University of Alberta

Risk Factors for Predicting Severe Croup and Bacterial Tracheitis

by

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ABSTRACT

Croup accounts for a large proportion of pediatric emergency department visits and sometimes unnecessary hospitalizations. Bacterial tracheitis presents similarly to croup but has more severe symptoms. While severe upper airway obstruction caused by croup and bacterial tracheitis is rare, significant morbidity is associated with it. The objective of this study was to determine risk factors for developing severe upper airway obstruction as indicated by croup requiring intubation or bacterial tracheitis. We conducted a retrospective case-control study by examining medical charts of children aged 0-16 years of age who were admitted to the Calgary Health Region or Capital Health Region for croup or bacterial tracheitis. In a multivariate logistic regression model, presentation to the Emergency Department with indrawing and sore throat were significant risk factors for developing severe upper airway obstruction; increased percent oxygen saturation was a protective factor. We conclude that children who present to the Emergency Department with the indrawing or sore throat should be closely monitored and potentially admitted.

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LIST OF ABBREVIATIONS

AHCIP: Alberta Health Care Insurance Plan
CIHI: Canadian Institute for Health Information
ICU: Intensive care unit
LTB: laryngotracheobronchitis
OR: Odds ratio
PICU: Pediatric intensive care unit
RCT: Randomized controlled trial
SEM: Standard error of the mean

CHAPTER 1

INTRODUCTION

CROUP NOMENTCLATURE

There are several clinical terms used to describe the heterogeneous group of illnesses known as croup. Croup can also be classified as acute laryngotracheobronchitis (LTB) or spasmodic/recurrent and).[1] Children with acute LTB are thought to have 12-48 hours of a non-specific viral upper respiratory tract infection and fever before developing a barky cough and stridor. Children with spasmodic croup typically develop a barky cough and stridor without a preceding upper respiratory tract infection or fever. Symptoms due to spasmodic croup are thought to be, on average, milder and shorter. Children with spasmodic croup are thought to have recurrent episodes in contrast with those with acute LTB who tend to have a single episode. Because of these recurring episodes, spasmodic croup is thought to represent an allergic reaction to an infecting virus.[1] In support of this theory, Welliver compared the nasopharyngeal secretions among children with parainfluenza viral croup to those with upper respiratory tract infections and found the titers to parainfluenza virus IgE antibodies were 3.6-fold higher among children with parainfluenza viral croup.[2] Hide found a significant association between parents' atopic disease status and the likelihood of their child having recurrent croup (10.8% with recurrent croup had atopic parents versus 4.1% without).[3] Currently, there is poor clinical differentiation between spasmodic and acute LTB croup and both conditions are believed to represent different spectrums of croup.[4 5]

Depending where the narrowing or inflammation occurs, croup can be described as acute laryngotracheitis (inflammation of the larynx and trachea) or

laryngotracheobronchitis (LTB), which also involves inflammation of the bronchi. Acute laryngotracheitis occurs in the upper airway, whereas LTB also involves the lower airway.[6] A third term used to describe croup is laryngotracheobronchopneumonitis, which is caused by a bacterial infection secondary to a virus.

PHYSIOLOGY OF CROUP AND PEDIATRIC AIRWAY ANATOMY

Because children have narrower airways than adults, children are more susceptible to respiratory distress when even the slightest narrowing of the airways occurs.[7] Airway inflammation in children is of great concern. Their subglottic airway is surrounded by less rigid cartilage than adults and obstruction of the subglottic airway can easily occur from mucous, edema, constriction, or pressure differences caused by respiratory efforts.[7] In addition, while children older than 10 years of age and adults have a cylindrical larynx, infants and younger children have a funnel shaped larynx. [7] Poiseuille's Law, which represents the relationship between airflow resistance and airway radius, states that resistance is equal to one fourth power of the radius. Because of the exponential relationship between resistance to airflow and decreasing airway radius, even the slightest decrease in airway radius causes significant resistance to airflow and thus an increased effort to breathe. The smallest increase in underlying disease results in increased difficulties in breathing.[8]

A common feature of croup is airway inflammation which can occur after the virus is inhaled and the respiratory epithelial cells are infected.[7] Inflammation results in mucosal edema, subglottic inflammation, and increased mucous production.[7] When air is indrawn, the subglottic tracheal walls come together and this can cause further inflammation, edema, and narrowing; this results in further obstruction and respiratory distress.[7] The narrowed radius of the airway results in greater turbulence and the effectiveness of ventilation is decreased. This obstruction can progress to stridor, that is, the noise associated with air passing through the constricted passage

and leads to increased difficulty in breathing.[7] Respiratory distress becomes apparent when there is an increase in heart rate, respiratory rate, nasal flaring, and suprasternal, intercostal, and sternal indrawing. Signs of respiratory failure include: listlessness or restlessness, fatigue, increased retractions, quieter breathing, pallor, and cyanosis.[9] If respiratory distress is severe, hypoxia can result.[7]

EPIDEOMIOLOGY OF CROUP

Croup is a common viral infection of the upper respiratory tract that is most commonly caused by parainfluenza viruses. Other viruses known to cause croup include influenza, respiratory syncytial, metapneumovirus, adenovirus, rhinovirus, enterovirus, measles, and herpes simplex.[10 11] Transmission of croup occurs via droplets or direct contact and the incubation period ranges from two to six days.[12]

Generally, croup is a self-limiting disease. Twelve to 48 hours prior to developing croup, rhinorrhea, mild cough, and a low grade fever occur and is followed by a barky cough, hoarseness, and stridor. Symptoms are more pronounced at night and are exacerbated by crying or agitation.[13] Croup generally resolves within two to five days; however, severe croup can last for seven to 14 days.[14 15]

It is most frequent in children between 6 months and 3 years of age, with the peak incidence occurring in the second year of life.[16] Denny found the incidence of croup cases to be 60/1000 child-years in children between the ages of one to two years.[17] By the age of eight years, 18% of children have had croup and 5% have recurrent episodes.[18] Male children are more likely than females to suffer from croup; the sex distribution of male to female croup is 3:2.[19] In general, the incidence of croup peaks in the fall and winter and a secondary peak occurs in the spring.[20 21] Croup outbreaks are often dictated by epidemics of the etiological agent. For example, parainfluenza virus 1 outbreaks occur in odd-numbered years and there is a corresponding outbreak of increased croup.[20] However, parainfluenza virus 3 croup

is related to circulating parainfluenza virus and this type of croup occurs more frequently in the spring months.[20]

Croup is a common pediatric respiratory tract infection, as it represents 15% of respiratory tract infections.[22] Although many children are treated at home without visiting a doctor, the high incidence rate of croup creates a significant burden of disease. The combination of clear clinical treatment guidelines and the well-documented effectiveness of glucocorticoid treatment has decreased health services utilization and resources needed to treat an episode of croup. Geelhoed examined croup in western Australia's only tertiary pediatric hospital from 1980 to 1995.[23] The number of croup presentations and admissions did not change over the study period; however, there was a reduction in annual intubations and total ICU days after the routine use of steroids policy was implemented. Segal et al examined 14 years of croup hospitalizations in Ontario and found that fewer children were hospitalized as an increased proportion of the croup was treated with corticosteroids.[21]

It has been hypothesized that moderate to severe croup may be associated with later development of respiratory problems and immunodeficiencies. There is some evidence to suggest that older children who had previous episodes of croup are more likely to have bronchial hyperresponsiveness, positive allergy skin prick tests, and higher levels of total serum immunoglobulin E.[24-28] Castro-Rodriguez et al prospectively examined the long term outcome of croup prior to three years of age among children enrolled in the Tucson Children's Respiratory Study birth cohort between 1980 and 1984.[29] Children were categorized as croup with wheeze, croup

without wheeze, other lower respiratory infection, or no lower respiratory infection. Positivity to one or more skin test was not significantly associated with croup with or without wheeze or other lower respiratory infections. However, compared to children with no lower respiratory infection, children who experienced croup with wheeze earlier in life were significantly more likely to have any current wheezing or have current frequent wheezing at six, eight, eleven, and thirteen years. This association was not found among those with a previous diagnosis of croup without wheeze or children with other lower respiratory tract infections. A temporal relationship between developing moderate to severe croup and subsequent immondeficiencies and respiratory problems has not been established.

OVERVIEW OF SEVERE UPPER AIRWAY OBSTRUCTION

Severe upper airway obstruction caused by severe croup or bacterial tracheitis is not common. In 2001, there were 3 cases of severe upper airway obstruction in Edmonton and Calgary, all of which were a result of bacterial tracheitis. Using Health Canada data from the 2001 Canada Census, the annual incidence of bacterial tracheitis was calculated. In Edmonton, the annual incidence in 2001 of bacterial tracheitis in children 0-4 years of age was 3.60/100,000/year and 0.77/100,000/year in children 5-14 years of age.[30] The annual 2001 incidence rate in Calgary was similar: 1.55/100,000/year among children 0-4 years of age and 1.37/100,000/year 5-14 year old children.[31]

Severe viral croup can be fatal or result in substantial morbidity due to anoxic brain injury. Symptoms of severe croup include marked tachycardia, tachypnea, nasal flaring, increased stridor, cyanosis, restlessness, agitation, irrational behavior, hypotonia, and retractions of the following muscle groups: supraclavicular, infraclavicular, and intercostal.[16 32] A second cause of severe upper airway obstruction is bacterial tracheitis. It is also characterized by symptoms similar to that of croup: fever, hoarseness, barky cough, and inspiratory stridor. Bacterial tracheitis can also result in substantial morbidity and mortality.

During an episode of severe croup or bacterial tracheitis, the airway is significantly narrowed and due to the risk of complete obstruction, airway support is often required to maintain the airway. An artificial airway can be achieved by nasotracheal intubation or a more intrusive tracheotomy.[33] Because nasotracheal

intubation is quicker to perform, less traumatic and associated with a shorter hospital stay, it is the preferred method of airway support.[33] The success of intubation is dependent upon choosing the correct tube size.[34] If the tube is too small, it will be difficult to remove secretions and achieve spontaneous ventilation; however, too big a tube will result in excessive compression of the subglottic region.[34]

Hypothesized Risk Factors

Several risk factors for severe upper airway obstruction have been put forth: fever at presentation (>38.0C), male sex[33] , age[35], Aboriginal status, acute LTB, a history of previous intubation[33] , and co-morbidities such as prematurity, Down's syndrome, chronic disease, immune deficiency, cardiac anomalies, and congenital stridor[36 37].

Prior intubation may make children more susceptible to severe upper airway obstruction. A relatively common adverse event associated with intubation is the development of subglottic stenosis and this will result in a narrowed airway[38] and a smaller airway may be associated with severe upper airway obstruction. Additional adverse events associated with intubation include airway injury, barotraumas, hemodynamic instability, nosocomial pneumonia, and a longer hospital stay.[39-41]

A hypothesized risk factor for severe upper airway obstruction is the presence of the chromosomal abnormality Trisomy 21, or Down's syndrome because children with Down's syndrome tend to have smaller airways and fewer T cells.[36] Six and half years of admissions among children with Down's syndrome were reviewed at an

Australian teaching hospital and of the 86 identified cases, 83 survived.[37] The primary reason for hospitalization was respiratory tract pathology (54%), most commonly pneumonia, bronchiolitis, and croup. The length and cost of hospitalization for respiratory illness was greater among children with Down's syndrome compared to children without Down's syndrome.

Aboriginal children have a more respiratory disease than Caucasian children.[42] Evers compared annual rates of lower respiratory tract illness among Aboriginal and non-Aboriginal children. Non-Aboriginal children experienced an annual disease rate of 26.5/100 children, whereas Aboriginal children experienced 75 cases/100 children.[43] Because very young children have smaller airways than older children, younger children may be at higher risk for developing severe upper airway obstruction that requires airway support. There is repeated evidence showing that boys are more likely to develop croup than girls. It is possible than boys may also be at greater risk for developing the severe form of the disease.[19]

Children with acute LTB may be at greater risk for developing severe upper airway obstruction. Opposed to children with spasmodic croup, acute LTB has longer and more severe symptoms and this may increase the likelihood of developing severe upper airway obstruction.[1]

OVERVIEW OF BACTERIAL TRACHEITIS

Bacterial tracheitis is a life threatening illness whose epidemiological and clinical features are not well understood.[44] Bacterial tracheitis, also known as nondiphtheritic laryngitis with marked exudate, bacterial croup, membranous laryngotracheobronchitis, bacterial laryngotracheobronchitis, and pseudomembranous croup, was mentioned in pediatric textbooks prior to the 1940's. After 1940, bacterial tracheitis appeared to disappear as a clinical entity until 1972 when Howard described eight children with severe croup and influenza A2 who required a tracheotomy.[45] The children had a normal epiglottis and thick, secretions in the trachea and larynx, characteristics of bacterial tracheitis. In 1979, Jones named this disease entity 'bacterial tracheitis'.[46] Today, bacterial tracheitis is perceived as an uncommon cause of severe upper airway obstruction that often requires endotracheal intubation.

Bacterial tracheitis is thought to be a secondary bacterial infection of viral croup.[7 5] The most common etiology of bacterial tracheitis is *Staphylococcus aureus*, and *Haemophilus* influenzae.[47] The original viral infection may cause bacterial tracheitis by either altering the patient's immune response or causing tracheal mucosal damage. Consistent with this theory, the seasonal variation of viral croup and bacterial tracheitis are similar occurring predominantly in fall and winter months.[36] In addition, children often have a mild respiratory tract infection prior to developing bacterial tracheitis.[48] In support of that hypothesis, Han isolated viruses in six of 12 children with bacterial tracheitis.[49]

Because children present with similar symptoms, bacterial tracheitis is often clinically difficult to distinguish from viral croup. Both are associated with fever, hoarseness, barky cough, and inspiratory stridor.[50] However, bacterial tracheitis does not respond to interventions used to treat viral croup.[36] It has also been hypothesized that corticosteroid use, a common treatment for viral croup, is a risk factor for developing bacterial tracheitis.[50] Bacterial tracheitis mortality rates are higher than that of croup, although mortality associated with bacterial tracheitis appears to be decreasing.[51] In addition, bacterial tracheitis may be associated with systemic complications, such as toxic shock syndrome, sepsis syndrome, pulmonary edema, acute respiratory distress syndrome, and cardio-pulmonary arrest.[52]

Bacterial tracheitis is generally thought to be much less common than viral croup, though the precise relative frequency is unknown. Because bacterial tracheitis is likely a secondary bacterial infection of viral croup and has very similar clinical symptoms, we have chosen to focus on severe upper airway obstruction due to bacterial tracheitis as well as viral croup.

DIAGNOSIS OF CROUP AND BACTERIAL TRACHEITIS

A combination of history taking and assessing symptoms are used to diagnose croup. The differential diagnosis of croup includes epiglottitis, foreign body aspiration, vocal cord paralysis, angioneurotic edema, hypocalcemia, and bacterial tracheitis.[16] Mild croup is characterized by mild chest-wall retractions, mild tachycardia, and no stridor at rest.[32] Moderate croup occurs when there is stridor at rest, chest-wall retractions, increased heart rate, and accessory respiratory muscles are used to aid breathing.[32] Characteristics of severe croup include restlessness, agitation, irrational behavior, decreased consciousness, hypotonia, cyanosis, and marked pallor.

Although they have little clinical practicality, various rating scales have been developed to determine the severity of croup. These scales are primarily developed for conducting research. The most common scale is the Westley croup score.[53] It is a 17-point scale that assesses level of consciousness (normal or disoriented), cyanosis (none, with agitation, or at rest), stridor (none, with agitation, or at rest), air entry (normal, decreased, markedly decreased), and retractions (none, mild, moderate, severe).

Children with bacterial tracheitis present with symptoms similar to that of severe viral croup, epiglottitis, or foreign-body aspiration.[54] Both croup and bacterial tracheitis may show marked subglottic narrowing when examined radiologically.[55] Eckel was unable to identify a clinical, radiological, or laboratory test, used in isolation or combination, that would reliably diagnose bacterial tracheitis.[56] Bacterial tracheitis should be suspected when a child with suspected LTB or laryngitis becomes

more ill than anticipated and does not respond to epinephrine treatment.[57] Direct laryngotracheobronchoscopy was found to be the best method to quickly and accurately diagnose bacterial tracheitis. Upon examination via endoscope, thick adherent secretions along the inflamed, edemateous tracheal wall is indicative of bacterial tracheitis.[54] Other common findings seen during laryngotracheobronchoscopy include subglottic narrowing, mucopurulent exudates in the airway, and a normal epiglottis.[58] The gold standard for diagnosing bacterial tracheitis is a bacterial culture of tracheal secretions obtained by endoscope or at the time of intubation. Bacterial tracheitis does not respond to conventional croup treatment and this lack of response to therapy is one way bacterial tracheitis is diagnosed.[16]

TREATMENT OF CROUP AND BACTERIAL TRACHEITIS

Treatment of croup depends on the severity of the disease episode and can range from supportive care to endotracheal intubation; it is not dependent on the specific type or cause. Clinical pathways for treating croup in the emergency department have been developed to determine pharmacological and admission needs.[59] The majority of children require minimal intervention, as symptoms resolve within two to five days in 60-95% of children with croup.[15] Common treatments include glucocorticoids, racemic epinephrine, mist therapy, supplemental oxygen, and endotracheal intubation. To date, there is minimal evidence supporting the use of mist therapy or supplemental oxygen.[60-62] Racemic epinephrine and glucocorticoids are effective treatments for non-severe croup.[63 64 65] Both treatments are thought to reduce the likelihood of endotracheal intubation.[4 66]

Corticosteroids reduce airway inflammation and are the current cornerstone of croup treatment. Numerous randomized, double-blind trials and meta-analyses have been conducted and have consistently shown that corticosteroids improve croup scores, reduce length of stay, reduce likelihood of repeat visits to a health care provider, and decrease hospitalization rates.[65] As previously noted, Geelhoeld et al examined 16 years of croup treatment in Western Australia. While the annual incidence of croup was similar during each year, there was marked decrease in the number of children requiring intubation, transfers to the ICU, and length of both ICU stay and inpatient stay during the sixteen years. There was a significant increase in the number of children who were discharged from the Emergency Department. The

implementation of a mandatory policy to treat children with corticosteroids is credited for the improvements in croup outcomes. Because corticosteroids are an effective treatment strategy to reduce airway inflammation, there is likely to be a reduction in the number of children who progress to severe croup and require intubation because of a narrowed airway. In a second longitudinal study, Segal et al also found a significant decrease in croup hospitalizations in Ontario. [21] Peak seasonal hospitalization occurred in the fall of 1993 (~300/100,000) and this was followed by a dramatic decrease to ~40/100,000 by the fall of 2001. The authors attribute the reduction in hospitalization to the Canadian Pediatric Society's recommendation to treat croup with corticosteroids and the associated implementation of this treatment option.

The two most common glucocorticoids are dexamethasone and budesonide. Compared to intramuscular dexamethasone, oral dexamethasone is preferred because it is less costly and easier to administer.[67-69] In addition, a single dose of dexamethasone is associated with a minimal risk of adverse events. Budesonide is administered via nebulizer, which can be traumatizing to the child and increased agitation often worsens croup symptoms.[16] The individual trials provide conflicting evidence regarding a dose-response relationship between the dose of corticosteroids and improvement in croup[70]; however, a meta-analysis conducted in 1989 by Kairys found there to be a direct relationship between dose of corticosteroid and improvement in croup[4].

Racemic epinephrine causes relaxation of the bronchial smooth muscle and mucosal vasoconstriction and decreased subglottic edema.[12] Because there are minimal bronchial smooth muscles in the upper airway, the effects of epinephrine on croup act primarily to increase vasoconstriction. After administration, the benefits of racemic epinephrine occur within 10 to 30 minutes. The effect lasts for approximately two hours and then the child returns to pre-epinephrine croup severity. Several randomized controlled studies have compared racemic epinephrine to placebo or no treatment and racemic epinephrine has repeatedly been shown to improve croup.[63 71] Epinephrine treatment is not without risk; adverse events, such as tachycardia and circumoral pallor are associated with epinephrine treatment. It is recommended that epinephrine be used as an adjunct to glucocorticoid treatment.

If glucocorticoids and epinephrine treatment fail and respiratory failure is looming, an endotracheal tube may need to be inserted to support the child's airway. An intubated child requires ICU admission, extensive nursing care, and monitoring to ensure the endotracheal tube is constantly moist and that thick secretions are frequently suctioned.[33] To prevent self-extubation, the child must be continuously observed, placed in arm restraints, and/or sedated. Typically, a child is extubated within 3-7 days .[33 72 55]

Unlike viral croup in which only a very small percentage of children have airway obstruction severe enough to require intubation, children with bacterial tracheitis often require intubation and ventilation, as well as intravenous antibiotics.[51]

Prompt diagnosis, airway support, and immediate antibiotic treatment make up the treatment regimen for bacterial tracheitis.[48] Racemic epinephrine or glucocorticoids do not resolve bacterial tracheitis. The treatment for bacterial tracheitis most often involves admission into a pediatric intensive care unit (PICU) and airway support via endoscopy or tracheotomy.[56] Previously, endotracheal intubation versus tracheotomy was controversial for children with bacterial tracheitis. Liston recommended that children receive a tracheotomy to reduce the likelihood of complications, such as subsequent subglottic stenosis or problems associated with suctioning the thick tracheal secretions in the endotracheal tube.[73] Mahajan believed that only younger children require a tracheotomy because of their smaller airways.[48] Currently, few children receive tracheotomies. Endoscopy can be considered diagnostic or therapeutic; tracheal secretions can be extracted endoscopically and additional frequent tracheal suctioning is required to prevent obstruction.[56] Because of airway inflammation, the size of the inserted endotracheal tube is generally smaller than would be expected for the child's age.[58] Extubation is indicated when the child is afebrile, has a leak around the nasogastric tube, and has significantly less secretion[33]; this usually occurs within 3-7 days.[33 55 72] Standard treatment for bacterial tracheitis includes a 10-14 day course of broad-spectrum antibiotics.[55] If a bacterium is isolated from tracheal secretions, broad-spectrum antibiotics can be replaced with a pathogen-specific antibiotic.[74] No clinical trails have been performed to determine the optimal duration of antibiotic treatment.[58]

OBJECTIVE

The objective of this study is to determine risk factors, both from the patients' medical history and presenting signs and symptoms, for severe upper airway obstruction. Based on previous research, we hypothesize that a history of prior intubation and congenital stridor will be more strongly associated with severe upper airway obstruction than the other named risk factors. This study, which included all cases of severe upper airway obstruction in Alberta from 1994 to 2004, is the first population-based case-control study to identify risk factors associated with developing severe upper airway obstruction. A better understanding of the factors that put children at risk for severe upper airway obstruction would help to clarify indications for hospital admission.

CHAPTER 2

LITERATURE REVIEW

LITERATURE SEARCH

Medline and Embase were searched using key words and MESH headings for variations of terms for "croup", "bacterial tracheitis", and "laryngotracheobronchitis". This search yielded a search output of 1297 references. In addition, the reference lists of pertinent articles were reviewed. More specific details of the search strategy and exact search strings appear in Appendix I.

EPIDEMIOLOGY OF SEVERE VIRAL CROUP

In population-based studies, less than 5% of all children diagnosed to have croup are hospitalized.[64 75 17] Of those children who are admitted to hospital, 1-3% are intubated. There have been several published case series describing severe upper airway obstruction in children with croup. The individual studies are described in Table 1.

Table 1: Description of Studies Examining Children with Severe Croup

Author Year Country	Inclusion Criteria	Number of children	Male (%)	Age (months) (median (range))	Steroids Treatment (%)	Length of Stay (days)	Outcome
Danksy[76] 1978 South Africa	Admitted to ICU with acute LTB	50	NR	NR	27 (54%)	ICU 6.7±6.3	Intubated: 36 Tracheotomy: 6 Death: 8 (co-morbidities)
Dawson[77] 1991 Australia	Admitted to ICU with diagnosis of croup from 1980-1989	44	29 (66%)	31 (6-101)	8 (18%)	ICU 3.0 (0.08-21)	Intubated: 12 Mechanical ventilation:10 1.3% of all children with croup who presented to that hospital and 27% of children with severe viral croup
Durward[78] 1998 England	Admitted to PICU with subglottic obstruction from June 1993-Jan 1997	*Viral coup: 34 Recurrent croup: 5	NR	Viral: 60 (24-72) Recurrent: 21 (3-96)	NR	NR	Intubated: 30/39

Author Year Country	Inclusion Criteria	Number of children	Male (%)	Age (months) (median (range))	Steroids Treatment (%)	Length of Stay (days)	Outcome
Freezer[79] 1990 Australia	Diagnosis of croup and admitted to ICU from Jan 1983-July 1988	416	300 (72%)	21 (2-168)	NR	NR	Intubated: 176 Reintubated: 59 Tracheotomy: 2
McEniery [33] 1991 Australia	Acute LTB and managed with artificial airway from Jan 1979-Dec 1988	208	152 (73%)	28.8 (3-108)	NR	NR	Intubated: 201 Tracheotomy 27 Death:1
Postma[14] 1984 USA	Admitted with acute LTB from Jan 1977-Dec 1981	43	35 (81%)	21 (mean)	7 (16%)	Mean 3.9	Intubated: 5 Tracheotomy: 2

Author Year Country	Inclusion Criteria	Number of children	Male (%)	Age (months) (median (range))	Steroids Treatment (%)	Length of Stay (days)	Outcome
Sendi[80] 1992 Canada	Presented to ED with viral tracheitis from 1985-1986	1533 to the ED 374 admitted	Of the 12 intubated: 8 (67%)	Of the 12 intubated: 19.5±14.9 (mean ± SD)	17 of those admitted (5%)	~300 hospitalized <4 days	Intubated: 12 Tracheotomy: 0 Death: 0
Tan[81] 1992 Canada	Diagnosed with LT admitted from Jan 1984-Aug 1988	416	~75%	NR	38% of those admitted to ICU 7% of non-ICU admissions	ICU: majority <1 day Hospital: majority <4 days	Intubated: 24

* As defined by Durward

ED: emergency department; ICU: intensive care unit; LTB: laryngotrachealbronchitis; LT: laryngotracheitis; NR: not reported

In Sendi's cohort, 1533 children presented to the Emergency Department and 374 were subsequently admitted (24%).[80] This is a higher proportion of admissions than reported in a study by Freezer reported in which a total of 416 patients (16%) were admitted to the Intensive Care Unit (ICU) and 176 of these patients required intubation.[82] When reported, the mean or median age of the children with severe croup is around two to three years of age. Boys were more likely to suffer from croup requiring hospitalization at minimum than girls; the proportion of boys ranged from 66-81%. This is congruent with other studies that consistently find that boys are approximately twice as likely to develop croup.[19]

The inclusion criteria of the individual case-studies were variable. One study reviewed charts of Emergency Department admissions[80], while four studies only examined children admitted to the ICU.[76-79] Level of admission is a marker of disease severity, and it is expected that the proportion of intubations would range accordingly. Proportions of intubation ranged from 0.7-96% and tracheotomies were performed in four of the studies. McEniery found that risk factors for requiring tracheotomy versus endotracheal intubation included previous intubation for LTB ($p<0.10$), pre-existing subglottic stenosis ($p<0.001$), and neonatal intubation ($p<0.01$).[33]

Only two studies attempted to determine the causative croup virus.[77 79] Both studies found that when virology assessment was conducted, the most common identified virus was parainfluenza. Parainfluenza viruses have been previously reported as the most common isolated virus.

Four studies did not report the use of steroids to treat croup.[21 33 78 79] Steroid treatment was relatively uncommon among the remaining five studies. Dansky reported that 54% of children were treated with steroids[76], while Sendi found that only 5% of children received steroids[80]. The wide rage in percentage of children receiving steroids may be due to the severity of croup. Danksy examined children who were admitted to the intensive care unit[76], whereas Sendi examined children who presented to the emergency department[80]. A second explanation may be that the studies that reported steroid treatment were conducted between 1978 and 1992 and the efficacy of steroids treatment was not widely accepted until the mid 1990s.

The time to extubation was documented in two studies.[33 78] Children were extubated after approximately 5 days; however, Durward reported that children with a history of croup were extubated after 3 days. Since spasmodic, or recurrent croup, is often a less severe form of croup, it is not surprising that such children were extubated earlier.

The studies were conducted predominantly in Australia and North America. Only one study was conducted in a developing country and the mortality rate in this study was much higher (16% versus ~0% of children in more developed countries)[76]; however none of the causes of death were specifically attributed to croup and the majority of children who died had at least one co-morbidity. Among the two other studies that reported the mortality, the proportion of children who died was 0.5% and 16%.

RISK FACTORS FOR SEVERE CROUP

There are two studies that have attempted to identify risk factors for developing severe croup. Neither study used a population-based cohort and both studies examined children who were hospitalized in a tertiary hospital.

Most recently, Chan examined 122 Malaysian children less than five years of age who were hospitalized with viral croup from January 1994 to December 1999.[35] Children were classified as Grade I (mild respiratory distress: stridor at rest or with mild excitement and no accessory muscle use), Grade II (moderate respiratory distress: stridor at rest and subcostal, intracostal, and sternal recession), or Grade III (severe respiratory distress: stridor at rest with marked recession, central cyanosis, or altered level of consciousness). Compared to children with Grade I or II respiratory distress, children with severe croup were more likely to be older, have a shorter duration of illness prior to admission, higher Westley croup score, higher heart rate, increased respiratory rate, and lower oxygen saturation. Eighteen children had Grade III respiratory distress and all were admitted to the pediatric intensive care unit. Three children were intubated. Risk factors for developing severe croup were age between 12-24 months (OR=3.9 [95%CI: 1.3, 12.7]) and fever of at least 38.5C at admission (OR=5.7 [95%CI: 2.9, 15.6]).

The second study was conducted by Waganer and classified croup severity similarly to that of Chan. Waganer evaluated 527 admissions over a one-year period from 1981-1982 in Australia.[83] Croup severity was classified as Grade I (stridor at rest without retractions and no distress), Grade II (stridor at rest with sternal and chest wall retractions), and Grade III (marked respiratory distress with impending complete

airway obstruction). There were 498 children included, of which nineteen children were readmitted at least 48 hours after their first admission and were considered separate disease episodes. The median age was 20 months and 69% of children did not have a prior history of croup. Grade II and III children were more likely to test positive for parainfluenza type II. Six percent of Grade II and 53% of Grade III patients were intubated. Among the Grade II children, those that worsened following admission were older than stable patients (29 versus 16 months, $p<0.02$). The authors recommend that children with stridor at rest and sternal and chest wall retractions, that is children with Grade II croup, should be admitted. This study was conducted prior to widespread use of corticosteroids and epinephrine.

EPIDEMIOLOGY OF BACTERIAL TRACHEITIS

There have been several case-series describing children with bacterial tracheitis and the clinical course of the disease. Gallagher found the incidence of bacterial tracheitis to be 0.4-0.8/1000 pediatric admissions[84]; it is an uncommon reason for hospital admission. Table 2 describes the case-series that have examined children with bacterial tracheitis.

Table 2: Description of Studies Examining Children with Bacterial Tracheitis

Author Year Country	Inclusion Criteria	Number of children	Male (%)	Age (months)	Medical History	*Stapylococcus aureus* Isolation	Length of Stay (days)	Outcome (%)
Alonso[44] 2005 Spain	Admitted to PICU with bacterial tracheitis from June 1992-May 2004	12	6 (50%)	Median 24 Range 1-156	Croup: 4 Down's syndrome: 1 Interauricular communication: 1	3/7 (43%)	NR	Intubated: 12 Serious complication: 2 Death: 0
Donaldson[57] 1989 Canada	Treated for bacterial tracheitis	3	0 (0%)	Median 30 Range 2-48	Down's syndrome and ALL: 1 RSV: 1 High-dose steroids: 1	1/3 (33%)	NR	Tracheotomy: 3 Serious complication: 3
*Donnelly[36] 1990 United States	NR	118	59 reported: 38 (64%)	Mean 54 Range 0.8-156 (majority less than 3 years)	NR	55/118 (47%)	NR	Intubated: 100 Serious complication: 13 Tracheotomy: 14 Death: 4

Author Year Country	Inclusion Criteria	Number of children	Male (%)	Age (months)	Medical History	*Stapylococcus aureus* Isolation	Length of Stay (days)	Outcome (%)
Durward[78] 1998 England	Admitted to PICU with subglottic obstruction from June 1993-Jan 1997	6	NR	Median 32 Range 12-125	NR	3/6 (50%)	PICU 8 (4-12)	Intubated: 6 Serious complication: 1 Death: 1
Eckel[56] 1993 Germany	Admitted to PICU with bacterial tracheitis from Feb 1980-Feb 1992	11	8 (73%)	Range 8-138	Down's syndrome: 2 Croup: 1 immunodeficiency: 1 Prematurity: 1	6/10 (60%)	Hospital 7-21	Intubated: 11 Reintubated: 4/11 Tracheotomy: 0 Serious complication: 1 Death: 4

Author Year Country	Inclusion Criteria	Number of children	Male (%)	Age (months)	Medical History	*Stapylococcus aureus* Isolation	Length of Stay (days)	Outcome (%)
Gallagher[84] 1991 United States	Admitted with bacterial tracheitis from 1986-1988	18	12 (67%)	Mean 5.1 Range 2.5-132	Multiple handicaps: 1 Down's syndrome and aplastic anemia: 1 Subglottic hemangioma: 1	6/18 (33%)	Hospital Mean 8.7 Range: 4-78 PICU Mean 6.8 Range 2-19 (15 patients)	Intubation: 10 Death: 0
Hopkins[85] 2006 United States	Admitted with bacterial tracheitis from 1997-2006	18	10 (56%)	Mean 67.2 SD 51.6	NR	6/10 (60%)	Hospital 11±11 PICU 9.1±8.8	Intubated: 15 Tracheotomy: 1 Serious complication: 5 Death: 0

Author Year Country	Inclusion Criteria	Number of children	Male (%)	Age (months)	Medical History	*Stapylococcus aureus* Isolation	Length of Stay (days)	Outcome (%)
Kasian[74] 1989 Canada	Admitted to PICU with bacterial tracheitis from May 1982-Dec 1987	14	9 (64%)	Median 39.6 Range 7-124	NR	7/14 (50%)	Hospital 9.2	Intubated: 13 Tracheotomy: 1 Death: 3
Mahajan[48] 1985 United States	Admitted with bacterial tracheitis from June 1982-Mar 1984	5	3 (60%)	Range6-13	NR	4/5 (80%)	Hospital 7-21	Intubated: 5 Tracheotomy: 3 Serious complication: 2 Death: 0
Tan[81] 1992 Canada	Admitted with bacterial tracheitis from Jan 1984-Aug 1988	9	5 (55%)	Mean 34 Range 6-75	NR	6/9 (67%)	Hospital Median: 17 Range: 6-187	Intubated: 9

ALL: acute lymphoblastic leukemia PICU: pediatric intensive care unit; NR: not reported; RSV: respiratory synticial virus; SD: standard deviation

*Case-series published prior to 1990 and included in Donnelly's review are not further described in this section

There were 10 case-series describing children with bacterial tracheitis. The studies were published between 1985 and 2006; only two studies were published after 2004[85 44]. The sample size ranged from 3[57] to 118[36]; however, nine of the studies examined less than 20 children. An equal number of studies included children admitted to the hospital[48 81 84 85] and children admitted to the PICU[78 44 56 74]; two studies did not report this information [57 36]. The majority of children who were admitted to the hospital were subsequently transferred to the PICU.

The majority of children were male (61%); this sex distribution is similar to that of croup. The median or mean age hovered between 30-40 months and this is slighter older than what is seen among children with croup. Several children had significant medical histories, with the most common being the presence of Down's syndrome[44 56 57 84]. The most common isolated bacterium was *Stapylococcus aureus* and it was found in 49% of children who were cultured. Bacterial tracheitis should be suspected in any child who presents with associated symptoms and has a bacterial culture positive for *Stapylococcus aureus*.

A high proportion of children were intubated and in six studies, all of the children required intubation.[44 48 56 57 81 86] Compared to croup, a higher proportion of children with bacterial tracheitis were intubated. Half of the studies reported one or more children undergoing a tracheotomy. There was also a number of children who had a serious complication as part of their disease progression. The most common serious complications were respiratory distress syndrome (4 studies) and cardio or cardio-pulmonary arrest (4 studies). The hospital stay was at least one week. Six percent of all children with bacterial tracheitis succumbed to their illness. Mortality

ranged from 0[44 63 84 85] to 36%[56]; the majority of the studies did not state if there was an association between death and important medical history, that is, if children with medical histories were more likely to die from bacterial tracheitis.

RISK FACTORS FOR BACTERIAL TRACHEITIS

To the best of our knowledge, risk factors for bacterial tracheitis have not been studied using a case-control study design, nor have any high-risk groups been identified to date.[58] There does not appear to be a relationship between gender, race, or socioeconomic status and contracting bacterial tracheitis.[57]

Only one study has compared children with bacterial tracheitis who were and were not intubated. Bernstein examined 14 months of admissions to Cincinnati's Children's Hospitals' PICU and found that bacterial tracheitis resulted in 46 pediatric admissions.[51] The average age of the children was older than previously reported case-series (69.3 months ± SEM 6.8) and the children were less toxic. Twenty-six children were intubated, a proportion the authors believed to be smaller than other studies. Children who were intubated were younger (46.9 months ± SEM 6.5 versus 98.9 ± SEM 9.9) and exhibited more stridor (19/26 [73%] versus 6/20 [30%]) than those whose treatment did not include tracheal intubation. There was no significant difference in sex, length of prodromal illness, cough, rhinorrhea, hoarseness, drooling, toxic appearance, severe retractions, maximum temperature, response to epinephrine, radiographical results, or white blood cell count. On average, children were intubated for 3.2 days (SEM 0.2) and discharged after 7.0 days (SEM 0.5). The most common bacterium isolated from respiratory cultures was *Moraxella catarrhalis*.

There does appear to be a suspiciously high frequency of bacterial tracheitis among children with Down's syndrome.[56 73 87] In a cohort of 11 children with bacterial tracheitis, two children had Down's syndrome.[56] Cant reports four children

with Down's syndrome and no congenital heart disease who developed bacterial tracheitis that were seen in a three year period.[87] During the same time frame, 206 children were diagnosed with croup; bacterial tracheitis was not diagnosed in any children who did not have Down's syndrome. Compared to healthy children, children with Down's syndrome may be more susceptible to bacterial tracheitis because of pre-existing immunodeficiency and smaller subglottic airways.

RISK FOR REINTUBATION

Current clinical practice suggests that a child may be extubated once an audible air leak is achieved.[86] The air leak test is performed by placing the stethoscope over the larynx and determining the minimum amount of air pressure that results in an audible rush of air around the endotracheal tube.[88] The air leak test is not absolutely predictive of successful extubation and the child may need to be reintubated if breathing is too labored. Adderley and Mullins evaluated the reliability of the leak test among 31 planned nasotracheal extubations in children with croup.[34] A positive leak test occurred when there was vocalization around the tube, a coughing child produced an air leak, or when positive pressure insufflation 40cm H_2O resulted in a leak. Twenty-three extubations passed the leak test and three of the 23 extubations required reintubation (13%). Eight extubations were performed in afebrile children who had been intubated for seven days and did not have a leak; three extubations required reintubation (38%).

Two studies have examined the incidence of reintubation among children with croup. In an effort to identify risk factors associated with reintubation, Rajah conducted a retrospective review of 82 South African children with LTB who were intubated and admitted into the ICU.[6] The median age was 12.5 months and the male to female ratio was slightly greater than 2:1. Age, pneumonia, duration of intubation, PaO_2:FIO_2, presence of atelectasis, antibiotic use, and steroid use were not significant risk factors for reintubation in either univariate or multivariate analysis. The steroids administered varied in type, dosage, and timing of administration. The second study was conducted in Melbourne, Australia and included 176 children with croup who

required intubation between January 1983 and July 1988.[82] One hundred seventeen children were successfully extubated on the first attempt, while 59 children were reintubated. Children who received steroid treatment before a second extubation was attempted were more likely to be successfully extubated (34/35 with steroid treatment versus 14/24 without steroid treatment). The authors concluded that among children who are reintubated, steroid treatment increases the likelihood of successful subsequent extubation.

CHAPTER 3

INTRODUCTION TO THE STUDY

Croup is a common pediatric upper respiratory disease that is often self-limiting and resolves without medical attention; however, many children visit the Emergency Department and are subsequently admitted. While mortality and significant morbidity associated with developing severe upper airway obstruction caused by viral croup and/or bacterial tracheitis are extremely uncommon, the possibility that these outcomes may occur motivates physicians to hospitalize children with croup. Thus far, risk factors associated with developing severe upper airway obstruction caused by croup or bacterial tracheitis has yet to be established. Such risk factors would assist physicians in predicting which children are likely to develop severe croup and/or bacterial tracheitis and subsequently help determine which children are at highest risk for endotracheal intubation, anoxic brain injury, or death and should be admitted.

By determining which children are at risk for severe upper airway obstruction, high-risk children would be appropriately monitored and there may be fewer unnecessary hospital admissions. Fewer hospitalizations would also minimize the number of children at risk for the adverse events associated with hospitalization, such as nosocomial infections, medication prescription errors, and psycho-social stress.[89-91]

This thesis describes a case-control study of Albertan children who are at risk for developing severe upper airway obstruction as a result of severe croup or bacterial tracheitis compared to children who do not develop severe upper airway obstruction. It is a case-control study that determines risk factors for developing severe upper airway obstruction caused by viral croup or bacterial tracheitis among Albertan children. Administrative databases were used to identify children aged 0 to 16 years

of age who presented to the Emergency Department with croup or bacterial tracheitis. A retrospective chart review was conducted to identify the risk factors for severe upper airway obstruction. Cases and controls were identified by using the appropriate ICD-9/10 codes and a retrospective review of medical records was completed. The characteristics of children presenting to the Emergency Department who developed severe upper airway obstruction were compared to children who did not develop a severe form of croup or bacterial tracheitis (Appendix II). The sample size for this study was determined based on the estimated risk of severe upper airway obstruction in patients with prior intubation. Based on pilot data, it was estimated that the proportion of cases with prior intubation is approximately 0.13. Using a ratio of 1:3 for cases to controls, 50 cases yields a design that has 72% power to detect an OR of 0.14 (control rate=0.02) and 82% power to detect an OR of 0.09 (control rate=0.01) at a 0.05 significance level (Appendix III). Patient demographics, medical history, and details concerning current episode of upper respiratory illness were collected on a standardized data collection form (Appendix IV). The data were entered into a Microsoft Access® database. Logistic regression was used to determine risk factors for predicting the development of severe upper respiratory illness.

This study will identify children who are at risk for developing severe croup or bacterial tracheitis. The high and variable hospitalization rates of croup and bacterial tracheitis imply that physicians are uncertain which children are likely to develop severe croup and bacterial tracheitis. The identification of children at the highest risk of serious adverse outcomes may assist physicians in determining the most appropriate admissions. In turn, this would reduce health care costs by

decreasing unnecessary hospital admissions. To date, no study has examined the health care costs of a croup episode. Hendrickson suggested that the costs associated with all hospitalization are approximately three times as great as the costs of all emergency department visits.[92] Bronchiolitis, another common pediatric respiratory disease, and croup are likely to have a similar costing structure. Langley found that 62% of health care costs were incurred by the 1% of children who were hospitalized due to bronchiolitis.[93] If we were able to identify children that could be discharged safely from the Emergency Department, then health care spending on inpatient stay would be reduced.

DEFINITIONS

Upper airway obstruction occurs when there is an acute blockage of the upper airway and this can be caused by viral croup, bacterial tracheitis, epiglottitis, and upper airway/esophageal foreign body aspiration. We examined severe upper airway obstruction caused by either severe viral croup or bacterial tracheitis and the following definitions were used to describe each illness. 'Viral croup' was defined as any child with acute onset of inspiratory stridor associated with a seal-like barky cough who does not meet the definition of definite or possible bacterial tracheitis. The term 'viral croup' encompassed both spasmodic croup and acute laryngotracheobronchitis (LTB). Spasmodic croup was defined specifically as a child who has sudden onset of stridor (less than two hours prior to presentation), afebrile (temperature <38.0C), and does not have a preceding upper respiratory tract infection.[94] Acute LTB was defined as a child who has symptoms of an upper respiratory tract infection at least 12 hours prior to the onset of stridor and has a fever or a history of fever.[94]

'Bacterial tracheitis' was defined as any child with acute onset of respiratory distress who has a positive culture for bacteria taken from the upper airway either at the time of intubation or bronchoscope. A child who did not have a positive bacterial tracheal culture, but who has a hospital discharge diagnosis of 'bacterial tracheitis' was considered to have 'possible bacterial tracheitis'. There is no specific ICD9/10 code for bacterial tracheitis. When a physician from Stollery Childrens' Hospital or Alberta Childrens' Hospital lists a diagnosis of 'bacterial tracheitis' at discharge, the health record technicians use ICD 9/10 codes 46410/J04.1 (acute tracheitis without

obstruction) and 46411/J04.1 (acute tracheitis with obstruction). All children who have a discharge diagnosis consistent with bacterial tracheitis had their medical chart audited to determine if they met our study definitions.

'Severe upper airway obstruction' was defined as children who were 1) admitted to an ICU in one of the two children's hospitals in Alberta due to viral croup or bacterial tracheitis, 2) endotracheally intubated in any health care setting because of viral croup or bacterial tracheitis, or 3) had a respiratory arrest, died, or had an apparent brain injury as a result of a period of anoxia stemming from viral croup or bacterial tracheitis.

CHAPTER 4

METHODS

PARTICIPANTS

Definition of Cases

A case was defined as a child (0-16 years of age) who is a resident of Alberta, cared for by an Alberta physician, and has 'severe upper airway obstruction' due to viral croup or bacterial tracheitis as per our study definition. For the purpose of the study, the following definitions were established. 'Severe upper airway obstruction' was defined as children diagnosed with bacterial tracheitis or children who have been admitted to an ICU in one of the two children's hospitals in Alberta, endotracheally intubated in any health care setting, had a respiratory arrest, died, or had an apparent brain injury as a result of a period of anoxia stemming from viral croup.

'Bacterial tracheitis' was defined as any child with acute onset of a barky cough and respiratory distress who has a positive culture for bacteria taken from the upper airway either at the time of intubation or with a bronchoscope. A child who did not have a positive bacterial tracheal culture but who has a discharge diagnosis from hospital of 'bacterial tracheitis' was considered to have 'possible bacterial tracheitis'.

Severe 'viral croup' was defined as any child with acute onset of inspiratory stridor associated with a seal-like barky cough who does not meet the definition of bacterial tracheitis (definite or possible) who requires admission to a PICU in Alberta, endotracheally intubated in any health care setting, or had a respiratory arrest, died, or had an apparent brain injury as a result of a period of anoxia.

Definition of Controls

A control was defined as a child (0-16 years of age) who resides within Alberta and diagnosed with croup following assessment by an Alberta physician.

'Croup' was defined as any child with acute onset of inspiratory stridor associated with a seal-like barky cough who does not meet the definition of bacterial tracheitis (definite or possible). The term 'croup' encompassed both spasmodic croup and acute laryngotracheobronchitis (LTB). Spasmodic croup was defined specifically as a child who has sudden onset of stridor (less than two hours prior to presentation), no fever (temperature <38.0C), and does not have a preceding upper respiratory tract infection. Acute LTB was defined as a child who has symptoms of an upper respiratory tract infection at least 12 hours prior to the onset of stridor and has a fever or a history of fever.[94]

Selection of Cases

To identify the cases, health records analysts at Calgary Health Region and Capital Health Region accessed data from the Canadian Institute for Health Information (CIHI) Hospital Inpatient database to identify children with croup and/or bacterial tracheitis as the probable or possible primary or secondary diagnosis and who presented to one of 107 Alberta hospitals from 1994 to 2004.

The health records analysts used a combination of disease and procedural ICD-9/10 codes. The following disease codes were used: 46410/J04.1 (acute tracheitis without obstruction), 46411/J04.1 (acute tracheitis with obstruction), 46420/J04.2 (acute laryngotracheitis without obstruction), 46421/J04.2 (acute laryngotracheitis with obstruction), and 46440/J05.0 (croup). There is no specific ICD9/10 code for bacterial tracheitis. To circumvent this issues, health record technicians at Stollery Childrens' Hospital and Alberta Childrens' Hospital use ICD9/10 codes 46410/J04.1 (acute tracheitis without obstruction) and 46411/J04.1

(acute tracheitis with obstruction) to represent bacterial tracheitis. The following procedural codes were used: CM 96.04/1.GZ.31 (intubated), CM 348.1/G93.1 (anoxic brain damage), and CM 348.5/G936 (cerebral edema).

To ensure that all cases of severe upper airway obstruction were identified, the hospital-specific admission logs at Alberta's two pediatric intensive care units (PICU) and the medical examiner records of children dying from "respiratory causes" were also examined. The charts of each suspected case of severe upper airway obstruction was examined to ensure the disease incident met the inclusion criteria listed in the above section.

Selection of Controls

The controls were selected from the same 107 Alberta hospitals and were those diagnosed to have croup but did not meet the definition of 'severe upper airway obstruction' and presented to the same emergency department at approximately the same time as a child with severe croup (i.e.: a case).

Health records analysts used Emergency Visits Databases to identify controls. The following disease codes were used: 46410/J04.1 (acute tracheitis without obstruction), 46411/J04.1 (acute tracheitis with obstruction), 46420/J04.2 (acute laryngotracheitis without obstruction), 46421/J04.2 (acute laryngotracheitis with obstruction), and 46440/J05.0 (croup).

Controls were identified from the same initial presenting hospital based on time of entry into the hospital emergency department. For each case identified, the five croup presentations closest to the time of the case presentation were identified. Three controls were randomly selected from these five charts. When cases were

transferred to a tertiary hospital, the controls were selected from the hospital where the case originally presented. The charts of each suspected control were examined to ensure the disease episode met the inclusion criteria for a control.

Ethics

This case-control study was part of a CIHR funded randomized controlled trial (RCT) examining dissemination methods for croup treatment. We notified the Health Ethics Review Boards at the University of Alberta and University of Calgary that we were conducting the case-control sub-study and submitted our data collection form. Both institutions agreed that we did not have to complete a separate ethics application because this sub-study was incorporated into the RCT and ethics was granted for the RCT.

MEASUREMENTS

Definitions of the risk factors are described in Appendix II and the final data collection form appears in Appendix IV.

Data from Emergency Department and Triage Records

Data on risk factors (predictors) were collected from emergency department records and triage notes. The following data were extracted from these sources: diagnosis (croup, severe croup, or bacterial tracheitis) patient demographics (date of birth, age, sex, race, and Aboriginal status), health history (history or presence of: congenital heart disease, cancer history, immunodeficiency, asthma, congenital anomalies, prematurity, Down's syndrome, and recent infections), and recent medication use. Also, details concerning croup history were recorded (i.e.: previous

croup, croup requiring emergency department visits, hospitalization, ICU admission, or previous croup requiring intubation). Details about the prodromal obstructive history (presence of non-barky and barky cough, rhinorrhea, fever, stridor, and respiratory distress) were recorded. These details were likely provided by the parents when the nurse asked the parents about the child's symptoms prior to arriving at the Emergency Department. In addition, initial signs (non-barky and barky cough, stridor, indrawing, cyanosis, and level of consciousness) when the child first presented at the Emergency Department were recorded. These signs would have been assessed by a health care professional. In addition, details concerning the physiological assessment were extracted (heart rate, respiratory rate, blood pressure, oxygen saturation, and temperature). In order to obtain the most complete data possible, risk factors recorded by a nurse, medical student, resident, or physician were included. When a risk factor was measured more than once in the emergency department (e.g.: respiratory rate), the most serious finding was recorded.

Data from Inpatient and PICU Records

Pertinent details concerning the course of disease during the hospital admission were extracted from inpatient and PICU records: length of intubation, length of hospital stay in ICU/PICU and total hospital stay, hypotension, cardiac arrest, or death. The following information was also extracted: X-ray findings (chest and neck) and laboratory results (white blood cells, lymphocytes, neutrophils, blood gases, and pH). The microbiologic cause or causes of croup or bacterial tracheitis and where the organism was isolated (see Appendix IV for a complete list of organisms) was collected. When information on a risk factor that normally would have been

collected on the emergency department or triage records appeared for the first time in the inpatient or PICU records (e.g.: an important event in the child's medical history), this information was recorded.

Method of Data Collection

The data for this study were collected by performing a retrospective chart review. The data collection form was developed and piloted by a pediatric research nurse who has experience in both pediatric respiratory disease and conducting chart reviews. After consulting with one of the clinical leaders of this project (a practicing pediatric emergency physician), the data collection form was altered to ensure the appropriate data were captured.

The pediatric research nurse then trained a pediatrician to complete the chart review. The pediatric research nurse and pediatrician both extracted data from the same five charts. Discrepancies were reviewed and it was determined that reasonable agreement had been established (intraclass correlation coefficient 0.48 [0.31, 0.62]). Subsequently, the pediatrician was solely responsible for data extraction of all hospital records. Data were extracted directly into an Access database designed for this study and single-data entry was used. The database contained built-in data consistency checks to improve data accuracy.

ANALYSIS

Sample Size Calculation

The hypothesized primary risk factor, previous intubation, was used for sample size calculations. In a pilot sample of children with severe croup who

presented to the Alberta Children's Hospital, the proportion of cases with a previous intubation was 13% (5/38). Among the controls identified in the Alberta Croup database from 1994-2000, 0/2958 children were intubated. Assuming a prevalence of previous intubation of 0.01 (1%) among the controls, 50 cases and 150 controls gave a design with 80% power to detect a significant difference at the 0.05 level. Sample size calculations were conducted in NCSS-PASS.[95]

Data Cleaning

Data cleaning was conducted by examining the variables for outliers and inconsistent data. For dichotomous and categorical risk factors, frequencies were conducted; continuous risk factors were examined using histograms and stem and leaf plots after categorizing. All discrepancies were reviewed with the data extractor; those that could not be resolved were assigned a value to indicate missing data. Where possible, inconsistencies were corrected. For example, when a control was identified as 'severe croup' but did not meet the study definition of a case, the control's diagnosis was changed to 'croup'. Intraclass correlation coefficient was calculated to determine inter-rater reliability.

Descriptive Analysis

Patient demographics and risk factors were summarized for the entire population. Categorical risk factors were described as both number of occurrences and percentages. Continuous risk factors were summarized using means and standard deviations if the data were normally distributed or median with the interquartile range (IQR; 25^{th} percentile, 75^{th} percentile) if the data were skewed. Normality was assessed visually using stem and leaf plots and histograms.

Similar summaries were prepared for patient characteristics and symptoms among cases and controls. Some risk factors that described the croup episode were initially recorded as categorical data indicating absence, or presence with a level of severity (e.g.: stridor, cyanosis, and level of consciousness) or location (e.g.: indrawing). Due to limited observations in higher severity categories, these risk factors were collapsed into presence/absence for analysis purposes. For dichotomous risk factors, the cases and controls were compared using the chi-squared test or the Fischer's Exact test if an expected cell count was less than five. Continuous risk factors were compared using the 2 independent sample t-test when normally distributed or the Wilcoxon test when the data were skewed.

Univariate Logistic Regression Modeling

Because cosmetic matching was employed, that is, controls were selected from the same hospital as cases as a convenient manner for obtaining controls,[96] a matched analysis was not conducted. For all risk factors that were significant at $p<0.2$ by the chi-square test, Fischer's Exact test, 2 independent sample t-test, or Wilcoxon test, a univariate logistic regression was completed to calculate odds ratios (OR) and 95% confidence intervals. These risk factors included prior intubation, history of croup, prodromal symptoms, presenting signs, modified Westley croup score, respiratory rate, heart rate, oxygen saturation, and temperature. We did not consider pre-emergency department health care visit to be a risk factor for severe upper airway obstruction because it is subject to parental bias and decision-making and thus we did not include this variable in the univariate logistic regression analysis.

Croup is described in terms of non-barky cough, barky cough, stridor, indrawing, cyanosis, and level of consciousness. There were five croup signs that were measured prodromally and at presentation; they were non-barky cough, barky cough, stridor, indrawing, and cyanosis. Variables for a sensitivity analysis described below were created for each croup symptom that was measured at both time points. Although when children with a specific prodromal symptom generally also presented with the specific sign, there were a few discordinate pairs. We wanted to determine the risk of a child developing severe upper airway obstruction if the child had ever had the particular sign or symptom (even if they did not present with the sign). In the new "combined" risk factors, the child was considered to have the croup sign if it was recorded prodromally, at presentation, or at both time points. Therefore, using the "combined" risk factor, there will be more children to have the croup sign because they could have had it prodromally (prior to presenting at the Emergency Department), at presentation to the Emergency Department, or at both time points. This was done to allow us to further understand the risk of developing severe upper airway obstruction among children who had had the croup signs at any time point within this disease episode. Univariate logistic regression models were fitted for prodromal and presenting symptoms as well as the new "combined" risk factors.

Two approaches were employed to determine the impact of missing data for dichotomous risk factors. In the first set of univariate models, for any given risk factor, observations with missing data were excluded from the model. In the second set of univariate models, for any given risk factor, observations with missing data were coded as "no" so that the model could include all observations. For example,

there were missing data for 127 observations for the history of croup. In the first set univariate model, only 75 observations were included because the 127 observations with missing data were excluded. In the second model, the 127 observations had the history of croup risk factor coded to "no", so that the logistic regression model was fit to all 202 observations. The derived data, where missing values in dichotomous risk factors were coded to "no" were used in all subsequent analyses.

Multivariate Logistic Regression Modeling

An adjusted analysis was performed using purposeful selection logistic regression, where the outcome was developing severe upper respiratory illness, as defined by cases and controls. Using the Wald test from the univariate logistic regression models, all dichotomous risk factors that were significant at $p<0.1$ level were then entered into a full multivariate logistic regression model. There were some exceptions to this rule. First, because all of the individual components of the croup score met this criterion and were more informative than the combined croup score, the latter was not included in the multivariate model. Second, when the specific croup sign was significant as both a prodromal symptom and a presenting sign, we chose to use the croup sign that was measured at presentation based on the advice of one of the clinical leaders of this project. The rational provided was that the presence of the croup sign at Emergency Department presentation was not susceptible to the recall bias that may have occurred when parents were asked if their child had the specific croup sign prior to presenting at the Emergency Department. There were some croup symptoms that were only measured prodromally; these include prodromal

sore throat, prodromal fever, and prodromal rhinorrhea. The timing of the risk factors measurement is described in Table 3.

Table 3: Timing of risk factor collection

Risk Factor	Presenting	Prodromal
Non-barky cough	√	√
Barky cough	√	√
Indrawing	√	√
Cyanosis	√	√
Stridor	√	√
Sore throat		√
Rhinorrhea		√
Fever		√
Level of consciousness	√	

Third, risk factors in which there were no recorded observations among the cases and/or controls were not entered into the multivariable model because logistic regression methodology does not allow for such data. These risk factors were included in the model if they met the above criteria of being significant at $p<0.1$ in the univariate models. Thus, in total, nine risk factors were entered into the initial multivariable model.

Dichotomous risk factors that were significant at $p<0.05$ in the full model were retained in the initial reduced model. Risk factors that were excluded from the initial reduced model were added back in one at a time and were subsequently retained if they achieved significance at $p<0.05$. This model was used as the basis for testing for confounding dichotomous risk factors.

Confounding was assessed by comparing each risk factor's beta estimate with the confounder in the model to the risk factor's beta estimate without the confounder in the model. The following formula was used:

$$[(\beta c-\beta)/\beta]*100$$

and when the change in the beta estimate was greater than 15%, the risk factor in question was determined to be a confounder and retained in the model. Confounding occurs when a second risk factor is associated with the risk factor of interest and is also an independent risk factor for disease development.

Next, continuous risk factors (respiratory rate, heart rate, and oxygen saturation) were added one at a time to the model containing the dichotomous risk factors and confounders. This was done in an attempt to overcome loss of power issues due to missing data. Each of these risk factors contained different numbers of observations with missing data. If more than one continuous risk factor was significant (at the 0.05 level) when added one at a time to the dichotomous multivariate model, the next step was to add both of these risk factors into the dichotomous multivariate model. If both continuous risk factors remained significant, both were retained in the model. If, however, both of the risk factors were not significant when they were both added to the model (i.e.: the risk factors were collinear) further steps were necessary. The subset of observations that had no missing data for either of the risk factors in question was used to run models which included the dichotomous risk factors and confounders and each continuous risk factor separately. The (-2*log-likelihood) from these 2 models were compared. The model that achieved the lowest (-2*log-likelihood) was retained.

In an effort not to over-fit the model, no risk factors were forced into the model. Interaction terms were not assessed due to the collinearity of croup signs and because adding of interaction terms would have included more risk factors in a model that already contained a high number of risk factors relative to the number of cases.

Finally, a sensitivity analysis was conducted by starting with a full dichotomous risk factors model that included the "combined" variables for each of the croup signs that were measured at both time points (i.e.: combined non-barky cough, combined barky cough, combined indrawing, combined stridor, and combined cyanosis). The subsequent model fitting proceeded in the identical manner that is described above in the primary analysis.

The Hosmer-Lemeshow test was used to test the final multivariate model for goodness-of-fit, where $p>0.05$ indicates a good fit. All logistic regression results were reported as an odds ratio with associated 95% confidence intervals. All statistical analysis was conducted in SPSS 14.0.[97]

CHAPTER 5

RESULTS

DESCRIPTION OF THE OVERALL STUDY SAMPLE

There were 202 children included in this study (52 cases and 150 controls). The majority of children were male (126/202) and the median age was 29.50 months (IQR 14, 52.50). Few children had a history of prior intubation (5/202), congenital stridor (25/200), developmental delay (3/202), or congenital heart disease (4/202). More than half of the children had a previous episode of croup (45/75). Many of the parents reported that their child had croup symptoms prior to arriving at the Emergency Department (rhinorrhea: 64/202; fever 83/202; sore throat: 38/202; cough: 110/195; stridor: 105/201; indrawing: 84/201; and cyanosis: 10/198). Upon presentation to the Emergency Department, the most common croup symptom was stridor (110/189), followed by barky cough (106/180), indrawing (86/188), decreased level of consciousness (18/181), cyanosis (12/179), and non-barky cough (12/180). The median croup score was 0 (IQR 0, 3).

DESCRIPTION OF THE CASES AND CONTROLS

Between 1994-2004, 52 children met our case definition of severe upper airway obstruction. Twenty-six children were diagnosed with severe croup and 26 children had bacterial tracheitis. Five children in Edmonton were diagnosed with bacterial tracheitis and the remaining twenty-one children were diagnosed in Calgary.

Patient Characteristics

Table 4 describes the patient characteristics of those that did (cases) and did not (controls) develop severe upper airway obstruction. Sex and age were not significantly different between cases and controls. The following patient

characteristics were significantly higher among those who developed severe upper airway obstruction: prior intubation (p=0.016), developmental delay (p=0.016), and previous croup requiring an ICU admission (p=0.020). Children who did not develop severe upper airway obstruction were more likely to have previously suffered from croup (p=0.007). Only one child had Down's syndrome; this child did not develop severe upper airway obstruction. At presentation, no child in either the case or control group had previously had any of the following conditions: chronic lung disease, congenital anomalies, reflux, meningitis, sepsis, encephalitis, osteomyelitis, septic arthritis, urinary tract infection, asthma requiring ICU admission, or required supplemental oxygen.

Table 4: Patient characteristics associated with severe upper airway obstruction

	Cases	Controls	p-value
	n/N (%)	n/N (%)	
Sex (males)	31/52 (59.6)	95/150 (63.3)	0.633*
Age (months; median IQR)	28 (11,59)	32 (14.5, 50.5)	0.787^
Prematurity	2/52 (3.8)	2/150 (1.8)	0.273#
Any congenital stridor	4/50 (8.0)	21/150 (14.0)	0.267*
Down's syndrome	0/52 (-)	1/150 (0.7)	0.999#
Developmental delay	3/52 (5.8)	0/150 (-)	0.016#
Congenital heart disease	2/52 (3.8)	2/150 (1.8)	0.273#
Prior intubation	4/52 (7.7)	1/150 (0.7)	0.016#
History of croup	13/31 (41.9)	32/44 (72.7)	0.007*
Previous croup ED admission	4/50 (8.0)	5/133 (3.8)	0.259#
Previous croup hospitalization	2/50 (4.0)	6/134 (4.5)	0.999#
Previous croup ICU admission	3/51 (5.9)	0/131 (-)	0.020#
History of asthma	5/52 (9.6)	16/150 (10.7)	0.831*
Previous asthma hospitalization	0/51 (-)	1/142 (0.7)	0.999#
History of pneumonia	1/52 (1.9)	0/150 (-)	0.257#
History of fundoplication	2/52 (3.8)	0/150 (-)	0.065#
History of cancer	1/52 (1.9)	0/150(-)	0.257#

*: Chi square; #: Fischer's Exact test; ^: Mann-Whitney

Presenting Signs and Symptoms

Table 5 describes the distribution of presenting signs and symptoms among children with (cases) and without (controls) severe upper airway obstruction. Overall, there were significant differences between symptoms and developing severe upper airway obstruction. In addition, the croup score among cases was significantly higher than that of controls (p=0.012). Children who developed severe upper airway obstruction had significantly higher respiratory rate (p=0.002), higher heart rate (p=0.006), and lower oxygen saturation (p=0.006). Cases and controls presented to the Emergency Department with similar temperature (p=0.133). Two risk factors, prodromal rhinorrhea and temperature were not significant predictors; however, they were approaching significance. Among croup symptoms that were measured prodromally and at presentation, the croup symptoms were significant at both time points with the exception of barky cough. X-rays, laboratory results, and causes of severe upper airway obstruction were assessed too infrequently to analyze.

Table 5: Presenting signs and symptoms associated with severe upper airway obstruction

	Cases	Controls	p-value
	n/N (%)	n/N (%)	
Pre-visit care	18/49 (36.7)	14/127 (11.0)	<0.001*
Prodromal fever	30/52 (57.7)	52/150 (35.3)	0.005*
Prodromal sore throat	19/52 (36.5)	19/150 (12.7)	<0.001*
Prodromal rhinorrhea	22/52 (42.3)	42/150 (28.0)	0.056*
Prodromal barky cough	28/46 (60.9)	82/149 (55.0)	0.485*
Any presenting barky cough	17/38 (44.7)	89/142 (62.7)	0.046*
Combined barky cough	30/52 (57.7)	93/150 (62.0)	0.583*
Prodromal non-barky cough	22/52 (42.3)	31/150 (20.7)	0.002*
Any presenting non-barky cough	7/38 (15.4)	5/142 (3.5)	0.004#
Combined non-barky cough	22/52 (42.3)	34/150 (22.7)	0.006*
Prodromal obstructive stridor	39/51 (76.5)	66/150 (44.0)	<0.001*
Any presenting stridor	39/48 (81.3)	71/141 (50.4)	<0.001*

Combined obstructive stridor	42/52 (80.8)	73/150 (48.7)	<0.001*
Prodromal obstructive indrawing	43/52 (82.7)	41/149 (27.5)	<0.001*
Any presenting indrawing	39/48 (81.3)	47/140 (33.6)	<0.001*
Combined obstructive indrawing	45/52 (80.8)	48/150 (32.0)	<0.001*
Prodromal obstructive cyanosis	9/48 (18.8)	1/150 (0.7)	<0.001#
Any presenting cyanosis	10/45 (22.2)	2/134 (1.5)	<0.001#
Combined obstructive cyanosis	11/52 (21.2)	2/150 (1.3)	<0.001#
Presenting decreased level of consciousness	14/48 (29.2)	4/133 (3.0)	<0.001#
Presenting croup score (median IQR)	2 (0,4)	0 (0,2)	0.012^
Presenting respiratory rate (breath per minute; median IQR)	40 (25, 48)	29 (24, 36)	0.002^
Presenting heart rate (beats per minute; mean SD)	145.18 (30.3)	131.2 (22.2)	0.006$
Presenting O2 saturation (%; median IQR)	95.5 (89.25, 97.75)	97 (95.5, 98)	0.006^
Presenting temperature (C; mean SD)	37.6 (1.1)	37.3 (1.1)	0.133$

*: Chi square; #: Fishers Exact test; ^: Mann-Whitney; $: T-test

Outcome of Children with Severe Upper Airway Obstruction

The median length of hospital stay was significantly longer in children who developed severe upper airway obstruction compared to those that did not (129.5 hrs [IQR 52.9, 265.2] versus 1.8 hrs [1.2, 2.7]; p<0.001). Among children with severe upper airway obstruction, the only significant negative outcome was requiring intubation (Table 6). In addition, two children suffered from hypotension or arrest; however, this was not significant. The medical charts indicated that no child suffered asphyxia, anoxic brain injury, or died.

Table 6: Outcome among children with and without severe upper airway obstruction

	Cases (n/N)	Controls (n/N)	p-value
Intubation	36/52	0/150	<0.000*
Hypotension	2/52	0/150	0.065#
Arrest	2/52	0/150	0.065#

*: Chi square; #: Fishers Exact test

UNIVARIATE LOGISTIC REGRESSION MODELING

Severe upper airway obstruction was associated with sixteen risk factors (Table 7a). Children who had been previously intubated had an OR of 12.417 (95% CI: 1.355, 113.790) more likely to develop severe upper airway obstruction. As indicated by significant odds ratios for the majority of all prodromal symptoms and all presenting signs, children who presented with specific croup symptoms were significantly more likely to develop severe upper airway obstruction. As respiratory rate and heart rate increased, the odds of developing severe upper airway obstruction significantly increased (OR 1.058 [95% CI: 1.027, 1.090] and OR 1.023 [95% CI: 1.009, 1.038]), respectively). History of croup was significantly protective for developing severe upper airway obstruction (OR 0.271 [95% CI: 0.102, 0.717)]). The odds of developing severe upper airway obstruction were significantly higher among children with a higher presenting croup score (OR 1.351 [95% CI: 1.125, 1.624]). Severe upper airway obstruction was not associated with sex or age.

Table 7a: Odds ratios (and 95% CI) of risk factors associated with severe upper airway obstruction (missing data is excluded)

	OR (95%CI)	Wald p-value
Prior intubation	12.417 (1.355, 113.790)	0.026
History of croup	0.271 (0.102, 0.717)	0.009
Prodromal fever	2.496 (1.311, 4.752)	0.005
Prodromal sore throat	3.970 (1.891, 8.334)	<0.001
Prodromal rhinorrhea	1.886 (0.979, 3.632)	0.058
Any presenting barky cough	0.482 (0.234, 0.995)	0.048
Prodromal non-barky cough	2.815 (1.430, 5.542)	0.003
Any presenting non-barky cough	6.187 (1.841, 20.791)	0.014
Combined non-barky cough	2.973 (1.409, 6.271)	0.004
Prodromal obstructive stridor	4.136 (2.008, 8.522)	<0.001
Any presenting stridor	4.272 (1.927, 9.474)	<0.001
Combined obstructive stridor	4.430 (2.071, 9.476)	<0.001
Prodromal obstructive indrawing	12.585 (5.636, 28.104)	<0.001
Any presenting indrawing	8.574 (3.833, 19.183)	<0.001
Combined obstructive indrawing	16.834 (6.252, 45.328)	<0.001
Prodromal obstructive cyanosis	34.385 (4.228, 279.626)	0.001
Any presenting cyanosis	18.857 (3.950, 90.029)	<0.001

Combined obstructive cyanosis	21.353 (4.518, 100.913)	<0.001
Presenting decreased level of consciousness	13.279 (4.106, 42.944)	<0.001
Presenting croup score	1.351 (1.125, 1.624)	0.001
Presenting respiratory rate (breaths per minute)	1.058 (1.027, 1.090)	<0.001
Presenting heart rate (beats per minute)	1.023 (1.009, 1.038)	0.002
Presenting O2 saturation (%)	0.873 (0.800, 0.953)	0.002
Presenting temperature (C)	1.272 (0.929, 1.741)	0.134

A sensitivity analysis was conducted to assess the effects of missing data from the dichotomous risk factors (Table 7b). With the exception of history of croup, the results did not differ substantially when missing data was excluded from the analysis versus included as a non-event. The change in significance of history of croup likely occurred due to the amount of missing data, as only 75 children had history of croup recorded in their medical chart. In order to maximize the data available, the missing data were coded as a non-event and this was used to fit the multivariate model.

Table 7b: Odds ratios (and 95% CI) of dichotomous risk factors associated with severe upper airway obstruction (missing data coded as no)

	OR (95% CI)	Wald p-value
History of croup	1.229 (0.587, 2.575)	0.584
Any presenting barky cough	0.333 (0.171, 0.647)	0.001
Any presenting non-barky cough	4.511 (1.365, 14.908)	0.014
Combined non-barky cough	2.502 (1.280, 4.889)	0.007
Prodromal obstructive stridor	3.818 (1.885, 7.732)	<0.001
Any presenting stridor	3.338 (1.650, 6.754)	0.001
Prodromal obstructive indrawing	12.702 (5.689, 28.359)	<0.001
Any presenting indrawing	6.574 (3.212, 13.456)	<0.001
Combined obstructive indrawing	13.661 (5.740, 32.512)	<0.001
Prodromal obstructive cyanosis	31.186 (3.842, 253.061)	0.001
Any presenting cyanosis	17.619 (3.716, 83.542)	<0.001
Combined obstructive cyanosis	19.854 (4.231, 93.151)	<0.001
Presenting decreased level of consciousness	13.447 (4.186, 43.202)	<0.001

MULTIVARIATE LOGISITIC REGRESSION MODELING

At the end of modeling the dichotomous risk factors, the risk factors included in the model were: prodromal sore throat, presenting indrawing, presenting barky cough, prodromal rhinorrhea and presenting decreased level of consciousness. Any presenting stridor confounded the relationship between presenting indrawing and severe upper airway obstruction and was retained in the multivariate model in the next step. Finally, presenting oxygen saturation was the only other risk factor that was retained when the continuous risk factors were assessed.

In the final multivariate model, there were two significant risk factors that were positively associated with developing severe upper airway obstruction and one that was negatively associated (Table 8). After controlling for other factors, children with a prodromal sore throat (i.e.: sore throat prior to presenting at the Emergency Department) were seven times more likely to develop severe upper airway obstruction (OR 7.131 [95% CI: 1.927, 26.397]). Children who present with any indrawing were at significantly higher risk for developing severe upper airway obstruction (OR 9.530 [95% CI: 2.561, 35.456]) after adjusting for other factors. The third factor, presenting oxygen saturation level, was significantly protective against developing severe upper airway obstruction (OR 0.860 [95% CI: 0.753, 0.983]). That is, children who presented with a higher percent oxygen saturation level were significantly less likely to develop severe upper airway obstruction. In the adjusted analysis, one factor was approaching significantly protective: barky cough at presentation (OR 0.355 [95% CI: 0.111, 1.010]. After controlling for other risk factors and most likely due to observations with missing oxygen saturation that were

excluded from the final model (n=69), prodromal rhinorrhea and presenting level of consciousness were no longer significant. Any presenting stridor confounded the relationship between presenting indrawing and severe upper airway obstruction. Because of missing data in the oxygen saturation variable, the significance of confounders was assessed without oxygen saturation in the model. Prodromal rhinorrhea and presenting level of consciousness were significant in the model that did not contain oxygen saturation and for this reason were retained in the final model. The multivariate model was a good fit (p=0.705).

Table 8: Adjusted odds ratios (and 95% CI) of risk factors associated with severe upper airway obstruction using presenting signs*

	OR (95% CI)
Prodromal sore throat	7.131 (1.927, 26.397)
Any presenting indrawing	9.530 (2.561, 35.456)
Any presenting barky cough	0.355 (0.111, 1.010)
Presenting oxygen saturation	0.860 (0.753, 0.983)
Prodromal rhinorrhea	1.934 (0.665, 5.621)
Presenting decreased level of consciousness	2.143 (0.402, 11.427)
Any presenting stridor	2.084 (0.525, 8.266)

* For the croup signs that were measured at two time points (prodromally and at Emergency Department presentation), this model only includes croup signs measured at presentation. Prodromal risk factors that are only measured prodromally (sore throat, rhinorrhea) were included.

Sensitivity Analysis of Either Prodromal or Presenting Croup Symptoms

In the sensitivity analysis, the 'combined' croup signs for barky cough, non-barky cough, stridor, indrawing, and cyanosis were used in the model (i.e.: the croup sign occurred prodromally, at presentation to the Emergency Department, or at both time points). This is in contrast to the primary analysis described above that only included croup signs that were present when initially presenting to the Emergency Department. Risk factors that were included at the end of modeling the dichotomous

variables were: prodromal sore throat, combined indrawing, presenting decreased level of consciousness, and combined non-barky cough. Any presenting cyanosis confounded the relationship between decreased level of consciousness at presentation and developing severe upper airway obstruction and was retained in the multivariate model in the next step. Finally, presenting respiratory rate was the only other risk factor that was retained when the continuous risk factors were assessed.

There were three significant risk factors in the sensitivity analysis model that included combined risk factors instead of the presenting risk factors: prodromal sore throat (OR 9.390 [95% CI: 2.812, 31.359]), prodromal indrawing or indrawing at presentation (OR 19.443 [95% CI: 5.617, 67.305]), and presenting respiratory rate (OR 1.051 [95% CI: 1.010, 1.094]). After controlling for other risk factors and most likely due to observations with missing respiratory rate (n=23) that were excluded from the final model, decreased level of consciousness at presentation and combined non-barky cough were not significant; however, they were retained in the final model. The final sensitivity analysis multivariate model is described in Table 9 and was considered to be a good fit (p=0.109).

Table 9: Adjusted odds ratios (and 95% CI) of risk factors associated with severe upper airway obstruction using combined prodromal and presenting sings*

	OR (95% CI)
Prodromal sore throat	9.390 (2.812, 31.359)
Combined indrawing	19.443 (5.617, 67.305)
Presenting decreased level of consciousness	5.625 (0.971, 32.587)
Combined non-barky cough	2.682 (0.927, 7.755)
Presenting respiratory rate	1.051 (1.010, 1.094)
Combined cyanosis	2.284 (0.165, 31.568)

* This model contains the 'combined' variable where children could have the croup sign prodromally, at presentation to the Emergency Department, or at both time points. Prodromal risk factors that are only measured prodromally (sore throat, rhinorrhea) were included.

The detailed results appear in Appendix V.

CHAPTER 6

DISCUSSION

MAIN FINDINGS

In an effort to determine risk factors for severe upper airway obstruction due to croup or bacterial tracheitis, we conducted the first population-based case-control study of children with related symptoms who present to emergency departments in Alberta. Children who present to the emergency department with prodromal sore throat and indrawing are at significantly higher risk for developing severe upper airway obstruction, while children with higher oxygen saturation are less likely to develop such obstruction. Children with a history of croup are significantly less likely to develop severe upper airway obstruction because these children are likely to be presenting with spasmodic croup, a less severe form of the disease. The results may assist emergency physicians and pediatricians in identifying children who are at greater risk for developing severe upper airway obstruction and those children who can be treated in the emergency department and discharged safely.

In the univariate analysis, two patient characteristics were associated with severe upper airway obstruction. The odds of developing severe upper airway obstruction were significantly higher among children who had been previously intubated and significantly lower among children with a previous history of croup. While this may seem counterintuitive, croup is often defined as spasmodic or acute LTB. Spasmodic croup is thought to be less severe than acute LTB. Children with a previous history of croup are more likely to suffer an additional episode of spasmodic croup, the milder form of the disease, as opposed to acute LTB. The role of prior intubation and history of croup warrant further examination as risk factors for severe upper airway obstruction due to viral croup or bacterial tracheitis.

Symptoms associated with the presenting upper airway obstruction were significantly worse among children who subsequently developed severe upper airway obstruction. In the multivariate model, we included the individual symptoms rather than the composite croup score. In our sample, the median croup score among children with severe upper airway obstruction was significantly higher than those without severe upper airway obstruction. We did not use the Westley croup score, a validated croup score that is often used in prospective croup research and was not applicable to this study because data were collected retrospectively.[53] The croup score we used appears to be sensitive to the true differences in croup severity among children with and without severe upper airway obstruction. This statement is supported by the consistent findings that the components of the croup score were significantly different among the two groups.

In an adjusted analysis, significant risk factors for severe upper airway obstruction included presence of sore throat and presence of indrawing at presentation to the emergency department. Increased oxygen saturation at presentation was protective against developing severe upper airway obstruction. Indrawing is a key symptom of croup and a useful diagnostic characteristic.[53] Sore throat is a symptom of croup and it is characteristic of bacterial tracheitis[98] because of tenderness with pressure on the upper airway. Sore throat warrants further examination in future research, as very young children will not be able to communicate this symptom. This risk factor may only be significant for older children. The presence of a barky cough as a protective factor was approaching statistical significance and may be clinically significant. That is, children with a barky cough were significantly less likely to

develop severe upper airway obstruction. A possible explanation for this finding is that children with severe upper airway obstruction are too sick to cough. An alternative explanation is that this is an artifact of charting. It may be that children who present with a more severe form of upper airway obstruction are less likely to have 'barky cough' recorded on their chart because the diagnosis is more obvious due to marked signs and symptoms and not because barky cough is truly absent. Children with marked stridor, cyanosis, reduced oxygen saturation, and altered level of consciousness may be unable to cough. For this reason, having a barky cough may be indicative of a more mild form of upper airway obstruction. Obstructive stridor confounded the relationship between indrawing and severe upper airway obstruction. Both indrawing and stridor are key characteristics of serve upper airway obstruction and it would be expected that children who had one sign would also have the other. Stridor occurs when there is airway inflammation and breathing becomes more labored. The increased use of chest muscles to aid breathing (i.e.: indrawing) would be expected in children with severe upper airway obstruction.

The sensitivity analysis in which we included the 'combined' croup sign (i.e.: when children could have the croup sign prodromally, at presentation to the Emergency Department, or at both time points), produced somewhat similar results as the primary analysis. In both models, prodromal sore throat and indrawing were significant risk factors for severe upper airway obstruction. Although both models initially contained a cough risk factor (barky cough in the primary analysis and non-barky cough in the sensitivity analysis), neither cough risk factor was significant after controlling for other risk factors and observations with missing data in the continuous

risk factors were excluded. In the primary analysis, increased oxygen saturation was protective against developing severe upper airway obstruction, while increased respiratory rate was a risk factor in the sensitivity analysis. If children are able to take in more oxygen, their respiratory rate would decrease so the importance of airflow as related to severe upper airway obstruction is similar in both models. The other risk factors included in both models were not significant. Both models were considered good fits according to the Hosmer-Lemeshow goodness-of-fit statistic.

SIMILAR STUDIES

Two previous studies have attempted to identify risk factors for severe croup.[35 83] Both studies limited case definition to include only severe croup and not bacterial tracheitis. Our results are in concordance with Wagener but contrast those of Chan. Similar to our findings, Wagener found that children who presented with more severe symptoms were significantly more likely to develop severe croup. Chan concluded that among their 18 cases of severe croup, older age (12-24 months) and fever significantly predicted severe croup. In our study, children who developed severe upper airway obstruction were significantly more likely to have had a prodromal fever but there was no difference in presenting temperature. Prodromal fever was present when parents answered affirmatively when asked if their child has had a fever; whereas presenting temperature would have been recorded by a health care practitioner in the emergency department. In contrast to previous literature, age was not a significant risk factor for severe upper airway obstruction.[35] Similar to our results, neither study reported sex as a risk factor for severe upper airway obstruction.

We used a different definition of severe upper airway obstruction than Chan and Wagener. Chan identified children to have severe croup when they exhibited stridor at rest with marked recession associated with central cyanosis or altered level of consciousness and Wagener defined severe croup as children with stridor and sternal and chest wall retractions on admission. Based on our definition of severe upper airway obstruction, it is possible that our cases were more "severe" than those of Chan and Wagener. Also, our definition of controls differed. In both Chan and Wagener's studies, controls were children that were hospitalized due to croup, whereas we chose to use children with croup who presented to an Emergency Department as controls. Overall, it is likely that our study has a greater disparity in disease severity and thus, it may have been easier for us to identify risk factors. However, because our objective was to identify risk factors for severe upper airway obstruction in children who present to the Emergency Department and not among hospitalized children, our study may not be comparable to that of Chan and Wagener.

STRENGTHS

To the best of our knowledge, this is the first study to examine risk factors for severe upper airway obstruction among children who presented to the emergency department in a population based study. This topic is poorly researched, as only two other studies have examined this topic. As such, this research substantially adds to what is currently known about risk factors for severe upper airway obstruction. Previously studies have examined risk factors for severe croup. Severe upper airway obstruction can be caused by other diseases and for this reason, we chose to not only

include children with croup, but also those with bacterial tracheitis. Half of our cases were diagnosed with bacterial tracheitis as opposed to severe croup, thus it is evident that bacterial tracheitis is an important cause of severe upper airway obstruction and warrants further investigation.

LIMITATIONS

There are several limitations associated with this study. The primary limitation is that the data were collected by conducting a retrospective chart review and therefore the data are incomplete and subject to evolving charting techniques. In an effort to determine the effects of the missing data among dichotomous risk factors, we conducted a sensitivity analysis. The initial analysis was conducted where missing data was excluded; for the sensitivity analysis, the missing data was treated as a non-event. For example, where the presence of barky cough was not recorded, it was assumed the child did not have a barky cough. With the exception of history of croup, the odds ratios were not substantially different. In order to maximize power of the multivariate model, the "non-missing" variables were used. Sensitivity analysis for missing data was not carried out for continuous variables.

Observational studies are subject to many different types of bias. There is a chance that misclassification of case and control status may have occurred. A component of our definition of severe upper airway obstruction stated that children with severe croup must have been intubated; if this was done but not recorded on the chart and then this potential case would have been classified as a control. However, it is unlikely that an intubation would not be recorded on a medical chart. Because

there are thousands children who present to the emergency departments with croup in Alberta each year and we only chose three controls for each case, it is likely that this misclassified control would not be identified. We individually reviewed and audited each potential case chart; therefore, it is extremely unlikely that a case of severe croup would have been incorrectly excluded and perceived as a control. Intubation was not a component of the bacterial tracheitis definition and therefore there is a greater chance we missed identifying a case of bacterial tracheitis. We identified potential cases and controls from administrative databases and if those responsible for assigning disease and procedural ICD 9/10 codes miscoded a chart, then this would result in misclassification of cases and/or as controls. We were unable to control for this possibility; however, the misclassification is likely to be non-differential and biases our results to the null.

There is an association between the increased use of corticosteroid treatment for croup and decreased hospitalization rates. This chart review examined cases of severe upper airway obstruction from 1994-2004 and during this time period, first-line croup treatment was undergoing a transition as corticosteroids gained widespread use. Therefore, a child presenting in 1994 with the exact same risk factors as a child in 2004 may have a different outcome because of the change in treatment standards. In 1994, a child presenting to emergency department may not have received corticosteroid treatment and as such, their croup episode progressed to severe upper airway obstruction and the child was intubated and for the purpose of this study, defined as a case. By contrast, in 2004, an identical child with the same characteristics may have presented to the emergency department and received

corticosteroids. This child may have improved and been discharged home and thereby met the definition of a control. The effectiveness of steroid treatment may have caused a time bias, as children that presented to the emergency department during the earlier years of this retrospective chart review may have been more likely to become a case than those who presented later with the same symptoms. This is likely not a problem for children with bacterial tracheitis because they do not respond to corticosteroid (or any other croup) treatment. [36]

Data were extracted over a 10 year time period and the information collected on the medical charts has changed in this time frame. For example, it is only relatively recently that nurses asked if a child's immunizations were up-to-date. As such, it is not possible to obtain complete data on this potential risk factor. Also, other risk factors for severe upper airway obstruction were not recorded on medical charts. Children with Aboriginal heritage are at higher risk for many diseases; however, in Alberta, First Nations status is only recorded in medical charts if the child resides on a reserve and has a treaty number.

While we initially intended to analyze the severity of presenting symptoms, this was not possible because there were not enough children who presented with severe versus less severe symptoms. To overcome this limitation of the data, we collapsed the symptom severity gradient to presence or absence of the symptom. As such, we were unable to use the information regarding symptom severity.

We collected data on numerous potential patient characteristic risk factors. Unfortunately, there were no or infrequent events for several of these potential risk factors, such as Down's syndrome, to allow for the assessment of these variables in

our model. It could be that some co-morbidities were not recorded on the patient chart.

Feasibility and resource limitations prevented us from examining all cases of severe upper airway obstruction in Alberta. There were two situations where we could not identify any appropriate controls and these cases were removed from the dataset. We included all cases from Edmonton and Calgary; the two largest urban centers in Alberta and the only cities with a children's hospital. Children who were transferred to either childrens' hospital were also included. Thus, it is unlikely that by restricting our population to Edmonton and Calgary that we excluded a large proportion of severe upper airway obstruction cases because it is unlikely that a small community hospital would have treated a child with a severe upper airway obstruction at their site, rather than transfer them to one of the children's hospitals to receive the required specialized care. There were two cases in Camrose that we did not include and a potential case in Medicine Hat although we do not know if this potential case would have met our case definition. We were also unable to ensure we had not missed any cases of severe upper airway obstruction by reviewing the admission logs, as only Alberta Children's Hospital kept admission logs for a portion of the study period and Stollery Children's Hospital did not keep such logs. We also did not review the coroner reports over the study period and as such, we would have inadvertently excluded any child with severe upper airway obstruction who died at home without being seen in an emergency department. We do not believe that the reduction in potential sample size left our study underpowered. Proportion of previous intubation was used to determine the sample size and there were

significantly more children with severe upper airway obstruction who had been previously intubated than children who did not develop severe upper airway obstruction.

We established a definition of severe upper airway obstruction for the purpose of this study. Others may define severe upper airway obstruction using different criteria, such as children requiring hospitalization. Therefore a portion of the children that we classified as controls may have been cases according to alternative case definitions. The risk factors that we identified are risk factors for our definition of severe upper airway obstruction.

IMPLICATIONS AND FUTURE RESEARCH

Our results identified several risk factors for developing severe upper airway obstruction; however, the majority of the risk factors were severity of signs at presentation. It is intuitive to expect that children with marked symptoms are more likely to develop severe upper airway obstruction. From a clinical perspective, it would be more useful to identify specific patient characteristics that are associated with developing severe upper airway obstruction. In case-series, researchers have found common patient characteristics among children with severe upper airway obstruction, such as Down's syndrome, and we were unable to confirm those findings.

Future research should be conducted in a prospective manner. Due to the low incidence of severe upper airway obstruction, this may seem like a daunting task. However, a large research network, such as Pediatric Emergency Research Canada,

would be capable of carrying out such research in a reasonable time frame. Prospective research would allow for more complete data collection. Missing data was a limitation of this dataset, as only 126 of 202 children were included in the final analysis. Specifically, when recorded in the chart, the history of croup was protective against developing severe upper airway obstruction. When the missing data were treated as no previous history of croup, it was no longer significant. Unfortunately, this risk factor was poorly recorded and the amount of missing data prevented this protective factor from being included in the final model. If history of croup truly is protective against developing severe upper airway obstruction, this is a factor that is easily determined by physicians during the initial exam. If the presenting child has a history of previous croup, this information may change the physician's perception as to the likelihood of the child developing severe upper airway obstruction. Future research is needed to determine if previous croup is a protective factor.

REFERENCE LIST

1. Feigin RD, Cherry J, Demmler GJ, Kaplan S (editors). Textbook of Pediatric Infectious Diseases, 5th Edition. W.B. Saunders Company, 2003.

2. Welliver RC, Sun M, Rinaldo D. Defective regulation of immune response in croup due to parainfluenza virus. Pediatr Res 1985; 19(7):716-20.

3. Hide DW, Guyer BM. Recurrent croup. Arch Dis Child 1985; 60(6):585-6.

4. Kairys SW, Olmstead EM, O'Connor GT. Steroid treatment of laryngotracheitis: A meta-analysis of the evidence from randomized trials. Pediatrics 1989; 83(5):683-93.

5. Brown JC. The management of croup. Br Med Bull 2002; 61:189-202.

6. Rajah J, Riera-Fanego J, Keeton J *et al.* Do steroids prevent reintubation in children with laryngotracheobronchitis? Critical Care (London) 2000; 4(5):314-8.

7. Dykes J. Managing children with croup in emergency departments. Emerg Nurse 2005; 13(6):14-9.

8. Henneveld HT, Tobe TJ. Inspiratory stridor: an ominous sign. Lancet 2003; 362:1583.

9. King L. Pediatrics, Croup or Laryngotracheobronchitis. Http://Www.Emedicine.Com/Emerg/Topic370.Htm 2006.

10. Ewig JM . Croup. Pediatr Ann 2002; 31(2):125-30.

11. McIntosh K, McAdam AJ. Human metapneumonvirus- an important new respiratory virus. N Engl J Med 2004; 350(5):443-50.

12. Cressman WR, Myer III CM. Diagnosis and management of group and epiglottitis. Pediatr Clin North Am 1994; 41(2):265-76.

13. Knutson D, Aring A. Viral croup. Am Fam Physician 2004; 69 (3):535-40.

14. Postma DS, Jones RO, Pillsbury HC3. Severe hospitalized croup: treatment trends and prognosis. Laryngoscope 1984; 94(9):1170-5.

15. Johnson DW, Williamson J. Croup: duration of symptoms and impact on family function. Pediatr Res 2001; (49):83A.

16. Leung AK, Kellner JD, Johnson DW. Viral croup: a current perspective. J Pediatr Health Care 2004; 18(6):297-301.

17. Denny FW, Clyde WA Jr. Acute lower respiratory tract infections in nonhospitalized children. J Pediatr 1986; 108(5 Pt 1):635-46.

18. Van Bever HP, Wieringa MH, Weyler JJ, Nelen VJ, Fortuin M, Vermeire PA. Croup and recurrent croup: their association with asthma and allergy. An epidemiological study on 5-8-year-old children. Eur J Pediatr 1999; 158(3):253-7.

19. Denny FW, Murphy TF, Clyde WA Jr, Collier AM, Henderson FW. Croup: an 11-year study in a pediatric practice. Pediatrics 1983; 71(6):871-6.

20. Cherry JD. State of the evidence for standard-of-care treatments for croup: are we where we need to be? Pediatr Infect Dis J 2005; 24(11 Suppl):S198-202.

21. Segal AO, Crighton EJ, Moineddin R, Mamdani M, Upshur RE. Croup hospitalizations in Ontario: a 14-year time-series analysis. Pediatrics 2005; 116(1):51-5.

22. Malhotra A, Krilov LR. Viral croup. [erratum appears in Pediatr Rev 2001 Sep;22(9):292]. Pediatr Rev 2001; 22(1):5-12.

23. Geelhoed GC. Sixteen years of croup in a Western Australian teaching hospital: effects of routine steroid treatment. Ann Emerg Med 1996; 28(6):621-6.

24. Zach M, Erben A, Olinsky A. Croup, recurrent croup, allergy, and airways hyper-reactivity. Arch Dis Child 1981; 56:336-41.

25. Koning P. The relationship between croup and asthma. Ann Allergy 1978; 41:227-31.

26. Limanovitch M, Kivity S, Soferman R, Topilsky M. The relationship between recurrent croup and airway hyperreactivity. Ann Allergy 1990; 65:239-41.

27. Pearlman DS. The relationship between allergy and croup. Allergy Proc 1989; 10:227-31.

28. Zach MS, Schnall PR, Landau LI. Upper and lower airway hyperreactivity in recurrent croup. Am Rev Respir Dis 1980; 121:979-83.

29. Castro-Rodriguez JA, Holberg CJ, Morgan WJ *et al.* Relation of two different subtypes of croup before age three to wheezing, atopy, and pulmonary function during childhood: a prospective study. Pediatrics 2001; 107(3):512-8.

30. Statistics Canada. Community Profiles- Edmonton. Http://Www12.Statcan.Ca/English/Profil01/CP01/Details/Page.Cfm?Lang=E&Geo1=CMA&Code1=835__&Geo2=PR&Code2=48&Data=Count&SearchText=Edmonton&SearchType=Begins&SearchPR=48&B1=All&Custom= 2006.

31. Statistics Canada. Community Profiles- Calgary. Http://Www12.Statcan.Ca/English/Profil01/CP01/Details/Page.Cfm?Lang=E&Geo1=HR&Code1=4822&Geo2=PR&Code2=48&Data=Count&SearchText=Calgary&SearchType=Begins&SearchPR=48&B1=All&Custom= 2006.

32. Fitzgerald DA, Kilham HA. Croup: assessment and evidence-based management. Med J Aust 2003; 179(7):372-7.

33. McEniery J, Gillis J, Kilham H, Benjamin B. Review of intubation in severe laryngotracheobronchitis. Pediatrics 1991; 87(6):847-53.

34. Adderley RJ, Mullins GC. When to extubate the croup patient: the "leak" test. Can J Anaesth 1987; 34:304-6.

35. Chan PW. Risk factors associated with severe viral croup in hospitalised Malaysian children. Singapore Med J 2002; 43(3):124-7.

36. Donnelly BW, McMillan JA, Weiner LB. Bacterial tracheitis: report of eight new cases and review. Rev Infect Dis 1990; 12(5):729-35.

37. Hilton JM, Fitzgerald DA, Cooper DM. Respiratory morbidity of hospitalized children with Trisomy 21. J Paediatr Child Health 1999; 35(4):383-6.

38. Duynstee ML, de Krijger RR, Monnier P, Verwoerd CD, Verwoerd-Verhoef HL. Subglottic stenosis after endolaryngeal intubation in infants and children: result of wound healing processes. Int J Pediatr Otorhinolaryngol 2002; 62 :1-9.

39. Mansel JK, Stogner SW, Petrini MF, Norman JR. Mechanical ventilation in patients with acute severe asthma. Am J Med 1990; 89:42-8.

40. Dales RE, Munt PW. Use of mechanical ventilation in adults with severe asthma. Can Med Assoc J 1984; 130:391-5.

41. Roberts JS, Bratton SL, Brogan TV. Acute severe asthma: differences in therapies and outcomes among pediatric intensive care units. Crit Care Med 2002; 30:581-5.

42. MacMillan HL, MacMillan AB, Offord DR, Dingle JL. Aboriginal health. CMAJ 1996; 155(11):1569-78.

43. Evers S, Orchard J, McCracken E. Lower respiratory disease in Indian and non-Indian infants. Can J Public Health 1985; 76:195-8.

44. Marcos Alonso S, Molini Menchon N, Rodriguez Nunez A, Martinon Torres F, Martinon Sanchez JM. [Bacterial tracheitis: an infectious cause of upper airway obstruction to be considered in children]. [Spanish]. Anales De Pediatria 2005; 63(2):164-8.

45. Howard JB, McCracken GH Jr, Luby JP. Influenza A2 virus as a cause of croup requiring tracheotomy. J Pediatr 1972; 81(6):1148-50.

46. Jones R, Santos JI, Overall JC Jr. Bacterial tracheitis. JAMA 1979; 242(8):721-6.

47. Rosekrans JA. Viral croup: current diagnosis and treatment. Mayo Clin Proc 1998; 73(11):1102-6; discussion 1107.

48. Mahajan A, Alvear D, Chang C, Warren WS, Varma BK. Bacterial tracheitis, diagnosis and treatment. Int J Pediatr Otorhinolaryngol 1985; 10(3):271-7.

49. Han BK, Dunbar JS, Striker TW. Membranous laryngotracheobronchitis (membranous croup). Am J Roentgenol 1979; 133(1):53-8.

50. Stroud RH, Friedman NR. An update on inflammatory disorders of the pediatric airway: epiglottitis, croup, and tracheitis. Am J Otolaryngol 2001; 22(4):268-75.

51. Bernstein T, Brilli R, Jacobs B. Is bacterial tracheitis changing? A 14-month experience in a pediatric intensive care unit. Clin Infect Dis 1998; 27(3):458-62.

52. Britto J, Habibi P, Walters S, Levin M, Nadel S. Systemic complications associated with bacterial tracheitis. Arch Dis Child 1996; 74(3):249-50.

53. Westley CR, Cotton EK, Brooks JG. Nebulized racemic epinephrine by IPPB for the treatment of croup: a double-blind study. Am J Dis Child 1978; 132(484-7).

54. Gold DR, Burge HA, Carey V, Milton DK, Platts-Mills T, Weiss ST. Predictors of repeated wheeze in the first year of life: the relative roles of cockroach, birth weight, acute lower respiratory illness, and maternal smoking. Am J Respir Crit Care Med 1999; 160(1):227-36.

55. Rotta AT, Wiryawan B. Respiratory emergencies in children. Respiraotry Care 2003; 48(3):248-58.

56. Eckel HE, Widemann B, Damm M, Roth B. Airway endoscopy in the diagnosis and treatment of bacterial tracheitis in children. Int J Pediatr Otorhinolaryngol 1993; 27(2):147-57.

57. Donaldson JD, Maltby CC. Bacterial tracheitis in children. J Otolaryngol 1989; 18(3):101-4.

58. Al-Mutairi B, Kirk V. Bacterial tracheitis in children: Approach to diagnosis and treatment. J Paediatr Child Health 2004; 9(1):25-30.

59. Chin R, Browne GJ, Lam LT, McCaskill ME, Fasher B, Hort J. Effectiveness of a croup clinical pathway in the management of children with croup presenting

to an emergency department. J Paediatr Child Health 2002; 38(4):382-7.

60. Neto GM, Kentab O, Klassen TP, Osmond MH. A randomized controlled trial of mist in the acute treatment of moderate croup. Acad Emerg Med 2002; 9:873-9.

61. Scolnik D, Coates AL, Stephens D, Da Silva Z, Lavine E, Schuh S. Controlled delivery of high vs low humidity vs mist therapy for croup in emergency departments: a randomized controlled trial. JAMA 2006; 295:1274-80.

62. Moore M, Little P. Humidified air inhalation for treating croup. Cochrane Database Syst Rev 2006; 3:CD002870.

63. Kristjansson S, Berg-Kelly K, Winso E. Inhalation of racemic adrenaline in the treatment of mild and moderately severe croup. Clinical symptom score and oxygen saturation measurements for evaluation of treatment effects. Acta Paediatr 1994; 83(11):1156-60.

64. Johnson D. Croup. Clin Evid 2004; 11:1-26.

65. Russell K, Wiebe N, Saenz A *et al.* Glucocorticoids for croup.[update of Cochrane Database Syst Rev. 2000;(2):CD001955; PMID: 10796674]. Cochrane Database of Systematic Reviews 2004; (1):CD001955.

66. Adair JC, Ring WH, Jordan WS, Elwyn RA. Ten-year experience with IPPB in the treatment of acute laryngotracheobronchitis. Anesth Analg 1971; 50(4):649-55.

67. Klassen TP, Craig WR, Moher D *et al.* Nebulized budesonide and oral dexamethasone for treatment of croup: A randomized controlled trial. JAMA 1998; 279(20):1629-32.

68. Donaldson D, Poleski D, Knipple E *et al.* Intramuscular versus oral dexamethasone for the treatment of moderate-to-severe croup: a randomized, double-blind trial. Acad Emerg Med 2003; 10:16-21.

69. Rittichier KK, Ledwith CA. Outpatient treatment of moderate croup with dexamethasone: intramuscular versus oral dosing. Pediatrics 2000; 106:1344-8.

70. Geelhoed GC, Macdonald WB. Oral and inhaled steroids in croup: a randomized, placebo-controlled trial. Pediatr Pulmonol 1995; 20(6):355-61.

71. Ledwith CA, Shea LM, Mauro RD. Safety and efficacy of nebulized racemic epinephrine in conjunction with oral dexamethasone and mist in the outpatient treatment of croup. Ann Emerg Med 1995; 25(3):331-7.

72. Tibballs J, Shann FA, Landau LI. Placebo-controlled trial of prednisolone in children intubated for croup. Lancet 1992; 340:745-8.

73. Liston SL, Gehrz RC, Siegel LG, Tilelli J. Bacterial tracheitis. Am J Dis Child 1983; 137(8):764-7.

74. Kasian GF, Bingham WT, Steinberg J *et al.* Bacterial tracheitis in children. CMAJ 1989; 140(1):46-50.

75. Chapman RS, Henderson FW, Clyde WA Jr, Collier AM, Denny FW. The epidemiology of tracheobronchitis in pediatric practice. Am J Epidemiol 1981; 114 (6):786-97.

76. Dansky R, Buchanan N, Cane RD. The I.C.U. treatment of acute laryngotracheobronchitis in a developing country. Intensive Care Med 1978; 4(1):51-3.

77. Dawson KP, Mogridge N, Downward G. Severe acute laryngotracheitis in Christchurch 1980-90. N Z Med J 1991; 104(919):374-5.

78. Durward AD, Nicoll SJ, Oliver J, Tibby SM, Murdoch IA. The outcome of patients with upper airway obstruction transported to a regional paediatric intensive care unit. Eur J Pediatr 1998; 157(11):907-11.

79. Freezer N, Butt W, Phelan P. Steroids in croup: do they increase the incidence of successful extubation? Anaesth Intens Care 1990; 18:224-8.

80. Sendi K, Crysdale WS, Yoo J. Tracheitis: outcome of 1,700 cases presenting to the emergency department during two years. J Otolaryngol 1992; 21(1):20-4.

81. Tan AK, Manoukian JJ. Hospitalized croup (bacterial and viral): the role of rigid endoscopy. J Otolaryngol 1992; 21(1):48-53.

82. Freezer N, Butt W, Phelan P. Steroids in croup: do they increase the incidence of successful extubation? Anaesth Intens Care 1990; 18:224-8.

83. Wagener JS, Landau LI, Olinsky A, Phelan PD. Management of children hospitalized for laryngotracheobronchitis. Pediatr Pulmonol 1986; 2:159-62.

84. Gallagher PG, Myer III CM. An approach to the diagnosis and treatment of membranous laryngotracheobronchitis in infants and children. Pediatr Emerg Care 1991; 7(6):337-42.

85. Hopkins A, Lahiri T, Salerno R, Heath B. Changing epidemiology of life-threatening upper airway infections: the reemergence of bacterial tracheitis. Pediatrics 2006; 118:1418-21.

86. Durward AD, Nicoll SJ, Oliver J, Tibby SM, Murdoch IA. The outcome of patients with upper airway obstruction transported to a regional paediatric intensive care unit. Eur J Pediatr 1998; 157(11):907-11.

87. Cant AJ, Gibson PJ, West RJ. Bacterial tracheitis in Down's syndrome. Arch Dis Child 1987; 62(9):962-3.

88. Finholt. Abstract. Anesthesiology 1984; A450.

89. Kaushal R, Bates DW, Landrigan C. Medication errors and adverse drug events in pediatric inpatients. JAMA 2001; 285:2114-20.

90. Walther FJ, Bruggeman C, Daniels-Bosman MS. Symptomatic and asymptomatic rotavirus infections in hospitalized children. Acta Paediatr Scand 1983; 72(659-63).

91. Zetterson R. Responses of children to hospitalization. Acta Paediatr Scand 1984; 73:289-95.

92. Henrickson KJ, Kuhn SM, Savatski LL. Epidemiology and cost of infection with human parainfluenza virus types 1 and 2 in young children. 1994; 18:770-9.

93. Langley JM, Wang EE, Law BJ *et al.* Economic evaluation of respiratory syncytial virus infection in Canadian children: a Pediatric Investigators Collaborative Network on Infections in Canada (PICNIC) study. J Pediatr 1997; 131:113-7.

94. Johnson DW, Jacobson S, Edney PC, Hadfield P, Mundy ME, Schuh S. A comparison of nebulized budesonide, intramuscular dexamethasone, and placebo for moderately severe croup. N Engl J Med 1998; 339:498-503.

95. Hintze J. NCSS and PASS. Number Cruncher Statistical Systems. Kaysville, Utah. www.ncss.com. 2001.

96. Bland JM, Altman DG. Statistics notes: matching. BMJ 1994; 309:1128.

97. SPSS 14.0. copyright SPSS Inc. 1989-2005.

98. Rajan S, Clark K. Bacterial Tracheitis. http://www.emedicine.com/ped/topic200.htm; Accessed September 29, 2006.

APPENDIX I: Literature Search

Medline and Embase were searched using the search strategies described below.

Medline: Croup and Bacterial Tracheitis
Searched on March 28, 2006

1. exp Croup/cl [Classification]
2. Croup/cl, ep, et, vi [Classification, Epidemiology, Etiology, Virology]
3. 1 or 2
4. exp Croup/
5. croup.mp.
6. 4 or 5
7. limit 6 to "etiology (optimized)"
8. limit 7 to ("therapy (optimized)" or "diagnosis (optimized)" or "prognosis (optimized)")
9. exp Risk Factors/
10. risk.mp. or exp Risk/
11. predict$.mp.
12. 9or 10.mp. or 11 [mp=title, original title, abstract, name of substance word, subject heading word]
13. 9 or 10 or 11
14. 6 and 13
15. 3 or 7 or 8 or 14
16. exp Tracheitis/ep, et, vi [Epidemiology, Etiology, Virology]
17. exp Tracheitis/
18. tracheitis.mp.
19. 17 or 18
20. limit 19 to ("therapy (optimized)" or "diagnosis (optimized)" or "etiology (optimized)" or "prognosis (optimized)")
21. 13 and 19
22. 21 or 20 or 16
23. 15 or 22

Embase: Croup and Bacterial Tracheitis
Searched on March 29, 2006

1. exp Tracheitis/ep, et [Epidemiology, Etiology]
2. tracheitis.mp.
3. tracheitis.mp. or exp TRACHEITIS/
4. limit 3 to ("diagnosis (optimized)" or "prognosis (optimized)" or "causation-etiology (optimized)" or "treatment (2 or more terms high sensitivity)")
5. 1 or 4
6. exp CROUP/et, ep [Etiology, Epidemiology]
7. exp CROUP/
8. croup.mp.
9. croup.mp. or exp CROUP/
10. limit 9 to ("diagnosis (optimized)" or "prognosis (optimized)" or "causation-etiology (optimized)" or "treatment (2 or more terms high sensitivity)")
11. 6 or 10
12. 5 or 11

APPENDIX II: Definitions of Collected Risk Factors

Patient demographics:
- Age (continuous)
- Sex (dichotomous)
- Aboriginal status (dichotomous): band number on the admission chart will identify Aboriginal children living in a reserve.

Patient health history:
- Presence of other conditions or co-morbidities and croup history (dichotomous and categorical): will include co-morbidities that increase the risk of developing severe croup. These include fever at presentation (>38.0C), prematurity, Down's syndrome, chronic disease, immune deficiency, cardiac anomalies, congenital stridor, and history of previous intubation.

Recent medication:
- Medication use within the previous 14 days (dichotomous) and treatment details (categorical and continuous). Medications will include over-the-counter treatments and prescribed antibiotics. The use of vitamins will not be collected.

Initial symptoms and obstructive history:
- List of symptoms (dichotomous) as presented on the admission chart. To obtain the most complete description of initial symptoms, triage notes, nursing notes, and physician notes all recorded within the first hour of presentation were used. When discrepancies existed, the most severe (or worst case) value was recorded.

Croup symptoms:
- Presence of barky cough, stridor, indrawing, cyanosis, and/or level of consciousness (dichotomous).

Physiological assessment:
- Symptom severity (ordinal)
- Croup score (continuous): modified Westley score (indrawing, stridor, cyanosis, and level of consciousness). The indrawing and stridor the scores range from 0-2. Cyanosis is documented as 0 (absent) or 1 (present). Level of consciousness is scored as 0 (normal) or 5 (disoriented). The maximum croup score is 10.
- Temperature (ordinal),
- Respiratory rate (continuous)
- Heart rate (continuous)
- Blood pressure (continuous)
- NOTE: in instances where physiological measurements are recorded more than once within an hour, the worst values obtained at presentation will be used in the analysis.
- NOTE: the physiological assessment will be recorded at presentation, any time the child worsens, and transferring to a different unit. Worsening was defined as the croup score increased by 2 or more points and this was likely to be linked to an event, such as intubation.

X-ray results:

Neck and chest x-ray (categorical)
NOTE: X-ray results that document the position of a feeding tube or intubation tube will not be recorded.
Laboratory results:
Laboratory tests (continuous): bacterial culture/testing methods, viral culture/testing methods, CBC, blood culture, and gases (arterial, capillary, and blood)
NOTE: in instances where physiological measurements are recorded more than once in a chart, the first values obtained at presentation will be used in the analysis. In addition, laboratory results were collected when the child worsened (defined as an increase of at least two points on the Croup Score).
Cause of croup:
List of organisms (categorical): such as Staph aureus, Group A Streptococcus, Pneumonoccus, H Flu Non B, H Flu B, Nisseria, Brahamellis, and Klebisella. Where the organism was isolated from (serum, sputum, cerebral spinal fluid, wound, or other) will also be documented.

APPENDIX III: Sample Size Calculations

Option 1

Sample size calculation with the following parameters:

Number of cases: 50

Proportion of cases with previous history of intubation: 0.13 (derived from 5/38 in pilot data)

Proportion of controls with previous history of intubation: 0.02 (very conservative estimate derived from Alberta Croup database where 0/2958 of children with non-severe croup were intubated)

Alpha: 0.05 (two-sided)

Power	N1	N2	Ratio	P1	P2	Odds Ratio	Alpha	Beta
0.40393	50	50	1.00	0.13	0.02	0.137	0.05	0.59607
0.63747	50	100	2.00	0.13	0.02	0.137	0.05	0.36253
0.72421	50	150	3.00	0.13	0.02	0.137	0.05	0.27579
0.77254	50	200	4.00	0.13	0.02	0.137	0.05	0.22746
0.79695	50	250	5.00	0.13	0.02	0.137	0.05	0.20305
0.81337	50	300	6.00	0.13	0.02	0.137	0.05	0.18663

Option 2

Sample size calculation with the following parameters:

Number of cases: 50

Proportion of cases with previous history of intubation: 0.13 (derived from 5/38 in pilot data)

Proportion of controls with previous history of intubation: 0.01 (conservative estimate derived from Alberta Croup database where 0/2958 of children with non-severe croup were intubated)

Alpha: 0.05 (two-sided)

Power	N1	N2	Ratio	P1	P2	Odds Ratio	Alpha	Beta
0.50311	50	50	1.00	0.13	0.01	0.068	0.05	0.49689
0.74498	50	100	2.00	0.13	0.01	0.068	0.05	0.25502
0.82263	50	150	3.00	0.13	0.01	0.068	0.05	0.17737
0.86289	50	200	4.00	0.13	0.01	0.068	0.05	0.13711
0.88248	50	250	5.00	0.13	0.01	0.068	0.05	0.11752
0.89536	50	300	6.00	0.13	0.01	0.068	0.05	0.10464

APPENDIX IV: Data Collection Form

ABORT CHART REVIEW RATIONALE

Coding Error ☐ Croup ☐ Other Disease ☐

List Other Disease _____ Intubation ☐ Diagnosis_____

Coding Notes

SITE DEMOGRAPHICS Admit Date _____

Site ID _____ Site Name _____

ICD 9 Code _____ Flag Outcome _____

PATIENT DEMOGRAPHICS

ID _____ HRN _____ DOB _____

Age _____Gender _____ Race _____

PATIENT HEALTH HISTORY

Child has history or present condition of:

	Congenital Heart	Cancer History	Immuno History	Asthma History	Cong Anom History	Other History
History of or Present Condition						

Prematurity ☐

Prior Intubation ☐

Down's Syndrome ☐

Croup History		Recent Infections		Other Specify
Never	0	Sepsis	1	
ED Visit	1	Meningitis	2	
Admissions	2	Encephalitis	3	
ICU Admissions	3	Osteomyelitis	4	
ICU/Tube	4	Septic Arthritis	5	
		Pneumonia	6	
# episodes ☐		UTI	7	
		Super infection	8	

RECENT MEDICATIONS

Date	Drug	Route Neb 1 PO 2 IV 3 IM 4	Usual Dose	Duration of Treatment	Weight kgs

PRODROMAL AND OBSTRUCTIVE HISTORY

NB Cough ☐ Rhinnorhea ☐ Fever ☐ Other ☐

Onset Barky Cough ☐ Stridor ☐

Respiratory Distress ☐

ASSESSMENT THIS EPISODE

Date _____ **Time** _____

Assess	Location	Cough	Stridor	Indrawing	Cyanosis
Triage 1	ED 1	None 0	None 0	None 0	None 0
RN 2	Clinic 2	Non-Barky 1	Agitation 1	Mild 1	Noted 1
MD 3	ICU 3	Barky 2	At rest 2	Moderate 2	NR 9
Student 4	IP 4	NR 9	NR 9	Severe 3	
Unsure 9	Unsure 9			NR 9	

Croup Score ☐ RR ☐ HR ☐ O2 Sat ☐ BP ☐ Temp ☐

PHN ☐

Repeat for each visit

TREATMENT THIS EPISODE

Date	Time	Drug	Other Specify	Route	Units
		Racemic 1 Dexamethasone 2 Pulmicort 3 Antibiotics 4 Ventolin 5 Other 6		Neb 1 PO 2 IV 3 IM 4 Dose ☐	☐ Mgs ☐ Mls

Repeat for each treatment

XRAY RESULTS

Date	Type of Xray	Other List	Neck Results	Chest Results
	AP Lat Neck 1		Normal 0	Normal 0
	Chest 2		Consistent croup 1	Consistent viral illness 1
	Other 3		Consistent BT 2	Infiltrate 2
			Consistent Epi 3	Atelectasis 3
			Other 4	Other 4
			Inclusive 9	Inclusive 9

Repeat for each x-ray

LAB RESULTS

Date _____ **Time** _____

WBC	PMN	Bands	Lymphs	Monos	Reac ly	EOS
PO2	PCO2	pH	BE			

Repeat for each lab test

ISOLATION Of ORGANISMS

Organism Type	Pure Organism	Mixed Organism	Predominant Organism
Serum 1	Staph Aureus 1	Staph Aureus 1	Staph Aureus 1
Sputum 2	Grp A Strep 2	Grp A Strep 2	Grp A Strep 2
CSF 3	Pneumonoc 3	Pneumonoc 3	Pneumonoc 3
Wound 4	H Flu Non B 4	H Flu Non B 4	H Flu Non B 4
Other 5	H Flu B 5	H Flu B 5	H Flu B 5
	Nisseria 6	Nisseria 6	Nisseria 6
	Brahamellis 7	Brahamellis 7	Brahamellis 7
	Klebisella 8	Klebisella 8	Klebisella 8

Repeat for each result

SUMMARY OF EVENTS

S Date	Location	Disposition	Reason

Repeat for each event

DETAILS OF NEGATIVE OUTCOME

Intub date and time	Extub date and time	# days ICU	Hypotension ☐ Intubation ☐ Arrest ☐	Discharge Date	Disposition NR 9 D/C Home 1 Transferred 2 Deceased 3

Chart comleted

ADDITIONAL DETAILS AND NOTES

APPENDIX V: Statistical Analysis

From Table 4: Patient characteristics associated with severe upper airway obstruction

SEX

male * Case_control Crosstabulation

			Case_control		Total
			1	2	
male	0	Count	55	21	76
		Expected Count	56.4	19.6	76.0
		% within Case_control	36.7%	40.4%	37.6%
	1	Count	95	31	126
		Expected Count	93.6	32.4	126.0
		% within Case_control	63.3%	59.6%	62.4%
Total		Count	150	52	202
		Expected Count	150.0	52.0	202.0
		% within Case_control	100.0%	100.0%	100.0%

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	.227(b)	1	.633		
Continuity Correction(a)	.097	1	.756		
Likelihood Ratio	.226	1	.634		
Fisher's Exact Test				.740	.376
Linear-by-Linear Association	.226	1	.634		
N of Valid Cases	202				

a Computed only for a 2x2 table
b 0 cells (.0%) have expected count less than 5. The minimum expected count is 19.56.

AGE

Percentiles

		Case_ control	Percentiles						
			5	10	25	50	75	90	95
Weighted Average(Definition 1)	Age_miss	1	5.50	7.00	14.50	32.00	50.50	82.00	93.50
		2	4.20	7.00	11.00	28.00	59.00	101.60	119.60
Tukey's Hinges	Age_miss	1			15.00	32.00	50.00		
		2			11.00	28.00	58.00		

Test Statistics(a)

	Age_miss
Mann-Whitney U	3703.000
Wilcoxon W	5029.000
Z	-.271
Asymp. Sig. (2-tailed)	.787

a Grouping Variable: Case_control

PREMATURITY

Prematurity_bin * Case_control Crosstabulation

			Case_control		Total
			1	2	
Prematurity_bin	0	Count	148	50	198
		Expected Count	147.0	51.0	198.0
		% within Case_control	98.7%	96.2%	98.0%
	1	Count	2	2	4
		Expected Count	3.0	1.0	4.0
		% within Case_control	1.3%	3.8%	2.0%
Total		Count	150	52	202
		Expected Count	150.0	52.0	202.0
		% within Case_control	100.0%	100.0%	100.0%

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	1.256(b)	1	.262		
Continuity Correction(a)	.295	1	.587		
Likelihood Ratio	1.098	1	.295		
Fisher's Exact Test				.273	.273
Linear-by-Linear Association	1.250	1	.264		
N of Valid Cases	202				

a Computed only for a 2x2 table
b 2 cells (50.0%) have expected count less than 5. The minimum expected count is 1.03.

CONGENTIAL STRIDOR

any_congenital_stridor * Case_control Crosstabulation

			Case_control		Total
			1	2	
any_congenital_stridor	0	Count	129	46	175
		Expected Count	131.3	43.8	175.0
		% within Case_control	86.0%	92.0%	87.5%
	1	Count	21	4	25
		Expected Count	18.8	6.3	25.0
		% within Case_control	14.0%	8.0%	12.5%
Total		Count	150	50	200
		Expected Count	150.0	50.0	200.0
		% within Case_control	100.0%	100.0%	100.0%

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	1.234(b)	1	.267		
Continuity Correction(a)	.747	1	.388		
Likelihood Ratio	1.342	1	.247		
Fisher's Exact Test				.330	.196
Linear-by-Linear Association	1.228	1	.268		
N of Valid Cases	200				

a Computed only for a 2x2 table
b 0 cells (.0%) have expected count less than 5. The minimum expected count is 6.25.

DOWN'S SYNDROME

Downs_bin * Case_control Crosstabulation

			Case_control		Total
			1	2	
Downs_bin	0	Count	149	52	201
		Expected Count	149.3	51.7	201.0
		% within Case_control	99.3%	100.0%	99.5%
	1	Count	1	0	1
		Expected Count	.7	.3	1.0
		% within Case_control	.7%	.0%	.5%
Total		Count	150	52	202
		Expected Count	150.0	52.0	202.0
		% within Case_control	100.0%	100.0%	100.0%

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	.348(b)	1	.555		
Continuity Correction(a)	.000	1	1.000		
Likelihood Ratio	.597	1	.440		
Fisher's Exact Test				1.000	.743
Linear-by-Linear Association	.347	1	.556		
N of Valid Cases	202				

a Computed only for a 2x2 table
b 2 cells (50.0%) have expected count less than 5. The minimum expected count is .26.

DEVELOPMENTAL DELAY

Dev_Delay * Case_control Crosstabulation

			Case_control		Total
			1	2	
Dev_ Delay	FALSE	Count	150	49	199
		Expected Count	147.8	51.2	199.0
		% within Case_control	100.0%	94.2%	98.5%
	TRUE	Count	0	3	3
		Expected Count	2.2	.8	3.0
		% within Case_control	.0%	5.8%	1.5%
Total		Count	150	52	202
		Expected Count	150.0	52.0	202.0
		% within Case_control	100.0%	100.0%	100.0%

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	8.784(b)	1	.003		
Continuity Correction(a)	5.284	1	.022		
Likelihood Ratio	8.274	1	.004		
Fisher's Exact Test				.016	.016
N of Valid Cases	202				

a Computed only for a 2x2 table

b 2 cells (50.0%) have expected count less than 5. The minimum expected count is .77.

CONGENITAL HEARTH DISEASE

Congenital_Heart_bin * Case_control Crosstabulation

			Case_control		Total
			1	2	
Congenital_Heart_bin	0	Count	148	50	198
		Expected Count	147.0	51.0	198.0
		% within Case_control	98.7%	96.2%	98.0%
	1	Count	2	2	4
		Expected Count	3.0	1.0	4.0
		% within Case_control	1.3%	3.8%	2.0%
Total		Count	150	52	202
		Expected Count	150.0	52.0	202.0
		% within Case_control	100.0%	100.0%	100.0%

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	1.256(b)	1	.262		
Continuity Correction(a)	.295	1	.587		
Likelihood Ratio	1.098	1	.295		
Fisher's Exact Test				.273	.273
Linear-by-Linear Association	1.250	1	.264		
N of Valid Cases	202				

a Computed only for a 2x2 table
b 2 cells (50.0%) have expected count less than 5. The minimum expected count is 1.03.

PRIOR INTUBATION

Prior_Intubation_bin * Case_control Crosstabulation

			Case_control		Total
			1	2	
Prior_Intubation_bin	0	Count	149	48	197
		Expected Count	146.3	50.7	197.0
		% within Case_control	99.3%	92.3%	97.5%
	1	Count	1	4	5
		Expected Count	3.7	1.3	5.0
		% within Case_control	.7%	7.7%	2.5%
Total		Count	150	52	202
		Expected Count	150.0	52.0	202.0
		% within Case_control	100.0%	100.0%	100.0%

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	7.896(b)	1	.005		
Continuity Correction(a)	5.253	1	.022		
Likelihood Ratio	6.645	1	.010		
Fisher's Exact Test				.016	.016
Linear-by-Linear Association	7.856	1	.005		
N of Valid Cases	202				

a Computed only for a 2x2 table
b 2 cells (50.0%) have expected count less than 5. The minimum expected count is 1.29.

HISTORY OF CROUP

History_of_croup_bin * Case_control Crosstabulation

			Case_control		Total
			1	2	
History_of_croup_bin	0	Count	12	18	30
		Expected Count	17.6	12.4	30.0
		% within Case_control	27.3%	58.1%	40.0%
	1	Count	32	13	45
		Expected Count	26.4	18.6	45.0
		% within Case_control	72.7%	41.9%	60.0%
Total		Count	44	31	75
		Expected Count	44.0	31.0	75.0
		% within Case_control	100.0%	100.0%	100.0%

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	7.185(b)	1	.007		
Continuity Correction(a)	5.959	1	.015		
Likelihood Ratio	7.223	1	.007		
Fisher's Exact Test				.009	.007
Linear-by-Linear Association	7.089	1	.008		
N of Valid Cases	75				

a Computed only for a 2x2 table

b 0 cells (.0%) have expected count less than 5. The minimum expected count is 12.40.

HISTORY OF CROUP PRESENTING TO THE EMERGENCY DEPARTMENT

Prev_crp_ED_bin * Case_control Crosstabulation

			Case_control		Total
			1	2	
Prev_crp_ED_bin	0	Count	128	46	174
		Expected Count	126.5	47.5	174.0
		% within Case_control	96.2%	92.0%	95.1%
	1	Count	5	4	9
		Expected Count	6.5	2.5	9.0
		% within Case_control	3.8%	8.0%	4.9%
Total		Count	133	50	183
		Expected Count	133.0	50.0	183.0
		% within Case_control	100.0%	100.0%	100.0%

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	1.397(b)	1	.237		
Continuity Correction(a)	.638	1	.425		
Likelihood Ratio	1.275	1	.259		
Fisher's Exact Test				.259	.207
Linear-by-Linear Association	1.390	1	.238		
N of Valid Cases	183				

a Computed only for a 2x2 table
b 1 cells (25.0%) have expected count less than 5. The minimum expected count is 2.46.

HISTORY OF CROUP REQUIRING HOSPITALIZATION

Prev_crp_hosp_bin * Case_control Crosstabulation

			Case_control		Total
			1	2	
Prev_crp_hosp_bin	0	Count	128	48	176
		Expected Count	128.2	47.8	176.0
		% within Case_control	95.5%	96.0%	95.7%
	1	Count	6	2	8
		Expected Count	5.8	2.2	8.0
		% within Case_control	4.5%	4.0%	4.3%
Total		Count	134	50	184
		Expected Count	134.0	50.0	184.0
		% within Case_control	100.0%	100.0%	100.0%

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	.020(b)	1	.888		
Continuity Correction(a)	.000	1	1.000		
Likelihood Ratio	.020	1	.887		
Fisher's Exact Test				1.000	.624
Linear-by-Linear Association	.020	1	.888		
N of Valid Cases	184				

a Computed only for a 2x2 table
b 1 cells (25.0%) have expected count less than 5. The minimum expected count is 2.17.

HISTORY OF CROUP REQUIRING ICU ADMISSION

Prev__crp_ICU_bin * Case_control Crosstabulation

			Case_control		Total
			1	2	
Prev__crp_ICU_bin	0	Count	133	47	180
		Expected Count	130.8	49.2	180.0
		% within Case_control	100.0%	94.0%	98.4%
	1	Count	0	3	3
		Expected Count	2.2	.8	3.0
		% within Case_control	.0%	6.0%	1.6%
Total		Count	133	50	183
		Expected Count	133.0	50.0	183.0
		% within Case_control	100.0%	100.0%	100.0%

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	8.113(b)	1	.004		
Continuity Correction(a)	4.819	1	.028		
Likelihood Ratio	7.919	1	.005		
Fisher's Exact Test				.020	.020
Linear-by-Linear Association	8.069	1	.005		
N of Valid Cases	183				

a Computed only for a 2x2 table

b 2 cells (50.0%) have expected count less than 5. The minimum expected count is .82.

HISTORY OF ASTHMA

Asthma_History_bin * Case_control Crosstabulation

			Case_control		Total
			1	2	
Asthma_History_bin	0	Count	134	47	181
		Expected Count	134.4	46.6	181.0
		% within Case_control	89.3%	90.4%	89.6%
	1	Count	16	5	21
		Expected Count	15.6	5.4	21.0
		% within Case_control	10.7%	9.6%	10.4%
Total		Count	150	52	202
		Expected Count	150.0	52.0	202.0
		% within Case_control	100.0%	100.0%	100.0%

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	.046(b)	1	.831		
Continuity Correction(a)	.000	1	1.000		
Likelihood Ratio	.047	1	.829		
Fisher's Exact Test				1.000	.533
Linear-by-Linear Association	.046	1	.831		
N of Valid Cases	202				

a Computed only for a 2x2 table
b 0 cells (.0%) have expected count less than 5. The minimum expected count is 5.41.

HISTORY OF ASTHMA REQUIRING HOSPITALIZATION

Hospitalizations_bin * Case_control Crosstabulation

			Case_control		Total
			1	2	
Hospitalizations_bin	0	Count	141	50	191
		Expected Count	141.3	49.7	191.0
		% within Case_control	99.3%	100.0%	99.5%
	1	Count	1	0	1
		Expected Count	.7	.3	1.0
		% within Case_control	.7%	.0%	.5%
Total		Count	142	50	192
		Expected Count	142.0	50.0	192.0
		% within Case_control	100.0%	100.0%	100.0%

Hospitalizations_bin * Case_control Crosstabulation

			Case_control		Total
			1	2	
Hospitalizations_bin	0	Count	141	50	191
		Expected Count	141.3	49.7	191.0
		% within Case_control	99.3%	100.0%	99.5%
	1	Count	1	0	1
		Expected Count	.7	.3	1.0
		% within Case_control	.7%	.0%	.5%
Total		Count	142	50	192
		Expected Count	142.0	50.0	192.0
		% within Case_control	100.0%	100.0%	100.0%

PNEUMONIA

Pneumonia_bin * Case_control Crosstabulation

			Case_control		Total
			1	2	
Pneumonia_bin	0	Count	150	51	201
		Expected Count	149.3	51.7	201.0
		% within Case_control	100.0%	98.1%	99.5%
	1	Count	0	1	1
		Expected Count	.7	.3	1.0
		% within Case_control	.0%	1.9%	.5%
Total		Count	150	52	202
		Expected Count	150.0	52.0	202.0
		% within Case_control	100.0%	100.0%	100.0%

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	2.899(b)	1	.089		
Continuity Correction(a)	.309	1	.578		
Likelihood Ratio	2.728	1	.099		
Fisher's Exact Test				.257	.257
Linear-by-Linear Association	2.885	1	.089		
N of Valid Cases	202				

a Computed only for a 2x2 table

b 2 cells (50.0%) have expected count less than 5. The minimum expected count is .26.

FUNDOPLICATION

Fundo_bin * Case_control Crosstabulation

			Case_control		Total
			1	2	
Fundo_bin	0	Count	150	50	200
		Expected Count	148.5	51.5	200.0
		% within Case_control	100.0%	96.2%	99.0%
	1	Count	0	2	2
		Expected Count	1.5	.5	2.0
		% within Case_control	.0%	3.8%	1.0%
Total		Count	150	52	202
		Expected Count	150.0	52.0	202.0
		% within Case_control	100.0%	100.0%	100.0%

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	5.827(b)	1	.016		
Continuity Correction(a)	2.564	1	.109		
Likelihood Ratio	5.486	1	.019		
Fisher's Exact Test				.065	.065
Linear-by-Linear Association	5.798	1	.016		
N of Valid Cases	202				

a Computed only for a 2x2 table
b 2 cells (50.0%) have expected count less than 5. The minimum expected count is .51.

HISTORY OF CANCER

Cancer_History_bin * Case_control Crosstabulation

			Case_control		Total
			1	2	
Cancer_History_bin	0	Count	150	51	201
		Expected Count	149.3	51.7	201.0
		% within Case_control	100.0%	98.1%	99.5%
	1	Count	0	1	1
		Expected Count	.7	.3	1.0
		% within Case_control	.0%	1.9%	.5%
Total		Count	150	52	202
		Expected Count	150.0	52.0	202.0
		% within Case_control	100.0%	100.0%	100.0%

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	2.899(b)	1	.089		
Continuity Correction(a)	.309	1	.578		
Likelihood Ratio	2.728	1	.099		
Fisher's Exact Test				.257	.257
Linear-by-Linear Association	2.885	1	.089		
N of Valid Cases	202				

a Computed only for a 2x2 table
b 2 cells (50.0%) have expected count less than 5. The minimum expected count is .26.

From Table 5: Presenting signs and symptoms associated with severe upper airway obstruction

PREVISIT CARE

Dr_Visit_bin * Case_control Crosstabulation

			Case_control		Total
			1	2	
Dr_Visit_bin	0	Count	113	31	144
		Expected Count	103.9	40.1	144.0
		% within Case_control	89.0%	63.3%	81.8%
	1	Count	14	18	32
		Expected Count	23.1	8.9	32.0
		% within Case_control	11.0%	36.7%	18.2%
Total		Count	127	49	176
		Expected Count	127.0	49.0	176.0
		% within Case_control	100.0%	100.0%	100.0%

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	15.712(b)	1	.000		
Continuity Correction(a)	14.031	1	.000		
Likelihood Ratio	14.319	1	.000		
Fisher's Exact Test				.000	.000
Linear-by-Linear Association	15.623	1	.000		
N of Valid Cases	176				

a Computed only for a 2x2 table

b 0 cells (.0%) have expected count less than 5. The minimum expected count is 8.91.

PRODROMAL FEVER

Fever_bin * Case_control Crosstabulation

			Case_control		Total
			1	2	
Fever_bin	0	Count	97	22	119
		Expected Count	88.4	30.6	119.0
		% within Case_control	64.7%	42.3%	58.9%
	1	Count	53	30	83
		Expected Count	61.6	21.4	83.0
		% within Case_control	35.3%	57.7%	41.1%
Total		Count	150	52	202
		Expected Count	150.0	52.0	202.0
		% within Case_control	100.0%	100.0%	100.0%

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	7.975(b)	1	.005		
Continuity Correction(a)	7.078	1	.008		
Likelihood Ratio	7.884	1	.005		
Fisher's Exact Test				.006	.004
Linear-by-Linear Association	7.935	1	.005		
N of Valid Cases	202				

a Computed only for a 2x2 table

b 0 cells (.0%) have expected count less than 5. The minimum expected count is 21.37.

PRODROMAL SORE THROAT

Sore_throat_bin * Case_control Crosstabulation

			Case_control		Total
			1	2	
Sore_throat_bin	0	Count	131	33	164
		Expected Count	121.8	42.2	164.0
		% within Case_control	87.3%	63.5%	81.2%
	1	Count	19	19	38
		Expected Count	28.2	9.8	38.0
		% within Case_control	12.7%	36.5%	18.8%
Total		Count	150	52	202
		Expected Count	150.0	52.0	202.0
		% within Case_control	100.0%	100.0%	100.0%

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	14.408(b)	1	.000		
Continuity Correction(a)	12.887	1	.000		
Likelihood Ratio	13.056	1	.000		
Fisher's Exact Test				.000	.000
Linear-by-Linear Association	14.336	1	.000		
N of Valid Cases	202				

a Computed only for a 2x2 table
b 0 cells (.0%) have expected count less than 5. The minimum expected count is 9.78.

PRODROMAL RHINORRHEA

Rhinnorhea_bin * Case_control Crosstabulation

			Case_control		Total
			1	2	
Rhinnorhea_bin	0	Count	108	30	138
		Expected Count	102.5	35.5	138.0
		% within Case_control	72.0%	57.7%	68.3%
	1	Count	42	22	64
		Expected Count	47.5	16.5	64.0
		% within Case_control	28.0%	42.3%	31.7%
Total		Count	150	52	202
		Expected Count	150.0	52.0	202.0
		% within Case_control	100.0%	100.0%	100.0%

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	3.652(b)	1	.056		
Continuity Correction(a)	3.021	1	.082		
Likelihood Ratio	3.543	1	.060		
Fisher's Exact Test				.060	.043
Linear-by-Linear Association	3.634	1	.057		
N of Valid Cases	202				

a Computed only for a 2x2 table
b 0 cells (.0%) have expected count less than 5. The minimum expected count is 16.48.

PRODROMAL BARKY COUGH

Obst_Barky_cough_bin * Case_control Crosstabulation

			Case_control		Total
			1	2	
Obst_Barky_cough_bin	0	Count	67	18	85
		Expected Count	64.9	20.1	85.0
		% within Case_control	45.0%	39.1%	43.6%
	1	Count	82	28	110
		Expected Count	84.1	25.9	110.0
		% within Case_control	55.0%	60.9%	56.4%
Total		Count	149	46	195
		Expected Count	149.0	46.0	195.0
		% within Case_control	100.0%	100.0%	100.0%

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	.487(b)	1	.485		
Continuity Correction(a)	.278	1	.598		
Likelihood Ratio	.490	1	.484		
Fisher's Exact Test				.502	.300
Linear-by-Linear Association	.484	1	.486		
N of Valid Cases	195				

a Computed only for a 2x2 table

b 0 cells (.0%) have expected count less than 5. The minimum expected count is 20.05.

PRODROMAL NON-BARKY COUGH

Non_barky_cough_bin * Case_control Crosstabulation

			Case_control		Total
			1	2	
Non_barky_cough_bin	0	Count	119	30	149
		Expected Count	110.6	38.4	149.0
		% within Case_control	79.3%	57.7%	73.8%
	1	Count	31	22	53
		Expected Count	39.4	13.6	53.0
		% within Case_control	20.7%	42.3%	26.2%
Total		Count	150	52	202
		Expected Count	150.0	52.0	202.0
		% within Case_control	100.0%	100.0%	100.0%

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	9.344(b)	1	.002		
Continuity Correction(a)	8.259	1	.004		
Likelihood Ratio	8.810	1	.003		
Fisher's Exact Test				.003	.003
Linear-by-Linear Association	9.298	1	.002		
N of Valid Cases	202				

a Computed only for a 2x2 table

b 0 cells (.0%) have expected count less than 5. The minimum expected count is 13.64.

PRODROMAL OBSTUCTIVE STRIDOR

Obst_Stridor_bin * Case_control Crosstabulation

			Case_control		Total
			1	2	
Obst_Stridor_bin	0	Count	84	12	96
		Expected Count	71.6	24.4	96.0
		% within Case_control	56.0%	23.5%	47.8%
	1	Count	66	39	105
		Expected Count	78.4	26.6	105.0
		% within Case_control	44.0%	76.5%	52.2%
Total		Count	150	51	201
		Expected Count	150.0	51.0	201.0
		% within Case_control	100.0%	100.0%	100.0%

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	16.083(b)	1	.000		
Continuity Correction(a)	14.808	1	.000		
Likelihood Ratio	16.812	1	.000		
Fisher's Exact Test				.000	.000
Linear-by-Linear Association	16.003	1	.000		
N of Valid Cases	201				

a Computed only for a 2x2 table
b 0 cells (.0%) have expected count less than 5. The minimum expected count is 24.36.

PRODROMAL OBSRUCTIVE INDRAWING

Obst__Indr_bin * Case_control Crosstabulation

			Case_control		Total
			1	2	
Obst__Indr_bin	0	Count	108	9	117
		Expected Count	86.7	30.3	117.0
		% within Case_control	72.5%	17.3%	58.2%
	1	Count	41	43	84
		Expected Count	62.3	21.7	84.0
		% within Case_control	27.5%	82.7%	41.8%
Total		Count	149	52	201
		Expected Count	149.0	52.0	201.0
		% within Case_control	100.0%	100.0%	100.0%

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	48.241(b)	1	.000		
Continuity Correction(a)	45.999	1	.000		
Likelihood Ratio	49.964	1	.000		
Fisher's Exact Test				.000	.000
Linear-by-Linear Association	48.001	1	.000		
N of Valid Cases	201				

a Computed only for a 2x2 table
b 0 cells (.0%) have expected count less than 5. The minimum expected count is 21.73.

PRODROMAL OBSTRUCTIVE CYANOSIS

Obst_Cyano_bin * Case_control Crosstabulation

			Case_control		Total
			1	2	
Obst_Cyano_bin	0	Count	149	39	188
		Expected Count	142.4	45.6	188.0
		% within Case_control	99.3%	81.3%	94.9%
	1	Count	1	9	10
		Expected Count	7.6	2.4	10.0
		% within Case_control	.7%	18.8%	5.1%
Total		Count	150	48	198
		Expected Count	150.0	48.0	198.0
		% within Case_control	100.0%	100.0%	100.0%

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	24.797(b)	1	.000		
Continuity Correction(a)	21.169	1	.000		
Likelihood Ratio	20.858	1	.000		
Fisher's Exact Test				.000	.000
Linear-by-Linear Association	24.672	1	.000		
N of Valid Cases	198				

a Computed only for a 2x2 table

b 1 cells (25.0%) have expected count less than 5. The minimum expected count is 2.42.

PRESENTING BARKY COUGH

PSBarky_cough_bin * Case_control Crosstabulation

			Case_control		Total
			1	2	
PSBarky_cough_bin	.00	Count	53	21	74
		Expected Count	58.4	15.6	74.0
		% within Case_control	37.3%	55.3%	41.1%
	1.00	Count	89	17	106
		Expected Count	83.6	22.4	106.0
		% within Case_control	62.7%	44.7%	58.9%
Total		Count	142	38	180
		Expected Count	142.0	38.0	180.0
		% within Case_control	100.0%	100.0%	100.0%

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	3.985(b)	1	.046		
Continuity Correction(a)	3.278	1	.070		
Likelihood Ratio	3.930	1	.047		
Fisher's Exact Test				.063	.036
Linear-by-Linear Association	3.963	1	.047		
N of Valid Cases	180				

a Computed only for a 2x2 table
b 0 cells (.0%) have expected count less than 5. The minimum expected count is 15.62.

PRESENTING NON-BARKY COUGH

PSNon_barky_cough_bin * Case_control Crosstabulation

			Case_control		Total
			1	2	
PSNon_barky_cough_bin	.00	Count	137	31	168
		Expected Count	132.5	35.5	168.0
		% within Case_control	96.5%	81.6%	93.3%
	1.00	Count	5	7	12
		Expected Count	9.5	2.5	12.0
		% within Case_control	3.5%	18.4%	6.7%
Total		Count	142	38	180
		Expected Count	142.0	38.0	180.0
		% within Case_control	100.0%	100.0%	100.0%

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	10.696(b)	1	.001		
Continuity Correction(a)	8.435	1	.004		
Likelihood Ratio	8.582	1	.003		
Fisher's Exact Test				.004	.004
Linear-by-Linear Association	10.637	1	.001		
N of Valid Cases	180				

a Computed only for a 2x2 table
b 1 cells (25.0%) have expected count less than 5. The minimum expected count is 2.53.

PRESENTING STRIDOR

any_PSstridor * Case_control Crosstabulation

			Case_control		Total
			1	2	
any_PSstridor	0	Count	70	9	79
		Expected Count	58.9	20.1	79.0
		% within Case_control	49.6%	18.8%	41.8%
	1	Count	71	39	110
		Expected Count	82.1	27.9	110.0
		% within Case_control	50.4%	81.3%	58.2%
Total		Count	141	48	189
		Expected Count	141.0	48.0	189.0
		% within Case_control	100.0%	100.0%	100.0%

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	14.050(b)	1	.000		
Continuity Correction(a)	12.809	1	.000		
Likelihood Ratio	15.114	1	.000		
Fisher's Exact Test				.000	.000
Linear-by-Linear Association	13.976	1	.000		
N of Valid Cases	189				

a Computed only for a 2x2 table

b 0 cells (.0%) have expected count less than 5. The minimum expected count is 20.06.

PRESENTING INDRAWING

any_PSindrawing * Case_control Crosstabulation

			Case_control		Total
			1	2	
any_PSindrawing	0	Count	93	9	102
		Expected Count	76.0	26.0	102.0
		% within Case_control	66.4%	18.8%	54.3%
	1	Count	47	39	86
		Expected Count	64.0	22.0	86.0
		% within Case_control	33.6%	81.3%	45.7%
Total		Count	140	48	188
		Expected Count	140.0	48.0	188.0
		% within Case_control	100.0%	100.0%	100.0%

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	32.740(b)	1	.000		
Continuity Correction(a)	30.847	1	.000		
Likelihood Ratio	34.250	1	.000		
Fisher's Exact Test				.000	.000
Linear-by-Linear Association	32.566	1	.000		
N of Valid Cases	188				

a Computed only for a 2x2 table
b 0 cells (.0%) have expected count less than 5. The minimum expected count is 21.96.

PRESENTING CYANOSIS

any_PScyanosis * Case_control Crosstabulation

			Case_control		Total
			1	2	
any_PScyanosis	0	Count	132	35	167
		Expected Count	125.0	42.0	167.0
		% within Case_control	98.5%	77.8%	93.3%
	1	Count	2	10	12
		Expected Count	9.0	3.0	12.0
		% within Case_control	1.5%	22.2%	6.7%
Total		Count	134	45	179
		Expected Count	134.0	45.0	179.0
		% within Case_control	100.0%	100.0%	100.0%

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	23.145(b)	1	.000		
Continuity Correction(a)	19.949	1	.000		
Likelihood Ratio	19.574	1	.000		
Fisher's Exact Test				.000	.000
Linear-by-Linear Association	23.016	1	.000		
N of Valid Cases	179				

a Computed only for a 2x2 table
b 1 cells (25.0%) have expected count less than 5. The minimum expected count is 3.02.

PRESENTING DECREASED LEVEL OF CONSIOUSNESS

any_PSloc * Case_control Crosstabulation

			Case_control		Total
			1	2	
any_PSloc	0	Count	129	34	163
		Expected Count	119.8	43.2	163.0
		% within Case_control	97.0%	70.8%	90.1%
	1	Count	4	14	18
		Expected Count	13.2	4.8	18.0
		% within Case_control	3.0%	29.2%	9.9%
Total		Count	133	48	181
		Expected Count	133.0	48.0	181.0
		% within Case_control	100.0%	100.0%	100.0%

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	26.950(b)	1	.000		
Continuity Correction(a)	24.108	1	.000		
Likelihood Ratio	23.380	1	.000		
Fisher's Exact Test				.000	.000
Linear-by-Linear Association	26.801	1	.000		
N of Valid Cases	181				

a Computed only for a 2x2 table

b 1 cells (25.0%) have expected count less than 5. The minimum expected count is 4.77.

COMBINED NON-BARKY COUGH (EITHER PRODROMAL, PRESENTING OR BOTH)

comb_nonbarkycough_miss * Case_control Crosstabulation

			Case_control		Total
			1	2	
comb_nonbarkycough_miss	0	Count	109	20	129
		Expected Count	101.8	27.2	129.0
		% within Case_control	76.8%	52.6%	71.7%
	1	Count	33	18	51
		Expected Count	40.2	10.8	51.0
		% within Case_control	23.2%	47.4%	28.3%
Total		Count	142	38	180
		Expected Count	142.0	38.0	180.0
		% within Case_control	100.0%	100.0%	100.0%

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	8.595(b)	1	.003		
Continuity Correction(a)	7.448	1	.006		
Likelihood Ratio	8.041	1	.005		
Fisher's Exact Test				.005	.004
Linear-by-Linear Association	8.548	1	.003		
N of Valid Cases	180				

a Computed only for a 2x2 table

b 0 cells (.0%) have expected count less than 5. The minimum expected count is 10.77.

COMBINED BARKY COUGH (EITHER PRODROMAL, PRESENTING OR BOTH)

comb_barkycough_miss * Case_control Crosstabulation

			Case_control		Total
			1	2	
comb_barkycough_miss	0	Count	57	19	76
		Expected Count	57.3	18.7	76.0
		% within Case_control	38.0%	38.8%	38.2%
	1	Count	93	30	123
		Expected Count	92.7	30.3	123.0
		% within Case_control	62.0%	61.2%	61.8%
Total		Count	150	49	199
		Expected Count	150.0	49.0	199.0
		% within Case_control	100.0%	100.0%	100.0%

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	.009(b)	1	.923		
Continuity Correction(a)	.000	1	1.000		
Likelihood Ratio	.009	1	.923		
Fisher's Exact Test				1.000	.526
Linear-by-Linear Association	.009	1	.923		
N of Valid Cases	199				

a Computed only for a 2x2 table
b 0 cells (.0%) have expected count less than 5. The minimum expected count is 18.71.

COMBINED STRIDOR (EITHER PRODROMAL, PRESENTING OR BOTH)

comb_stridor_miss * Case_control Crosstabulation

			Case_control		Total
			1	2	
comb_stridor_miss	0	Count	77	10	87
		Expected Count	64.6	22.4	87.0
		% within Case_control	51.3%	19.2%	43.1%
	1	Count	73	42	115
		Expected Count	85.4	29.6	115.0
		% within Case_control	48.7%	80.8%	56.9%
Total		Count	150	52	202
		Expected Count	150.0	52.0	202.0
		% within Case_control	100.0%	100.0%	100.0%

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	16.230(b)	1	.000		
Continuity Correction(a)	14.947	1	.000		
Likelihood Ratio	17.387	1	.000		
Fisher's Exact Test				.000	.000
Linear-by-Linear Association	16.149	1	.000		
N of Valid Cases	202				

a Computed only for a 2x2 table
b 0 cells (.0%) have expected count less than 5. The minimum expected count is 22.40.

COMBINED INDRAWING (EITHER PRODROMAL, PRESENTING OR BOTH)

comb_indrawing_miss * Case_control Crosstabulation

			Case_control		Total
			1	2	
comb_indrawing_miss	0	Count	92	5	97
		Expected Count	72.1	24.9	97.0
		% within Case_control	66.2%	10.4%	51.9%
	1	Count	47	43	90
		Expected Count	66.9	23.1	90.0
		% within Case_control	33.8%	89.6%	48.1%
Total		Count	139	48	187
		Expected Count	139.0	48.0	187.0
		% within Case_control	100.0%	100.0%	100.0%

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	44.452(b)	1	.000		
Continuity Correction(a)	42.246	1	.000		
Likelihood Ratio	49.036	1	.000		
Fisher's Exact Test				.000	.000
Linear-by-Linear Association	44.214	1	.000		
N of Valid Cases	187				

a Computed only for a 2x2 table

b 0 cells (.0%) have expected count less than 5. The minimum expected count is 23.10.

COMBINED CYANOSIS (EITHER PRODROMAL, PRESENTING OR BOTH)

comb_cyanosis_miss * Case_control Crosstabulation

			Case_control		Total
			1	2	
comb_cyanosis_miss	0	Count	132	34	166
		Expected Count	124.3	41.7	166.0
		% within Case_control	98.5%	75.6%	92.7%
	1	Count	2	11	13
		Expected Count	9.7	3.3	13.0
		% within Case_control	1.5%	24.4%	7.3%
Total		Count	134	45	179
		Expected Count	134.0	45.0	179.0
		% within Case_control	100.0%	100.0%	100.0%

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	26.349(b)	1	.000		
Continuity Correction(a)	23.051	1	.000		
Likelihood Ratio	22.373	1	.000		
Fisher's Exact Test				.000	.000
Linear-by-Linear Association	26.201	1	.000		
N of Valid Cases	179				

a Computed only for a 2x2 table

b 1 cells (25.0%) have expected count less than 5. The minimum expected count is 3.27.

PRESENTING CROUP SCORE

Percentiles

		Case_ control	Percentiles						
			5	10	25	50	75	90	95
Weighted Average(Definition 1)	PSCroup_Score_miss	1	.00	.00	.00	.00	2.00	3.00	4.00
		2	.00	.00	.00	2.00	4.00	6.00	8.00
Tukey's Hinges	PSCroup_Score_miss	1			.00	.00	2.00		
		2			.00	2.00	4.00		

Test Statistics(a)

	PSCroup_Score_miss
Mann-Whitney U	2506.500
Wilcoxon W	13532.500
Z	-2.506
Asymp. Sig. (2-tailed)	.012

a Grouping Variable: Case_control

PRESENTING RESPIRATORY RATE

Percentiles

		Case_ control	Percentiles						
			5	10	25	50	75	90	95
Weighted Average(Definition 1)	PSResp_Rate_ miss	1	20.00	23.00	24.00	29.00	36.00	42.00	49.00
		2	20.60	23.20	25.00	40.00	48.00	60.00	77.00
Tukey's Hinges	PSResp_Rate_ miss	1			24.00	29.00	36.00		
		2			25.00	40.00	48.00		

Test Statistics(a)

	PSResp_Rate_ miss
Mann-Whitney U	2077.000
Wilcoxon W	11122.000
Z	-3.138
Asymp. Sig. (2-tailed)	.002

a Grouping Variable: Case_control

PRESENTING HEART RATE

Group Statistics

	Case_control	N	Mean	Std. Deviation	Std. Error Mean
PSHeart_Rate_miss	1	137	131.23	22.198	1.897
	2	44	145.18	30.257	4.561

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means				
		F	Sig.	t	df	Sig. (2-tailed)	95% Confidence Interval of the Difference	
							Lower	Upper
PSHeart_Rate_miss	Equal variances assumed	6.938	.009	-3.302	179	.001	-22.284	-5.612
	Equal variances not assumed			-2.824	58.598	.006	-23.835	-4.062

PRESENTING OXYGEN SATURATION

Percentiles

		Case_ control	Percentiles						
			5	10	25	50	75	90	95
Weighted Average(Definition 1)	PSO2_Sat_miss	1	90.00	93.00	95.50	97.00	98.00	99.00	100.00
		2	58.95	75.30	89.25	95.50	97.75	99.00	100.00
Tukey's Hinges	PSO2_Sat_miss	1			96.00	97.00	98.00		
		2			89.50	95.50	97.50		

Test Statistics(a)

	PSO2_Sat_miss
Mann-Whitney U	1211.000
Wilcoxon W	1877.000
Z	-2.733
Asymp. Sig. (2-tailed)	.006

a Grouping Variable: Case_control

PRESENTING TEMPERATURE

Group Statistics

	Case_control	N	Mean	Std. Deviation	Std. Error Mean
PSTemp_miss	1	140	37.3214	1.08182	.09143
	2	42	37.6119	1.13615	.17531

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means				
		F	Sig.	t	df	Sig. (2-tailed)	95% Confidence Interval of the Difference	
							Lower	Upper
PSTemp_miss	Equal variances assumed	.038	.846	-1.509	180	.133	-.67041	.08946
	Equal variances not assumed			-1.469	64.920	.147	-.68536	.10441

From Table 6: Outcome among children with and without severe upper airway obstruction

HYPOTENSION

Hypotension_bin * Case_control Crosstabulation

			Case_control		Total
			1	2	
Hypotension_bin	0	Count	150	50	200
		Expected Count	148.5	51.5	200.0
	1	Count	0	2	2
		Expected Count	1.5	.5	2.0
Total		Count	150	52	202
		Expected Count	150.0	52.0	202.0

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	5.827(b)	1	.016		
Continuity Correction(a)	2.564	1	.109		
Likelihood Ratio	5.486	1	.019		
Fisher's Exact Test				.065	.065
Linear-by-Linear Association	5.798	1	.016		
N of Valid Cases	202				

a Computed only for a 2x2 table
b 2 cells (50.0%) have expected count less than 5. The minimum expected count is .51.

INTUBATION

Intubation_bin * Case_control Crosstabulation

			Case_control		Total
			1	2	
Intubation_bin	0	Count	150	16	166
		Expected Count	123.3	42.7	166.0
	1	Count	0	36	36
		Expected Count	26.7	9.3	36.0
Total		Count	150	52	202
		Expected Count	150.0	52.0	202.0

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	126.367(b)	1	.000		
Continuity Correction(a)	121.684	1	.000		
Likelihood Ratio	125.154	1	.000		
Fisher's Exact Test				.000	.000
Linear-by-Linear Association	125.741	1	.000		
N of Valid Cases	202				

a Computed only for a 2x2 table
b 0 cells (.0%) have expected count less than 5. The minimum expected count is 9.27.

ARREST

Arrest_bin * Case_control Crosstabulation

			Case_control		Total
			1	2	
Arrest_bin	0	Count	150	50	200
		Expected Count	148.5	51.5	200.0
	1	Count	0	2	2
		Expected Count	1.5	.5	2.0
Total		Count	150	52	202
		Expected Count	150.0	52.0	202.0

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	5.827(b)	1	.016		
Continuity Correction(a)	2.564	1	.109		
Likelihood Ratio	5.486	1	.019		
Fisher's Exact Test				.065	.065
Linear-by-Linear Association	5.798	1	.016		
N of Valid Cases	202				

a Computed only for a 2x2 table
b 2 cells (50.0%) have expected count less than 5. The minimum expected count is .51.

From Table 7a: Odds ratios (and 95% CI) of risk factors associated with severe upper airway obstruction (missing data is excluded)

PRIOR INTUBATION

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)	95.0% C.I.for EXP(B)	
								Lower	Upper
Step 1(a)	Prior_Intubation_bin	2.519	1.130	4.967	1	.026	12.417	1.355	113.790
	Constant	-1.133	.166	46.583	1	.000	.322		

a Variable(s) entered on step 1: Prior_Intubation_bin.

Model Summary

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	223.775(a)	.032	.048

a Estimation terminated at iteration number 4 because parameter estimates changed by less than .001.

HISTORY OF COUP

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)	95.0% C.I.for EXP(B)	
								Lower	Upper
Step 1(a)	History_of_croup_bin	-1.306	.497	6.906	1	.009	.271	.102	.717
	Constant	.405	.373	1.184	1	.277	1.500		

a Variable(s) entered on step 1: History_of_croup_bin.

Model Summary

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	94.485(a)	.092	.124

a Estimation terminated at iteration number 3 because parameter estimates changed by less than .001.

PRODROMAL FEVER

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)	95.0% C.I.for EXP(B)	
								Lower	Upper
Step 1(a)	Fever_bin	.915	.329	7.747	1	.005	2.496	1.311	4.752
	Constant	-1.484	.236	39.475	1	.000	.227		

a Variable(s) entered on step 1: Fever_bin.

Model Summary

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	222.536(a)	.038	.056

a Estimation terminated at iteration number 4 because parameter estimates changed by less than .001.

PRODROMAL SORE THROAT

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)	95.0% C.I.for EXP(B)	
								Lower	Upper
Step 1(a)	Sore_throat_bin	1.379	.378	13.274	1	.000	3.970	1.891	8.334
	Constant	-1.379	.195	50.104	1	.000	.252		

a Variable(s) entered on step 1: Sore_throat_bin.

Model Summary

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	217.364(a)	.063	.092

a Estimation terminated at iteration number 4 because parameter estimates changed by less than .001.

PRODROMAL RHINORRHEA

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)	95.0% C.I.for EXP(B)	
								Lower	Upper
Step 1(a)	Rhinnorhea_bin	.634	.334	3.597	1	.058	1.886	.979	3.632
	Constant	-1.281	.206	38.523	1	.000	.278		

a Variable(s) entered on step 1: Rhinnorhea_bin.

Model Summary

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	226.877(a)	.017	.026

a Estimation terminated at iteration number 4 because parameter estimates changed by less than .001.

PRODROMAL NON-BARKY COUGH

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)	95.0% C.I.for EXP(B)	
								Lower	Upper
Step 1(a)	Non_barky_cough_bin	1.035	.346	8.968	1	.003	2.815	1.430	5.542
	Constant	-1.378	.204	45.492	1	.000	.252		

a Variable(s) entered on step 1: Non_barky_cough_bin.

Model Summary

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	221.611(a)	.043	.063

a Estimation terminated at iteration number 4 because parameter estimates changed by less than .001.

PRODROMAL OBSTRUCTIVE STRIDOR

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)	95.0% C.I.for EXP(B)	
								Lower	Upper
Step 1(a)	Obst_Stridor_bin	1.420	.369	14.819	1	.000	4.136	2.008	8.522
	Constant	-1.946	.309	39.759	1	.000	.143		

a Variable(s) entered on step 1: Obst_Stridor_bin.

Model Summary

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	210.879(a)	.080	.118

a Estimation terminated at iteration number 5 because parameter estimates changed by less than .001.

PRODROMAL OBSTRUCTIVE INDRAWING

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)	95.0% C.I.for EXP(B)	
								Lower	Upper
Step 1(a)	Obst__Indr_bin	2.533	.410	38.173	1	.000	12.585	5.636	28.104
	Constant	-2.485	.347	51.298	1	.000	.083		

a Variable(s) entered on step 1: Obst__Indr_bin.

Model Summary

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	179.859(a)	.220	.323

a Estimation terminated at iteration number 5 because parameter estimates changed by less than .001.

PRODROMAL OBSTRUCTIVE CYANOSIS

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)	95.0% C.I.for EXP(B)	
								Lower	Upper
Step 1(a)	Obst_Cyano_bin	3.538	1.069	10.945	1	.001	34.385	4.228	279.626
	Constant	-1.340	.180	55.533	1	.000	.262		

a Variable(s) entered on step 1: Obst_Cyano_bin.

Model Summary

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	198.470(a)	.100	.149

a Estimation terminated at iteration number 5 because parameter estimates changed by less than .001.

PRESENTING BARKY COUGH

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)	95.0% C.I.for EXP(B)	
								Lower	Upper
Step 1(a)	PSBarky_cough_bin	-.730	.370	3.899	1	.048	.482	.234	.995
	Constant	-.926	.258	12.890	1	.000	.396		

a Variable(s) entered on step 1: PSBarky_cough_bin.

Model Summary

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	181.623(a)	.022	.034

a Estimation terminated at iteration number 4 because parameter estimates changed by less than .001.

PRESENTING NON-BARKY COUGH

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)	95.0% C.I.for EXP(B)	
								Lower	Upper
Step 1(a)	PSNon_barky_cough_bin	1.822	.618	8.685	1	.003	6.187	1.841	20.791
	Constant	-1.486	.199	55.822	1	.000	.226		

a Variable(s) entered on step 1: PSNon_barky_cough_bin.

Model Summary

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	176.971(a)	.047	.072

a Estimation terminated at iteration number 4 because parameter estimates changed by less than .001.

PRESENTING STRIDOR

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)	95.0% C.I.for EXP(B)	
								Lower	Upper
Step 1(a)	any_PSstridor	1.452	.406	12.771	1	.000	4.272	1.927	9.474
	Constant	-2.051	.354	33.555	1	.000	.129		

a Variable(s) entered on step 1: any_PSstridor.

Model Summary

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	199.081(a)	.077	.113

a Estimation terminated at iteration number 5 because parameter estimates changed by less than .001.

PRESENTING INDRAWING

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)	95.0% C.I.for EXP(B)	
								Lower	Upper
Step 1(a)	any_PSindrawing	2.149	.411	27.357	1	.000	8.574	3.833	19.183
	Constant	-2.335	.349	44.755	1	.000	.097		

a Variable(s) entered on step 1: any_PSindrawing.

Model Summary

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	179.357(a)	.167	.245

a Estimation terminated at iteration number 5 because parameter estimates changed by less than .001.

PRESENING CYANOSIS

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)	95.0% C.I.for EXP(B)	
								Lower	Upper
Step 1(a)	any_PScyanosis	2.937	.798	13.559	1	.000	18.857	3.950	90.029
	Constant	-1.327	.190	48.749	1	.000	.265		

a Variable(s) entered on step 1: any_PScyanosis.

Model Summary

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	182.289(a)	.104	.153

a Estimation terminated at iteration number 4 because parameter estimates changed by less than .001.

PRESENTING DECREASED LEVEL OF CONSCIOUSNESS

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)	95.0% C.I.for EXP(B)	
								Lower	Upper
Step 1(a)	any_PSloc	2.586	.599	18.652	1	.000	13.279	4.106	42.944
	Constant	-1.333	.193	47.845	1	.000	.264		

a Variable(s) entered on step 1: any_PSloc.

Model Summary

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	186.008(a)	.121	.177

a Estimation terminated at iteration number 4 because parameter estimates changed by less than .001.

COMBINED NON-BARKY COUGH (PRODROMAL, PRESENTING OR BOTH)

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)	95.0% C.I.for EXP(B)	
								Lower	Upper
Step 1(a)	comb_nonbarkycough_miss	1.089	.381	8.184	1	.004	2.973	1.409	6.271
	Constant	-1.696	.243	48.587	1	.000	.183		

a Variable(s) entered on step 1: comb_nonbarkycough_miss.

Model Summary

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	177.512(a)	.044	.068

a Estimation terminated at iteration number 4 because parameter estimates changed by less than .001.

COMBINED STRIDOR (PRODROMAL, PRESENTING OR BOTH)

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)	95.0% C.I.for EXP(B)	
								Lower	Upper
Step 1(a)	comb_stridor_miss	1.488	.388	14.721	1	.000	4.430	2.071	9.476
	Constant	-2.041	.336	36.877	1	.000	.130		

a Variable(s) entered on step 1: comb_stridor_miss.

Model Summary

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	213.033(a)	.082	.121

a Estimation terminated at iteration number 5 because parameter estimates changed by less than .001.

COMBINED INDRAWING (PRODROMAL, PRESENTING OR BOTH)

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)	95.0% C.I.for EXP(B)	
								Lower	Upper
Step 1(a)	comb_indrawing_miss	2.823	.505	31.212	1	.000	16.834	6.252	45.328
	Constant	-2.912	.459	40.223	1	.000	.054		

a Variable(s) entered on step 1: comb_indrawing_miss.

Model Summary

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	163.979(a)	.231	.339

a Estimation terminated at iteration number 6 because parameter estimates changed by less than .001.

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COMBINED CYANOSIS (PRODROMAL, PRESENTING OR BOTH)

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)	95.0% C.I.for EXP(B)	
								Lower	Upper
Step 1(a)	comb_cyanosis_miss	3.061	.792	14.924	1	.000	21.353	4.518	100.913
	Constant	-1.356	.192	49.745	1	.000	.258		

a Variable(s) entered on step 1: comb_cyanosis_miss.

Model Summary

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	179.490(a)	.117	.174

a Estimation terminated at iteration number 4 because parameter estimates changed by less than .001.

PRESENTING CROUP SCORE

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)	95.0% C.I.for EXP(B)	
								Lower	Upper
Step 1(a)	PSCroup_Score_miss	.301	.094	10.338	1	.001	1.351	1.125	1.624
	Constant	-1.711	.247	47.988	1	.000	.181		

a Variable(s) entered on step 1: PSCroup_Score_miss.

Model Summary

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	195.931(a)	.055	.083

a Estimation terminated at iteration number 4 because parameter estimates changed by less than .001.

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PRESENTING RESPIRATORY RATE

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)	95.0% C.I.for EXP(B)	
								Lower	Upper
Step 1(a)	PSResp_Rate_miss	.057	.015	14.174	1	.000	1.058	1.027	1.090
	Constant	-3.092	.574	28.995	1	.000	.045		

a Variable(s) entered on step 1: PSResp_Rate_miss.

Model Summary

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	186.037(a)	.085	.125

a Estimation terminated at iteration number 4 because parameter estimates changed by less than .001.

PRESENTING HEART RATE

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)	95.0% C.I.for EXP(B)	
								Lower	Upper
Step 1(a)	PSHeart_Rate_miss	.023	.007	9.770	1	.002	1.023	1.009	1.038
	Constant	-4.282	1.044	16.815	1	.000	.014		

a Variable(s) entered on step 1: PSHeart_Rate_miss.

Model Summary

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	190.361(a)	.056	.083

a Estimation terminated at iteration number 4 because parameter estimates changed by less than .001.

PRESENTING OXYGEN SATURATION

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)	95.0% C.I.for EXP(B)	
								Lower	Upper
Step 1(a)	PSO2_Sat_miss	-.136	.045	9.226	1	.002	.873	.800	.953
	Constant	11.893	4.262	7.787	1	.005	146269.019		

a Variable(s) entered on step 1: PSO2_Sat_miss.

Model Summary

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	140.018(a)	.109	.158

a Estimation terminated at iteration number 5 because parameter estimates changed by less than .001.

PRESENTING TEMPERATURE

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)	95.0% C.I.for EXP(B)	
								Lower	Upper
Step 1(a)	PSTemp_miss	.240	.160	2.244	1	.134	1.272	.929	1.741
	Constant	-10.207	6.025	2.871	1	.090	.000		

a Variable(s) entered on step 1: PSTemp_miss.

Model Summary

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	194.378(a)	.012	.019

a Estimation terminated at iteration number 4 because parameter estimates changed by less than .001.

From Table 7b: Odds ratios (and 95% CI) of dichotomous risk factors associated with severe upper airway obstruction (missing data coded as no)

HISTORY OF CROUP

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)	95.0% C.I.for EXP(B)	
								Lower	Upper
Step 1(a)	History_of_croup_nomiss	.206	.377	.299	1	.584	1.229	.587	2.575
	Constant	-1.107	.185	35.928	1	.000	.331		

a Variable(s) entered on step 1: History_of_croup_nomiss.

Model Summary

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	230.126(a)	.001	.002

a Estimation terminated at iteration number 4 because parameter estimates changed by less than .001.

PRODROMAL OBSTRUCTIVE STRIDOR

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)	95.0% C.I.for EXP(B)	
								Lower	Upper
Step 1(a)	Obst_Stridor_nomiss	1.340	.360	13.848	1	.000	3.818	1.885	7.732
	Constant	-1.866	.298	39.193	1	.000	.155		

a Variable(s) entered on step 1: Obst_Stridor_nomiss.

Model Summary

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	214.967(a)	.074	.108

a Estimation terminated at iteration number 4 because parameter estimates changed by less than .001.

PRODROMAL OBSTRUCTIVE INDRAWING

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)	95.0% C.I.for EXP(B)	
								Lower	Upper
Step 1(a)	Obst__Indr_nomiss	2.542	.410	38.471	1	.000	12.702	5.689	28.359
	Constant	-2.494	.347	51.716	1	.000	.083		

a Variable(s) entered on step 1: Obst__Indr_nomiss.

Model Summary

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	180.019(a)	.221	.325

a Estimation terminated at iteration number 5 because parameter estimates changed by less than .001.

PRODROMAL OBSTRUCTIVE CYANOSIS

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)	95.0% C.I.for EXP(B)	
								Lower	Upper
Step 1(a)	Obst_Cyano_nomiss	3.440	1.068	10.370	1	.001	31.186	3.843	253.061
	Constant	-1.243	.173	51.537	1	.000	.289		

a Variable(s) entered on step 1: Obst_Cyano_nomiss.

Model Summary

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	210.741(a)	.093	.136

a Estimation terminated at iteration number 5 because parameter estimates changed by less than .001.

ANY PRESENTING BARKY COUGH

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)	95.0% C.I.for EXP(B)	
								Lower	Upper
Step 1(a)	PSBarky_cough_nomiss	-1.100	.339	10.518	1	.001	.333	.171	.647
	Constant	-.556	.212	6.863	1	.009	.574		

a Variable(s) entered on step 1: PSBarky_cough_nomiss.

Model Summary

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	219.296(a)	.054	.079

a Estimation terminated at iteration number 4 because parameter estimates changed by less than .001.

ANY PRESENTING NON-BARKY COUGH

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)	95.0% C.I.for EXP(B)	
								Lower	Upper
Step 1(a)	PSNon_barky_cough_nomiss	1.507	.610	6.102	1	.014	4.511	1.365	14.908
	Constant	-1.170	.171	47.017	1	.000	.310		

a Variable(s) entered on step 1: PSNon_barky_cough_nomiss.

Model Summary

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	224.317(a)	.030	.044

a Estimation terminated at iteration number 4 because parameter estimates changed by less than .001.

ANY PRESEINTING STRIDOR

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)	95.0% C.I.for EXP(B)	
								Lower	Upper
Step 1(a)	any_PSstridor_nomiss	1.205	.360	11.236	1	.001	3.338	1.650	6.754
	Constant	-1.804	.299	36.349	1	.000	.165		

a Variable(s) entered on step 1: any_PSstridor_nomiss.

Model Summary

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	217.995(a)	.060	.088

a Estimation terminated at iteration number 4 because parameter estimates changed by less than .001.

ANY PRESENTING INDRAWING

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)	95.0% C.I.for EXP(B)	
								Lower	Upper
Step 1(a)	any_PSindrawing_nomiss	1.883	.365	26.555	1	.000	6.574	3.212	13.456
	Constant	-2.070	.294	49.451	1	.000	.126		

a Variable(s) entered on step 1: any_PSindrawing_nomiss.

Model Summary

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	199.866(a)	.140	.206

a Estimation terminated at iteration number 5 because parameter estimates changed by less than .001.

ANY PRESENTING CYANOSIS

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)	95.0% C.I.for EXP(B)	
								Lower	Upper
Step 1(a)	any_PScyanosis_nomiss	2.869	.794	13.053	1	.000	17.619	3.716	83.542
	Constant	-1.260	.175	51.902	1	.000	.284		

a Variable(s) entered on step 1: any_PScyanosis_nomiss.

Model Summary

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	211.544(a)	.089	.131

a Estimation terminated at iteration number 4 because parameter estimates changed by less than .001.

PRESENTING DECREASED LEVEL OF CONSCIOUSNESS

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)	95.0% C.I.for EXP(B)	
								Lower	Upper
Step 1(a)	any_PSloc_nomiss	2.599	.595	19.046	1	.000	13.447	4.186	43.202
	Constant	-1.346	.182	54.629	1	.000	.260		

a Variable(s) entered on step 1: any_PSloc_nomiss.

Model Summary

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	206.496(a)	.112	.164

a Estimation terminated at iteration number 4 because parameter estimates changed by less than .001.

COMBINED NON-BARKY COUGH (PRODROMAL, PRESENTING, OR BOTH)

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)	95.0% C.I.for EXP(B)	
								Lower	Upper
Step 1(a)	comb_nonbarkycough_nomiss	.917	.342	7.199	1	.007	2.502	1.280	4.889
	Constant	-1.352	.205	43.595	1	.000	.259		

a Variable(s) entered on step 1: comb_nonbarkycough_nomiss.

Model Summary

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	223.349(a)	.034	.051

a Estimation terminated at iteration number 4 because parameter estimates changed by less than .001.

COMBINED INDRAWING (PRODROMAL, PRESENTING, OR BOTH)

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)	95.0% C.I.for EXP(B)	
								Lower	Upper
Step 1(a)	comb_indrawing_nomiss	2.615	.442	34.927	1	.000	13.661	5.740	32.512
	Constant	-2.679	.391	47.015	1	.000	.069		

a Variable(s) entered on step 1: comb_indrawing_nomiss.

Model Summary

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	180.805(a)	.218	.320

a Estimation terminated at iteration number 5 because parameter estimates changed by less than .001.

COMBINED CYANOSIS (PRODROMAL, PRESENTING, OR BOTH)

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)	95.0% C.I.for EXP(B)	
								Lower	Upper
Step 1(a)	comb_cyanosis_nomiss	2.988	.789	14.356	1	.000	19.854	4.231	93.151
	Constant	-1.284	.176	52.902	1	.000	.277		

a Variable(s) entered on step 1: comb_cyanosis_nomiss.

Model Summary

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	208.855(a)	.101	.149

a Estimation terminated at iteration number 4 because parameter estimates changed by less than .001.

From Table 8: Adjusted odds ratios (and 95% CI) of risk factors associated with severe upper airway obstruction using presenting symptoms

ALL RISK FACTORS SIGNIFICANT AT P<0.10 IN THE FULL MODEL

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)	95.0% C.I.for EXP(B)	
								Lower	Upper
Step 1(a)	Sore_throat_bin	1.694	.528	10.288	1	.001	5.443	1.933	15.328
	Fever_bin	.661	.444	2.223	1	.136	1.937	.812	4.622
	Prior_Intubation_bin	1.885	1.315	2.053	1	.152	6.585	.500	86.739
	Rhinnorhea_bin	.945	.467	4.091	1	.043	2.572	1.030	6.424
	any_PSloc_nomiss	1.398	.817	2.931	1	.087	4.048	.817	20.061
	any_PSstridor_nomiss	.607	.528	1.323	1	.250	1.835	.652	5.162
	any_PSindrawing_nomiss	1.655	.513	10.423	1	.001	5.236	1.916	14.304
	PSBarky_cough_nomiss	-1.448	.466	9.647	1	.002	.235	.094	.586
	PSNon_barky_cough_nomiss	1.011	.931	1.177	1	.278	2.747	.443	17.053
	any_PScyanosis_nomiss	.742	1.089	.465	1	.495	2.101	.249	17.749
	Constant	-2.993	.535	31.294	1	.000	.050		

a Variable(s) entered on step 1: Sore_throat_bin, Fever_bin, Prior_Intubation_bin, Rhinnorhea_bin, any_PSloc_nomiss, any_PSstridor_nomiss, any_PSindrawing_nomiss, PSBarky_cough_nomiss, PSNon_barky_cough_nomiss, any_PScyanosis_nomiss.

Model Summary

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	148.002(a)	.335	.492

a Estimation terminated at iteration number 6 because parameter estimates changed by less than .001.

SIGNIFICANT RISK FACTORS FROM THE FULL MODEL (REDUCED MODEL)

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)	95.0% C.I.for EXP(B)	
								Lower	Upper
Step 1(a)	Sore_throat_bin	1.933	.485	15.892	1	.000	6.907	2.671	17.861
	any_PSindrawing_nomiss	2.319	.433	28.644	1	.000	10.163	4.348	23.758
	PSBarky_cough_nomiss	-1.489	.411	13.090	1	.000	.226	.101	.505
	Rhinnorhea_bin	1.221	.425	8.243	1	.004	3.390	1.473	7.803
	Constant	-2.492	.434	32.973	1	.000	.083		

a Variable(s) entered on step 1: Sore_throat_bin, any_PSindrawing_nomiss, PSBarky_cough_nomiss, Rhinnorhea_bin.

Model Summary

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	163.347(a)	.283	.415

a Estimation terminated at iteration number 5 because parameter estimates changed by less than .001.

RISK FACTORS NOT SIGNIFICANT IN THE FULL MODEL THAT ARE ADDED ONE AT A TIME TO THE REDUCED MODEL

PRESENTING DECREASED LEVEL OF CONSCIOUSNESS

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)	95.0% C.I.for EXP(B)	
								Lower	Upper
Step 1(a)	Sore_throat_bin	1.878	.491	14.647	1	.000	6.538	2.499	17.103
	any_PSindrawing_nomiss	2.104	.442	22.674	1	.000	8.199	3.449	19.494
	PSBarky_cough_nomiss	-1.379	.427	10.461	1	.001	.252	.109	.581
	Rhinnorhea_bin	1.024	.442	5.353	1	.021	2.783	1.169	6.625
	any_PSloc_nomiss	1.721	.699	6.062	1	.014	5.593	1.421	22.017
	Constant	-2.510	.431	33.991	1	.000	.081		

a Variable(s) entered on step 1: Sore_throat_bin, any_PSindrawing_nomiss, PSBarky_cough_nomiss, Rhinnorhea_bin, any_PSloc_nomiss.

Model Summary

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	156.660(a)	.306	.450

a Estimation terminated at iteration number 5 because parameter estimates changed by less than .001.

ANY PRESENTING STRIDOR

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)	95.0% C.I.for EXP(B)	
								Lower	Upper
Step 1(a)	Sore_throat_bin	1.964	.489	16.170	1	.000	7.131	2.737	18.578
	any_PSindrawing_nomiss	2.032	.490	17.226	1	.000	7.632	2.923	19.928
	PSBarky_cough_nomiss	-1.527	.415	13.532	1	.000	.217	.096	.490
	Rhinnorhea_bin	1.221	.430	8.077	1	.004	3.392	1.461	7.874
	any_PSstridor_nomiss	.571	.493	1.338	1	.247	1.770	.673	4.655
	Constant	-2.681	.476	31.765	1	.000	.068		

a Variable(s) entered on step 1: Sore_throat_bin, any_PSindrawing_nomiss, PSBarky_cough_nomiss, Rhinnorhea_bin, any_PSstridor_nomiss.

Model Summary

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	162.011(a)	.287	.422

a Estimation terminated at iteration number 5 because parameter estimates changed by less than .001.

PRODROMAL FEVER

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)	95.0% C.I.for EXP(B)	
								Lower	Upper
Step 1(a)	Sore_throat_bin	1.705	.501	11.571	1	.001	5.502	2.060	14.696
	any_PSindrawing_nomiss	2.303	.435	28.002	1	.000	10.004	4.263	23.475
	PSBarky_cough_nomiss	-1.526	.417	13.370	1	.000	.217	.096	.492
	Rhinnorhea_bin	1.212	.430	7.933	1	.005	3.361	1.446	7.813
	Fever_bin	.646	.415	2.423	1	.120	1.907	.846	4.299
	Constant	-2.711	.466	33.778	1	.000	.066		

a Variable(s) entered on step 1: Sore_throat_bin, any_PSindrawing_nomiss, PSBarky_cough_nomiss, Rhinnorhea_bin, Fever_bin.

Model Summary

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	160.919(a)	.291	.428

a Estimation terminated at iteration number 5 because parameter estimates changed by less than .001.

PRIOR INTUBATION

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)	95.0% C.I.for EXP(B)	
								Lower	Upper
Step 1(a)	Sore_throat_bin	1.909	.485	15.501	1	.000	6.744	2.608	17.443
	any_PSindrawing_nomiss	2.223	.437	25.838	1	.000	9.236	3.919	21.766
	PSBarky_cough_nomiss	-1.532	.419	13.367	1	.000	.216	.095	.491
	Rhinnorhea_bin	1.169	.431	7.372	1	.007	3.220	1.384	7.489
	Prior_Intubation_bin	1.745	1.261	1.913	1	.167	5.724	.483	67.836
	Constant	-2.448	.432	32.135	1	.000	.086		

a Variable(s) entered on step 1: Sore_throat_bin, any_PSindrawing_nomiss, PSBarky_cough_nomiss, Rhinnorhea_bin, Prior_Intubation_bin.

Model Summary

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	161.055(a)	.291	.427

a Estimation terminated at iteration number 5 because parameter estimates changed by less than .001.

ANY PRESENTING NON-BARKY COUGH

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)	95.0% C.I.for EXP(B)	
								Lower	Upper
Step 1(a)	Sore_throat_bin	1.998	.498	16.090	1	.000	7.377	2.778	19.585
	any_PSindrawing_nomiss	2.359	.443	28.336	1	.000	10.581	4.439	25.220
	PSBarky_cough_nomiss	-1.347	.424	10.115	1	.001	.260	.113	.596
	Rhinnorhea_bin	1.226	.427	8.236	1	.004	3.407	1.475	7.869
	PSNon_barky_cough_nomiss	1.321	.824	2.569	1	.109	3.746	.745	18.830
	Constant	-2.683	.463	33.581	1	.000	.068		

a Variable(s) entered on step 1: Sore_throat_bin, any_PSindrawing_nomiss, PSBarky_cough_nomiss, Rhinnorhea_bin, PSNon_barky_cough_nomiss.

Model Summary

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	160.765(a)	.292	.429

a Estimation terminated at iteration number 5 because parameter estimates changed by less than .001.

ANY PRESENTING CYANOSIS

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)	95.0% C.I.for EXP(B)	
								Lower	Upper
Step 1(a)	Sore_throat_bin	1.819	.488	13.878	1	.000	6.166	2.368	16.056
	any_PSindrawing_nomiss	2.084	.445	21.967	1	.000	8.034	3.361	19.202
	PSBarky_cough_nomiss	-1.495	.424	12.455	1	.000	.224	.098	.514
	Rhinnorhea_bin	1.120	.436	6.606	1	.010	3.066	1.305	7.205
	any_PScyanosis_nomiss	1.768	.910	3.774	1	.052	5.859	.984	34.873
	Constant	-2.405	.428	31.559	1	.000	.090		

a Variable(s) entered on step 1: Sore_throat_bin, any_PSindrawing_nomiss, PSBarky_cough_nomiss, Rhinnorhea_bin, any_PScyanosis_nomiss.

Model Summary

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	158.810(a)	.298	.439

a Estimation terminated at iteration number 5 because parameter estimates changed by less than .001.

TEST FOR CONFOUNDING- FEVER

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)	95.0% C.I.for EXP(B)	
								Lower	Upper
Step 1(a)	Sore_throat_bin	1.661	.507	10.724	1	.001	5.265	1.948	14.230
	any_PSindrawing_nomiss	2.079	.444	21.956	1	.000	7.999	3.352	19.090
	PSBarky_cough_nomiss	-1.398	.432	10.482	1	.001	.247	.106	.576
	Rhinnorhea_bin	1.002	.448	5.004	1	.025	2.723	1.132	6.551
	any_PSloc_nomiss	1.690	.697	5.881	1	.015	5.417	1.383	21.221
	Fever_bin	.634	.423	2.250	1	.134	1.885	.823	4.318
	Constant	-2.729	.466	34.334	1	.000	.065		

a Variable(s) entered on step 1: Sore_throat_bin, any_PSindrawing_nomiss, PSBarky_cough_nomiss, Rhinnorhea_bin, any_PSloc_nomiss, Fever_bin.

Model Summary

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	154.410(a)	.314	.461

a Estimation terminated at iteration number 5 because parameter estimates changed by less than .001.

TEST FOR CONFOUNDING- PRIOR INTUBATION

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)	95.0% C.I.for EXP(B)	
								Lower	Upper
Step 1(a)	Sore_throat_bin	1.853	.491	14.251	1	.000	6.377	2.437	16.687
	any_PSindrawing_nomiss	1.963	.449	19.078	1	.000	7.118	2.950	17.173
	PSBarky_cough_nomiss	-1.414	.437	10.472	1	.001	.243	.103	.573
	Rhinnorhea_bin	.928	.454	4.182	1	.041	2.529	1.039	6.155
	any_PSloc_nomiss	1.836	.694	6.994	1	.008	6.271	1.609	24.451
	Prior_Intubation_bin	2.044	1.247	2.689	1	.101	7.725	.671	88.945
	Constant	-2.461	.428	33.055	1	.000	.085		

a Variable(s) entered on step 1: Sore_throat_bin, any_PSindrawing_nomiss, PSBarky_cough_nomiss, Rhinnorhea_bin, any_PSloc_nomiss, Prior_Intubation_bin.

Model Summary

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	153.365(a)	.317	.466

a Estimation terminated at iteration number 5 because parameter estimates changed by less than .001.

TEST FOR CONFOUNDING- STRIDOR

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)	95.0% C.I.for EXP(B)	
								Lower	Upper
Step 1(a)	Sore_throat_bin	1.910	.493	15.023	1	.000	6.755	2.571	17.746
	any_PSindrawing_nomiss	1.811	.498	13.233	1	.000	6.118	2.306	16.232
	PSBarky_cough_nomiss	-1.430	.432	10.983	1	.001	.239	.103	.557
	Rhinnorhea_bin	1.024	.448	5.216	1	.022	2.784	1.156	6.704
	any_PSloc_nomiss	1.742	.705	6.094	1	.014	5.706	1.432	22.742
	any_PSstridor_nomiss	.592	.502	1.393	1	.238	1.808	.676	4.838
	Constant	-2.705	.474	32.630	1	.000	.067		

a Variable(s) entered on step 1: Sore_throat_bin, any_PSindrawing_nomiss, PSBarky_cough_nomiss, Rhinnorhea_bin, any_PSloc_nomiss, any_PSstridor_nomiss.

Model Summary

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	155.270(a)	.311	.457

a Estimation terminated at iteration number 5 because parameter estimates changed by less than .001.

TEST FOR CONFOUNDING- NON-BARKY COUGH

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)	95.0% C.I.for EXP(B)	
								Lower	Upper
Step 1(a)	Sore_throat_bin	1.933	.502	14.825	1	.000	6.909	2.583	18.480
	any_PSindrawing_nomiss	2.143	.451	22.582	1	.000	8.526	3.523	20.636
	PSBarky_cough_nomiss	-1.260	.438	8.273	1	.004	.284	.120	.669
	Rhinnorhea_bin	1.021	.445	5.267	1	.022	2.775	1.161	6.634
	any_PSloc_nomiss	1.611	.699	5.308	1	.021	5.007	1.272	19.710
	PSNon_barky_cough_nomiss	1.087	.833	1.705	1	.192	2.965	.580	15.161
	Constant	-2.662	.457	33.906	1	.000	.070		

a Variable(s) entered on step 1: Sore_throat_bin, any_PSindrawing_nomiss, PSBarky_cough_nomiss, Rhinnorhea_bin, any_PSloc_nomiss, PSNon_barky_cough_nomiss.

Model Summary

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	154.958(a)	.312	.458

a Estimation terminated at iteration number 5 because parameter estimates changed by less than .001.

TEST FOR CONFOUNDING- CYANOSIS

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)	95.0% C.I.for EXP(B)	
								Lower	Upper
Step 1(a)	Sore_throat_bin	1.846	.493	14.050	1	.000	6.335	2.413	16.633
	any_PSindrawing_nomiss	2.019	.447	20.365	1	.000	7.531	3.134	18.101
	PSBarky_cough_nomiss	-1.400	.431	10.563	1	.001	.247	.106	.574
	Rhinnorhea_bin	.996	.446	4.980	1	.026	2.707	1.129	6.490
	any_PSloc_nomiss	1.418	.778	3.328	1	.068	4.131	.900	18.960
	any_PScyanosis_nomiss	1.136	1.065	1.139	1	.286	3.115	.387	25.092
	Constant	-2.461	.430	32.725	1	.000	.085		

a Variable(s) entered on step 1: Sore_throat_bin, any_PSindrawing_nomiss, PSBarky_cough_nomiss, Rhinnorhea_bin, any_PSloc_nomiss, any_PScyanosis_nomiss.

Model Summary

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	155.479(a)	.310	.456

a Estimation terminated at iteration number 5 because parameter estimates changed by less than .001.

DETERIMING THE EFFECTS OF CYANOSIS VERSUS LEVEL OF CONSCIOUNESS

CYANOSIS AND LEVEL OF CONSCIOUSNESS IN THE MODEL

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)	95.0% C.I.for EXP(B)	
								Lower	Upper
Step 1(a)	Sore_throat_bin	1.875	.495	14.369	1	.000	6.522	2.473	17.198
	any_PSindrawing_nomiss	1.740	.501	12.063	1	.001	5.700	2.135	15.220
	PSBarky_cough_nomiss	-1.454	.437	11.079	1	.001	.234	.099	.550
	Rhinnorhea_bin	1.000	.452	4.897	1	.027	2.720	1.121	6.597
	any_PSloc_nomiss	1.443	.783	3.393	1	.065	4.233	.912	19.654
	any_PScyanosis_nomiss	1.095	1.066	1.055	1	.304	2.989	.370	24.147
	any_PSstridor_nomiss	.574	.503	1.302	1	.254	1.776	.662	4.761
	Constant	-2.650	.473	31.361	1	.000	.071		

a Variable(s) entered on step 1: Sore_throat_bin, any_PSindrawing_nomiss, PSBarky_cough_nomiss, Rhinnorhea_bin, any_PSloc_nomiss, any_PScyanosis_nomiss, any_PSstridor_nomiss.

Model Summary

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	154.179(a)	.314	.462

a Estimation terminated at iteration number 5 because parameter estimates changed by less than .001.

ONLY CYANOSIS

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)	95.0% C.I.for EXP(B)	
								Lower	Upper
Step 1(a)	Sore_throat_bin	1.849	.491	14.184	1	.000	6.352	2.427	16.624
	any_PSindrawing_nomiss	1.814	.498	13.279	1	.000	6.136	2.313	16.281
	PSBarky_cough_nomiss	-1.545	.429	12.946	1	.000	.213	.092	.495
	Rhinnorhea_bin	1.129	.441	6.551	1	.010	3.092	1.303	7.339
	any_PScyanosis_nomiss	1.753	.910	3.707	1	.054	5.772	.969	34.376
	any_PSstridor_nomiss	.552	.497	1.231	1	.267	1.736	.655	4.602
	Constant	-2.587	.470	30.255	1	.000	.075		

a Variable(s) entered on step 1: Sore_throat_bin, any_PSindrawing_nomiss, PSBarky_cough_nomiss, Rhinnorhea_bin, any_PScyanosis_nomiss, any_PSstridor_nomiss.

Model Summary

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	157.583(a)	.303	.445

a Estimation terminated at iteration number 5 because parameter estimates changed by less than .001.

ONLY LEVEL OF CONSCIOUSNESS

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)	95.0% C.I.for EXP(B)	
								Lower	Upper
Step 1(a)	Sore_throat_bin	1.910	.493	15.023	1	.000	6.755	2.571	17.746
	any_PSindrawing_nomiss	1.811	.498	13.233	1	.000	6.118	2.306	16.232
	PSBarky_cough_nomiss	-1.430	.432	10.983	1	.001	.239	.103	.557
	Rhinnorhea_bin	1.024	.448	5.216	1	.022	2.784	1.156	6.704
	any_PSloc_nomiss	1.742	.705	6.094	1	.014	5.706	1.432	22.742
	any_PSstridor_nomiss	.592	.502	1.393	1	.238	1.808	.676	4.838
	Constant	-2.705	.474	32.630	1	.000	.067		

a Variable(s) entered on step 1: Sore_throat_bin, any_PSindrawing_nomiss, PSBarky_cough_nomiss, Rhinnorhea_bin, any_PSloc_nomiss, any_PSstridor_nomiss.

Model Summary

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	155.270(a)	.311	.457

a Estimation terminated at iteration number 5 because parameter estimates changed by less than .001.

oL1

ADDING CONTINOUS VARIABLES TO THE MODEL ONE AT A TIME

PRESETNING HEART RATE

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)	95.0% C.I.for EXP(B)	
								Lower	Upper
Step 1(a)	Sore_throat_bin	2.293	.591	15.058	1	.000	9.908	3.111	31.554
	any_PSindrawing_nomiss	2.044	.583	12.278	1	.000	7.721	2.461	24.219
	PSBarky_cough_nomiss	-1.188	.484	6.025	1	.014	.305	.118	.787
	Rhinnorhea_bin	.764	.516	2.194	1	.139	2.147	.781	5.899
	any_PSloc_nomiss	1.798	.758	5.632	1	.018	6.036	1.368	26.638
	any_PSstridor_nomiss	1.059	.598	3.138	1	.076	2.883	.893	9.306
	PSHeart_Rate_miss	.017	.009	3.200	1	.074	1.017	.998	1.036
	Constant	-5.868	1.450	16.386	1	.000	.003		

a Variable(s) entered on step 1: Sore_throat_bin, any_PSindrawing_nomiss, PSBarky_cough_nomiss, Rhinnorhea_bin, any_PSloc_nomiss, any_PSstridor_nomiss, PSHeart_Rate_miss.

Model Summary

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	122.443(a)	.351	.524

a Estimation terminated at iteration number 6 because parameter estimates changed by less than .001.

PRESENTING RESPIRATORY RATE

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)	95.0% C.I.for EXP(B)	
								Lower	Upper
Step 1(a)	Sore_throat_bin	2.338	.593	15.532	1	.000	10.358	3.239	33.128
	any_PSindrawing_nomiss	2.006	.583	11.854	1	.001	7.430	2.372	23.273
	PSBarky_cough_nomiss	-1.461	.513	8.120	1	.004	.232	.085	.634
	Rhinnorhea_bin	.653	.519	1.580	1	.209	1.921	.694	5.317
	any_PSloc_nomiss	1.755	.757	5.370	1	.020	5.782	1.311	25.506
	any_PSstridor_nomiss	1.107	.593	3.480	1	.062	3.024	.945	9.672
	PSResp_Rate_miss	.053	.021	6.725	1	.010	1.055	1.013	1.098
	Constant	-5.215	.965	29.197	1	.000	.005		

a Variable(s) entered on step 1: Sore_throat_bin, any_PSindrawing_nomiss, PSBarky_cough_nomiss, Rhinnorhea_bin, any_PSloc_nomiss, any_PSstridor_nomiss, PSResp_Rate_miss.

Model Summary

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	119.015(a)	.371	.548

a Estimation terminated at iteration number 6 because parameter estimates changed by less than .001.

PRSENTING OXYGEN SATURATION

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)	95.0% C.I.for EXP(B)	
								Lower	Upper
Step 1(a)	Sore_throat_bin	2.114	.668	10.026	1	.002	8.283	2.238	30.656
	any_PSindrawing_nomiss	2.167	.645	11.296	1	.001	8.733	2.468	30.901
	PSBarky_cough_nomiss	-1.481	.565	6.862	1	.009	.227	.075	.689
	Rhinnorhea_bin	.982	.566	3.015	1	.083	2.670	.881	8.090
	any_PSloc_nomiss	.562	.883	.405	1	.525	1.754	.310	9.908
	any_PSstridor_nomiss	.966	.682	2.008	1	.156	2.627	.691	9.994
	PSO2_Sat_miss	-.153	.066	5.293	1	.021	.858	.754	.978
	Constant	11.360	6.235	3.320	1	.068	85810.244		

a Variable(s) entered on step 1: Sore_throat_bin, any_PSindrawing_nomiss, PSBarky_cough_nomiss, Rhinnorhea_bin, any_PSloc_nomiss, any_PSstridor_nomiss, PSO2_Sat_miss.

Model Summary

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	96.480(a)	.358	.519

a Estimation terminated at iteration number 6 because parameter estimates changed by less than .001.

SIGNIFICANT CONTINOUS VARIABLES ADDED TO THE MODEL

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)	95.0% C.I.for EXP(B)	
								Lower	Upper
Step 1(a)	Sore_throat_bin	2.478	.741	11.185	1	.001	11.923	2.790	50.957
	any_PSindrawing_nomiss	2.324	.702	10.947	1	.001	10.216	2.579	40.472
	PSBarky_cough_nomiss	-1.701	.625	7.414	1	.006	.183	.054	.621
	Rhinnorhea_bin	.595	.608	.958	1	.328	1.813	.551	5.967
	any_PSloc_nomiss	.565	.930	.368	1	.544	1.759	.284	10.897
	any_PSstridor_nomiss	1.315	.736	3.191	1	.074	3.727	.880	15.782
	PSO2_Sat_miss	-.133	.069	3.718	1	.054	.875	.765	1.002
	PSResp_Rate_miss	.040	.024	2.772	1	.096	1.041	.993	1.090
	Constant	7.818	6.718	1.354	1	.245	2485.254		

a Variable(s) entered on step 1: Sore_throat_bin, any_PSindrawing_nomiss, PSBarky_cough_nomiss, Rhinnorhea_bin, any_PSloc_nomiss, any_PSstridor_nomiss, PSO2_Sat_miss, PSResp_Rate_miss.

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Model Summary

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	85.873(a)	.394	.568

a Estimation terminated at iteration number 6 because parameter estimates changed by less than .001.

TESTING SIGNIFICANT CONTINOUS VARIABLES WITH THE SAME PAITENTS

PRESENTING OXYGEN SATURATION

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)	95.0% C.I.for EXP(B)	
								Lower	Upper
Step 1(a)	Rhinnorhea_bin	.401	.567	.500	1	.479	1.493	.491	4.538
	Sore_throat_bin	2.054	.704	8.520	1	.004	7.803	1.964	30.998
	Obst__Indr_nomiss	2.458	.714	11.841	1	.001	11.682	2.881	47.373
	Obst_Barky_cough_nomiss	-1.106	.595	3.454	1	.063	.331	.103	1.062
	any_PSstridor_nomiss	.990	.751	1.737	1	.188	2.691	.617	11.725
	any_PSloc_nomiss	.778	.877	.788	1	.375	2.178	.390	12.148
	PSO2_Sat_miss	-.162	.072	5.101	1	.024	.850	.739	.979
	Constant	12.083	6.778	3.178	1	.075	176836.996		

a Variable(s) entered on step 1: Rhinnorhea_bin, Sore_throat_bin, Obst__Indr_nomiss, Obst_Barky_cough_nomiss, any_PSstridor_nomiss, any_PSloc_nomiss, PSO2_Sat_miss.

Model Summary

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	90.871(a)	.369	.532

a Estimation terminated at iteration number 6 because parameter estimates changed by less than .001.

PRESENTING RESPIRATORY RATE

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)	95.0% C.I.for EXP(B)	
								Lower	Upper
Step 1(a)	Rhinnorhea_bin	.040	.561	.005	1	.943	1.041	.347	3.123
	Sore_throat_bin	2.131	.707	9.083	1	.003	8.422	2.107	33.669
	Obst__Indr_nomiss	2.507	.716	12.251	1	.000	12.262	3.013	49.903
	Obst_Barky_cough_nomiss	-1.058	.591	3.206	1	.073	.347	.109	1.105
	any_PSstridor_nomiss	.780	.706	1.221	1	.269	2.182	.547	8.704
	any_PSloc_nomiss	1.910	.795	5.772	1	.016	6.752	1.422	32.066
	PSResp_Rate_miss	.048	.023	4.239	1	.040	1.049	1.002	1.099
	Constant	-4.992	1.123	19.745	1	.000	.007		

a Variable(s) entered on step 1: Rhinnorhea_bin, Sore_throat_bin, Obst__Indr_nomiss, Obst_Barky_cough_nomiss, any_PSstridor_nomiss, any_PSloc_nomiss, PSResp_Rate_miss.

Model Summary

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	92.860(a)	.359	.518

a Estimation terminated at iteration number 6 because parameter estimates changed by less than .001.

FINAL MODEL

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)	95.0% C.I.for EXP(B)	
								Lower	Upper
Step 1(a)	Rhinnorhea_bin	.659	.544	1.467	1	.226	1.934	.665	5.621
	Sore_throat_bin	1.964	.668	8.655	1	.003	7.131	1.927	26.397
	Obst__Indr_nomiss	2.254	.670	11.310	1	.001	9.530	2.561	35.456
	Obst_Barky_cough_nomiss	-1.094	.563	3.773	1	.052	.335	.111	1.010
	any_PSstridor_nomiss	.734	.703	1.091	1	.296	2.084	.525	8.266
	any_PSloc_nomiss	.762	.854	.797	1	.372	2.143	.402	11.427
	PSO2_Sat_miss	-.151	.068	4.904	1	.027	.860	.753	.983
	Constant	11.297	6.460	3.058	1	.080	80606.774		

a Variable(s) entered on step 1: Rhinnorhea_bin, Sore_throat_bin, Obst__Indr_nomiss, Obst_Barky_cough_nomiss, any_PSstridor_nomiss, any_PSloc_nomiss, PSO2_Sat_miss.

Model Summary

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	99.153(a)	.344	.500

a Estimation terminated at iteration number 6 because parameter estimates changed by less than .001.

GOODNESS OF FIT

Hosmer and Lemeshow Test

Step	Chi-square	df	Sig.
1	5.486	8	.705

SENSITIVITY ANALYSIS USING COMBINED SYMPTOMS

From Table 9: Adjusted odds ratios (and 95% CI) of risk factors associated with severe upper airway obstruction using combined prodromal and presenting symptoms

ALL RISK FACTORS SIGNIFICANT AT P<0.10 IN THE FULL MODEL

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)	95.0% C.I.for EXP(B)	
								Lower	Upper
Step 1(a)	Sore_throat_bin	1.774	.544	10.646	1	.001	5.895	2.031	17.111
	Fever_bin	.506	.440	1.321	1	.250	1.659	.700	3.930
	Prior_Intubation_bin	1.230	1.245	.976	1	.323	3.421	.298	39.250
	Rhinnorhea_bin	.300	.478	.395	1	.530	1.350	.529	3.445
	any_PSloc_nomiss	1.814	.853	4.517	1	.034	6.134	1.152	32.670
	comb_stridor_nomiss	.398	.570	.488	1	.485	1.489	.487	4.554
	comb_indrawing_nomiss	2.300	.575	16.022	1	.000	9.971	3.234	30.744
	comb_nonbarkycough_nomiss	.907	.497	3.332	1	.068	2.476	.935	6.554
	comb_cyanosis_nomiss	.820	.999	.673	1	.412	2.271	.320	16.097
	Constant	-4.054	.607	44.621	1	.000	.017		

a Variable(s) entered on step 1: Sore_throat_bin, Fever_bin, Prior_Intubation_bin, Rhinnorhea_bin, any_PSloc_nomiss, comb_stridor_nomiss, comb_indrawing_nomiss, comb_nonbarkycough_nomiss, comb_cyanosis_nomiss.

Model Summary

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	143.131(a)	.351	.516

a Estimation terminated at iteration number 6 because parameter estimates changed by less than .001.

SIGNIFICANT RISK FACTORS FROM THE FULL MODEL (REDUCED MODEL)

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)	95.0% C.I.for EXP(B)	
								Lower	Upper
Step 1(a)	Sore_throat_bin	1.746	.501	12.139	1	.000	5.729	2.146	15.296
	comb_indrawing_nomiss	2.605	.483	29.029	1	.000	13.525	5.244	34.885
	any_PSloc_nomiss	2.332	.722	10.432	1	.001	10.304	2.502	42.432
	Constant	-3.316	.464	51.045	1	.000	.036		

a Variable(s) entered on step 1: Sore_throat_bin, comb_indrawing_nomiss, any_PSloc_nomiss.

Model Summary

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	154.304(a)	.314	.461

a Estimation terminated at iteration number 6 because parameter estimates changed by less than .001.

RISK FACTORS NOT SIGNIFICANT IN THE FULL MODEL THAT ARE ADDED ONE AT A TIME TO THE REDUCED MODEL

PRODROMAL FEVER

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)	95.0% C.I.for EXP(B)	
								Lower	Upper
Step 1(a)	Sore_throat_bin	1.568	.517	9.206	1	.002	4.798	1.742	13.212
	comb_indrawing_nomiss	2.582	.486	28.229	1	.000	13.229	5.103	34.295
	any_PSloc_nomiss	2.355	.726	10.517	1	.001	10.537	2.539	43.735
	Fever_bin	.565	.420	1.809	1	.179	1.759	.772	4.007
	Constant	-3.527	.503	49.251	1	.000	.029		

a Variable(s) entered on step 1: Sore_throat_bin, comb_indrawing_nomiss, any_PSloc_nomiss, Fever_bin.

Model Summary

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	152.495(a)	.320	.470

a Estimation terminated at iteration number 6 because parameter estimates changed by less than .001.

PRIOR INTUBATION

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)	95.0% C.I.for EXP(B)	
								Lower	Upper
Step 1(a)	Sore_throat_bin	1.786	.505	12.485	1	.000	5.963	2.215	16.055
	comb_indrawing_nomiss	2.501	.489	26.174	1	.000	12.197	4.679	31.800
	any_PSloc_nomiss	2.430	.718	11.443	1	.001	11.364	2.779	46.461
	Prior_Intubation_bin	2.007	1.168	2.952	1	.086	7.440	.754	73.415
	Constant	-3.342	.468	50.981	1	.000	.035		

a Variable(s) entered on step 1: Sore_throat_bin, comb_indrawing_nomiss, any_PSloc_nomiss, Prior_Intubation_bin.

Model Summary

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	150.599(a)	.326	.480

a Estimation terminated at iteration number 6 because parameter estimates changed by less than .001.

PRODROMAL RHINNORHEA

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)	95.0% C.I.for EXP(B)	
								Lower	Upper
Step 1(a)	Sore_throat_bin	1.832	.508	12.978	1	.000	6.244	2.305	16.914
	comb_indrawing_nomiss	2.602	.484	28.856	1	.000	13.497	5.222	34.884
	any_PSloc_nomiss	2.151	.747	8.294	1	.004	8.596	1.988	37.167
	Rhinnorhea_bin	.657	.438	2.248	1	.134	1.928	.817	4.550
	Constant	-3.536	.496	50.811	1	.000	.029		

a Variable(s) entered on step 1: Sore_throat_bin, comb_indrawing_nomiss, any_PSloc_nomiss, Rhinnorhea_bin.

Model Summary

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	152.072(a)	.321	.473

a Estimation terminated at iteration number 6 because parameter estimates changed by less than .001.

COMBINED STRIDOR

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)	95.0% C.I.for EXP(B)	
								Lower	Upper
Step 1(a)	Sore_throat_bin	1.783	.505	12.453	1	.000	5.949	2.210	16.017
	comb_indrawing_nomiss	2.389	.544	19.314	1	.000	10.906	3.757	31.655
	any_PSloc_nomiss	2.335	.725	10.383	1	.001	10.329	2.496	42.746
	comb_stridor_nomiss	.431	.537	.646	1	.422	1.539	.538	4.406
	Constant	-3.480	.519	44.921	1	.000	.031		

a Variable(s) entered on step 1: Sore_throat_bin, comb_indrawing_nomiss, any_PSloc_nomiss, comb_stridor_nomiss.

Model Summary

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	153.657(a)	.316	.465

a Estimation terminated at iteration number 6 because parameter estimates changed by less than .001.

COMBINED NON-BARKY COUGH

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)	95.0% C.I.for EXP(B)	
								Lower	Upper
Step 1(a)	Sore_throat_bin	1.859	.511	13.238	1	.000	6.414	2.357	17.456
	comb_indrawing_nomiss	2.709	.498	29.622	1	.000	15.013	5.660	39.823
	any_PSloc_nomiss	2.067	.763	7.335	1	.007	7.897	1.770	35.237
	comb_nonbarkycough_nomiss	1.105	.458	5.820	1	.016	3.018	1.230	7.404
	Constant	-3.720	.518	51.539	1	.000	.024		

a Variable(s) entered on step 1: Sore_throat_bin, comb_indrawing_nomiss, any_PSloc_nomiss, comb_nonbarkycough_nomiss.

Model Summary

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	148.441(a)	.334	.490

a Estimation terminated at iteration number 6 because parameter estimates changed by less than .001.

COMBINED CYANOSIS

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)	95.0% C.I.for EXP(B)	
								Lower	Upper
Step 1(a)	Sore_throat_bin	1.773	.501	12.520	1	.000	5.887	2.205	15.714
	comb_indrawing_nomiss	2.499	.488	26.197	1	.000	12.174	4.675	31.703
	any_PSloc_nomiss	2.007	.788	6.494	1	.011	7.442	1.590	34.843
	comb_cyanosis_nomiss	1.255	.912	1.894	1	.169	3.510	.587	20.977
	Constant	-3.298	.464	50.498	1	.000	.037		

a Variable(s) entered on step 1: Sore_throat_bin, comb_indrawing_nomiss, any_PSloc_nomiss, comb_cyanosis_nomiss.

Model Summary

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	152.272(a)	.321	.472

a Estimation terminated at iteration number 6 because parameter estimates changed by less than .001.

TEST FOR CONFOUNDING- FEVER

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)	95.0% C.I.for EXP(B)	
								Lower	Upper
Step 1(a)	Sore_throat_bin	1.692	.530	10.194	1	.001	5.428	1.922	15.331
	comb_indrawing_nomiss	2.695	.502	28.768	1	.000	14.806	5.530	39.640
	any_PSloc_nomiss	2.072	.767	7.290	1	.007	7.938	1.764	35.714
	comb_nonbarkycough_nomiss	1.067	.461	5.353	1	.021	2.907	1.177	7.181
	Fever_bin	.496	.431	1.326	1	.249	1.642	.706	3.821
	Constant	-3.895	.554	49.460	1	.000	.020		

a Variable(s) entered on step 1: Sore_throat_bin, comb_indrawing_nomiss, any_PSloc_nomiss, comb_nonbarkycough_nomiss, Fever_bin.

Model Summary

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	147.119(a)	.338	.497

a Estimation terminated at iteration number 6 because parameter estimates changed by less than .001.

TEST FOR CONFOUNDING- PRIOR INTUBATION

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)	95.0% C.I.for EXP(B)	
								Lower	Upper
Step 1(a)	Sore_throat_bin	1.860	.512	13.211	1	.000	6.423	2.356	17.510
	comb_indrawing_nomiss	2.597	.501	26.877	1	.000	13.423	5.029	35.831
	any_PSloc_nomiss	2.165	.756	8.199	1	.004	8.714	1.980	38.349
	comb_nonbarkycough_nomiss	.982	.469	4.388	1	.036	2.670	1.065	6.690
	Prior_Intubation_bin	1.605	1.190	1.817	1	.178	4.976	.483	51.303
	Constant	-3.676	.514	51.083	1	.000	.025		

a Variable(s) entered on step 1: Sore_throat_bin, comb_indrawing_nomiss, any_PSloc_nomiss, comb_nonbarkycough_nomiss, Prior_Intubation_bin.

Model Summary

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	146.238(a)	.341	.501

a Estimation terminated at iteration number 6 because parameter estimates changed by less than .001.

TEST FOR CONFOUNDING- RHINNORHEA

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)	95.0% C.I.for EXP(B)	
								Lower	Upper
Step 1(a)	Sore_throat_bin	1.898	.515	13.613	1	.000	6.675	2.435	18.298
	comb_indrawing_nomiss	2.681	.495	29.332	1	.000	14.605	5.535	38.542
	any_PSloc_nomiss	1.978	.775	6.516	1	.011	7.229	1.583	33.016
	comb_nonbarkycough_nomiss	.988	.480	4.240	1	.039	2.687	1.049	6.884
	Rhinnorhea_bin	.371	.468	.630	1	.427	1.450	.579	3.627
	Constant	-3.792	.526	52.053	1	.000	.023		

a Variable(s) entered on step 1: Sore_throat_bin, comb_indrawing_nomiss, any_PSloc_nomiss, comb_nonbarkycough_nomiss, Rhinnorhea_bin.

Model Summary

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	147.817(a)	.336	.493

a Estimation terminated at iteration number 6 because parameter estimates changed by less than .001.

TEST FOR CONFOUNDING- STRIDOR

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)	95.0% C.I.for EXP(B)	
								Lower	Upper
Step 1(a)	Sore_throat_bin	1.915	.518	13.663	1	.000	6.788	2.459	18.740
	comb_indrawing_nomiss	2.428	.567	18.308	1	.000	11.331	3.727	34.450
	any_PSloc_nomiss	2.054	.766	7.193	1	.007	7.798	1.738	34.985
	comb_nonbarkycough_nomiss	1.138	.463	6.036	1	.014	3.121	1.259	7.736
	comb_stridor_nomiss	.527	.563	.878	1	.349	1.694	.562	5.103
	Constant	-3.914	.570	47.119	1	.000	.020		

a Variable(s) entered on step 1: Sore_throat_bin, comb_indrawing_nomiss, any_PSloc_nomiss, comb_nonbarkycough_nomiss, comb_stridor_nomiss.

Model Summary

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	147.559(a)	.336	.495

a Estimation terminated at iteration number 6 because parameter estimates changed by less than .001.

TEST FOR CONFOUNDING- COMBINED CYANOSIS

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)	95.0% C.I.for EXP(B)	
								Lower	Upper
Step 1(a)	Sore_throat_bin	1.886	.512	13.579	1	.000	6.592	2.418	17.973
	comb_indrawing_nomiss	2.612	.503	26.954	1	.000	13.620	5.082	36.503
	any_PSloc_nomiss	1.773	.826	4.605	1	.032	5.887	1.166	29.718
	comb_nonbarkycough_nomiss	1.094	.462	5.603	1	.018	2.987	1.207	7.389
	comb_cyanosis_nomiss	1.230	.941	1.707	1	.191	3.420	.541	21.622
	Constant	-3.704	.520	50.678	1	.000	.025		

a Variable(s) entered on step 1: Sore_throat_bin, comb_indrawing_nomiss, any_PSloc_nomiss, comb_nonbarkycough_nomiss, comb_cyanosis_nomiss.

Model Summary

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	146.633(a)	.340	.499

a Estimation terminated at iteration number 6 because parameter estimates changed by less than .001.

ADDING CONTINOUS VARIABLES TO THE MODEL ONE AT A TIME

PRESETNING OXYGEN SATURATION

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)	95.0% C.I.for EXP(B)	
								Lower	Upper
Step 1(a)	Sore_throat_bin	1.787	.641	7.769	1	.005	5.970	1.699	20.971
	comb_indrawing_nomiss	2.730	.633	18.603	1	.000	15.331	4.434	53.003
	any_PSloc_nomiss	1.085	.882	1.515	1	.218	2.960	.526	16.669
	comb_nonbarkycough_nomiss	.979	.578	2.866	1	.090	2.661	.857	8.260
	comb_cyanosis_nomiss	.166	1.142	.021	1	.885	1.180	.126	11.073
	PSO2_Sat_miss	-.126	.067	3.548	1	.060	.882	.774	1.005
	Constant	8.357	6.327	1.745	1	.187	4261.203		

a Variable(s) entered on step 1: Sore_throat_bin, comb_indrawing_nomiss, any_PSloc_nomiss, comb_nonbarkycough_nomiss, comb_cyanosis_nomiss, PSO2_Sat_miss.

Model Summary

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	99.158(a)	.344	.500

a Estimation terminated at iteration number 6 because parameter estimates changed by less than .001.

PRESENTING RESPIRATORY RATE

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)	95.0% C.I.for EXP(B)	
								Lower	Upper
Step 1(a)	Sore_throat_bin	2.240	.615	13.251	1	.000	9.390	2.812	31.359
	comb_indrawing_nomiss	2.967	.634	21.938	1	.000	19.443	5.617	67.305
	any_PSloc_nomiss	1.727	.896	3.714	1	.054	5.625	.971	32.587
	comb_nonbarkycough_nomiss	.987	.542	3.316	1	.069	2.682	.927	7.755
	comb_cyanosis_nomiss	.826	1.340	.380	1	.538	2.284	.165	31.568
	PSResp_Rate_miss	.050	.020	6.013	1	.014	1.051	1.010	1.094
	Constant	-5.925	1.067	30.857	1	.000	.003		

a Variable(s) entered on step 1: Sore_throat_bin, comb_indrawing_nomiss, any_PSloc_nomiss, comb_nonbarkycough_nomiss, comb_cyanosis_nomiss, PSResp_Rate_miss.

Model Summary

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	116.157(a)	.380	.563

a Estimation terminated at iteration number 6 because parameter estimates changed by less than .001.

PRSENTING HEART RATE

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)	95.0% C.I.for EXP(B)	
								Lower	Upper
Step 1(a)	Sore_throat_bin	2.240	.609	13.546	1	.000	9.398	2.850	30.987
	comb_indrawing_nomiss	2.975	.635	21.982	1	.000	19.595	5.649	67.967
	any_PSloc_nomiss	1.884	.848	4.940	1	.026	6.583	1.249	34.683
	comb_nonbarkycough_nomiss	.933	.519	3.238	1	.072	2.543	.920	7.027
	comb_cyanosis_nomiss	.675	1.031	.428	1	.513	1.964	.260	14.827
	PSHeart_Rate_miss	.019	.010	4.035	1	.045	1.019	1.000	1.039
	Constant	-6.890	1.559	19.523	1	.000	.001		

a Variable(s) entered on step 1: Sore_throat_bin, comb_indrawing_nomiss, any_PSloc_nomiss, comb_nonbarkycough_nomiss, comb_cyanosis_nomiss, PSHeart_Rate_miss.

Model Summary

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	118.001(a)	.367	.548

a Estimation terminated at iteration number 6 because parameter estimates changed by less than .001.

SIGNIFICANT CONTINOUS VARIABLES ADDED TO THE MODEL

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)	95.0% C.I.for EXP(B)	
								Lower	Upper
Step 1(a)	Sore_throat_bin	2.374	.634	14.029	1	.000	10.742	3.101	37.207
	comb_indrawing_nomiss	2.910	.645	20.371	1	.000	18.357	5.188	64.957
	any_PSloc_nomiss	1.685	.886	3.617	1	.057	5.392	.950	30.605
	comb_nonbarkycough_nomiss	1.021	.547	3.491	1	.062	2.776	.951	8.103
	comb_cyanosis_nomiss	.904	1.335	.458	1	.498	2.468	.180	33.778
	PSResp_Rate_miss	.042	.023	3.414	1	.065	1.043	.997	1.090
	PSHeart_Rate_miss	.010	.011	.927	1	.336	1.010	.990	1.031
	Constant	-7.080	1.592	19.787	1	.000	.001		

hbl

a Variable(s) entered on step 1: Sore_throat_bin, comb_indrawing_nomiss, any_PSloc_nomiss, comb_nonbarkycough_nomiss, comb_cyanosis_nomiss, PSResp_Rate_miss, PSHeart_Rate_miss.

Model Summary

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	112.169(a)	.385	.570

a Estimation terminated at iteration number 6 because parameter estimates changed by less than .001.

TESTING SIGNIFICANT CONTINOUS VARIABLES WITH THE SAME PAITENTS

PRESENTING HEART RATE

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)	95.0% C.I.for EXP(B)	
								Lower	Upper
Step 1(a)	comb_nonbarkycough_nomiss	.951	.530	3.215	1	.073	2.587	.915	7.313
	comb_cyanosis_nomiss	1.172	1.262	.862	1	.353	3.227	.272	38.299
	comb_indrawing_nomiss	2.952	.635	21.604	1	.000	19.140	5.513	66.454
	any_PSloc_nomiss	1.728	.866	3.986	1	.046	5.630	1.032	30.705
	Sore_throat_bin	2.168	.607	12.738	1	.000	8.740	2.657	28.743
	PSHeart_Rate_miss	.019	.010	3.795	1	.051	1.019	1.000	1.038
	Constant	-6.736	1.549	18.900	1	.000	.001		

a Variable(s) entered on step 1: comb_nonbarkycough_nomiss, comb_cyanosis_nomiss, comb_indrawing_nomiss, any_PSloc_nomiss, Sore_throat_bin, PSHeart_Rate_miss.

Model Summary

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	115.710(a)	.373	.551

a Estimation terminated at iteration number 6 because parameter estimates changed by less than .001.

PRESENTING RESPIRATORY RATE

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)	95.0% C.I.for EXP(B)	
								Lower	Upper
Step 1(a)	comb_nonbarkycough_nomiss	1.051	.546	3.700	1	.054	2.860	.980	8.345
	comb_cyanosis_nomiss	.851	1.353	.395	1	.530	2.341	.165	33.223
	comb_indrawing_nomiss	2.923	.640	20.885	1	.000	18.600	5.309	65.159
	any_PSloc_nomiss	1.756	.896	3.841	1	.050	5.791	1.000	33.537
	Sore_throat_bin	2.300	.621	13.698	1	.000	9.973	2.950	33.711
	PSResp_Rate_miss	.051	.020	6.147	1	.013	1.052	1.011	1.095
	Constant	-5.999	1.086	30.513	1	.000	.002		

a Variable(s) entered on step 1: comb_nonbarkycough_nomiss, comb_cyanosis_nomiss, comb_indrawing_nomiss, any_PSloc_nomiss, Sore_throat_bin, PSResp_Rate_miss.

Model Summary

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	113.104(a)	.382	.565

a Estimation terminated at iteration number 6 because parameter estimates changed by less than .001.

FINAL MODEL

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)	95.0% C.I.for EXP(B)	
								Lower	Upper
Step 1(a)	comb_nonbarkycough_nomiss	.987	.542	3.316	1	.069	2.682	.927	7.755
	comb_cyanosis_nomiss	.826	1.340	.380	1	.538	2.284	.165	31.568
	comb_indrawing_nomiss	2.967	.634	21.938	1	.000	19.443	5.617	67.305
	any_PSloc_nomiss	1.727	.896	3.714	1	.054	5.625	.971	32.587
	Sore_throat_bin	2.240	.615	13.251	1	.000	9.390	2.812	31.359
	PSResp_Rate_miss	.050	.020	6.013	1	.014	1.051	1.010	1.094
	Constant	-5.925	1.067	30.857	1	.000	.003		

a Variable(s) entered on step 1: comb_nonbarkycough_nomiss, comb_cyanosis_nomiss, comb_indrawing_nomiss, any_PSloc_nomiss, Sore_throat_bin, PSResp_Rate_miss.

Model Summary

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	116.157(a)	.380	.563

a Estimation terminated at iteration number 6 because parameter estimates changed by less than .001.

GOODNESS OF FIT

Hosmer and Lemeshow Test

Step	Chi-square	df	Sig.
1	11.753	7	.109