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Research Article

Bronchiolitis Management -Towards a Recommendation, Why We Bend the Rules?

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Abstract

Purpose: Guidelines adherence and identification factors influencing non-compliance with recommendations in bronchiolitis management. **Methods:** A retrospective study of children hospitalized with bronchiolitis from December 1, 2014, to December 31, 2016. Infants aged under 24 months, with an episode of bronchiolitis, were included. Data was analyzed separately for children aged under 12 months with the first episode of dyspnea (strict bronchiolitis) and aged 12 up to 24 months or with the history of previous dyspnea (loose bronchiolitis). There were compared patients treated with the recommendations (adherent group) and not (non-adherent group). **Results:** 306 infants were included. 253 patients (82.7%) were treated according to recommendations. 162 (94.2%) of the 172 meeting the "strict bronchiolitis" criteria and 91 (67.9%) of the 134 with "loose bronchiolitis". In the non-adherent group (n=53, 17.3%) more patients were aged over 12 months (56.6% vs 24.1%), with risk factors (43.4% vs. 30%), previous episodes of bronchiolitis (41.5% vs 15.4%), higher respiratory rate (49 vs 44/min), greater need of oxygen therapy (32% vs 16.6%) and PICU transfer (5.7% vs 0.8%). **Conclusions:** Children with bronchiolitis under the age of 12 months with the first episode of dyspnea are more likely to be treated in accordance with the guidelines. The use of additional drugs is due to older age, significant medical history, and severe clinical symptoms.

Keywords: Bronchiolitis; Guidelines Compliance; Hospitalized Infants

Introduction

Bronchiolitis is an acute viral infection of the lower respiratory tract occurring in infants and children around the World [1]. There is lack of one common definition. The diversity primarily concerns those that are under the age of 12 or 24 months, the presence of auscultation findings (rales, crackles with or without wheezing), and the first or subsequent episode of the disease [2]. The literature also distinguishes a group meeting the restrictive definition of bronchiolitis, being patients under 12 months of age with the first episode of dyspnea (strict bronchiolitis) and the second group as over 12 months of age or with a history of dyspnea (loose bronchiolitis) [3].

Respiratory Syncytial Virus (RSV) is the most frequent cause of this disease and over 90% of children by age two years are infected with this virus. Other viruses as Rhinovirus or Bocavirus can cause it as well [4]. It was estimated that in 2019-year, RSV causes 33 million infections of the lower respiratory tract, resulting in 3.6 million hospitalizations and approximately 101.400 deaths in in children aged 0-60 months [5]. According to Polish latest publications the reported rates of hospitalization for RSV infections are 267.5/100.000 for children under 5 years of age and 1132.1/100.000 for those under 1 year of age in Poland [6].

The diagnosis of bronchiolitis is based on clinical symptoms and there is no need to perform laboratory blood tests, blood gas analysis or chest radiography. According to evidence-based guidelines only supportive treatment is recommended, what includes water–electrolyte balance maintenance, suctioning nasal secretions, and oxygen supplementation when needed. The use of inhaled bronchodilators, nebulized adrenaline, antibiotics and nebulized or systemic steroids is not recommended [7,8].

Even though the presented guidelines are based on reliable clinical trials and endorsed by expert groups, so far, their adherence is limited. Our recent multicenter, retrospective study in Poland

showed that 70% of inpatient children undergo examinations and treatment methods that are not supported by current guidelines [9]. Studies from other countries have also confirmed lack of compliance with guidelines [10,11]. Among indicated factors influencing no adherence interventions to the guidelines, the use of salbutamol and steroids was associated with older age and a previous history of atopy in children with wheezing and in infants admitted to the intensive care unit [12-13].

In Canada it has been shown that high adherence to bronchiolitis recommendations across care settings was associated with shorter length of stay and lower cost [14]. Therefore, clinicians should aim to increase the guidelines compliance.

Objective

The aim of this study was assessment of adherence to the guidelines and identification the factors influencing non-compliance with recommendations.

Patients and Methods

This was a retrospective study of hospitalized infants with bronchiolitis that used a cohort study design. The study was conducted according to the STOBE statement.

Data were collected in Pediatric Department of St Hedwig of Silesia hospital. All infants less than 24 months of age on admission day, hospitalized for their first or subsequent episode of bronchiolitis from December 1, 2014, and December 31, 2016, were included. The exclusion criteria were to age over 24 months and hospitalization in the Pediatric Intensive Care Unit (PICU) immediately before the admission due to bronchiolitis. Patients were identified based on the ICD10 code diagnosis of bronchiolitis (J21, J 21.0, 21.8, 21.9).

Physicians from the Department reviewed the medical records to collect the data. The clinical data were collected from the time of the bronchiolitis episode.

Outcomes

The primary outcome measure was the assessment of adherence to the diagnostic and therapeutic process used in the management of children hospitalized for bronchiolitis according to American Academy of Pediatrics (APP) guidelines 2014. The analysis of data from 2014-2016 was performed due to direct training of healthcare providers after the publication of the APP recommendations. Subgroup analysis was also planned. Based on data from literature, we have isolated one group meeting the restrictive definition of bronchiolitis (as proposed in some European countries), being patients under 12 months of age with the first episode of dyspnea (strict bronchiolitis) and a second group as over 12 months of age or with a history of dyspnea (loose bronchiolitis) [3]. According to APP guidelines the bronchiolitis diagnosis is based on the clinical symptoms. The is no need of lab test or chest X-ray to be performed. In the treatment only supportive therapy is recommended, it includes oxygen supplementation, water-electrolyse balance, probe feeding and nose suctioning [15]. Non-adherence was defined as receiving any of test or treatments: bronchodilators, steroids, adrenaline, antibiotics or chest X-ray. Antibiotics used in treatment because of bacterial superinfection were not classified as a non-adherence to the recommendation. Due to the patients were admitted to the hospital, viral tests were justified for epidemiological reasons.

The secondary outcome measure was identification factors influencing non-adherence to the guideline. We have decided to compare groups of patients treated according to the guidelines with group where no adherence to the guideline was observed.

Both groups were compared in terms:

1. Age
2. Risk factors for developing severe bronchiolitis [age less than 12 weeks, premature birth, hemodynamically significant heart defects, chronic lung disease (bronchopulmonary dysplasia), congenital malformation, genetic diseases, immune disorders, smoking by mother whilst pregnant or in the child's environment]
3. Number of previous bronchiolitis episodes
4. Respiratory parameters on the day of admission (saturation, respiratory rate, CO2 level in blood gas analysis)
5. Number of RSV infections in groups
6. Necessity for oxygen therapy
7. Necessity for breathing support and transfer to PICU.
8. Duration of hospitalization

Our research hypothesis assumes that the primary reason for the use of additional drugs is a significant medical history and severe clinical symptoms, primarily dyspnea.

Statisical Analysis

Descriptive statistics were used to summarize baseline characteristics. The Student t test was used to compare mean values of continuous variables for approximating a normal distribution. The $\chi 2$ test was used to compare percentages. The difference between study groups was considered significant when the p value is <0.05.

Results

306 patients with bronchiolitis who met the inclusion criteria were hospitalized at St. Hedwig of Silesia Hospital in Trzebnica, Poland from December 2014 to December 2016. The characteristics of

patients at admission are presented in (Table 1)

Demographics and medical history	**n (%)**
Sex m/f	**175** (57.2)/**131** (42.8)
Age (months)	**8.9** (± 6)
< 3 m	**54** (17.6)
3-12 m	**161** (52.6)
12-24 m	**91** (29,8)
Patients with risk factors for developing severe bronchiolitis*	**100** (32.7)
1 factor	**74** (24.2)
2 and more	**26** (8.5)
Episode of bronchiolitis	
1	**229** (74.8)
2 or more	**61** (20)
No data	**16** (5.2)

Table 1: Patient demographic and clinical characteristics in the studied group (n=306);*age less than 12 weeks, premature birth, hemodynamically significant heart defects, chronic lung disease (bronchopulmonary dysplasia), congenital malformation, genetic diseases, immune disorders, smoking by mother whilst pregnant or in the child's environment.

253 (82.7%) patients were treated in accordance with guideline recommendations. Antibiotic therapy was used for comorbidity or for complications (acute otitis media (AOM) or pneumonia). No patient received intravenous steroids or physiotherapy. Diagnostic and therapeutic procedures are presented in (Table 2).

Diagnostic procedures	**n (%)**
Chest X-ray	35(11.4)
RSV	243 (79.4)
Laboratory	305 (99.7)
Treatment	
B-mimetics inhaled	38 (12.4)
Steroids inhaled	33 (10.7)
Adrenaline inhaled	2 (0.7)
Steroids systemic	0 (0)
Antibiotics	37 (12.1)
Oxygen therapy	29 (9.5)
Comorbidity/complications	61 (19.9)
Hospital re-admission	3(1)
Transfer to PICU	5 (1.6)
Duration of hospitalization (h)	69.8 (± 37.6) (11.1-287.9)

Table 2: Diagnostic and therapeutic procedures in the studied group during hospitalization (n=306).

Sub-group analysis

162 (94.2%) of the 172 patients who met the "strict bronchiolitis" criteria and 91 (67.9%) of the 134 patients who met the criteria of "loose bronchiolitis" were treated in accordance with present guidelines. Subgroup analysis is presented in (Figure 1).

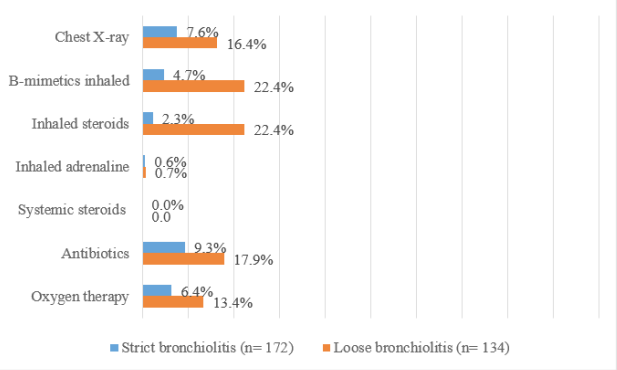

Figure 1: Analysis of diagnostic and therapeutic procedures depending on the defined type of bronchiolitis.

To identify factors influencing non-adherence to guidelines we compared the group where treatment was consistent with the recommended procedures – "adherent group" **(A)** with the group where recommended treatment was discontinued – "non-adherent group" **(B).** Both groups were compared at admission and during hospitalization (Table 3 and 4).

In the "non-adherent" patient group there were significantly more children over the age of 12 months, a higher number of patients with risk factors for developing severe bronchiolitis and a prior

history of bronchiolitis (Table 3).

	A – "ADHERENT" (n = 253) n (%)	**B – "NON-ADHERENT" (n = 53)** n (%)	**P**
Sex m/f	142 (56.1)/111 (43.9)	33 (62.3)/20 (37.7)	NS
Age (m)	8.2 (± 5.8)	12.2 (± 6)	NS
< 3 months	50 (19.8)	4 (7.5)	0.04
3-12 months	142 (56.1)	19 (35.8)	0.005
>12 months	61 (24.1)	30 (56.6)	0.00006
Risk factors for developing severe bronchiolitis	77 (30)	23 (43.4)	0.0003
1 factor	63 (24.9)	11 (20.6)	NS
2 and more	14 (5.5)	12 (22.6)	0.00005
Episode of bronchiolitis			
1	203 (80)	26 (49.1)	<0.000001
2 or more	39 (15.4)	22 (41.5)	0.0004
No data	11 (4.3)	5 (9.4)	

Table 3: Patient group characteristics at the time of admission, depending on the method of treatment later used.

Non-adherent interventions were associated with lower saturation, higher respiratory rate and level of carbon dioxide in arterial blood at the time of admission (Table 4).

	A – "ADHERENT" (n = 253) n (%)	B – "NON-ADHERENT" (n = 53) n (%)	P
Saturation in first day	95 (± 2)	94 (± 3)	<0.000001
Respiratory rate in first day	44 (± 6)	49 (± 8)	0.02
Arterial blood gas CO2 level	34 (±5.6)	37.6 (± 7.3)	0.001
RSV positive	86 (34)	12 (22.6)	0.02
Oxygen therapy	42 (16.6)	17 (32)	0.02
Transfer to PICU	2 (0.8)	3 (5.7)	0.01
Duration of hospitalization (h)	67.5 (±35.8)	80.9 (± 43.8)	0.02

Table 4: Adherent and non-adherent group comparison.

Discussion

Our study indicated a high percentage of inpatient children treated in accordance with APP guidelines (82.9%). We believe that such a high compliance rate results from the teamwork of clinicians and the mandatory training of healthcare providers in applicable guidelines. Our recent study analyzing adherence to the guidelines revealed lower level of adherence to the guidelines [9]. A randomized trial showed that interventions such as site-based clinical leads, stakeholder meetings, a train-the-trainer workshop, targeted educational delivery, other educational and promotional materials can de-implement low-value care [16].

We found multiple factors associated with no adherence to the guidelines. Our results are, overall, in line with previous reports [12-13]. The factors included older age of children (>12 months), occurrence of risk factors and another episode of bronchiolitis. This correlation was also demonstrated in the comparison of the strict and loose bronchiolitis groups, where children over 12 months of age and/or with a second episode of dyspnea more often received treatment inconsistent with the recommendations. This may be due a higher suspicion of asthma in this group of children. Table 3.

Differences in vital signs at admission day (saturation, respiratory rate and level of carbon dioxide in arterial blood), need of oxygen and need for PCIU transfer in both groups indicate that non-compliance decisions are related to the more severe clinical condition of the patient. Also, a negative RSV result may raise the suspicion of a diagnosis other than bronchiolitis due to the frequent emphasis on this pathogen as the main cause.

Based on the above results, we can conclude that the formulated hypothesis where primary reason for the use of additional drugs is a significant medical history and severe clinical symptoms, primarily dyspnea was correct. Bearing in mind that adherence to guidelines is associated with shorter length of hospitalization and lower costs, [14]. We believe that knowing the specific factors is an opportunity to reduce unnecessary procedures and treatments in subsequent seasons. Due to the lack of one consistent definition of bronchiolitis and the need to define it, we consider limiting it to children up to 12 months of age with the first episode of dyspnea. This would eliminate two main factors leading to higher adherence to the guidelines.

Our study has several limitations. The major one is the retrospective nature of the study, resulting in a lack of full access to patients' data. Secondly, the data is obtained from 2014-2016. This period was chosen as the time in which the center declared to train the medical workers to applicable by that time APP guidelines. Another aspect is the fact that our population includes only patients from one center, therefore the results cannot be generalized to other medical centers in Poland.

Conclusion

Children with bronchiolitis under the age of 12 months with the first episode of dyspnea are more likely to be treated in accordance with the guidelines. The use of additional drugs is due to age, significant medical history and severe clinical symptoms.

Declarations

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Competing interest statement

All authors declare no conflicts of interest.

Author contribution statement

HS conceptualized the study. SS developed the first draft of the manuscript. HS, SS, KP, AGO, AB and MO contributed to the development of the study protocol. HS, SS, KP, AGO, AB and MO participated in the collection of the data, were involved in the analyses or interpretation of the data and approved the final draft of the manuscript.

Ethics

The study was conducted in accordance with the Declaration of Helsinki, and approved by Bioethics Committee of the Lower Silesia Medical Chamber in Wroclaw approved the study protocol (4/PNDR/2023).

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