Physicochemical stability of alcohol-based chlorhexidine solutions: A scoping review

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Introduction

Alcohol-based chlorhexidine solutions are strongly recommended by clinical guidelines for antisepsis during the insertion, maintenance, and manipulation of vascular access devices. In routine clinical practice, particularly in settings where multidose containers are used, these solutions are frequently handled and used over several days. Recommendations for replacing opened containers are predominantly based on concerns related to microbiological contamination, while evidence addressing the physicochemical stability of the antiseptic during prolonged use remains limited.

Objective

To map and synthesize the available evidence on the physicochemical stability of alcohol-based chlorhexidine solutions.

Method

A scoping review was conducted in accordance with the PRISMA-ScR guidelines.
Searches were performed in the following databases: PubMed, Scopus, Web of Science and Embase; and were supplemented by grey literature and manual searching.
Study selection was independently conducted by two reviewers using the Rayyan platform in blind mode to ensure independent screening.
The research question was structured using the PICO framework.

Does the physicochemical stability of alcohol-based chlorhexidine vary over time when exposed to environmental factors?

(P) Alcohol-based chlorhexidine solutions
(I) Environmental exposure
(C) Recommended storage conditions
(O) Physicochemical stability and/or antimicrobial efficacy

Evidence level and quality were assessed using the Johns Hopkins Nursing Evidence-Based Practice Model (JHNEBP), and synthesis followed the PAGER framework.

Results

The study selection process are summarized in the Figure 1.

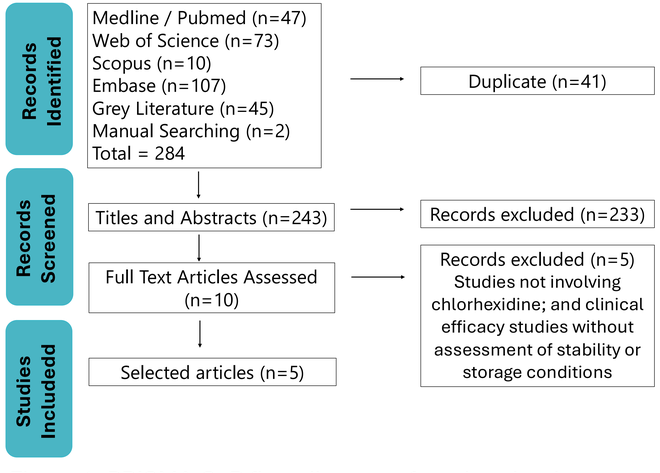

Figure 1. PRISMA-ScR flow diagram of study selection.

The characteristics of the included studies and the physicochemical stability conditions investigated are summarized in Table 1.

Table 1: Characteristics and main findings of the included studies.

Authors/ Year	Study design	Condition investigated	Analytical technique	Main finding
Saadatpour et al. 2022	Experimental study	Formulation additives	Minimum Inhibitory Concentration (MIC)	Additives enhanced antimicrobial activity
Kaur et al. 2023	Physicochemical study	Temperature variation	Density / ultrasound	Temperature affected physicochemical properties
Alanazi et al. 2024	Analytical study	Degradation conditions	High-performance liquid chromatography (HPLC)	Chlorhexidine detected with degradation products
Feng et al. 2019	Physicochemical study	Solvent composition	Solubility analysis	Solubility varied with solvent and temperature
Alam et al. 2021	Analytical study	Forced degradation	High-performance thin-layer chromatography (HPTLC)	Degradation products detected under stress

Five studies were included in the final synthesis, all Level IV (JHNEBP) and predominantly laboratory-based. Evidence on the physicochemical stability of alcohol-based chlorhexidine remains limited, particularly in real-world clinical settings.

Conclusion

Current evidence is predominantly experimental (Level IV) and highlights important gaps regarding the physicochemical stability of alcohol based chlorhexidine under real world conditions. Applied simulating clinical practice, particular in tropical climates, are needed to support evidence based vascular access care and patient safety.

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