The purpose of this evidence-based, quality improvement practice project was to increase anesthesia providers’ knowledge and awareness of the taping practice for securing the endotracheal (ET) tube that increases the patient’s exposure to pathogens and the risk of nosocomial infections. A change in the taping practice by anesthesia providers was the desired outcome. Participants completed an anonymous questionnaire about their knowledge and use of a taping practice to secure the ET tube. They then received an in-service on ET tube taping, which included reading an investigator-developed article about the evidence regarding patient safety during securing of the ET tube. The project ran for 4 weeks. Final data collection followed, in which participants completed the same anonymous questionnaire.

After the intervention, there was strong agreement that the tape for securing the ET tube needs to be designated solely for this purpose. A Mann-Whitney U test demonstrated statistical significance ($U = 55, P = .003$). Additionally, anesthesia providers gave a strong indication that they would not use adhesive tape that had fallen to the floor ($U = 78, P = .04$, Mann-Whitney U test). This project demonstrated that a change in practice occurred after an intervention regarding securing the ET tube with adhesive tape.

**Keywords:** Anesthesia, anesthesia equipment, contamination, disinfection, hand hygiene.

Hospitral-acquired infections (HAIs) pose a major concern for our patients. Approximately 440,000 patients develop HAIs annually in the United States, with surgical site infections and *Clostridium difficile* infections reported with the most frequency (36% and 30.3%, respectively).<sup>1</sup> Although all patients with HAIs have an extended hospital stay, patients with methicillin-resistant *Staphylococcus aureus* (MRSA) stay the longest, with an additional 15.7 to 23.0 days, respectively.<sup>1</sup> Furthermore, Zimlichman et al<sup>1</sup> in their meta-analysis on the costs associated with HAIs, report that as many as 75% of HAIs are preventable.

Before anesthesia delivery, the anesthesia provider prepares the anesthetic location to ensure the functionality and the availability of equipment and supplies. Commonly, nonsterile adhesive tape is cut or torn and adhered to the anesthesia gas machine during this preparation. The tape will be used to secure the endotracheal (ET) tube to the patient’s face on induction of general anesthesia. The current practice for securing the ET tube with adhesive tape appears be a benign task, yet research reveals that it increases the patient’s exposure to pathogens and pathogen transmission.<sup>2-6</sup> Anesthesia providers have an important role in preventing pathogen exposure and pathogen transmission. The taping practice for securing the ET tube is a modifiable risk factor related to anesthesia care. With accepted best practices of infection prevention and control incorporated into the taping practice, anesthesia providers can lead in this effort to advance patient safety in this area.

- **Literature Review.** A literature review was conducted to determine whether the adhesive tape that is currently used, Durapore surgical tape (3M), permits the transmission of pathogens to the patient through this vector and, therefore, poses a significant risk to the surgical patient. The identification of the best current evidence involved searches of the following online electronic databases: MEDLINE/PubMed, The Cochrane Library, Cumulative Index to Nursing & Allied Health Literature (CINAHL), and SUMSearch. To capture the largest number of relevant citations available, the authors manually searched the reference lists of all articles obtained from any reports of research not already identified. Guidelines from professional, national, and international organizations were reviewed. The Food and Drug Administration Medical Device Classifications, the Centers for Disease Control and Prevention guidelines, and the US Federal Register were searched as well. The following keywords and word strings were used alone and in combination: anesthesia, anesthesia equipment, contamination, disinfection, hand hygiene, and operating room. The international literature search was limited to English-language articles published between 1974 and 2013. Items were included for review if the literature addressed 1 or all of the common elements of the taping practice, which are the tape, the anesthesia gas machine, and the anesthesia provider. Unpublished reports, research, and findings were not
used. The search yielded 31 items that met the inclusion criteria, with a minimum of 6 items addressing each of the common elements of the taping practice.

The adhesive tape that is typically available in the clinical setting is contaminated. Many researchers have found tape, once outside its original packaging, to be contaminated. The bacteria found on the tape in these studies included *Pseudomonas, Escherichia coli, Klebsiella, Enterobacter*, coagulase-positive staphylococci, methicillin-resistant *Staphylococcus aureus* (MRSA), vancomycin-resistant enterococci, coagulase-negative staphylococci, and *Micrococcus* species. A 7-day bacteriologic survey of adhesive tape being used in a 16-bed intensive care unit of a 560-bed teaching hospital revealed that 8 of 23 rolls of tape yielded pure cultures. Harris et al. in a bacteriologic survey conducted in 3 hospitals in Australia, found 11 of 21 tape batches contained pathogens; specifically, MRSA or MRSA and vancomycin-resistant enterococci were identified. Redelmeier and Liveskey, in a bacteriologic survey, found 74% of their tape specimens colonized with pathogenic bacteria. The inner layer of the tape had 2 of 42 specimens, and the outer layer had 59 of 80 specimens ($P < .001$). The evidence consistently found pathogens on the adhesive tape that is currently available.

Anesthesia gas machine and equipment contamination occurs despite disinfection. Munoz-Price et al found in their environmental study at a 1,500-bed, county teaching facility that despite disinfection, 12.5% of the surfaces continued to have pathogens in their 43 operating rooms ($P = .998$). Research reveals that the likely contaminated items of the anesthesia gas machine included the flow control knobs, vaporizer dials, and the breathing system bags. Loftus et al. reported that stopcock transmission events with contamination occurred in 23% (126 of 548) of the cases, with 14 between-case and 30 within-case transmission events confirmed. Loftus et al. in their prospective observational study in 28 operating rooms, found that bacterial contamination of the operating room environment occurred in 89% (146 of 164) of cases studied. Interestingly, a patient does not need to have direct contact with the anesthesia gas machine, a part of the environment, for pathogen transmission to occur.

Otter et al. report that the presence of pathogens does not indicate the cause of the infection solely. According to their review, it does matter when considering that the environmentally associated nosocomial dose of pathogens to cause an infection can be low. They reported that “less than 15 S. aureus cells were sufficient to cause infection in experimental lesions, less than 1 CFU/cm² was sufficient to cause *C. difficile* in mice, and a single norovirus particle is thought to have the capacity to cause infection.” Furthermore, this adds evidence confirming that contaminated surfaces transmit pathogens that can be detrimental to patients.

Hand hygiene is important but often ineffective, and providers are often noncompliant with this prevention measure. Bacterial contamination during the delivery of anesthesia occurs often and is serious. Loftus et al. found that in 12% of the cases (17 of 146) that had bacterial contamination, the anesthesia providers were the origin of it. Munoz-Price et al. reported that during an 8-hour period, anesthesia providers performed only 13 hand disinfections but touched 1,132 objects. Biddle and Shah, in their observational study of anesthesia providers over a 4-week period, found a hand-hygiene failure rate ranging from 64% to 93%, with a mean aggregate failure rate of 82%. Evidence confirms that hand contamination, the inadvertent transmission of pathogens, and poor hand hygiene are associated with the current taping practice.

The primary purpose of this evidence-based quality improvement practice project was to increase anesthesia providers’ knowledge and awareness of the common elements of the taping practice for securing the ET tube that increase the patient’s exposure to pathogens and the risk of nosocomial infection. The secondary goal was to present taping practice guidelines for securing the ET tube with an education module for the anesthesia providers to improve patient safety. Overall, the desired outcome was a change in the anesthesia providers’ current taping practice for securing the ET tube due to this project to improve patient safety. If there were a change in the anesthesia providers’ perceptions related to pathogen exposure of the current taping practice, they would adopt the taping practice guidelines for securing the ET tube. This would be interpreted as a positive result of the project.

### Materials and Methods

**Project Design.** This evidence-based quality improvement project used a 1-group before-and-after design to measure differences between the groups with an 11-item anonymous questionnaire obtained from the anesthesia providers for data collection. Fixed-alternative and open-ended questions about a variety of issues related to cleanliness and the taping practice were used in the questionnaire developed by the principal investigator (L.K.). The anesthesia providers completed the same 11-item anonymous questionnaire at the end of the project, which ran for 4 weeks.

**Sample.** A convenience sample was used, consisting of all the anesthesia providers of a 400-bed hospital in South Florida. Eighteen anesthesia providers agreed to participate (78% of 23); the participants included 5 anesthesiologists, 9 nurse anesthetists, and 4 nurse anesthesia residents. The anesthesia providers’ experience varied within their specialty. Both male and female anesthesia providers of different specialties participated.

**Materials.** Criteria were established for the alternative tapes that would be used for this project. These
included a tape length of at least 76.2 cm (30 in), good adhesive quality, hypoallergenic, latex free, durable, and disposable. Most importantly, the tape needed to be a single patient use item, and each roll needed to be individually packaged. For securing the ET tube, it needed to be clean but not sterile. Currently, there are 5 tape products from 4 companies on the market for securing ET tubes, but not all of them met the criteria of this project. Durapore is commonly available in 2.5 cm × 9.14 m (1 in × 10 yd) multiple patient use lengths or in 2.5 cm × 1.37 m (1 in × 1.5 yd) single patient use lengths. Neither tape is individually packaged as a single-use item. Thus, they did not meet the criteria for inclusion in the project. TrioMed Antimicrobial Medical Adhesive Tape (TrioMed Corp) is not yet available for use in the US. It has an antimicrobial agent engineered into the product that is 99.99% effective against pathogens, including resistant organisms. It, too, did not meet the criteria for inclusion in the project. A precut foam adhesive ET tube holder tape (ET Tape, B&B Medical Technologies Inc) is marketed for patients who require a few days of ventilator support and must be wrapped around the patient’s neck. It is packaged as a clean, single patient use item. This tape met the criteria for inclusion in the project. Last, a zinc oxide adhesive tape (Hy-Tape, Hy-Tape International Inc) is marketed for short-term use and longer-term ventilator-dependent patients. It can be packaged individually when it is assembled as part of a kit. It, too, met the criteria for the project. Thus, the 2 alternative tapes that met the inclusion criteria for this project were ET Tape and Hy-Tape.

• Data Collection Procedure. The institutional review boards of both the university and the hospital granted the project exempt status and determined that the project was a nonresearch activity. At the beginning of the project, the anesthesia providers were given a cover letter that explained the project and were asked to complete an 11-item questionnaire that focused on their knowledge of pathogen transmission related to anesthesia, the taping methods, tape requirements, and the role that anesthesia providers have in preventing pathogen transmission to patients. Immediately following the initial questionnaire, the anesthesia providers had an educational in-service at the hospital, where they read an evidence-based article that was written by the principal investigator about the taping of the ET tube and its impact on patient safety. In these individual and small group meetings with the anesthesia providers, the principal investigator presented the project’s purpose and plan, their participation requirements, the process for the collection of data, and the distribution of results. Also, during the in-service, the principal investigator demonstrated the key points of the taping method that would be used for this project using alternative tapes. A printed taping guideline was distributed to all anesthesia providers. The project took place over 4 consecutive weeks. Final data collection, in which the anesthesia providers completed the same anonymous questionnaire in a similar manner, was done 4 weeks following the preintervention questionnaire.

• Instrumentation. The data collection instrument was an 11-item investigator-developed questionnaire regarding the anesthesia provider’s knowledge and use of a taping practice to secure the ET tube. All questions had multiple-choice answers except the last one, which asked to provide a short answer. Demographic data such as gender, provider type, years in practice, and job status was sought. In addition, the questionnaire asked the following:

1. What features do the anesthesia providers identify as attributes and deterrents of the taping practice before and after an education module?
2. What percentage of anesthesia providers were able to identify situations that increased the patient’s exposure to pathogens when performing the taping practice before and after an education module?
3. What is the anesthesia provider’s overall evaluation of the taping practice after an education module?
4. What is the rationale that anesthesia providers give for failing to use the taping practice?
5. What are the recommendations that anesthesia providers give as a result of the taping practice?

The intervention involved the anesthesia providers reading an article given to them by the principal investigator. Over the period of the project, the anesthesia providers were to secure the ET tube for adult patients who required general anesthesia for elective surgery in the supine position using the alternative tapes and the taping practice presented. The anesthesia providers had 5 opportunities to secure the ET tube with the 2 alternative tapes. The intervention tool was an evidence-based article that was written by the principal investigator about the most recent clinical evidence of practices that have an impact on patient safety while securing the ET tube. This article was later published in the AANA Journal.23

Results

Of the 18 (78% of 23) anesthesia providers who participated in the evidence-based quality improvement practice project, 11 (61.1%) were women and 7 (38.9%) were men. Five (27.9%) of the anesthesia providers were anesthesiologists, 9 (50%) were nurse anesthetists, and 4 (22.2%) were nurse anesthesia residents. Six (33.3%) of the anesthesia providers had been in practice between 1 and 3 years. Two (11.1%) of the anesthesia providers had been in practice between 4 and 6 years, 1 (5.6%) had been in practice between 7 and 10 years, and 9 (50%) had been in practice for 11 or more years. All anesthesia providers practiced at least 2 days per week in the facility. All the anesthesia providers stated that they currently used adhesive tape from an 11.1-m (10- yd) roll. Four anesthesia providers dropped out of the study after completing
the preintervention survey: 2 nurse anesthetists and 2 nurse anesthesia residents. Thus, the anesthesia providers who completed the project consisted of 8 women (57.1%) and 6 men (42.8%), for a total of 14 (61% of 23). Five (35.7%) of the anesthesia providers were anesthesiologists, 7 (50%) were nurse anesthetists, and 2 (14.2%) were nurse anesthesia residents. Four (28.5%) of the anesthesia providers had been in practice between 1 and 3 years, 1 (7.1%) had been in practice between 4 and 6 years, 1 (7.1%) had been in practice between 7 and 10 years, and 8 (57.1%) had been in practice for 11 or more years.

• **Statistically Significant Results.** Figure 1 shows the results for the survey question related to the anesthesia provider’s level of agreement of having designated tape for securing the ET tube. A Mann-Whitney U test was conducted to evaluate the hypothesis that after the intervention the median level of agreement that “the ET tube needs to be secured with tape designated for anesthesia use” would increase. The difference in ranks between the preintervention and the postintervention responses was significant ($U = 55, P = .003$). The median level of agreement for designated adhesive tape changed from 2 (agree) at the preintervention to 1 (strongly agree) at the postintervention questionnaire.

Figure 2 shows the results for the survey question related to the likelihood that the anesthesia provider would use the adhesive tape if it dropped to the floor during the taping process and was immediately retrieved. A Mann-Whitney U test was conducted to evaluate the hypothesis that after the intervention anesthesia providers would be less likely to use the adhesive tape if it fell to the floor. The difference in ranks between the preintervention and the postintervention responses was significant ($U = 78, P = .04$). The median likelihood for using the adhesive tape changed from 4 (probably not) at the preintervention to 5 (definitely not) at the postintervention questionnaire.

Anesthesia providers were asked to rank factors that prevented them from using a clean taping practice for securing the ET tube. A Mann-Whitney U test was conducted to evaluate the hypothesis that after the intervention “I did not realize the importance of the practice” would be ranked as more descriptive of factors that prevent using a clean taping practice. The difference in median responses between the preintervention and the postintervention questionnaire was significant ($U = 27.5, P = .05$, Figure 3). The median rank for not realizing the importance of the practice changed from 1 (least describes) at the preintervention to 4 (describes) at the postintervention questionnaire. Not realizing the importance of a clean taping practice became more important after the intervention as a reason for not following a clean taping practice.

A Mann-Whitney U test was conducted to evaluate the hypothesis that after the intervention “difficult to incorporate into practice” would be ranked as less descriptive of factors that prevent using a clean taping practice. The difference in median responses between the preintervention and the postintervention questionnaire was significant ($U = 16, P = .001$). The median rank for difficult to incorporate into practice changed from 3 (most describes) at the preintervention to 4 (describes) at the postintervention questionnaire.
The median rank for difficult to incorporate into practice changed from 4 at the pretest to 2 at the posttest. A Mann-Whitney U test was conducted to evaluate the hypothesis that after the intervention “length and width of the tape” would be ranked as less descriptive of factors that prevent using a clean taping practice. The difference in median responses between the pretest and the posttest was significant (U = 46.5, P = .02). The median rank for length and width of the tape changed from 3 before the intervention to 2 after the intervention. The factor, the length and width of the tape, was more descriptive of reasons for not using a clean taping practice before compared with after the intervention.

Results With No Statistical Significance. When asked whether the taping practice for securing the ET tube was part of anesthesia care, the anesthesia providers agreed (11%) or strongly agreed (89%) on the pretest that it was part of anesthesia care, and they agreed (14%) or strongly agreed (86%) with the statement on the posttest (not significant: U = 122, P = .45, Table 1). The anesthesia providers confirmed their belief that securing the ET tube is part of anesthesia care.

Anesthesia providers did not significantly change their responses when asked whether the taping practice for securing the ET tube needed to maintain cleanliness from preintervention to postintervention (U = 115, P = .35). All anesthesia providers either agreed or strongly agreed with the statement both before and after the intervention (see Table 1). As well, there was no statistically significant change in the responses of the anesthesia providers from preintervention to postintervention questionnaires when asked about the importance of a clean taping practice to decrease pathogen exposure to the patient (U = 106, P = .23). Before the intervention, 89% of anesthesia providers responded that they agreed or strongly agreed. After the intervention, 93% of anesthesia providers responded that they agreed or strongly agreed that a clean taping practice is needed to prevent pathogen exposure to the patient. Regarding the anesthesia provider’s re-

<table>
<thead>
<tr>
<th>Question and possible responses</th>
<th>Preintervention Responses (%)</th>
<th>Postintervention Responses (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>The taping practice for securing the ET tube is a part of anesthesia care.</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Strongly agree</td>
<td>88.8</td>
<td>85.7</td>
</tr>
<tr>
<td>Agree</td>
<td>11.1</td>
<td>14.3</td>
</tr>
<tr>
<td>Neither agree nor disagree</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td>Disagree</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td>Strongly disagree</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td><strong>The taping practice for securing the ET tube needs to maintain cleanliness.</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Strongly agree</td>
<td>55.5</td>
<td>64.3</td>
</tr>
<tr>
<td>Agree</td>
<td>44.4</td>
<td>35.7</td>
</tr>
<tr>
<td>Neither agree nor disagree</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td>Disagree</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td>Strongly disagree</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td><strong>A clean taping practice is needed to decrease pathogen exposure to the patient.</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Strongly agree</td>
<td>55.6</td>
<td>71.4</td>
</tr>
<tr>
<td>Agree</td>
<td>33.3</td>
<td>21.4</td>
</tr>
<tr>
<td>Neither agree nor disagree</td>
<td>11.1</td>
<td>7.1</td>
</tr>
<tr>
<td>Disagree</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td>Strongly disagree</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td><strong>What is the likelihood that you would use visibly soiled adhesive tape for securing the ET tube?</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Definitely not</td>
<td>77.8</td>
<td>92.9</td>
</tr>
<tr>
<td>Probably not</td>
<td>16.7</td>
<td>7.1</td>
</tr>
<tr>
<td>Not sure</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td>Probably</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td>Definitely</td>
<td>0.0</td>
<td>0.0</td>
</tr>
</tbody>
</table>

Table 1. Preintervention and Postintervention Survey Results

Abbreviation: ET, endotracheal.

%Percentages may not total to 100% because of rounding.
response to using visibly soiled tape to secure the ET tube, nearly 94% of the anesthesia providers responded that they would not use the visibly soiled adhesive tape to secure the ET tube before intervention vs 100% of anesthesia providers after the intervention ($U = 109, P = .27$). Cronbach coefficient $\alpha$ for internal consistency for these 3 survey questions was .78.

The 2-way contingency table analysis found no significant change in the preferences of anesthesia providers regarding the packaging of the adhesive tape as a result of the intervention, $\chi^2$ (df = 1) = 1.003, $P = .801$ (Table 2). Before the intervention, 14 of 18 (78%) of the anesthesia providers preferred adhesive tape that was packaged clean, a single patient use item. After the intervention, 2 of 18 (11%) indicated that they preferred the tape to be packaged clean as a multiple-patient-use item. After the intervention, 1 of 14 (7%) indicated that they preferred the tape to be packaged clean as a single-patient-use item. One of 18 anesthesia providers (6%) preferred tape packaged sterile as a single-patient-use item before the intervention, whereas none of the anesthesia providers gave this response after the intervention, a nonsignificant change.

The tape identification features were ranked (1 = least desirable to 5 = most desirable) based on the anesthesia provider’s preference on both preintervention and postintervention questionnaires (Figure 4). The importance of packaging did not significantly change with a median score of 2.0 on the pretest and a median score of 2.5 on the posttest ($U = 60.5, P = .21$). The importance of the tape color did not significantly change, with a median preintervention score of 3.0 and a median postintervention score of 3.0 ($U = 59.5, P = .41$). The median score for importance of the width of the tape did not significantly change either (3.0 pre- and postintervention, $U = 51, P = .21$).

When asked about the tape features that would most promote a clean taping practice, anesthesia providers responded by ranking the following options: the tape qualities such as breathability, waterproof, and flexibility; the techniques of tape application and removal; the cost of the tape; and its use on all patients (Figure 5). Overall, the anesthesia providers did not significantly change their responses from preintervention to postintervention questionnaires. Tape qualities had a median preintervention score of 4.5 and a median postintervention score of 5.0 ($U = 75, P = .27$). Use on all patients had a median score of 3.5 before the intervention and a median score of 4.0 after the intervention ($U = 51, P = .14$). Techniques of tape application and removal had a median score of 3.0 on preintervention and postintervention surveys ($U = 60.5, P = .29$). Lastly, the cost of the tape had a median score of 1.0 on both pretest and posttest ($U = 80, P = .36$).

### Table 2. Packaging Preferences

<table>
<thead>
<tr>
<th>Packaging preference</th>
<th>Preintervention, No. (%)</th>
<th>Postintervention, No. (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clean, single-patient use</td>
<td>14 (78)</td>
<td>12 (86)</td>
</tr>
<tr>
<td>Clean, multiple-patient use</td>
<td>2 (11)</td>
<td>1 (7)</td>
</tr>
<tr>
<td>Sterile, single-patient use</td>
<td>1 (6)</td>
<td>1 (7)</td>
</tr>
<tr>
<td>Packaging does not matter</td>
<td>1 (6)</td>
<td>0 (0)</td>
</tr>
</tbody>
</table>

*Percentages may not total to 100% because of rounding.*
Questions and Possible Responses

What BEST describes the factor that prevents you from using a clean taping practice? Rank your response as 1 = least describes to 5 = best describes.

___ I did not realize the importance of the practice.
___ No knowledge of another way. I thought I was using a clean practice.
___ Difficult to incorporate into practice.
___ Lack of suitable products
___ Assumption that a clean taping practice is unattainable.

For anesthesia purposes, the adhesive tape used for securing the endotracheal tube needs to be designated solely for securing the endotracheal tube.

___ Strongly agree
___ Agree
___ Neither agree nor disagree
___ Disagree
___ Strongly disagree

If the adhesive tape fell to the floor during the taping process and was immediately returned to you, how likely would you use the tape for securing the endotracheal tube?

___ Definitely
___ Probably
___ Not sure
___ Probably not
___ Definitely not

If another tape product were available, which factor would facilitate your use of a clean taping practice the MOST? Rank your responses as 1 = least describes to 5 = most describes.

___ The tape qualities such as breathability, waterproof, and flexibility
___ The techniques of tape application and removal
___ The cost of the tape
___ The length and width of the tape
___ Its use on all patients

Table 3. Questions and Responses Where Change Occurred

ET tube taping practice increase the patient's exposure to pathogens. Most anesthesia providers fail to relate these findings with anesthesia delivery. This project found that the anesthesia providers began the intervention with awareness and knowledge of the facts and the concepts of infection control practices that relate to a clean taping practice. Furthermore, this project demonstrated that the anesthesia providers gained awareness and received new information about the taping practice. This encouraged the anesthesia providers to apply practical, procedural knowledge to a clean taping practice for securing the ET tube that they had not previously considered. Also, this project illustrated the preferences of anesthesia providers that would facilitate a clean taping practice and those preferences that they would use to identify the tape for securing the ET tube.

- Level of Improvement. Statistical significance was demonstrated in 5 areas (Table 3). First, the anesthesia providers saw a lack of awareness as an unimportant factor in preventing an unclean taping practice before the intervention. After the intervention, the anesthesia providers saw the lack of awareness as second only to the lack of a suitable product as a reason for explaining an unclean taping practice (Figure 6). This change suggests that there was a lack of knowledge among anesthesia providers about a clean taping practice. They perceived the importance of a clean taping practice as more important reason for not following a clean taping practice. This realization by the anesthesia providers led them to consider the feasibility of a cleaner practice.

Second, the anesthesia providers indicated before the intervention that incorporating a clean taping practice would be difficult. Yet after the intervention, the anesthesia providers saw a clean taping practice as less difficult to incorporate into practice. This suggests that the anesthesia providers had an improved understanding, conceptually, of a clean taping practice. This change in response suggests that they could consider incorporating a clean taping practice and apply it in the clinical setting.
Third, there was a change in the median responses of the anesthesia providers, from agree to strongly agree, regarding the designation of adhesive tape for securing the ET tube. After the intervention, there was strong agreement that the tape for securing the ET tube needs to be designated for this use exclusively. Their responses suggest an increased awareness and understanding of the need for this special tape. In addition, their responses suggest that they processed new information beyond factual and conceptual knowledge levels to make practical determinations regarding a clean taping practice.

Contamination of the tape through inadvertent dropping to the floor was addressed indirectly in the research of Munoz-Price et al.8 Her group observed, “Objects fall onto the operating room floors and are frequently placed back either on the horizontal work surfaces or on patients themselves.”8(p8) In an observational study of 7,976 hand-hygiene opportunities, Biddle and Shah16(p78) noted that tape is one of those items that falls to the floor, is picked up, and is used. The anesthesia provider’s responses to the situational question regarding the use of tape that falls to the floor and is retrieved for securing the ET tube demonstrated that they had factual and conceptual knowledge about this possible occurrence. The change in the anesthesia provider’s responses from “probably not” to “definitely not” suggests that they increased their understanding of a clean taping practice and applied practical knowledge to respond to this question. Presenting a scenario as in this question challenged the anesthesia providers to refine their practice. They responded that they would definitely not use tape that had fallen to the floor for securing the ET tube. Thus, the taping practice improved.

When the anesthesia providers were asked to consider another tape product, the length and width of the adhesive tape was a moderately descriptive factor that anesthesia providers initially indicated would facilitate their use of a clean taping practice, but after the intervention the length and width of the tape was seen as less descriptive. With their increase in knowledge and experience gained from this project, the anesthesia providers recognized that length and width of the tape of another tape product may not be an important factor to facilitate a clean taping practice.

There were a number of items where no significant change was demonstrated. The anesthesia providers confirmed that the taping practice for securing the ET tube is part of anesthesia care. There was no lack of understanding that this is a duty of anesthesia providers. Factually and conceptually, the anesthesia providers demonstrated that they had awareness and understanding of the importance of maintaining cleanliness when securing the ET tube. They demonstrated that they had understanding of the factual information regarding the prevention of pathogens and that this was an important component of a clean taping practice. Avoiding the use of visibly soiled tape for securing the ET tube demonstrated that they conceptually understood that the taping practice must be clean. It suggests an increased awareness of the importance of infection control practice even when the tape is not visibly soiled. There was no change in the anesthesia provider’s responses regarding tape preferences for securing the ET tube. The anesthesia providers indicated that the tape needs to be packaged clean as a single-patient-use item. Their not choosing a tape that is packaged sterile suggests that the anesthesia providers had factual and conceptual knowledge about pathogen transmission and of infection control practices.

To facilitate a clean taping practice, anesthesia providers identified tape qualities such as breathable, waterproof, and flexible as needed features. Additionally, the tape needs to be able to be used on all patients, including those that have skin sensitivities, facial hair, and open wounds of the face. It must be easy to apply and remove. The packaging of the tape was unimportant as long as it was clean and for single patient use. As well, the anesthesia provider’s preferences regarding the designation and identification of tape for securing the ET tube was unchanged.

**Implications for Clinical Practice.** Based on the results of this evidence-based practice project, the researchers recommend that the adhesive tape for securing the ET tube be packaged as a clean, single-patient-use item. To facilitate a clean taping practice, the tape needs to be breathable, waterproof, and flexible. As well, it needs to be suited for all patients, even those with facial wounds, facial hair, and allergies. It should be easy to apply and remove. The best way to designate the tape is by color and packaging. It is less important to designate the tape by location on the anesthesia gas machine or by tape type, width, or length. Anesthesia providers may need education and training to improve their knowledge of and experience with a clean taping practice. Healthcare facilities should provide a suitable tape for use on their surgical patients who require general anesthesia. Anesthesia providers may then decrease pathogen exposure to patients while securing the ET tube.

**Strengths, Weaknesses, and Limitations of the Project.** Strengths of this project come from the amount, type, and variety of information regarding the taping practice that was gained because of this project and the impact that this information has on patient safety. There were 4 major weaknesses of this project, the small sample size, the duration of the project, the quality of the survey questions, and the preparation of some of the providers. The small sample size of those who participated (N = 18) and the lack of normality limited the type of statistical test that could be applied for this project. The Mann-Whitney U test was selected because of its application for small groups. As well, all test assumptions were met. Thus, results and generalizations could be determined. In the end, the anesthesia providers who did partici-
pate were representative of the population of anesthesia providers at this hospital. The duration of the project, 4 weeks, was too short, as some providers noted that they could not get the required tape practices on patients. The wording of some of the questions on the survey was convoluted, resulting in results that were difficult to interpret. Soliciting information according to importance would have made interpretation easier. There was limited variability in the questions because all participants were well informed about the importance of cleanliness. In addition, the intervention was not administered uniformly to all providers. Three providers were unable to attend the group in-service and had to have individualized sessions. There is a potential that the Hawthorne effect, in which behaviors change because the subjects know they are being watched, may have contributed to the responses of the anesthesia providers. Another consideration for the behavior change of the anesthesia providers is that a suitable alternative tape was part of the intervention, which facilitated their knowledge and experience.

A major limitation of the project was that some anesthesia providers failed to rank all responses in the surveys. Some providers rated all responses with the same rank or only ranked a few, rather than ranking all of the responses as they were instructed to do. This violated the assumption of independence for some of the questions in the survey. The second limitation of this project deals with the response options for a few of the questions on the survey. On one question, the response options were not displayed progressively. The response option “Probably not” and “Not sure” were out of order. Because they were numeric responses, they were reordered to make “Not sure” appear as the middle response without adjusting the numeric value or the anesthesia provider’s selection before data entry.

Last, nurse anesthesia residents were included as participants in this evidence-based quality improvement practice project. Their inclusion was disclosed and approved by all entities related to the project. Some may argue that the nurse anesthesia residents’ questionnaire responses may have been influenced by their preceptor’s bias. Although this may be a consideration, it is important to note that safeguards were in place to protect all participants. In addition, all questionnaires were anonymous and secured after completion as described in the approved project protocol.

**Implications for Future Projects.** This short, evidence-based quality improvement practice project increased the anesthesia provider’s awareness and knowledge of the common elements of the taping practice that increase the patient’s exposure to pathogens and the risk of nosocomial infection. As well, this project presented a clean taping practice with an education module and suitable alternative tapes for anesthesia providers to reduce pathogen transmission, thereby improving patient safety. This project can serve as a pilot project for a larger hospital project. It can be continued and expanded to include multiple facilities to test for consistency of results. Also, it is recommended that this project be broadened to patient populations other than anesthesia. These could include trauma, cancer, and wound care patients. Future research will need to investigate the application of other means to secure the ET tube when they become available.

**Conclusion**

Anesthesia providers have the responsibility of securing the ET tube once the patient is intubated for a general anesthetic. Research concludes that the current taping practice is a high-risk practice. All the common elements independently and collectively involve the tape and its potential to increase the patient’s exposure to pathogens through the taping practice. The anesthesia providers involved in this project changed their perceptions about the taping practice because of an increase in their awareness and knowledge of the taping practice. This evidence-based quality improvement project has demonstrated that a change in practice occurred after an intervention that focused on presenting the best and most current evidence regarding securing the ET tube with adhesive tape.

**REFERENCES**


**AUTHORS**

Lois Krug, DNP, CRNA, ARNP, was a DNP-Anesthesiology candidate at Barry University in the College of Nursing and Health Sciences Doctor of Nursing Practice (DNP) Anesthesiology Program, Miami Shores, Florida, at the time this article was written. She is a full-time nurse anesthetist employed by Anesco North Broward LLC of Fort Lauderdale, Florida, as well as a clinical coordinator at Barry University in the College of Nursing and Health Sciences Master of Science Program in Anesthesiology. Email: lois.krug@mymail.barry.edu.

Melissa D. Machan, DNP, CRNA, ARNP, is a full-time nurse anesthetist at Plantation General Hospital, Plantation, Florida, as well as an adjunct faculty member at Barry University in the College of Nursing and Health Sciences DNP Anesthesiology Program.

Jose Villalba, MD, is director of infectious disease for Broward Health, Fort Lauderdale, Florida.

**DISCLOSURES**

The authors have declared no financial relationships with any commercial interest related to the content of this activity. The authors did not discuss off-label use within the article.