Suction Accuracy and the Need for Clinician Education and Suction Equipment Maintenance Protocols

Lynn Curry
Molly Back

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Running head: SUCTION ACCURACY AND THE NEED FOR CLINICIAN EDUCATION

Suction Accuracy and the Need for
Clinician Education and Suction Equipment Maintenance Protocols

Lynn Curry and Molly Back
Dr. Pamela O'Neal, PhD, RN

University of Alabama Huntsville
College of Nursing Honors Program
Spring 2008-2009
Honors Senior Project
Approval

Form 3 – Submit with completed thesis. All signatures must be obtained.

Name of candidate: Lynn Curry

Department: Nursing

Degree: BSN

Full title of project: Suction Accuracy & the Need for Clinician Education & Suction Equipment Maintenance Protocols

Approved by:

[Signature]
Project Advisor
4/9/09

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Department Chair
4/9/09

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Honors Program Director for Honors Council
15 April 2009

Date
Date
Date
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Abstract

Suctioning is a routine and critical procedure performed numerous times a day for patients who require mechanical assistance to breathe. Effective suctioning removes secretions that can contribute to a pneumonia, which increases the cost of care and the length of stay. Effective in the fall of 2008, Medicare announced they would no longer pay for infections developed when a patient is hospitalized. It is imperative that suction equipment functions appropriately, and secretions are maximally evacuated to prevent complications such as pneumonia, which is an infectious process. Since a clinician’s expertise is the front line of defense to prevent infections, health care providers need to know that the suction equipment is operating accurately. Without correct readings, suctioning is simply a best guess practice, and patient safety is questionable.
or leaking around the ETT further increases the risk for developing VAP. Impaired mucociliary clearance and limitation of sinus drainage due to the ETT allows for a biofilm to form on the lumen of the tube, encouraging the colonization of pathogens. Normally, coughing is an effective way the body rids itself of secretions, however with an endotracheal tube in place, the epiglottis cannot properly close and oropharyngeal secretions pool just above the endotracheal tube cuff (DePew and McCarthy, 2007). Research suggests that most suctioning equipment is colonized with a VAP pathogen within 24 hours of use (Sole, Byers, Ludy, Zhang, Banta, and Brummel, 2002).

In a study completed in 2003, out of ninety-nine critically ill patients with percutaneous tracheotomy (an endotracheal tube not surgically inserted), eighteen patients acquired pneumonia within seven days after admission. Those patients developed the infectious complication even with the administration of prophylactic antibiotic therapy forty-eight hours prior to the insertion of the endotracheal tube. *Pseudomonas aeruginosa* was found in eight of the patients and the remaining ten were colonized with Gram-negative bacilli (Rello, Lorente, Diaz, Bodi, Boque, & Sandiumenge, 2003). Rello and colleagues (2003) also found that the estimated cost of treating VAP was $40,000 per case; excluding pharmacological intervention (Rello et al., 2003). While endotracheal suctioning is an important nursing intervention, the risk for VAP is dependent upon three major factors: the clinicians' knowledge and adherence to evidence base practice in preventing the spread of VAP organisms, the ability of the system to adequately remove secretions with optimal pressures, and the reliability and accuracy of the endotracheal suctioning system itself.
Suctioning Pressure

Given its role in preventing complications in intubated patients, there is a surprising gap between suggested guidelines for suctioning and actual suctioning practice. Research suggests that nurses are not suctioning at safe pressures. Twenty-eight nurses were selected from a large teaching hospital in England (Day, Farnell, Haynes, Wainwright, and Wilson-Barnett, 2002). They were observed using non-participant observation. Each nurse was interviewed and questioned about suctioning practices and completed a knowledge-based questionnaire. During suctioning, twenty-six nurses were observed using suctioning pressures of 150-200 mm Hg, and five were observed suctioning with pressures from 263-300 mm Hg. These suctioning pressures far exceeded the recommended 80-150 mmHg (Day et al., 2002).

Kelleher and Andrews (2008) investigated endotracheal suction (ETS) practices of ICU nurses in two Intensive Care Unit’s in Ireland: General Intensive Care Unit (GICU) and the Cardiac Intensive Care Unit (CICU). The study examined nurses practices prior to, during, and post ETS and their compliance with current research recommendations. The results indicated that nurses vary in their ETS practices, do not adhere to recommendations, and provide sub-standard care. This study showed discrepancies between respiratory assessment techniques, hyperoxygenation, infection control practices, patient reassurance, and the level of negative pressure used to clear secretions. As far as suctioning was concerned, both groups complied with evidenced-based recommendations and guidelines in relation to suctioning time and application of pressure; however, both groups exceeded the recommended pressure of 80-150 mmHg (Kelleher and Andrews, 2008).

Flow and Vacuum

The rate at which air, fluid, or secretions are removed is referred to as "flow rate." Clinicians strive to achieve the optimal flow rate with the least amount of vacuum or pull on the mucosal lining of the airway, lungs or stomach. Within a vacuum, and specifically within the ETT, secretions optimally move from an area of higher pressure within the patient, to an area of lower pressure in the suctioning apparatus (Carroll, 2008). As catheters remove secretions from the body, the degree of open flow changes constantly, based on the fill of the catheter and the substance being removed (Carroll, 2008). It is
recommended that negative pressures should be between 80 and 150 mm Hg to preserve the integrity of the tissues in contact with the vacuum. While there are guidelines for the vacuum rate, it is really up to the clinician to set the rate. The rate depends upon where the suction is applied (stomach, trachea, pleural space), the age and size of the patient and the risk of damage to tissue lining being suctioned (Carroll, 2008).

In order to set the vacuum rate, a closed system must be established with the clinician occluding the suction tubing. If the system is not occluded properly, the clinician may dial in an incorrect setting resulting in dangerous pressure levels when suctioning the patient (Carroll, 2008). Incorrect suctioning may result in irreversible tissue necrosis to the trachea and the lungs which only elevates the risk for pathogen colonization (Stenqvist, Lindgren, Karason, Sondergard, and Lundin, 2007).

**Viscosity of Secretions**

As mentioned earlier, a major risk factor for ventilator associated pneumonia (VAP) is the pooling of what may be 100-150 ml of secretions in a 24-hour period. O'Neal, et al in 2007 showed that proper management of secretion viscosity may help to delay the onset of VAP. In 2007, O'Neal et al performed a study where subglottic secretions were collected from eleven patients in a respiratory Intensive Care Unit (ICU) in the south. They used a French Hi-Lo Evac ETT placed in a simulated trachea. The mean age was sixty two (four males and seven female) with the most admitting diagnosis being respiratory arrest. The study showed that while there is a recommended range of applied vacuum pressure when performing endotracheal suctioning, suctioning pressure and removal of secretions also varies according to secretion viscosity. The suction pressure that allowed for the most effective secretion removal and highest mean secretion recovery was 30 mm Hg. Higher viscosity secretions were easier to evacuate than lower viscosity ones with 30 mm Hg of pressure. The current recommended medical practice of pressure is 20 mm Hg; well below what was found to be maximally effective (O'Neal, Munro, Grap, and Rausch, 2007).

**Calibration Policy**

While it is crucial that clinicians practice according to evidence-based guidelines, it is also imperative that clinicians have reliable equipment that is user-friendly and can be trusted to be accurate. At the present time, there appears to be no standard policy
which mandates the calibration of endotracheal suction equipment on a routine schedule. Intensive care units, cardiac floors, general patient populations and their families are reliant upon individual clinicians’ knowledge and implementation of that knowledge to provide safe and effective care. The Ohio Medical Group, a large suction equipment manufacturer, has published a suggested checklist regarding care of suction equipment in their equipment manual. It states that the equipment should be thoroughly cleaned and sterilized after each use, carefully inspected with special regard to filters, the performance be analyzed, and the equipment adjusted and repaired if necessary (Ohio medical group). None of the published literature mandates calibration specifics for suctioning equipment. This study hopes to look at the accuracy of in-line versus dialed in suction pressures and prove that there is a level of discrepancy that necessitates the need for regular calibration. Suctioning is an imperative event in the daily care of intubated patients. Since clinicians’ expertise is the front line of defense against infectious processes, health care providers need to trust that the readings they are taught to rely on are accurate. Without correct readings suctioning is simply a best guess practice and patient safety cannot be left to assumptions.

Introduction/Methods

A descriptive study was conducted. University institutional review board and hospital research approval were obtained. Intermittent suction equipment was bench-tested for specification compliance. Regulators were removed from walls in patient rooms and transported to a lab and analyzed for bleed up/down time and timing on/off cycle using an Ashcroft digital pressure analog vacuum gauge, Cole-Parmer mercury flow meter, and a stopwatch. The setting was a not-for-profit, teaching hospital with 881 licensed acute care beds in the southern region. The sample included ninety-six suction units. Our objectives for performing this research were to identify maintenance protocols that need to be in place to routinely identify broken or inaccurate suction equipment and to identify accurate use of suction equipment and protocols when suction equipment is not working.
Variables

- **Bleed Up/Down (Intermittent):** The time it takes for the gauge to register what the clinician has dialed in so as to achieve the desired pressure for suctioning.
- **Timing Cycle “On” (Intermittent):** The time interval the desired pressure remains on in the intermittent cycle.
- **Timing Cycle “Off” (Intermittent):** The time interval the regulator is off in the intermittent setting before cycling on again.

Results (Appendix A):

A total of 12% of suction regulators were tested for accuracy. Our study concluded that specific “bleed” and “time” variables were accurate in the majority of suction regulators tested. “Bleed up” was accurate in 56% of suction regulators and “Bleed down” was accurate in 65% of suction regulators. During active suctioning, “timing-on” cycles were accurate in 65% of the suction regulators and “timing-off” cycles were accurate in 74% of the suction regulators. “Bleed” and “time” variables when combined, indicated 48% suction accuracy. Less than half of the suction regulators were accurate in both bleed and time variables.

Limitations

Our study was limited to only one hospital; thus preventing the results from being generalized. Only 12% of the acute care facility’s suction regulators were tested.

Discussion/ Implications for Practice

Maintenance protocols need to be in place to routinely identify broken or inaccurate equipment. Clinicians need to be educated on identifying accurate suction procedures and following protocol when a machine is not working.

Acknowledgements

Thank you to Dr. Pamela O’Neal, Dr. Lynx McClellan, Dr. Bernard Vogler, UAHuntsville College of Nursing, UAHuntsville Institutional Review Board, Medical Equipment Management, and Huntsville Hospital Institutional Review Committee. This was funded and supported by the UAHuntsville Office of the President and Senate Finance Committee.
References


The Ohio Medical Group. (2007). Enhancing the safety of medical suction through innovative technology. (Form No. SOT 645). Middleton, CT: Patricia Carroll.


Appendix A

Graph 1: (Percentage of suction regulators with bleed up/down accuracy)

Graph 2: (Percentage of suction regulators with timing on/off accuracy)

Graph 3: (Percentage of suction regulators with overall accuracy related to bleed and time variables)
Appendix B: University of Alabama Huntsville Institutional Review Board Application and Acceptance Letter
Principal Investigator/Study Director: Lynn Curry and Molly Back
Status: Faculty _____ Staff _____ Student _X___
Department: Nursing College/Research Center: College of Nursing
Supervising Faculty Member (if student): Dr. Pamela O’Neal, PhD, RN
Telephone: (256) 824-6669 Email: onealp@uah.edu

Title of Study: Suction Effectiveness: Inline Compared to Dialed-in Suction Pressure

Purpose of Study: The purpose of this study is to compare the differences between the accuracy of inline versus dialed-in suction pressure. The significance of describing these pressure readings is to be able to optimally care for clients who require suctioning to remove secretions. If suction pressures are not within recommended guidelines, a client can be harmed by developing complications such as erosion of the trachea and bleeding leading to hypovolemic shock.

Hypotheses: The null hypotheses is that there is no difference between inline versus dialed-in suction pressures.

Description of Subjects: There will be no human subjects involved in this study. The study will be performed at the Huntsville Hospital Biomedical Lab in collaboration with Bob Russell, manager of Biomedical Services for Huntsville Hospital. Suction equipment is the source of data collection.

How Subjects Will Be Selected: As previously stated, there will be no human subjects. Suction manometers in highly utilized client areas will be obtained for analysis. A suction manometer will be removed and the same apparatus will be replaced so that no client room is without this standard equipment.

Description of Procedure: Over the course of several days, five hundred suction manometers will be bench tested in the Huntsville Hospital Biomedical Lab. Uncalibrated manometers from client wall units will be removed, transported to the lab, pressure analyzed, calibrated, and the pressure analyzed again after calibration. Upon the removal of each uncalibrated suction manometer, a fully calibrated instrument will immediately replace the one removed, thus ensuring no disruption of client care. Once suction manometers from various floors of the hospital are gathered in the lab, the equipment will be tested for accuracy of flow using a flow meter. The inline pressure will be analyzed using a digital pressure analog vacuum gauge. If
those measurements prove to be outside of set acceptable ranges, we will calibrate the instrument under the supervision of Bob Russell and his staff. Calibrated manometers will then be available for use within the hospital.

**Instrumentation (if applicable):**
- **Flow:** Cole-Parmer Flow Meter (L/min)
- **Vacuum Pressure:** Ashcroft Digital Pressure Vacuum Analog Gauge (mm/Hg)

**Duration of Study:** May 27, 2008 – August 5, 2008 (10 weeks)
  
  a. **Total amount of time with each subject:** approx. 40 min.
  
  b. **Time to complete study:** approx. 350 hours

**Benefit(s) of the Study:** Suctioning is a routine and critical procedure performed numerous times a day for patient who require mechanical assistance to breathe. Effective suctioning removes secretions that can contribute to a pneumonia, which will increase the cost of care and the length of stay. Effective fall 2008, Medicare will no longer pay for infections developed when a patient is hospitalized. It is imperative that suction equipment functions appropriately, and secretions are maximally evacuated to prevent complications such as pneumonia, which is an infectious process. Since a clinician’s expertise is the front line of defense to prevent infections, health care providers need know that the suction equipment is operating accurately. Without correct readings, suctioning is simply a best guess practice, and patient safety is questionable.

**Possible Risks to Subject(s) and Precautions Taken to Avoid Risks:** As stated previously, there are no human subjects. Upon the removal of each uncalibrated suction manometer, a fully calibrated instrument will immediately replace the one removed, thus ensuring no disruption of patient care.

**Confidentiality/Anonymity:** Suction manometers will be identified only by model number and room/unit where removed. Huntsville Hospital will be identified only as a large, teaching hospital in the Southeast. Health Insurance Portability and Accountability Act of 1996 (HIPAA) Privacy Standards will be implemented at all times.

**Documentation of Informed Consent by Subject(s) Attached?** Yes [ ] No [X]

**Signature:** Lynn Curry and Molly Back

**Supervising Faculty Signature (if student):** Dr. Pam O’Neal

Updated: 5/01
June 17, 2008
Dr. Pamela O'Neal
College of Nursing
University of Alabama in Huntsville
Huntsville, AL 35899

Dear Dr. O'Neal,

As chair of the IRB Human Subjects Committee, I have reviewed your two proposals, *Inline Compared to Dialed-in Suction Pressure* and *Study of Knowledge of Suction Procedures*, and have found both meet the necessary criteria for exemption from review according to 45 CFR 46. I have granted these proposals exemptions, and you may commence your research. Please note that these exemptions are good for one year from the date on this letter. If data collection continues past this period, a renewal application must be filed with the IRB.

Contact me if you have any questions.

Sincerely,

[Signature]

Dr. William Wilkerson,
Chair, UHSC
Appendix C: Huntsville Hospital Institutional Review Committee Application and Acceptance Letter
(PLEASE TYPE)

Title of Project: Suction Effectiveness: Inline Compared to Dialed-in Suction Pressure

Principal Investigator: Lynn Curry; Molly Back

Investigator’s Signature: Lynn Curry

Today’s Date: 05/28/2008

E-Mail: lynnandnate@aol.com; Moser321@aol.com

Address: College of Nursing, University of Alabama in Huntsville, 202 Nursing Building, Huntsville, AL 35899

Phone: (256) 520-9611; (256) 527-6293

Fax: (256) 824-6026

or Home Address and Affiliation:

Source of Funds: None

Faculty Advisor/Course Instructor’s name: Dr. Pamela O’Neal, PhD, RN

Phone: (256)-824-6669

E-mail: onealp@uah.edu

Address: College of Nursing, University of Alabama in Huntsville, 202 Nursing Building, Huntsville, AL 35899

Advisor’s Signature: Dr. Pamela O’Neal, PhD, RN

(As contact for Student, Fellowship or Resident research project)

Mark the category or categories below which describe your research:

☐ 1. Research conducted in established or commonly accepted educational settings, involving normal educational practices, such as (I) research on regular and special education instructional strategies, or (II) research on the effectiveness of or the comparison among instructional techniques, curricula, or classroom management methods.

☐ 2. Research involving the use of educational tests (cognitive, diagnostic, aptitude, achievement), survey procedures, interview procedures, or observation of public behavior, unless: (I) information obtained is recorded in such a manner that human subjects can be identified, directly or through identifiers linked to the subjects; and (II) any disclosure of the human subjects’ responses outside the research could reasonably place the subjects at risk of criminal or civil liability or be damaging to the subjects’ financial standing, employability, or reputation. Attach questionnaire(s) and/or surveys.

☐ 3. Research involving the use of educational tests (cognitive, diagnostic, aptitude, achievement), survey procedures, interview procedures, or observation of public behavior that is not exempt under category (2), if: (I) the human subjects are elected or appointed public officials or candidates for public office; or (II) federal statute(s) require(s) without exception that the confidentiality of the personally identifiable information will be maintained throughout the research and thereafter. Attach to this application a copy of any questionnaire or survey to be used.

☒ 4. Research involving the collection or study of existing data, documents, records, pathological specimens, or diagnostic specimens, if these sources are publicly available or if the information is recorded by the investigator in such a manner that subjects cannot be identified, directly or through identifiers linked to
the subjects. Attach a specimen release form if applicable. (Specimens must be preexisting.)

☐ 5. Research and demonstration projects which are conducted by or subject to the approval of department or agency heads, and which are designed to study, evaluate, or otherwise examine: (i) public benefit or service programs; (ii) procedures for obtaining benefits or services under those programs; (iii) possible changes in or alternatives to those programs or procedures; or (iv) possible changes in methods or levels of payment for benefits or services under those programs.

☐ 6. Taste and food quality evaluation and consumer acceptance studies, (i) if wholesome foods without additives are consumed or (ii) if a food is consumed that contains a food ingredient at or below the level and for a use found to be safe, or agricultural chemical or environmental contaminant at or below the level found to be safe, by the Food and Drug Administration or approved by the Environmental Protection Agency or the Food Safety and Inspection Service of the U.S. Department of Agriculture.

Please give a brief description of your project to explain the exemption: (PLEASE TYPE)
(Include a description of the gender and racial/ethnic composition of the subject population.)

Purpose of Study: The purpose of this study is to compare the differences between the accuracy of inline versus dialed-in suction pressure. The significance of describing these pressure readings is to be able to optimally care for clients who require suctioning to remove secretions. If suction pressures are not within recommended guidelines, a client can be harmed by developing complications such as erosion of the trachea and bleeding leading to hypovolemic shock.

Hypotheses: The null hypothesis is that there is no difference between inline versus dialed-in suction pressures.

Description of Subjects: There will be no human subjects involved in this study. The study will be performed at the Huntsville Hospital Biomedical Lab in collaboration with Bob Russell, manager of Biomedical Services for Huntsville Hospital. Suction equipment is the source of data collection.

How Subjects Will Be Selected: As previously stated, there will be no human subjects. Suction manometers in highly utilized client areas will be obtained for analysis. A suction manometer will be removed and the same apparatus will be replaced so that no client room is without this standard equipment.

Description of Procedure: Over the course of several days, five hundred suction manometers will be bench tested in the Huntsville Hospital Biomedical Lab. Uncalibrated manometers from client wall units will be removed, transported to the lab, pressure analyzed, calibrated, and the pressure analyzed again after calibration. Upon the removal of each uncalibrated suction manometer, a fully calibrated instrument will immediately replace the one removed, thus ensuring no disruption of client care. Once suction manometers from various floors of the hospital are gathered in the lab, the equipment will be tested for accuracy of flow using a flow meter. The inline pressure will be analyzed using a digital pressure analog vacuum gauge. If those measurements prove to be outside of set acceptable ranges, we will calibrate the instrument under the supervision of Bob Russell and his staff. Calibrated manometers will then be available for use within the hospital.
Instrumentation (if applicable): Flow: Cole-Parmer Flow Meter (L/min)
Vacuum Pressure: Ashcroft Digital Pressure Vacuum Analog Gauge (mm/Hg)
Duration of Study: June 1, 2008 – August 5, 2008 (10 weeks)
   a. Total amount of time with each subject: approx. 40 min
   b. Time to complete study: approx. 350 hours
Benefit(s) of the Study: Suctioning is a routine and critical procedure performed numerous times a day for patients who require mechanical assistance to breathe. Effective suctioning removes secretions that can contribute to pneumonia, which will increase the cost of care and the length of stay. Effective in the Fall of 2008, Medicare will no longer pay for infections developed when a patient is hospitalized. It is imperative that suction equipment functions appropriately, and secretions are maximally evacuated to prevent complications such as pneumonia, which is an infectious process. Since a clinician’s expertise is the front line of defense to prevent infections, health care providers need know that the suction equipment is operating accurately. Without correct readings, suctioning is simply a best guess practice, and patient safety is questionable.
Possible Risks to Subject(s) and Precautions Taken to Avoid Risks: As stated previously, there are no human subjects. Upon the removal of each uncalibrated suction manometer, a fully calibrated instrument will immediately replace the one removed, thus ensuring no disruption of patient care.
Confidentiality/Anonymity: Suction manometers will be identified only by model number and room/unit where removed. Huntsville Hospital will be identified only as a large, teaching hospital in the Southeast. Health Insurance Portability and Accountability Act of 1996 (HIPAA) Privacy Standards will be implemented at all times.

03/11/03
/aeg
Form 3: Application for Exemption from UHSC Review

Name: Lynn Curry, Molly Back  Date: May 7, 2008
Address: 7019 Eagle Park Circle
City, State, Zip: Owens Cross Roads, AL 35763
Telephone: (256) 520-9611  Email: lac0003@uah.edu
Course Title & Number (if applicable): Suction Effectiveness: Inline compared to dialed-in suction pressure

Course Instructor (if applicable):
Pamela O’Neal, PhD, RN

Research conducted may be exempted from UHSC approval if the research fully meets at least one of the following (please check all that apply):

_____ Research conducted in established or commonly accepted educational settings, involving normal educational practices, such as (a) research on regular and special education instructional strategies, or (b) research on the effectiveness of or the comparison among instructional techniques, curricula, or classroom management methods.

_____ Research involving the use of educational tests (cognitive, diagnostic, aptitude, achievement), survey procedures, interviews, or observation of public behavior in which information is obtained in a manner that human subjects cannot be identified directly or through identifiers linked to the subjects and any disclosure of the human subject’s responses outside the research would NOT place the subjects at risk of criminal or civil liability or be damaging to the subject’s financial standing, employability, or reputation.

_____ Research involving the use of educational tests (cognitive, diagnostic, aptitude, achievement) survey procedures, interview procedures, or observation of public behavior if (a) the human subjects are elected or appointed public officials or candidates for public office, or (b) Federal statute(s) require(s) without exception that the confidentiality of the personally identifiable information will be maintained throughout the research and thereafter.

_____ X Research involving the collection or study of existing data, documents, records, pathological specimens, or diagnostic specimens, if these sources are publicly available or if the information is recorded by the investigator in such a manner that subjects cannot be identified, directly or through identifiers linked to the subjects.

Surveys, interviews, or observation of public behavior involving children cannot be exempt.

I hereby certify that my research fully meets the categories indicated above. In the event that my research becomes ineligible for such exemption(s) for any reason, I will re-apply for appropriate UHSC review.

Lynn A Curry, Molly Back

Signature 5/30/2008 Date

Updated 5/01
June 5, 2008

Ms. Lynn Curry
Ms. Molly Back
UAH School of Nursing
University of Alabama-Huntsville
202 Nursing Building
Huntsville, AL 35899

RE: Request for Institutional Review Committee Exemption of Study
Suction Effectiveness: Inline Compared to Dialed-In Suction Pressure

Dear Ms. Curry and Ms. Back:

Thank you for forwarding the application for Institutional Review Committee exemption to me for your proposed nursing study. Dr. John Cox, Chair, has reviewed your information and agreed that this study does qualify for exemption.

If you have any questions or I can be of further service, please feel free to call me at 265-6990.

Sincerely,

Allison E. Greene, Division Assistant/Institutional Review Committee Coordinator

cc: Karol Jones, Chief Nursing Officer
Appendix D: Research Experience for Undergraduates Poster
**Background**

- Endotracheal suctioning removes pathogenic secretions that can lead to pneumonia
- Suction accuracy is important to adequately remove secretions, prevent costly complications which may lengthen stay, and minimize tissue trauma and injury for intubated patients
- Adequate patient care relies on the suction regulator accuracy. Most hospitals do not have suction regulator maintenance policies

**Methods**

- Descriptive study
- University institutional review board and the hospital research approval obtained
- Intermittent suction regulators were bench tested for specification compliance
- Regulators were removed from walls in patient rooms and transported to a lab and analyzed for bleed up/down time and timing on/off cycle using an Ashcroft digital pressure analog vacuum gauge, Cole-Parmer mercury flow meter, and a stopwatch

**Setting:** Not-for-profit, teaching hospital with 881 licensed acute care beds in the southeast region

**Sample:** Ninety-six suction regulators were removed from patient rooms and assessed in the biomedical lab for accuracy

**Variables Measured**

- **Bleed Up/Down (Intermittent):** The time it takes for the gauge to register what the clinician has dialed in so as to achieve the desired pressure for suctioning
- **Timing Cycle "On" (Intermittent):** The time interval the desired pressure remains on in the intermittent cycle
- **Timing Cycle "Off" (Intermittent):** The time interval the regulator is off in the intermittent setting before cycling on again

**Results**

- Specific bleed and time variables were accurate in the majority of suction regulators tested
- Bleed up was accurate in 56% of suction regulators
- Bleed down was accurate in 65% of suction regulators

**Discussion**

- A total of 12% suction regulators were tested for accuracy
- Less than half of the suction regulators were accurate in both bleed and time variables

**Questions**

- Does this indicate that the suction regulators were ineffective in removing secretions?
- Secretion removal and with inaccurate suction regulators was not tested, but does indicate the need for additional studies in this area
- Other variables to study include suction regulator flow and gauge accuracy

**Limitations**

- Study limited to only one hospital; results cannot be generalized

**Implications for Practice**

- Maintenance protocols need to be in place to routinely identify broken or inaccurate equipment
- Clinicians need to be educated on identifying accurate suction procedures and following protocol when a machine is not working

**Acknowledgments**

Funded and supported by UAHuntsville Office of the President and the Senate Finance committee and Medical Equipment Management

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**College of Nursing**

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Appendix E: Hudson Alpha Biotechnology Poster
Suction Accuracy: Is Hospital Equipment Causing Pneumonia?

Molly Back, BA
Pam O’Neal, PhD, RN
Lynn Curry, MA

Background
- Endotracheal suctioning removes pathogenic secretions that can lead to pneumonia.
- Suction accuracy is important to adequately remove secretions, prevent costly complications which may lengthen stay, and minimize tissue trauma and injury for intubated patients.
- Adequate patient care relies on the suction regulator accuracy. Most hospitals do not have suction regulator maintenance policies.

Methods
- Descriptive study
- University institutional review board and the hospital research approval obtained.
- Intermittent suction regulators were bench tested for specification compliance.
- Regulators were removed from walls in patient rooms and transported to a lab and analyzed for bleed up/down time and timing on/off cycle using an Ashcroft digital pressure analog vacuum gauge, Cole-Parmer mercury flow meter, and a stopwatch.

Setting: Not-for-profit, teaching hospital with 881 licensed acute care beds in the southeast region.

Sample: Ninety-six suction regulators were removed from patient rooms and assessed in the biomedical lab for accuracy.

Variables Measured
- **Bleed Up/Down (Intermittent):** The time it takes for the gauge to register what the clinician has dialed in so as to achieve the desired pressure for suctioning.
- **Timing Cycle “On” (Intermittent):** The time interval the desired pressure remains on in the intermittent cycle.
- **Timing Cycle “Off” (Intermittent):** The time interval the regulator is off in the intermittent setting before cycling on again.

Results
- Specific bleed and time variables were accurate in the majority of suction regulators tested.
- Bleed up was accurate in 56% of suction regulators.
- Bleed down was accurate in 65% of suction regulators.

- During Active Suctioning:
  - Timing-on cycle accurate in 65% of the suction regulators.
  - Timing-off cycle accurate in 74% of the suction regulators.

- Bleed and time variables when combined indicated 48% suction accuracy.

Discussion
- A total of 12% suction regulators were tested for accuracy.
- Less than half of the suction regulators were accurate in both bleed and time variables.

Questions
- Does this indicate that the suction regulators were ineffective in removing secretions?
- Secretion removal and with inaccurate suction regulators was not tested, but does indicate the need for additional studies in this area.
- The length of time suction regulators stay calibrated is another area to study.
- What is the degree of accuracy to be expected with suction regulators that promotes optimal secretion removal?
- What is the influence of secretion viscosity on secretion removal when suction regulators are inaccurate in bleed and time variables?
- Other variables to study include suction regulator flow and gauge accuracy.

Limitations
- Study limited to only one hospital; results cannot be generalized.
- Only 12% of suction regulators were tested.

Implications for Practice
- Maintenance protocols need to be in place to routinely identify broken or inaccurate equipment.
- Clinicians need to be educated on identifying accurate suction procedures and following protocol when a machine is not working.

Acknowledgments
Funded and supported by UAHuntsville Office of the President and the Senate Finance committee and Medical Equipment Management.
Appendix F: Sigma Theta Tau Research Day Presentation
Suction Accuracy and the Need for Clinician Education and Suction Equipment Maintenance Protocols

**OUTLINE**

1. Background
2. Problem Focus Areas
3. Methods
4. Results
5. Conclusions
6. Questions

**BACKGROUND**

- Suctioning: Purpose & Procedure
- Medicare Involvement
- Nursing Role
**PROBLEM FOCUS AREAS**

1. Intermittent Suction Equipment
2. Training Shortfalls

**METHODS**

- Descriptive study
- University institutional review board and hospital research approval obtained
- Intermittent suction regulators bench tested for specification compliance
- Suction equipment removed from walls in patient rooms, transported to a lab, and analyzed

**Setting:** Not-for-profit, teaching hospital with 881 licensed acute care beds in the south

**Sample:** 98 suction units assessed in the biomedical lab for accuracy

**RESULTS**

**Definition of Variables**

- Bleed Up
- Bleed Down
- Timing On
- Timing Off

**RESULTS**

- Percentage of suction regulators with bleed up setting
- Percentage of suction regulators with bleed down setting

- Percentage of suction regulators with overall accuracy related to bleed and time variables
CONCLUSION

Implications for Practice

- Adequate Secretion Removal
- Cost Containment
- Prevention of Injury
- Clinician Education
- Maintain current Hospital Protocols

QUESTIONS

REFERENCES


