1999

Relationship Between Pulse Oximetry Measurements and Admission to a Hospital in the Wheezing Pediatric Population

Christine K. Dunnuck

Grand Valley State University

Follow this and additional works at: http://scholarworks.gvsu.edu/theses

Part of the Nursing Commons

Recommended Citation

Dunnuck, Christine K., "Relationship Between Pulse Oximetry Measurements and Admission to a Hospital in the Wheezing Pediatric Population" (1999). Masters Theses. 481.
http://scholarworks.gvsu.edu/theses/481

This Thesis is brought to you for free and open access by the Graduate Research and Creative Practice at ScholarWorks@GVSU. It has been accepted for inclusion in Masters Theses by an authorized administrator of ScholarWorks@GVSU. For more information, please contact scholarworks@gvsu.edu.
RELATIONSHIP BETWEEN PULSE OXIMETRY MEASUREMENTS AND
ADMISSION TO A HOSPITAL IN THE WHEEZING PEDIATRIC POPULATION

By
Christine K. Dunnuck

A THESIS
Submitted to
Grand Valley State University
in partial fulfillment of the requirements for the
degree of

MASTER OF SCIENCE IN NURSING

Kirkhof School of Nursing

1999

Thesis Committee Members:
Andrea C. Bostrom, PhD., R.N.
Kay Setter Kline, PhD., R.N.
Theresa Bacon-Baguley, PhD., R.N.
ABSTRACT

RELATIONSHIP BETWEEN PULSE OXIMETRY MEASUREMENTS AND ADMISSION TO A HOSPITAL IN THE WHEEZING PEDIATRIC PATIENT

By

Christine K. Dunnuck

The purpose of this study was to assess the usefulness of pulse oximetry measurements as an objective measure of the severity of wheezing in pediatric emergency clients as demonstrated by subsequent admission. An ex-post facto study design with a retrospective chart review was used. Subjects (n=198) ranged in age from one month to 17 years. Consecutive admissions and random sampling of those discharged were used. Hypotheses were: (a) lower initial pulse oximetry measurements would increase the likelihood of admission and (b) younger patients would be admitted with higher pulse oximetry measurements.

Chi-square analysis and one way ANOVA statistical testing demonstrated that lower pulse oximetry readings were found with those admitted. Younger patients were not admitted with higher measurements. Other variables analyzed were sex, distance from the hospital, diagnosis, and health insurance. No statistically significant findings among admissions and discharges and these variables were present except for diagnosis.
Acknowledgments

It is with great joy at completing this project that I would like to thank the following:

Thank you God for sparing my life on June 21, 1997.

Thank you Mike, Aaron and Lizzi for your patience, love and understanding.

Thank you Andrea Bostrom for your gentle persuasion and assistance.

Thank you Alicia Westrate for all your help gathering data.

Thank you Linda Scott (and mom) for your wonderful analytical mind and willingness to help.

Thank you to my coworkers, Diana Underhill and Linda Rossman for keeping me focused on the task at hand.
# Table of Contents

List of Tables ........................................................................................................ vi

List of Appendices .................................................................................................vii

## CHAPTER

1  INTRODUCTION ..................................................................................1

2  CONCEPTUAL FRAMEWORK AND REVIEW IF LITERATURE .. 4
   Conceptual Framework ........................................................................ 4
   Literature Review ............................................................................ 6
   Hypotheses ................................................................................. 12
   Definition of Terms ..................................................................... 12

3  METHODS ........................................................................................ 13
   Design ....................................................................................... 13
   Threats ..................................................................................... 14
   Sample ....................................................................................... 14
   Procedure ................................................................................... 15
   Instrument ............................................................................... 18

4  RESULTS ............................................................................................20
   Data Analysis ............................................................................. 20
   Hypothesis One ......................................................................... 20
      Characteristics of admitted and discharged groups ............ 20
      Hypothesis testing ................................................................. 22
   Hypothesis Two ........................................................................ 22
      Characteristics of age grouping ............... 22
      Hypothesis testing ................................................................. 23

5  DISCUSSION AND IMPLICATIONS............................................... 26
   Hypothesis One ......................................................................... 26
   Hypothesis Two ......................................................................... 27
List of Tables

Table

| 1 | Characteristics of Sample ......................................................... 17 |
| 2 | Comparison of Characteristics of Admitted and Discharged Groups.. 21 |
| 3 | Pulse Oximetry Readings in the Admitted and Discharged Groups.... 22 |
| 4 | Comparison of Variables Between Age Groups.............................. 24 |
| 5 | Pulse Oximetry Values by Age Group............................................. 25 |
List of Appendices

Data Collection Tool ................................................................. 35
CHAPTER 1
INTRODUCTION

Hypoxemia, or reduced oxygenation of arterial blood, can quickly lead to rapid deterioration and cardiovascular instability in children. It is therefore imperative that the emergency department nurse can rapidly, accurately, and reliably assess the degree of hypoxemia the wheezing pediatric client is experiencing. One method used to accomplish this in the emergency department is by pulse oximetry. Obtaining pulse oximetry measurements is a routine component of a respiratory assessment in most emergency departments. Pulse oximetry requires placing a probe over a pulsating arterial bed, usually the fingertip, toe, or earlobe, and allows arterial hemoglobin saturation to be measured optically by the differential light absorption of oxygenated and deoxygenated hemoglobin (Anderson, Zwerdling, & DeWitt, 1991). When arterial hemoglobin desaturation is occurring, hypoxemia is present the use of pulse oximetry allows the clinician to detect hemoglobin desaturation and treat hypoxemia before clinical signs become apparent. When applying new technology in the clinical arena, research is essential to determine its usefulness in each clinical setting.

Wheezing is a common respiratory problem in the pediatric age group and is a frequent cause of emergency department visits and hospitalizations. The degree of
hypoxemia correlates with the severity of airway obstruction (McWilliams, Kelly, & Murphy, 1989). Pulse oximetry readings have been correlated with wheezing severity (Geelhoed, Landau, & LeSouef, 1988; Hedges, Amsterdam Cionni, & Embry, 1987; Rosen, Yamamoto, & Wiebe, 1988; Yamamoto, Wiebe, & Mathews, 1992; Yamamoto, Wiebe, Rosen et al., 1992; Yamamoto, Wiebe, Anaya et al, 1992). Previous studies have shown that the initial room air pulse oximetry values obtained have been useful in predicting the need for hospitalization in the wheezing pediatric patient (Geelhoed et al., 1988; Hedges et al., 1987; Rosen et al., 1989; Yamamoto, Wiebe, Rosen et al., 1992).

Hemoglobin saturation is dependent upon ventilation and perfusion. A low initial hemoglobin saturation may be indicative of a more severe inflammatory phase as shown in research done by Mihatsch, Geelhoed, Landau, and LeSouef (1990). Gift (1991) found pulse oximetry readings were significantly lower during times of high dyspnea in the adult asthmatic patient.

Research has shown that pulse oximetry measurements are accurate and reliable for the assessment of oxygenation in adults (Yelderman & New, 1983), children of all ages (Anderson et al., 1991), and premature infants (Henderson, 1988). Pulse oximetry is a cost-effective, painless, noninvasive monitoring technique that requires no special skin preparation. Pulse oximetry has a short response time and facilitates response to rapidly changing conditions (Fanconi, Soherty, Edmonds, Barker, & Bohn, 1985; Yelderman & New, 1983).

The purpose of this research study is to assess the clinical usefulness of pulse oximetry measurements as an objective measure of the severity of wheezing (demonstrated by in-patient admission) in the pediatric emergency department client.
This study will build on previous research examining the clinical significance of pulse oximetry readings in the emergency department in the pediatric population done by Bishop and Nolan (1991); Geelhoed et al. (1988, 1990); Hedges et al. (1986); Kerem et al. (1990); Yamamoto, Wiebe, Anaya et al. (1992); Yamamoto, Wiebe, and Matthews (1992); and Yamamoto, Wiebe, Rosen et al. (1992). Nursing research literature did not specifically address the use of pulse oximetry in the emergency department. This study will replicate a study done by Rosen, Yamamoto, and Wiebe (1989) which looks at the correlation between initial pulse oximetry readings and the identification of a high risk group of children with wheezing.
CHAPTER 2

CONCEPTUAL FRAMEWORK AND REVIEW OF LITERATURE

Conceptual Framework

Levine's conservation model (1971) was the conceptual framework used for this research. The concepts of this model are wholeness, change, adaptation, and environment. Levine's theory consists of four conservation principles. These are: (a) principle of Conservation of Energy, (b) principle of Conservation of Structural Integrity, (c) principle of Conservation of Personal Integrity, and (d) principle of Conservation of Social Integrity. Specific to this study are the principles of Conservation of Energy and Structural Integrity. The conservation model considers the individual as a whole. Change and adaptation is defined by Levine (1971) as the process of change whereby the individual retains his integrity, his wholeness, within the realities of his environment. Environment is both internal and external. It is a setting, a background, and the dynamic exchange that involves both the person and the setting and background. Energy is described by Levine as the life source. It cannot be directly observed but the consequences of its exchange is quantifiable. Structural integrity is defined by Levine (1969) as the physical structure of the body.

Nurses are participants in every patient's environment and may influence patient's adaptation. Nursing intervention should be designed so that it fosters successful adaptation. Every nursing act is dedicated to the conservation of the wholeness of the
Conservation of the patient's energy is a consequence of nursing intervention. Parameters of concern to nurses include body temperature, pulse and respiratory rates, and arterial hemoglobin saturation readings. Physiologic alterations associated with illness will often be manifested as changes in some of these quantifiable measures. Understanding the qualitative and quantitative portion of the illness is absolutely essential if the nurse is to promote adaptation and maintain wholeness of patients.

Emergency department (ED) nurses practice in a unique setting. The ED nurse is the first to assess patients as they arrive to the department. Based on this assessment, the nurses then triage or prioritize the rapidity of treatment and the placement of the patient within the department (i.e., critical care area or nonacute area). The implications of this are that the assessment must be accurate and second, that the triage decision must be appropriate for the severity of the patient's symptoms to prevent any delays in medical care and potential adverse outcomes.

According to Levine (1971), nurses play a key role in influencing patient's adaptation. This is easily seen in the emergency department when the nurses are making the decisions that guide the initial care of the patient. The hemoglobin saturation values reflect the patient's adaptation and attempt to conserve energy by reflecting the amount of oxygen exchanged in the lungs and used by body exertion. When the ED nurse understands the significance of these values, the potential for adverse outcomes is reduced.

Conservation of structural integrity focuses on healing. It is defined as maintaining or restoring the structure of the body by preventing physical breakdown and
promoting healing. By preventing hypoxemia, the nurse can help the client to maintain structural integrity.

**Literature Review**

Nursing research literature on the use of pulse oximetry is limited. Some nursing research on the topic has been documented. However, the available research looks at increasing the usage of pulse oximetry (Peters, Caulfield, Schultz, Miller, & Larson, 1990) and reliability in the neonate population (Henderson, 1988). Gift (1991) studied the use of pulse oximetry in determining the differences in physiologic and psychological variables in a patient during an acute asthma attack. There is no documented nursing research on the use of pulse oximetry in the emergency setting. However, the documented research done by the medical field is abundant. Therefore, the literature review will reflect medical research primarily.

Much of the available literature on the use of pulse oximetry in the emergency department focuses on children with the clinical diagnosis of asthma. Geelhoed, Landau, and LaSouef (1988) used a descriptive correlational research design to look at the pulse oximetry values of children with asthma when they arrived to the emergency department (ED). They examined whether the hemoglobin saturation value measured in the ED is an objective measure of the severity of asthma and if it could predict outcome. The convenience sample consisted of 52 children, 2-14 years of age, with the clinical diagnosis of acute asthma. Unfavorable outcomes were defined as admission or relapse that occurred after the patient was discharged from the emergency department and which led to seeking further treatment. The initial saturation of those who presented once was higher than those who presented twice (p< 0.05). A saturation of 91% was found to
discriminate between a favorable and an unfavorable outcome. Ninety percent of those with a pulse oximetry value of 91% or less who were discharged had unfavorable outcomes. According to this study, pulse oximetry values can be useful in judging the severity of an asthma attack but the pulse oximetry value has greater potential to predict relapse in those not admitted. The initial pulse oximetry value at the original visit was lower for the children who required additional care than for those who did not (p<0.001). The authors concluded that the initial pulse oximetry value was highly predictive of outcome. A limitation to this study is the relatively small convenience sample size, which affects the ability to generalize the results. Another issue is the sample consisting of only those patients with the clinical diagnosis of asthma. Many patients present to the ED with symptoms of asthma, specifically wheezing, but do not have the diagnosis of asthma.

Geelhoed, Landau, and LeSouef (1990) expanded on their 1988 study by adding peak expiratory flow rate (PEFR) measurements. These were compared with the pulse oximetry values to determine which could accurately indicate the severity of symptoms and predict relapse in children with asthma. A convenience sample of 110 pediatric ED patients, 4-14 years of age, was used. Patients included in the study had a clinical diagnosis of asthma and could adequately perform a PEFR measurement. The pulse oximetry values and PEFR values were obtained on arrival to the ED. The outcomes evaluated were favorable (patient discharged home) or unfavorable (patient admitted or discharged then needing further medical treatment). The admitted children's pulse oximetry values and PEFR values were lower than the values of those discharged (p<0.001). The initial pulse oximetry value at the original visit was lower for the
children who required additional care than for those who did not (p<0.001). The PEFR of those who returned to the hospital did not differ significantly from that of children who did not (p=0.46). The authors concluded that both the PEFR and pulse oximetry values can be useful in judging the severity of an asthma attack, but pulse oximetry values have greater potential to predict outcomes in those not admitted. Limitations to this study include the use of PEFR. Children too young or ill to perform PEFR were excluded from the study. Pulse oximetry can be used on children of all ages and could have been measured alone on those children unable to perform PEFR. Again, using the clinical diagnosis of asthma excludes a large portion of the pediatric population who may have wheezing but not the clinical diagnosis of asthma. Finally, the issue of generalizability is applicable. Because of the exclusion factors of age, diagnosis and the small convenience sample the results may not apply in all settings.

Kerem et al. (1990) conducted a descriptive correlational study to determine the value of historic data, clinical score, spirometry, oxygen saturation, or any combination of these variables in predicting the outcome of acute asthma episodes in children. Clinical investigators evaluated 200 children presenting to the ED with exacerbation of asthma at a time when one of the investigators was available. The children were treated independently by the ED medical staff who were unaware of the investigator's assessment results. Outcomes were defined as admission to the hospital or discharge home. Using classification tree analysis, their results showed that pulse oximetry measurements were not predictive of outcome. The clinical score, based on a standard physical exam, was found to be most effective in predicting outcome. Limitations to this study include generalizability. The dependent variable of admission or discharge may
have limited validity. The decision to admit a patient is influenced by social and behavioral factors such as parental support of home therapy and may vary according to patient population. Also the distance the family lives from the institution can affect the decision to admit or discharge a patient. This may limit the results when applying them to other institutions. Furthermore, the training of the research investigator was not discussed. An issue of interrater reliability may exist.

Bishop and Nolan (1991) conducted a study using a descriptive correlational design to evaluate whether the pulse oximetry value on arrival to the ED and after treatment could predict an unfavorable outcome. The study group consisted of 100 pediatric ED patients ranging in age from six months to 17 years with the clinical diagnosis of asthma. Unfavorable outcome was defined as admission to the hospital, return to the ED within five days, or parent dissatisfaction with patient's condition. Results of the study showed that there was no overall significant difference in pulse oximetry before treatment among patients who were discharged home, who were discharged and then admitted, or who were admitted immediately (p=0.30). The authors concluded that pulse oximetry alone is of limited value in predicting the outcome of the pediatric asthma patient in the ED. In the study, 24% of the subjects had the initial pulse oximetry measurement after a nebulizer treatment. A dip in pulse oximetry reading can occur following a nebulizer treatment. This will alter the initial value and confound the data. Again it is important to note that other factors will influence admission to the hospital such as distance of home from the hospital and social circumstances. Also in this study the inclusion of only asthmatic patients and the small convenience sample limits the generalizability of the study.
In 1989, Rosen, Yamamoto, and Wiebe conducted a descriptive correlational study investigating the use of initial pulse oximetry on room air as an indicator of disease severity as reflected by admission. A convenience sample of 1,001 pediatric emergency department patients aged 19 years and less who were seeking care for wheezing associated respiratory illnesses were used. A control group of pre-surgical patients who did not have respiratory disease was used. Results showed that the mean pulse oximetry value for those hospitalized was significantly lower than for those not requiring hospitalization (p<0.001). Based on their data, the authors concluded that the degree of desaturation on initial presentation is an indicator of disease severity. Historical events may have confounded the study. Pulse oximetry use in the ED was introduced at the same time of the study. As the physicians began to appreciate the significance of the initial pulse oximetry value, disposition of the patients may have been influenced.

In 1992, Yamamoto, Wiebe, Rosen et al. reported on a descriptive correlational study which compared the usefulness of initial versus discharge pulse oximetry measurements in correlating the need for hospitalization. A convenience sample of 4,913 wheezing pediatric patients less than 21 years of age in a children's ED were used. Findings indicated that patients with lower initial hemoglobin saturation values were given a higher number of bronchodilator treatments in the ED (correlation coefficient -0.3289, p<0.001). This suggests that a lower initial pulse oximetry value is indicative of greater severity. The positive predictive value of pulse oximetry readings for hospitalization was higher for those with low initial pulse oximetry values. Patients presenting with initial pulse oximetry values of less than 90% had a 58% probability of
requiring admission. Infants with initial pulse oximetry values of less than 90% had a 73% probability of requiring hospitalization.

Yamamoto, Wiebe, Anaya et al. (1992) expanded the above study to include the initial pulse oximetry values and PEFR values. These were correlated with the number of bronchodilator treatments and the need for admission. Researchers used a convenience sample of 785 pediatric patients ranging in age from 5-20 years. Those with the complaint of wheezing were included in the study. Both initial pulse oximetry value and PEFR values had significant correlation with wheezing severity as indicated by the number of bronchodilator treatments (p<0.0001). Their respective correlations were 0.428 and 0.421. In the study only 81% of the subjects were able to obtain PEFR measurements in contrast to 98% of the subjects for whom pulse oximetry measurements were obtained. Another factor that may alter the generalizability of the results is that of all the patients presenting to this institution with wheezing, only 28% were 5 years old and above. This excluded a huge subsample of wheezing pediatric patients who were not of the developmental ability to perform PEFR measurements. In this study, the value of peak flow measurements was applicable to only 28% of wheezing children.

In several of the studies examined, the convenience samples used were small or limited to one diagnosis. In these same studies the convenience sample was also limited by the authors’ decision to exclude children developmentally unable to perform peak expiratory flow rates. However, in the studies that did use large convenience samples and minimal exclusion criteria, both were done in the same geographical location within the same institution. All the studies did reflect to varying degrees a positive correlation
of admission with initial pulse oximetry readings. It is important to validate that given similar samples, results from a different geographical location will yield similar results.

Hypotheses

This study examined if pulse oximetry values reflect the severity of wheezing as demonstrated by hospitalization for the wheezing pediatric emergency clients. The hypotheses of the study were: (a) the lower the initial pulse oximetry reading, the greater the likelihood of admission in the wheezing pediatric client and (b) younger patients will be admitted with higher pulse oximetry measurements.

Definition of Terms

Key terms relevant to this study are pulse oximetry, wheezing pediatric emergency client, and severity of wheezing. Pulse oximetry is defined as a noninvasive method used to measure arterial hemoglobin oxygen saturation. According to Levine (1971), procedures like pulse oximetry are a nursing act directed toward the conservation of the patient's energy and are useful in the conservation of structural integrity. The wheezing pediatric emergency client is defined as any child 17 years of age or less presenting to the emergency department with the objective findings of wheezing for any reason except an airway foreign body. Severity of wheezing will be operationalized as severe in those needing admission and mild in those being discharged home.
CHAPTER 3

METHODS

Design

The design of the study was ex-post facto and descriptive correlational. It used a retrospective chart review to determine if there was a relationship between the initial pulse oximetry reading and hospital admission in the wheezing pediatric client. Competing hypotheses to the study included selection bias. It is possible that the younger children and infants may be admitted with higher pulse oximetry readings due to their age. This was factored into the statistical analysis of the data. Furthermore, a major threat could be instrumentation. Pulse oximetry measurements can be difficult to obtain in children who are excessively active, irritable, and uncooperative. Those children for whom an initial pulse oximetry value was not obtained were excluded. Other potential factors that enter into a decision for admission are socio-economic reasons such as insurance, parental compliance or parental pressure to admit. The distance a child lives from the institution may also help decide whether a child is admitted or discharged. The decision to admit is ultimately that of the admitting physician. Whether the child has a primary care physician or is a clinic patient or has no physician may affect the decision. Of these factors, insurance, physician status, and distance to the institution were analyzed statistically with the hospitalization rate.
Threats

Threats to the external validity include experimenter effects and generalizability. The emergency department (ED) records reflected successful data collection and documentation. This documentation may be affected by the interaction between the nurse and the patient. To counteract this, all nurses have completed a skill validation on obtaining pulse oximetry on the pediatric patient as part of a competency-based orientation. Also, the results obtained from this ED setting may not apply to other settings such as physician's offices, clinics or other EDs which are teaching facilities with both emergency and pediatric residency programs. Other EDs that see fewer children and are less comfortable with the assessment and treatment of children may admit patients with higher values.

Sample

A systematic sampling of pediatric emergency patients' records was obtained from the emergency department at a 529 bed midwestern hospital. This ED sees over 76,000 patients annually of which 33% are pediatric. It is the main tertiary care facility in this Midwestern city and serves as a pediatric referral center for its geographical area.

Subjects ranged in age from one month to 17 years and sought care at the emergency department for wheezing associated respiratory illnesses. The mean age was 6 years (77 months) with a median of 5 years (60 months) and a mode of 16 years (192 months). Wheezing is an objective documented finding and may include asthma/reactive airway disease, bronchiolitis, respiratory illnesses with bronchospasm, pneumonia with wheezing, upper respiratory infections associated with wheezing, and croup with
wheezing. The subjects were hemodynamically stable (pulse rate greater than 60 but less than 200 and a systolic blood pressure greater than 70 mmHg). Those with hypothermia (temperature less than 96 degrees Fahrenheit), vasoconstrictive states (pallor, cool skin, slow capillary filling), or carbon monoxide poisoning were excluded. Other exclusion criteria were airway foreign body and those clients in which a room air pre-treatment pulse oximetry value could not be obtained. Also excluded were those children with a known chronic lung and/or heart disease or bronchopulmonary dysplasia who may be admitted more readily based on their medical history.

Based on the literature review and on the number of pediatric patients treated at the institution where the research was conducted, the researcher attempted to include 200 subjects in the study. The subjects were further divided into four age groups with fifty subjects per age group. Within each group, identification of 25 admissions and 25 nonadmissions was attempted. The final sample, per age group, was as follows: group one included infants less than one year (n=54), group two were toddlers age one to four (n=44), group three contained school-age children age five to eleven (n=48), and the final group included children 12 to 17 years of age (n=52).

Procedure

The subjects were recruited using a retrospective chart review. The practice in this ED is the primary nurse obtains a pulse oximetry measurement on room air prior to any treatment for all patients presenting with respiratory related complaints. This reading is recorded on the ED record. The assumption was made by the investigator that all initial pulse oximetry measurements recorded are consistent with this practice. Patients are registered into a database daily by discharge diagnosis. All pediatric patients
with the ED discharge diagnosis of asthma, bronchiolitis, pneumonia, reactive airway disease, and croup were identified through the database. Medical records for each patient with these diagnoses were then examined to determine if wheezing was documented on physical exam.

All consecutive admissions were included up to 25 for each age group during the time period of the study. If not enough admissions were available, then the number of admissions available during the time period was used. In case of multiple ED visits by the same subject, only the first ED visit was used. Random sampling of nonadmitted patients using a systematic sampling technique was conducted during the 18-month time interval of December, 1995, to June, 1997 to help control for confounding variables such as time of year.

The data were collected over an 18-month period between the months of December, 1995 to June, 1997. The data were collected by the researcher using a data collection tool (see Appendix for complete tool). The research used existing medical records exclusively from the emergency department. As stated, participants were pediatric patients 17 years old and younger presenting to the ED seeking medical care for wheezing associated respiratory illnesses. Emergency department nurses collected and documented the data. The nurses have documented through skills validation that they are capable of performing an accurate pulse oximetry reading. It is a standard of care within the ED to obtain pulse oximetry values on room air prior to nebulizer treatments for all patients presenting with respiratory complaints. Therefore, for this study consent was not necessary.
Other variables available from the records included the distance the parents live from the hospital, health insurance, primary physician status, discharge or admission diagnosis, and the child's sex. These are summarized in Table 1. The distance to the hospital was further broken down into three groups. The proximal group included those living inside the city limits in which the institution is located. The local group included those living outside the city limits but within the county. The distant group included those living outside the county lines. The address is documented on the ED record and a county map was used.

Table 1

Characteristics of Sample

<table>
<thead>
<tr>
<th>Variable</th>
<th>Total Number</th>
<th>Percentage (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sex</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>120</td>
<td>61</td>
</tr>
<tr>
<td>Female</td>
<td>78</td>
<td>39</td>
</tr>
<tr>
<td>Disposition</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Admitted</td>
<td>100</td>
<td>50</td>
</tr>
<tr>
<td>Discharged</td>
<td>98</td>
<td>50</td>
</tr>
<tr>
<td>Insurance</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Medicaid</td>
<td>93</td>
<td>47</td>
</tr>
<tr>
<td>Private</td>
<td>63</td>
<td>32</td>
</tr>
<tr>
<td>HMO</td>
<td>22</td>
<td>11</td>
</tr>
<tr>
<td>None</td>
<td>20</td>
<td>10</td>
</tr>
<tr>
<td>Diagnosis</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Asthma</td>
<td>89</td>
<td>45</td>
</tr>
<tr>
<td>Bronchiolitis</td>
<td>33</td>
<td>17</td>
</tr>
<tr>
<td>Reactive Airway Disease</td>
<td>20</td>
<td>10</td>
</tr>
<tr>
<td>Pneumonia</td>
<td>22</td>
<td>11</td>
</tr>
<tr>
<td>Upper Respiratory</td>
<td>14</td>
<td>7</td>
</tr>
<tr>
<td>Bronchitis</td>
<td>11</td>
<td>6</td>
</tr>
<tr>
<td>Other</td>
<td>9</td>
<td>4</td>
</tr>
<tr>
<td>Distance</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Proximal</td>
<td>122</td>
<td>62</td>
</tr>
<tr>
<td>Local</td>
<td>39</td>
<td>20</td>
</tr>
<tr>
<td>Distant</td>
<td>37</td>
<td>18</td>
</tr>
</tbody>
</table>
The only risk to the patient was the potential of breaking confidentiality. To minimize this, subjects were given code numbers for identification and data collection. The principal investigator and an assistant collected the data. The principal investigator kept the data in a locked cabinet.

**Instrument**

The study used portable Nelcor N200 pulse oximeter (Nelcor, Inc., Hayward, CA) to measure the hemoglobin oxygen saturation. Pulse oximetry measures arterial hemoglobin oxygen saturation using a principle of spectrophotometric analysis in which two wavelengths of light is transmitted through a highly vascular area. The pulse oximetry value of arterial blood is measured by analyzing the change in density of the transmitted light as arterial blood flows into the vascularized area. The blood, depending on the hemoglobin saturation will absorb different amounts of light. The amount of light detected varies with the change in pulsation of the arterial vascular bed which will avoid reading the saturation of venous blood. The pulse oximeter unit translates this light reading into a saturation percentage, which is displayed on the unit. Normal pulse oximetry measurements are recorded values of 97% and above (Schneider, 1992; Carroll, 1993). The pulse oximeters within the ED are routinely (every six months) checked and calibrated by the biomedical engineering department within the institution to ensure their reliability.

Numerous experimental studies document the reliability of pulse oximetry values in relation to the arterial hemoglobin oxygen saturation values. Jones, Heiselman, Cannon, and Gradisek (1988) studied the reliability of the pulse oximeter reading in adults experiencing respiratory distress. Their findings of a correlation coefficient (r)
value when compared to arterial blood gases of 0.95 with a significance of \( p < 0.001 \) led them to conclude that pulse oximetry is accurate and reliable. Gussack and Tacchi (1987) studied children with airway disorders. Again, pulse oximetry was reliable and accurate with an \( r \) value of 0.98 and a standard deviation of 0.6265. Henderson (1988) reported in premature neonates with respiratory distress an \( r \) value of 0.87 and a significance of \( p < 0.001 \). Yelderman and New (1983) documented the reliability of pulse oximetry with an \( r \) value of 0.98 (\( p < 0.0001 \)).

Certain pathophysiologic conditions can affect the construct validity of pulse oximetry. The technology involved in pulse oximetry allows for the readings to be inaccurate under several conditions. These are hypothermia, vasoconstrictive states, and carbon monoxide poisoning. For these reasons, these patients were excluded from the study sample.

As previously stated as a demonstration of the criterion validity of pulse oximetry, a positive correlation between initial pulse oximetry values and the need for hospital admission has been documented (Geelhoed et al., 1988; Hedges et al., 1987; Rosen et al., 1989; Yamamoto, Wiebe, Rosen et al., 1992). Furthermore, several studies have demonstrated a correlation between pulse oximetry values and wheezing severity (Geelhoed et al., 1988; Hedges et al., 1987; Rosen et al., 1989; Yamamoto, Wiebe, Anaya et al., 1992; Yamamoto, Wiebe, Rosen et al., 1992). The research conducted thus far documents the validity of pulse oximetry.
CHAPTER 4

RESULTS

Data Analysis

The purpose of this study was to determine if pulse oximetry values reflect the severity of wheezing defined as admission in the wheezing pediatric population. To demonstrate this, it was hypothesized that lower initial pulse oximetry readings would increase likelihood of admission. Furthermore, the study sought to determine if younger patients are admitted with higher pulse oximetry readings. Data analysis was conducted using the Statistical Package for Social Sciences (SPSS-PC). A total of 198 subjects were included in the study. Two discharged subjects were excluded due to missing data. The primary investigator coded completed collection tool pages.

Hypothesis One

Characteristics of admitted and discharge groups. The first hypothesis suggests that lower initial pulse oximetry readings are associated with admissions for pediatric asthma clients. Prior to examining this hypothesis, several variables were compared for the admitted and discharged groups. These were sex, diagnosis, distance, and insurance provider. Using chi square analysis, these variables were compared for any significant differences between the admitted and discharged groups. There were no significant
differences in sex, distance, and insurance provider between these groups. A significant
difference was found between the groups in relation to diagnosis ($X^2 = 25.4$, df = 4,
p=.00004). The diagnoses were collapsed into five groups for statistical evaluation.
These groups are: Group 1 includes asthma/reactive airway disease, group 2 includes
upper respiratory infection/bronchitis, group 3 includes croup/bronchospasm/respiratory
synsinitial virus (RSV), group 4 includes pneumonia, and group 5 includes bronchiolitis.
However, the number of cells with expected frequencies below 5 still equaled two so this
statistical finding should be considered cautiously. See Table 2 for summary.

Table 2

Comparison of Characteristics of Admitted and Discharged Groups

<table>
<thead>
<tr>
<th>Variable</th>
<th>Admitted</th>
<th>Discharged</th>
<th>Total</th>
<th>Sample</th>
<th>$X^2$</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sex</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>58 (48)</td>
<td>62 (52)</td>
<td>120 (61)</td>
<td>.574</td>
<td>&gt;.05</td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>42 (54)</td>
<td>36 (46)</td>
<td>78 (39)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Diagnostic groups</td>
<td></td>
<td></td>
<td></td>
<td>25.4</td>
<td>.00004</td>
<td></td>
</tr>
<tr>
<td>Group 1</td>
<td>59 (54)</td>
<td>50 (46)</td>
<td>109 (55)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Group 2</td>
<td>2 (8)</td>
<td>23 (92)</td>
<td>25 (13)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Group 3</td>
<td>2 (29)</td>
<td>5 (71)</td>
<td>7 (4)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Group 4</td>
<td>16 (73)</td>
<td>6 (27)</td>
<td>22 (11)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Group 5</td>
<td>20 (61)</td>
<td>13 (39)</td>
<td>33 (17)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Distance</td>
<td></td>
<td></td>
<td></td>
<td>1.18</td>
<td>&gt;.05</td>
<td></td>
</tr>
<tr>
<td>Proximal</td>
<td>58 (48)</td>
<td>64 (52)</td>
<td>122 (61)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Local</td>
<td>21 (54)</td>
<td>18 (46)</td>
<td>39 (20)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Distant</td>
<td>21 (57)</td>
<td>16 (43)</td>
<td>37 (19)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Insurance</td>
<td></td>
<td></td>
<td></td>
<td>.47</td>
<td>&gt;.05</td>
<td></td>
</tr>
<tr>
<td>Medicaid</td>
<td>48 (52)</td>
<td>45 (48)</td>
<td>93 (47)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>None</td>
<td>9 (45)</td>
<td>11 (55)</td>
<td>20 (10)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>HMO</td>
<td>12 (55)</td>
<td>10 (45)</td>
<td>22 (11)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Private</td>
<td>31 (49)</td>
<td>32 (51)</td>
<td>63 (32)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Hypothesis testing. Of the 100 subjects admitted, the ranges of pulse oximetry readings were as low as 77% to a high of 99%. See Table 3 for pulse oximetry value comparisons. The mean pulse oximetry reading of the admitted group was 91%. In contrast, in the discharge group the pulse oximetry values ranged from 89% to 100% with a mean of 94.8%. A t-test was used to test for a significant difference between the mean values of those discharged and those admitted. A significant difference was found ($t = -7.14$, $df = 171$, $p = .000$). This supports the hypothesis that lower initial pulse oximetry readings would increase the likelihood of admission.

Table 3

Pulse Oximetry Readings in the Admitted and Discharged Groups

<table>
<thead>
<tr>
<th>Disposition</th>
<th>Mean (%)</th>
<th>Range (%)</th>
<th>S.D.</th>
<th>t</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Admitted</td>
<td>91.1</td>
<td>77-99</td>
<td>4.36</td>
<td>-7.14</td>
<td>.000</td>
</tr>
<tr>
<td>Discharged</td>
<td>94.8</td>
<td>89-100</td>
<td>2.84</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Hypothesis Two

Characteristics of age groupings. The second hypothesis of the study sought to explore whether younger patients would be admitted with higher pulse oximetry readings because of their age. By study design, the number of subjects was equally distributed by age group as well as disposition. However, for this study not only were age and disposition evaluated but also the variables of sex, distance, insurance, and diagnosis.
Table 4 shows a comparison of these variables between the four age groups. The characteristics of the subjects by age grouping, reflected findings seen with the sample as a whole. Each group had many more males than females except among the 12 to 17 years olds that had more females than males. Chi square analysis did show a significant difference ($X^2 = 11.98; df = 3; p = .007$) between age groups in regards to sex. As in the whole group, the predominant diagnosis in each age group was asthma and reactive airway disease (RAD) except in the youngest group which had bronchiolitis as the most common diagnosis. Chi square analysis did show a significant difference among the groups in relation to diagnosis ($X^2 = 103.2, df = 12, p = .0000$). Caution should be used in making conclusions from these data because of the number of cells involved with an expected frequency less than five. The remaining two characteristics were not significantly different based on Chi square analysis. Insurance coverage of the groups showed that the majority of the subjects were covered either by Medicaid or private insurance carriers. This again was reflective of the group as a whole.

**Hypothesis testing.** A one-way ANOVA was performed to test for significance in pulse oximetry values between the age groups in those admitted and discharged. There was no significant difference between the age groups; therefore, the second hypothesis of the study was not supported. However, in the youngest age group, the lowest pulse oximetry reading was at least one percent higher than the other groups and a higher mean, median, and mode is noted. Table 5 summarizes the pulse oximetry values by age group.
Table 4

Comparison of Variables Between Age Groups

<table>
<thead>
<tr>
<th>Variable</th>
<th>Group 1</th>
<th>Group 2</th>
<th>Group 3</th>
<th>Group 4</th>
<th>Total Group</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1 month-12</td>
<td>13 month-4 year</td>
<td>5 years-11 years</td>
<td>12 years-17 years</td>
<td></td>
</tr>
<tr>
<td></td>
<td>month n (%)</td>
<td>n (%)</td>
<td>n (%)</td>
<td>n (%)</td>
<td>n (%)</td>
</tr>
<tr>
<td>Admitted</td>
<td>26(26)</td>
<td>23(23)</td>
<td>25(25)</td>
<td>26(26)</td>
<td>100</td>
</tr>
<tr>
<td>Discharged</td>
<td>28(28)</td>
<td>21(21)</td>
<td>23(23)</td>
<td>26(26)</td>
<td>98</td>
</tr>
<tr>
<td>Sex</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>33 (61)</td>
<td>29 (66)</td>
<td>36 (75)</td>
<td>22 (42)</td>
<td>120</td>
</tr>
<tr>
<td>Female</td>
<td>21 (39)</td>
<td>15 (34)</td>
<td>12 (25)</td>
<td>30 (58)</td>
<td>78</td>
</tr>
<tr>
<td>Insurance</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Medicaid</td>
<td>35 (65)</td>
<td>20 (45)</td>
<td>16 (33)</td>
<td>22 (42)</td>
<td>93</td>
</tr>
<tr>
<td>Private</td>
<td>14 (26)</td>
<td>14 (32)</td>
<td>18 (37)</td>
<td>17 (32)</td>
<td>63</td>
</tr>
<tr>
<td>HMO</td>
<td>4 (7)</td>
<td>4 (9)</td>
<td>7 (15)</td>
<td>7 (24)</td>
<td>22</td>
</tr>
<tr>
<td>None</td>
<td>1 (2)</td>
<td>6 (13)</td>
<td>7 (15)</td>
<td>6 (12)</td>
<td>20</td>
</tr>
<tr>
<td>Distance</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Proximal</td>
<td>29 (54)</td>
<td>28 (64)</td>
<td>31 (64)</td>
<td>34 (65)</td>
<td>122</td>
</tr>
<tr>
<td>Local</td>
<td>11 (20)</td>
<td>7 (16)</td>
<td>13 (27)</td>
<td>8 (15)</td>
<td>39</td>
</tr>
<tr>
<td>Distant</td>
<td>14 (26)</td>
<td>9 (21)</td>
<td>4 (8)</td>
<td>10 (19)</td>
<td>37</td>
</tr>
<tr>
<td>Diagnosis</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Asthma/RAD</td>
<td>7 (11)</td>
<td>17 (39)</td>
<td>40 (84)</td>
<td>45 (86)</td>
<td>109</td>
</tr>
<tr>
<td>Bronchiolitis</td>
<td>26 (48)</td>
<td>5 (11)</td>
<td>0 (0)</td>
<td>2 (4)</td>
<td>33</td>
</tr>
<tr>
<td>Pneumonia</td>
<td>10 (18)</td>
<td>7 (16)</td>
<td>3 (6)</td>
<td>2 (4)</td>
<td>22</td>
</tr>
<tr>
<td>Other</td>
<td>6 (12)</td>
<td>16 (33)</td>
<td>6 (10)</td>
<td>4 (2)</td>
<td>32</td>
</tr>
</tbody>
</table>

* Note: Other diagnostic group includes RSV, croup, bronchitis, URI, and bronchospasm
Table 5

**Pulse Oximetry Values by Age Group**

<table>
<thead>
<tr>
<th>Group</th>
<th>Range in %</th>
<th>Mean in %</th>
<th>Median in %</th>
<th>Mode in %</th>
</tr>
</thead>
<tbody>
<tr>
<td>1mo-12mo</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total Group</td>
<td>86-100</td>
<td>94</td>
<td>94</td>
<td>94</td>
</tr>
<tr>
<td>Admitted</td>
<td>86-98</td>
<td>92</td>
<td>92</td>
<td>91</td>
</tr>
<tr>
<td>Discharged</td>
<td>92-100</td>
<td>96</td>
<td>96</td>
<td>94</td>
</tr>
<tr>
<td>13mo-4yr</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total Group</td>
<td>77-99</td>
<td>93</td>
<td>94</td>
<td>94</td>
</tr>
<tr>
<td>Admitted</td>
<td>77-99</td>
<td>90</td>
<td>91</td>
<td>88</td>
</tr>
<tr>
<td>Discharged</td>
<td>89-99</td>
<td>95</td>
<td>95</td>
<td>98</td>
</tr>
<tr>
<td>5yr-11yr</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total Group</td>
<td>85-99</td>
<td>92</td>
<td>92</td>
<td>91</td>
</tr>
<tr>
<td>Admitted</td>
<td>85-99</td>
<td>90</td>
<td>90</td>
<td>88</td>
</tr>
<tr>
<td>Discharged</td>
<td>91-99</td>
<td>94</td>
<td>94</td>
<td>91</td>
</tr>
<tr>
<td>12yr-17yr</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total Group</td>
<td>77-99</td>
<td>93</td>
<td>92</td>
<td>92</td>
</tr>
<tr>
<td>Admitted</td>
<td>77-98</td>
<td>91</td>
<td>91</td>
<td>90</td>
</tr>
<tr>
<td>Discharged</td>
<td>89-99</td>
<td>94</td>
<td>94</td>
<td>92</td>
</tr>
</tbody>
</table>
CHAPTER 5

DISCUSSION AND IMPLICATIONS

Hypothesis One

Pulse oximetry values in a wheezing pediatric emergency sample were examined in this study to determine if these values reflected the severity of wheezing. It was hypothesized that lower initial pulse oximetry readings would increase the likelihood of admission. This hypothesis was supported. The admitted group had a statistically lower mean pulse oximetry reading than the discharged group by almost 4% (91% and 94.8%, respectfully). This supports previous research by Geelhoed et al. (1990). In contrast to this finding, a more recent study with a different design completed by Wright, Santucci, Jay and Steele in 1997 concluded that the pretreatment oxygen saturation measurement is a poor predictor of admission and that a better predictor is the posttreatment measurement. In this study they looked at the pre and posttreatment pulse oximetry values in children over 18 months of age with one prior episode of wheezing. Treatments consisted of albuterol nebulizer use while in the emergency department and most (92%) received corticosteroids. They found that a posttreatment pulse oximetry of ≤91% increases the odds of admission 16-fold.
Hypothesis Two

It was also hypothesized that younger patients would be admitted with higher pulse oximetry readings. This was not supported. Although there were no statistically significant differences, the youngest age group had pulse oximetry readings at least one percent higher which can be clinically significant compared to the other age groups. A higher mean, median, and mode was also noted. This suggests that younger ages in general may get admitted with higher pulse oximeter readings. This may require further study with a larger sample.

Other Findings of Interest

Although there were no significant findings in the admission and discharge groups in regards to sex, distance, and insurance providers, there was a significant difference found in relation to diagnosis. Fifty-five percent of the total sample had a diagnosis of asthma/reactive airway disease. This is an expected finding since asthma is the most prevalent chronic disease of childhood and occurs in about 10% of children in the United States (Stein & Scarfone, 1996). Asthma is the most common respiratory condition in children presenting to emergency departments (Geelhoed, Landau, & LeSouef, 1988).

The subjects grouped by age did show a significant difference in regards to sex as each age had many more males than females. The male predominance in this cohort of wheezing children is consistent with the literature (McFaden & Gilbert, 1992) and with prior research by Kerem et al. (1990), Rosen et al. (1989), Yamamoto, Wiebe, Rosen et al. (1992), Yamamoto, Wiebe, Anaya et al. (1992), and Yamamoto, Wiebe,
and Matthews (1992). There were no significant differences found in regards to distance from hospital or insurance coverage. Again, a significant difference was found among the age groups in regards to diagnosis, with the predominant diagnosis of asthma/reactive airway disease.

Another finding of interest is in regards to the comparison of health care coverage. Although no statistical significance was found, among all age groups the majority of the population was covered by Medicaid except in the school-age children. In the school-age population, 33% and 37% respectfully were covered by Medicaid and private insurers. An explanation for this could be the facility in which the research was conducted. A large, metropolitan, urban facility may serve the poor population more readily and provide easier access to health care. An alternative explanation examines the population itself as potentially at risk due to environmental, socio-economic, or educational factors. Additional research to explore these findings may be of interest to those involved in the care of children, especially children with asthma and reactive airway disease.

Relationship of Findings to Conceptual Framework.

Levine's conservation model (1971) provided the conceptual framework for this study. Pulse oximetry readings are a quantifiable measurement of physiologic alterations associated with illness. They reflect the patient's adaptation and attempt to conserve energy. A client will maintain structural integrity through protective responses including the inflammatory process and perceptual awareness. Airway obstruction in asthma is the exaggerated response of the airway to stimuli including allergens. The inflammatory response is generated by the release of chemical mediators
from inflammatory cells. In preventing hypoxemia, nurses can help the client maintain structural integrity and promote adaptation. This is accomplished by nursing actions including accurate triage.

Recognition of respiratory distress at triage is essential in providing early intervention. Interventions provided by staff nurses include completion of treatment and medication orders, positioning, supplementary oxygen delivery and ongoing assessment. All of these help promote adaptation and maintain structural integrity. Advanced practice nurses (APNs) are involved in the assessment, diagnosis and treatment of these clients. The ordering of treatments and medications, which can promote adaptation, is a critical function of APNs in the emergency department. These nursing actions based on Levine are supported by the study data that showed a significant difference between the means in the admission and discharge groups. The data suggest that lower pulse oximetry readings are associated with more severe wheezing, therefore, nursing interventions would include assistance in energy conservation and maintenance of structural integrity.

Nurses can assist clients and families enhance perceptual awareness by discussing common known reactive airway disease triggers (cigarette smoke, pets, molds, mildew, dust, and viruses). Suggesting the use of a diary to monitor episodes of wheezing and activities prior to the attack can help the client become aware of individual triggers.

Recommendations for Nursing

The prevalence of asthma has increased dramatically over the past two decades making it the most prevalent chronic disease of childhood (Stein & Scarfone, 1996).
According to Bailey, Weingarten, Lewis and Mohsenifar (1998) it was estimated in 1990, that approximately 1% of all United States health-care costs (approximately $6.2 billion) were spent on asthma-related health expenses. To combat this costly and common childhood illness, nurses will need to continue research to enhance assessment, diagnosis and treatment of this illness.

**Application to advanced practice nurses.** As the role of advanced practice nursing expands into the acute care setting, the nurse clinician must be aware of the research available concerning assessment tools and their limitations. This is especially true for those involved in making the decisions to admit or discharge. This research study provided data to support that patients with lower initial pulse oximetry readings are more likely to be admitted. This gives additional objective data to support disposition decisions. However, no single objective measure can reflect the myriad of physiologic responses that occur during an asthma exacerbation. As more recent research suggests, both pre and posttreatment readings should be considered before decisions are made.

**Application to staff nurses.** Staff nurses can influence adaptation as they make triage decisions concerning the acuity and timeliness of treatment. The staff nurse knowing the significance of the pulse oximetry values reduces the potential for adverse outcomes. Also, the staff nurse is invaluable in educating the parents on how the readings are obtained and the significance of these values. This allows the parents to participate and gain some control of their child’s care while in the emergency department. Ongoing assessment and documentation of the child’s response to
treatment (adaptation) is also an important nursing role when caring for wheezing children.

**Application to nursing education.** Recommendations for nursing education include educating nursing staff on the use and limitations of pulse oximeters. Furthermore, staff should be taught that frequent pulse oximetry monitoring is important as a prevention tool for hypoxia and as an assessment tool of treatment outcomes. Research findings on the use of pulse oximetry should be included in the education.

**Application to nursing administration.** Based on the research, recommendations apply to nursing administration both in acute care and outpatient settings. The nurse administrator can support the use of pulse oximetry both in the emergency setting and in outpatient settings such as med-centers, primary care offices, and even in homes. Budgetary support is essential to provide the necessary equipment, maintenance, and training for the nursing staff. Cost analysis of the use of pulse oximetry would show clear cost savings when compared to repeated arterial blood gases. Early detection of decreased readings can enhance quick response and treatment. Placing and maintaining pulse oximeters at the initial sight of contact with the client, the triage area, is essential.

Administrators can develop and budget for community case managers. They could help provide resources and education for this population on in home use of pulse oximetry. A population of those children with frequent emergency department admissions could be targeted to begin aggressive in-home therapy. Parents could be taught to monitor pulse oximetry readings during an exacerbation and after home treatment to monitor success or failure of treatment before coming to the emergency
huge cost saving for families, hospitals and insurance companies if emergency
department usage is avoided. This idea is theoretical and would need further research to
support its validity.

Study Strengths and Limitations.

One of the study limitations is that seasonal variations were not factored in. The
length of the data collection was over an 18 month period and over several seasons.
The month could easily have been documented and analyzed for trends in emergency
visits and significance to admissions and discharges.

The site of the research facility limits generalizability of the research study.
Results from a large metropolitan teaching hospital may not apply to smaller rural
facilities. Distance from the hospital, resources available, and access to follow-up may
be different depending upon the location of the hospital.

One of the strengths of the study was the decision to use the clinical finding of
wheezing as the inclusion criterion. Many of the available research studies only used
the diagnosis of asthma or reactive airway disease in the study, excluding large portions
of the wheezing pediatric population. These diagnoses, however, were the largest group
in this study.

Recommendations for Further Research.

Part of the design of this research was to exclude the patient who had return
visits after treatment. It would be interesting to study those children who return
following treatment in comparison to those who did not. Recidivism could be studied
by looking at the variables of initial treatment, follow-up, education, and home therapy
following treatment in comparison to those who did not. Recidivism could be studied by looking at the variables of initial treatment, follow-up, education, and home therapy in an attempt to find what is the difference between those that respond well initially and those that require additional treatment.

The research showed that those with pulse oximetry readings below 94% had a greater likelihood of admission. However, there were those below 94% that were not admitted and many above 94% that were admitted. A study looking at only admissions and the clinical criteria used to make this decision would be of interest to all clinicians.

This study used a large metropolitan emergency department as the study site. Replication in a small rural emergency department would allow for greater application to all settings. Rural emergency departments do not always have the support staff and resources available to manage extremely ill children, and, therefore, often will transfer these children to the larger hospitals. Studying variables used to determine transfer could have a financial impact for small hospitals as all health care providers are competing for maximum reimbursement. As managed care becomes more aggressive, the need to keep clients within a defined health care system will be imperative in order to remain fiscally viable.

Further replication of the study is needed looking at seasonal variations in emergency department use within this population. Certain diseases such as respiratory syncytial virus are known to be cyclic as well as certain environmental triggers such as pollen, dust, and molds. It would be reasonable that during peaks in environmental and viral triggers the use of the emergency department would increase as would admissions.
because of the interaction between environmental triggers, the inflammatory response and hemoglobin oxygen saturation.

Finally, as stated earlier, researching the use of pulse oximetry in the homes of severe asthmatics may be a future study. The early detection of wheezing and mild hypoxia can alert families to begin home treatment sooner and prevent severe hypoxia. This could potentially reduce both emergency department visits, primary care visits, and corticosteroid use, resulting in huge cost savings for those suffering with this disease.

Conclusion.

In summary, the first hypothesis for this study was supported. A significant difference was found between the admission and discharge groups in the mean pulse oximetry reading showing that lower initial pulse oximetry readings would increase the likelihood of admission as a reflection of severity of wheezing. Age did not make a difference. There was a significant difference among the admission and discharge groups and the four age groups in relation to diagnosis. There was no significance in insurance or distance to the hospital. Furthermore, a significantly larger number of males were found in the four age groups.
APPENDIX
## APPENDIX

Data Collection Tool

<table>
<thead>
<tr>
<th>ID Number</th>
<th>Age/Sex</th>
<th>Disposition</th>
<th>Initial SaO2</th>
<th>Health Insurance</th>
<th>Diagnosis</th>
<th>Distance from hospital</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>In Miles</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1=proximal</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2=local</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>3=distant</td>
</tr>
</tbody>
</table>

M=Male  F=Female
A=Admit  D=Disch
M=Medicaid  P=Private  HMO  N=none
LIST OF REFERENCES
LIST OF REFERENCES


