

Comparison of Compliance of Glove Use Among Anesthesia Providers: A Prospective Blinded Observational Study

Basavana Goudra, MD, FRCA

Preet Mohinder Singh, MD, DNB, MNAMS

Eilish Galvin, MD, FCARCSI

Compliance of using gloves in the operating room (OR) is still poor amongst anesthesia providers. The practice of using gloves amongst OR anesthesia providers (attending anesthesiologists, anesthesia nurses, and trainees) in a tertiary care center was observed over 8 months. Observations were made during intravenous (IV) cannulations, laryngeal mask airway (LMA)/endotracheal tube (ETT) introductions, and ETT extubation/LMA removals, without alerting anesthesia personnel. Ten observations were made from each of the procedures for every provider involved. 1,240 observations were made involving 8 attending anesthesiologists, 9 trainees, and 14 nurses. A Chi-square test showed significant difference of glove utilization rates between the groups during all 4 procedures. The highest compliance was observed in trainees (50%), followed

by nurses (39.64%), and attending anesthesiologists (10.93%). All groups had their highest compliance levels during IV cannulation. Additionally, attending anesthesiologists had the lowest compliance levels during all individual procedures. Anesthesia nurses had the highest compliance during LMA removals (39.29%), whereas trainees showed the highest compliance in all other procedures. Glove usage by anesthesia providers during routine OR procedures continues to be low. Educational programs highlighting the hazards of noncompliance and strict departmental protocols may help to eliminate irregularities in the use of gloves.

Keywords: Anesthesia gloves, compliance of using gloves, glove use in operating room, gloving practices.

Hand hygiene and barrier protection form the crux of infection control in healthcare settings. In the operating room, barrier protection that primarily includes the use of gloves, disposable gowns, and face masks prevents contact with bodily fluids and thus protects healthcare providers from acquiring infections while also protecting patients by decreasing infections (from cross contamination). The role of gloves is well accepted in preventing infections amongst healthcare workers and in preventing the transmission of cross infections amongst patients. There is an enormous amount of evidence supporting their regular use. Despite multiple guidelines and directives recommending their mandatory use, compliance to glove use is still questionable. Health workers in the operating room environment face a higher risk of exposure to blood and other bodily fluids than workers do in any other clinical setting. Apart from coming in direct contact with blood and bodily fluids during the course of a surgical procedure, the anesthesia team is predisposed to needle stick injuries and infections from contaminated sharp instruments. Noncompliance to use of gloves not only increases the risk of healthcare-related infections, but also predisposes subsequent patients to infections via the use of contaminated equipment handled by the anes-

thesiologist.¹ Intravenous (IV) cannulation and insertion/removal of laryngeal mask airway (LMA)/endotracheal tubes are essential components of modern anesthetic practice. These procedures are often dealt with under the false presumptions that the equipment in use is not contaminated or that it can be handled without any contact with bodily fluids. Thus, anesthesia providers underestimate the need to use gloves. Unlike the fast-paced emergency department (another area of potential contact in the hospital), the operation room is a place where procedures are not performed in a hurry. Therefore, maximal barrier protection can be used. The attitude and understanding of medical staff toward the use of gloves is the key to “on field” implementation of “barrier protection.” The present study evaluates the compliance of glove usage by attending anesthesiologists, anesthesia trainees (resident doctors under anesthesia training), and anesthesia nurses (nurses with special training in the conduct of anesthesia and postoperative care, but with less training than American nurse anesthetists).

Methodology

The hospital staff is expected to follow the CDC-USA guidelines for using gloves during the procedure, but compliance levels continue to remain low. After obtain-

ing institutional ethical clearance, this prospective observational study was conducted in operating rooms and postanesthesia care units (PACU) of a tertiary care center (> 500 beds) in Ireland. As a routine hospital protocol, an anesthetic nurse was available for all inductions/extubations and anesthesia maintenance. Anesthesia induction was routinely performed in a separate induction room, from which patients were transferred to the main operating room. As per the standard practice, patients were transferred with LMA in situ to the post-anesthesia care unit (PACU). Trials show that trained anesthesia nurses (anesthesia nurses with experience in perioperative management) can safely remove/manage LMA in recovery.^{2,3} This practice is similar to other European countries and has shown consistently safe results. The anesthesia nurses in the recovery room removed the LMAs when the criteria were met. All patients with endotracheal tubes were, however, extubated by or under the supervision of attending anesthesiologists in the operating room prior to PACU transfer.

An unsuspecting observer (an attending anesthesiologist not involved in the surgery) recorded the gloving practices of attending anesthesiologists, trainees, and anesthesia nurses in the assigned operating rooms during the following 4 procedures:

1. At the time of intravenous cannulation
2. At the time of intubation (ETT insertion) or insertion of laryngeal mask airway.
3. At the time of tracheal extubation (removal of ETT).
4. At the time of removal of laryngeal mask airway.

Each involved anesthesia provider was observed on at least 10 occasions for each of the above 4 events. (Thus, 10 repeat readings were taken for each of the four aforementioned procedures, with a total of 40 readings per single observed individual). The observations were recorded for anesthesia staff during an 8-month period. It was made sure that the provider being observed was unaware of the ongoing study in order to avoid any performance bias.

Results

After a period of 8 months in randomly selected operating rooms, the gloving practices of 8 attending anesthesiologists, 9 anesthesia trainees, and 14 anesthesia nurses were recorded. A total of 1,240 events were recorded, wherein the number of observed events for attending anesthesiologists, trainees, and anesthesia nurses were 320, 360, and 560, respectively. Statistical analysis was done using JMP SAS statistical software, which used Chi-square testing. The results and statistical significance of differences (if any) are summarized in Tables 1-5. The percentage of anesthesia providers using gloves in various procedures are graphically represented in the Figure. The overall comparison toward glove compliance is shown in Table 6.

Adherence to the use of protective gloves was seen most frequently among anesthetic nurses, followed by the anesthesia trainees. The attending anesthesiologists were the least compliant ($P < .01$). Significantly, 2 of the attending anesthesiologists never wore gloves for any of the procedures—furthermore, 3 of them wore gloves only once during the 40 observations. There were inter-individual variations amongst trainees, with the seniors using them less frequently.

Discussion

The results of the present study are not totally unexpected. The attending anesthesiologists use gloves most sparingly. It is often related to the belief that with experience, one can perform the procedures without coming into contact with bodily fluids.^{4,5} However, this belief neglects the microparticles that lead to hand/surface contamination.⁶ A study by Naing et al⁷ among anesthesia nurses found that compliance of glove usage was 13.5%. They also concluded that younger and recently trained nurses were more aware and compliant with the use of gloves.⁷ Similar to our study, Osborne's study concluded that gloving/double-gloving practices in the operating room were around 55.6%, and highlighted the importance of the development of multifaceted perioperative infection control programs, including strategies for prevention, education, and policy development, to improve practices aimed at reducing occupational exposures among anesthesia personnel involved in operating rooms.⁸ In a recent analysis, Efstathiou and colleagues, while analyzing the factors contributing to noncompliance toward gloving and universal precautions, concluded that lack of integrated educational programs toward gloving plays a significant role in this casual approach.⁹ They suggested that the imparted knowledge of hazards would facilitate the implementation of programs and preventive actions that contribute to avoiding occupational exposures.⁹ Their findings have significance for those who still undervalue the importance of using gloves. Most teaching hospitals frequently update their courses, and in order to "set an example" to the trainees, they are likely to follow and demonstrate standard hygiene practices more stringently. The above additional motivations of using gloves (training and demonstration) are likely to be missing in non-teaching hospitals.¹⁰ Another possible explanation is that most of the attending anesthesiologists are relatively older and were trained in the era when blood borne infections did not pose a great danger to the anesthetic community.

Despite expert recommendations,¹¹ other studies have documented poor compliance. Most published studies are among emergency room providers,^{12,13,14} where observed glove use ranges from 62%–98%. In a recent study, Biddle et al concluded that anesthesia providers in operating rooms failed to fully comply to hand hygiene precautions

Event	IV Cannulation Percent (number)	Intubation/insertion of LMA Percent (number)	Extubation Percent (number)	Removal of LMA Percent (number)
Used	45.80 (142)	35.48 (110)	32.25 (100)	26.13 (81)
Not used	54.2 (168)	64.52 (200)	67.75 (210)	73.87 (229)

Table 1. Comparison of Glove Use Among All Anesthesia Providers on Procedure Basis

Abbreviation: LMA, laryngeal mask airway.

Event	Nurse anesthetist Percent (number)	Trainee anesthetist Percent (number)	Attending anesthesiologist Percent (number)	Chi-square test
Used	54.29 (76)	61.11 (55)	13.75 (11)	$\chi^2 = 46.49$
Not used	44.71 (64)	38.89 (35)	86.25 (69)	$P < .01$
				Statistically significant

Table 2. Comparison of 3 Groups at IV Cannulation^a

^aLarger χ^2 value denotes more substantial difference.

Event	Nurse anesthetist Percent (number)	Trainee anesthetist Percent (number)	Attending anesthesiologist Percent (number)	Chi-square test
Used	40.00 (56)	48.89 (44)	12.50 (10)	$\chi^2 = 31.06$
Not used	60.00 (84)	51.11 (46)	87.50 (70)	$P < .01$
				Statistically significant

Table 3. Comparison of 3 Groups at Intubation^a

^aLarger χ^2 value denotes more substantial difference.

Event	Nurse anesthetist Percent (number)	Trainee anesthetist Percent (number)	Attending anesthesiologist Percent (number)	Chi-square test
Used	25.00 (35)	66.67 (60)	11.25 (9)	$\chi^2 = 43.43$
Not used	75.00 (105)	33.33 (30)	88.75 (71)	$P < .01$
				Statistically significant

Table 4. Comparison of 3 Groups at Extubation^a

^aLarger χ^2 value denotes more substantial difference.

Event	Nurse anesthetist Percent (number)	Trainee anesthetist Percent (number)	Attending anesthesiologist Percent (number)	Chi-square test
Used	39.29 (55)	23.33 (21)	6.25 (5)	$\chi^2 = 48.23$
Not used	60.71 (85)	76.67 (69)	93.75 (75)	$P < .01$
				Statistically significant

Table 5. Comparison of 3 Groups at Removal of LMA^a

Abbreviation: LMA, laryngeal mask airway.

^aLarger χ^2 value denotes more substantial difference.

in almost 82% of the instances.¹⁵ A published study looking at the anesthesiologist's compliance with universal precautions found resident anesthesiologists to be more compliant than their attendings (61.8% vs 33.7%, $P < .0001$).¹⁶ Anesthetic nurses were also much more compliant than

doctors. There was no departmental policy on gloving at the time the study was carried out. Implementation of such a policy might change the casual approach toward regular use of gloves during invasive procedures.

One of the ways we can protect ourselves from

percutaneous and mucocutaneous contact with blood and bodily fluids is through the use of gloves, gowns, eyewear, and other personal protective equipment that provide a barrier. The Center for Disease Control and Prevention (CDC), USA, recognized the need for use of such precautions in routine patient care and issued guidelines for Universal Precautions in 1983 and 1987, with recent updates.^{17,18} These guidelines lay down global standards for the prevention of healthcare-related infections. International practices in both American and European subcontinents are expected to follow the guidelines. A Europe-based organization, the European Centre for Disease Prevention and Control (ECDC), also lays down a similar set of standards and recommendations as per the CDC-USA for using gloves (pertinent to present study). Although the CDC-directed practices seem to be universal (while handling documented HIV and hepatitis cases), often they are not adhered to in other settings. In fact, surface transmission of HIV is rare; however, bacteria (*staphylococcus*, *streptococcus*, etc) and hepatitis viruses are likely to be present on blood-contaminated surfaces for a significantly longer time. Presently, all patients cannot be routinely tested for these pathogens. Moreover, the patient might already be carrying new and unknown blood borne pathogens that could be discovered in the future. This makes it extremely important to adhere to

routine gloving practice. Although needle stick injuries are the most common modes of transmission of infection for anesthesia providers in operation room settings, there are documented cases of infection acquired through mucus membrane contact and non-intact skin contamination. As a result, the employee treats all these three events similarly and offers prophylactic antiretroviral therapy. Moreover, the use of gloves is known to reduce the transmission of the virus load to < 50% if a needle stick injury occurs. Because the chances of sero-conversion after the needle stick injuries depend on the virus inoculation dose, gloves can offer significant protection.¹⁹

One of the limitations of our study is the small population. Considering that this would be the average size of an anesthesia department for a 500-bed hospital, it actually simulated conditions in most medium-sized hospitals throughout the world. Changing the gloves for the next procedure is an equally important component of infection control. Recording the number of times gloves were removed after a procedure and how many procedures were performed with the same pair of gloves could have further strengthened the study.

In short, this study highlights the gross disparity among anesthesia providers in regard to the frequency of glove use. The incidence of glove use by attending anesthesiologists was only 10.93%, which was almost five times lower than the trainees and four times lower than the anesthetic nurses, who used gloves in 50% and 39.64% of the cases, respectively. It is important we all realize the implications of this study and change our gloving practices accordingly. The attending anesthesiologists should set an example for newcomers by adhering to these precautions and stressing their importance.

Conclusion

Despite multiple directives by the CDC, the present compliance for glove use in routine operating room procedures is still low. More educational programs highlighting the importance of using standard barrier protections and associated hazards of noncompliance, along with strict departmental protocols, may help to eliminate irregularities in the use of gloves among anesthesia providers.

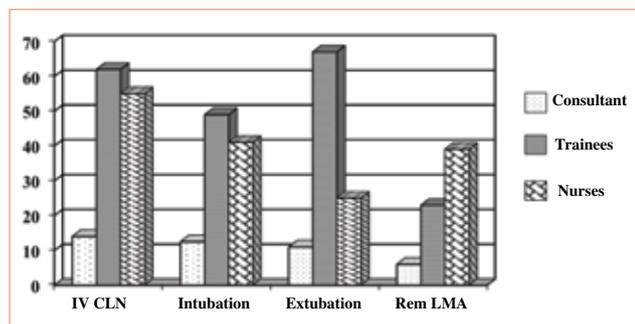


Figure. Comparison of the Gloving Practice Among all Groups During All 4 Selected Procedures

Note: Bars represent percentage of procedures in which gloves were used.

Abbreviations: CLN, cannulation; LMA, laryngeal mask airway.

Anesthesia personnel	Nurse anesthetist	Trainee anesthetist	Attending anesthesiologist	Chi-square test for gloves used
Gloves used (frequency)	222	180	35	$\chi^2 = 132.17$ $P < .01$
Gloves not used (frequency)	338	180	285	Statistically significant
% used	39.64	50.00	10.93	
Total events	560	360	320	

Table 6. Overall Compliance Toward Use of Gloves by Anesthesia Provider^a

^aLarger χ^2 value denotes more substantial difference.

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AUTHORS

Basavana Goudra, MD, FRCA, is currently an assistant professor of Anesthesiology and Critical Care Medicine at the Hospital of the University of Pennsylvania, Philadelphia, Pennsylvania. Email: goudrab@uphs.upenn.edu.

Preet Mohinder Singh, MD, DNB, MNAMS, is an assistant professor of Anesthesiology and Critical Care Medicine at the All India Institute of Medical Sciences, New Delhi, India. Email: Preetrjpal@gmail.com.

Eilish Galvin, MD, FCARCSI, is a consultant in the Department of Anesthesia at Beaumont Hospital in Dublin, Ireland.

The study was undertaken at the Waterford Regional Hospital, Waterford, Ireland.