

# Infection Control Practices of Laryngoscope Blades: A Review of the Literature

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*Current procedures for cleaning anesthesia airway equipment as assessed by the presence of visible and occult blood on laryngoscope blades and handles as labeled “ready for patient use” has been reported to be ineffective. Human immunodeficiency virus (HIV) and the hepatitis B virus (HBV) are 2 commonly seen pathogens that frequently are found in the healthcare setting. It has been shown that HBV can survive on a dry surface for at least 7 days and both HIV and HBV are transmitted via blood. The potential for cross-contamination from airway equipment to patient has been shown in several studies. To prevent further potential infections, it should be ascertained why*

*anesthesia providers are not all using disposable laryngoscope blades.*

*The purpose of this literature review is to determine the use and infection control practices of disposable laryngoscope blades. Their frequency of use, their evaluation of ease of use, and any complications encountered when using the disposable blade are reviewed, as well as the perceptions of anesthesia providers regarding disposable laryngoscope blades.*

**Keywords:** Disposable laryngoscope blade, laryngoscope, laryngoscope blade, reusable laryngoscope blade.

Nosocomial infections affect 1.7 million people and contribute to 99,000 deaths annually,<sup>1</sup> as well as cost hospitals \$6.7 billion per year in the United States.<sup>2</sup> These costs will not only be burdensome to hospitals but also felt by the average person. The greater the payout of insurance companies, the higher the standard premium will be. In view of these facts, healthcare providers should be doing everything to ensure that infections including human immunodeficiency virus (HIV) and hepatitis B virus (HBV) are not spread unknowingly by contaminated equipment. Because contaminated anesthesia airway equipment has a potential to transmit pathogenic organisms, anesthesia providers must be certain that reusable airway equipment such as laryngoscope blades are clean or use disposable equipment.

A cause and effect relationship between contaminated anesthesia airway equipment and nosocomial infection is difficult to establish.<sup>3</sup> However, blood is an excellent environment for all forms of pathogenic organisms to flourish. It is easy, therefore, to theorize that nosocomial infections could potentially result from visible and occult blood present on reusable anesthetic airway equipment. Because these infections often have major economic and health-related consequences, prevention is a top priority for hospitals and insurance companies.

In an era of deadly communicable diseases, it is easy to see the importance of proper cleaning and sterilization. Intubation of the trachea using reusable equipment creates a risk for cross-contamination because no perfect decontamination procedure exists.<sup>4</sup> It has been established in multiple studies that the current cleaning and

sterilization techniques for reusable anesthetic airway equipment are ineffective at removing all remnants of blood.<sup>3-9</sup> Disposable laryngoscope blades are available to prevent potential cross contamination. These single-use disposable laryngoscope blades have come with mixed reviews from anesthesia providers.<sup>10-17</sup>

This review will assess the literature regarding infection control practices in hospitals in general and for anesthesia airway equipment in particular. This will include a historical perspective on infection control practices with respect to reusable laryngoscope blades, the advent of disposable laryngoscope blades, and a synthesis of the available evidence with respect to provider preference and usability of reusable vs disposable blades.

Standard search procedures were used to locate published studies. Electronic databases searched were CINAHL, Medline, PubMed, and Cochrane library, using the key terms *disposable laryngoscope blade*, *single-use laryngoscope blade*, *reusable laryngoscope blades*, and *laryngoscopy*. The search was limited to the English language. Although this strategy captured a large number of studies, few of them dealt with anesthesia provider preference and usability.

## History and Review of the Literature

Favorable environmental conditions were initially established for hospital settings in the mid-20th century. Spaulding<sup>18</sup> devised a rational approach to disinfection and sterilization of patient care items and equipment. He believed the nature of disinfection could be mastered more readily if instruments and items for patient care were divided into 3 categories according to the degree

of risk of infection involved in the use of these items. The 3 categories of items were critical (ie, items that enter sterile tissue or the vascular system), semicritical (ie, items that come in contact with nonintact skin or mucous membranes), and noncritical (ie, items that come in contact only with intact skin). This classification scheme was so clear and logical that it has been used by the Association for Professionals in Infection Control and Epidemiology,<sup>19</sup> Centers for Disease Control and Prevention (CDC),<sup>20</sup> and Occupational Safety and Health Administration.<sup>21</sup>

In 1987, the CDC made recommendations for prevention of HIV transmission in healthcare settings suggesting that medical devices or items that contact intact mucous membranes should be sterilized or receive high-level disinfection.<sup>22</sup> They further recommended that items should be thoroughly cleaned before being exposed to the germicide. These recommendations have been adopted by many including the Association of Operating Room Nurses.<sup>23</sup>

In the mid-1980s, identification of HIV in blood and body fluids motivated researchers to look at the potential risk that blood borne pathogens presented to healthcare providers. Laboratory analysis of serum or plasma specimens scheduled to be discarded by a hospital laboratory demonstrated that 1.1% were positive for HIV, 4.9% were positive for HBV, and 5.7% were positive for both.<sup>24</sup> If inanimate objects become contaminated with Hepatitis B virus and are not properly cleaned and disinfected or sterilized, then these contaminated objects may contribute to disease transmission for periods of time up to 1 week and possibly longer.<sup>25</sup>

According to the Association of Operating Room Nurses,<sup>23</sup> reusable anesthesia equipment such as laryngoscope blades that come into contact with mucous membranes, blood, or body fluid are considered semicritical items and should be cleaned and then processed by high level disinfection such as glutaraldehyde or sterilized between each patient use. The decontamination process for surgical instruments involves 4 steps: pre-rinsing, washing, rinsing, and sterilization.<sup>26</sup> Multiple studies have looked at the decontamination process. Simply washing the blades with warm water is the least effective method.<sup>27</sup> The use of 70% isopropyl alcohol solution was more efficient but ineffective at inhibiting bacterial growth.<sup>27</sup> Autoclaving was found to be the best method for sterilization of laryngoscope blades.<sup>27</sup>

It is believed that with every reported case of disease transmission associated with endoscopes, the major cause was either in cleaning, disinfecting, or in the sterilization of the instrument.<sup>28</sup> This breakdown in the system is evident when discussing the laryngoscope handle. Although the laryngoscope handle does not contact the patient directly, the tip of the blade may contaminate it, which often touches the handle when in

the folded closed position; hence the handle must also be considered a potential source of cross-infection. There are multiple places that pathogens can exist in the anesthesia work environment.<sup>29</sup>

In a study to survey methods of laryngoscope cleaning in healthcare facilities throughout Great Britain, results indicated that in one third of the facilities the handle is not cleaned at all, only 5% routinely autoclave the handle, and in 12% of the facilities disposable laryngoscope blades are used. When asked, one third of responders stated they would not be prepared to put a laryngoscope, taken randomly from a room and considered ready for patient use, into their mouth.<sup>30</sup>

Although most anesthesia providers use appropriate precautions for the prevention of occupational transmission, the concept is not fully embraced. When patients were considered low risk, only 24% of anesthesia providers surveyed said they adhere to mandatory CDC guidelines for the prevention of HIV, HBV, and HCV transmission (universal precautions).<sup>31</sup> However, 88% always complied with the guidelines when presented with an HIV-infected patient.<sup>31</sup>

Observation alone is not a reliable method for assessing the level of contamination on airway equipment. Among others, 1 study that identified the presence of blood on anesthesia airway equipment following endotracheal intubation was conducted by Kanefield et al in 1989.<sup>32</sup> All equipment that contacted the airway during each case was inspected for blood and then submerged in a container of tap water for 5 minutes. The solution was tested for the presence of occult blood using a chemstrip. Of the 100 cases tested, 86 cases had equipment that was positive for bloody secretions. Thirty-six of those showed occult blood contamination (ie, blood not visible to the human eye).

Since then, various studies have helped validate the premise that visible and occult blood is significantly present on laryngoscope blades and handles that are identified as ready for patient use. Some studies tested the equipment for the presence of blood using a guaiac-based assay that can detect blood in concentrations as low as 1:10,000.<sup>33</sup> Some tested for the presence of blood using the modified version of the 3-stage phenolphthalein blood indicator test.<sup>3,6,34</sup> Yet others used a Hemocult Sensa card to determine the presence of blood<sup>5</sup> or erythrosine B dye, which stains proteins if present on surfaces.<sup>7</sup> Although studies have indicated that anesthesia airway equipment and monitoring equipment can be contaminated with blood, no studies have determined whether blood contamination actually represents an infection risk to patients or anesthesia providers. These tests have served as a rapid and inexpensive indicator system that potential contamination may exist.

The proximity of the oropharynx and multiple body fluids to anesthesia equipment poses the potential for cross-infection. Maslyk et al<sup>8</sup> conducted a study to deter-

mine the amount of microbial growth that develops on the anesthesia machine after a full day of use in the operating room. Many organisms were shown to survive on the tabletops such as coagulase-negative *Staphylococcus*, *Bacillus*, *alpha Streptococcus*, *Acinetobacter*, *Staphylococcus aureus*, and gram-negative rods. Some of these are known pathogenic organisms that can cause respiratory infections, especially in patients with compromised conditions.<sup>9</sup>

Although studies advocate sterilization of laryngoscope blades following their use, this may not occur at all times. Foweraker<sup>35</sup> noted that 4 pediatric patients had developed serious *Pseudomonas aeruginosa* infections, in which one of the children died from nosocomial pneumonia and septicemia. After a thorough investigation of the environment, they concluded that the probable source of infection came from a single laryngoscope blade that was used on each child. They noted that the blade had dried secretions around the bulb and on the blade and when cultured, a moderate amount of *P aeruginosa* of the same phage type isolated from the blood culture of the child who had died. He concluded that a breach in the cleaning and disinfection process had occurred.<sup>35</sup>

Wenzel and Edmond<sup>36</sup> acknowledged that instruments themselves are sources of pulmonary infections with gram-negative organisms such as *P aeruginosa* or *Serratia marcescens*, pathogens reflecting an inanimate environmental reservoir. They concluded that if 1% to 5% of all bronchoscopic procedures are performed on patients with tuberculosis (TB), and if each is followed by a second procedure with the same scope, 460 to 2,300 patients might become exposed to the virulent pathogen each year if only 10% of the scopes are contaminated. They suggested that the major issue is identifying whether bronchoscopes have been cleaned and disinfected inadequately after use. Cleansing the instrument before immersion in glutaraldehyde was found to be a critical step in ensuring that the instruments are effectively disinfected.

Perhaps the most compelling reason for reevaluating the cleaning, disinfection, and sterilization techniques of airway management equipment comes from the report of outbreaks of *Mycobacterium tuberculosis* infection following bronchoscopic procedures. Agerton et al<sup>37</sup> were concerned with nosocomial transmission of multidrug-resistant tuberculosis (MDR TB) after 8 patients with MDR TB were identified in South Carolina in 1995. All were resistant to 7 drugs and had matching DNA fingerprints. Community links were identified for 5 patients. However, no links were identified for the other 3 except being hospitalized at the same community hospital, and each had received a bronchoscopic procedure after one was performed on a patient with active MDR TB. Investigators concluded that inadequate cleaning and disinfection of the bronchoscope following each procedure led to cross-infection in these patients.

Gadalla and Fong<sup>38</sup> devised a clean way of performing an anesthesia induction to improve infection control in the operating room. First the anesthetist puts on 2 pairs of clean gloves, induction is carried out, and then as soon as endotracheal tube placement is completed, the blade of the laryngoscope is held in the gloved hand and 1 outer glove is peeled off the hand and inverted over the dirty laryngoscope blade. The other glove is also removed. The anesthetist then has on a clean pair of gloves. This technique ensures that the used laryngoscope blade never comes into contact with other equipment.

Tobin et al<sup>39</sup> developed a cost-effective way to decrease the risk of laryngoscope handle contamination. Small plastic bags available from GEM Medical Industries, Inc, for \$0.03 per unit can be placed over the laryngoscope handle and secured with tape. After the completion of each case, the blade is sent for sterilization and the bag is disposed of, after which a new one is applied.

To help decrease the spread of nosocomial infections, the American Association of Nurse Anesthetists recommends the use of a disposable laryngoscope blade when possible.<sup>40</sup> Single-use airway equipment is designed to be used once and then discarded.<sup>15</sup> There may be concern about the quality of some of these devices because they are manufactured at lower cost to justify their disposal.

Successful tracheal intubation depends on adequate visualization of the larynx, adequate illumination of the larynx, and operator skill. Therefore, anesthetists may be concerned about difficulties in obtaining a view of the glottis with single-use laryngoscope blades. Amour et al<sup>41</sup> conducted a study of 1,072 adult patients undergoing general anesthesia under emergency conditions and requiring rapid sequence induction. The patients were randomly assigned to either single-use metal or reusable metal laryngoscope blades on a weekly basis. Both groups were similar in their main characteristics and risk factors for difficult intubation. The purpose of the study was to determine the rate of failed intubations. The researchers found the rate of failed intubation was significantly decreased with the single-use metal blades at the first attempt compared with reusable blades (2.8% vs 5.4%,  $P < .05$ ).

However, single-use blades are manufactured with different designs and materials. The plastic single-use laryngoscope blade is reported to be less efficient than a metal reusable blade during a rapid sequence induction of anesthesia.<sup>10</sup> This idea has been corroborated by Jabre et al<sup>13</sup> and Galinski et al.<sup>4</sup> This is in part due to the increase in flexibility that is seen with disposable plastic laryngoscope blades.<sup>12</sup> In routine use, the single-use laryngoscope blade appears to be an efficient device, but it has been recommended to have conventional reusable laryngoscope blades reserved for difficult intubations.<sup>14</sup>

A comparison of 3 laryngoscopes including a standard stainless steel Macintosh 3 blade, the same blade with

a disposable cover applied and a disposable Macintosh 3 blade in reference to the ease of intubation using a high-fidelity human patient simulator was conducted.<sup>11</sup> The high-fidelity human patient simulator can provide a range of intubation conditions from easy to impossible. Anesthetists with similar experience performed laryngoscopy with each of the 3 laryngoscopes in both easy and difficult simulator intubation settings. For the easy setting, 34% ( $P = .001$ ) of anesthetists graded laryngoscopy more difficult with the covered laryngoscope and 22% ( $P = .008$ ) with the disposable laryngoscope considered laryngoscopy more difficult than with the standard reusable metal laryngoscope. Sixty-nine percent ( $P < .001$ ) of anesthetists found laryngoscopy more difficult with the disposable laryngoscope blade in the difficult simulator setting. Although a high-fidelity patient simulator allows for standardized, reproducible intubating conditions, there is debate as to whether it is an adequately validated tool for assessment of anesthetists. "However, despite reservations about induced harm and the unknown risk of an iatrogenic disease, most clinicians would want single-use devices used on themselves and their family if they were patients."<sup>15(p569)</sup>

Successful intubation requires appropriate skill but also depends heavily on access to good equipment. Researchers conducting a similar study determined there is better user satisfaction with metal disposable blades ( $P < .001$ ) and that there is greater force needed to intubate with the disposable laryngoscope blade.<sup>16</sup> There was a statistically significant ( $P < .01$ ) increase in illumination when a disposable blade was used.<sup>17</sup>

## Summary

Manipulation of a patient's airway, as with intubation procedures may often be bloody. Several studies suggest the current procedures for cleaning, disinfecting, sterilization, and handling of reusable laryngoscope blades and handles may be ineffective, or that there may be poor compliance with established protocols. The devastating spread of communicable diseases over the past few decades has resulted in the development of guidelines to be used to protect patients as well as healthcare workers from potential exposure to blood borne pathogens. The need for continued vigilance and evaluation of airway management equipment is evident. Although the concept of disposable laryngoscope blades makes sense, several previously published studies reported less user satisfaction than with the reusable laryngoscope blades. The main advantages of using a disposable laryngoscope blade involved infection control, cost, and bright fiberoptic lighting. Ultimately the decision to use a disposable laryngoscope blade rather than a reusable laryngoscope blade will come down to the provider of accrediting and regulatory bodies, institutions, and individual preference.

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