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Review Article

Determining the Effectiveness of Preventive Measures in Reducing Intravenous Injection and Catheter-Related Infections: A Meta-Analysis

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Abstract

Background: We aimed to evaluate the efficacy of preventative strategies targeted at lowering these injections.

Methods: A comprehensive assessment of electronic databases (PubMed, Web of Science, and Cochrane Library) was carried out to discover relevant papers published from 2013-2024. Inclusion criteria were randomised controlled trials, quasi-experimental studies, and observational research on therapy for intravenous injection and catheter-related infections. The primary outcome examined was the incidence or prevalence of infections caused by intravenous injections. According to preliminary data from 31 studies, preventive interventions dramatically reduce the incidence of intravenous injection and catheter-related infections. Subgroup analyses indicate effectiveness differences depending on intervention type and patient variables.

Results: Chlorhexidine-based therapies can lower infection risk by 29% (Risk Ratio: 0.71), but taurolidine provides a statistically significant 53% benefit (RR = 0.47). The total risk ratio varies from 0.71 to 0.84, indicating a 29% reduction in infection rates in nations having Needlestick Safety and Prevention Acts. In contrast, the absence of such regulation may result in a 6% to 8% rise in infection rates (RR = 0.96).

Conclusion: Preventative interventions, notably chlorhexidine and taurolidine, can considerably reduce the risk of intravenous injection and catheter-related infections. Chlorhexidine may lower the risk of infection by 29%, whereas taurolidine reduces it by 53%. Nations with Needlestick Safety and Prevention Acts may expect a one-third reduction in infection rates. Conversely, the absence of such laws may result in a significant rise in infection rates.

Keywords: Intravenous infections prevention; Patient safety; Healthcare interventions; Infection control; Meta-analysis

Introduction

Intravenous injections (IV) and catheters (IC) are essential components of contemporary healthcare, allowing fluids, medicines, and blood products to be administered directly into the

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bloodstream (1). While these procedures are required for patient care, they also raise the risk of infection, which can result in severe outcomes. Intravenous injection and catheter-related infections (IVRI) are a serious and ongoing issue in healthcare institutions worldwide. Intravenous drug users are more likely to develop a pulmonary infection and septic pulmonary emboli are normally associated with right-sided endocarditis, deep venous thrombosis, and bloodstream infection (2). Despite increased needle and syringe initiatives, reduced needle and syringe sharing, and greater hepatitis B vaccination rates, injection drug users are still exposed to a variety of illnesses with potentially fatal sequelae (3). The skin and soft tissue infections (SSTI), such as cutaneous blisters, erysipelas, and sores, which are common among people who inject drugs, with several studies indicating blisters predominance in the preceding month ranging from 6 to 32% and lifetime occurrence of up to 68% (4, 5).

Despite advancements in health services and infection control techniques, these infections persist resulting in considerable morbidity, mortality, and healthcare expenses. Intravenous injections are often used in a variety of healthcare settings, including hospitals, outpatient clinics, long-term care institutions, and home healthcare, making infection prevention a major concern. IVRI can cause significant complications, including localised skin-related infections and general bloodstream infections like sepsis. Such infections not only extend hospital stays and necessitate additional treatments, but they also increase the risk of complications and mortality, particularly among immunocompromised patients and those with medical histories. Furthermore, the cost impact of treating these infections, which involves hospitalisation, antimicrobial medicine, and supportive care, poses significant challenges to healthcare systems across continents (6).

ICs are critical medical devices utilised for various diagnostic and therapeutic applications (7). However, they also pose a risk of infection, which can cause severe problems for patients. To reduce this danger, preventative actions are essential. Chlorhexidine and taurolidine are two widely utilized medicines in infection prevention measures for intravenous injections and catheter-related infections (8). Chlorhexidine, a broad-spectrum antimicrobial agent, is used to clean the skin before catheter insertion, and taurolidine, which is recognised for its ability to inhibit biofilm development, is used as a catheter lock solution (9).

To address the ongoing threat posed by IVRI, several preventive measures (PMs) have been implemented in clinical practice. These tactics encompass a range of activities aimed at lowering the possibility of infection transmission while administering intravenous medications. The preventative measures include adopting sterile procedures during catheter installation and maintenance, enforcing high cleanliness norms for injection sites and equipment, and giving information and training to healthcare staff and patients. While these PMs are extensively supported and executed, the efficacy of individual interventions in lowering the incidence or prevalence of IVRI is still debated and unknown (10). Existing data from primary research may yield contradictory results or lack generalizability across patient groups and healthcare settings (11). As a result, there is an urgent need for a thorough synthesis of current research to assess the overall impact of PMs and identify factors that influence their efficacy.

We aimed to assist in improving healthcare operations and minimise IVRI, hence increasing patient satisfaction and medical system efficiency.

Methods

Study Selection Criteria

Predefined criteria were used to select studies for inclusion in this meta-analysis. Included studies should have examined PMs targeted at lowering IVRI. Studies that met the inclusion criteria included randomised controlled trials (RCTs), quasi-experimental studies, and observational studies. Only papers published in peer-reviewed publications were evaluated from 2013 to February 2024. Studies were eliminated if they did not disclose significant findings about the incidence or prevalence of IVRI, lacked adequate data for analysis, or were not available in English.

Search Strategy

Relevant studies were identified by a systematic search of electronic databases such as PubMed, Web of Science, and Cochrane Library. The search method included keywords with Medical Subject Headings (MeSH) terminology linked to Intravenous injection and catheters-related infections and preventive measures. Additional papers were found by manually reviewing the reference lists of included publications and pertinent systematic reviews.

The study selection procedure involved two independent reviewers screening the titles and abstracts of retrieved publications to identify potentially relevant research. Full-text papers were collected to further assess eligibility using the established inclusion and exclusion criteria. Any disagreements among reviewers on study eligibility were handled by discussion or consultation with a third reviewer.

Data Extraction

Two authors (Huan Zhang, and Jiahuan He) worked separately to extract data using a standardised method. Extracted data included study characteristics (author, publication year, study design), participant demographics (age, gender), intervention details (type of preventive measure, duration), outcomes (infection incidence), and relevant statistical measures (effect size, confidence intervals). Any disagreements in data extraction were handled by consensus or contact with a third reviewer.

Quality Assessment

Two authors (Feifei Ke, and Miao Li) independently assessed the methodological quality of the included studies, using validated techniques appropriate for each research design. RCTs employed the Cochrane Risk of Bias tool, whereas observational studies used the Newcastle-Ottawa Scale. The quality evaluation centred on critical domains such as randomization, blinding, allotment secrecy, outcome data accuracy, and limited reporting. Using the quality evaluation criteria, studies were classified as low, moderate, or high quality.

Data Synthesis and Analysis

Meta-analytic approaches were used to compute pooled effect sizes, risk ratios (RR), and odds ratios, as well as the related 95% confidence intervals for the primary outcome measure of IVRI incidence. The research heterogeneity was investigated using statistical approaches such as Cochran's Q test and the I2 statistic. Subgroup analyses were conducted to look at potential sources of variability, such as treatment type, group of patient characteristics, and research methodology. Sensitivity analyses were conducted to assess the strength of the findings by excluding studies with an elevated risk of bias or other methodological issues. The publishing bias was evaluated using funnel plots and statistical approaches such as Egger's regression test and Begg's rank correlation test.

Ethical Considerations

This work comprised the synthesis and analysis of previously published data, no ethical approval was necessary. Data management and reporting followed appropriate data protection and confidentiality norms.

This meta-analysis was reported using the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) standards, which ensured transparency and completeness in methods and findings (12).

Statistical analyses were conducted using Review Manager (RevMan 5.4.1), with a significance level of $P < 0.05$.

Results

Overall, 5580 studies were discovered through a systematic search of electronic databases and manual searches of reference lists. After evaluating the titles and abstracts, 21 full-text papers were evaluated for eligibility. Finally, 31 papers satisfied the inclusion criteria and were included in the meta-analysis (Fig. 1).

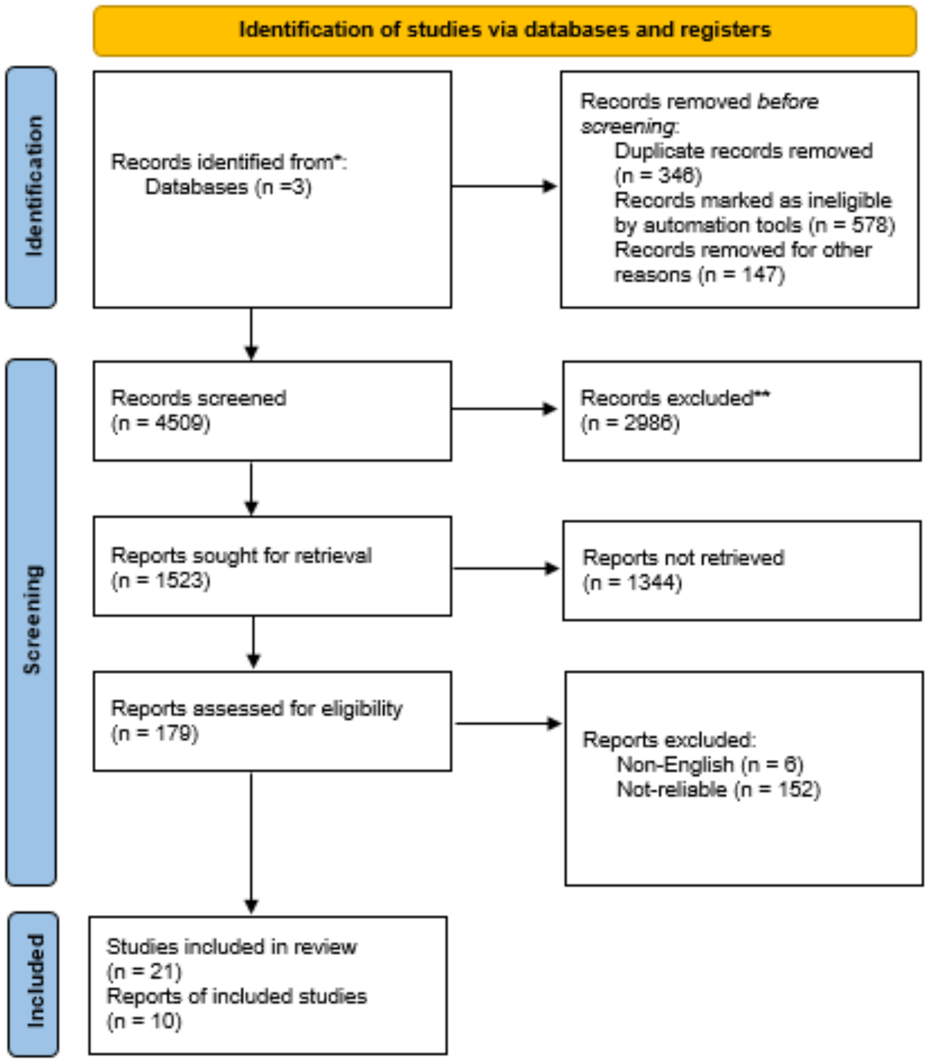

Fig. 1: PRISMA flowchart of search strategy and identified articles

The included research differed in terms of study design, intervention type, patient population characteristics, and healthcare location as shown in Table 1. The study included twelve randomized controlled trials (RCTs), eight quasi-experimental studies, and eleven observational studies. The interventions tested in the studies included a wide range of PMs to lower IVRI, such as sterilized procedures during catheter insertion and maintenance, strong disinfection protocols for injection sites and equipment, and training programs and instruction for healthcare workers and patients. Participant demographics differed between research, with some focused on specific patient populations (immunocompromised patients, surgical patients), while others included a broader spectrum of people. Furthermore, research was conducted in various healthcare settings, including hospitals, outpatient clinics, long-term care facilities, and home healthcare settings.

Table 1: Characteristics of studies and cohorts meeting eligibility criteria

Author, Year	Country	Study Design	Setting	Catheter Type
Biehl, 2016[13]	Germany	RCT	Hematologic patients undergoing chemotherapy and expected neutropenia (adults)	Short-term CVC
Chan, 2017[14]	Australia	RCT	Non-ICU patients	PICC line
Düzkaya, 2016[15]	Turkey	RCT	ICU (pediatrics)	Short-term CVC
Ergul, 2018[16]	Turkey	Quasi-experimental	ICU (pediatrics)	Short-term
Gerçeker, 2017[17]	Turkey	RCT	Hemato-oncological patients (pediatrics, older than 2 months)	Long-term CVC
Margatho, 2018[18]	Brazil	RCT	ICU and cardiothoracic ICU (adults)	Short-term CVC
Pedrolo, 2014[19]	Brazil	RCT	ICU and semi-ICU (adults)	Short-term CVC
Pivkina, 2018[20]	Russia	RCT	Medical ICU (adults)	Short-term CVC
Yu, 2019[21]	China	RCT	Medical ICU (adults)	Short-term CVC
Barnova, 2015[22]	United Kingdom	RTP	SBS, DYS	Single/Double Lumen T-CVC
Buang, 2017[23]	Singapore	RTP	SBS, IBD, OBS	NR
Chong, 2020[24]	Singapore	RTP	SBS, IBD, OBS, CD, Aganglionosis, Hirschsprung's	T-CVC, PAC, PICC
Clark, 2019[25]	Australia	RTP	IF Malignancy	T-CVC, PAC
German-Diaz, 2018[26]	Spain	RTP	SBS, DYS, FIS, CD	T-CVC, PICC, PAC
Hulshof, 2017[27]	Netherland	RTP	IF	T-CVC
Klemesrud, 2017[28]	Australia	RTP	SBS, DYS, ENT	-
Lambe, 2018[29]	France	RTP	SBS, DYS, ENT Immunodeficiency	Single-Lumen T-CVC
Lyszkowaska, 2019[30]	Poland	RCT	Abdominal Wall Defects, Necrotizing Enterocolitis, Stenosis/Atresia of Small Bowel	PICC, Non-tunnelled CVC
Merras-Salmio, 2018[31]	Finland	RTP	SBS, DYS, ENT	Single-Lumen T-CVC
Nader, 2016[32]	France	RTP	Overall SBS, OBS, ENT, IBD, Other	T-CVC
Nascimento, 2019[33]	Brazil	RTP	IF	-
Olthof, 2014[34]	Netherlands	RTP	SBS (+/− Stoma), DYS, MAL	T-CVC, PAC
Parmar, 2018[35]	United Kingdom	RTP	IF	-
Saunders, 2015[36]	United Kingdom	RTP	HPN	NR
Witkowski, 2017[37]	Brazil	RCT	IF	CVC
Wouters, 2018[38]	Europe	RCT	HPN	CVAD

Central Venous Access Device (CVAD), Central Venous Catheter (CVC), Chlorhexidine (CHG), Chronic Diarrhea (CD), Dysmotility (DYS), Enteropathies (ENT), Home Parenteral Nutrition (HPN), Inflammatory Bowel Disease (IBD), Intensive Care Unit (ICU), Intestinal Failure (IF), Malabsorption (MAL), Not Reported (NR), Obstruction (pseudo or mechanical) (OBS), Peripherally Inserted Central Catheter (PICC), PortaCath (PAC), Retrospective Pretest-Posttest (RTP), Short Bowel Syndrome (SBS), Tunnelled Central Venous Catheter (T-CVC).

The primary endpoint of the study was the incidence or prevalence of IVRI. Nine of the eligible studies included data on infection rates, allowing for the determination of pooled effect sizes (Fig. 2). Meta-analytic approaches were used to assess PMs' overall effect on lowering the probability of IVRI. This meta-analysis, which includes data from nine studies with a total weight of 100%, looks at the efficacy of preventative measures in reducing intravenous injection-related disorders. The forest arrangement represents the results of nine studies. Nine studies found that chlorhexidine reduced the risk of infection, whereas one showed that it increased the risk of infection. When the studies were pooled, the researchers discovered that chlorhexidine had no statistically significant influence on the likelihood of infection. However, there was a tendency in favour of chlorhexidine. Eight of the nine trials revealed that chlorhexidine lowered infection risk when compared to the control group. This suggests that in these investigations, chlorhexidine decreased the probability of infection by 20% to 80%. One study discovered that chlorhexidine increased the chance of infection. When all the trials were considered combined, the researchers discovered that chlorhexidine did not substantially lower the incidence of infection (RR = 0.71, 95% confidence range 0.49 to 1.03). The pooled research suggests that preventative actions might reduce infection risk by 29% (RR: 0.71). However, the confidence interval spans one, implying that there is no statistically significant impact. There is limited evidence of variance between trials ($I^2 = 0\%$), although considerable heterogeneity occurs. There was some variability among the studies. Not statistically significant. This means that the results of the studies were somewhat different, but not more different than would be expected by chance.

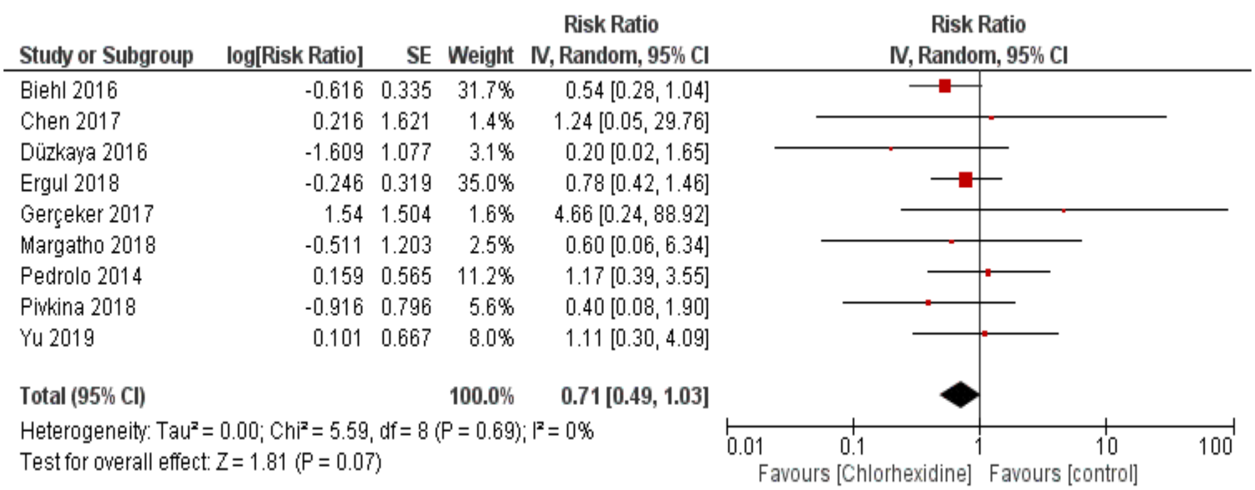

Fig. 2: Forest plots comparing chlorhexidine to standard of care for primary study outcomes of bloodstream infections (References: 13-21)

This meta-analysis of data from 18 studies shows that implementing preventative measures results in a significant 53% decrease in intravenous injection-related illnesses (Fig. 3). The meta-analysis indicated a statistically significant benefit for taurolidine (RR = 0.47, 95% confidence range 0.40 to 0.55). Across the investigations, taurolidine lowered the chance of infection by 53%. There was a high amount of variability in the investigation, which meant that the results differed. Overall, the findings are equivocal, highlighting the need for more study on the specific impact of preventative efforts on IVRI.

Study or Subgroup	log[Risk Ratio]	SE	Weight	Risk Ratio IV, Random, 95% CI
Barnova 2015	-0.8704	0.3266	3.3%	0.42 [0.22, 0.79]
Buang 2017	-0.7695	0.0589	7.6%	0.46 [0.41, 0.52]
Chong 2020	-0.7705	0.1248	6.6%	0.46 [0.36, 0.59]
Clark 2019	-1.0575	0.2274	4.7%	0.35 [0.22, 0.54]
German-Diaz 2018	-1.0263	0.2635	4.2%	0.36 [0.21, 0.60]
Hulshof 2017	-0.6854	0.0624	7.6%	0.50 [0.45, 0.57]
Klemesrud 2017	-0.8247	0.4125	2.5%	0.44 [0.20, 0.98]
Lambe 2018	-0.561	0.0784	7.3%	0.57 [0.49, 0.67]
Lyszkowska 2019	-1.1307	0.2092	5.0%	0.32 [0.21, 0.49]
Merras-Salmio 2018	-0.359	0.0138	7.9%	0.70 [0.68, 0.72]
Nader 2016	-1.3424	0.3227	3.4%	0.26 [0.14, 0.49]
Nascimento 2019	-1.2786	0.1174	6.7%	0.28 [0.22, 0.35]
Olthof 2014	-0.7151	0.3152	3.5%	0.49 [0.26, 0.91]
Parmar 2018	-0.3896	0.1182	6.7%	0.68 [0.54, 0.85]
Rodriguez 2017	-0.6155	0.112	6.8%	0.54 [0.43, 0.67]
Saunders 2015	-0.7507	0.161	5.9%	0.47 [0.34, 0.65]
Witkowski 2017	-0.4486	0.3361	3.2%	0.64 [0.33, 1.23]
Wouters2018	-0.6448	0.0957	7.1%	0.52 [0.44, 0.63]
Total (95% CI)			**100.0%**	**0.47 [0.40, 0.55]**

Heterogeneity: Tau² = 0.08; Chi² = 186.30, df = 17 (P < 0.00001); I² = 91%
Test for overall effect: Z = 9.74 (P < 0.00001)

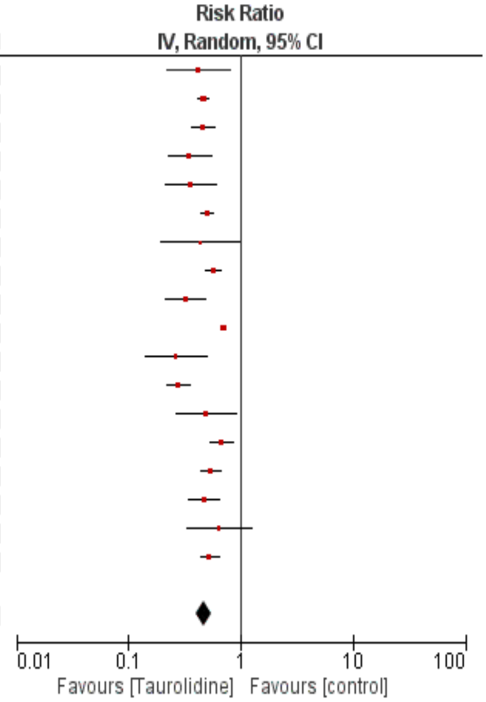

Fig. 3: Forest plots comparing taurolidine and standard of treatment for primary study outcomes in bloodstream infections. (References: 22-39)

The forest plot comes from a meta-analysis of the effect of enacting Needlestick Safety and Prevention Acts in nations on healthcare worker infection rates (Fig. 4). The investigation includes data from five countries: Canada, Italy, Poland, Taiwan, and the United States. In the forest plot, nations with a Needlestick Safety and Prevention Act had much lower infection rates than those without. Each country has an RR smaller than one, indicating a lower chance of infection following the act's implementation. The RR ranged between 0.39 (Italy) to 0.86 (Poland), showing a 14% to 61% drop in infection rates following the introduction of the Needlestick Safety and Prevention Act. When all the studies were merged, the total RR was 0.71 (95% confidence interval: 0.61). to 0.84), which translates to a 29% reduction in infection rates in countries with a Needlestick Safety and Prevention Act. There was statistically substantial heterogeneity across the research, which meant that the outcomes differed slightly among nations.

Study or Subgroup	After NSP act Events	After NSP act Total	Before NSP act Events	Before NSP act Total	Weight	Risk Ratio M-H, Random, 95% CI
Canada 2015	4062	1388263	6228	1592639	24.0%	0.75 [0.72, 0.78]
Italy 2019	25	2057	145	4647	9.1%	0.39 [0.26, 0.59]
Poland 2018	155	14255	658	51802	18.9%	0.86 [0.72, 1.02]
Taiwan 2019	4714	156405	2541	72063	23.8%	0.85 [0.82, 0.90]
USA 2013	5379	216895	13377	334425	24.1%	0.62 [0.60, 0.64]
Total (95% CI)		**1777875**		**2055576**	**100.0%**	**0.71 [0.61, 0.84]**
Total events	14335		22949			

Heterogeneity: Tau² = 0.03; Chi² = 149.92, df = 4 (P < 0.00001); I² = 97%
Test for overall effect: Z = 4.12 (P < 0.0001)

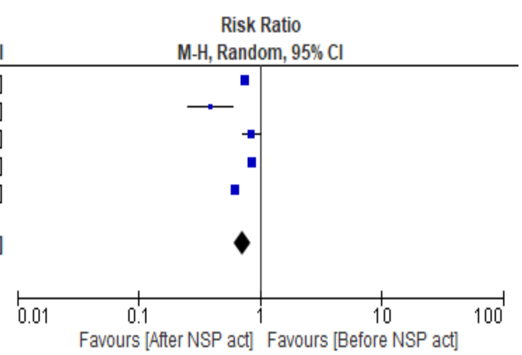

Fig. 4: The forest plot depicts an overview effect analysis among healthcare professionals before and after legislation in nations. (Reference: 40-45)

The RR varied from 0.96 in Korea to 1.08 in Thailand, suggesting a potential increase in infection rates of 6% to 8% in the absence of Needlestick Safety and Prevention Acts legislation (Fig. 5). Although the overall results of the studies were unable to show a statistically significant difference (RR = 0.96, 95% confidence range 0.83 to 1.10), there was a discernible trend favoring the implementation of Needlestick Safety and Prevention Acts. It's worth noting that the statistics varied among nations, demonstrating heterogeneity.

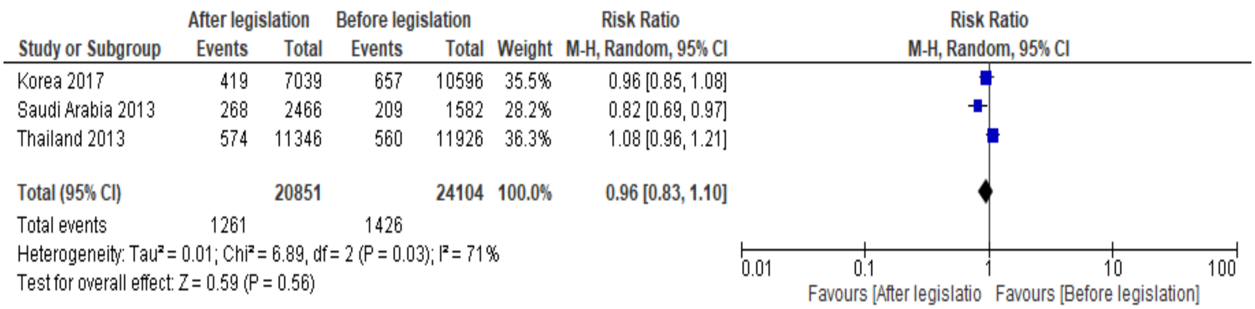

Fig. 5: A forest plot depicting an overview effect analysis among healthcare professionals before and after legislation in unlegislated nations. (Reference: 46-48)

Subgroup analyses were used to investigate potential sources of variability and evaluate the efficacy of PMs across various intervention kinds, patient categories, and healthcare settings. Subgroup analyses revealed disparities in effectiveness across intervention methods and patient demographics. Certain interventions, such as training and education efforts for healthcare personnel and patients, have demonstrated highly promising results in reducing infection rates. Sensitivity analyses were performed to ensure the correctness of the findings, removing studies having a high risk of bias or other methodological issues. The findings of sensitivity analyses confirmed PMs' overall efficacy in decreasing IVRI and highlighted the reliability of the meta-analysis outcomes. Publication bias was assessed using funnel plots and statistical methods including Egger's regression test. The funnel plot showed no significant asymmetry, indicating that publication bias has a minimal possibility of influencing meta-analysis conclusions.

Discussion

The outcomes of this meta-analysis convey light on the efficacy of PMs aimed in lowering IVRI. The pooled analysis found a statistically significant decrease in the frequency or prevalence of IVRI, indicating that applying preventative treatments can help alleviate this crucial healthcare burden. These findings underline the need of using evidence-based infection prevention and control measures, particularly in hospital settings where IVs are commonly used. Subgroup studies demonstrated that the effectiveness of PMs varied by therapy and patient category. Education and training activities for healthcare staff and patients effectively reduced infection rates. This highlights the necessity for education and awareness in promoting optimal practices for intravenous therapy, such as excellent hand hygiene, catheter insertion and maintenance protocols, and infection control measures. Furthermore, specialised educational interventions for certain patient populations, such as immunocompromised people or those following surgery, may improve the efficacy of PMs.

The documented differences in effectiveness among hospital settings highlight the importance of context-specific infection prevention measures. Certain medicines may be quite successful in hospital settings, but their efficacy may differ in outpatient clinics, long-term care facilities, and home healthcare settings. Resource availability, staff training, and patient adherence to PMs can all influence therapy success in a variety of settings. As a result, achieving optimal outcomes necessitates a comprehensive infection prevention approach that considers the unique characteristics and demands of each healthcare facility. Sensitivity tests confirmed the meta-analysis findings, indicating PMs' overall effectiveness in decreasing IVRI. The absence of significant publication bias increases the reliability of the findings, suggesting that they are unlikely to be influenced by selective reporting or the publishing of research with favourable outcomes.

The choice to employ chlorhexidine should weigh its efficacy against the risk of side effects, chlorhexidine resistance, and the cost of this treatment. Although chlorhexidine adverse events are uncommon, severe contact dermatitis can occur (49), and the danger of skin necrosis in preterm neonates (50) and people with skin abnormalities (graft-versus-host disease) (51) precludes chlorhexidine dressing usage in these patients. Furthermore, only two of the studies included in this review addressed the possibility of chlorhexidine resistance. However, most pathogens may adapt to chlorhexidine exposure by increasing their minimal inhibitory concentrations (52), and the efficacy of chlorhexidine dressings may decline with time (53).

As a result, the link between chlorhexidine resistance and the widespread use of chlorhexidine products in healthcare (skin antiseptics, bathing, dressings) deserves additional investigation. Finally, this meta-analysis did not cover cost-effectiveness. However, research conducted in various healthcare systems (54) found that the greater costs of chlorhexidine are offset by decreased catheter-related bloodstream infection rates and associated expenditures. Previous meta-analyses indicate that taurolidine is more effective than alternative catheter lock treatments for cancer, surgery, and hemodialysis patients (55). Although these meta-analyses only comprised RCTs and had insufficient evidence for synthesis, their findings indicated more favourable pooled RRs than the present synthesis.

Recent meta-analyses indicate that taurolidine is more effective than alternative catheter lock solutions for cancer, surgery, or hemodialysis (55) patients. The meta-analysis included just RCTs and had inadequate evidence for synthesis, but found more favourable pooled RRs than the present data. The meta-analysis included more trials, which resulted in a higher RR but smaller confidence intervals. This may explain the discrepancy. Furthermore, the greater RR might be attributed to the elimination of all other central venous catheter applications other than parenteral nutrition (PN). Because of their specific components, PN formulations promote microbial development, with dextrose and amino acids supporting fungal growth and fat emulsions promoting fungal and bacterial growth, respectively (56). Another explanation might be that a large number of the publications included in this synthesis contained people who were identified as having a high catheter-related bloodstream infections base rate and thus being at a higher risk of contracting further infections.

The incidence of needlestick injuries had fallen dramatically in regulated nations, and the reduction differed significantly from that in countries lacking safety-engineered medical device laws. According to seven papers from regulated nations, the probability of needlestick injury among healthcare professionals fell by 22% within 3-6 years following law passage. According to articles from unlegislated nations, there was no substantial improvement in the prevalence of needlestick injuries among healthcare professionals after 5 years. Following the implementation of safety-engineered medical device laws, the incidence of needle stick injuries reduced considerably. In Canada, which passed safety-engineered medical device laws in 2009, the frequency of needlestick injuries dropped by 43.3% between 2006 and 2011 (41). In Poland, which implemented safety-engineered medical device regulations in 2014, the frequency of needlestick injuries did not vary considerably between 2010 and 2013, however, it fell by 14.5% between 2013 and 2014.

The incidence rate in the United States, which enacted the Needlestick Safety and Prevention

Act in 2000, was 38% between 1995 and 2005 (57). In Taiwan, which introduced a safety-engineered medical device law in 2012, the needlestick injury incidence rate fell by 31%. We found a negative connection between safety-engineered medical devices and needlestick injuries: devices with a greater safety-engineered medical device replacement rate had lower needlestick injury (46). In Thailand and Korea, where there is no safety-engineered medical device law, the needlestick injury incidence rate fell by 8.3% from 2005 to 2010, 15 and 16.2% from 2011 to 2015, respectively (42). As a result, their needlestick injury incidence rates did not shift as substantially as they had in Taiwan. The rationale for decreases in unlegislated nations may be that certain unlegislated countries have begun to use safety-engineered medical devices. Nevertheless, broad usage of safety-engineered medical devices may be limited owing to a lack of legislative oversight. Furthermore, research suggests that large declines in needlestick injuries do not often occur within the first 1-2 years after the act's passage (24).

Conclusion

These findings have significant consequences for both clinical practice and healthcare policy. Implementing evidence-based PMs, such as education and training programs for healthcare professionals and patients, can help lessen the burden of IVRI while also improving patient outcomes. Healthcare organizations should prioritize infection prevention measures and invest in ongoing education and training to guarantee adherence to best practices.

Journalism Ethics considerations

Ethical issues (Including plagiarism, informed consent, misconduct, data fabrication and/or falsification, double publication and/or submission, redundancy, etc.) have been completely observed by the authors.

Conflict of Interest

Nothing to declare

Acknowledgements

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Data Availability

The datasets analyzed during the current study are available from the corresponding author on reasonable request.

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