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The Diagnosis and Management of Bronchiolitis at Makassed General Hospital Before and After the 2014 AAP Guidelines

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ABSTRACT

Background: Bronchiolitis is the leading cause of hospitalization among infants and young children. The 2014 AAP clinical practice guideline for bronchiolitis was implemented in Makassed hospital in an effort to decrease the number of non-recommended diagnostic evaluations and medications used without increasing length of hospital stay or transfers to the pediatric intensive care unit and eventually decreasing the cost. **Methods:** Implementation of the 2014 AAP guideline was done in both our Pediatric emergency department and Pediatric Ward. A total of 173 pediatric patients presenting to the emergency department (88 pre-implementation and 85 post-implementation) and 242 pediatric patients presenting toward (156 pre-implementation and 86 post-implementation) diagnosed clinically with bronchiolitis, were recruited, and data were collected through questionnaires (before implementation through retrospective charts reviews) regarding demographic characteristics and resources utilization for comparison purposes. **Results:** A statistically significant decrease was achieved in the utilization of short acting β_2 agonist in our emergency department from 77.3% to 61.2% (P-value 0.03). Our ward group had more statistically significant reductions in the utilization of blood culture from 79.5% to 67.4% (P-value 0.04), C reactive protein from 90.4% to 80.2% (P-value 0.03), chest x-ray from 82.7% to 50% (P-value <0.0001), epinephrine from 24.4% to 10.5% (P-value 0.01) and antibiotic use from 35.3% to 14% (P-value <0.0001). No major demographic differences were observed in the two study areas. **Conclusion:** The 2014 AAP bronchiolitis clinical practice guideline should be fully adopted in practice to reduce wasting resources.

Abbreviations

AAP—American Academy of Pediatrics

CBCD—Complete blood cell count and differential

CRP — C reactive protein

CXR—Chest radiography

LOS —Length of stay in hospital

SABA —Short acting β_2 agonists

ED—Emergency department

RSV—Respiratory syncytial virus

PICU— Pediatric intensive care unit

MOH — Ministry of Health

NSSF — National Social Security Fund

1. INTRODUCTION

Bronchiolitis is a term generally applied to a first episode of wheezing in infants younger than 24 months of age and is commonly caused by viral lower respiratory tract infections (1). Respiratory syncytial virus (RSV) is the major etiological agent, but other viruses, such as rhinoviruses, parainfluenza virus, adenovirus, influenza A and B viruses, may also cause bronchiolitis (2, 3). These pathogens act upon ciliated epithelial cells, causing inflammation by producing inflammatory mediators (2, 4). The clinical manifestations are nasal discharge, fever, cough, difficulty breathing and wheezing (5). The chest radiographic findings are characterized by hyperinflation, coarse infiltrates, atelectasis and peribronchial cuffing (6). Bronchiolitis is the most common cause of hospitalization among infants during the first 12 months of life and its variable course and the inability of medical personnel to predict whether supportive care will be needed often results in hospital admission even when symptoms are not severe (1, 7, 8). Estimated nation wise hospital charges for care related to bronchiolitis in children younger than 2 years of age exceeded 1.7 billion dollars in 2009 (8,

9).

The mainstay of treatment of bronchiolitis is supportive care, with good evidence that most specific treatments are ineffective, including bronchodilators, corticosteroids, antibiotics, and chest physiotherapy (10, 11).

In 2014 the AAP published the new guidelines for bronchiolitis to provide an evidence based approach to the diagnosis, management, and prevention of bronchiolitis in children from 1 month through 23 months of age (1). The evidence-based guidelines emphasize that a diagnosis should be based on the history and physical examination and that radiographic and laboratory studies should not be done routinely (7). Short acting $\beta_2$agonists (SABA), epinephrine, and systemic glucocorticoids are not recommended for the treatment.

However, the AAP states that this clinical practice guideline is not intended as the sole source of guidance in the management and should not replace clinical judgment or establish a protocol for the care of all children with bronchiolitis. Rather, AAP states that it is intended to assist in decision-making. So these recommendations may not provide the only appropriate approach to the management of children with bronchiolitis (1).

In view of the present dilemma, the management of bronchiolitis in our institution; Makassed General Hospital (MGH); has not been consistently adherent to the 2014 AAP guidelines and was mostly individualized, that is clinician and patient's condition dependent.

Therefore we conducted this study at MGH, in the pediatric ward (patients admitted) and pediatric emergency department (ED), and implemented through it the 2014 AAP clinical practice guidelines and compared our adherence to the guidelines pre and post-implementation hypothesizing that the use of diagnostic tests and medications would decrease after implementation, hence decreasing abuse of resources, radiation exposure and antibiotic resistance and decreasing the length of stay in hospital (LOS) of the patients, aiming ultimately to decrease the cost of management of bronchiolitis in our institution.

2. MATERIALS AND METHODS

Study Design

After obtaining the approval of the Makassed General Hospital Institutional Review Board, we conducted this practice based quality improvement project that implemented the 2014 AAP bronchiolitis clinical practice guidelines and compared our practice pre-implementation (through chart reviews retrospectively) and post-implementation.

Study Area

Pediatric emergency department (ED) and pediatric ward at Makassed General Hospital, a tertiary referral center, in Beirut, Lebanon.

Study Period

The pre-implementation period was from September 2014 to April 2015, and the post-implementation period was from September 2015 to April 2016.

The 8 months period from September to April was chosen based on the seasonal variability of bronchiolitis (12-15).

The month of August 2015 was considered as the washout period during which the 2014 AAP bronchiolitis clinical practice guidelines were implemented through reviewing the guidelines with medical staff (attending physicians, residents, and interns) via lectures and distributing handouts.

Study Subjects

The study subjects were children aged 29 days to 24 months of age given a diagnosis of bronchiolitis. Children with underlying chronic respiratory illness (cystic fibrosis, more than one episode of prior wheezing, bronchopulmonary dysplasia), neuromuscular disease, and those with hemodynamically significant congenital heart disease were all excluded from the study.

Subjects from the emergency department group and those from the ward group were categorized based on the date of their presentation to the hospital to 2 groups, pre-implementation and post-implementation.

Patients who were admitted to our floor through ED were studied with the group of the ward patients and were not included in the ED group.

Data Collection Methods

Data were collected by the project team (project leader and 2 first year pediatric residents) through a questionnaire that included all the demographic characteristics; age, sex, hometown, source of admission to floor whether from physician's private clinic or through ED, past medical history, family history of atopy, tobacco smoking exposure, severity of the patient's respiratory distress based on silverman score (Table 1), and the payer that is subdivided into either self, Ministry of Health (MOH), National Social Security Fund (NSSF), and others denoting those having private insurance companies funding them.

The questionnaire also gathered information regarding the investigations done to the patient (CBCD, CRP, blood culture, urine culture, CXR, and viral antigen detection studies) and treatment received (bronchodilators including SABA and epinephrine, corticosteroids whether inhaled, orally, intramuscularly or intravenously and antibiotic use) together with the length of hospital stay (LOS) calculated from the patient's admission and discharge dates (ED in hours and floor in days).

Table 1: Silverman-Anderson scoring system

Score	**0**	**1**	**2**
Chest/Abdominal Movements	Synchronized respirations	Lag in inspiration	Seesaw respirations
• **Intercostal Spaces**	No retraction	Retraction just visible	Marked retractions
• **Xiphoid Area**	No retraction	Retraction just visible	Marked retractions
• **Nares**	No dilation	Minimal dilation	Marked dilation
• **Expiratory Grunting**	No expiratory Grunting	Expiratory grunting by stethoscope	Expiratory grunting to unaided ear

0: no distress; [1-3]: mild; [4-6]: moderate; [≥7]: severe

Source: Sander's M: Mosby's Paramedic Textbook, third edition. Elsevier: St. Louis, Mo0,

2007. P1113.

Statistical Analysis

Categorical variables were presented as number and percent, whereas continuous ones were presented as mean and standard deviation. Bivariate analysis was carried out by using the chi-square for comparing categorical variables, whereas continuous ones were compared using the Student's t-test.

Multivariate analyses were carried out by multivariate linear regression for continuous outcomes or multivariate logistic regression for categorical variables. Results were presented as odds ratio (OR) and 95% confidence interval (95% CI) for logistic regression analyses, whereas the coefficient and 95% CI were presented for linear regression analyses.

The Statistical Package for Social Sciences (SPSS, version 21) program was used for data entry, management, and analyses. Statistical significance was indicated at the 0.05 level.

3. RESULTS

Emergency Department Demographic Characteristics

There were a total of 173 patients in the ED group with 88 of them being from the pre-implementation period and 85 from the post-implementation period (Table 2). There was no statistical significance between the two ED groups in the demographic characteristics age, sex, past medical history, family history of atopy, tobacco smoking exposure, payer and severity of symptoms, but it is noticed that most of the patients presenting were from Beirut with a significant difference between the two periods 88.6% pre-implementation and 69.4% post-implementation (P-value 0.002). Most of the patients were self-payers 68.2% and 74.1% from the pre and post-implementation periods respectively (P-value 0.39) and most were in mild respiratory distress 92% and 89.4% from the pre and post-implementation periods respectively (P-value 0.52).

Table 2: Demographic Characteristics of Patients in Emergency Department

Characteristics		Total	Pre-implementation	Post-Implementation	P-value
Age (months m)	≤3m >3-6 m >6-12 m >12m	27 (15.6%) 37 (21.4%) 60 (34.7%) 49 (28.3%)	15 (17.0%) 24 (27.3%) 25 (28.4%) 24 (27.3%)	12 (14.1%) 13 (15.3%) 35 (41.2%) 25 (29.4%)	0.16
Sex	Male	109 (63.0%)	60 (68.2%)	49 (57.6%)	0.16
Past medical history	Prior episode of wheezing	18 (10.4%)	8 (9.1%)	10 (11.8%)	0.62
Hometown	Beirut Others	137 (79.2%) 36 (20.8%)	78 (88.6%) 10 (11.4%)	59 (69.4%) 26 (30.6%)	0.002
Family history of Atopy	Yes	42 (70.0%)	20 (64.5%)	22 (75.9%)	0.41
Tobacco smoking exposure	Yes	10 (58.8%)	4 (80.0%)	6 (50.0%)	0.34
Payer	Self Others*	123 (71.1%) 50 (28.9%)	60 (68.2%) 28 (31.8%)	63 (74.1%) 22 (25.9%)	0.39
Severity of symptoms (Silverman score)**	No distress Mild Moderate Severe	2 (1.2%) 157 (90.8%) 14 (8.1%) 0 (0.0%)	0 (0.0%) 81 (92.0%) 7 (8.0%) 0 (0.0%)	2 (2.4%) 76 (89.4%) 7 (8.2%) 0 (0.0%)	0.52

*Others refers to patients having private insurance companies coverage

**Silverman score: 0: no distress; [1-3]: mild; [4-6]: moderate; [≥7]: severe

Emergency Department Recourses Utilization

The use of SABA as a bronchodilator in the management of ED patients with bronchiolitis has decreased significantly after implementation of the clinical practice guidelines from

77.3% to 61.2% (P-value 0.03). No change was noted in the use of investigations (CBCD, CRP, blood culture, urine culture, and chest radiography), also no statistically significant change was noted in the mean LOS between the two groups and most of the patients were discharged home (Table 3).

Table 3: Resources Utilization for Patients in Emergency Department

Utilization		**Total**	**Pre-Implementation**	**Post-Implementation**	**P-value**
CBCD		7 (4.0%)	4 (4.5%)	3 (3.5%)	1.00
CRP		1 (0.6%)	1 (1.1%)	0 (0.0%)	1.00
Blood Culture		0 (0.0%)	0 (0.0%)	0 (0.0%)	NA
Urine Culture		1 (0.6%)	0 (0.0%)	1 (1.2%)	0.49
CXR		18 (10.4%)	11 (12.5%)	7 (8.2%)	0.46
Viral Antigen Detection		1 (0.6%)	1 (1.1%)	0 (0.0%)	1.00
RSV identified		1 (100%)	1 (100%)	0 (0.0%)	NA
Bronchodilators	SABA Epinephrine	120 (69.4%) 10 (5.8%)	68 (77.3%) 6 (6.8%)	52 (61.2%) 4 (4.7%)	0.03 0.75
Corticosteroids		22 (12.7%)	13 (14.8%)	9 (10.6%)	0.50
Antibiotics		7 (4.0%)	2 (2.3%)	5 (5.9%)	0.27
Mean LOS		4.58 (sd=3.50)	4.54 (sd=3.32)	4.62 (sd=3.70)	0.88
Disposition	Home Another Hospital	158 (91.3%) 15 (8.7%)	84 (95.5%) 4 (4.5%)	74 (87.1%) 11 (12.9%)	0.06

CRP: C-reactive protein, CXR: chest X ray, RSV respiratory syncytial virus, LOS: length of stay in hospital, SABA: short acting beta 2 agonist

Given the potential for confounding factors regarding our initial findings for bronchiolitis management, we performed multivariate analysis controlling for age, sex, history of a prior episode of wheezing, payer, and severity. We could not control tobacco smoking exposure and family history of atopy because of missing data. The reduction in receiving SABA remained significant with a P-value of 0.01 (95% CI of 0.19-0.81) (Table 4).

Table 4: Multivariate analysis for Outcomes in Emergency Department

Confounding Variable	Adjusted OR	95% CI	P-value
CXR	0.61	0.22 – 1.69	0.35
SABA	0.40	0.19 – 0.81	0.01
Epinephrine	0.60	0.14 – 2.55	0.49
Antibiotics	2.27	0.41 – 12.48	0.35
	Adjusted coefficient	**95% CI**	**P-value**
Mean LOS	0.018	-1.05 ; 1.08	0.97

CRP: C-reactive protein, CXR: Chest X ray, LOS: length of stay in hospital, SABA: short acting beta 2 agonist

Pediatric Ward Demographic Characteristics

A total number of 242 patients were admitted to the pediatric ward in the study period with 156 of them being pre-implementation and 86 post-implementation. No statistical significance was noted between the two groups regarding the age, sex, past medical history, and hometown. However, most of the patients were younger than 1 year of age, were males and from Beirut, but no statistical significance was noted pre and post-implementation.

One hundred twenty patients (76.9%) were admitted to ward from ED in the pre-implementation group; however, 77 patients (89.5%) were admitted to floor in the post implementation period from ED (P-value 0.02). A highly statistical significance with a P-value of <0.0001 was noted between the two groups concerning the payer, 6.4% were self-payers pre-implementation compared to 1.2% post-implementation. Most of the patients from the two groups were non-self. Moreover, most of the patients were in mild respiratory distress, 69.9% pre-implementation and 81.4% post-implementation (P-value 0.03) (Table 5).

Table 5: Demographic Characteristics of Patients admitted to Floor

Characteristics		Total	Pre-implementation	Post-Implementation	P-value
Age (months m)	≤3m	70 (28.9%)	43 (27.6%)	27 (31.4%)	0.81
	>3-6 m	65 (26.9%)	45 (28.8%)	20 (23.3%)	
	>6-12 m	64 (26.4%)	41 (26.3%)	23 (26.7%)	
	>12m	43 (17.8%)	27 (17.3%)	16 (18.6%)	
Sex	Male	144 (59.5%)	91 (58.3%)	53 (61.6%)	0.68
Past medical history	Prior episode of wheezing	16 (6.6%)	14 (9.0%)	2 (2.3%)	0.06
Hometown	Beirut	221 (91.3%)	139 (89.1%)	82 (95.3%)	0.15
	Others	21 (8.7%)	17 (10.9%)	4 (4.7%)	
Family History of Atopy	Yes	97 (41.3%)	51 (33.3%)	46 (56.1%)	0.001
Tobacco smoking exposure	Yes	14 (13.5%)	8 (8.4%)	6 (66.7%)	<0.0001
Admission source	ED	197 (81.4%)	120 (76.9%)	77 (89.5%)	0.02
	Clinic	45 (18.6%)	36 (23.1%)	9 (10.5%)	
Payer	Self	11 (4.5%)	10 (6.4%)	1 (1.2%)	<0.0001
	NSSF	80 (33.1%)	58 (37.2%)	22 (25.6%)	
	NSSF + others	52 (21.5%)	20 (12.8%)	32 (37.2%)	
	MOH	29 (12.0%)	22 (14.1%)	7 (8.1%)	
	MOH + others	1 (0.4%)	1 (0.6%)	0 (0.0%)	
	Others	69 (28.5%)	45 (28.8%)	24 (27.9%)	
Severity of symptoms (Silverman score*)	No distress	9 (3.7%)	9 (5.8%)	0 (0.0%)	0.03
	Mild	179 (74.0%)	109 (69.9%)	70 (81.4%)	
	Moderate	51 (21.1%)	35 (22.4%)	16 (18.6%)	
	Severe	3 (1.2%)	3 (1.9%)	0 (0.0%)	

*Silverman score: 0: no distress; [1-3]: mild; [4-6]: moderate; [≥7]: severe

MOH: Ministry of Health, NSSF: National Social Security Fund

Ward Recourses Utilization

A significant decrease was noted in the post-implementation period concerning the utilization of blood culture from 79.5% to 67.4% (P-value 0.04), CRP from 90.4% to 80.2% (P-value 0.03) and chest X-ray from 82.7% to 50% (P-value <0.0001), with a significant increase in the utilization of urine culture post-implementation from 45.5% to 60.5% (P-value 0.03). A significant decrease post-implementation was also noted in offering epinephrine from 24.4% to 10.5% (P-value 0.01) and antibiotics from 35.3% to 14% (P-value <0.0001). No change was noted in the use of CBCD (P-value 0.53), viral antigen detection (P-value 0.24), SABA use (P-value 0.08) and corticosteroid use (P-value 0.35). In addition, no significant change was noted in the length of stay, however it decreased from a mean of 3.15 days pre-implementation to 2.68 days post-implementation (P-value 0.09) (Table 6).

Table 6: Resources Utilization for Patients Admitted to Floor

Utilization		Total	Pre Implementation	Post Implementation	P-value
CBCD		231 (95.5%)	150 (96.2%)	81 (94.2%)	0.53
CRP		210 (86.8%)	141 (90.4%)	69 (80.2%)	0.03
Blood Culture		182 (75.2%)	124 (79.5%)	58 (67.4%)	0.04
Urine Culture		123 (50.8%)	71 (45.5%)	52 (60.5%)	0.03
CXR		172 (71.1%)	129 (82.7%)	43 (50.0%)	<0.0001
Viral Antigen Detection		205 (84.7%)	129 (82.7%)	76 (88.4%)	0.24
RSV Identified		59 (28.8%)	37 (28.7%)	22 (28.9%)	0.97
Bronchodilators	SABA Epinephrine	170 (70.2%) 47 (19.4%)	116 (74.4%) 38 (24.4%)	54 (62.8%) 9 (10.5%)	0.08 0.01
Corticosteroids		60 (24.8%)	42 (26.9%)	18 (20.9%)	0.35
Antibiotics		67 (27.7%)	55 (35.3%)	12 (14.0%)	<0.0001
Mean LOS		4.76 (sd=3.01)	5.01 (sd=3.15)	4.31 (sd=2.68)	0.09
Disposition	Home PICU	236 (97.5%) 6 (2.5%)	151 (96.8%) 5 (3.2%)	85 (98.8%) 1 (1.2%)	0.43

CRP: C-reactive protein, CXR: chest X ray, RSV respiratory syncytial virus, LOS: length of stay in hospital, PICU; Pediatric Intensive Care Unit, SABA: short acting beta 2 agonist

Concerning our ward group results, multivariate analysis was also done controlling for age, sex, history of a prior episode of wheezing, payer, and severity, we also as in our ED group could not control for tobacco smoking exposure and family history of atopy because missing data. The statistically significant results we had concerning the blood and urine cultures, CRP, CXR, epinephrine, antibiotics remained significant. In addition, SABAuse and LOS remained statistically insignificant with P-values of 0.09 both (Table 7).

Table 7: Multivariate analysis for Outcomes in Floor

Confounding Variable	**OR**	**95% CI**	**P-value**
Blood Culture	0.51	0.27 – 0.96	0.04
Urine Culture	1.90	1.09 – 3.31	0.02
CXR	0.19	0.10 – 0.35	<0.0001
CRP	0.40	0.18 – 0.89	0.02
SABA	0.60	0.33 – 1.09	0.09
Epinephrine	0.37	0.16 – 0.82	0.015
Antibiotics	0.30	0.15 – 0.62	0.001
	Adjusted coefficient	**95% CI**	**P-value**
Mean LOS	-0.67	-1.45 ; 0.11	0.09

CRP: C-reactive protein, CXR: chest X ray, LOS: length of stay in hospital, SABA: short acting beta 2 agonist

4. DISCUSSION

We implemented the 2014 AAP bronchiolitis clinical practice guidelines in Makassed General Hospital in an effort to improve quality of care, decrease resource utilization, thereby decreasing cost, radiation exposure and antibiotic resistance; without affecting patient morbidity and length of stay.

Even though the AAP bronchiolitis guidelines were published in November 2014 and our institution had adopted these guidelines in management since then, the discrepancy and incomplete adherence to these guidelines with the continuing utilization of resources is what led us to conduct this study, implementing the guidelines as the sole management for patients, and thus comparing whether our adherence to the guidelines as medical staff would increase, hence decreasing unnecessary resource utilization, cost and patients' morbidity.

Emergency Department Group

Demographic characteristics

There was no notable significant difference in the demographic characteristics between patients in the two periods, but of note is that most of the patients presenting to our emergency departments were living in Beirut, this being mostly due to the location of our hospital, a tertiary referral center, in a modest neighborhood in Beirut, but with an increase in the number of patients presenting from hometowns other than Beirut, maybe because more people are now heading to live in the rural areas due to the high expenses in the capital, but anyhow this is beyond the scope of our study, but needs to be interpreted by specialists in the field.

Also of note is that most of the patients presenting to the ED from the two periods were self-payers with 68.2% and 74.1% from the pre and post-implementation groups respectively with the rest having ‘’others” that are private insurance companies as the payer. This is because the NSSF and MOH do not cover the ER fees; hence our findings could not be compared to the study by Parikh et al that found that the government was being the payer in 59% of patients in the ED (16).

Most of our patients presenting with bronchiolitis were having mild respiratory distress similar to what is known in literature (7).

Resources Utilization

There has been a significant decrease in the use of SABA as a bronchodilator in the treatment of patients with bronchiolitis from 77.3% to 61.2% (P-value 0.03) comparable to the findings in the study by Akenroye et al (17).

We noticed no change in the use of CBCD, blood and urine cultures, CRP, chest X-rays and viral antigen detection studies between the two study periods in our ED since there utilization is so limited if not negligible. This is thought to be first because as we have mentioned most of the patients in the ED are self-payers, and second because maybe if the patient was planned for admission the labs would have been done as in patients studies, since as we mentioned earlier that the patients who were admitted to floor through ED were not included in the study here. This could explain the difference that we found between our study and

other similar studies that utilizes such resources in the ED regardless whether their utilization decreased or not post-implementation of guidelines (16, 17).

Unlike Akenroye et al., the mean LOS did not change between the two groups with a mean of 4.54 hours in the pre-implementation period and 4.62 hours in the post-implementation period (17).

Ward Group

Demographic characteristics

Similar to our ED patients no significant demographic characteristics were made between the two groups with some exceptions that are to be discussed hereafter.

The age of patients admitted with bronchiolitis was mostly below 1 year of age. Young infants with bronchiolitis usually have a higher risk of hospital admission than older infants (18-21). Deshpande SA and Northern V found that 90% of cases requiring hospitalization occur in infants less than twelve months of age (22). Incidence peaks at age three to six months (23).

In addition, most of the patients were admitted through ED not private clinics. These findings are similar to multicenter retrospective cohort study findings by Mittal et al (24).

Concerning the markedly significant P-value in the tobacco smoking exposure and the family history of atopy, this could be explained by the missing data that we confronted regarding these two variables with an improvement in charting post implementation that explains the increase in tobacco exposure and family history of atopy percentages.

A significant difference (P-value <0.0001) was noticed in the payer in the floor between the two groups. But we noticed that most of the patients were non-self, i.e. had a certain party in charge of the fees (6.4% and 1.2% in the pre and post-implementation periods respectively were self-payers only).

Most of the patients admitted were males and most of them were in mild respiratory distress (69.9% pre and 81.4% post-implementation with a P-value 0.03) similar to what is stated in literature (1, 7, 16).

Resources Utilization

Successfully we were able to significantly reduce the use of blood culture, CRP, CXR, epinephrine and antibiotics. Hence radiation exposure was markedly decreased by 32.7% post implementation, and antibiotic usage decreased by more than 50%. These findings were similar to other studies by Mittal et al., Zamora-Flores et al. and Parikh et al. (16, 24 -26).

The 2 most commonly used antibiotics in our study were clarithromycin and amoxicillin clavulanic acid.

However, no significant reduction was noted in our use for CBCD. This might be due to the fact that most parents wouldn't accept the concept of being admitted to the hospital having a prick for intravenous hydration, if needed, and not taking any laboratory tests at all for their child, and second most of physicians and parents would like to know and have a baseline of their child's hematocrit level.

The use of corticosteroids whether inhaled, PO, intramuscular or intravenous decreased by only 6%, however, our use of corticosteroids in MGH as a treatment option in bronchiolitis was initially low 26.9%, however, we were aiming to decrease it further.

Also, the use of viral antigen detection studies for RSV mainly was still high and even increased from 82.7% to 88.4% post implementation. This is because it's a tool that helps us determine the Lebanese epidemiology of this virus, we also need to isolate patients who will have positive RSV bronchiolitis, and lastly, it will help predict the course of the illness since RSV bronchiolitis are usually more severe than other viral bronchiolitis (27).

Our use of SABA had a modest decrease from 74.4% to 62.8% with a P-value of 0.08, so why didn't SABA decrease significantly after implementation of the 2014 guidelines. First, this could be because some of the physicians might still be convinced by the 2006 AAP bronchiolitis guidelines option that allows a trial of beta adrenergic agonist and allows continuing it only if there is a documented positive clinical response using an objective means of evaluation (28). Second, some physicians feel secure providing a bronchodilator believing that even if it didn't help, it has minimal side effects. Lastlya potential barrier exists in convincing the anxious parents that no medication is needed for the treatment of their distressed child. Disagreeing with the AAP guidelines, Walsh and Rothenberg raised the concern that the use of bronchodilators is not supported by evidence and that the guidelines

ignored the potential clinical benefit of bronchodilators, however AAP committee replied with disagreement explaining that to recommend the use of a medication in any disease, the preponderance of benefit should outweigh the likelihood of harm across the entire population for whom the medication is prescribed. AAP authors add that although they clearly acknowledged in the guideline that a small proportion of children may appear to get a clinical benefit from bronchodilators (and there is significant disagreement as to whether the magnitude of said benefit is clinically meaningful), the majority of children with bronchiolitis do not stand to benefit. They also remind readers of the pathology of wheezing in bronchiolitis that serves in rejecting bronchodilators as a treatment modality (1, 29).

The utilization of urine culture post-implementation increased from 45.5% to 60.5% (P-value 0.03). This was explained by the fear of the presence of a coexisting bacterial urinary tract infection UTI especially in young febrile females, seeking a refuge in several retrospective studies that identified a low rate of serious bacterial infections in patients with bronchiolitis, most of these infections being UTI (30-37). The retrospective cross-sectional study by Hendaus et al found that UTIs were present in 10% of children zero to 24 months of age hospitalized with acute bronchiolitis. In their study UTIs were most common in children with a confirmed diagnosis of bronchiolitis caused by a virus other than RSV followed by bronchiolitis caused by an unidentified agent; UTIs were least common in children with bronchiolitis caused by RSV (37).

The mean LOS in our study has decreased from a mean of 5 days to 4.3 days with a P-value of 0.09, even if it is not statistically significant but this supports our aim from the study that stopping the utilization of unnecessary investigations and medications did not prolong LOS, and did not increase transfer to the PICU (3.2% pre-implementation, 1.2% post-implementation, P-value 0.43).

Limitations

First, since we reviewed the chart retrospectively in the pre-implementation period, we faced the problem of missing data specifically regarding tobacco smoking exposure and family history of atopy, hence we couldn't compare these two variables efficaciously and we were not able to control for them in the multivariate analysis. Second, it would have been stronger to compare our adherence to the guideline and change in resource utilization pattern by evaluating monthly rate of use. Finally, we were not able to calculate the exact reduction in

cost that we achieved through implementation of the guidelines.

5. CONCLUSION

Implementation of the AAP bronchiolitis clinical practice guideline resulted in a significant decrease in our resource utilization in both our ED regarding SBA utilization and in floor regarding blood culture, CRP, CXR, antibiotics and epinephrine use. These trends demonstrate the benefit of institutionally or nationally implementing clinical practice guidelines to reduce variations in care and unnecessary costs. Future studies should focus on emphasizing the importance of implementing clinical practice guidelines and searching for factors favoring implementation and adherence, in addition to implementing guidelines for other common diseases.

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7. CONFLICT OF INTEREST

No conflict of interest.

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