

THE SAFETY AND EFFECTIVENESS OF HYPOCHLOROUS ACID USED AS SURGICAL IRRIGATION SOLUTION TO REDUCE POSTOPERATIVE COMPLICATIONS: A SYSTEMATIC REVIEW AND NETWORK META-ANALYSIS

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Background

Despite surgical irrigation adoption, surgical site infections (SSIs) are a common postoperative complication, contributing heavily to patient morbidity, prolonged hospitalization, and increased healthcare costs. The incidence of SSIs can vary widely (1% to 30%) based on surgical procedure type and individual patient comorbidities.⁽¹⁾ Despite promising study-level data, evidence regarding hypochlorous acid (HOCl) surgical irrigation use remains limited compared to basic irrigation and other antimicrobial irrigation agents.

Objective

The objective of this systematic literature review (SLR) and network meta-analysis (NMA) was to determine the safety and effectiveness of HOCl surgical irrigation solution compared to alternative treatments. A secondary objective was to provide a baseline assessment of other surgical irrigation solution treatments used in a sterile operating room environment.

Methods

A study protocol was developed and registered in the PROSPERO database (CRD42025647996). PubMed and EMBASE databases were searched between 2009–2024. The search output files were imported into Nested Knowledge software (Saint Paul, Minnesota), a cloud-based platform designed to streamline the process of conducting SLRs and NMAs.

Quantitative synthesis technology was utilized for summary statistics and NMA. Meta-analytical regression analyses were performed using R, with two-sided p-values <0.05 considered statistically significant.

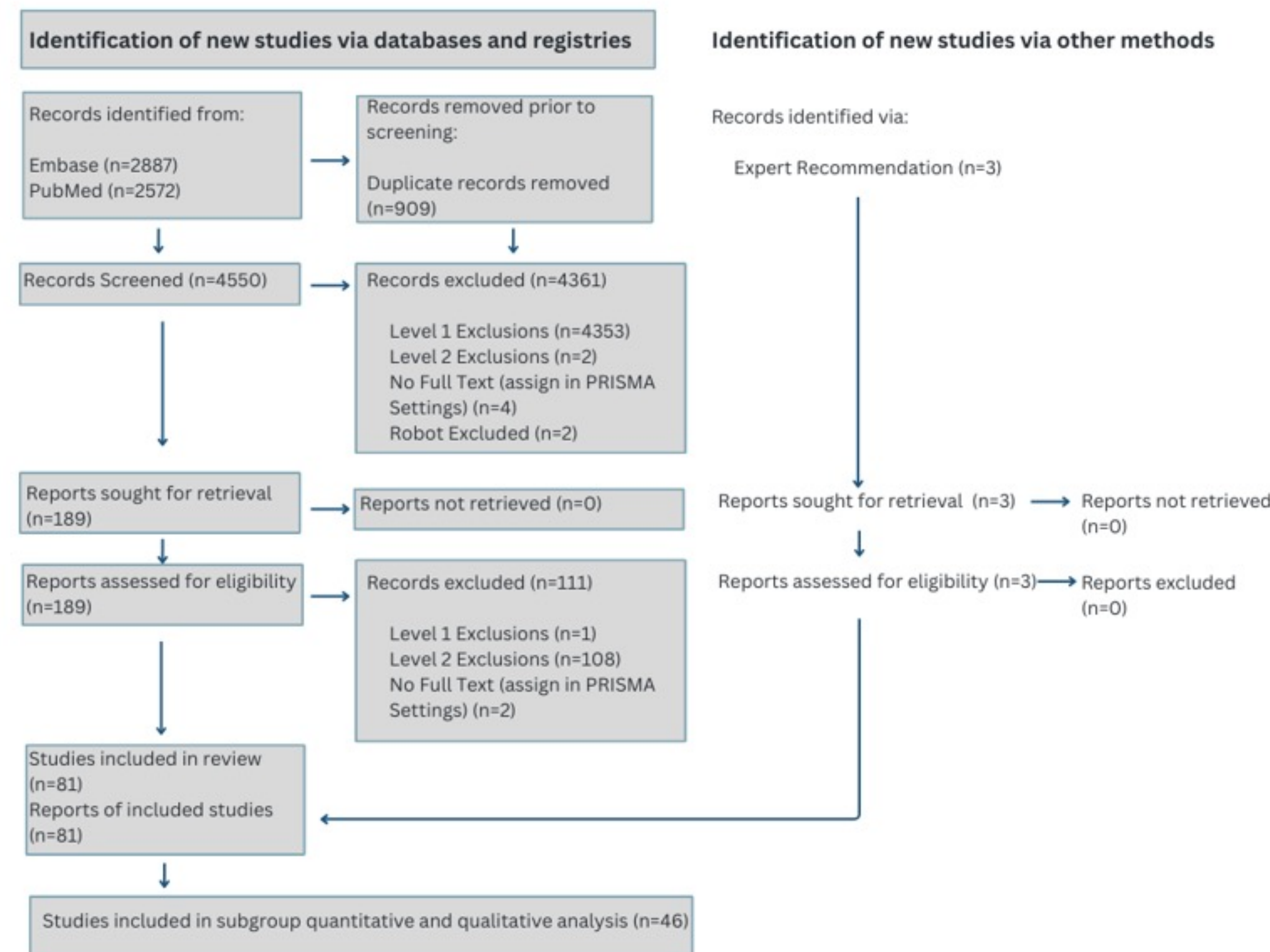
Results

The initial search of PubMed and EMBASE yielded 5,459 articles for review. Three additional clinical studies were included based on subject matter expert recommendation. After removing 909 duplicates, the remaining 4,550 articles underwent dual screening.

Results Continued

Following exclusions, 81 studies were included in the SLR, which included 27,083 unique patients.

Figure 1 PRISMA Diagram



The top three reported outcome measures across all included studies were SSI, 51 (63%), infection, 39 (48%), and LOS 22 (27%).

For the overall analysis (81 studies), a total of 18,558 patients were included for SSI with an overall rate of 12.4% (95% CI: 10.4%, 14.6%). The raw mean difference LOS was 8.33 days (95% CI: 7.79, 8.88) across 5,040 patients, and the rate of infection was 5.42% (95% CI: 3.51%, 8.27%) across 9,387 patients.

Compared to HOCl, the OR of SSI for non-agent protocols was 2.90 times as likely as HOCl (95% CI [1.48, 5.71]), 1.97 times for basic irrigation (95% CI [1.13, 3.44]), 1.22 times for antiseptic/disinfectant agents (95% CI, [.657, 2.26]), and 0.868 times for antibiotics (95% CI [0.440, 1.71]). Likewise, the NMA compared intervention groups using pairwise mean differences in LOS, analyzed with a random-effects model. Statistical heterogeneity was high for this outcome ($I^2 = 92.6%$ (95% CI [90.0%, 94.6%])).

Results Continued

Table 1 Overall (81 studies) NMA Odds Ratios Surgical Site Infection and Length of Stay Mean Difference

SSI Odds Ratio*	HOCl	Antibiotics	Antiseptics Disinfectants	Basic Irrigation	Non-agent Protocols	LOS Mean Difference*	Basic Irrigation	Non-agent Protocols	Antiseptics Disinfectants	Antibiotics	HOCl
HOCl	1.00	1.15	0.82	0.51	0.34	Basic Irrigation	0.00	-0.82	0.05	0.54	1.04
Antibiotics	0.87	1.00	0.71	0.44	0.30	Non-agent Protocols	0.82	0.00	0.87	1.36	1.86
Antiseptics Disinfectants	1.22	1.40	1.00	0.62	0.42	Antiseptics Disinfectants	-0.05	-0.87	0.00	0.49	0.99
Basic Irrigation	1.97	2.27	1.62	1.00	0.68	Antibiotics	-0.54	-1.36	-0.49	0.00	0.50
Non-agent Protocols	2.90	3.35	2.39	1.47	1.00	HOCl	-1.04	-1.86	-0.99	-0.50	0.00

* Each cell gives the OR SSI or LOS mean difference of the row intervention relative to the column intervention

Compared to HOCl, the mean LOS for non-agent protocols was 1.86 days greater than HOCl (95% CI [1.07, 2.64]), 1.04 days greater for basic irrigation (95% CI [0.403, 1.67]), 0.986 days greater for antiseptic/disinfectant agents (95% CI, [0.112, 1.86]), and 0.495 days greater for antibiotics (95% CI [-0.273, 1.26]).

A pairwise, study-level, meta-analytical regression of abdominal subgroup studies (46), directly comparing HOCl irrigation with other agents demonstrated a statistically significant reduction ($p=0.010$) in SSI risk. Across eleven contrasts, HOCl reduced odds of SSI approximately 50% relative to basic irrigation.

Limitations

This research has several important limitations to note. The available evidence is heterogeneous across surgical specialties, procedures, and comparator agents. Outcome reporting was inconsistent; SSI definitions and infection outcomes varied across studies, limiting precision. The regression and NMA models relied on published, study-level summary data rather than patient-level observations; as such, causal inference is limited, and residual confounding may remain.

Despite these limitations, the directionality of the analyses and consistency of findings across both the network and pairwise analyses support the robustness of the observed SSI reduction with HOCl irrigation.

Conclusion

These findings indicate that HOCl irrigation provides a safe, consistent, statistically, and both clinically meaningful reduction in SSI risk compared with basic irrigation and non-agent irrigation protocols, without prolonging hospitalization. Additional studies are warranted to validate this report as the magnitude of benefit may vary by intervention type and surgical context

Sources & Acknowledgements

References

1. Smyth ETM, Emmerson AM. Surgical site infection surveillance. J Hosp Infect. 2000 July;45(3):173–84.

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