

INCIDENCE OF VISIBLE AND OCCULT BLOOD ON LARYNGOSCOPE  
BLADES AND HANDLES

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## INCIDENCE OF VISIBLE AND OCCULT BLOOD ON LARYNGOSCOPE BLADES AND HANDLES

Rita A. Phillips

Anesthesia providers must take appropriate precautions to reduce the potential for transmission of infectious agents to the patients under their care. The devastating spread of human immunodeficiency virus (HIV) and hepatitis B virus (HBV) over the past decade has resulted in the development of specific guidelines for the cleaning, disinfection, sterilization, and handling of medical equipment and instruments. Contamination of laryngoscope blades and handles with visible and occult blood frequently occurs during routine airway management. Several studies suggest either procedures for cleaning, disinfection, sterilization, and handling of laryngoscope blades and handles are ineffective, or there may be poor compliance with the established protocols. The purpose of this study was to determine the incidence of visible and occult blood on laryngoscope blades and handles that were identified as ready for patient use. Sixty-five laryngoscope blades and handles identified as ready for patient use were observed for visible blood and tested for occult blood. A modified version of the three-stage phenolphthalein blood indicator test, used in forensic medicine, was employed to determine the presence of occult blood. A preliminary study was conducted in vitro and determined the sensitivity of the phenolphthalein test kit to be 1:10,000 parts blood to normal saline at sixty seconds. Collected data were analyzed and percentages were computed based on the relative rate of occurrence. None of the blades or handles observed had visible blood. Of the 65 blades tested for occult blood, 13 (20%) tested positive. Of the 65 handles tested for occult blood, 26 (40%) tested positive. The occurrence of occult blood on laryngoscope blades and handles in the afternoon (PM) was statistically significant more than the

occurrence of occult blood in the morning (AM). The degree to which contaminated anesthesia equipment plays in the overall nosocomial rate is difficult to determine. The presence of blood is an indicator of potential cross-infection, since biological fluids such as blood and saliva are known to transmit infectious diseases. The collected data in this study confirm that more rigorous decontamination protocols must be instituted to ensure complete removal of blood prior to sterilization, since laryngoscope blades and handles have irregular surfaces with repositories for infectious material. In addition, anesthesia providers need continuous in-service education to improve, supplement, and update knowledge of infection control procedures after initial training.

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ON LARYNGOSCOPE BLADES AND HANDLES

by

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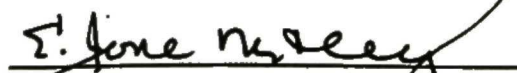
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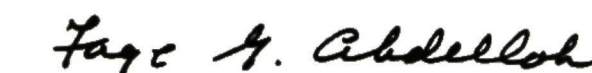
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## Dedication

I dedicate this thesis to my husband Darren, son Nicholas, and daughter Elizabeth. Thanks for your understanding, support, and encouragement.

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# CHAPTER I

## Introduction

### Background of the Problem

There are few documented cases of anesthesia related transmission of nosocomial infection. However, actual documented cross infection by anesthesia equipment may be rare due to the difficulty in establishing a causal relationship between anesthetic practice, equipment contamination, and post-operative infection (Rosenquist & Stock, 1989; Tait & Tuttle, 1995). This may be the result of long incubation periods and subclinical infections associated with certain blood-borne pathogens such as human immunodeficiency virus (HIV), hepatitis B virus (HBV), and hepatitis C virus (HCV) (Drew, 1994). Once contracted, these viruses are extremely difficult and costly to treat and are often times fatal. Therefore, the effectiveness of anesthesia equipment cleaning, disinfection, sterilization, and handling needs to be verified (Centers for Disease Control [CDC], 1987, 1988).

### Rationale and Significance of the Problem

Nosocomial infections, also called hospital-acquired infections, occur in approximately 6% of patients admitted to general hospitals. On an average these infections lengthen the hospital stay by 4 days, at a cost of at least \$ 4.5 billion annually nationwide. About 1% of nosocomial infections result directly in the patient's death, and another 3% of nosocomial infections contribute significantly to death. The impact on morbidity, mortality, and health care costs is substantial (CDC, 1992; Martone, Jarvis, Culver, & Haley, 1992). It is believed that nosocomial infections can be prevented in at least one third of these case with an effective infection control surveillance program (Haley et al., 1985).

It is estimated that 5% of nosocomial infections are viral (Bready, 1988). The actual percentage may be higher since infection control surveillance programs underestimate the frequency of viral infections and may even exclude viral infections from their surveys of nosocomial infections altogether because testing for a virus is time consuming, expensive, and often times impossible (Ryan, 1994).

The epidemiological features of HIV and HBV have much in common. These blood-borne viruses are associated with long incubation periods and high frequencies of subclinical infection. Epidemiological control of these viruses is more difficult since HIV and HBV may propagate and spread in a population for a long period of time before the extent of the problem is recognized (Drew, 1994). Once diagnosed, these viral infections are generally very difficult to treat and often times fatal; therefore, the emphasis has primarily been on prevention (Bready, 1988).

The CDC developed universal blood and body-fluid precautions to be used in the care of all patients in response to the increasing prevalence of several infectious diseases and the inability to determine which patients may be harboring HIV, HBV, or other blood-borne pathogens. Included in these recommendations are specific guidelines for cleaning, disinfection, and sterilization of patient care equipment (CDC, 1987, 1988). In addition, several professional organizations have adopted the CDC's recommendations and made more specific guidelines based on the special needs of the specialty (American Association of Nurse Anesthetists [AANA], 1989; Association of Operating Room Nurses [AORN], 1994). Failure to follow these recommendations can result in improper disinfection or sterilization of anesthesia equipment and potentially result in transmission of blood-borne pathogens, such as HIV, HBV,

HCV, and other infectious agents from patient to patient, or patient to provider. (CDC, 1987, 1988).

### Statement of the Problem

The purpose of this study was to determine the incidence of visible and occult blood on laryngoscope blades and handles that were identified as ready for patient use. The presence of blood is an excellent indicator of potential cross-infection since blood is known to transmit many blood-borne infectious diseases.

### Major Research Questions

The research questions are as follows:

1. Are current procedures for cleaning, disinfection, sterilization, and handling of laryngoscope blades and handles effective as evidenced by the incidence of visible or occult blood on laryngoscope blades or handles that are identified as ready for patient use?
2. Does the time of day influence the presence of visible or occult blood on laryngoscope blades and handles?

### Definitions

The following are key words used in this study:

**Universal precautions** are CDC's approach to infection control which states that blood and certain body fluids of all patients are considered potentially infectious for HIV, HBV, and other blood-borne pathogens. Body fluids included are blood

and other body fluids containing visible blood, as well as tissues, semen, vaginal secretions, cerebrospinal fluid, synovial fluid, pleural fluid, pericardial fluid, and amniotic fluid. Universal precautions do not usually apply to feces, nasal secretions, sputum, sweat, tears, urine, vomit, or saliva unless there is visible blood. Protective barriers include gloves, gowns, masks, and protective eyewear (CDC, 1987, 1988).

**Cleaning** is the removal of blood, mucus, and foreign material that should be done prior to sterilization or disinfection. This can be done manually with scrub-brush, detergent, and water (Rendell-Baker, 1993) or chemically with an enzymatic detergent presoak, (Kneedler & Darling, 1990) such as Klenzyme. Newer products that contain detergent and enzymes catalyze the decomposition process of organic debris with the enzyme and lift the enzyme-debris complex off the instrument with the detergent. Haemosol is a dry commercial product that requires proper mixing and it contains two enzymes, but no detergent. Residual organic material, such as blood and protein, can act as a barrier against the disinfectant or sterilizing agent.

**Sterilization** is a complete destruction of all microbial life, including spores. Commonly used methods include steam sterilization, ethylene oxide, and the use of the Steris sterilizer which uses peracetic acid (Young, 1990).

**High-level disinfection** destroys all vegetative bacteria, fungi, and viruses, but not necessarily bacterial spores. Examples are glutaraldehydes or hydrogen based chemicals (Young, 1990).

**Intermediate-level disinfection** destroys all vegetative bacteria, fungi, and some viruses, but not bacterial spores (Young, 1990). Examples are iodophors, phenolics, and 70% alcohol. Items to be disinfected with alcohol should be totally submerged in 70% alcohol for 5-10 minutes. Wiping with an alcohol swab is ineffective (Favero & Bond, 1991).

**Low-level disinfection** destroys most vegetative bacteria, fungi, and some viruses, but not mycobacterium tuberculosis or bacterial spores. Examples are quaternary ammonium compounds (Young, 1990).

The **laryngoscope**, unless otherwise specified, refers to the rigid, portable, battery operated medical instrument which is used to visualize larynx and adjacent structures, most often for the insertion of an endotracheal tube. Consists of two basic parts: (a) The handle which has a rough surface for traction and supplies the energy for the light source; and (b) the blade which is that portion of the laryngoscope that is inserted into the mouth, can be curved or straight, and has a socket with a small light bulb at the distal end (Dorsch & Dorsch, 1984). The rough surface on the handle and the socket-light bulb junction can serve as a repository for blood and saliva if not properly cleaned.

**Visible blood** is blood seen with the unaided eye.

**Occult blood** is blood that can be recognized only by microscopic examination or chemical means.

**Nosocomial infections** are infections acquired in a hospital (Bready, 1988).

## Summary and Overview

In summary, anesthesia providers must take appropriate precautions to reduce the potential for transmission of infectious agents to the patients under their care. The CDC developed universal precautions in an attempt to prevent the spread of potentially infectious and fatal blood-borne diseases. As a result, specific guidelines for the cleaning, disinfection, sterilization, and storage of patient care equipment have been developed. This study will determine the incidence of visible and occult blood on laryngoscope blades and handles that are identified as ready for patient use. The presence of blood is an indicator of potential cross-infection since blood is known to transmit several blood-borne infectious diseases.

The second chapter outlines the conceptual model and framework for this study and reviews the pertinent literature. Chapter three discusses the methodology of the study, including the study design, sample and procedure, data analysis, and limitations of the study. Chapter four reviews the results of the study. Lastly, chapter five reviews the implications of the results and discusses some recommendations.

## CHAPTER II

### Review of the Literature

#### Conceptual Model and Framework

Florence Nightingale predated the concept of infection surveillance and control over a hundred years ago. She was well aware that the number of hospital-associated infections that killed so many soldiers in military hospitals could be reduced by providing fresh air, light, pure water, efficient drainage, cleanliness, warmth, quiet, and appropriate diet. She recognized the importance of data collection and communicated her results to her peers (deGraaf, K. R., Marriner-Tomey, A., Mossman, C. L., & Slebodnik, M., 1994). While Nightingale was seen as outside interference by most medical officers, she was viewed as a ministering angel by the wounded soldiers. In time, the concept of aseptic technique became well established and resulted in drastic reductions of infection-related deaths. By the end of the Crimean War, the overall mortality rate among soldiers was reduced from 42% to 2% (Kalisch & Kalisch, 1986). This dramatic improvement in reducing mortality was due, in part, to the utilization of aseptic technique.

Another significant factor in preventing nosocomial infections was the development of disinfection and sterilization procedures for medical instruments and equipment. Dr. E. H. Spaulding devised a classification scheme that has been used as the framework for identifying appropriate levels of disinfection or sterilization for all medical instruments, equipment, and surfaces in patient treatment areas. His categories were based on the degree of risk of infection associated with their clinical use (Favero & Bond, 1991; Rendell-Baker, 1993). This classification scheme is so logical that the CDC also uses this system in its guidelines (CDC, 1987). The categories are as follows:

1. **Critical items** are devices that penetrate the skin or enter sterile areas of the body, such as spinal needles, surgical instruments, or implants. These items must be sterile prior to patient use.

2. **Semicritical items** are devices that come in contact with mucous membranes, such as laryngoscopes, breathing circuits, tracheal tubes, fiberoptic endoscopes and bronchoscopes. These items require a high-level of disinfection or sterilization.

3. **Noncritical items** are devices that may have contact with the patients intact skin and seldom, if ever, become contaminated with patient material such as blood. Examples of such items are blood pressure cuffs, pulse oximeter probes, electrocardiogram electrodes, and stethoscopes. These items can be washed or scrubbed with a detergent and warm water for an adequate level of safety; however, in some instances, an intermediate- to low-level chemical germicide may be used for added assurance of safety.

Using sterile disposable equipment is the best method of preventing spread of disease from patient to patient. However, for economical reasons, some anesthesia items, such as metal laryngoscope blades and handles, must be reused (Browne & Chernesky, 1988). While plastic, disposable laryngoscope blades are available, they often are too flexible for routine use (Stern & Dickinson, 1993).

According to Spaulding's categories the laryngoscope blade is a semi-critical item that, after each patient use, should receive either a high-level disinfection or sterilization after cleaning (Favero & Bond, 1991). After high-level disinfection or sterilization, the blade is kept in a clean area until the next use (Dorsch & Dorsch, 1984). The laryngoscope handle is a non-critical item that should be washed or scrubbed with detergent and warm water after each patient use, or possibly receive an intermediate- to low-level disinfection after each

patient use (Favero & Bond, 1991). Many sterilization and disinfection protocols state that the laryngoscope should receive a high-level disinfection or sterilization. These protocols do not specify if they mean laryngoscope blade or handle or both (AANA, 1989; Rosenquist & Stock, 1989).

### Literature Review

In 1973, Roberts cultured numerous organisms from laryngoscope blades that had been washed and cleaned. While wiping with 70% isopropyl alcohol was more efficient than detergent or warm water alone, it was ineffective at killing all bacteria present on laryngoscope blades. He found the autoclave to be the best available method for sterilization of laryngoscope blades.

Kanefield, Munro, and Eisele (1989) inspected airway equipment, such as laryngoscope blades, oral and nasal airways, and endotracheal tubes, for gross and occult blood after 100 general anesthetics. They found gross blood on 50% of the equipment, and occult blood on 36% of the equipment. Only 14% of the cases inspected were completely free from blood. They determined that observation alone is not a reliable method for assessing the level of contamination on airway equipment. In addition, anesthesia personnel should wear gloves when performing intubation.

A similar study was done by Chrisco and DeVane in 1992. They inspected 163 patients having general surgery for overt and occult blood on intubation and extubation. They demonstrated that blood was present after 34% of the intubations, and 72% of the extubations. Of the patients who were positive for blood, 50% were positive for overt blood and 50% were positive for occult blood. The majority of the blood (70%) found following intubation was from the oral/pharyngeal cavity (cheeks, tongue, and posterior soft palate).

Upon extubation, the majority (97%) of the blood found was present on the distal tip of the endotracheal tube. In addition, blood was present on the tip of the laryngoscope blade in 52% of the cases. They concluded that blood present during airway management can provide a vector for transmission of blood-borne viruses and that strict adherence to the CDC, AANA, and Anesthesiologists Society of America (ASA) guidelines is recommended.

These two studies confirm the need for anesthesia providers to wear disposable gloves during laryngoscopy, intubation, and nasogastric tube insertion. The CDC does not normally include exposure to saliva and sputum in their universal precautions (1987). The dental professionals have routinely, however, worn gloves throughout the previous decade. Gloves should be worn because of the known presence of blood in the airway while performing these procedures.

Stern and Dickinson (1993) discussed the dilemma paramedics are faced with concerning the cleaning of laryngoscope blades. In the past, non-hospital personnel commonly cleaned their laryngoscope blade with soap and water, since autoclave sterilization was not practical for non-hospital-based emergency medical services. In addition, paramedics found the plastic disposable blades too flexible for certain adult intubations. These authors suggest that paramedics who use metal laryngoscope blades should replace the contaminated blade with a clean blade while the contaminated blade receives a high level disinfection.

In 1994, Hall studied the extent to which anesthesia equipment and monitoring equipment was contaminated with blood in operating rooms. He used a three-stage phenolphthalein blood indicator test, commonly used in forensic medicine, that has a reported sensitivity of 1:10,000 for blood in stain form. He found that 33% of the anesthesia surfaces in operating rooms were contaminated with blood. While he did not determine whether the blood

contamination represents an infection risk or not, he did point out that the viability of the hepatitis virus on metal surfaces has been demonstrated for up to 2 weeks; the antigenic stability has been found to exist for 7 years; and that hepatitis antigen has been detected on 11% to 21% of environmental surfaces.

Morell, Ririe, James, Crews, and Huffstetler (1994) looked at the presence of occult blood on laryngoscope blades and handles that were "set up" and ready for the next patient. Both of their institutions followed rigorous guidelines for decontaminating laryngoscope blades after patient use. Neither of the two institutions had a protocol for laryngoscope handle cleaning, however, the anesthesia technicians wiped the handles if they appeared grossly dirty. The frequency of handle contamination with occult blood was 50%, while the frequency of blade contamination was 10.5%. They came to the conclusion that since the surfaces of laryngoscope blades and handles are irregular and contain repositories for infectious material, then the use of more rigorous decontamination protocols, disposable equipment, or disposable blade and handle covers were needed.

Tobin, Stevenson, and Hall (1995) wrote a letter describing their simple, cost-effective method of preventing laryngoscope handle contamination they started using as a result of the findings of Morell et al. (1994). They utilized small, disposable plastic bags that cost only \$0.03 each, which they secured to the top of the handle with piece of tape. They found the drawbacks of other commercially prepared disposable products for handle protection to be high costs ranging from \$0.90 to \$ \$2.75 each, a risk of latex allergy since many of these products contain latex, and difficulty in applying many of the products.

In addition, Tait and Tuttle (1995) surveyed approximately 4% of practicing anesthesiologists in the United States to examine the degree to which good hygienic practices were used in the prevention of transmission of infectious

agents to patients. Results of the disinfection/sterilization of laryngoscope blades were as follows: (a) 0.2% rinsed the blade with water; (b) 6.4% used soap and water; (c) 2.9% used an alcohol swab; (d) 63.9% used a disinfectant; (e) 6.0% used betadine; (f) 5.2% autoclaved their blades; and (g) 15.5% did something "other".[sic] With regards to the routine use of gloves, 1% replied that they never wore gloves, 12.7% replied that they rarely wore gloves, 36.9% replied that they frequently wore gloves, and 49.4 % replied that they always wore gloves. The authors emphasized the need for all anesthesia personnel to receive appropriate training and education in the implementation of universal precautions and other hygienic protocols in clinical practice.

In 1995 a laryngoscope blade was possibly responsible for four serious *Pseudomonas aeruginosa* infections on a pediatric intensive care unit in the United Kingdom. One of the four children, whom full recovery from the surgical procedure was expected, died of nosocomial pneumonia and septicemia. At this facility, the laryngoscope blades were routinely cleaned with an alcohol-impregnated wipe, although the policy was to clean the blades with detergent prior to wiping with the alcohol wipe. The blade that the child was intubated with seven days prior was noted to have dried secretions around the bulb. When cultured, the plate grew out *Pseudomonas aeruginosa* of the same phage type as the blood culture isolate from the child who died. This facility now disassembles the bulb from the laryngoscope blade, cleans them with detergent, followed by a 10 minute soak in 70% alcohol, then allows them to dry (Foweraker).

### Summary

The devastating spread of HIV and HBV over the past decade has resulted in the development of several guidelines to be used to protect health

care workers, patients, and society at large from potential exposure to blood-borne pathogens. Several studies suggest the current procedures for cleaning, disinfecting, sterilization, and handling of laryngoscope blades and handles may be ineffective, or there may be poor compliance with established protocols. The degree to which contaminated anesthesia equipment plays in the overall nosocomial rate has not been determined.

## CHAPTER III

### Methodology

#### Study Design

Following institutional approval, data for this descriptive study was collected at a local medical facility with five to seven operating rooms in daily use. According to the facility protocol, at the end of every general anesthesia case, an anesthesia technician dismantles the blade from the handle and proceeds with the following protocol: (a) The blades are soaked in Haemosol, mechanically washed, then followed with a sterilization cycle in the Steris sterilizer. The sterile blades are then kept in a clean area until needed; (b) The handles are supposed to be washed with a hospital approved agent after every use, then returned to the top of the anesthesia cart (Decker, personal communication, April, 1995; Department of the Air Force, 1993), although in reality they are only cleaned if grossly contaminated. The usual practice for cleaning and disinfecting equipment in these operating rooms was continued throughout the study.

The Steris sterilizer is an FDA and EPA approved sterilizer that utilizes peracetic acid which is bactericidal, fungicidal, and sporacidal at 0.3% concentration. Unlike other automated processors, the Steris machine has no cleaning cycle. To ensure the system is operational, a diagnostic cycle is performed at the beginning of each day. In addition, a biologic spore strip is used to challenge the sterilizer, usually at the beginning of each day (AORN, 1994; Crow, 1993). One major advantage of this system over the glutaraldehyde technique is that personnel are not directly exposed to the chemical agent, although the costs per cycle are higher since the peracetic acid is not re-used.

### Sample and Procedure

The laryngoscopes studied were identified as "patient ready" prior to inspection. Daily sampling occurred prior to the beginning of the day's cases and at the end of the day's cases until 65 laryngoscope blades and handles were inspected. The surface of each laryngoscope blade and handle was first carefully inspected for the presence of visible blood. Next, the blade and handle were wiped with separate 70% isopropyl alcohol pads. Each alcohol wipe was placed in a plastic zipper storage bag appropriately labeled with either blade or handle, AM or PM, and room number. To test for occult blood the modified three-stage phenolphthalein blood indicator test was performed at the end of the day. The samples were placed on a white background to better distinguish between the positive and negative results and a second reading was obtained for all results.

A preliminary study was be done in vitro to determine the sensitivity of the three-stage phenolphthalein blood indicator test. The literature is varied on this subject, ranging from 1: 1,000 to 1: 10,000,000 concentration ( Olsen, 1986; Phenolphthalein Test Kit, Cluefinders, Inc., Tampa, FL). A ten-tube serial dilution was conducted in the laboratory starting with 1:10 (one drop of blood in 9 drops of normal saline) and ending with 1: 10,000,000,000. The negative control contained ten drops of normal saline. A standardized plastic disposable pipette was used to place one drop (0.05 milliliters) from each test tube on an alcohol wipe. The modified three-stage phenolphthalein blood indicator test was utilized: (a) The alcohol pad was observed for discoloration, then (b) one drop of phenolphthalein was added to the center of the alcohol pad. If a pink color was present at this time, a contaminant was present which made the test invalid (false-positives were eliminated). If no reaction occurred at this time (normal),

then (c) one drop of hydrogen peroxide was added. Blood was indicated if a pink color was observed within sixty seconds.

The test was repeated as above with the following changes: (a) The alcohol wipes were placed in plastic, disposable, zipper lock bags after being contaminated and (b) the modified three-stage phenolphthalein test was performed 12 hours later to simulate how actual testing would be performed.

The manufacturer's instructions are to wipe the suspected blood contaminated surface with filter paper, followed by the addition of one drop of 70% isopropyl alcohol. The modification of the three-stage phenolphthalein test combines these first two steps into one. The same 10 tube serial dilution was repeated a third time with filter paper and alcohol instead of alcohol wipes to ensure that the modification did not change the validity of the phenolphthalein blood indicator test.

A known bloodstain control card, supplied by the phenolphthalein test kit manufacturer, was used to test the solutions prior to using to ascertain if all chemicals were working properly. In addition, the reagents were tested on plain, uncontaminated alcohol wipes and filter paper to ascertain if a false positive reaction was occurring.

The phenolphthalein test works on the principle of an oxidation-reduction reaction. The phenolphthalein reagent is oxidized in the presence of the hemoglobin group which possesses a catalytic peroxidase like activity. As a result of the heme group, the hydrogen peroxide is broken down and the oxygen is transferred to the phenolphthalein reagent, causing it to be oxidized. This results in the pink color change.

In all three preliminary studies, the sensitivity of the phenolphthalein blood indicator test at sixty seconds was 1:10,000 parts blood to normal saline (see Figure 1). There were no differences between the three tests. The known

bloodstain control card tested positive immediately and at no time did the negative controls test positive.

### Data Analysis

All results were recorded as yes or no on a data collection tool (see Figure 2). The collected data were analyzed and percentages were computed based on the relative rate of occurrence. Finally, the standard error of a proportion of rates of occurrence were calculated to determine the significance ( $P < .01$ ) using the following formula (Welkowitz, Ewen, & Cohen; 1991):

$$z = \frac{p - \pi}{\sqrt{\pi(1 - \pi) / N}}$$

where  **$p$**  = proportion observed in the sample  
 **$\pi$**  = hypothesized value of the *population* proportion  
 **$N$**  = number of people in the sample

### Limitations

There are several limitations to this study. First, the anesthesia staff were all made aware of the proposed study, and, therefore, there may have been a "Hawthorne effect" (where subjects knowledge of a study could influence their behavior and possibly alter the outcome of a study)(Burns & Grove, 1993) that could possibly have skewed the results of the study. This is, however, unlikely since eight months had passed from when the staff were first briefed on the study and when the data was actually collected.

Data were collected at the medical facility for two weeks in which 65 blades and handles were sampled. Generalizing the results of this study beyond this medical facility is limited. Studies would have to be done involving several medical facilities, using a larger sample size, for a longer time period to generalize the results of this study beyond this medical facility.

The data collector did not wear disposable gloves when sampling. It is theoretically possible that some positive results could be secondary to unintentional contamination by the data collector. This is not likely since the sampler had no open wounds on his hands and he wiped his hands with an alcohol pad prior to sampling each laryngoscope blade and handle.

The use of the three-stage phenolphthalein blood indicator test in the medical profession has only been used in one other known study. As a result, the preliminary study was done to test the sensitivity and reliability of this blood indicator test with very reassuring results.

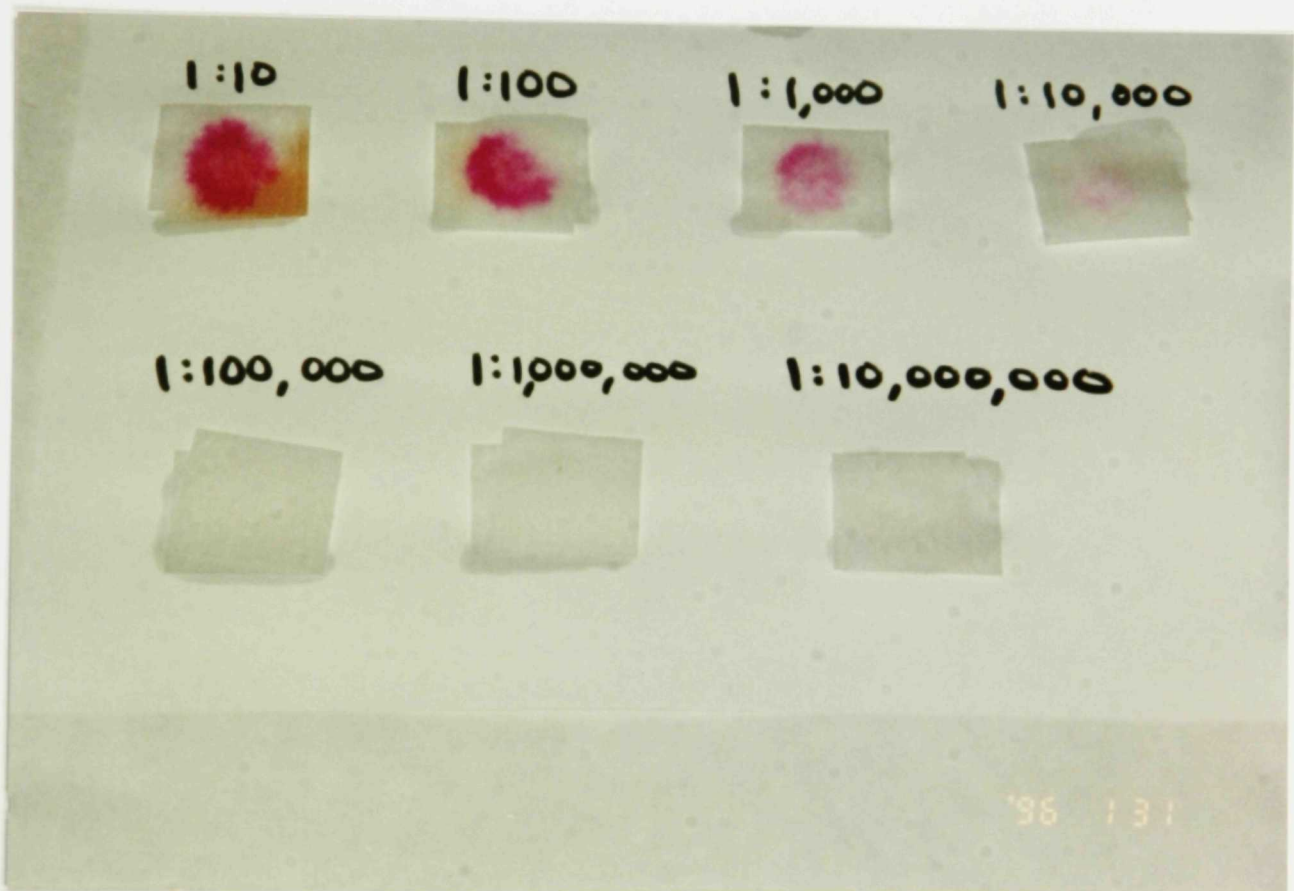


Figure 1. Results of modified three-stage phenolphthalein blood indicator test showing the sensitivity at sixty seconds to be 1:10,000.

| Week _____<br>Day _____ | Visible Blood |        | Alcohol Pad Discolored |        | Contaminant Present |        | Occult Blood Present |        | Totals |  |
|-------------------------|---------------|--------|------------------------|--------|---------------------|--------|----------------------|--------|--------|--|
|                         | Blade         | Handle | Blade                  | Handle | Blade               | Handle | Blade                | Handle |        |  |
| O.R. #<br>1             |               |        |                        |        |                     |        |                      |        |        |  |
| 2                       |               |        |                        |        |                     |        |                      |        |        |  |
| 3                       |               |        |                        |        |                     |        |                      |        |        |  |
| 4                       |               |        |                        |        |                     |        |                      |        |        |  |
| 5                       |               |        |                        |        |                     |        |                      |        |        |  |
|                         |               |        |                        |        |                     |        |                      |        |        |  |
| Totals                  |               |        |                        |        |                     |        |                      |        |        |  |

**Figure 2.** Data collection tool. A yes or no response was recorded in the appropriate box.

## CHAPTER IV

### The Results

#### Restatement of the Questions

The research questions are as follows:

1. Are current procedures for cleaning, disinfection, sterilization, and handling of laryngoscope blades and handles effective as evidenced by the incidence of visible or occult blood on laryngoscope blades or handles that are identified as ready for patient use?

2. Does the time of day influence the presence of visible or occult blood on laryngoscope blades and handles?

#### Results

None of the sixty-five blades or handles observed in this study had visible blood. The alcohol pad was visibly discolored after wiping 1(2%) blade and 4 (6%) handles. Of the sixty-five blades tested for occult blood, 13 (20%) tested positive at sixty seconds. Of the sixty-five handles tested for occult blood, 26 (40%) tested positive at sixty seconds (see Tables 1 and 2)(see Figure 3). Of the total 65 blades and handles tested, there were 35 blades and handles tested in the AM and 30 blades and handles tested in the PM. There were statistically significantly more PM blades (n=9) and handles (n=14) that tested positive for occult blood than AM blades (n=4) and handles (n=12) (see Figure 4). Standard error of a proportion of rates of occurrence were calculated to test the significance of the differences of the total rates of occurrences of 20% and 40% and to test the significance of the differences of the AM and PM occurrences. All tests were significant at the 0.01 level or less ( $P < .01$ ).

Table 1

Incidence of Occult Blood on Laryngoscope Blades and Handles (N = 65)

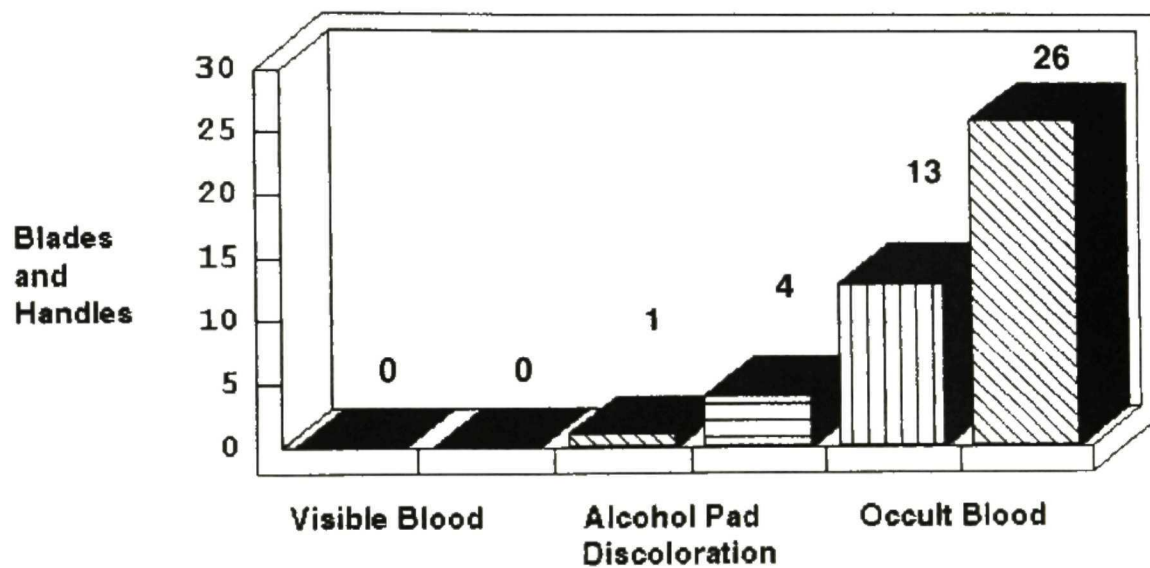
|        | Total  |         | Occult Blood |         |
|--------|--------|---------|--------------|---------|
|        | Blades | Handles | Blades       | Handles |
| AM     | 35     | 35      | 4            | 12      |
| PM     | 30     | 30      | 9            | 14      |
| Totals | 65     | 65      | 13           | 26      |

Table 2

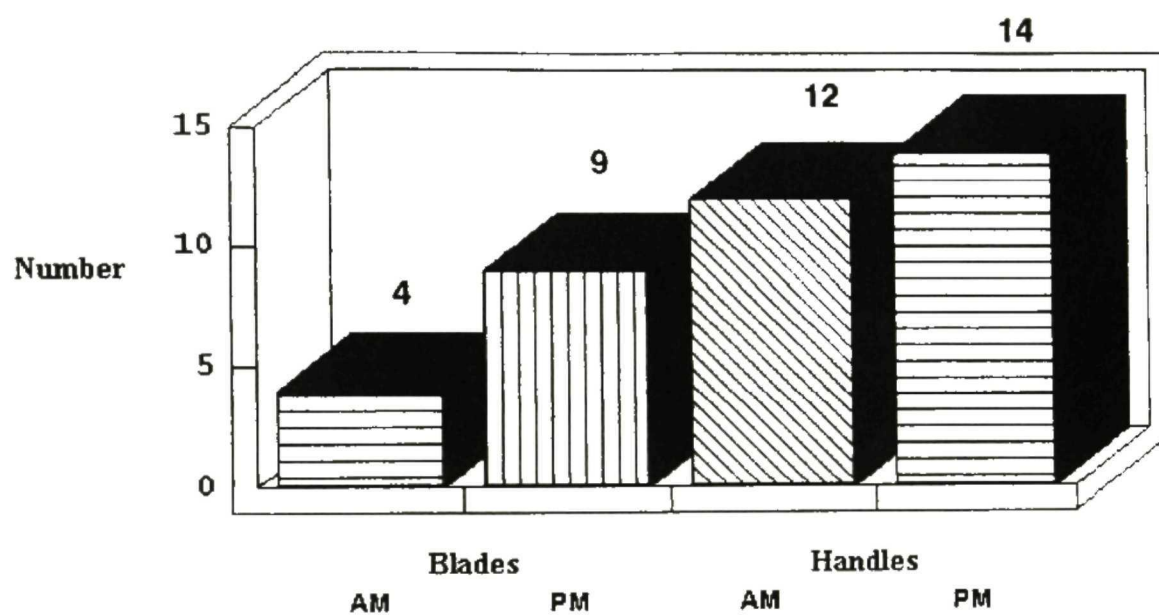
The Occurrence of Occult Blood on Laryngoscope Blades and Handles (N = 65)

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|        | <u>Blades</u> | <u>Handles</u> |
|--------|---------------|----------------|
| AM     | 11%           | 34%            |
| PM     | 30%           | 47%            |
| Totals | 20%           | 40%            |



**Figure 3.** The occurrence of blood on “Ready to use” laryngoscope blades and handles (N = 65).



**Figure 4.** The occurrence of occult blood on laryngoscope blades and handles in the morning (AM) and afternoon (PM) (N = 65).

## CHAPTER V

### Conclusions

#### Overview of the Study

The purpose of this study was to determine the incidence of visible and occult blood on laryngoscope blades and handles that were identified as ready for patient use. The presence of either overt or occult blood on anesthesia equipment is suggestive of either ineffective sterilization procedures or poor compliance with established cleaning and sterilization protocols. Blood was used as an indicator since testing for occult blood is easy, economical, and reliable. Whether the presence of blood poses an actual risk of infection to the patient was not studied at this time.

#### Implications of the Results

This study revealed that occult blood was present on 20% of laryngoscope blades and 40% of laryngoscope handles that were identified as ready for patient use. These findings are consistent with a similar study done by Morell et al. in 1994. Using the guiac based test for occult blood with a sensitivity of 1:10,000, they found occult blood on 10.5% of laryngoscope blades and 50% of laryngoscope handles tested. Their conclusions were that the use of more rigorous decontamination protocols, disposable equipment, or disposable blade and handle covers are necessary if anesthesia providers are to use clean equipment free of infectious material.

None of the sixty-five blades or handles tested revealed visible blood. In addition, only 1 (2%) blade and 4 (6%) handles had discoloration on the alcohol pad after wiping and before testing the sixty-five blades and handles for occult

blood. This finding demonstrates that equipment may appear clean to the anesthesia provider, but still be contaminated with blood, or other potentially infectious materials, such as bacteria. Visual inspection is not a reliable means of detecting blood contamination. The modified three-stage phenolphthalein blood indicator test should be used periodically to monitor the incidence of occult blood on laryngoscope blades and handles, as well as other anesthesia equipment. The test is easy, economical, and provides immediate feedback to the investigator. Results should be shared with co-workers to increase awareness of infection control issues.

This study also showed the modified three-stage phenolphthalein blood indicator test to have a sensitivity of 1:10,000 at sixty seconds. These findings are different from the available literature on the sensitivity of phenolphthalein. The manufacturer reports a 1:1,000 to 1:10,000 sensitivity, while an independent study reports a sensitivity of 1:100,000 to 1:10,000,000 (Olsen, 1986). This difference in sensitivity may be due to the following incidental finding. After the sixty second reading, when the tested alcohol wipes and filter papers were set aside, the pink color on the positive samples became much more vivid and some of the negative results even showed a slight pink color beyond two minutes. This suggests that the three-stage phenolphthalein blood indicator test is time dependent and capable of detecting even more dilute concentrations of occult blood based on the time allowed for the reaction to occur. In addition, if the researcher wanted to detect concentrations of occult blood less dilute, it seems the time allowed for the reaction to occur could be shortened. Additional studies will need to be done to determine the exact time necessary for different dilutions.

This study did not determine whether the presence of blood poses an actual risk of infection to the patient or not. However, the presence of blood is an indicator of potential cross-infection since blood is known to transmit blood-

borne infectious disease. HBV and HIV antigen testing shows HBV to be much more viable than HIV. The viability of the hepatitis virus has been demonstrated for up to two weeks on metal surfaces, and the antigenic stability can exist for up to seven years (Hall, 1994). Using HIV infectious doses 100,000 times greater than that typically found in the blood or serum of patients with HIV infection, studies showed HIV detectable by tissue-culture techniques 1-3 days after drying. The CDC has also shown the rapid reduction in HIV concentration (several hours) with drying (CDC, 1987). Based on these findings, HBV and HIV could possibly be spread from patient to patient or patient to provider unless proper cleaning and disinfection of laryngoscope blades and handles is performed between each patient use.

The degree to which contaminated anesthesia equipment plays in the overall nosocomial infection rate is difficult to determine. The intact oral mucosa is an excellent barrier against infection. However, it has been demonstrated that the oral mucosa is often times traumatized during routine laryngoscopy and oral intubation (Chrisco & DeVane, 1992; Kanefield et al, 1989). Anesthesia providers routinely care for patients with functionally impaired immune systems such as patients with diabetes mellitus, alcoholism, uremia, burns, pregnancy, prematurity, rheumatic diseases, and cancer. Less frequently, we care for transplant recipients and patients with acquired immunodeficiency syndrome. Care for these patients must be more meticulous than usual (Bready, 1988). The anesthetic state itself decreases the body's response to surgical trauma by blunting pain reflexes, providing cardiovascular stability, and decreasing the release of stress hormones (Smith, Pelliccia, & Lumb, 1995). The patient with an impaired immune system and altered mucous membranes is more vulnerable to postoperative nosocomial infection. Laryngoscope blades should therefore receive a thorough cleaning and high level disinfection or sterilization after each

patient use. The laryngoscope handle should receive an intermediate or low level disinfection after each patient use to prevent transmission of infectious disease from patient to patient or patient to provider.

### Recommendations

This study found a statistically significant increased incidence of occult blood on the blades and handles in the PM when compared to the AM. This finding suggest that there is an increased incidence of contamination of blades and handles in the PM when compared with the AM. This may be due to improper handling of anesthesia equipment throughout the day. For instance, dirty laryngoscope handles are frequently returned to the top of the cart with all the clean syringes, tubes, airways and other equipment. An unused laryngoscope blade is then placed on the used handle. The laryngoscope blade routinely comes in contact with the laryngoscope handle in the folded, waiting to be used position. Therefore, the used laryngoscope handle can serve as a fomite for infectious agents. In addition, the anesthesia provider often times performs many tasks with the same pair of disposable gloves. For example, the same pair of disposable gloves used to intubate the patient are often times also worn to turn on the anesthetic agents, adjust monitoring equipment, give additional intravenous medications, tape the patients eyes closed, and many other tasks that must be done expediently at the start of a general anesthetic. The contaminated gloves could also serve as fomites for infectious agents and contaminate other anesthesia equipment. Hall's study in 1994 found that 33% of the anesthesia surfaces in operating rooms were contaminated with occult blood. Gadalla and Fong (1990) suggest that the following "clean" technique be employed during an induction: (a) The anesthesia provider puts on two pairs of

gloves, and (b) induction is carried out as normal, then (c) as soon as the endotracheal tube is in place, the blade is held in the gloved hand and the outer glove is peeled off the hand and inverted over the dirty laryngoscope blade. The other outer glove is also removed leaving a clean pair of gloves to perform the other necessary tasks. This is just one way in which anesthesia providers can improve infection control procedures in the operating rooms.

Another possible reason occult blood may be present on laryngoscope blades and handles identified as ready for patient use is equipment failure. In this study, the technician soaked their blades in Haemosol, scrubbed the blades manually, and then cycled the blades in the Steris sterilizer. Since the Haemosol contains an enzyme, but does not contain a detergent, perhaps the blood or debris was not being completely removed prior to sterilization. Kneedler and Darling (1990) looked at the effectiveness of soaking instruments in an enzymatic detergent solution during the initial cleaning process as a means of loosening and removing the bioburden before sterilization. Their conclusions were that detergent-enzymes can eliminate the need for manual cleaning, thus reduce the exposure of personnel to pathogens during the cleaning process. In addition, soaking in enzymatic detergent solutions can reduce the number of bacteria in many cases, but these products are not substitutes for sterilization.

Poor compliance with established cleaning and disinfecting protocols is another reason occult blood might be present on laryngoscope blades and handles. Tait and Tuttle's (1995) survey of 4% of practicing anesthesiologists in the United States suggests either poor compliance or unfamiliarity with established cleaning and disinfection protocols. Only 69% of those surveyed disinfected their laryngoscope blades in an acceptable manner. Anesthesia providers should be instructed in basic infection control procedures during their anesthesia education. Continuous in-service education is needed, however, to

improve, supplement, and update knowledge in this field after their formal education. Anesthesia providers should be made aware of studies related to infection control, to increase their awareness of the disinfection and sterilization policies and procedures.

An effort must be made by manufacturers of reusable anesthesia equipment to design more durable equipment that can be more easily and effectively cleaned and sterilized. Manufacturers have designed disposable equipment such as single use laryngoscope blades and handles or disposable plastic or latex blade and handle covers. Anesthesia providers find this equipment cumbersome and costly while being an insufficient substitution for currently used laryngoscope blades and handles.

### Summary

Over the last decade several guidelines have been developed to protect health care workers, patients, and society as a whole from potential exposure to blood-borne pathogens in response to the heightened awareness of HBV and HIV infections. Results from this study suggest the procedures for cleaning, disinfection, sterilization, and handling of laryngoscope blades and handles are not effective as evidenced by occult blood detected on laryngoscope blades and handles identified as ready for patient use. The presence of blood is an indicator of potential cross-infection, since biological fluids such as blood and saliva are known to transmit infectious diseases. The degree to which contaminated equipment plays in the overall nosocomial rate has not been fully determined. Anesthesia providers must take appropriate precautions to reduce the potential for transmission of infectious agents to the patients under their care. The data collected in this study confirm that more rigorous decontamination protocols must

be instituted to ensure complete removal of blood prior to sterilization, since the laryngoscope blade and handle have irregular surfaces with repositories for infectious material. In addition, anesthesia providers need in-service education to improve, supplement, and update their knowledge of infection control procedures after their anesthesia education to protect the patient and provider from potential cross-infection.

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