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Review Article

Adherence to surgical hand antisepsis technique steps by surgical teams: an integrative review

Adesão às etapas da técnica de degermação das mãos pelas equipes cirúrgicas: revisão integrativa

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ABSTRACT

Objective: to synthesize evidence on adherence to surgical hand antisepsis technique steps by surgical teams. **Methods:** an integrative review conducted in six stages across MEDLINE, Embase, LILACS, BDENF, CINAHL, Web of Science, SCOPUS, Redalyc, and SciELO databases, covering the period 2009-2024. Studies were classified according to their level of evidence. **Results**: initially, 647 studies were identified. After applying eligibility criteria and thorough reading, 11 were selected. Most publications originated from SCOPUS (36.4%) and MEDLINE (36.4%) databases, predominantly from Brazil, evaluating multiprofessional teams (90.9%), with a predominance of observational studies (63.6%) at evidence level IV (81.8%). Main gaps identified: low adherence to the complete technique, inadequate hand drying, low adherence to nail cleaning, low adherence to the recommended duration, low adherence to the removal of adornments, and inadequate rinsing. **Conclusion:** the findings reveal gaps that compromise technique effectiveness (friction time, nail cleaning, and complete technique execution), while reinforcing its importance for patient safety. **Contributions to practice:** this study is expected to guide educational interventions, audits, and standardized protocols.

Descriptors: Health Personnel; Hand Disinfection; Surgicenters.

RESUMO

Objetivo: sintetizar às etapas da técnica de degermação das mãos pelas equipes cirúrgicas. **Métodos**: revisão integrativa em seis etapas realizada nas bases de dados MEDLINE, Embase, LILACS, BDENF, CINAHL, *Web of Science,* SCOPUS, Redalyc e SciELO, recorte temporal de 2009-2024. Realizada classificação do nível de evidência dos estudos. **Resultados**: inicialmente, foram identificados 647 estudos. Após aplicação dos critérios de elegibilidade e leitura minuciosa, 11 foram selecionados. A maioria das publicações foi proveniente das bases de dados SCOPUS (36,4%) e MEDLINE (36,4%), prevalentemente de origem brasileira, que avaliaram equipes multiprofissionais (90,9%), com predominância de estudos observacionais (63,6%), de nível de evidência IV (81,8%). Principais lacunas evidenciadas: baixa adesão à técnica completa, secagem inadequada das mãos, baixa adesão à limpeza das unhas, baixa adesão ao tempo recomendado, baixa adesão à retirada de adornos e enxágue inadequado. **Conclusão**: os achados revelam lacunas que comprometem a eficácia da técnica (tempo de fricção, limpeza das unhas e execução completa da técnica), mas reforçam sua importância para a segurança do paciente. **Contribuições para a prática**: espera-se que este estudo contribua para orientar intervenções educativas, auditorias e protocolos padronizados.

Descritores: Profissionais de Saúde; Desinfecção das Mãos; Centros Cirúrgicos.

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Introduction

Healthcare-associated infections, particularly surgical site infections, represent a serious global problem with significant impacts on morbidity, mortality, and healthcare system costs. In high-income countries such as the USA and Europe, these constitute the second most common infection, extending hospitalization by nearly 9.7 days, increasing mortality up to 11-fold, and generating additional costs of approximately US$ 10 billion annually. In Brazil, surgical site infections are estimated to rank third among all healthcare-associated infections, affecting approximately 14-16% of hospitalized surgical patients. In low- and middle-income countries, the incidence may be even higher due to resource limitations and infection control practices[1].

Within this prevention context, surgical hand antisepsis presents itself as a standard preoperative procedure involving friction of hands and forearms with antiseptics for 2 to 5 minutes, aiming to eliminate transient microbiota and reduce resident microbiota. The residual action of antiseptics provides additional protection in case of glove failure[2]. This globally recognized technique is emphasized by the World Health Organization (WHO) as a fundamental strategy capable of saving lives, preventing surgical site infections, and reducing substantial healthcare system costs[3-5].

The success of this strategy demands co-responsibility from all surgical team professionals, including surgeons, assistants, anesthesiologists, surgical technologists, and circulating nurses. The perioperative nurse particularly stands out for supervising aseptic preparation and protocol adherence, ensuring compliance with recommendations. This joint effort aims to reduce pathogen transmission and strengthen the safety culture[3-4].

Despite proven effectiveness in surgical site infection control, assessment of hand antisepsis adherence remains a gap. A microbiological study of cardiac surgery professionals' hands, post-antisepsis and glove removal, detected failures in adherence to recommended duration in 14% of participants[6]. This non-compliance significantly increases the risk of pathogen contamination.

Given this scenario, synthesizing studies on this topic emerges as an opportunity to assist surgical center managers in identifying and implementing effective models for evaluating antisepsis technique adherence by teams, aligned with guidelines and strengthening evidence-based practices in surgical site infection prophylaxis[5,7]. This initiative aligns with the 3rd Sustainable Development Goal, which focuses on health and well-being, seeking solutions to improve patient safety in development settings[8].

Considering the topic's relevance and related evidence, this review aimed to synthesize evidence on adherence to surgical hand antisepsis technique steps by surgical teams.

Methods

This integrative review was conducted in six stages following the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) tool[9-10], adapted to ensure transparency and methodological reporting completeness.

In the first stage, the review question was formulated using the PICo acronym (P-Population, I--Phenomenon of Interest, Co-Context), where P (surgical team), I (adherence to surgical hand antisepsis technique), and Co (surgical center): What evidence is available in the scientific literature regarding surgical teams' adherence to hand antisepsis technique in the surgical center context?

In the second stage, eligibility criteria were established. Articles published from 2009 onwards were considered eligible, coinciding with the WHO's "Safe Surgery Saves Lives" manual publication[11]. Included were studies addressing adherence to surgical hand antisepsis technique performed by surgical team professionals in the surgical center, encompassing different specialties and ages, regardless of product or

technique adopted, original articles in any language with different study designs. Secondary studies, letters to the editor, abstracts, and incomplete texts were excluded.

The search strategy was conducted via the Coordination for the Improvement of Higher Education Personnel (CAPES) Journal Portal, with librarian collaboration, using correlated descriptors "Health Personnel," "Hand Disinfection," "Infection Control," and "Surgicenters," plus synonymous free terms. Controlled vocabulary terms from Health Sciences Descriptors (*Descritores em Ciências da Saúde* - DeCS), Medical Subject Headings (MeSH), and Emtree were consulted, combined with synonyms using Boolean operators OR and AND according to each database.

The publication survey was conducted on June 7, 2024, in the following databases: Medical Literature Analysis and Retrieval System Online (MEDLINE) via PubMed, Excerpta Medica Database (Embase), Web of Science (WoS), Cumulative Index to Nursing and Allied Health Literature (CINAHL) via EBSCOhost, SCOPUS, Latin American and Caribbean Health Sciences Literature (*Literatura Latino-americana e do Caribe em Ciências da Saúde* - LILACS), Nursing Database (*Base de Dados de Enfermagem* - BDENF) via Virtual Health Library (*Biblioteca Virtual em Saúde* - BVS), Scientific Electronic Library Online (SciELO), and Redalyc, Figure 1.

Database	**Search strategy**
LILACS	(mh:("Pessoal de Saúde" OR "Equipe de Assistência ao Paciente" OR "Profissionais de enfermagem" OR "Auxiliares de Cirurgia" OR "Enfermagem Médico-Cirúrgica" OR "Cirurgiões" OR anestesiologistas) OR "Pessoal da Saúde" OR "Personal de Salud" OR "Health Personnel" OR "Profissionais de Saúde" OR "Patient Care Team" OR "Grupo de Atención al Paciente" OR "Equipe Multiprofissional" OR "Equipe Interdisciplinar de Saúde" OR "Equipe de Saúde" OR "Nurse Practitioners" OR "Enfermeras Practicantes" OR "Profissional de Enfermagem" OR "Profissionais de enfermagem" OR "Auxiliares de Sala Cirúrgica" OR "Auxiliares de Cirurgia" OR "Operating Room Technicians" OR "Auxiliares de Cirugía" OR "Instrumentação Cirúrgica" OR "Medical-Surgical Nursing" OR "Enfermería Médico-Quirúrgica" OR cirurgiões OR cirurgiães OR surgeons OR cirujanos OR anestesiologistas OR anesthesiologists OR anestesiólogos OR "Médicos Anestesistas") AND (mh:("Desinfecção das mãos" OR "Antissepsia" OR "Luvas Cirúrgicas") OR "degermação cirúrgica das mãos" OR "degermação das mãos" OR "hand degermation" OR "hands degermation" OR "Antissepsia cirúrgica das mãos" OR "Antissepsia cirúrgica" OR "Surgical hand antisepsis" OR "Escovação das mãos" OR "Hand scrubbing" OR "Escovação cirúrgica das mãos" OR "Surgical hand scrubbing" OR "Fricção cirúrgica das mãos" OR "surgical hand rubbing" OR "Surgical antisepsis" OR "preparo pré-operatório das mãos") AND (mh:("Centro Cirúrgico Hospitalar" OR "Centros Cirúrgicos" OR "Procedimentos Cirúrgicos Operatórios" OR "Salas Cirúrgicas") OR "Centro Cirúrgico Hospitalar" OR "Hospital Surgery Departments" OR "Servicio de Cirugía en Hospital" OR surgicenters OR "Centros Cirúrgicos" OR "Procedimentos Cirúrgicos Operatórios" OR "Intervenção Cirúrgica" OR "Intervenções Cirúrgicas" OR "Operação Cirúrgica" OR "Operações Cirúrgicas" OR "Procedimento Cirúrgico" OR "Procedimento Cirúrgico Operatório" OR "Procedimento Operatório" OR "Procedimentos Cirúrgicos" OR "Procedimentos Operatórios" OR "Processos Cirúrgicos" OR "Sala Cirúrgica" OR "Sala Operatória" OR "Sala de Cirurgia" OR "Salas Operatórias" OR "Salas de Cirurgia")
MEDLINE	("Hand Disinfection"[MeSH] OR "Surgical Scrubbing"[Title/abstract] OR "Surgical hand antisepsis"[Title/abstract] OR "Hand scrubbing"[Text word] OR "Surgical hand scrubbing"[Text word] OR "surgical hand rubbing"[Text word] OR "surgical scrubbing"[Text word] OR "gloves, surgical"[MeSH Terms] OR "antisepsis"[MeSH Terms] OR "Surgical antisepsis"[All fields] OR pre-operative hand preparation[All fields] OR surgical degermation[All fields]) AND ("Surgery Department, Hospital"[MeSH] OR "Hospital Surgery Departments"[Title/abstract] OR "Hospital Surgery Department"[Title/abstract] OR Surgicenters[MeSH] OR surgicenters[Title/abstract] OR surgicenter*[Text word] OR "operating rooms"[MeSH Terms] OR "operating rooms"[Text Word])
CINAHL	((MM "Surgical Scrubbing") OR (MM "Surgical Scrubbing/MT/RF/TD/UT/ST/PC/HI/ES/NA") OR (MM "Handwashing+") OR (TW "Surgical Scrubbing" OR "Hand Disinfection" OR "Surgical Handwashing" OR "Surgical Scrub" OR "Surgical hand antisepsis" OR "Hand scrubbing" OR "Surgical hand scrubbing" OR "surgical hand rubbing" OR "surgical scrubbing" OR "surgical gloves" OR "antisepsis" OR "Surgical antisepsis" OR pre-operative hand preparation OR "surgical degermation")) AND ((MM "Surgicenters") OR (MM "Operating Rooms") OR (TW "Hospital Surgery Departments" OR "Hospital Surgery Department" OR surgicenter* OR "operating rooms"))

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Database	Search strategy
BDENF	(mh:("Pessoal de Saúde" OR "Equipe de Assistência ao Paciente" OR "Profissionais de enfermagem" OR "Auxiliares de Cirurgia" OR "Enfermagem Médico-Cirúrgica" OR "Cirurgiões" OR anestesiologistas) OR "Pessoal da Saúde" OR "Personal de Salud" OR "Health Personnel" OR "Profissionais de Saúde" OR "Patient Care Team" OR "Grupo de Atención al Paciente" OR "Equipe Multiprofissional" OR "Equipe Interdisciplinar de Saúde" OR "Equipe de Saúde" OR "Nurse Practitioners" OR "Enfermeras Practicantes" OR "Profissional de Enfermagem" OR "Profissionais de enfermagem" OR "Auxiliares de Sala Cirúrgica" OR "Auxiliares de Cirurgia" OR "Operating Room Technicians" OR "Auxiliares de Cirugía" OR "Instrumentação Cirúrgica" OR "Medical-Surgical Nursing" OR "Enfermería Médico-Quirúrgica" OR cirurgiões OR cirurgiães OR surgeons OR cirujanos OR anestesiologistas OR anesthesiologists OR anestesiólogos OR "Médicos Anestesistas") AND (mh:("Desinfecção das mãos" OR "Antissepsia" OR "Luvas Cirúrgicas") OR "degermação cirúrgica das mãos" OR "degermação das mãos" OR "hand degermation" OR "hands degermation" OR "Antissepsia cirúrgica das mãos" OR "Antissepsia cirúrgica" OR "Surgical hand antisepsis" OR "Escovação das mãos" OR "Hand scrubbing" OR "Escovação cirúrgica das mãos" OR "Surgical hand scrubbing" OR "Fricção cirúrgica das mãos" OR "surgical hand rubbing" OR "Surgical antisepsis" OR "preparo pré-operatório das mãos") AND (mh:("Centro Cirúrgico Hospitalar" OR "Centros Cirúrgicos" OR "Procedimentos Cirúrgicos Operatórios" OR "Salas Cirúrgicas") OR "Centro Cirúrgico Hospitalar" OR "Hospital Surgery Departments" OR "Servicio de Cirugía en Hospital" OR surgicenters OR "Centros Cirúrgicos" OR "Procedimentos Cirúrgicos Operatórios" OR "Intervenção Cirúrgica" OR "Intervenções Cirúrgicas" OR "Operação Cirúrgica" OR "Operações Cirúrgicas" OR "Procedimento Cirúrgico" OR "Procedimento Cirúrgico Operatório" OR "Procedimento Operatório" OR "Procedimentos Cirúrgicos" OR "Procedimentos Operatórios" OR "Processos Cirúrgicos" OR "Sala Cirúrgica" OR "Sala Operatória" OR "Sala de Cirurgia" OR "Salas Operatórias" OR "Salas de Cirurgia") AND (db:("BDENF")) AND (year_cluster:[2009 TO 2024])
EMBASE	('hand disinfection'/exp OR 'surgical scrubbing':ti,ab,kw OR 'surgical hand antisepsis':ti,ab,kw OR 'hand scrubbing':ti,ab,kw,-de,dn,df,mn,tn OR 'surgical hand scrubbing':ti,ab,kw,de,dn,df,mn,tn OR 'surgical hand rubbing':ti,ab,kw,de,dn,df,mn,tn OR 'surgical scrubbing':ti,ab,kw,de,dn,df,mn,tn OR 'surgical glove'/exp OR 'antisepsis'/exp OR 'surgical antisepsis' OR 'pre-operative hand preparation' OR 'surgical degermation') AND ('hospital department'/exp OR 'hospital surgery departments':ti,ab,kw OR 'hospital surgery department':ti,ab,kw OR 'outpatient department'/exp OR 'surgicenters':ti,ab,kw OR 'surgicenter*':ti,ab,kw,de,dn,df,mn,tn OR 'operating room'/exp OR 'operating rooms':ti,ab,kw,de,dn,df,mn,tn) AND [2009-2024]/py AND [embase]/lim NOT ([embase]/lim AND [medline]/lim)
WoS	TS=(("Surgical Scrubbing" OR "Surgical hand antisepsis" OR "Hand scrubbing" OR "Surgical hand scrubbing" OR "surgical hand rubbing" OR "surgical scrubbing" OR "surgical gloves" OR "antisepsis" OR "Surgical antisepsis" OR "surgical degermation") AND ("Hospital Surgery Departments" OR "Hospital Surgery Department" OR Surgicenters OR "operating rooms"))
SCOPUS	TITLE-ABS-KEY(("Surgical Scrubbing" OR "Surgical hand antisepsis" OR "Hand scrubbing" OR "Surgical hand scrubbing" OR "surgical hand rubbing" OR "surgical scrubbing" OR "surgical gloves" OR "antisepsis" OR "Surgical antisepsis" OR "surgical degermation") AND ("Hospital Surgery Departments" OR "Hospital Surgery Department" OR Surgicenters OR "operating rooms"))
SciELO	("degermação cirúrgica das mãos" OR "degermação das mãos" OR "Surgical hand degermation" OR "antissepsia cirúrgica" OR "Luvas Cirúrgicas" OR "Surgical gloves")
Redalyc	("equipe de saúde" OR "equipe cirúrgica" OR "Health Personnel" OR "surgical team") AND ("degermação cirúrgica das mãos" OR "degermação das mãos" OR "Surgical hand degermation" OR "antissepsia cirúrgica" OR "Luvas Cirúrgicas" OR "Surgical gloves")

Figure 1 – Search strategy. Rio de Janeiro, RJ, Brazil, 2024

In the third stage, Rayyan software, developed by Qatar Computing Research Institute, was used to assist in article management and selection[12]. The selection process was performed independently by two reviewers. Initially, both screened studies by title and abstract. Discrepancies were resolved after consensus, with support from a third reviewer. Subsequently, pre-selected articles were read in full to confirm eligibility and avoid bias.

The fourth stage consisted of critical evaluation of selected studies individually, based on methodological rigor and each study's characteristics, considering the adopted evidence classification system and applying eligibility criteria.

In the fifth stage, pertinent data were extracted from each study (authors, year, country, method, objective, main results, gaps, and evidence levels) and exported to an Excel spreadsheet according to selected variables. A data extraction instrument with 16 items was developed to systematize antisepsis technique steps. This supported the formulation of analysis categories: pre-antisepsis and surgical hand antisepsis.

According to research design, evidence levels

are classified from I to VI. Level I encompasses meta-analyses of randomized clinical trials, level II individual experimental studies (such as randomized clinical trials), level III quasi-experimental studies, level IV descriptive or qualitative studies, level V experience or case reports, and level VI expert opinions[13].

In the sixth stage, a synthesis of related evidence on hand antisepsis technique adherence by surgical teams was performed according to recommended practices. Technique steps were organized based on national and international guidelines from selected studies.

Results

The initial search strategy resulted in identifying 647 studies. After removing 126 duplicates, 521 studies underwent title and abstract screening. Of these, 438 were excluded for not meeting inclusion criteria, resulting in 83 articles for full reading. After complete reading and rigorous application of eligibility criteria, the final sample comprised 11 articles, Figure 2.

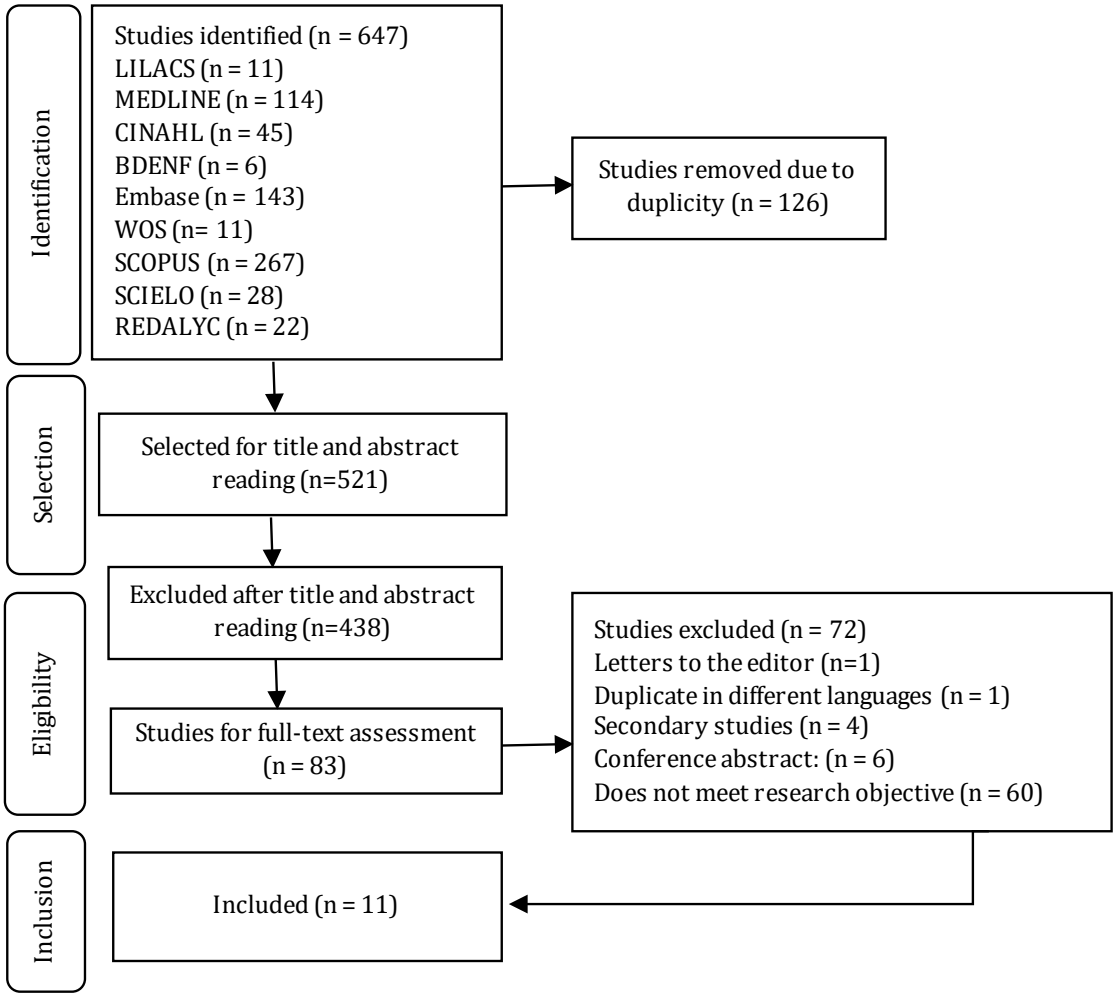

Figure 2 – PRISMA flowchart of study selection. Rio de Janeiro, RJ, Brazil, 2024

The distribution of the 11 selected articles was as follows: SCOPUS 4 (36.4%)[14-17], MEDLINE/PubMed 4 (36.4%)[18-21], REDALYC 1 (9.1%)[22], CINAHL 1 (9.1%)[23] and BDENF 1 (9.1%)[24]. Regarding geographical origin, Brazil led contributions with three studies (27.3%)[20,22,24], followed by Turkey[14,23] and Iran[17,19] both with two studies (18.2%) each. Meanwhile, USA[15], France[21], Finland[16], and Scotland[18] each contributed 1 (9.1%).

Regarding publication year, 2014: 1 (9.1%)[14], 2015: 3 (27.3%)[16–18], 2016: 1 (9.1%)[22], 2017[19,21] and 2018[15,20] 2 (18.2%) each, 2020[24] and 2022[23] 1 (9.1%) each. Regarding the studied population, 10 (90.9%)[14-23] studies evaluated multiprofessional teams, 1 (9.1%)[24] focused exclusively on medical professionals. Concerning typology, observational studies predominated, comprising seven publications (63.6%)[14,16-18,22-24]. Two studies (18.2%) were before-and-after audits[19,21]. The remainder were represented by quasi-experimental[20] and mixed methods studies, 1 (9.1%)[15] each. Regarding evidence levels, most studies, 10 (90.9%), were classified as level IV[14-19,21-24], and 1 (9.1%) as level III[20].

Guidelines underpinning research on surgical hand antisepsis technique adherence demonstrated variability. Five studies (45.5%) were based on WHO recommendations[16,18,20,23-24]; 2 (18.2%) did not specify guidelines[15,22]; 2 (18.2%) followed Centers for Disease Control and Prevention (CDC)[22-23]; 1 (9.1%) the *Société Française d'Hygiène Hospitalière*[21], 1 (9.1%) Berry & Kohn's Operating Room Technique guidelines[17], 1 (9.1%) the Association of Surgical Technologists (AST)[23], and 1 (9.1%) the Ministry of Health and Medical Education (MOHME)[19].

Regarding adherence to pre-antisepsis phase steps, there was variability among studies. Four (36.4%) included information about appropriate attire[15,17-18,23]. Jewelry removal (rings, bracelets, watches) was widely observed in seven studies (63.6%)[15,17-18,20,22-24], with high compliance rates in most research. However, effectiveness in removing nail polish and artificial nails proved to be a weak point, reported by five studies (45.5%)[15,17-18,20,23]. Inspection of hand and forearm skin integrity was inconsistent, mentioned by only three studies (27.3%), with nail cutting and cleaning, as well as absence of long nails, cited as significant compliance challenges at this stage[19,23-24], Figure 3.

Adherence to the surgical hand antisepsis technique itself also showed heterogeneity. Seven studies (63.6%) presented the step of cleaning under nails with brush bristles or nail cleaners under running water; however, non-use of brushes was a notable failure[14,17,20,23-24]; ten studies (81.8%) reported scrubbing time of 3 to 5 minutes, but most presented inadequate results[14-16,18-24], Figure 3.

No.	Stage	Evidence found	%
	Pre-antisepsis		
1	Appropriate attire: cap, mask, surgical scrubs	A11, A9, A3, A4	36.4
2	Jewelry removal	A11, A10, A8, A9, A5, A3, A4	63.6
3	Nail inspection: clean, short, healthy, and without polish	A11, A8, A9, A3, A4	45.5
4	Absence of cuts, scratches, etc. on hands and forearms	A11, A10, A7	27.3
5	Wash hands with soap and water if visibly soiled	A11, A10, A8, A9	36.4
6	Remove debris from under nails using a disposable cleaner under running water	A11, A9	18.2
7	Thoroughly dry hands and forearms with disposable paper towel	A2	9.1
	Surgical hand antisepsis		
8	Turn on faucet to wet hands and forearms	A11, A3	18.2
9	Wet hands, forearms, and elbows	A11, A3	18.2
10	Cup hands to collect antiseptic and spread on hands, forearms, and elbows. In case of antiseptic-impregnated sponge, press the sponge against skin and spread over all areas	A11, A5, A3, A7	36.4
11	Clean under nails with brush bristles or nail cleaner under running water	A11, A10, A8, A3, A9, A7, A1	63.6
12	Scrub hands, paying attention to interdigital spaces and forearms effectively, observing all four sides	A11, A5, A4	36.4

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No.	Stage	Evidence found	%
13	Minimum time: 3-5 minutes, keeping hands above elbows	A11, A10, A8, A9, A6, A5, A2, A4, A7, A1	81.8
14	Rinse hands under running water, from fingertips to elbows, removing all product residue. Turn off faucet with elbow, knee, or foot if faucet does not have sensor	A11, A9, A5	27.3
15	Keep hands above elbows, away from surgical attire	A11, A9, A5, A3, A7	45.5
16	In the operating room, dry hands and forearms with a sterile towel using sterile technique before donning surgical gown and sterile gloves	A5, A11, A9, A7	36.4

Figure 3 – Relationship between hand antisepsis technique phases and evidence found in selected studies, Rio de Janeiro, RJ, Brazil, 2024

The evidence found revealed fragile adherence by surgical teams to hand antisepsis, particularly regarding recommended time, nail cleaning, inadequate drying, and complete technique execution. Friction time emerges as the most reported failure among studies, present in most analyses. In contrast, the frequency of other deficiencies, such as jewelry removal and inadequate head covering, varied more among investigations, suggesting that while important, these steps may not be universally monitored with the same rigor or may present adherence variability depending on context or specific guidelines of each study, Figure 4.

Year/Authors/ Country	Type of the study/ Sample	Main steps presented/ Guidelines	Main gaps	LE
A1 - 2014 Umit et al[14] Turkey	- Observational - 107 residents, scrub nurses, attending surgeons, and academic surgeons	Partial hand antisepsis steps; nail care; time/Not mentioned	Low adherence to recommended time (mean presented: 69.1 seconds); Low adherence to nail cleaning (73.8% did not use brushes).	IV
A2 - 2015 Laurikainen et al[16] Finland	- Prospective observational before and after - 687 physicians, nurses, medical and nursing students	Nail care; complete surgical hand antisepsis steps; time; drying; intervention/WHO	Before: low adherence to recommended time (58.0% at 2 minutes and 38 seconds); inadequate hand drying (40.0% in pre-wash and 45.0% after antiseptic application); incomplete application (only 35.0% applied product to elbow twice); After: limited time improvement (mean of 2 minutes and 16 seconds).	IV
A3 - 2015 Shoaei et al[17] Iran	- Cross-sectional observational - 56 surgeons, surgery residents, and surgical technologists	Appropriate attire; nail care; jewelry; complete surgical hand antisepsis steps; adherence vs. experience/Berry & Kohn's Operating Room Technique 13th edition	Inadequate head covering (50.0%); Low adherence to nail cleaning (100.0% did not use brush and did not clean nails); low adherence to complete technique (absence of lateral hand edge scrubbing (55.4%), absence of medial hand edge scrubbing (57.1%), and absence of individual finger scrubbing (32.1%).	IV
A4 - 2015 Ezzat et al[18] Scotland	- Prospective observational - 303 consultant surgeons, trainees, and operating room nurses	Appropriate attire; nail care; jewelry; complete surgical hand antisepsis steps; time; adherence vs. experience/WHO	Low adherence to nail cleaning (69.0% did not use brushes in first antisepsis of the day and only 8.0% used in subsequent ones); low adherence to eye protection (only 29.4% protected their eyes); low adherence to jewelry removal (17.0% wore wedding rings during technique).	IV
A5 - 2016 Oliveira; Gama[22] Brazil	- Cross-sectional observational - 50 physicians, medical students, nursing technicians	Jewelry; complete surgical hand antisepsis steps; time; drying/ WHO, AORN, CDC, and ANVISA	Low adherence to complete technique: only 8 (16.0%) adequately met time requirement and appropriate techniques; low adherence to recommended time: 20 (40.0%) considered adequate; inadequate hand drying: only 12 (24.0%) dried hands unidirectionally from fingertips to elbows and 31 (62.0%) did not use different compress sides for distinct antisepsis areas.	IV

(the Figure 4 continue in the next page...)

Year/Authors/ Country	Type of the study/ Sample	Main steps presented/ Guidelines	Main gaps	LE
A6 - 2017 Francois et al[21] France	- Continuous internal audit - 213 surgeons, surgical assistants, and surgical technologists	Complete surgical hand antisepsis steps; time; drying; intervention/*Recommandations pour l'higiène des mains*	Low adherence to recommended time: first and second frictions of the day did not always reach recommended 90 seconds; unequal performance between professional categories [internal and external staff had better results in 2nd friction (p=0.007)].	IV
A7 - 2017 Abdollahi et al[19] Iran	- Clinical audit before and after - 70 surgeons, nurses, and operating room technicians	Complete surgical hand antisepsis steps; time; drying; intervention/Ministry of Health and Medical Education	Low adherence to recommended time (mean of 22.0% considered adequate); low adherence to recommended complete technique (inadequacies: not starting with nails, not using circular movements on arms, and not going beyond elbows); inadequate drying.	IV
A8 - 2018 Gaspar et al[20] Brazil	- Quasi-experimental - 534 surgeons and surgical technologists	Nail care; jewelry; complete surgical hand antisepsis steps; time; intervention/WHO	Low adherence to nail cleaning: only 33.7% performed adequately during chlorhexidine use and 41.5% during PVPI use; low adherence to unidirectional technique: only 13.5% and 18.0% performed hand and forearm friction this way while using chlorhexidine and PVPI, respectively); low adherence to complete technique (pre-intervention: 0.03%; post-implementation: 36.4%), p=0.002.	III
A9 - 2018 Schwartz et al[15] USA	- Mixed methods - 50 surgical team members	Appropriate attire; nail care; jewelry; complete surgical hand antisepsis steps; time; drying/Not clear	Low adherence to recommended complete technique: nine (18.0%), of these, five (31.0%) were among water-based scrubs, and four (12.0%) were among alcohol-based scrubs.	IV
A10 - 2020 Peixoto et al[24] Brazil	- Prevalence observational - 45 surgeons	Jewelry; partial surgical hand antisepsis steps; time/WHO	Low adherence to mean time below recommended (116 seconds, below recommended 120 seconds); low adherence to recommended time (only 40.0% considered adequate).	IV
A11 - 2022 Gülşen et al[23] Turkey	- Cross-sectional observational - 66 surgeons and nurses	Appropriate attire; nail care; jewelry; complete surgical hand antisepsis steps; time; drying; intervention; adherence *vs.* experience/CDC, WHO, and AST	Low adherence to complete technique: no professional performed all technique steps correctly; low execution of washing technique with circular movements up to 3-5 cm above elbow (only 48.5% performed correctly); inadequate rinsing (47.0% performed only partially adequately); inadequate hand and arm drying (only 37.9% avoided contamination when turning compress); Low adherence to nail cleaning (100.0% did not use brushes or nail cleaners); low adherence to recommended time (51.5% performed inappropriately).	IV

LE: Level of evidence; WHO: World Health Organization; AORN: Association of periOperative Registered Nurses; CDC: Centers for Disease Control and Prevention; ANVISA: Agência Nacional de Vigilância Sanitária; AST: Association of Surgical Technologists: PVPI: Povidone-iodine

Figure 4 – Synthesis of main study information related to surgical hand antisepsis technique adherence. Rio de Janeiro, RJ, Brazil, 2024

Discussion

Rigorous adherence to surgical hand antisepsis technique constitutes an essential component for ensuring patient safety and preventing surgical site infections; however, this review's findings revealed significant gaps in surgical teams' compliance with established protocols, particularly low conformity with recommended friction time, adequate nail cleaning, and complete technique execution. These gaps indicate vulnerabilities in infection prevention and point to a disconnect between established guidelines and daily practice[6,25-26].

The temporal distribution of publications on this topic, 2014-2022, suggests a relationship with global initiatives such as WHO's "Save Lives: Clean Your Hands" campaign and advancement of patient safety strategies[5]. The launch of global patient safety challenges, a central program of the World Alliance for Patient Safety during 2005-2015, was a historic milestone that boosted attention to patient safety and, consequently, hand antisepsis practices in the surgical context[7].

The predominance of multiprofessional populations in analyzed investigations reinforces the comprehensiveness of surgical hand antisepsis technique adherence, involving all professionals in the surgical environment. Given infection reduction as a global public health imperative and its significant contribution to healthcare-associated infections, integrating a multiprofessional approach is fundamental to effectively address challenges such as ensuring adherence to complex protocols, overcoming behavioral barriers to correct technique practice, implementing continuous surveillance, and the need for permanent education for all professional categories[1-2].

Observational studies at level IV predominated, justified not only by methodological simplicity but by the nature of the research question focused on behavioral observation and situational diagnosis. This choice allowed identifying non-protocolized behaviors in real-time, plus relevant contextual variables[27]. The diversity of employed guidelines — WHO, CDC, AST, among others — evidenced absence of protocol uniformity. Although 45.5% of studies follow WHO recommendations, the remainder present variations in described steps. This fragmentation compromises practice quality and suggests need for technical consensus[2].

Regarding the pre-antisepsis phase, low adherence to jewelry removal and nail cleaning was recurrent. These practices are recognized as essential to avoid microbial retention. Use of sterile sponges instead of brushes is recommended, plus reinforcement of this step via training and audits[5,25,28]. An analysis of 534 hand hygiene events revealed low initial adherence among surgical teams: surgeons (10.0%), assistants (15.6%), and technicians (18.6%) in the pre-feedback period. However, after intervention, significant improvement in adherence rates was observed: surgeons (87.0%), assistants (96.8%), and technicians (97.6%)[2,5,28-30].

The surgical hand antisepsis phase equally revealed important gaps. Although seven studies (63.6%) addressed the subungual cleaning step with brushes or cleaners under running water[14,17,20,23-24], adherence to this practice was low in five (45.5%) of them[14,17-18,20,23], with one study recording that 100% of professionals did not use such tools[23]. This finding contradicts essential recommendations for removing resident microbiota and reducing transient microbiota in the subungual bed[2,5,17,28].

Non-compliance with minimum friction time was the most prevalent finding. Non-observance of this step significantly reduces antimicrobial efficacy, even when other steps are correctly executed[30].

Rinsing also revealed negligence. Antiseptic residues can cause dermatitis and compromise glove integrity. Drying should occur with sterile compress, unidirectionally, from fingertips to elbow. These procedures, though simple, are determinant in microbiological effectiveness[2,5,28-30].

Study limitations

This study presents a predominance of level IV evidence studies, which may affect the strength of synthesized evidence. Additionally, methodological diversity makes meta-analysis difficult. There is also possibility of publication bias, where studies with positive results are more likely to be published, leading to possible overestimation of efficacy and favorable results in available literature.

Contributions to practice

This study is expected to foster discussion about identified gaps in surgical hand antisepsis adherence, aiming to support practice improvement, pointing to the need for permanent education programs and development of standardized protocols for technique implementation and evaluation.

Conclusion

This review highlights the persistence of significant gaps in hand antisepsis adherence by teams, especially in friction time, nail cleaning, and complete technique execution. These weaknesses, though varying in frequency, indicate the need to strengthen protocol compliance through permanent education and rigorous monitoring to optimize patient safety and reduce surgical site infection risk.

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Authors' contributions

Conception and project: Pinto FD, Ferreira RA, Fassarella CS. Data analysis and interpretation: Pinto FD, Siqueira FMCS, Silva JOL, Fassarella CS. Redação do manuscrito: Pinto FD, Ferreira RA, Fassarella CS. Relevant critical review of intellectual content: Pinto FD, Ferreira RA, Henrique DM, Camerini FG, Fassarella CS. Final approval of the version to be published; Agreement to be responsible for all aspects of the manuscript ensuring that issues relating to the accuracy or completeness of any part of the manuscript are properly investigated and resolved. Pinto FD, Ferreira RA, Siqueira FMCS, Silva JOL, Henrique DM, Camerini FG, Fassarella CS.

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