Risk of Complications Using Laryngeal Mask Airway vs. Endotracheal Tube During General Anesthesia in Pediatric Patients with Upper Respiratory Infections: A Narrative Review.

Creation of The Upper Respiratory Infection Screening Tool© and Management Algorithm for Children Presenting for General Anesthesia with Upper Respiratory Infection ©.

Megan M. Grelson RN, BSN
megan.grelson@tcu.edu

Capstone Project

DOCTOR OF NURSING PRACTICE

Primary Advisor: Mark Welliver CRNA, DNP, ARNP
Secondary Advisor: Hylda Nugent CRNA, DNP, ARNP

Harris College of Nursing and Health Sciences
School of Nurse Anesthesia
Texas Christian University

DATE 2012
Word Count
ABSTRACT

The inflammatory process that occurs in an upper respiratory infection poses an increased risk of complications for children undergoing general anesthesia for a surgical procedure. For the last 20 years, the increased risk for complications has resulted in providers postponing surgical procedures. Today, surgeons are able to proceed with these surgical procedures because of advanced airway management techniques. Anesthesia professionals now have the additional option of using a laryngeal mask airway in addition to intubation or cancelation. The question that arises is; which airway device is better and carries less risk of adverse respiratory complications, laryngeal mask airways or endotracheal tubes, in pediatric patients with upper respiratory infections requiring anesthesia for surgery.

The literature was searched using Embase, CINAHL, and The Cochrane Library for articles comparing the use of laryngeal mask airways and endotracheal tubes in children with upper respiratory infections. Findings include laryngeal mask airways have a decreased risk of complications when compared to endotracheal tubes when used in children with upper respiratory infections. Laryngeal mask airways should be considered in place of endotracheal tubes in children with upper respiratory infections undergoing general anesthesia.

A Upper Respiratory Infection Screening Tool was designed to provide quick recognition of children at high risk for complications associated with upper respiratory infection. Additionally A Management Algorithm for Children Presenting for General Anesthesia with Upper Respiratory Infections was developed to guide anesthesia professionals in determining whether to postpone a general anesthetic or proceed with an endotracheal tube verses laryngeal mask airway in pediatric patients with upper respiratory infections. A continuing educational course for the American Association of Nurse Anesthetists Journal was developed to distribute
this information. The ACE Star Model was the guiding framework used to implement this evidence-based clinical guide.
PART ONE: Introduction and Overview Methodology

Introduction

Upper respiratory infections (URIs) are the most common illnesses among children, with most children developing 6-10 URIs a year.¹ These infections can be caused by more than 200 different viruses, the most common being the rhinovirus.¹ Children can contract any URI causing virus through droplets in the air or from direct contact with someone who is ill.¹ Children are more susceptible to the illness due to their immature immune systems and close contact with other children in schools and daycares.¹ The most common symptoms of URIs are runny nose, cough, congestion, sore throat, and low grade fever. A complete list of symptoms can be found in Table 1. Upper respiratory infections are so common in children, their URI may be present when the child is scheduled for surgery.

In 1979, McGill et al were the first to conclude that there is an increased risk of respiratory complications in children with recent URIs who undergo general anesthesia.² The infection causes an acute inflammatory process that results in hyper-reactivity of the airway smooth muscle that can last anywhere from 4 to 6 weeks.³,⁴,⁵ Since this observation, anesthesia providers have disagreed as to whether a child should undergo an elective surgical procedure or if it should be postponed or even canceled, allowing more time for the child to recover from their URI. The problem with waiting is by the time 4 to 6 weeks pass, the child usually has acquired a new URI. The belief was that children with recent or current URIs were at an increased risk of peri- and post-operational complications including laryngospasm, bronchospasm, oxygen desaturation.³,⁴,⁵,⁶,⁷,⁸,⁹,¹⁰ (see Table 2) In 1991, Cohen and Cameron published the largest prospective observational study involving 1,283 children with URIs and 20,876 without.¹¹ Their
research found that children presenting with URIs were two to seven times more likely to have respiratory complications peri- and postoperatively.\textsuperscript{11}

Upper respiratory infections increase the risk for complications in children, as seen in Table 2. The infection causes an acute inflammatory process that results in hyper-reactivity of the airway smooth muscle that can last anywhere from 4 to 6 weeks.\textsuperscript{3,4,5} Anesthetic gases and airway manipulation can irritate the already hyper-reactive smooth muscle, causing an increased risk of bronchoconstriction and laryngospasm in the child.\textsuperscript{3,4,5} An important part of the anesthesia provider’s tasks is to avoid stimulation of the larynx in the already sensitive airway, therefore decreasing the likeliness of laryngospasms, bronchospasms and/or bronchoconstriction.\textsuperscript{3}

\textit{Different invasive airway devices}

Several different types of airway devices can be used during a general anesthetic to provide the patient the ability to spontaneous breathe to provide positive pressure ventilation either mechanically by the ventilator or manually by the provider. The airway device is directly connected to the breathing circuit on the anesthesia machine to deliver carrier gasses to the patient.

An endotracheal tube (ETT) is “a large-bore catheter inserted through the mouth or nose and into the trachea to a point above the bifurcation of the trachea. It is used for delivering oxygen and other gases at or above atmospheric pressure.”\textsuperscript{12} Endotracheal tubes were the primary means of facilitating mechanical ventilation of patients for decades, and are still the primary means of securing an airway.

Laryngeal mask airways (LMAs) were first approved by the U.S. Food and Drug Administration in 1991, and have since been used as a passive and positive-pressure ventilating device in surgeries.\textsuperscript{13} They are a slightly less invasive way to provide an airway in patients.
undergoing general anesthesia and have been gaining in popularity. Laryngeal mask airways are “inserted blindly into the pharynx, forming a low-pressure seal around the laryngeal inlet and permitting spontaneous or gentle positive-pressure ventilation.”

Debate has begun regarding what method of airway management has the least laryngeal stimulation and lowest risk of complications to the patient. Current research is attempting to determine which airway device, an ETT or LMA, is better for use in children with a current or recent URI undergoing general anesthesia.

**Overview Methodology**

**Institutional Review Board (IRB)**

Approval from the Texas Christian University IRB was requested for this TCU systematic review project in October 2011. Approval from the IRB board was granted December 2011 as shown in Appendix 1.

**Data Collection**

A literature search was conducted using Embase, CINAHL, and The Cochrane Library to find articles comparing the use of ETTs and LMAs in pediatric patients with recent or current URIs undergoing general anesthesia. The keywords used were “anesthe*,” “surgery,” “pediatric*,” “child*,” “respiratory infection,” “upper respiratory infection,” “ETT,” “endotracheal tube,” “LMA,” and “laryngeal mask airway.” Keywords were combined using OR and AND to limit the results. The final search was ran as “(anesthes* OR surgery) AND (pediatric* OR child) AND (“respiratory infection” OR “upper respiratory infection”) AND (ett OR “endotracheal tube” OR lma OR “laryngeal mask airway”).” One hundred thirty-one abstracts were reviewed with eight relevant articles found. The reference lists from the eight studies were reviewed finding an additional two articles meeting inclusion criteria. This search
was conducted in October 2010, and repeated in May 2011, September 2011, November 2011, February 2012, and March 2012 with the same articles found on each search.

**Inclusion/Exclusion Criteria**

In order to be included in this literature review, articles had to compare ETTs and LMAs used in pediatric patients undergoing general anesthesia with a recent or current URI. The studies had to compare ETTs and LMAs to determine which airway device had the higher incidence of complications. Editorial or opinion pieces were included, but the clinical guidelines provided in this synthesis were not made based on opinion pieces.

Studies including adults in the studied population were excluded in this literature review. Any study that excluded children with recent or current URIs was excluded. If only one airway device (LMA or ETT) was studied, the article was excluded from the literature review.

**Levels of Evidence**

Each article was compared to the Joanna Briggs Institute Levels of Evidence (LOE) rating system (Table 3). After reading the articles, a score from 1 to 4 was given based on the characteristics of the article content. The LOE rating of each article can be seen in Table 4.
PART TWO: Literature

Background

For the past 20 years, surgeries had been postponed for children with current or recent URIs. More recently, research has suggested that anesthesia can still be safely provided to children with careful planning. Anesthesia providers have the responsibility of selecting the right plan of care for each individual patient based on the type of procedure they are having and their health history. Airway management is one of the decisions made by the anesthesia provider and can be a critical decision when a patient has a current or recent URI. Anesthesia providers need to choose between the different airway devices for the most optimal device, ETT or LMA, for the patient.

Review of Literature

Although there is a sufficient amount of research available on children with recent or current URIs undergoing anesthesia, there is not much research on what is the best airway device to use in those patients, an ETT or LMA. The only level 1 article in this literature review was the study by Tartari et al. This randomized control trial (RCT) consisted of 400 patients between the ages 6 months and 12 years. The subjects were assigned to either the LMA or ETT group and within those groups it was determined whether or not the child had an URI. This study determined that adverse respiratory events were more frequent in children with an URI when compared to children without an URI. Children with URIs had more adverse respiratory events including laryngospasm, stridor, and excessive coughing, when an ETT was used compared to an LMA. This study advocates the use of LMAs over the use of ETTs in children with URIs.

In the RCT performed by Wakhloo et al, 40 patients with clear rhinorrhoea and mild cough only were included in the study. There was random assignment to two different groups,
the ETT or LMA group, based on what airway device was used during their surgical procedures. This study found less oxygen desaturation, bronchospasm, and laryngeal stimulation in the LMA group as compared to the ETT group and an increased risk of postoperative complications when using an ETT. In the 1998 study performed by Tait et al, 82 patients with URIs who were eligible to use either LMA or ETT in their surgery were included in the study and were randomly assigned to one of these airway devices. Both of the studies by Wakhloo et al and Tait et al found that LMAs had more advantages and fewer respiratory related complications than ETTs. The advantages of using an LMA are decreased incidence of laryngospasm, sore throat and bronchospasm. The complications seen with the ETT group were coughing, sore throat, laryngospasm, bronchospasms, arterial oxygen desaturation, and breath-holding.

Tait and Malviya’s 2005 study was a literature review that compared nine different studies, all of which studied the complications caused by recent or current URIs in children undergoing anesthesia. When comparing ETTs and LMAs, this study concluded that LMAs were associated with fewer adverse respiratory events than ETTs. Another literature review written by Höhne et al came to the conclusion that LMAs should be used in children with URIs undergoing anesthesia. Höhne et al recommend waiting four weeks after an URI for elective surgeries if possible to allow healing. If the surgery cannot be postponed, LMAs should be used in those children rather than ETTs due to the decreased risk of complications.

Parnis et al’s 2001 observational survey of practice study showed that LMAs provide a safe and non-irritating airway to patients with a decreased risk of adverse reactions when compared to ETTs. Homer et al’s 2007 study used data from several prospective observational and interventional studies to come up with their conclusions that LMAs have an increased amount of respiratory complications when compared to ETTs.
Flick et al’s 2008 retrospective study went through the medical records of 130 pediatric patients who had experienced a laryngospasm during anesthesia.\textsuperscript{16} This study found that LMAs had an increased risk of laryngospasm when compared to ETTs in children with URIs.\textsuperscript{16} It was not clear what caused the increase risk of laryngospasm with LMAs, but it was thought to be the accumulation of secretions in the airway during emergence.\textsuperscript{16}

Eikermann wrote an editorial in response to a study by von Ungern-Sternberg where LMAs were used in children with and without current or recent URI symptoms.\textsuperscript{5,9} Von Ungern-Sternberg’s study found an increased risk of respiratory complications when LMAs were used in children who had URIs, and a lower risk of adverse respiratory complications in those without recent URIs.\textsuperscript{5} Eikermann argued that children with recent URIs were more likely to have adverse respiratory reactions with ETTs rather than with LMAs.\textsuperscript{9} Eikermann claimed that, in his experience, LMAs were a better choice of airway protection and had a lower risk of complications.\textsuperscript{9} In reply to the editorial, von Ungern-Sternberg defended his claim by writing that LMAs being used in children with URIs have an increased risk of complications.\textsuperscript{17} Both authors agreed that more RCTs need to be conducted to come to provide a clearer position on what airway device has the decreased risk of complications.\textsuperscript{9,17} Both von Ungern-Sternberg and Eikermann agreed, that children without URI symptoms in the previous 2 weeks could be safely anesthetized without an increased risk of respiratory complications.\textsuperscript{5,9}

Discussion

Eight studies have explored whether LMAs or ETTs have an increased risk of adverse reactions when used in children with recent or current URIs. An additional two editorials discuss the use of LMAs and ETTs in children with recent or current URIs.
Three articles disagree with the statement that LMAs have a lower rate of respiratory adverse events than ETTs in children with URIs. \(^7,^{16,17}\) The two studies provided by Homer et al and Flick et al advocated the use of ETTs when comparing them to LMAs in children with recent or current URIs. \(^7,^{16}\) The studies did not clearly define the reason for the increased risk of complications in LMAs, but the authors thought it was related to the way the airway devices were removed and the secretions found on the vocal cords. \(^7,^{16}\) Von Ungern-Sternberg et al expressed that they thought LMAs had a higher risk of complications when used in children with URIs. \(^17\) This original study supported the use of ETTs in children with current URIs but did not compare the complication rates between LMAs and ETTs. \(^5\) The original study is not included in this review due to the fact that the ETT and LMA was not compared against one another.

Six of the eight articles in which a study was performed have determined that LMAs have a decreased risk of complications when compared to ETTs when used in children with recent or current URIs. \(^3,^4,^6,^8,^{10,15}\) LMAs have a decreased risk of complications due to the minimal manipulation and irritation to the already hyper-reactive airway. \(^3,^4,^6,^8,^{10,15}\) LMAs sit above the glottic opening so there is less stimulation to the laryngeal opening and vocal cords, limiting the risk of complications. \(^3,^4,^6,^8,^{10,15}\) Eikermann and Cote, in their editorial, agree from personal experience that LMAs have less risk of complications when compared with ETTs when caring for children with URIs. \(^9\)

There were some limitations in the literature. In Tait and Malviya’s 2005 study, all of the nine studies included in the literature review looked at complications caused by recent or current URIs in children undergoing anesthesia. \(^3\) However, not all of the nine studies compared the different airway devices being used in the subjects.
Another inconsistency with the literature is the amount of time after URI symptoms are resolved that surgery is still considered high risk for the child. Some of the literature says to wait 2-4 weeks for surgery\textsuperscript{3,5,9}, when others say to wait 4-6 weeks\textsuperscript{4,7,8,15}. A study should be performed to find the specific time window after symptoms are resolved to consider airway manipulation at risk for complications or not. Most of the dispute is related to how long the smooth muscle of the airway is hyper-reactive. It may be extremely difficult or impossible to determine an exact time since all patients are different.

\textit{Synthesis}

According to the literature, LMAs should be preferentially used instead of ETTs in children with recent or current URIs undergoing anesthesia\textsuperscript{3,4,6,8,9,10,15}. LMAs have a decreased risk of peri- and postoperative complications than ETTs\textsuperscript{3,4,6,8,9,10,15}. Endotracheal tube use in children with hyper-reactive airways secondary to URIs results in a higher risk of respiratory complications including laryngospasm, bronchospasm, arterial oxygen desaturation, and breath-holding\textsuperscript{3,4,6,8,9,10,15}. (a complete list of complications is available in table 2).
PART THREE: Intervention

Through synthesis of the literature, the Upper Respiratory Infection Screening Tool (Appendix 2) was created by the author so parents/guardians can fill out a questionnaire regarding the child’s recent health prior to surgery. On the Upper Respiratory Infection Screening Tool, common signs and symptoms are listed and the parent/guardian is to answer whether the patient currently has the symptom, has had the symptom within the past 4 weeks, or has not had the symptom. Using the Upper Respiratory Infection Screening Tool, anesthesia providers will be able to see quickly if the patient is at a higher risk for complications due to their current or recent URI symptoms. Symptoms 1-5 on the screening tool, nasal congestion, sputum production, wheezing, productive cough, and fever greater than 100.4°F, are symptoms associated with a severe URI. Two or more of those symptoms puts the child at higher risk for respiratory complications.

The information found on the Upper Respiratory Infection Screening Tool can then be used in the decision tree referred to as the Management Algorithm for Children Presenting for General Anesthesia with Upper Respiratory Infection (Appendix 3) also created by the author. The decision tree was created as a clinical guidance algorithm for anesthesia providers to refer to when deciding the best option for the management of the child presenting for surgery. To use the Management Algorithm for Children Presenting for General Anesthesia with Upper Respiratory Infection, the clinician starts at the top with the first question and each answer will lead the clinician to another question. The result at the end of the decision tree is a recommendation of the safest way to provide anesthesia care for the child. If the end result recommends proceed with caution, the anesthesia provider needs to ensure the child is adequately hydrated through intravenous fluids, humidification on the patient breathing circuit,
and that airway manipulation is only performed when the child is deeply anesthetized.\textsuperscript{3,6}

Medications such as sevoflurane, bronchodilators and anticholinergics can be used to help minimize the risk of respiratory complications, but do not need to be routinely administered.\textsuperscript{3,6}

A continuing education article (Appendix 4) has been written for submission for publication to the American Association of Nurse Anesthetist (AANA) Journal to provide education and guidance for anesthesia providers on the risks of airway complications in children with current or recent URIs presenting for surgery and the best way to manage the airway of those children. The Upper Respiratory Infection Screening Tool and Management Algorithm for Children Presenting for General Anesthesia with Upper Respiratory Infection are included in the article.
PART FOUR: Implementation and Results

Guiding Framework

The ACE Star Model (Figure 1) was used to implement the clinical recommendation of LMA use in children with recent or current URIs presenting for general anesthesia. This five step model “provides a framework for systematically putting evidence-based practice processes into operation:” discovery, evidence summary, translation, integration, and evaluation.\textsuperscript{18}

\textit{Step 1: Discovery}

The first step is the discovery of new knowledge.\textsuperscript{18} Research studies were previously conducted and published by several authors. Through a literature search, articles were found comparing the risk of complications in children with recent or current URIs undergoing general anesthesia when using a LMA versus an ETT. The literature found during the search was reviewed.

\textit{Step 2: Evidence Summary}

The second step includes synthesizing “the corpus of research knowledge into a single, meaningful statement of the state of the science.”\textsuperscript{18} The synthesis of the literature concluded that LMAs result in fewer respiratory complications when compared to ETTs when used in children with recent or current URIs undergoing general anesthesia.\textsuperscript{3,4,6,8,9,10,15}

\textit{Step 3: Translation}

Step three is used to “provide a useful and relevant package of summarized evidence to clinicians and clients in a form that suits the time, cost, and care standard needed.”\textsuperscript{18} The clinical recommendation concluded from this literature synthesis is, LMAs should be used preferentially over an endotracheal tube in pediatric patients undergoing general anesthesia that has URI symptoms currently or within the last four weeks.
A narrative review was written for publication (Appendix 4) to provide continuing education to other anesthesia providers. The Management Algorithm for Children Presenting for General Anesthesia with Upper Respiratory Infection (Appendix 3) and The Upper Respiratory Infection Screening Tool (Appendix 2) were submitted along with the narrative review as a concise way to determine the best way to treat any child presenting for surgery.

*Step 4: Integration*

This step implements the clinical recommendation. Education of the anesthesia providers at Baylor University Medical Center in Dallas, TX was originally planned. With the facility lacking a pediatric population, education of the anesthesia providers was not conducted. Publishing a narrative review in the AANA journal is a way to educate many providers nationwide who care for children on a regular basis. An example of The Upper Respiratory Infection Screening Tool and the Management Algorithm for Children Presenting for General Anesthesia with Upper Respiratory Infection has been provided with the article so practitioners can use the tools to screen their patients and pick the safest way to provide anesthesia.

*Step 5: Evaluation*

At the end of the narrative review article there will be a post-test. The certified registered nurse anesthetists (CRNAs) who read the article will then take the post-test to see if they have met the objectives of the article. That post-test is then submitted back to the AANA and they will analyze the post-tests to see what the CRNAs have learned from the article. Evaluation of the anesthesia providers on the education they received from the continuing education article will be completed by the AANA journal.
PART FIVE: Evaluation

Evaluation

The current literature supports the use of LMAs over ETTs when used in children with recent or current URIs.\textsuperscript{3,4,6,8,9,10,15} There is a lower risk of respiratory complications when using a LMA in these children.\textsuperscript{3,4,6,8,9,10,15} A continuing educational article will be submitted for publication in the AANA Journal that includes The Upper Respiratory Infection Screening Tool and the Management Algorithm for Children Presenting for General Anesthesia with Upper Respiratory Infection. The continuing education course will be evaluated as per AANA Journal established criteria.

Future Directions

Random-control trials with children having mild, moderate, and severe symptoms of URIs should be performed to identify levels of risks with using a LMA versus postponing surgery. Placement and removal of LMAs and ETTs are another area of potential study that could be beneficial. More studies assessing the placement and removal of LMAs and ETTs should be performed to see if these variables affect outcomes. The specific method for removing a LMA is another area that should be studied. Keeping the LMA inflated when removing from the patient should, in theory, help remove the secretions from the pharynx. If the LMA was deflated prior to removal, are patients at risk for respiratory complications due to the secretions possibly dropping into the glottic opening? These additional studies may improve the effectiveness of LMAs for use in pediatric patients with URIs undergoing general anesthesia.
References


<table>
<thead>
<tr>
<th><strong>Infants</strong></th>
<th><strong>Older Children</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>● unable to sleep</td>
<td>● stuffy, runny nose</td>
</tr>
<tr>
<td>● fussiness</td>
<td>● scratchy, tickly throat</td>
</tr>
<tr>
<td>● congestion in the nose</td>
<td>● watery eyes</td>
</tr>
<tr>
<td>● sometimes vomiting and diarrhea</td>
<td>● sneezing</td>
</tr>
<tr>
<td>● fever</td>
<td>● mild hacking cough</td>
</tr>
<tr>
<td></td>
<td>● congestion</td>
</tr>
<tr>
<td></td>
<td>● sore throat</td>
</tr>
<tr>
<td></td>
<td>● achy muscles and bones</td>
</tr>
<tr>
<td></td>
<td>● headaches</td>
</tr>
<tr>
<td></td>
<td>● low grade fever</td>
</tr>
<tr>
<td></td>
<td>● chills</td>
</tr>
<tr>
<td></td>
<td>● watery discharge from nose and throat</td>
</tr>
<tr>
<td></td>
<td>● mild fatigue</td>
</tr>
</tbody>
</table>
Table 2 – Possible anesthetic complications in children with URIs

- laryngospasm\textsuperscript{4,5,6,7,9,10}
- bronchospasm\textsuperscript{3,4,5,6,7,8}
- breath-holding\textsuperscript{3,4,6,8}
- coughing\textsuperscript{3,4,5,6,7,8,9,10}
- oxygen desaturation\textsuperscript{3,5,6,7,8,9}
- sore throat\textsuperscript{6}
- secretions\textsuperscript{3,4,8}
- airway obstruction\textsuperscript{4,5,8}
- atelectasis\textsuperscript{3,5,6}
- stridor\textsuperscript{3,7,10}
- hypoxemia\textsuperscript{5}
- vomiting\textsuperscript{8}
- regurgitation\textsuperscript{8}
- hypotension\textsuperscript{8}
- arrhythmia\textsuperscript{8}
- cardiac arrest\textsuperscript{8}
- death\textsuperscript{8}
<table>
<thead>
<tr>
<th>Levels of Evidence</th>
<th>Feasibility F (1-4)</th>
<th>Appropriateness A (1-4)</th>
<th>Meaningfulness M (1-4)</th>
<th>Effectiveness E (1-4)</th>
<th>Economic Evidence</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Metasynthesis of research with unequivocal synthesized findings</td>
<td>Metasynthesis of research with unequivocal synthesized findings</td>
<td>Metasynthesis of research with unequivocal synthesized findings</td>
<td>Meta-analysis (with homogeneity) of experimental studies (eg. RCT with concealed randomization) OR One or more large experimental studies with narrow confidence intervals</td>
<td>Metasynthesis (with homogeneity) of evaluations of important alternative interventions comparing all clinically relevant outcomes against appropriate cost measurement, and including a clinically sensible sensitivity analysis</td>
</tr>
<tr>
<td>2</td>
<td>Metasynthesis of research with credible synthesized findings</td>
<td>Metasynthesis of research with credible synthesized findings</td>
<td>Metasynthesis of research with credible synthesized findings</td>
<td>One or more smaller RCTs with wider confidence intervals OR Quasi-experimental studies (without randomization)</td>
<td>Evaluations of important alternative interventions comparing all clinically relevant outcomes against appropriate cost measurement, and including a clinically sensible sensitivity analysis</td>
</tr>
<tr>
<td>3</td>
<td>a. Metasynthesis of text/opinion with credible synthesized findings b. One or more single research studies of high quality</td>
<td>a. Metasynthesis of text/opinion with credible synthesized findings b. One or more single research studies of high quality</td>
<td>a. Metasynthesis of text/opinion with credible synthesized findings b. One or more single research studies of high quality</td>
<td>a. Cohort studies (with control group) b. Case-controlled c. Observational studies (without control group)</td>
<td>Evaluations of important alternative interventions comparing a limited number of appropriate cost measurement, without a clinically sensible sensitivity analysis</td>
</tr>
<tr>
<td>4</td>
<td>Expert opinion</td>
<td>Expert opinion</td>
<td>Expert opinion</td>
<td>Expert opinion, or physiology bench research, or consensus</td>
<td>Expert opinion, or based on economic theory</td>
</tr>
<tr>
<td>Article</td>
<td>LOE</td>
<td>n</td>
<td>Study</td>
<td>Findings</td>
<td></td>
</tr>
<tr>
<td>------------------</td>
<td>-----</td>
<td>-----</td>
<td>----------------------------</td>
<td>----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
<td></td>
</tr>
<tr>
<td>Tartari</td>
<td>1</td>
<td>400</td>
<td>RCT of LMA vs. ETT</td>
<td>LMAs had less adverse respiratory events than ETTs in children with URIs. LMAs are preferred over ETT in children with URIs. Less coughing &amp; o2 desaturation in LMA, no bronchospasm in LMA. Total resp. complications significantly greater in ETT than LMA. LMAs lack laryngeal stimulation. &quot;LMA seems to offer several advantages over the ETT for airway management.&quot; Less oxygen desaturation, no bronchospasm in LMA group compared to ETT. ETT use increases risk of post-operative complications. LMAs have decreased amount of laryngeal stimulation &amp; decreased airway complications with URIs. More severe URI symptoms should wait 4 weeks for surgery. ETT should be avoided because of increased risk of respiratory complications. LMAs are a safe alternative for ETTs with significantly less complications. LMA safe airway device, especially in children with URIs. Surgery should be delayed 4 weeks if possible, when not possible use LMA.</td>
<td></td>
</tr>
<tr>
<td>Tait</td>
<td>2</td>
<td>82</td>
<td>RCT of LMA vs. ETT</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wakhloo</td>
<td>2</td>
<td>40</td>
<td>RCT of LMA vs. ETT</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tait</td>
<td>2</td>
<td>-</td>
<td>Literature Review</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Höhne</td>
<td>2</td>
<td>-</td>
<td>Literature Review</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Author/Year</td>
<td>Study Design</td>
<td>Sample Size</td>
<td>Findings</td>
<td></td>
<td></td>
</tr>
<tr>
<td>-------------</td>
<td>--------------</td>
<td>-------------</td>
<td>----------</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Homer(^7), 2007</td>
<td>Logistic regression model. Several prospective interventional and observational clinical studies.</td>
<td>335</td>
<td>In general, there was a higher percentage of adverse events with LMA than ETT. URI 2-4 weeks prior to surgery had the highest rate of respiratory complications.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Parnis(^8), 2001</td>
<td>Logistic regression model. Observational survey of practice</td>
<td>2514</td>
<td>Pts with ETTs had highest rate of adverse reactions. LMAs or FMs had the lowest. LMA provides clear safe airway without irritating pt airway.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Flick(^{16}), 2008</td>
<td>Retrospective study of ped. patients having experienced a laryngospasm during anesthesia</td>
<td>130</td>
<td>Chart reviews identified that LMAs have an increased risk of laryngospasm when compared to ETTs.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Eikermann(^9), 2008</td>
<td>Editorial responding to von Ungern-Sternberg's article</td>
<td>-</td>
<td>Clinical standpoint, children without URI in past few weeks may be safely anesthetized. Disagree with von Ungern-Sternberg’s study that LMAs increase the risk of respiratory complications.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Von Ungern-Sternberg(^{17}), 2008</td>
<td>In Reply to Eikermann’s editorial</td>
<td>-</td>
<td>“Recent URI is a risk factor for the occurrence of perioperative respiratory complications with the use of an LMA.”</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Figure 1 – ACE Star Model\textsuperscript{18}
Appendix 1

---

**College Review for Human Subjects**

**To:** Megan Greason  
**From:** Dr. Rhea  
**CC:** Dr. Mark Welliver; Dr. Terri Jones  
**Date:** 11/28/2011  
**Re:** Nurse Anesthesia

---

Dear Megan:

Your protocol entitled, “Risk of Complications Using Endotracheal Tube vs. Laryngeal Mask Airway During General Anesthesia in Pediatric Patients with Upper Respiratory Infections: A TCU Systematic Review”, has been recommended for approval by the NA Review Board and has now been approved by Dr. Rhea, Associate Dean of Research at Harris College, for the period of 11/28/11 to 11/28/12. Please note that any changes in the protocol will have to be submitted and recommended for approval by the NA Review Board and then on to Dr. Rhea. You must also report in writing any adverse events to Dr. Terri Jones, Chair of NA Review Board, and Dr. Rhea within one week of the event taking place. This letter is to verify that your study is identified as minimal risk with no high risk populations. This letter will be your proof of approval.

Best wishes with your study,

[Signature]

Dr. Rhea  
Associate Dean – Research  
Harris College
Appendix 2

**Upper Respiratory Infection Screening Tool**

©Grelson M. 2012

Please check any symptoms currently present or present within the last 4 weeks. *Please answer as accurately as possible.*

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>1. Runny Nose/Nasal Congestion</strong></td>
<td><strong>6. Malaise</strong> (feeling unwell)</td>
</tr>
<tr>
<td>[□] Yes, Currently</td>
<td>[□] Yes, Currently</td>
</tr>
<tr>
<td>[□] Yes, in last 4 weeks</td>
<td>[□] Yes, in last 4 weeks</td>
</tr>
<tr>
<td>[□] No</td>
<td>[□] No</td>
</tr>
</tbody>
</table>

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>2. Sputum Production</strong></td>
<td><strong>7. Muscular Pains</strong></td>
</tr>
<tr>
<td>[□] Yes, Currently</td>
<td>[□] Yes, Currently</td>
</tr>
<tr>
<td>[□] Yes, in last 4 weeks</td>
<td>[□] Yes, in last 4 weeks</td>
</tr>
<tr>
<td>[□] No</td>
<td>[□] No</td>
</tr>
</tbody>
</table>

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>3. Wheezing/Reactive Airway</strong></td>
<td><strong>8. Sneezing</strong></td>
</tr>
<tr>
<td>[□] Yes, Currently</td>
<td>[□] Yes, Currently</td>
</tr>
<tr>
<td>[□] Yes, in last 4 weeks</td>
<td>[□] Yes, in last 4 weeks</td>
</tr>
<tr>
<td>[□] No</td>
<td>[□] No</td>
</tr>
</tbody>
</table>

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>4. Productive Cough</strong></td>
<td><strong>9. Hoarse Voice</strong></td>
</tr>
<tr>
<td>[□] Yes, Currently</td>
<td>[□] Yes, Currently</td>
</tr>
<tr>
<td>[□] Yes, in last 4 weeks</td>
<td>[□] Yes, in last 4 weeks</td>
</tr>
<tr>
<td>[□] No</td>
<td>[□] No</td>
</tr>
</tbody>
</table>

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>5. Fever</strong> (greater than 100.4°F)</td>
<td><strong>10. Sore/Scratchy Throat</strong></td>
</tr>
<tr>
<td>[□] Yes, Currently</td>
<td>[□] Yes, Currently</td>
</tr>
<tr>
<td>[□] Yes, in last 4 weeks</td>
<td>[□] Yes, in last 4 weeks</td>
</tr>
<tr>
<td>[□] No</td>
<td>[□] No</td>
</tr>
</tbody>
</table>

Comments:____________________________________________________________________
______________________________________________________________________________
______________________________________________________________________________

Information provided by:_________________________________________________________

Relationship: __________________________________________________________________

Signature: ___________________________________________ Date:____________________
Appendix 3

Management Algorithm for Children Presenting for General Anesthesia with Upper Respiratory Infection

©Grelson M. 2012

* When proceeding with surgery the following can help reduce the risk of respiratory complications post-operatively: adequate IV hydration, humidification, bronchodilators, use of sevoflurane, anticholinergics, ensuring adequate depth of anesthesia prior to airway manipulation.3,6