The State-of-the-Art Review and Meta-Analysis of High-Risk Conditions for Nosocomial Diseases (2019-2023)

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Abstract. Nosocomial infections are common complications in hospitals and health services, affecting 5-10% of hospital admissions in developed and developing countries, particularly in low-income countries. The effects of these infections vary, and the risk extends to patients, health workers, and visitor families. Patients may experience loss of income, injury, disability, death, treatment prolongation, increased hospital costs, and a weakening hospital's image. The risk is not limited to the patient but also extends to health workers and visitor families. The articles used in this research were articles that were published from 2019-2023 and were obtained from the Google Scholar, PubMed, Science Direct databases. The keywords used in finding articles were "vaccine and nosocomial and disease ", "affecting vaccine and nosocomial and cross-sectional study ", "vaccines and nosocomial and adjusted odds ratio ", "vaccine or nosocomial ", "affecting vaccine or nosocomial or cross-sectional study". Patients and health workers who were not vaccinated or whose vaccine status was incomplete had 1.54 times the risk of experiencing nosocomial disease compared to patients and health workers who had vaccines and complete vaccine status (aOR 1.54; 95% CI 0=1.01–2.33, p<0.001). There is a positive interaction and increases the risk of experiencing nosocomial disease in patients and health workers who are not vaccinated or whose vaccine status is incomplete.

Keywords: Vaccine, nosocomial infection, health status.

1 Background

Nosocomial infections are the most common complications that occur in hospitals and other health services. A systematic review found that healthcare workers (HCW) are at significantly greater risk of infection compared with adults working in non-care settings. However, vaccination coverage among health workers is still not optimal in many countries. In 2017-2018 the coverage rate among health workers was 40.2 % in Greece. Data from the World Health Organization (WHO) 2009 shows that around 8.7% of hospital patients experience nosocomial infections and more than 1.4 million people in the world suffer from hospital-acquired infections. 68.7% in the UK and 78.4% in the United States (Nabil J Awadalla et al, 2019).

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This nosocomial infection is an infectious disease that can be prevented with the Acinetobacter baumannii vaccine which can cause high morbidity and mortality in susceptible populations. In Honduras, an expanded program of immunization (EPI) was established to reduce morbidity and mortality from vaccine-preventable diseases. The world health organization (WHO) recommends that healthcare workers receive annual vaccinations. Vaccine effectiveness is 40-60% among healthy adults (Zachary J Madewell et al, 2021). An estimated 405,000 hospitalizations and 22,000 deaths result from this infection in the United States. Nosocomial infections are the most frequent local side effects in health care throughout the world, they are caused by bacteria, viruses, parasites and fungi around health institutions and continue to develop in hospitalized patients (Venkataraman et al, 2023).

A study in Singapore reported that hospital-acquired nosocomial infections, which account for an incidence rate of 1.03 per 10,000 patient days, had reached 7.1% of inpatient cases during 2013-2018 making nosocomial infections an important concern. According to the World Health Organization (WHO), 96 countries have recommended vaccination to health workers. Despite this, their vaccination coverage remains at a moderate level. Average vaccination rates of 37.4% and 30.2% are estimated in Asia and Europe, respectively (Chin Pok Chan et al, 2021). Data from the World Health Organization (WHO) in 2009 showed that around 8.7% of hospital patients experienced nosocomial infections and more than 1.4 million people in the world suffered from hospital-acquired infections.

Indonesia, through the Indonesian Ministry of Health, conducted a survey in 2019 of 10 general teaching hospitals, which found a fairly high number of 6-16% nosocomial infections, with an average of 9.8%. This survey, which was conducted at 10 hospitals in DKI Jakarta, showed that 9.8% of inpatients had new infections while being treated in hospital (Riani & Syafriani, 2019). From an epidemiological perspective, it can be explained that patients are the main source of infection which can spread bacteria through the clinical environment, medical equipment and hospital staff. In addition, Acinetobacter infection incidence can be influenced by person-to-person contact and bacterial resistance to antibiotics and disinfectants (Allen et al, 1987; Munoz-Price et al, 2013 in Akrami et al, 2018).

Many studies in North America have indicated the emergence of multidrug-resistant strains. Nosocomial infections are associated with seasonal infectious diseases, especially with the summer season (Akrami et al, 2018). Other research shows that there has been high inflation of AMR (Antimicrobial Resistance) in recent years and there has been no development of an effective vaccine for nosocomial pathogens (Venkataraman R, et al. 2023). Various studies have been carried out to look at the interaction of vaccination status with the incidence of nosocomial diseases However, research results still do not show consistent results. Further analysis is needed to obtain convincing conclusions regarding the interaction of vaccination status with the incidence of nosocomial diseases.

2 Method

2.1 Study design

This research is a systematic review and meta-analysis. The articles used in this research are articles that have been published from 2019-2023 and were obtained from Google Scholar, PubMed, Science Direct. The keywords used in finding articles were "vaccine and nosocomial and disease ", "affecting vaccine and nosocomial and cross-sectional study ", "vaccines and nosocomial and adjusted odds ratio ", "vaccine or nosocomial ", "affecting vaccine or nosocomial or cross-sectional study", "vaccine or disease or nosocomial or adjusted odds ratio".

2.2 Population and sample

The articles included in this research are text articles with observational studies that have been published from 2019-2023. The selected articles discuss the influence of vaccines and nosocomial viruses as predictors of exposure to nosocomial viruses in patients and health workers who have physical contact. The articles used are articles published in English. The research samples were hospital patients and health workers who had intense physical contact with patients. The research data is multivariate. The final results of the study were reported using the adjusted odds ratio (aOR).

2.3 Inclusion and exclusion criteria

The exclusion criteria in this study were articles with RCT, case control, quasi-experimental and protocol studies. Article not published in English. The statistical results reported are not aOR.

2.4 Definition of Operational Research

Nosocomial Infections are infections that occur in the hospital environment. A person is said to have a nosocomial infection if the infection is acquired while undergoing treatment in hospital. The impact of nosocomial infections can also be felt by medical and non-medical staff, namely increasing workload, feeling threatened in carrying out their work and allowing malpractice claims to occur (Karo et al, 2019).

The Acinetobacter Baumannii Vaccine is an inactivated or weakened antigen (microorganism) which, when given to a healthy person, produces specific antibodies against the microorganism, so that if they are then exposed, they will be immune and not get sick. The basic ingredients for making vaccines certainly require microorganisms, both viruses and bacteria. Growing microorganisms requires a growth medium that is stored at a certain temperature. The growing microorganisms will then be harvested, activated, purified, formulated and then packaged (Bio Farma, 2023).

2.5 Data Analysis

Data processing was carried out using Review Manager (RevMan 5.3) by calculating effect size and heterogeneity values to determine the combined study model and form the final meta-analysis forest plot results (Wiji Winarsih et al., 2019).

3 Result and Conclusion

3.1 Result

The process of searching for articles using a journal database is shown in Figure 1. Figure 2 shows the areas where articles are published according to the inclusion criteria. The articles in this research come from 3 continents are Asia, Africa and North America.

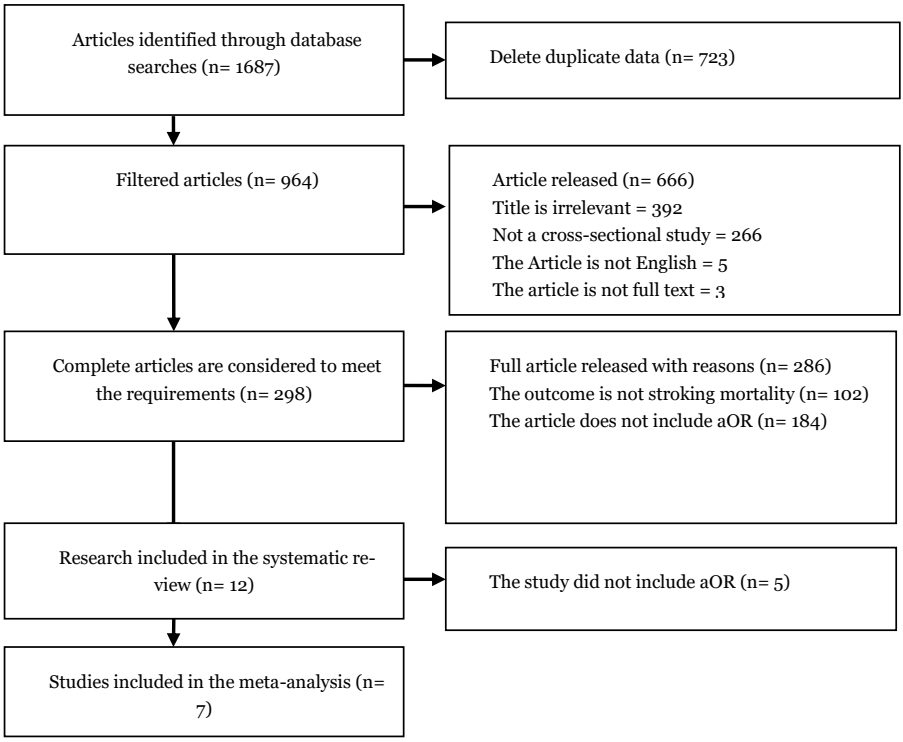

Figure 1. Flow diagram of the *review process*

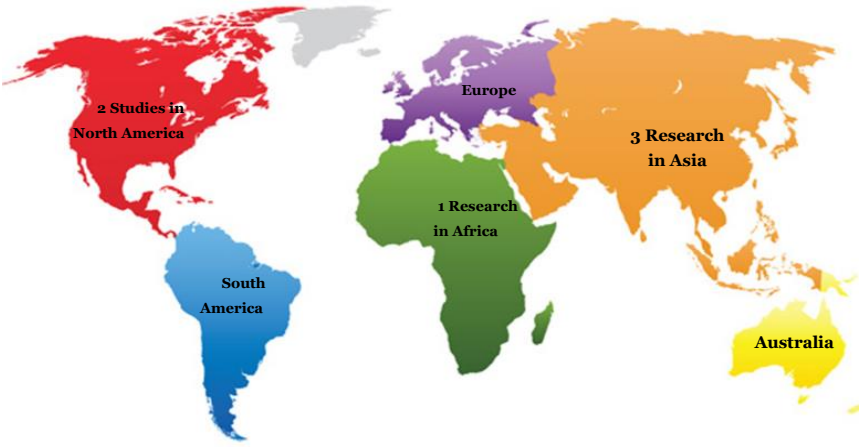

Figure 2. Map of the research area

Table 1. Interaction of Acinetobacter baumannii vaccine status on the incidence of nosocomial disease

Author (year)	Country	aOR	CI 95%	p
Chan *et al*. (2021)	Hong Kong	0.51	0.34 – 0.76	0.001
Awadalla *et al*. (2020)	Saudi Arabia	4.22	2.13 –8.35	<0.001
Ogunbosi *et al*. (2022)	Nigeria	4.13	2.99 - 5.70	< 0.001
McGrath *et al*. (2022)	Ireland	0.40	0.23 – 0.70	0.001
Madewell *et al*. (2021)	Honduras	1.73	1.12 – 2.68	0.013
She *et al.* (2022)	China	1.50	1.32 – 1.70	< 0.001
Garcia *et al*. (2022)	Canada	2.14	1.90 - 2.41	<0.001

Table 1 shows that there are 7 observational study articles that show the interaction of vaccine status on the incidence of nosocomial diseases.

Forest plot

Figure 3 shows the forest plot results of the interaction of vaccine status on the incidence of nosocomial diseases. The forest plot results show that patients and health

workers who are not vaccinated and/or whose vaccine status is incomplete can increase the incidence of nosocomial diseases by 1.54 times compared to patients and health workers whose vaccines and/or vaccine status are complete. The results are statistically significant (p< 0.001). Heterogeneity (I2) = 95% indicates heterogeneous data distribution (random effect model).

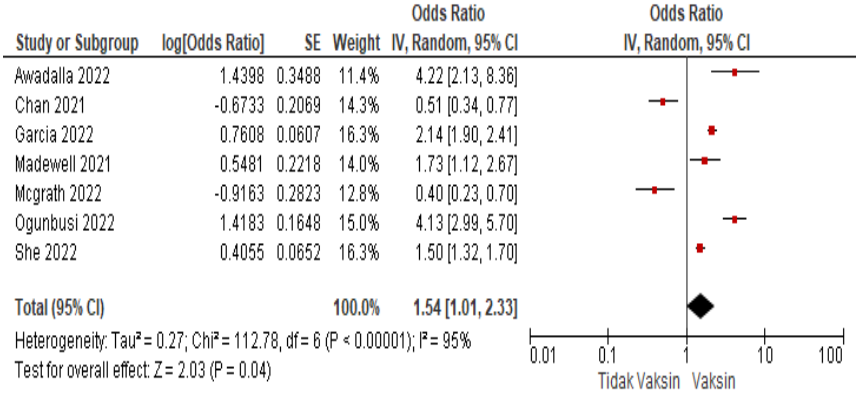

Figure 3. Interaction of Acinetobacter baumannii vaccine status on the incidence of nosocomial disease

Funnel plots

Figure 4 shows that there is publication bias marked by an asymmetry in the graph, there are 4 plots on the right and 2 plots on the left and 1 plot is on the line. The left plot has a standard error of 0.3 to 0.2 while the plot on the right has a standard error between 0.4 and 0.1. Bias also occurs from unequal distances between studies on both the right plot and the left plot where studies on the right side are further away from studies than those on the left plot.

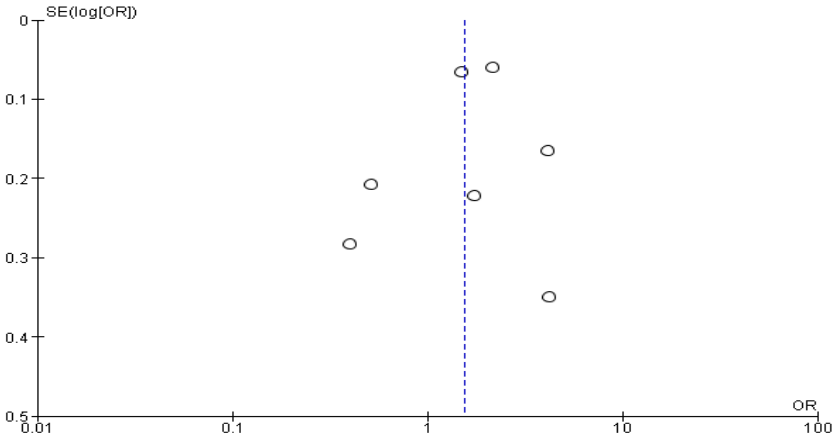

Figure 4. Funnel plot of interaction between Acinetobacter baumannii vaccine status and the incidence of nosocomial disease

3.2 Discussion

This research are systematic review and meta-analysis research raise the theme of the state-of-the-art review and meta-analysis regarding vaccination status on the incidence of nosocomial diseases. The independent variable analyzed was vaccination status. Research that discusses data on the incidence of nosocomial diseases, especially in patients and health workers, is considered important because of its rarity and urgency. The number of relevant research published and accessible is still small and also has data access problems (data duplication) (Murti, 2018). Most of the statistical results reported are in percent or *crude odds ratio* (cOR), where the research does not control for confounding *factors. Confounding factors* influence the relationship or effect of exposure to the occurrence of disease that is estimated (predicted) by a study which is not the same as the relationship or effect that actually occurs in the target population, aka the study results are invalid (incorrect) (Murti, 2018). This systematic review and meta-analysis research use research that controls *confounding factors* which can be seen from the research inclusion requirements, namely using multivariate analysis and the statistical results reported are the *adjusted odds ratio* (aOR), *generic inverse-variance* method (Widayati *et al*., 2016; Anulus *et al*., *2019).*

This method is used to analyze data in the form of rate, *time-to-event,* hazard ratio, ordinal scale, adjusted estimate, average difference (difference *of mean)* or average ratio (ratio *of mean).* The results of the systematic study and meta-analysis are presented in the form of *forest plots* and *funnel plots. The forest plot* shows visually the magnitude of variation (heterogenity) (Akobeng, 2005 in Murti, 2018). *The funnel plot* shows the relationship between the study *effect size* and the sample size of the various studies studied, which can be measured in various different ways (Murti,

2018). *Funnel plots* can be assessed from the asymmetry of studies, namely looking at the number of points on the right and left compared to *the standard error* and balance of the number of studies on the right and left (D'Souza *et al*., 2002).

The results of the analysis show that patients and health workers who do not have vaccines or whose vaccine status is incomplete are 1.54 times more likely to experience nosocomial disease compared to patients and health workers who have vaccines and have complete vaccine status (aOR 1.54; 95% CI 0=1.01–2.33, p<0.001). With the Acinetobacter baumannii vaccine, it is one of the simplest ways to prevent disease and helps create immunity for both the patient and the health worker, without causing side effects that will result in the risk of hospital infection or what is known as nosocomial infection. Vaccination against Acinetobacter baumannii can be an effective way to prevent infections caused by this bacterium, especially in high-risk patients and health workers. The results of research conducted by Mancuso et al, 2023 show that vaccinating patients is at high risk if they do not vaccinate with the Acinetobacter baumannii vaccine, and if they vaccinate, they can reduce the incidence of infections caused by these bacteria by 50%. Other supporting research also conducted by Chen et al (2018) stated that health workers with the Acinetobacter baumannii vaccine reduced the incidence of infections caused by these bacteria by 70%, as well as patients who were hospitalized, had a higher risk of becoming infected. nosocomial and Acinetobacter baumannii vaccines can reduce the risk of these events (Rangel et al, 2021).

However, there are no studies that directly compare patients who received vaccination with patients who did not receive vaccination against Acinetobacter baumannii. Patients who are likely to be admitted to a hospital intensive care unit (ICU) can be vaccinated with sufficient time to allow the formation of an immune response to prepare them for exposure to A. baumannii (Singh, R, et al. 2022). So, the prevalence of transmission or contracting of nosocomial infections caused by Acinetobacter Baumannii can be reduced because the body has a strong immune system against this bacterium. Many studies have stated that Acinetobacter Baumannii is resistant to several groups of *antibiotics* (Lopez, Rosalino Vazquez, et al. 2020)

Several factors can influence the risk of nosocomial infections in patients, including age, gender, underlying medical conditions, duration of hospital stay, and use of antibiotics. Patients who are older, have underlying medical conditions, or have been hospitalized for a longer time may be at higher risk for nosocomial infections. In addition, crowded hospital environments, transferring patients from one unit to another, as well as combining infectious disease patients and patients with weakened immune systems in the same room, also increase the risk of nosocomial infections (Chen et al, 2018).

Therefore, other infection prevention measures are also important in preventing the spread of bacteria in health care settings. In Honduras, health facilities are advised to maintain health worker vaccination registries (LIVATS), which show the vaccination status of health workers for all vaccination-preventable diseases including nosocomial infections. The limitation of this research is that the articles collected were only articles published in the 2019-2023 range. Apart from that, the author only used 3 databases to search for articles used in the research. It is hoped that future research can expand the search for articles by adding indexing databases that have not been used and searching for articles that have a different time period from previous research. The most frequent local side effects in health care throughout the world, these are caused by bacteria, viruses, parasites and fungi around health institutions and continue to develop in hospitalized patients. Therefore, it affects the well-being of the patient, who can transmit the infection to other patients and health workers. This is more than 1.4 million people who have suffered from this nosocomial infection (WHO, 2009).

4 Conclusion

There is a positive interaction and increases the risk of experiencing nosocomial disease in patients and health workers who are not vaccinated against Acinetobacter baumannii or whose Acinetobacter baumannii vaccine status is incomplete.

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