

## A Model of an Evidence-Based Medicine in the Management of Pneumonia in a Sample of Preschool Children

Ahmed Farid Ahmed, Salah Mostafa, Omar El Shourbagy and Hanan El Gamal  
Dep. of Medical Studies for Children, Institute of Postgraduate Childhood Studies, Ain Shames University

### Abstract

**Background:** Community acquired pneumonia (CAP) is a serious illness with significant costs to the society. Clinical decisions based on evidence based medicine (EBM) improve the outcome of management in an approach for appropriate treatment and prompt referral for care.

**Objective:** Observing cases managed on EBM and comparing the outcomes with cases managed without EBM in a community hospital, providing approach for the clinician in evaluating and treating children.

**Methodology:** A descriptive study on 56 children divided into 28 children EBM group and 28 children Non- EBM group, from June 2015 to May 2016 at Abo El Resh hospital, reviewing demographic, clinical data, observing therapies and outcomes.

**Results:** EBM group showed statistically significant short days ( $6.8 \pm 2.1$  days) for antimicrobial therapy than NEBM group ( $P = 0.001$ ). Outcomes of Non- EBM group who needed admission to ICU for  $4.2 \pm 2.6$  days, while no children of EBM group need admission ( $P = 0.001$ ).

**Conclusion:** Effective case management is strategy to reduce pneumonia- related morbidity. Guidelines based on sound evidence are available but used variably.

**Recommendation:** Unifying clinical practice and scientific evidence could rationalize the use of health resources, improving health care quality.

Keywords: Community acquired pneumonia; Evidence based medicine.

### نموذج بحثي يتناول معالجة الالتهاب الرئوي لدى عينة من الأطفال ما قبل سن المدرسة وفقاً للطب المدعم بالبراهين

**خلفية:** الطب المبني على البراهين يشمل اتخاذ القرارات المدعمة بالدلائل والتي لن تحل محل الخبرة في مجال الطب واكتساب المهارات ويتناول عرض المشكلة وإيجاد الحل المناسب ونقد وتقييم الدليل مع تطبيقه في القرارات الطبية، ومن تحديات العصر ومتطلباته تصنيف وتمييز الأدلة الصالحة للتطبيق. العدوى الصدرية لدى الأطفال من أهم الأسباب للتردد على الطبيب والحجز بالمستشفيات ومن ثم اتسع مفهوم الطبيب من كونه طبيب معالج إلى مختص بتقديم الرعاية الصحية وتنفيذ معايير تهدف إلى منع انتشار المرض والحفاظ على الصحة. عدوى الالتهاب الرئوي من أهم وأخطر الأمراض التي تشكل عبء على المجتمع اقتصادياً وصحياً ومن أهم أسبابها البيئة المحيطة الغير صحية.

**الهدف:** دراسة وصفية لتأثير تطبيق الممارسة الطبية المدعمة بالدلائل. وضع توجيهات للطبيب المختص لتقييم ومعالجة المرضى.

**المنهجية:** دراسة تحليلية تعتمد على الطب المدعم بالبراهين.

**معايير الإدخال:** الأطفال من عمر شهرين إلى ستة أعوام. من الجنسين. مصابين بالتهاب رئوي بالجهاز التنفسي.

**معايير الاستبعاد:** مرض مناعي أو أمراض متوطنة. عيوب خلقية بالجهاز التنفسي أو القلب أو الأوعية الدموية. وجود تاريخ مرضي لأمراض المناعة بالعائلة، وتم الأتي معرفة تاريخهم بالكامل بما في ذلك تاريخ الميلاد وتاريخ مرضي سابق بالجهاز التنفسي. الفحص الاكلينيكي بما في ذلك: الفحص العام والفحص النظامي للصدر، الفحص المعمل - أشعة على الجهاز التنفسي.

**خطوات تطبيق الطب المدعم بالبراهين:** صياغة سؤال له علاقة بالحالة المرضية موضوع البحث، وبحث عن أفضل دليل لعلاج الحالة المرضية، وانتقاد الدليل، وتطبيق الدليل في الممارسات الطبية، وتقييم النتائج.

**Introduction:**

Evidence- based medicine (EBM) in primary care aims to explore the concept of its relevance and applicability to general practice. EBM is neither a new concept, nor its application in general practice a straightforward task. Indeed, some argue that the culture of EBM is too narrow and overly prescriptive to be made relevant to the complexities and uncertainty of general practice (God lee, 2000).

The need for an evidence- based medicine approach to decision-making in general practice which can range from simple clinical types of decision to a practice level about how services should be organized, the decisions ought to involve a team of primary health care professionals and their practice population, and takes account of factors such as children need, preferences, priorities, available resources and evidence of the effects of providing different forms of care (Bero and Drummond, 1995).

Providing evidence- based medicine care to children involves turning a clinical problem into an answerable question, systematically searching for the best evidence relevant to the question, critically appraising that evidence, and, finally, using the evidence as the basis for clinical decisions to solve the problem. While the overload of medical information today presents a demanding challenge to physicians to sort and identify relevant and valid evidence, it is vitally important to translate that evidence into clinically useful terms (Sackett and Rosenberg, 1995).

Pediatric respiratory tract infections are one of the most common reasons for physician visits and hospitalization, and are associated with significant morbidity and mortality so the role of physicians and other healthcare providers has expanded from merely treating disease to implementing measures aimed at health maintenance and disease prevention (Schaad et.al., 2015).

Community acquired pneumonia (CAP) is a common and potentially serious illness with significant human and economic costs to society. The recent collaborative statement from the Infectious Diseases Society of America (IDSA) represents the most up to date evidence based guidelines from North America, incorporating important advances in the management of children with CAP (Bra dely et.al., 2011).

Recurrent respiratory tract infections (RRI) are a common problem mainly in preschool age, usually due to the presence of unfavorable environmental conditions, including early socialization, as well as the immaturity and inexperience of the immune system. In infancy and early childhood the immune system encounters antigens for the first time, mounting immune responses and acquiring memory. (Sackett et.al., 1997)

Although children want effective care and health care providers want to provide this, gaps are frequently found between evidence based decisions and what is done in practice. There are a variety of reasons for these gaps. Consequently, a variety of strategies may be needed to reduce them.

**Objective:**

Observing cases managed on EBM and comparing the outcomes with cases managed without EBM in a community hospital, providing

approach for the clinician in evaluating and treating children.

**Subjects And Methods:**

This descriptive study included 56 preschool children; 28 children managed on EBM (EBM group), diagnosed according to revised WHO criteria and 28 children managed on non EBM (NEBM group). Children were admitted and referred to Abo El Resh hospital.

Exclusion criteria (Congenital developmental anomalies of the respiratory tract, Chronic diseases and under drugs treatment, Cardiac diseases, Severe and invasive systemic infections).

All children were subjected to full clinical assessment filling a model questionnaire fulfilling demographic, clinical characteristic and reviewing their regimen of therapy and outcomes. Written informed consent will be obtained from caregivers.

Laboratory investigations (Complete blood picture, acute phase reactant ESR, CRP) were done in children with more serious disease or those with pneumonia- associated complications.

Chest radiograph is indicated when clinical criteria suggests pneumonia.

**Statistical Analysis:**

Data were collected, tabulated and statistically analyzed using SPSS version 12, quantitative (numerical) data will be presented as mean and standard deviation qualitative (nominal) data will be presented in the form of number and percent, the probability at 0.05 will be used as minimum cut- off points for all significance test.

**Results:**

Demographic characteristics of the study groups are illustrated in table (1).

Table (1) Age& sex characteristics among studied groups

		EBM Group		NEBM Group	
		Mean± SD			
Age/ Months		19.7±18.2		20.1±21.4	
		NO	%	NO	%
Gender	Male	14	50	18	64.3
	Female	14	50	10	35.7

Table (2) Demographic characteristics among studied groups

		EBM Group		NEBM Group	
		Mean± SD			
Birth Order Of Child		2.8±1.6		2.8±1.3	
		NO	%	NO	%
Residence	Cairo	7	25	7	25
	Giza	7	25	6	22

Table (3) showed that most of children of EBM group (96.4%) came presenting with combined symptoms of cough (89.2%), fever (96.4%), wheezes (67.8%) and tachypnea (78.5%); some had feeding difficulties (53.5%) and neurological sequelae of drowsiness and convulsion (14.2%) while children of NEBM group (89.3%) came presenting with combined symptoms of cough (78.5%), fever (85.7%), wheezes (92.8%), tachypnea (85.7%), feeding difficulties (60.7%) and some had neurological sequels (14.2%) with no statistical difference (P= 0.3).

Table (3) Presenting symptoms in the two studied groups

Presenting Symptoms	EBM Group	NEBM Group
	No (%)	
Cough	25 (89.2%)	22 (78.5%)
Fever	27 (96.4%)	24 (85.7%)
Wheezes	19 (67.8%)	26 (92.8%)
Tachypnea	22 (78.5%)	24 (85.7%)
Feeding Difficulties	15 (53.5%)	17 (60.7%)
Neurological Sequalae	4 (14.2%)	4 (14.2%)

Table (4) showed that (71.4%) of children in EBM group were hospitalized due to fever and rapid breathing with or without cyanosis, while children in NEBM group (67.9%) were hospitalized for fever, rapid breathing and failure of previous antibiotic therapy (P= 0.001).

Table (5) showed that nearly all children of NEBM group needed to be admitted to intensive care unit (ICU) for a certain duration(4.2± 2.6 days), while no child of EBM group admitted to ICU or ventilated (P= 0.001). Children of EBM group took a statistically significant shorter time to resolution of symptoms (5.3±1.7 days) than NEBM group (17.1± 5.3 days) (P= 0.001). EBM group had a statistically significant shorter hospital stay to receive the course of treatment (8.2± 1.8 days) than NEBM group (17.1± 5.3 days) (P= 0.001).

Table (4) Indication of hospitalization in the two studied groups

Indications Of Hospitalization	EBM Gr	NEBM Gr	P. Value
	No (%)		
Children aged <3/ fever	2 (7.1%)	0	0.001**
Children aged <3/ fever/ Rapid breathing	2 (7.1%)	1 (3.6%)	
Fever/ Rapid Breathing	20(71.4%)	1 (3.6%)	
Children aged <3/ Rapid breathing	1 (3.6%)	0	
Rapid Breathing	1 (3.6%)	0	
Fever/ Rapid breathing, failure of previous antibiotic therapy.	1 (3.6%)	19(67.9%)	
Rapid Breathing, Recurrent Pneumonia	1(3.6%)	1(3.6%)	
Rapid breathing, failure of previous antibiotic therapy recurrent pneumonia.	0	6 (20.7%)	

\*\* Highly Significant.

Figure (1) showed that children of NEBM group presented with infective complication in the form of bilateral diffuse affection (17.9%), empyema and lung abscess (10.7%), pleural effusion (7.1%) and lung collapse (7.1%), while no child of EBM group developed an infective complication (P= 0.005).

Table (5) Outcome results of observational study

	Ebm Group	Nebm Group	P Value
	Mean±SD	Mean±SD	
Time To Resolution Of Symptoms	5.3±1.7	14.7±3.2	0.001**
Length Of Hospital Stay	8.2±1.8	17.1±5.3	0.001**

\*\* Highly Significant.

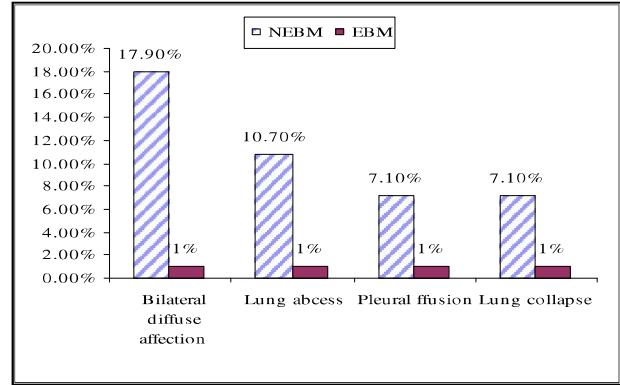


Figure (1) Infective complication in children.

**Discussion:**

The findings of previous reviews together with our observational study conducted on fifty- six immune- competent children hospitalized for the treatment of acute CAP who further divided into 2 groups; EBM group: managed on evidence based practice and NEBM group managed empirically, revealing their demographic, clinical, laboratory, radiological and regimen of therapy.

The demographic characteristic of both groups demonstrated that a large proportion of studied children were male 32 (57.2%) and only 24 female (42.8%) with male to female ratio 1.3: 1, their age ranged from 1 to 72 months, age category from 1 month to 2 year were 42 (75%) while the rest from 2 to 5 year were 14 (25%) commonly the order of child was 4th or fifth sibling, nearly all of children received their scheduled vaccination and no one received pneumococcal vaccine.

This goes with Marfatia et.al. (2015) on 67 pediatric children diagnosed with CAP admitted into public hospital in Mumbai. Yehia et.al. (2016) agreed that the most common age category presented with CAP were 1 month- 2 year (66.7%) and remaining above 2 year of age were (33.3%), most of them also males (63.3%).

Most of children admitted to Abo El Resh hospital presented with combined symptoms during their course of illness that is ranged in the EBM group from 9 to 30 (14.8± 5.2 days), while NEBM group ranged from 16 to 35 (23.8± 3.9 days). The most frequent presenting symptom was fever in 50 children (89%), cough in 46 children (82%), forty- six children (82%) had recorded signs of respiratory distress (tachypnea and wheezes), some had feeding difficulties (57%) and only 9 children (16%) had neurological sequalae of drowsiness and convulsion.

This goes in concordance with study done by Yehia et.al. (2016) conducted on ninety infant and preschool children admitted to pediatric hospital at Ain Shames University that also revealed that their most frequent symptom was fever 83 (92.2%), Cough 67 (74.4%), but only 48.9% presented with wheezes.

In the current study, the hospital stay in EBM group ranged from 5 to 12 days (8.2±1.8) with no children developed an infective complication while NEBM group had prolonged hospital stay ranged from 10 to 30 (17.1± 5.3) with nearly all children 27 (96.4%) admitted to pediatric intensive care unit (PICU) for a certain duration with mean (4.2± 2.6)

days with ventilation use and subsequently more infective complication in 13 children (46.6%), the most common complication is bilateral diffuse affection (17.9%), empyema and lung abscess (10.7%), pleural effusion (7.1%) and lung collapse (7.1%).

Our result was consistent with study done by Yun et.al. (2015) who studied hospitalized children of CAP and further subdivided into 2 groups before and after the age of 5 years and reported that the sixty- one children who were 5 years or younger had a more complicated clinical course, outcome and higher hospitalization rate with mean length of hospitalization (10.87± 9.20) and high need for intensive care unit (ICU) admission in 20 children (32.8%) and with ventilation use in 6 (9.8%) oxygen supplement in 29 (47.5%). Subsequently higher rate of complicated pneumonia in 24 children (39.3%) of children 5 year or younger but those children were complicated by pleural effusion 21 (34.4%), respiratory failure 6 (9.8%) and pneumatocele 2 (3.3%).

Most of children of EBM group were presented with grade II respiratory distress; chest indrawing (35.7%), grade III; Grunting (32.1%), grade IV; cyanosis (28.5%) and hospitalized due to fever and rapid breathing with or without cyanosis while 50% of children of NEBM group presented with; grade III, 35% grade IV and 14.2% grade II hospitalized for fever, rapid breathing and failure of previous antibiotic therapy.

In this context the study of Yun et.al. (2015) revealed that most of hospitalized children (46.7%) were suffering from grade III respiratory distress (grunting) and (24.4%) grade IV respiratory distress (cyanosis).

As for regimen of therapy, (57.1%) of children of EBM group received an early appropriate interventions either at ER or shortly after admission by administrating IV bronchodilator and starting first line of combined antibiotic of IV amoxicillin and aminoglycoside showed more rapid improvement with decrease of length of hospital stay and need to ventilation and subsequently low rate of infectious complication to develop while NEBM group with delayed start of appropriate management showed persistence of respiratory signs of severe pneumonia, need for ventilation due to respiratory distress with PICU admission with developing clinical deterioration and treatment failure with development of infectious complication in the form of lung abscess, collapse and pleural effusion.

The high clinical and economic burden of pneumonia especially in children (2- 59) months necessitates an updated systematic review to derive the best external evidence to determine the most effective antibiotic therapy for treating pneumonia (very severe, severe and non- severe), therefore a meta- analysis of trials conducted by Lassi et.al. (2014) focusing on 22 studies which enrolled 20 593 children. Evidence derived from the review found that a combination of penicillin/ ampicillin and gentamicin as a first line for managing very severe pneumonia in children to be effective and further recommended if parenteral treatment is challenging so oral amoxicillin is equally efficacious, as other parenteral antibiotics for managing severe and non- severe pneumonia in children of this particular age group.

WHO's Integrated Management of childhood infections (IMCI) 2006 guidelines recommended a dose of 7.5mg/ kg intramuscular injection of gentamycin to be preferably used with 50 mg/kg injection of ampicillin for severe pneumonia and such recommendation for these spectrum of antibiotics was further updated by Lassi et.al. (2014) to be an effective first line of treatment and emphasized that further studies are also warranted to explore an effective second line antibiotics.

Evidence from another trial conducted by Asghar et.al. (2008) showed that a combination of parenteral ampicillin and gentamicin is superior as first line for the treatment of community acquired very severe pneumonia in children aged (2- 59) months in low resource settings. Such trial carried out at a consensus protocol at tertiary care hospitals over seven different countries and enrolled 958 children who further subdivided into 2 groups one started with ampicillin plus gentamicin and the other started by chloramphenicol with significant decrease in failure rates on day 5 by 30%, day 10 by 27% and day 21 by 25% compared to chloramphenicol group.

Harris et.al. (2011) showed that prescribing antibiotics can be rationalized to simple narrow spectrum antibiotics (intravenous benzylpenicillin or oral penicillin V) with the introduction of a local management protocol. This has the potential to reduce the likelihood of antibiotic resistance developing.

Any consideration for improving of case management interventions should consider the weak infrastructure, shortage of essential supplies, other supportive technology for accessing databases and, most of all, the human resource crisis are essential elements underlying the successful delivery of such interventions.

#### **Conclusion:**

Effective case management is an important strategy to reduce pneumonia- related mortality in children. Guidelines based on sound evidence are available but are used variably so unifying guidelines for childhood pneumonia management in the setting where most child pneumonia deaths occur incorporating the appropriate choice of antibiotic, clinical overlap with other conditions, management of treatment failure and the outcomes integrated within strategies to improve overall pediatric care.

#### **Recommendation:**

Unifying clinical practice based on scientific evidence could rationalize the use of health resources, improving health care quality and equity of access to services.

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