Review Article

# Prevalence of Needlestick Injuries among Iranian Nurses: A Systematic Review and Meta Analysis


## Abstract

**Background:** Injuries caused by sharp objects are a major health risk for nurses. These injuries can be extremely dangerous and lead to various diseases. The purpose of this study was to establish the pooled prevalence of Needle Stick Injuries (NSIs) among nurses in Iran. **Materials and Methods:** This study was a systematic review and meta-analysis. Eligible articles were searched from five electronic databases (Scientific Information Database (SID), Magiran, Web of Science, PubMed, and Scopus) and one search engine. A random effects model was conducted to estimate the pooled prevalence. The heterogeneity of the sample was tested using the $I^2$ index, and the meta-regression function was used to evaluate variables suspected of heterogeneity at the 0.05 significance level. Finally, 21 articles were analyzed using the Comprehensive Meta-Analysis software (ver. 2.2.064). **Results:** Based on the random-effects model, the frequency of NSIs among Iranian nurses is 18.70% (95% CI: 15.10%–22.90%). The highest frequency is recorded in a teaching hospital in Tehran in 2007 (19.80%; 95% CI: 16.40%–23.70%), and the lowest frequency was recorded in a teaching hospital in Tehran in 2008 (17.90%; 95% CI: 14.60%–21.80%). Sample size, mean age, and work experience were significantly associated with and mean and frequency of NSIs in nurses ($p < 0.05$). **Conclusions:** NSIs occur in about one-fifth of nurses in Iranian hospitals. In addition to its cost burden, the increase in NSIs has negative consequences for nurses. Therefore, health policymakers and managers must take serious action to reduce these injuries.


**Keywords:** *Hospitals, needle stick injuries, nurse, patient safety, prevalence*


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## Introduction

Needle Stick Injuries (NSIs) are percutaneous wounds caused by hypodermic needles, broken glass, or other sharp objects contaminated with blood or bodily fluids. NSIs often occur during activities such as blood transfusion, blood sampling, needle disposal, handling of disposed materials, and transfer of blood or other bodily fluids.[1] Each year, approximately 600,000–800,000 NSIs are reported in the US, 500,000 in Germany, and 100,000 in the UK.[2,3] Medical staff, including doctors, nurses, laboratory technicians, operating room staff, and service workers, are more susceptible to these injuries than others. However, nursing staff are more at risk as they often perform multiple injections per shift.[4-6] Various factors can lead to injuries among medical staff, including nurses. Heavy workload, inadequate staffing, frequent shifts, and excessive fatigue are among the factors that increase the risk of injuries among nurses, especially in developing and developing countries.[7-9] For example, several studies such as Sindoni[10] in Italy, Watterson[11] in the US, and Jahan[12] in Saudi Arabia have shown that nurses are more susceptible to sharps injuries due to the nature of their work, especially during fluid therapy, blood transfusion, and blood sampling. Another study in South Korea in 2013 identified three factors in the occurrence of NSIs among health workers: engineering factors (e.g., design of devices and tools), organizational factors (e.g., reporting policies), and behavioral factors (e.g., issues with needle recapping and disposal).[13]

In addition to the potential transmission of bacteria, viruses, fungi, and parasites, NSIs can have a range of psychological effects on health care workers, including depression, insomnia, and post-traumatic stress disorder.[14-16] Moreover, individuals who sustain these injuries tend to experience



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fear, anxiety, stress, and emotional distress, resulting in occupational and behavioral changes.[17,18] NSIs can incur substantial direct costs. For example, a 2005 study in the US found that the estimated cost of NSIs ranged from $51 to $3,766, with an incidence rate of 14 to 839 NSIs per 1,000 healthcare workers.[19] The results of a study in Yazd in 2004 estimated the cost of sharps injury management in employees at about $500 million, with about $1 million in additional costs in case of HIV or hepatitis infection and the subsequent absenteeism.[20] NSIs also incur indirect costs to the health system, including lost productivity, heavy workload for other healthcare workers, and workers' compensation.[21]

Several researches have been conducted on the prevalence of needle stick injuries in nurses in Iran. However, these studies cannot provide a complete picture of the prevalence of needle stick injuries in Iranian nurses. Aggregation and integration of the results of the conducted studies provides correct information for evidence-based decision-making by health policymakers and hospital managers. Therefore, the present research was conducted to determine the prevalence of NSIs among Iranian nurses. In this study, question according to Population, Intervention, Control, and Outcomes (PICO) includes Population: nurses. The purpose of this study was to establish the pooled prevalence of needle-stick injuries (NSIs) among nurses in Iran.

## Materials and Methods

This study was a systematic review and meta-analysis of the prevalence of NSIs among Iranian nurses. This study was conducted and designed in 2020. All the articles published on this topic were identified through a systematic search of five databases (i.e., Scientific Information Database (SID), Magiran, Web of Science, PubMed, and Scopus) and the Google Scholar search engine. Database search was performed using Persian keywords and their English equivalents with the appropriate Boolean operators, including the words Prevalence, needlestick injur*, needlestick, needle stick, needle injur*, needle* stick injur*, Sharp Injury, nurse, and Iran [Table 1]. In this study, question according to Population, Intervention, Control, and Outcomes (PICO) includes Population: Nurses; Intervention: prevention measures against needle stick injuries; Comparison: no injuries; and Outcome: needle stick injuries. In addition, the reference lists of all related articles were reviewed to find additional papers. The data were updated until 30/1/2023.

**Table 1: Search strategy specific to the international electronic databases**

| | Search strategy |
|---|---|
| #1 | "needlestick injur*" OR "needle stick *" OR needlestick OR "needle injur*" OR "needle* stick injur*" OR "sharp injury" |
| #2 | nurse |
| #3 | Prevalence |
| #4 | Iran |
| #5 | (#1 AND #2 AND #3 AND #4) |

All Persian and English articles that examined the frequency of NSIs among Iranian nurses, published until the end of January 2023, were included. Exclusion criteria were as follows: studies published in languages other than Persian or English; articles published after January 2023; articles for which the full text was not available; reviews and books; qualitative studies; injury assessment in only one ward of the hospital; and studies that did not report NSI frequency among nurses. In total, 3127 articles were identified in the initial search. In the first screening stage, 3033 duplicates and articles without full texts available were removed. Next, by reviewing the titles and abstracts of articles, 69 unrelated studies were excluded. After a careful review of the remaining articles, eight articles that did not report NSI prevalence among nurses were removed. Four articles were obtained from the reference lists. Finally, 21 articles were used to evaluate the prevalence of NSIs among Iranian nurses [Figure 1].

The Joanna Institute (JBI) Critical Appraisal checklist was used to evaluate the quality of the reviewed articles.[22] This checklist consists of 8 items. The overall score above 7 indicates a high quality, between 4 and 6 shows medium quality, and below 3 shows poor quality. Articles were scored independently by three researchers. Any disagreement was resolved by a fourth reviewer. A data extraction form designed was used to collect information about the author (s), done year, location, population, sample size, type of hospital, mean age, mean work experience, type of activity leading to injury, article quality, and prevalence of injury [Table 2]. In studies that did not specify the done year, the year of publication was used.

The Comprehensive Meta-Analysis software was used to analyze the data. Due to the difference in incidence rates across studies, Cochran's Q test and $I^2$ index were used to evaluate the heterogeneity of the studies, which was calculated to be 92.03%. Due to the significance of the heterogeneity index, a random effects model was used in the meta-analysis. Finally, the effect of variables suspected of causing heterogeneity was evaluated using the meta-regression function. The point estimate of the frequency of NSIs among Iranian nurses was calculated with a 95% confidence interval (CI) in a forest plot, where the size of the squares indicates the weight of each study and the horizontal lines running through the squares indicate the 95% CI. The ethical considerations of the research, such as collecting data with precision and accuracy and interpreting the data without bias were observed.

### Ethical considerations

In this article, the authors avoided plagiarism in any form. The analysis results were quite honest. Moreover, the authors avoided data fabrication.

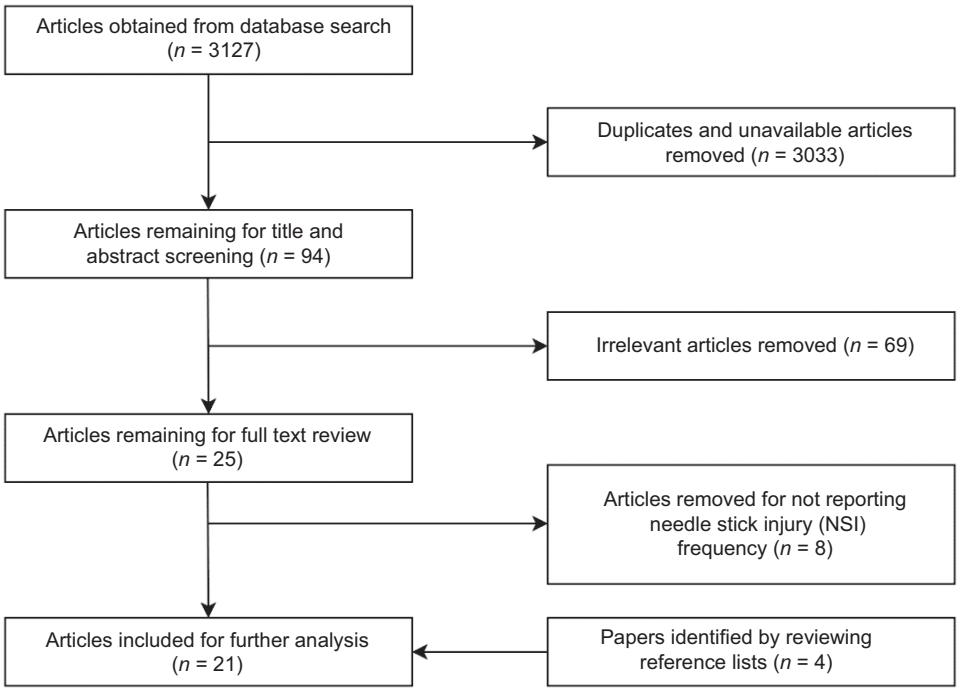


**Figure 1: Database search and article screening procedure**

## Results

A total of 21 studies have investigated the frequency of NSIs among Iranian nurses until January 2023. About 85.71% of the articles focus on teaching hospitals. Most of the articles have been published in 2014 ($n$ = 5). There is a spike in the number of publications between 2012 and 2015. Most articles have been conducted in the provinces of Tehran ($n$ = 6). The most common activities leading to injury are recapping ($n$ = 5). Six studies do not mention the cause of injury [Figure 2].

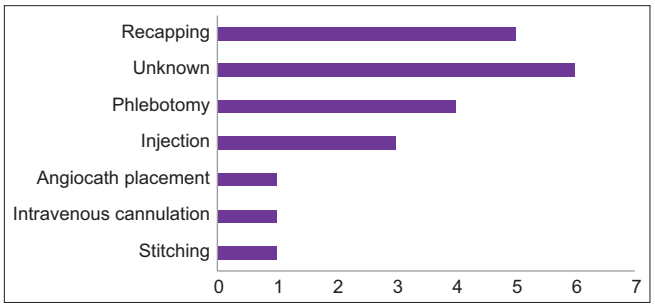


**Figure 2: Frequency distribution of reviewed articles by activities leading to injury**

Based on the random-effects model, the frequency of NSIs among Iranian nurses is 18.7% (95% CI: 15.1%–22.90%). The highest frequency is recorded in a teaching hospital in Tehran in 2007 (19.80%; 95% CI: 16.40%–23.70%), and the lowest frequency is recorded in a teaching hospital in Tehran in 2008 (17.90%; 95% CI: 14.60%–21.80%) [Figure 3].

NSIs have been more frequent in the southern provinces of Iran and in teaching hospitals compared to other types of hospitals. In addition, higher-quality studies tend to report higher frequency rates [Table 3]. The results indicated that the heterogeneity between studies is high ($Q$ = 251.218, $p < 0.001$). Therefore, the suspected variables were entered into a meta-regression model to identify the cause of heterogeneity. Based on the analysis results reported in Table 4, year, mean age, mean experience, and sample size contributed to the heterogeneity of the studies.

## Discussion

Based on a random-effects model, the frequency of NSIs among Iranian nurses was calculated to be 18.70%. Studies around the world have reported different results. For example, the prevalence of NSIs among nurses was reported to be 17.70% in Australia in 2006,[18,40] 27.90% in Malaysia in 2010,[2] 70.40% in Korea in 2013,[13] and 34.50% in Ethiopia in 2016.[17] These discrepancies could be in part due to differences in safety measures and self-reporting (culture) in hospitals. In addition, reported NSI frequency rates tend to vary depending on the measurement tool that has been used, which could explain some of the observed differences.

Nurses are more exposed to serious risks and injuries as they spend a great deal of time with patients and handle many invasive interventions. For example, a 2008 study of a tertiary hospital in the Republic of Korea found that nurses had the second highest incidence of NSIs after interns.[41] In addition, frequent shifts and overtime can increase the risk of these injuries.[42,43] A 2016 study showed that the incidence of NSIs in nurses was higher in the morning shift when nurses have

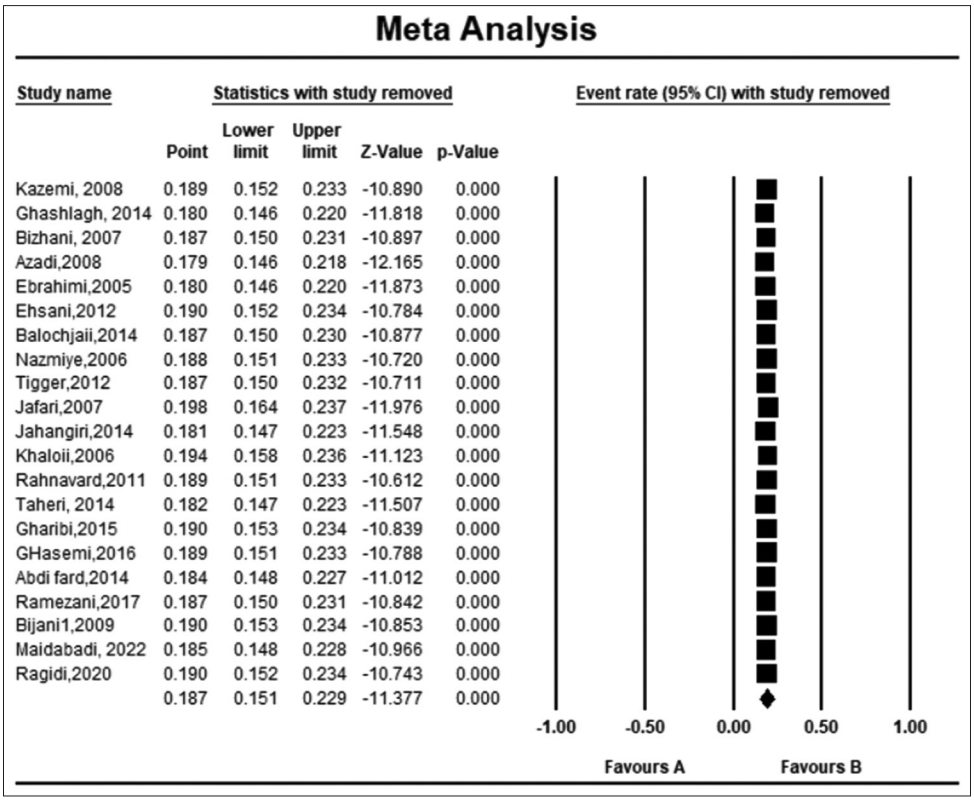


**Figure 3: Meta-analysis of the frequency of needle stick injuries among Iranian nurses based on the random-effects model**

**Table 2: Summary information of the reviewed articles**

| Ref. | Lead author | Year | Location | Mean age | Hospital Type | Sample size | NSI* Freq. (%) | Mean experience | Activity | Quality Score |
|---|---|---|---|---|---|---|---|---|---|---|
| [23] | Kazemi | 2008 | Tehran | 33.26 | Military | 158 | 22.15 | 13.53 | Injection | 7 |
| [24] | Gheshlagh | 2014 | Saqqez | 33.40 | Teaching | 120 | 44.20 | 9.80 | Stitching | 6 |
| [4] | Bijani | 2007 | Qazvin | 30.00 | Teaching | 172 | 32.00 | - | Phlebotomy | 6 |
| [25] | Azadi | 2008 | Tehran | 31.50 | Teaching | 111 | 45.90 | - | Recapping | 7 |
| [26] | Ebrahimi | 2005 | Shahrud | 32.50 | Teaching | 180 | 63.30 | 9.40 | - | 6 |
| [27] | Ehsani | 2012 | Tehran | 30.71 | Teaching | 328 | 45.12 | 9.03 | Recapping | 7 |
| [28] | Balouchi | 2014 | Kerman | 31.00 | Teaching | 200 | 39.00 | 9.30 | Recapping | 6 |
| [20] | Nazmieh | 2006 | Yazd | 35.00 | Teaching | 340 | 54.10 | - | Injection | 6 |
| [29] | Tirgar | 2012 | Babol | 33.8 | Teaching & Private | 333 | 59.70 | 10.30 | - | 6 |
| [30] | Jafari | 2007 | Tehran | 34.00 | Teaching | 613 | 32.78 | - | Phlebotomy | 5 |
| [31] | Jahangiri | 2014 | Shiraz | 29.67 | Teaching | 168 | 54.00 | 7.10 | Recapping | 7 |
| [32] | Khalouei | 2006 | Kerman | 34.00 | Teaching | 388 | 33.00 | 11.70 | Intravenous cannulation | 7 |
| [33] | Rahnavard | 2011 | Rasht | - | Teaching | 500 | 77.20 | - | Angiocath placement | 5 |
| [21] | Taheri | 2014 | Isfahan | 34.80 | Teaching | 175 | 55.20 | - | - | 4 |
| [34] | Ghasemi | 2016 | Tehran | 33.06 | Military | 267 | 41.20 | - | - | 5 |
| [35] | Gharibi | 2015 | Tabriz | 34.20 | Teaching | 265 | 34.30 | - | - | 5 |
| [36] | Abdifard | 2014 | Kermanshah | 32.31 | Teaching | 258 | 64 | 8.45 | Recapping | 7 |
| [37] | Ramzani | 2017 | Sari | 38.80 | Public & Private | 212 | 38.10 | - | Phlebotomy | 5 |
| [4] | Bijani | 2009 | Qazvin | 30.10 | Teaching | 246 | 31.30 | 6.00 | Phlebotomy | 5 |
| [38] | Majdabadi | 2022 | Tehran | 34.00 | Teaching | 200 | 45.50 | 6.70 | | 6 |
| [39] | Rashidi | 2020 | Khorramabad | - | Teaching | 380 | 53.70 | - | Injection | 7 |

*Needle Stick Injurie

a heavier workload in terms of the number of patients and medical duties. Factors such as new admissions, high patient turnover, surgical procedures, and other medical services such as blood tests all contribute to a higher workload for nurses in morning shifts.[44] Administrative controls can play an important role in reducing these injuries. These controls can include policies to reduce nurses' working hours and provide longer breaks between work shifts.[45]

**Table 3: Frequency of NSIs in the studied subgroups**

| Variables | No. Studies | NSI* (%) | 95% CI | Heterogeneity | |
|---|---|---|---|---|---|
| | | | | Percentage | *p* |
| Region | | | | | |
| Central | 8 | 17.60 | 16.00–19.40 | 93.79 | ≤0.01 |
| Northern | 6 | 19.20 | 13.70–26.30 | 89.75 | 0.10 |
| Southern | 1 | 32.10 | 5.60–25.39 | - | - |
| Eastern | 3 | 14.00 | 8.70–21.70 | 87.02 | ≤0.01 |
| Western | 3 | 23.40 | 13.00–38.50 | 92.71 | ≤0.01 |
| Hospital Type | | | | | |
| Teaching | 17 | 19.30 | 14.90–24.60 | 93.50 | ≤0.01 |
| Military | 2 | 14.90 | 11.80–18.60 | 0 | 0.69 |
| Teaching and Private | 1 | 17.90 | 14.20–22.40 | - | - |
| Public and Private | 1 | 18.00 | 13.40–23.70 | - | - |
| Quality Score | | | | | |
| High | 7 | 19.30 | 12.60–28.30 | 93.75 | ≤0.01 |
| Moderate | 14 | 18.40 | 14.30–23.30 | 91.58 | ≤0.01 |

*Needle stick injuries

**Table 4: Adjusted results for factors causing heterogeneity between the studies (meta-regression model)**

| Suspected variables | No. studies | Coefficient | *p* |
|---|---|---|---|
| Year | 21 | 0.014 | 0.07 |
| Mean Age | 19 | 0.008 | ≤0.01 |
| Mean Experience | 10 | 0.02 | ≤0.01 |
| Sample Size | 21 | −0.003 | ≤0.01 |

The results of this study showed that the most common activity leading to NSIs in nurses was recapping. This is not consistent with the results of the 2007 study by Bijani *et al*.[4] However, a study on Washington DC hospitals showed that most NSIs occurred during recapping. The use of engineering controls can make the workplace safer for nurses and reduce occupational injuries.[46] Hospital managers must pay attention to safety mechanisms when purchasing needles. In addition, needles that do not meet safety standards should be removed from the workplace. The results also showed that per unit increase in the mean age of nurses, the frequency of NSIs increases by 0.008%. This is not consistent with the results of Ghanei Gheshlagh *et al*.[24] and Smith *et al*.[18] Similarly in Cho *et al*.,[13] age was identified as a protective factor against NSI. In addition, per unit increase in the mean experience of nurses, the frequency of NSIs increased by 0.02%. This finding is consistent with the results of a 2012 study by Martins *et al*.[47] who found that staff with more than 10 years of experience were at higher risk than less-experienced staff. Perhaps this is because in the early years, nurses take all precautions in the workplace to prevent occupational injuries. With more experience, caution and attention to work may decrease, thus increasing the likelihood of human error and engaging in risky behaviors.

The highest frequency of NSIs among nurses was observed in teaching hospitals. This could be explained by the relatively high workload of nurses in these hospitals. In addition, NSIs were more frequent in the southern regions of Iran, which could be attributed to differences in hospital environment, organizational culture, personal protective equipment, and the types of services provided in different regions. However, this finding should be interpreted with caution since only one study was conducted in the southern region of the country and further research is needed for a more accurate assessment. Various factors such as training, personal protection equipment, and a self-reporting system can be effective in reducing NSIs in hospital nurses.[17,48] Training plays a specially important role in reducing these injuries.[48] For example, a 2012 study found that nurses who did not attend any training courses on the prevention and management of needlestick and sharps injuries were more susceptible to NSIs.[17] Therefore, holding training courses can increase awareness among nurses and enable them to avoid or reduce risky behaviors.

Adherence to international standards such as the use of protective equipment is another key factor in reducing NSIs.[49] Nurses who do not use personal protective equipment during their activities are about four times more likely to sustain injuries.[17] In addition, timely reporting can play a significant role in reducing exposure to occupational injuries in nurses. However, some studies have reported low levels of self-reporting in health centers.[42,50,51] Data from a university hospital in Germany showed that although an emergency medicine consultant is responsible for reporting occupational accidents, only 28.70% of healthcare workers reported their injuries.[51] In addition, the results of a study on Asian countries showed that the rate of underreporting was 76.20% in Thai hospitals and 99.30% in Pakistan.[50]

Hospital managers must develop and promote a workplace safety culture that encourages all members to report their occupational injuries without any fear. Improving workplace safety, promoting a safety culture, improving

work processes, creating an effective injury reporting system, training, and enhancing the well-being, motivation, and satisfaction of staff play an important role in reducing occupational injuries. Therefore, hospital managers should adopt a proactive approach to occupational injuries. They should identify occupational injuries, analyze their likelihood and severity, and take steps to prevent their reoccurrence. Managers should also develop and implement policies and guidelines for identifying and reporting occupational injuries. The limited number of high-quality studies on the frequency of NSIs led to this conclusion. However, more high-quality studies are needed in different provinces of Iran, followed by a systematic review and meta-analysis of their findings. Another limitation is the incomplete data for some of the variables used in this review. Some articles did not report any data for all the latent variables of interest for this review. Future researchers are advised to include such information to be used in systematic reviews and meta-analyses and to report the frequency of NSIs for each of the factors leading to such injuries among nurses.

## Conclusion

NSIs occur in approximately one-fifth of nurses in Iranian hospitals. Therefore, policymakers and administrators should consider preventive approaches such as the accomplishment of complete vaccination coverage, the maintenance of safety measures in a working environment, and reliable reporting system provision to confront this problem.

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### Conflicts of interest

Nothing to declare.

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