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ORIGINAL ARTICLE

Management of acute bronchiolitis in emergency wards in Spain: variability and appropriateness analysis (aBREVIADo Project)

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Abstract Most patients with acute bronchiolitis have a mild course and only require outpatient care. However, some of them have to go to emergency departments, because they have respiratory distress or feeding problems. There, they frequently receive diagnostic and therapeutic procedures. We want to know the variability and appropriateness of these procedures. A cross-sectional study (October 2007 to March 2008) was carried out on 2,430 diagnosed cases of bronchiolitis in hospital emergency departments, which required no hospitalization. An analysis of the appropriateness of the treatments was made in 2,032 cases gathered in ten departments with at least 100 cases, using as criterion the recommendations of a consensus conference. We estimated the adjusted percentages of each department. Most of the bronchiolitis were mild, in spite that they underwent multiple diagnostic and therapeutic procedures. In the acute phase, different treatments were used: inhaled beta 2 agonists (61.4%), antipyretics (17.1%), oral steroids (11.3%), and nebulized adrenaline (9.3%). In the maintenance phase, the most common treatments were: inhaled beta 2 agonists (50.5%), oral steroids (17%), oral beta 2 agonists (14.9%), and antibiotics (6.1%). The 64% of the treatments used in the acute phase and the 55.9% in the maintenance phase were considered inappropriate in the appropriateness analysis; a great heterogeneity among centers was found. *Conclusions*: There are discrepancies between clinical practice and evidence-based management of bronchiolitis in Spanish emergency departments. Inappropriate treatments were used in more than half of patients. The wide variation between centers shows the influence of local prescribing habits and reveals the scope for improvement.

Keywords Viral bronchiolitis/diagnosis · Viral bronchiolitis/treatment · Infants · Emergency hospital service · Physician's practice patterns

Members of the Research Group are specified in Appendix 1.

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Introduction

Acute bronchiolitis is the main cause of hospital admissions related to acute lower respiratory airway infections in infants. It has significant repercussions in all levels of pediatric health care. Most patients have a mild course and only require outpatient care. However, some of them have to go to emergency departments (EDs), because they have respiratory distress or feeding problems, where they frequently receive diagnostic and therapeutic procedures. Diagnostic tests and treatments used in the EDs and admission criteria vary widely between areas and health systems [2, 29, 30, 38], but this variability does not correspond to differences in the severity of patients or recommendations of clinical practice guidelines [1, 6, 14, 19, 42] and probably does not have any effect on clinical outcomes.

Bronchiolitis does not usually require the use of diagnostic tests [33]. Only occasionally do we need to use them to rule out alternative diagnoses, classify the severity of respiratory compromise, or indicate other additional diagnostic or therapeutic procedures. Also, only a small percentage of

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patients are going to require hospital admission [34], which is usually motivated by the need for care such as the administration of supplemental oxygen, suctioning, or administering intravenous fluids or enteral feeding. Despite the existence of multiple clinical trials over the past 25 years examining the potential efficacy of pharmacological interventions in bronchiolitis [16, 17] (mainly bronchodilators, anti-inflammatory, and antiviral), there is little progress in the management of cases of bronchiolitis, with repeated studies (occasionally contradictory) and only little new evidence of the efficacy of some treatments (heliox, hypertonic saline solution, etc.). With respect to bronchiolitis, there remains the question of defining the right drug for the right patient at the appropriate dose and at the right time [25].

With the objective of describing the variability and appropriateness of the diagnostic and therapeutic procedures used in bronchiolitis attended in hospital EDs, we will analyze a sample of patients collected in a larger study on the management of bronchiolitis in Spain [18]. The appropriateness of the treatments in EDs with at least 100 cases will be compared, using as standard reference the recommendations of a consensus conference [15].

Methods

Design This was a cross-sectional, descriptive study of bronchiolitis cases diagnosed in a sample of hospital EDs. All cases that did not require hospital admission were selected for this study. The participating centers belonged to 11 Spanish autonomous communities. The information of this descriptive study is part of the aBREVIADo Project (Bronchiolitis–Study of Variability, Adequacy, and Adherence), in which the recommendations made by the consensus conference of bronchiolitis were used as reference standards [15].

Study period The study period is from October 2007 to March 2008.

Inclusion criteria All bronchiolitis cases diagnosed during the study period according to the McConnochie [31] criteria: first acute episode of respiratory distress with wheezing preceded by a cold-like clinical picture of the upper respiratory airway (rhinitis, cough, with/without fever), which affects children younger than 2 years of age. In each participating center, we defined a priori the following areas for gathering cases: doctor's office, ED, hospitalization, and/or intensive care units. In four EDs, in which we estimated the number of cases would be greater than 150, we gathered all of the diagnosed bronchiolitis cases on 30 randomly selected days.

Exclusion criteria Exclusion criteria are patients with previous wheezing episodes.

Data gathering Data gathering included collecting the consecutive records of cases diagnosed by collaborating doctors in the study as well as the periodical review of databases and lists or copies of reports for the records of cases diagnosed by other doctors. We considered the following codes of the international classification of diseases (ICD 9 Clinical Modification) for the primary and secondary search criteria: 466.1—bronchiolitis; 079.6—infections by respiratory syncytial virus (RSV); 466.11—bronchiolitis by RSV; 466.19—bronchiolitis, others; and 493—asthma. Likewise, we conducted text searches with the term "bronchiolitis." The results of all those searches were manually verified including only cases with McConnochie criteria [31].

We designed a standardized data collection form that included general data, signs and symptoms, risk factors, diagnostic tests, and treatments. The data were abstracted by collaborating doctors of each center; interrater reliability was not tested. A complete description of these items is available in a previous article [15]. We designed a score of the severity of disease by gathering the variables that had been shown in previous studies to have an adequate inter-observer concordance [22, 24, 26, 27, 40, 45, 47], including the following: respiratory rate, pulmonary ventilation, wheezing, retractions, and consciousness; these variables were measured after adequate aspiration of secretions (0 to 2 for each component; maximum score of 10). The treatments were differentiated according to their use in the acute or maintenance phases of the disease. We considered acute phase treatments in ambulatory patients those administered at the place of diagnosis and those recommended during the following 24 h.

The treatment was classified according to its appropriateness following the recommendations of the consensus conference as: first choice, alternative, or inappropriate (Table 1). Patients admitted to the ICU were excluded from this classification [14, 15].

Ethical aspects It was specifically recommended not to modify, in any way, the routine management of patients with bronchiolitis. Data were gathered anonymously without registering the patient's identifying data.

Statistical aspects Statistical processing was performed with SPSS version 11.5.1 (serial number 9036057). We did not conduct an estimation of the sample size necessary for each setting because in almost all of the centers, all of the patients diagnosed with bronchiolitis were included. However, we had calculated that a subsample of 100 patients would allow for the estimation of percentages with a precision of ±10%.

We calculated measures of central tendency for the quantitative variables and performed a frequency analysis of the qualitative variables. We estimated confidence intervals for the main measurements.

Table 1 Therapeutic appropriateness criteria [14, 15]

Treatment[a, b]	First choice or systematic use	Alternative or optional use	Inappropriate or unnecessary use
Oxygen	Saturation <92% or severe respiratory distress	Saturation between 92 and 94% (according to other parameters)	Saturation >94% without respiratory distress
Oral beta 2 agonists			Inappropriate use
Inhaled beta 2 agonists		Trial essay in moderate–severe[c] bronchiolitis; maintain it in cases of objective improvement	Mild bronchiolitis or routine use
Nebulized adrenaline		Trial essay in moderate–severe[c] bronchiolitis (preferable in <6 months patients), when a posttreatment observation period is available (hospital or emergency wards); maintain it in cases of objective improvement	Mild bronchiolitis or routine use
Ipratropium bromide			Inappropriate use
Inhaled steroids			Inappropriate use
Systemic steroids		Not recommended. It would not be inappropriate in moderate–severe[c] bronchiolitis, associated with bronchodilators	Inappropriate use in other circumstances
Antibiotics			Inappropriate use
Nebulized hypertonic saline solution		Trial essay associated with bronchodilators	Mild bronchiolitis
Heliox	Severe bronchiolitis (intensive care units) with intense respiratory distress	Moderate–severe bronchiolitis with increasing respiratory distress	Mild bronchiolitis or routine use
Xanthines		Bronchiolitis with apnea in neonates o preterm patients	Inappropriate use in other circumstances

[a] Other inappropriate or not recommended treatments: subcutaneous adrenaline, nebulized ribavirine, intravenous or nebulized immunoglobulins, nitric oxide, respiratory physiotherapy, nebulized recombinant DNase, intramuscular interferon, nebulized furosemide

[b] Other restricted treatments: nebulized ribavirine (high risk and severe patients with respiratory syncytial virus infection in intensive care units), surfactants

[c] Operative moderate–severe criteria: hospitalized or with a severity score ≥4 or with a oxygen saturation ≤94%

An analysis of variability among centers that had collected data from at least 100 patients was made. Qualitative variables were evaluated by χ^2 test or exact tests. Quantitative variables were evaluated by analysis of variance or Kruskal–Wallis test. We estimated percentages of inappropriate treatment for EDs, adjusted by unconditional logistic regression for age, history of apnea or prematurity, severity score >4, and oxygen saturation at diagnosis <94%. We used a "backward" modeling strategy based on changes in the likelihood ratio. The adjusted percentages of each service and their confidence intervals were estimated from the model coefficients and their standard errors. Finally, Spearman's correlation coefficients were estimated to contrast the association between adjusted percentages of appropriateness in each center and their volume of cases.

Results

Between October 2007 and March 2008, we gathered 2,430 cases of bronchiolitis from 25 hospital EDs. These cases accounted for 43.1% of all bronchiolitis included in the overall study (5,636). In ten centers at least 100 cases had been diagnosed in their EDs (total 2,032 cases, median 219 per center, range between 115 and 281). All these EDs belong to university hospitals.

Clinical data

The highest incidence of cases occurred during the months of December (38.9%), November (20.2%), and January (16.9%), which together accounted for 76% of all cases. A total of 58.1% of cases were male. The mean age was 0.53 years (CI 95%, 0.52 to 0.54) with a predominance of children between 3 months and 1 year of age (Table 2).

In Table 2 the main clinical data are shown. They are by decreasing frequency: cough (95.7%), rhinitis (81.3%), rejection of feeding (33.5%), vomiting (19.5%), and fever (22.9%). Apnea (0.8%), dehydration (0.1%), and a septic appearance (0.2%) were infrequent. The EDs with at least 100 cases had a higher mean severity score, although this information was only available in 81.8% of cases (79.2% in EDs with at least 100 cases and 94% in the rest).

Table 2 Demographic and clinical characteristics (counts and percentages)

	Hospitals with >100 cases (2,032)		Other hospitals (398)		Total (2,430)		*p*
	No.	%	No.	%	No.	%	
Age							0.018
Neonates	40	2.0	14	3.5	54	2.2	
1–3 months	356	17.6	49	12.4	405	16.7	
>3–11 months	1,459	71.9	292	73.9	1,751	72.3	
≥12 months	173	8.5	40	10.1	213	8.8	
Clinic							
Temperature at diagnosis							0.006
<37°C	853	46.1	177	47.6	1,030	46.4	
37–37.9°C	551	29.8	132	35.5	683	30.8	
>38°C	445	24.1	63	16.9	508	22.9	
Cough	1,848	95.7	376	95.9	2,224	95.7	0.813
Night cough	968	88.0	242	91.7	1,210	88.7	0.091
Rhinitis	1,511	80.2	334	87.0	1,845	81.3	0.002
Dehydration	3	0.2	0	0.0	3	0.1	0.442
Vomiting	336	18.2	99	25.3	435	19.5	0.001
Feeding rejection	598	32.2	151	39.7	749	33.5	0.004
Apnea	18	0.9	1	0.3	19	0.8	0.185
Septic picture	3	0.2	2	0.5	5	0.2	0.158
Severity score at diagnosis[b]							
Median (IQR)	1.0 (2)		1.0 (2)		1.0 (2)		0.042
Score >4	42	2.6	10	2.7	52	2.6	0.962

IQR interquartile range

[a]There are cases with unspecified data for some variables; thus, the counts do not add up to the total

[b]Information only available in 1,987 cases (81.8%; 79.2% in hospital with >100 cases and 94.7% in other hospitals)

A total of 9.3% of cases had a history of preterm birth and 1.4% of congenital heart disease. Other risk factors were infrequent: bronchopulmonary dysplasia (0.8%) and neuromuscular disease (0.1%). Thirteen percent of cases had a past medical history of maternal atopy, although this information was only available in just over half the cases.

Diagnostic tests

Diagnostic tests and results are presented in Table 3. Oxygen saturation was obtained in 75.7% of cases. RSV identification tests were performed in 14.9% of cases (with 59.7% positive results), chest X-rays in 14.9%, procalcitonin in 3.3%, C-reactive protein in 1.2%, complete blood counts (CBCs) in 1.2%, blood cultures in 0.9%, and blood gases in 0.9%.

In Table 3 we can see the range of variation in the use of diagnostic procedures in EDs with at least 100 cases. The variability was statistically significant for all tests. Relevant examples of this heterogeneity are the identification of RSV (between 0% and 43.3% of cases), the performance of chest radiography (between 13.6% and 45.3%), CBC (between 0% and 25.7%), C-reactive protein (between 0% and 22.3%), procalcitonin (between 0% and 35.9%), or blood gases (between 1.1% and 21.2%). The measurement of oxygen saturation was normal practice in most centers; only one center showed a rate of use lower than 70% (32.1%).

Treatments

Table 4 shows the treatments used during the acute and maintenance phases of bronchiolitis. In the acute phase, the treatments most frequently offered were: inhaled beta 2 agonists (61.4%), antipyretics (17.1%), oral steroids (11.3%), and nebulized adrenaline (9.3%), and in the maintenance phase inhaled beta 2 agonists (50.5%), oral steroids (17%), oral beta 2 agonists (14.9%), and antibiotics (6.1%).

Table 4 shows the variation range of treatments used in centers with at least 100 cases. For most of them, there is a significant heterogeneity. Relevant examples of the heterogeneity of acute phase treatment are oral steroids (between 0.5% and 44.1%), nebulized adrenaline (between 0% and 23.2%), and inhaled beta 2 agonist (between 29%, 7%, and 95.3%), and in the maintenance phase oral steroids (between 0% and 72.5%), inhaled beta 2 agonist (between 11.2% and 85.2%), oral beta 2 agonists (between 0% and 76.9%), and antibiotics (between 3.9% and 33.3%).

Table 3 Diagnostic tests used and main results

Diagnostic test	No.	%	Min–max[a] (%)
Measured oxygen saturation at diagnosis	1,509	75.7	32.1–99.3
Median and IQR (%)	97	2	94–98
Chest X-ray	301	14.9	13.6–45.3
Hyperinflation	68	26.6	4.3–94.7
Atelectasis	17	6.3	8.7–34.5
Infiltrates	48	17.7	12.5–57.4
Air leak	0	0.0	0.0–1.7
RSV identification	131	6.5	0.0–43.3
Positive RSV	74	59.7	0.0–81.6
Obtained blood gas	18	0.9	1.1–21.2
Arterial	0	0.0	0.0–2.2
Venous	14	0.7	0.0–19.2
Capillary	4	0.2	0.0–7.4
Not obtained	2,007	99.1	78.8–98.9
Obtained CBC	24	1.2	0.0–25.7
Obtained C-reactive protein	25	1.2	0.0–22.3
Obtained procalcitonin	68	3.3	0.0–35.9
Obtained blood cultures	9	0.9	0.0–100.0

Counts, percentages and range of values by departments (min–max). There are cases with unspecified data for some variables; thus, the counts do not add up to the total

CBC complete blood count, *Min* minimum, *Max* maximum, *IQR* interquartile range

[a] Statistically significant heterogeneity between emergency departments for all diagnostic test ($p<0.001$)

Table 5 presents the classification of the appropriatenes of treatment, both in the acute and maintenance phases. The treatments were inappropriate in the acute phase in 64% of cases and in the maintenance phase in 55.9%. The use of inhaled bronchodilators in mild cases is the main cause of inappropriateness. There are small differences in the appropriateness of treatment between the bronchiolitis of centers with at least 100 cases and the rest. However, the difference of criterion in the indication of treatment between different hospitals is very important. Figures 1 and 2 represent the percentages of inappropriate treatment of the various sites, adjusted for differences in age, history of prematurity or apnea, and severity scale. The adjustment for severity of patients produced an important reduction in the percentage of inappropriate use. In spite of this, there remain great differences, ranging from 6.6% to 71.5% in the acute phase and between 0% and 96.6% in the maintenance phase. Globally, 38.4% of the inappropriateness in acute phase and 41.9% in maintenance phase cannot be explained by severity differences. There was no correlation between the adjusted percentages of inappropriateness of each center and their volume of cases.

Discussion

Our study provides a descriptive analysis of routine clinical management of patients with bronchiolitis treated in Spanish EDs, as consecutive cases of an epidemic period were prospectively collected. We used a standardized data collection form to assess the clinical characteristics of patients and the procedures conducted according to their physicians' criteria. In addition, the amplitude of the sample collected permits us to explore the variability between EDs. Finally, we used standards developed in a consensus conference to classify the degree of appropriateness of the treatments used.

Table 4 Main treatments during the acute and maintenance phases

Treatments	No.	%	Min–max[a] (%)
Acute phase			
Oxygen	109	5.4	4.8–39.2
Intravenous fluids	9	0.4	1.1–24.0
Oral beta 2+	28	1.4	0.0–4.3
Inhaled beta 2+	1,241	61.4	29.7–95.3
Oral antibiotic	49	2.4	0.0–7.1
i.v./i.m. antibiotic	1	0.0	0.0–11.5
Respiratory physiotherapy	23	1.1	0.0–14.5
Nebulized adrenaline	188	9.3	0.6–23.2
Oral steroids	228	11.3	0.5–44.1
Inhaled steroids	52	2.6	0.0–18.0
Parenteral steroids	0	0.0	0.0–21.9
Ipratropium bromide	77	3.8	0.0–17.5
Antipyretic	346	17.1	0.5–48.9
Humidification	24	1.2	0.0–6.0
Nasal irrigation	754	39.1	0.0–97.8
Aspiration of respiratory airway	525	26.0	7.3–82.8
Maintenance			
Antitussives	6	0.3	0.0–1.8
Mucolytic decongestants	16	0.9	0.0–2.6
Oral beta 2+	274	14.9	0.0–76.9
Inhaled beta 2+	932	50.5	11.2–85.2
Antibiotics	112	6.1	3.9–33.3
Oral steroids	313	17.0	0.0–72.5
Inhaled steroids	16	0.9	0.0–5.0
Ipratropium bromide	2	0.1	0.0–0.6
Montelukast	0	0.0	0.0–0.6

Counts, percentages and range of values by departments (min–max). There are cases with unspecified data for some variables; thus, the counts do not add up to the total

Min minimum, *Max* maximum

[a] Statistically significant heterogeneity between emergency departments for all treatments ($p<0.001$) except for mucolytic/decongestants, ipratropium bromide, and montelukast in maintenance phase

Table 5 Appropriateness of the treatments in the acute and maintenance phases

Appropriateness	No.	%	Min–max[a] (%)
Acute phase			
First choice	493	24.3	2.4–57.1
Alternative use	238	11.7	6.8–43.6
Inappropriate	1,301	64.0	36–83.5
Alternative use:			
Beta 2+ or adrenaline in moderate–severe[b]	209	10.3	1.8–38.2
Systemic steroids associated with bronchodilators in moderate–severe[b]	29	1.4	0.5–12.3
Inappropriate use:			
Beta 2+ or adrenaline in mild	968	47.6	17.1–52.4
Systemic steroids in mild	129	6.3	0–19.2
Other inappropriate treatments[c]	65	3.2	2.6–15.9
Various inappropriate[c]	139	6.8	0–23.1
Maintenance phase[d]			
First choice	783	38.5	3.6–98.4
Alternative use	114	5.6	0.5–34.3
Inappropriate use	1,135	55.9	1.1–94.6

Counts, percentages and range of values by departments (min–max)

[a] Statistically significant heterogeneity between emergency departments for all criteria

[b] Patients hospitalized or with a severity score ≥4.or with a oxygen saturation ≤94%

[c] Antibiotics, oral salbutamol, inhaled steroids, ipratropium bromide, and physiotherapy. When these treatments were associated with the use of bronchodilators and/or steroids in mild cases were classified as "various inappropriate"

[d] Use of steroid (inhaled or systemic), methylxanthine, montelukast, and bronchodilators not indicated for use in the acute phase was considered inappropriate during the maintenance phase

We note that there is a high use of diagnostic and therapeutic procedures which are not recommended in practice clinical guidelines [1, 6, 14, 19, 42], with a great variability between EDs that are not explained by differences in the type of patients treated. This fact shows the effect of patterns of inappropriate clinical management. More than half of the treatments used in the bronchiolitis are inappropriate, existing in most of the studied EDs a wide margin for improvement.

Few studies have reviewed the bronchiolitis treated in EDs [30, 38]. The only one with sufficient sample size to draw conclusions was a review of computerized health records, which did not provide data on patient characteristics [30]. Two studies have explored the views of pediatricians or emergency physicians or revised their protocols [2, 29]. Most published works have focused on the study of hospitalized [3–5, 7–10, 12, 13, 20, 23, 32, 35, 44, 46] or ambulatory patients [3, 4, 11, 28, 41, 43]. If we take into account the characteristics of our patients, most of them with minimal respiratory compromise, they show few differences with ambulatory patients.

Diagnostic tests

The measurement of oxygen saturation is a routine practice in our setting (75.7%), and it is a recommended test, at least

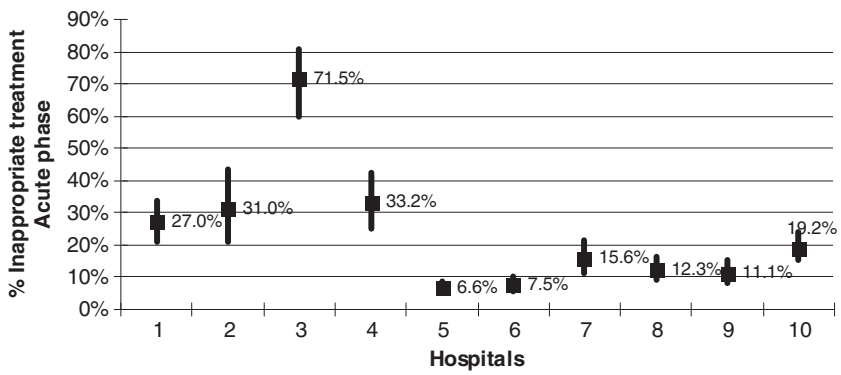

Fig. 1 Appropriateness of acute phase treatment by centers: adjusted percentages with their 95% confidence intervals

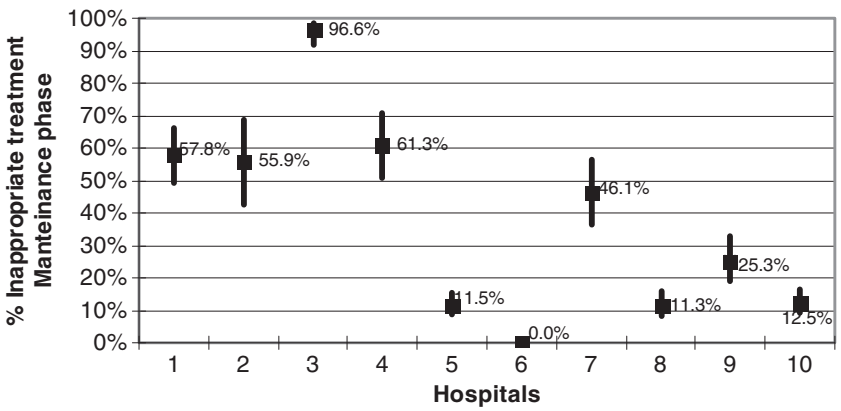

Fig. 2 Appropriateness of maintenance phase treatment by centers: adjusted percentages with their 95% confidence intervals

at the time of diagnosis, as it facilitates the objective evaluation of severity, which is different from information offered by other signs and symptoms [14]. It is possible that the remaining patients had been mild cases in which oxygen saturations had not been measured or registered. In contrast, the usefulness of the identification of the presence of RSV or a chest X-ray is unclear. Both are procedures that have been used in low percentages of patients (6.5% and 14.9%, respectively), but with some EDs that use them in near than half of patients. Blood tests for ruling out associated bacterial infections have been little used in our patients, except for some centers where they have been used in almost a quarter of cases.

In other case series of emergency patients, the use of chest X-ray or RSV identification tests is frequent [30, 38], whereas in a survey to pediatricians these tests have been considered advisable [29]. In contrast, their use in a series of ambulatory patients was rare [43]. Regarding the use of diagnostic tests for bacterial infection, it has been shown that the risk of bacterial infection is very low, even in infants younger than 3 months. Thus, although CBCs and blood cultures are frequently used for these patients, they do not seem to be necessary [28].

Treatments

In this study, we observed a wide use of bronchodilators, steroids, and other treatments of unclear efficacy (antibiotics, oral bronchodilators, inhaled steroids, ipratropium bromide, etc.). The treatment rendered to patients with bronchiolitis attended in EDs is composed of the wide use of inhaled beta 2 agonists (61.4%) or nebulized adrenaline (9.3%) together with support or symptomatic measures (antiemetics, nasal lavage, secretion aspiration, oxygen therapy, and intravenous fluids). Eleven and three-tenths percent of patients received systemic steroids and only 2.4% antibiotics. Against this overall pattern, it is worth noting that in some settings, the use of steroids, ipratropium bromide, and even antibiotics is high. Other studies have found rates of use of inhaled bronchodilators and systemic steroids similar to ours (between 53% and 100% of bronchodilators and between 0% and 13% steroids) [30, 38]. With respect to the use of nebulized hypertonic saline solution, for which recent evidence suggests a certain efficacy, neither our study nor other previously published studies allowed for the description of its implementation in clinical practice.

In the maintenance phase of treatment, more than half of patients received inhaled (50.5%) or oral (14.9%) bronchodilators, 17% systemic steroids and 6.1% antibiotics. When we analyze the variability between EDs, we note that in some of them the employment of bronchodilators and oral steroids is standard practice. The only study that describes the maintenance treatment of emergency patients shows a similar use of bronchodilators and steroids [38]. Two studies conducted on outpatients in France demonstrate a lower use of beta 2 agonists and steroids, and widespread use of chest physiotherapy [41, 43]. Due to the extensive information available, the following facts are well known about the treatment of bronchiolitis in emergency rooms[15, 16]: (1) it is fundamental to use symptomatic support measures for the management of fever, respiratory secretions, hyporexia, respiratory distress, and hypoxemia; (2) the alternative use of a therapeutic trial with salbutamol or nebulized adrenaline (better with nebulized hypertonic saline solution) can be considered in selected moderate–severe cases and maintained only if there is a positive documented response (clinical severity score) and no adverse effects; and (3) the use of the majority of the remaining drugs is considered inappropriate (steroids, oral salbutamol, subcutaneous adrenaline, ipratropium, antibiotics, immunoglobulins, etc.).

Despite these fundamental data, it is worrying that in our environment there is a high use of medications for which the evidence is not convincing. While the use of bronchodilators may be warranted in patients with moderate to severe impairment, in other patients the potential margin of benefit is so small that it does not justify its use. Something similar occurs with systemic steroids, associated or not to bronchodilators. Although in some EDs it is standard practice, there is no clear

evidence about its effectiveness [15, 16], and any benefit to patients is unlikely.

The efficacy of combined nebulized epinephrine plus systemic steroids was discussed in our consensus conference. According to the results of a clinical trial published by Plint et al. [37], this combination could slightly reduce the risk of admission on day 7. Nevertheless, this effect was no longer significant after adjustment for multiple comparisons (four treatment groups) and the treated group had a higher atopic risk (nonsignificant but of the same size as the observed effect). A recent systematic review has considered this study to support the effect of dexamethasone plus nebulized epinephrine [21], but this was not supported in previous reviews [36]. Until new studies specifically designed to test this combined treatment are available, it was considered only as an alternative in moderate–severe patients.

When classifying the appropriateness of our treatments, following the established criteria in the consensus conference [15, 16] and even assuming the optional or alternative use of certain interventions (trial of bronchodilators with or without steroids in moderate–severe cases), we found that in our study, 64% of the treatments in the acute phase and 55.9% in the maintenance phase were inappropriate. Behind these figures is the widespread use of bronchodilators and, to a lesser extent, of systemic steroids in mild cases, which are the most frequent criteria of inappropriateness. Nevertheless, we cannot exclude that a small percentage of mild patients have been able to experience some improvement in symptoms with the use of bronchodilators. As in our consensus conference, other guidelines recommend a restrictive use of bronchodilators and steroids [1, 6, 42].

The scope for improvement in the therapeutic management of bronchiolitis is reflected in the analysis of the appropriateness of the different EDs. The wide variation in adjusted rates of inappropriate use shows the influence of local practice patterns. Some experiences have showed that it is possible to improve the treatment of bronchiolitis with the implementation of local guidelines [32].

The management of bronchiolitis cases in emergency rooms is one example of the current state of medicine, where daily practice ("what we do") is more different from the scientific evidence ("what we know"). This reflects the existence of heterogeneous clinical practices, which are more related to the preferences of the physicians who treat children with bronchiolitis or some imitated temporary habits, than with the severity of the episodes and its adjustment to evidence-based criteria [39].

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Appendix 1

Members of the research group

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