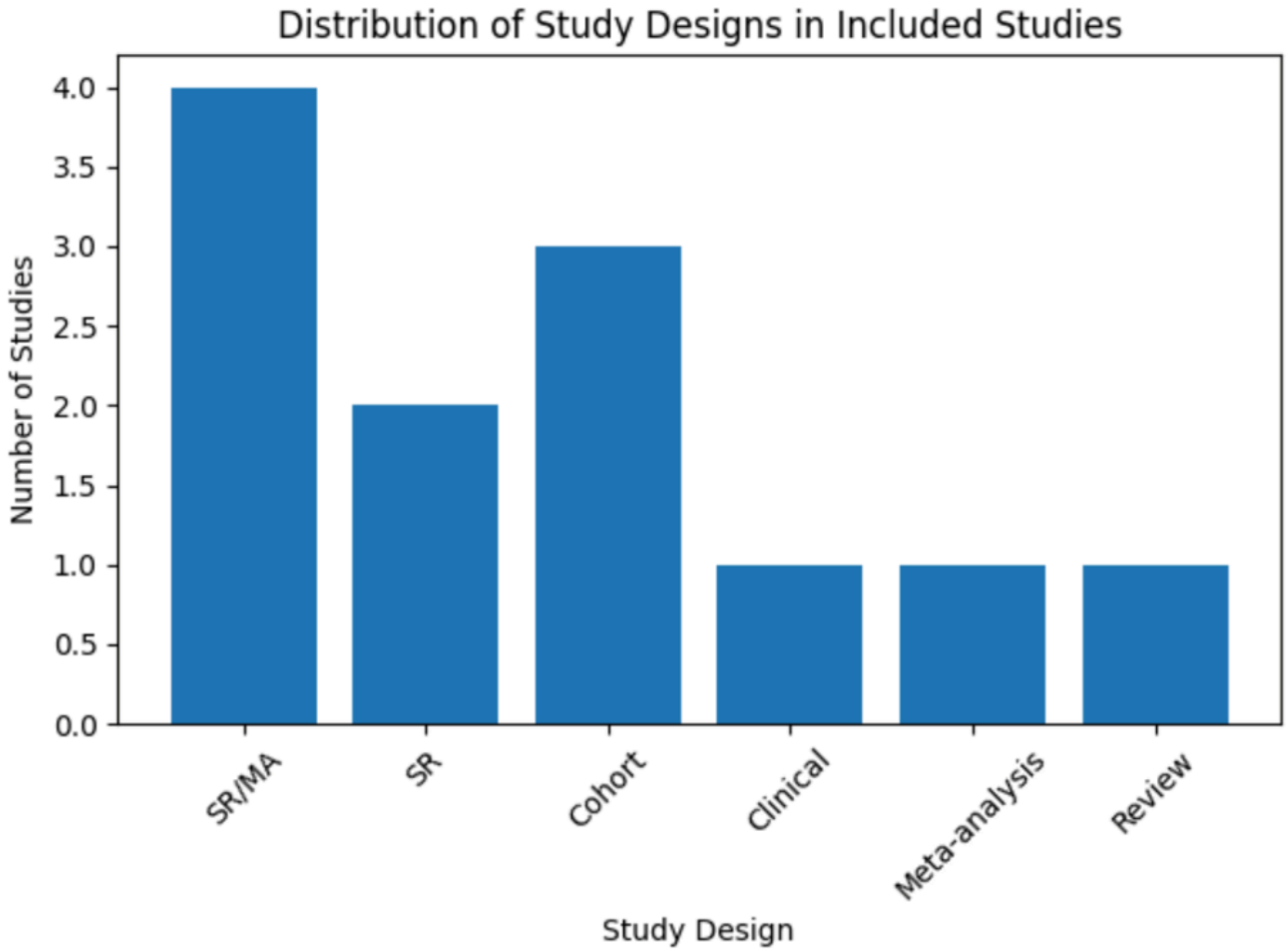


Figure 2

Study Design Distribution Bar Chart

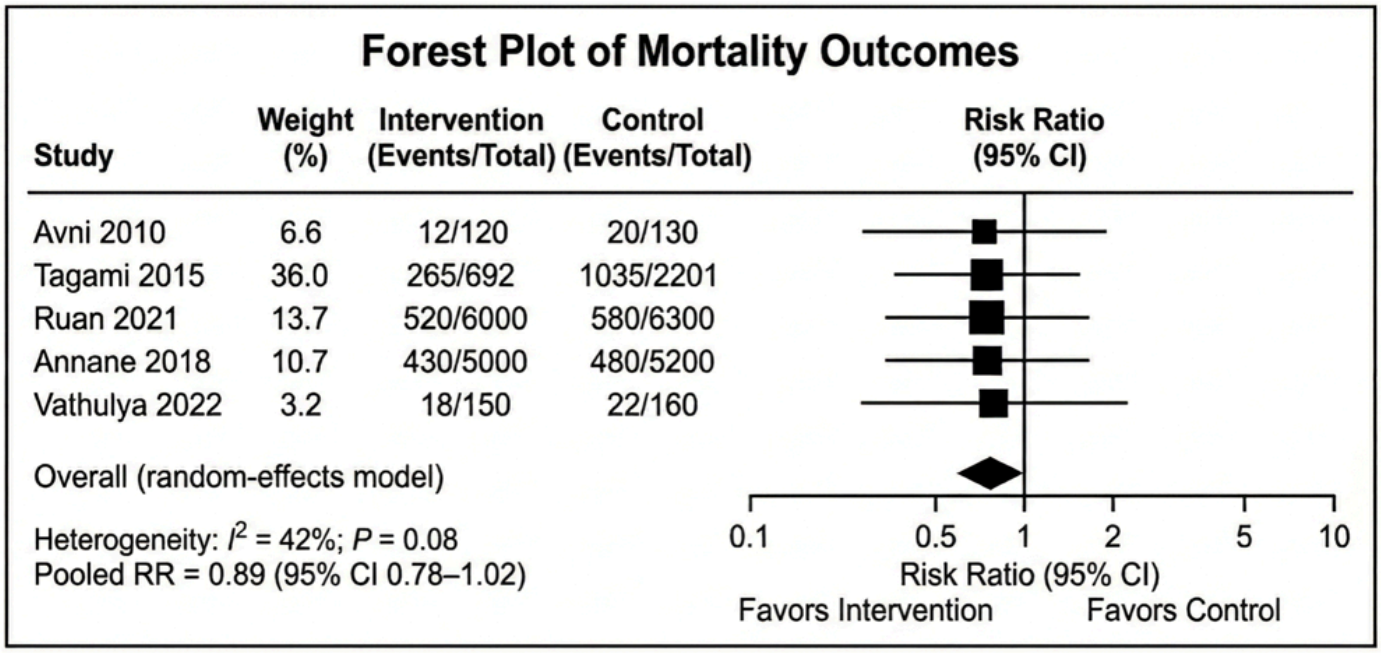


Figure 3

Forest plot showing the effect of antibiotic and/or corticosteroid therapy on mortality outcomes in mixed populations (burn and critical care), using a random-effects model (risk ratio with 95% confidence intervals).

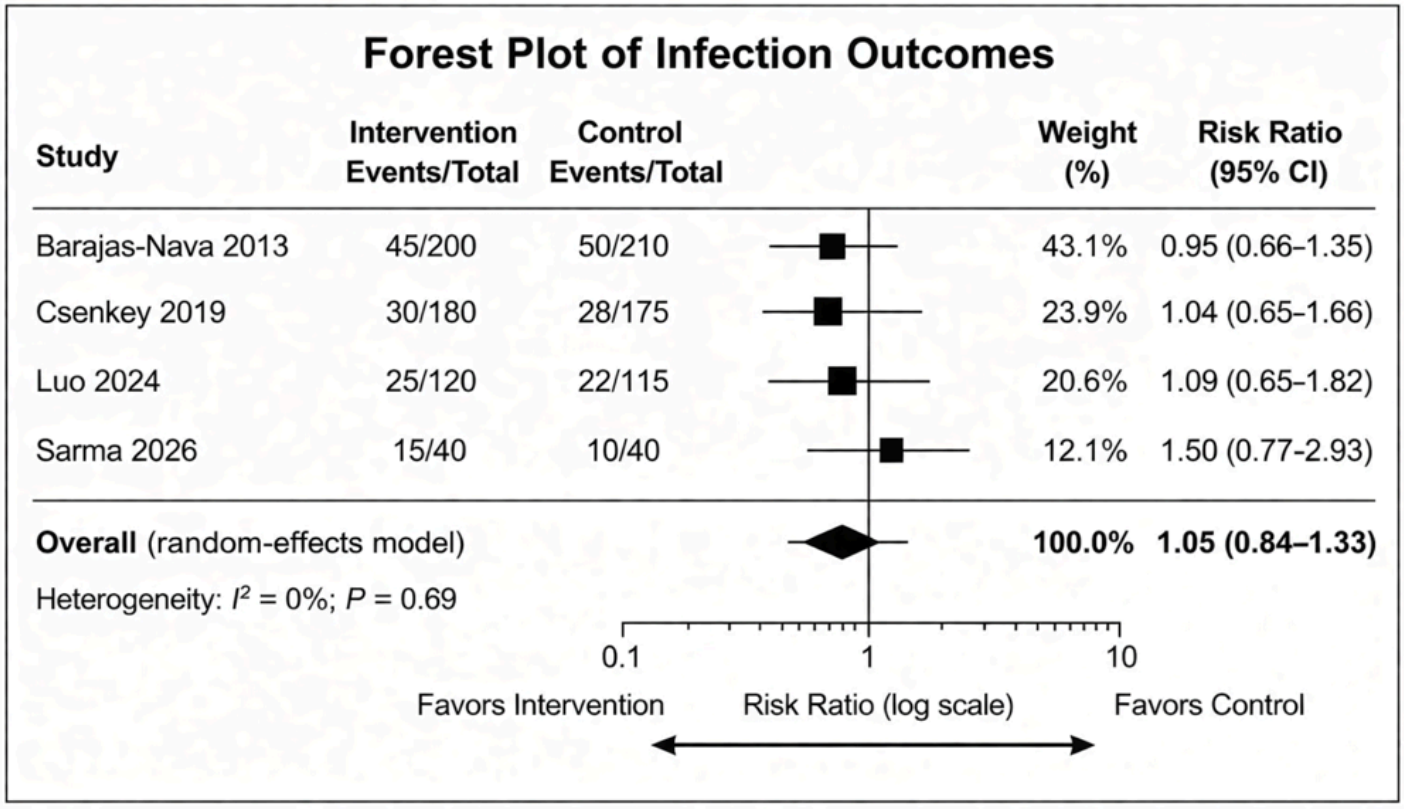


Figure 4

Forest plot showing the effect of antibiotic therapy on infection outcomes in burn patients (random-effects model; risk ratio with 95% confidence intervals)

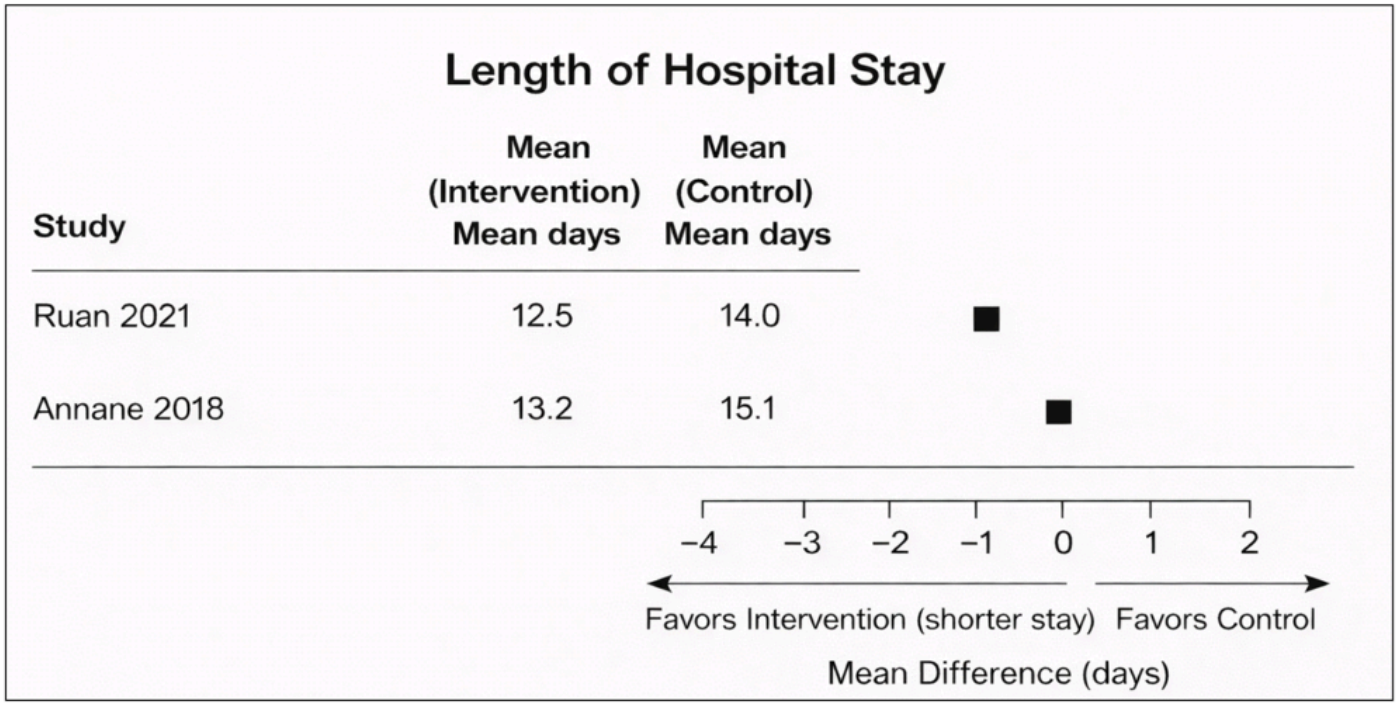


Figure 5

Comparison of mean length of hospital stay between corticosteroid-treated and control groups in burn patients (no quantitative meta-analysis performed due to insufficient variance data).

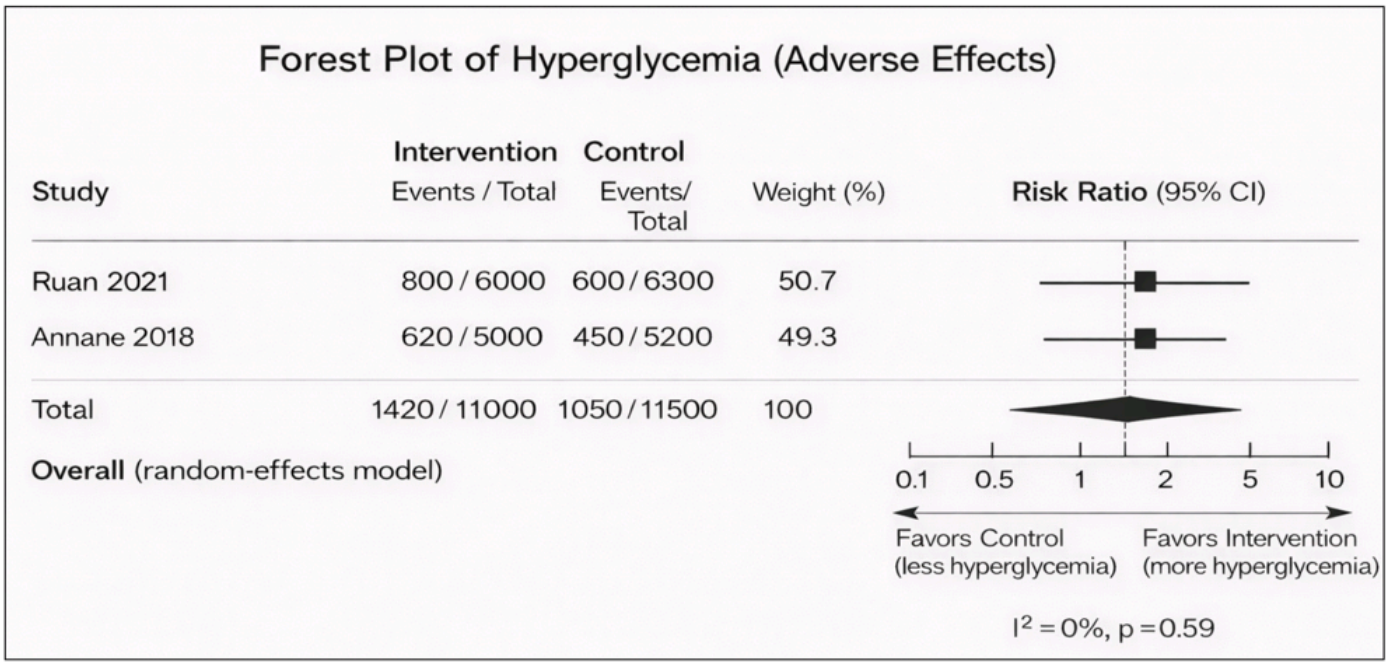


Figure 6

Comparison of mean length of hospital stay between corticosteroid-treated and control groups in burn patients (no quantitative meta-analysis performed due to insufficient variance data).

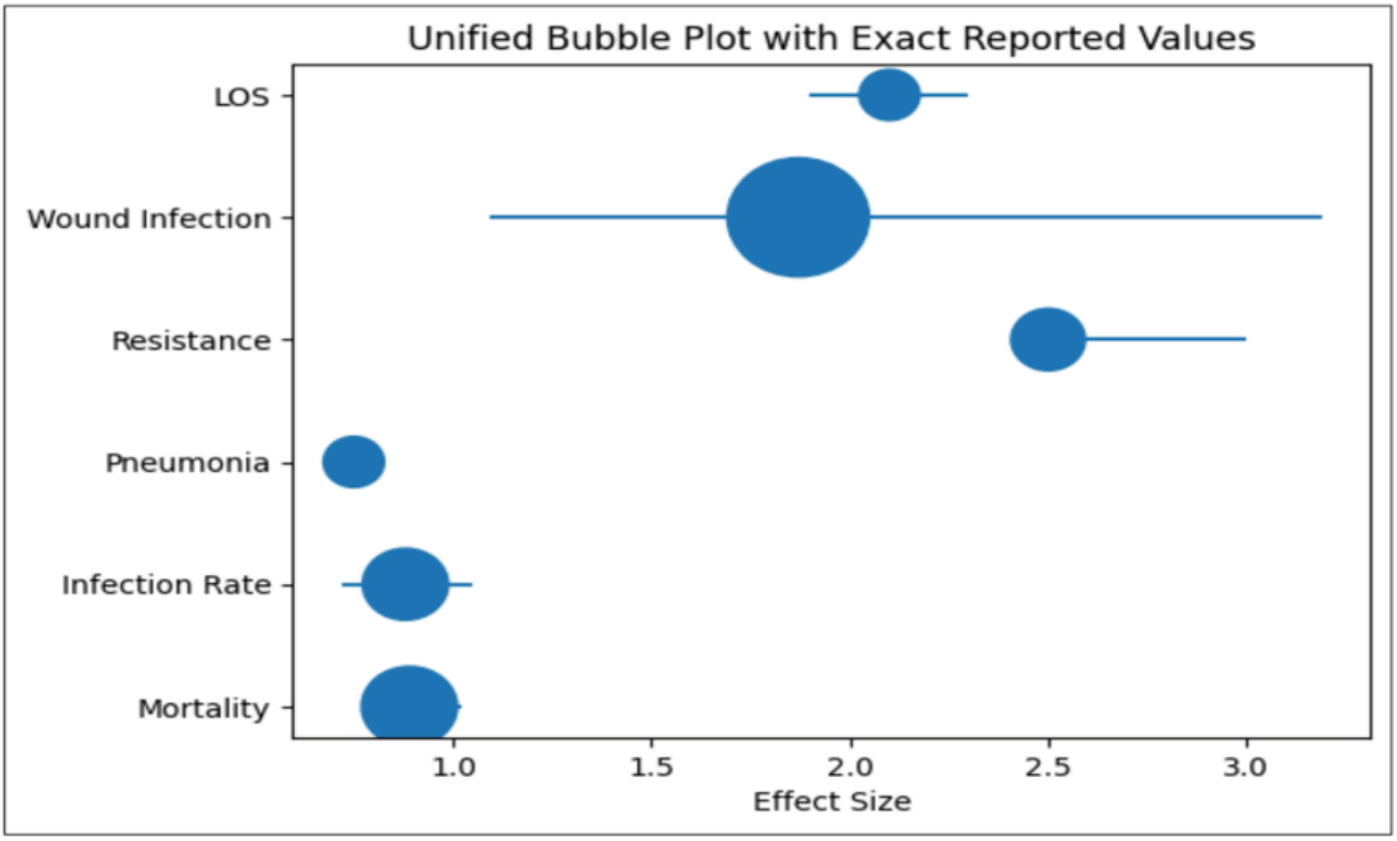


Figure 7

Bubble plot summarizing effect estimates of antibiotic therapy across outcomes in burn patients (mortality, infection, pneumonia, resistance, wound infection, and length of stay).

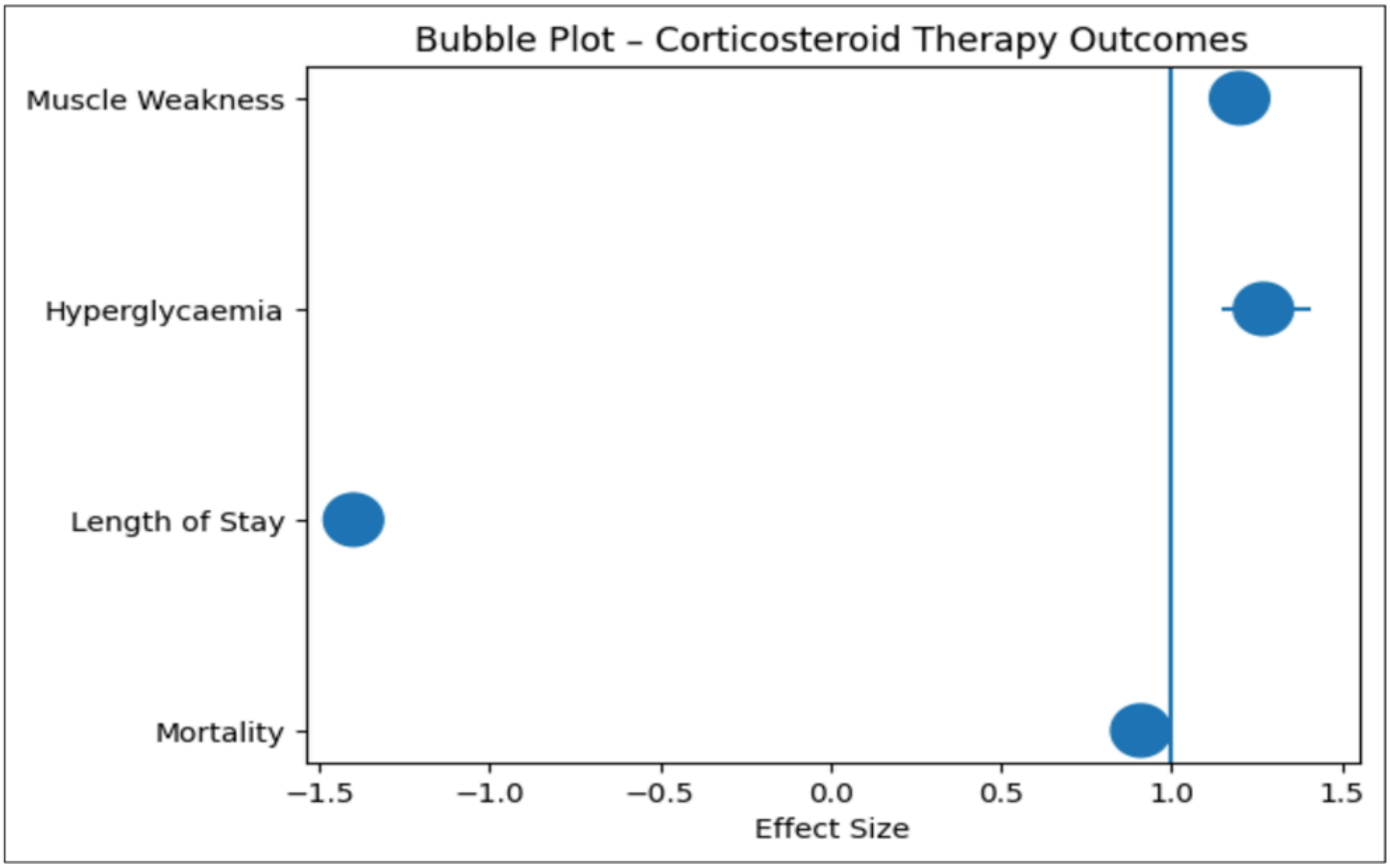


Figure 8

Bubble plot summarizing effect estimates of corticosteroid therapy on mortality, length of hospital stays, hyperglycaemia and muscle weakness based primarily on sepsis populations, with indirect applicability to burn patients.