Inpatient Care for Uncomplicated Bronchiolitis
Comparison With Milliman and Robertson Guidelines

Narendra M. Kini, MD, MHA; James M. Robbins, PhD; Mark S. Kirschbaum, RN, PhD; Stephanie J. Frisbee, MSc; Uma R. Kotagal, MBBS, MSc; for the Child Health Accountability Initiative

Context: Bronchiolitis is the most common lower respiratory tract infection in infancy. A recent Centers for Disease Control and Prevention report confirmed that hospitalization rates for bronchiolitis have increased 2.4-fold from 1980 to 1996. Controversies exist about optimal treatment plans. Milliman and Robertson recommend ambulatory care management; in case of hospitalization, the recommended length of stay is 1 day.

Objectives: To relate actual practice variation for infants admitted with uncomplicated bronchiolitis to Milliman and Robertson's recommendations.

Design: Prospective observational study.


Patients: First-time admissions for uncomplicated bronchiolitis in patients not previously diagnosed as having asthma and who were younger than 1 year.

Main Outcome Measures: Respiratory rate, monitored interventions, attainment of discharge criteria goals, and length of stay.

Results: Eight hundred forty-six patients were included in the final analysis: 85.7% were younger than 6 months, 48.5% were nonwhite, and 64.1% were Medicaid recipients or self-pay. On admission to the hospital, 18.3% of the infants had respiratory rates higher than 80 breaths per minute, 53.8% received supplemental oxygen therapy, and 52.6% received intravenous fluids. These proportions decreased to 1.9%, 33.8%, and 20.3%, respectively, 1 day after admission, and to 0.7%, 20.1%, and 8.6%, respectively, 2 days after admission. The average length of stay was 2.8 days (SD, 2.3 days).

Conclusions: Milliman and Robertson’s recommendations do not correspond to practice patterns observed at the hospitals participating in this study; no hospital met the Milliman and Robertson recommended 1-day goal length of stay. Administration of monitored intervention persisted past the second day of hospitalization.


B R O N C H I O L I T I S is the most common lower respiratory tract infection in infancy, and it has been estimated that 95% of all infants, based on serologic test results, have been infected by their second birthday. Respiratory syncytial virus is responsible for approximately 40% to 50% of all hospitalizations for bronchiolitis and 25% of all pediatric hospitalizations for pneumonia. Respiratory syncytial virus has 2 known subtypes, A and B, and outbreaks are both highly seasonal and highly contagious, especially through hand-to-nose and hand-to-eye modes. While adults can contract bronchiolitis, the small air passages in infant lungs are especially susceptible to this infection. Common symptoms include tachypnea, clear coryza, nasal congestion, cough, retractions, wheezing and rales, low-grade or no fever, and hypoxemia; dehydration resulting from poor oral intake may also develop. Most infants will develop only mild or moderate symptoms that can be cared for on an outpatient basis, but approximately 1% to 2% of the infected infants will require hospitalization. A recent report from the Centers for Disease Control and Prevention, Atlanta, Ga, indicates that hospitalization rates for children with bronchiolitis have risen substantially in the past 2 decades. In infants younger than 1 year, hospitalization rates have increased from 12.9 per 1000 in 1980 to 31.2 per 1000 in 1996, representing a 2.4-fold increase. Furthermore, the proportion of all hospitalizations resulting from bronchiolitis increased from 5.4% to 16.4% during the same period. Respiratory syncytial virus–related hospitalizations are estimated to cost the United States $300 million each year.
PATIENTS AND METHODS

The Child Health Accountability Initiative is a 13-hospital collaborative established to enhance the quality of child health services with evidence- and consensus-derived outcome measures. In December 1998, member hospitals of Child Health Accountability Initiative implemented a previously published, evidence-based guideline for inpatient bronchiolitis. Results are reported for the 8 member hospitals completing all data collection and evaluations for this study.

PATIENT POPULATION AND DATA COLLECTION

All patients admitted between January 1, 1999, and March 31, 1999, younger than 1 year at the time of admission and with a principal report of bronchiolitis were considered for enrollment in the study. Prospective exclusion criteria included the following: previous hospital admissions for bronchiolitis, patients with a history of lung disease (eg, asthma or bronchopulmonary dysplasia), congenital cardiovascular disorders, or immunodeficiency disorders. Patients with bronchiolitis admitted directly to a critical care service or patients requiring ventilator care were also excluded. To ensure that all patients included in the final analysis were truly patients with uncomplicated bronchiolitis, patients with discharge International Classification of Diseases, Ninth Revision diagnostic codes other than bronchiolitis or indicative of a more complicated course of illness were excluded retrospectively from the data set. The practice guideline, supporting documents, and medical record packets including preprinted orders were made available on all wards caring for study-eligible patients. Patient enrollment on the guideline was voluntary. Medical record data were collected prospectively for each patient and then retrospectively matched with discharge diagnoses from the electronic administrative record from the admitting institution for that patient.

STUDY VARIABLES

Variables collected prospectively included the following: medical history including history of wheezing, bronchodilator (eg, albuterol) use, and reactive airway disease; laboratory and diagnostic tests performed; therapeutic interventions including oximetry; nasopharyngeal suctioning; administration of intravenous fluids; pharmacological treatments including antibiotics and inhalation therapies; attainment of discharge criteria; discharge details including discharge medications; readmissions or emergency department visits for bronchiolitis within 7 days of discharge; and enrollment on the guideline. Information obtained during post-discharge telephone interviews with caregivers is reported elsewhere. Guideline-established clinical discharge criteria were as follows: patient breathing room air or stable breathing oxygen at less than 0.5 L/min for longer than 1 day; documented teaching of bulb suctioning to parents or caregivers; oral feedings at a level sufficient to prevent dehydration; and respiratory rate usually 80 breaths per minute. Comparatively, M-R criteria for hospital discharge are listed in the P-HSIM as absence of fever, ability to tolerate regular diet and activity, oral and inhaled medication, and breathing comfortably with adequate oximetry.

GLOS AND LOS: DEFINITIONS AND CALCULATION

Milliman and Robertson define GLOS as:

The expected length of inpatient hospitalization required to manage each condition. . . . This length of stay assumes that treatment and healing occur without significant complications. Should treatment and healing not occur in the time frames outlined, the guidelines become appropriate when the patient’s stage of recovery reaches a level of acute care similar to those listed. For bronchiolitis (International Classification of Diseases, Ninth Revision codes 466.1), the M-R P-HSIM define the GLOS as 1 day.

For this study, LOS was calculated in accord with health care industry standards. That is, the date of admission was subtracted from the date of discharge resulting in an integer representing the number of ‘midnights’ for which the patient was in the hospital. The same method of calculating LOS is used by the M-R P-HSIM. ‘The M-R GLOS is counted the way the health care industry counts hospital days; that is, overnight stays in the hospital.’

DATA ANALYSIS

Data were entered into a relational database and data from all 8 hospitals were analyzed at a central location. All mean values are reported as the aggregate (data pooled from all 8 hospitals) mean (N=846) ±SD. All proportional values are reported as the aggregate study proportion (data pooled for all 8 hospitals) with the lowest and highest proportion from individual participating sites reported in parentheses. Direct statistical comparisons with M-R GLOS are not possible because the M-R recommendations are not published with any measures of variance.
documented evidence from the medical literature to support each recommendation. Similar evaluation of commercially produced guidelines may be difficult because of their proprietary nature.

A well-known, commercially available series of guidelines are those from Milliman and Robertson (M-R). Milliman and Robertson is an actuarial consulting firm based in Seattle, Wash, whose health care guidelines are widely used by managed care organizations across the country. Milliman and Robertson has recently released the Pediatric Health Status Improvement and Management (PHSIM) manual and, despite assertions of evidence-based development, the P-HSIM has been criticized in the medical literature for failing to meet American Medical Association standards for guideline development. Furthermore, the most controversial aspects of the M-R recommendations, goal lengths of stay (GLOS), have been questioned in recent reports.

While these studies have been valuable in raising questions about the M-R recommendations, their use of administrative data inherently limits the conclusions that can be drawn, as these data sets can neither account for daily patient clinical status nor ensure homogeneous patient populations. The objective for this study was to use a prospective design that tightly controlled patient inclusion criteria to examine not only the LOS but also the daily patient clinical parameters, thereby allowing comparisons with and assessment of the M-R recommendations. The hypothesis for this study was that observed LOS for uncomplicated bronchiolitis is longer than the M-R-recommended GLOS.

Eight hundred forty-six patients were enrolled in the study between January 1, 1999, and March 31, 1999. Demographic characteristics of the 846 patients were as follows: 51.5% were white (3.9%-82.6%), 27.0% African American (0.0%-61.0%), and 16.7% Hispanic (0.0%-78.6%); 3.59 months old (0.34 months) with 50.6% of the patients aged between 2 and 6 months (36.9%-69.6%) and 35.1% younger than 1 month (17.4%-46.7%); 45.3% of the patients had publicly funded health insurance (Medicaid) (19.9%-85.5%) while 35.9% had commercially funded insurance (11.6%-55.8%); and 42.1% (10.1%-62.0%) of all patients, with either commercially or publicly funded insurance, were members of a managed care organization. Additionally, 18.7% of the patients were born at fewer than 38 weeks gestation (4.3%-28.3%), and almost one fifth of the patients had a history of prior wheezing, albuterol use, or parenteral nutrition (4.3%-52.2%), 11.5% (2.9%-39.1%), and 18.3% (7.3%-25.0%), respectively. A total of 80.1% of the 846 study patients were enrolled on the treatment guideline (52.2%-97.1%).

Figure 1 shows the trajectory of patient treatment for the first 5 days of the hospital stay. On admission, more than half of all patients (53.8% [34.8%-84.0%]) received supplemental oxygen support or intravenous fluids to maintain hydration (52.6% [27.3%-96.0%]). Therapeutic support persisted: one fifth of all patients (20.1% [8.7%-56.7%]) continued to receive supplemental oxygen therapy 2 days after admission.

Patient attainment of the 3 guideline-determined clinical discharge criteria (patient breathing room air or stable breathing oxygen at <0.5 L/min for >1 day; oral feedings at a level sufficient to prevent dehydration; and respiratory rate usually <80/min) is shown in Figure 2. One quarter (26.7% [2.9%-47.8%]) of all patients attained all 3 clinical discharge criteria on the same day as admission. After 1 day of hospitalization, one half of all patients (53.3% ± [21.4%-87.0%]) met all 3 clinical discharge criteria. However, after 2 days of hospitalization, one quarter of the patients (28.7% ± [13.0%-64.1%]) still had not met all 3 clinical discharge criteria after 5 days of hospitalization, 11.5% of patients (4.4%-35.9%) remained hospitalized, not meeting all 3 clinical discharge criteria.

Figure 3 shows the LOS for all patients and individual study sites. Site LOS ranged from a low of...
This study reports substantial difference in hospital LOS from the M-R GLOS for bronchiolitis at each of the 8 pediatric study hospitals. In this study, implementation of the M-R GLOS for bronchiolitis at each of the 8 pediatric study hospitals was tightly controlled, uncomplicated population reported herein, the perceived need for continued monitored intervention and therapy, as measured by the attainment of clinical discharge criteria, persisted past the second day of hospitalization in one quarter (28.7%) of all patients. The role of supportive therapy by trained caregivers is important to avoid unnecessary morbidity. Additionally, the role of parent learning in a controlled environment cannot be overemphasized, as it has been reported that symptoms persist for 5 days or longer after discharge for 20% of the infants.

Milliman and Robertson state, “...the purpose of the inpatient guidelines is to define care for patients who recover from their illness as well as can be expected and without complications.” However, it is unclear if the M-R GLOS guidelines are intended for all patients with bronchiolitis or for only uncomplicated patients, as the P-HSIM guidelines for bronchiolitis describe, in the same section of the guidelines, reasons for admission to the intensive care unit or to routine floor care. In the tightly controlled, uncomplicated population reported herein, almost half (43.2%) of all patients exceeded the M-R 1-day GLOS. It is likely that the proportion of patients exceeding this 1-day GLOS would be much higher when patients requiring intensive care are considered as this patient population is very medically and clinically dissimilar to the patient population included in this study.

The important and positive contribution of commercial groups in the development of practice guidelines should not be understated; valid medical management recommendations can greatly improve the quality and efficiencies of care. However, the methods used for the development of the guideline must be made available for evaluation. The credibility of guidelines, including a full understanding of their possible effects on patient safety, hinges on their development in robust evidence- and outcomes-based methods. Guideline or treatment recommendations advocating GLOS based on “ideal” patient and clinical situations, as is the assumption with the M-R GLOS, have the potential to be arbitrarily applied to all patients, with possible adverse health outcomes for some patients. In summary, rather than attempting to discharge patients within a predefined or recommended period, the focus of care should be expedi-

Figure 2. Trajectory of patient treatment during hospital stay. The cumulative percentage of patients meeting all 3 clinical discharge criteria the day after hospital admission.

Figure 3. Patient length of stay at the individual sites (n=8) of the Child Health Accountability Initiative, study average. Based on the Milliman and Robertson recommendations of a goal length of stay of 1 day.

2.21±1.44 days to a high of 4.11±2.26 days. The mean LOS for all study patients was 2.82 days with an SD of 2.31 days, a minimum LOS of 0 days, a maximum LOS of 32 days, and a median LOS of 2 days. For all study patients, 56% (29.1%-68.3%) had a LOS of 0 to 2 days, 32.8% (31.7%-70.9%) had a LOS of 3-5 days, and 10.4% (3.9%-25.2%) had a LOS longer than 5 days. Neither the study mean LOS nor the mean LOS at any individual study site achieved the M-R 1-day GLOS.

This study reports substantial difference in hospital LOS.
What This Study Adds

Commercially available guidelines are in widespread use for clinical and reimbursement purposes. The basis for their development, applicable patient cohorts, and whether they apply to the population at large is unclear. Our work demonstrates that there is tremendous variation across the country for care of a common respiratory condition but more importantly, none of the centers met the GLOS of a commercially available guideline. This highlights the need for clinicians and other users to be able to have full access to the basis for development of such guidelines to determine their applicability with the same rigor given to scientific literature.

CONCLUSIONS

This study reports, in an uncomplicated patient population, a statistically significant deviation from the M-R 1-day GLOS for bronchiolitis. Monitored intervention persisted past the second day of hospitalization in a substantial portion of infants. Effective guidelines or practice recommendations must be evidence- and outcomes-based and have published methods of development available for peer review.

Accepted for publication May 9, 2001.

We gratefully acknowledge and appreciate the assistance of Lisa Franz and Jefferson Frisbee, PhD, in the preparation of the manuscript.

Corresponding author: Narendra M. Kini, MD, MSHA, Children’s Hospital of Wisconsin, 9000 W Wisconsin Ave, PO Box 1997–MS 950, Milwaukee, WI 53201 (e-mail: nkini@chw.org).

REFERENCES