

ORIGINAL ARTICLE

Evaluation of the use of personal protective equipment by healthcare professionals

Evaluación del uso de equipos de protección personal en profesionales de salud

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Abstract

Biosafety encompasses essential regulations and precautions to protect people's health against biological, physical, chemical and radioactive risks, with the use of Personal Protective Equipment being the main containment barrier. Objective: to identify compliance with biosafety protocols by professionals. Methodology: descriptive, quantitative and prospective cross-sectional study, a Checklist was applied to 32 workers from various areas of a Manabi Hospital, during a period of three months in 2025, ensuring ethical procedures. The results show that while there is strong support for mask mandates, staff attend trainings on PPE and safe practical implementation. Notably, respondents practice hand hygiene before and after removing their equipment, and a worrying percentage reveal a universal lack of awareness of the synergistic nature of infection control measures. In conclusion, although the willingness towards training is positive, effective adherence to PPE practices in combination with other fundamental measures, such as hand hygiene, is insufficient.

Keywords safety, efficacy, risk, training, health.

Resumen

La bioseguridad engloba regulaciones y precauciones esenciales para proteger la salud de las personas contra riesgos biológicos, físicos, químicos y radiactivos, siendo el uso de Equipos de Protección Personal la principal barrera de contención. Objetivo: identificar el cumplimiento de los protocolos de bioseguridad por parte de los profesionales. Metodología: estudio descriptivo, cuantitativo y prospectivo de corte transversal, se aplicó un Checklist a 32 trabajadores de diversas áreas de un Hospital Manabita, durante un periodo de tres meses en 2025, asegurando procedimientos éticos. Los resultados demuestran que, si bien existe un fuerte apoyo a la obligatoriedad de la mascarilla, el personal asiste a capacitaciones sobre EPP y la implementación práctica segura. Notablemente los encuestados practica la higiene de manos antes y después de quitarse su equipo y un porcentaje preocupante revela una falta de conciencia universal sobre la naturaleza sinérgica de las medidas de control de infecciones. En conclusión, aunque la disposición hacia la formación es positiva, la adherencia efectiva a las prácticas de EPP en combinación con otras medidas fundamentales, como la higiene de manos, es insuficiente.

Palabras clave seguridad, eficacia, riesgo, formación, salud.

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Introduction

The term "Biosafety" encompasses regulations and precautions designed to protect human health against biological, physical, chemical, and other occupational risks while supporting safe care environments. In healthcare, infection prevention and control depends on the consistent application of standard precautions, including hand hygiene and the appropriate use of personal protective equipment (PPE) (World Health Organization [WHO], 2022). Compliance with protocols, techniques, and appropriate use of resources is therefore a fundamental component of biosafety.

Personal protective equipment (PPE) comprises barriers used alone or in combination to protect the skin, respiratory and other mucous membranes, eyes, and clothing from exposure to potentially infectious material. PPE selection depends on the expected interaction with patients and the mechanism of transmission, and its effectiveness relies on correct selection, donning, use, and removal (Moris Vidal et al., 2021; Verbeek et al., 2020).

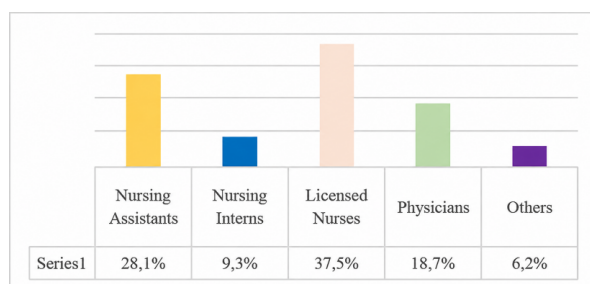
Healthcare-associated infections remain a major patient- and worker-safety challenge. The World Health Organization reports that infection prevention and control programs, including appropriate hand hygiene and related precautions, can prevent a substantial proportion of healthcare-associated infections (WHO, 2022). These findings reinforce the importance of adherence to biosafety measures among healthcare professionals.

Healthcare workers are exposed to occupational infections through contact with patients, contaminated materials, body fluids, and respiratory hazards. Standard precautions—particularly hand hygiene, respiratory hygiene, safe handling of healthcare waste, and appropriate PPE—are central to reducing these risks (WHO, 2022). Evidence from the COVID-19 period also showed that deficiencies in infection-prevention measures and PPE availability can increase occupational risk among healthcare personnel (Palacio Lapuente et al., 2021).

The evaluation of personal protective equipment (PPE) use among healthcare professionals reveals important challenges in adherence and perception. In Ecuador, Cordero Ramirez et al. (2024) found that 48.3% of nurses had a poor perception of PPE use, while workplace motivation showed a positive relationship with professional performance. Evidence also indicates that appropriate masks and other PPE contribute to reducing exposure to respiratory and highly infectious diseases (Chou et al., 2020; Verbeek et al., 2020). However, adherence depends not only on equipment availability but also on knowledge, training, organizational support, and compliance with standard precautions (De Sousa et al., 2019; Palacio Lapuente et al., 2021).

This study is highly relevant in the healthcare setting, as all healthcare professionals must be familiar with the protocols for the correct use of biosafety measures. These protocols play a vital role in preventing hospital-acquired infections and reducing occupational risks. This research will yield valuable and up-to-date data that will allow for a better understanding of compliance with these protocols by all healthcare professionals at this prestigious institution.

Figure 2. Professional activity of the study population



Methodology

This study is classified as descriptive, meaning its main objective is to provide a detailed overview of the characteristics and conditions of the selected population. A quantitative method is employed, allowing for the collection and analysis of numerical data, facilitating the identification of patterns and trends. Furthermore, the study design is prospective, meaning that data will be collected over time, specifically in a cross-sectional period. This methodology is suitable for capturing a current and specific picture of the use of personal protective equipment (PPE) in a hospital setting. The target population consists of 36 healthcare workers, representing a significant sample of the staff working at a hospital in Manabí. From this population, 32 workers were selected from various areas where PPE is used. This selection ensures adequate representation that reflects the diverse realities and needs of healthcare professionals within the hospital context.

The inclusion criteria are fundamental to the rigor of the study, allowing only those professionals who voluntarily agree to participate to do so. This decision ensures that the data collected is relevant and that the participants are willing to collaborate in the research. In contrast, the exclusion criteria were based on excluding those workers who did not wish to participate, which reinforces the ethical standards and respect for the individuals involved.

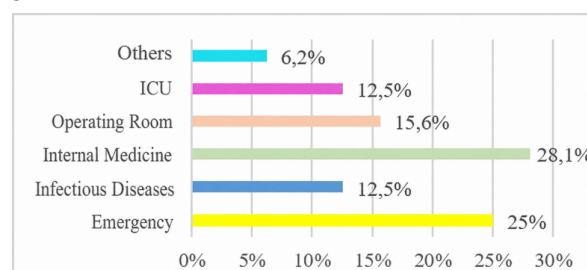
Procedure for collecting information

The data collection technique used was a validated survey, employing indirect observation to gather relevant information on the use of personal protective equipment. The data collection instrument was a checklist, which facilitated direct observation during May, June, and July of 2025, obtaining precise and specific data within a defined period, thus allowing for a better interpretation of the results. Data processing and analysis were carried out using Microsoft Excel, and the results were subsequently represented in graphs, facilitating the understanding of the findings. This quantitative approach ensures that the results are objective and easily interpretable.

Regarding ethical procedures, informed consent was obtained from all participants, ensuring they understood the nature of the study and their right to participate voluntarily. Furthermore, permission was requested from teaching managers and department heads to conduct direct observation. The information collected was used exclusively for academic purposes, guaranteeing the absence of conflicts of interest and respecting the privacy and integrity of the participants.

Results and Discussion

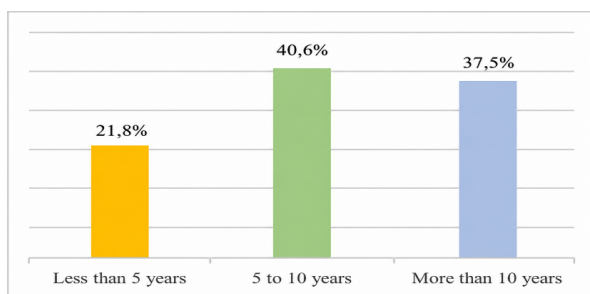
Figure 1. Work area



The geographical distribution of staff indicates that the majority of respondents work in high-demand, high-complexity units. Internal Medicine accounts for 28.1%, Emergency Medicine for 25% (53.1% combined), reflecting the reality of frontline staff who manage both complex cases requiring prolonged hospitalization and the high volume of emergency and critical patients. In addition to primary care units, the operating room contributes 15.6%, while Infectious Diseases and the Intensive Care Unit (ICU) account for 12.5%, establishing a profile of staff who are highly exposed and directly responsible for implementing infection control measures in high-risk environments.

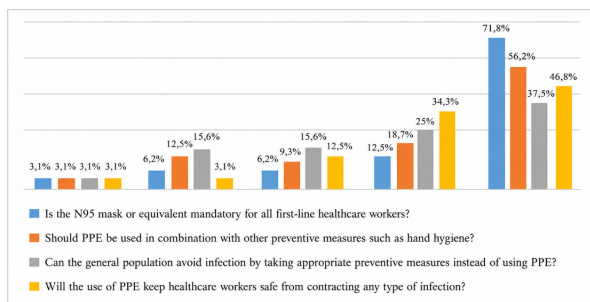
The distribution of professional activity shows that nursing staff constitute the largest segment of the analyzed population, representing 37.5%. When combined with nursing interns (18.7%) and nursing assistants (9.3%), the nursing and related fields group comprises the absolute majority of the sample (65.5% in total). Physicians represent the next largest group, with 28.1% of the studied population, although they are a minority compared to nursing staff. Finally, 6.2% of the sample is classified as "Other."

Chart 3. Service time



The sample is characterized by a significant degree of seniority and experience, with the majority of staff having intermediate experience of 5 to 10 years, comprising 40.6% of the population. This is followed by the most experienced staff, with more than 10 years of service, at 37.5%. The observed successes or failures in adherence to PPE practices should be interpreted as reflecting systemic problems or persistent shortcomings in PPE quality or ongoing training, rather than simply user inexperience. On the other hand, those with less than 5 years of service are a minority, representing 21.8%. If this younger group had received more recent training with updated protocols, its positive impact could be moderated by the influence of the large number of staff with decades of experience.

Chart 4A. Attitudes of healthcare personnel towards PPE



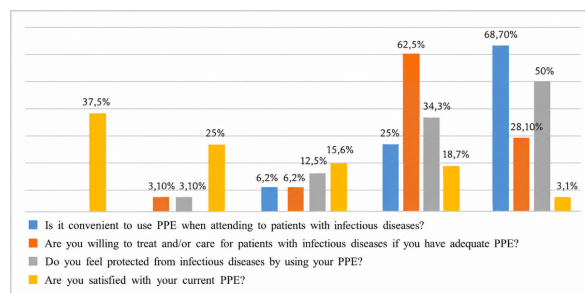
The most prominent attitude is the strong support for mandatory N95 masks or equivalent, with 71.8% of respondents believing that this high-filtration respiratory protection should be mandatory. Regarding the integration of PPE with other safety protocols, the majority of respondents agree that PPE should be used in combination with other precautionary measures, such as hand hygiene, reaching 56.2% agreement. A significant number of respondents disagreed (12.5% disagreed, 18.7% somewhat agreed or somewhat disagreed, and 9.3% neither agreed nor disagreed). While staff value hand hygiene, there is a lack of widespread awareness of the synergistic nature of infection control measures, where PPE acts as a barrier but is ineffective without the strict practice of hand hygiene before and

Furthermore, the study reveals that 56.2% of respondents practice hand hygiene before and after removing PPE, a concerning percentage given that hand hygiene is one of the most effective measures for preventing infection transmission (Chopin Doroteo & Ortega Soto, 2025; WHO, 2022). This discrepancy highlights the need to strengthen education and awareness regarding the complementary role of PPE and hand hygiene in infection-control practices.

after use.

The appropriate use of personal protective equipment (PPE) is essential to ensure the safety of healthcare personnel, especially in high-risk infection settings. According to the findings, there is strong support for mandatory N95 mask use, with 71.8% of respondents in favor. This finding is consistent with Chou et al. (2020), who emphasize the protective role of appropriate masks in healthcare settings. However, effective protection also depends on correct use, risk assessment, and adherence to broader infection-prevention measures, which reinforces the importance of continuous training (Verbeek et al., 2020).

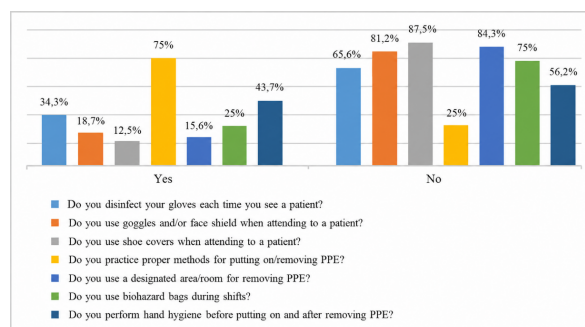
Chart 4B. Attitudes of healthcare personnel towards PPE



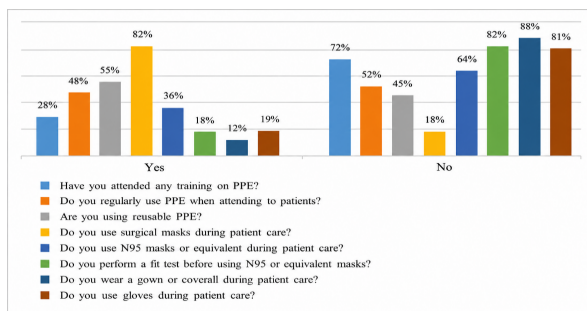
The responses are notably divided, with 40.6% answering 'Yes', 15.6% 'No', 15.6% 'Somewhat agree' or 'Somewhat disagree' and 25% respectively, and 3.1% 'Neither agree nor disagree'. Regarding whether the use of PPE will keep healthcare workers safe from contracting any type of infection, the most common response is 'No', supported by 34.3%, while only 46.8% answer 'Yes'.

On the other hand, concerns about the effectiveness of reusable PPE are highlighted in the analysis presented, with 88% of respondents indicating their use of reusable PPE. Reuse may be appropriate only when reprocessing or decontamination procedures are explicitly supported for the specific equipment and are performed under established protocols; otherwise, protection can be compromised (WHO, 2020). This suggests that, despite a positive attitude toward training (82%), practical implementation may be insufficient, which is consistent with Verbeek et al. (2020), who emphasize the importance of training in correct PPE use, donning, and doffing.

Figure 5A. Healthcare personnel practices regarding PPE



First, 81.27% report disinfecting their gloves after each interaction with a patient. However, a disparity is revealed in the application of other hygiene measures. For example, the use of goggles and/or face shields during patient care shows a considerably lower percentage at 43.7%, indicating a lack of awareness about the risk of exposure to aerosols or bodily fluids, or a misperception of the need for such measures. The fact that only 56.2% of respondents practice hand hygiene before and after removing personal protective equipment (PPE) is equally concerning, as this practice is important for minimizing the risk of cross-contamination. Furthermore, the use of shoe covers and biohazard bags appears to be even less common, at 34.3% and 37.5% respectively, raising questions about safety training and culture in the workplace.

Figure 5 B. Health personnel practices regarding PPE

First, 82% of respondents indicated they attend some form of PPE training, reflecting a positive commitment to training and updates on safety protocols. However, the regular use of PPE suggests a lack of enthusiasm for training, and practical implementation may be insufficient. Regarding the use of surgical and N95 masks, the percentages are also concerning: only 64% reported using them during patient care, and 81% used gloves during contact with patients. On the other hand, 88% of respondents indicated they are using reusable PPE, which could be positive if proper disinfection measures are implemented; however, it also raises concerns about the effectiveness of these reuse methods and their correct handling.

The results show that 40.6% of staff have between 5 and 10 years of experience, while 37.5% have more than 10 years. This distribution underscores the need for ongoing infection-prevention training regardless of professional seniority. Palacio Lapuente et al. (2021) emphasize that effective infection prevention requires sustained organizational measures, updated guidance, and adequate protective resources. Finally, the implementation of effective infection-control measures requires a multidimensional approach that includes not only the proper use of PPE but also continuous training and a strong institutional safety culture.

Conclusions

An assessment of personal protective equipment (PPE) use among healthcare professionals reveals a critical situation that affects not only staff safety but also the quality of care. Although a high percentage of respondents recognize the importance of PPE, such as the N95 mask, effective adherence to its use is compromised by factors such as resource availability, insufficient training, and risk perception. Furthermore, the results indicate that staff experience does not always translate into greater adherence to safety practices. Most respondents have years of experience, but this is not reflected in compliance with measures such as hand hygiene and the proper use of PPE.

Finally, it is essential to adopt a multidimensional approach that includes ongoing training, the availability of adequate resources, and awareness of the synergy between the use of PPE and other infection control measures. Only through a collective effort can the safety of healthcare professionals be guaranteed and, consequently, the quality of patient care improved, thus reducing the risk of hospital-acquired infections and contributing to a more robust and safer healthcare system.

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Conflicts of interest

The author declares that she has no conflicts of interest.

Author contribution

Conceptualization: Cedeño Barberán, CM, Aguilar Cano, JD Data curation: Cedeño Barberán, CM, Aguilar Cano, JD, Sabando Saltos, VM, Piguave Lino, MM Formal analysis: Sabando Saltos, VM, Piguave Lino, MM, Bravo Bonoso, DG, and Delgado Bernal, DS Research: Cedeño Barberán, CM, Bravo Bonoso, DG, and Delgado Bernal, DS Methodology: Cedeño Barberán, CM, Aguilar Cano, JD Supervision: Bravo Bonoso, DG, and Delgado Bernal, DS Validation: Bravo Bonoso, DG, and Delgado Bernal, DS Visualization: Cedeño Barberán, CM, Bravo Bonoso, DG, and Delgado Bernal, DS Writing the original draft: Aguilar Cano, JD, Sabando Saltos, VM, and Delgado Bernal, DS Writing, review, and editing: Cedeño Barberán, CM, Aguilar Cano, JD, Bravo Bonoso, DG, and Delgado Bernal, DS.

Data availability statement

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

Statement on the use of AI

The authors acknowledge the use of generative AI and AI-assisted technologies to improve the readability and clarity of the article.

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