

# An Audit on the Practice of Performing a Chest X-Ray in Infants with Bronchiolitis

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## Abstract

**Introduction:** Bronchiolitis is one of the most common medical emergencies in infancy. One in three infants will develop bronchiolitis in the first year of life. 2 - 3 % of these require hospitalisation.

**Aims:** To assess the local practice of performing a chest X-ray in infants aged less than 6 months presenting with viral bronchiolitis and to compare this practice with the recommendations of the National Institute for Health and Care Excellence (NICE)<sup>1</sup> and American Academy of Paediatrics (AAP) clinical practice guidelines for bronchiolitis<sup>2</sup>. The secondary aim was to quantify how many of the chest X-rays performed were abnormal, and whether these were indicated or not.

**Methodology:** Approval was obtained from the Audit Committee and Data Protection Act Committee. Data was collected on infants aged less than 6 months who presented to the Paediatric Accident and Emergency department, Mater Dei Hospital, Malta between January - April 2016 and October 2016 - February 2017, with symptoms of bronchiolitis. The data was retrieved retrospectively from medical records and compared to a set of indications from NICE and AAP guidelines. Picture Archiving and Communication System was utilised to view chest X-rays and obtain radiologists' reports.

**Results:** 148 patients satisfied the inclusion criteria for bronchiolitis. 81 (54.7%) had a chest X-ray performed. Only 28 (34.6%) of the chest X-rays were indicated according to the guidelines. Overall percentage compliance to the guidelines was 64.2%. 67 (82.7%) of the chest X-rays performed were normal. 8 (57.1%) of the 14 abnormal chest X-rays were performed according to the guidelines.

**Conclusion:** There is room for improvement in abiding to the AAP and NICE guidelines with regards to the practice of performing chest X-rays in patients presenting with bronchiolitis. Abnormal chest X-rays, whether indicated or not, should be interpreted with caution. Adhering to the guidelines would result in a decrease in patient radiation exposure.

## Keywords

Chest x-ray, bronchiolitis, compliance, guidelines

## Introduction and Aims

Bronchiolitis is the most common disease of the lower respiratory tract during the first year of life and one of the most common medical emergencies in infancy. 1 in 3 infants develop bronchiolitis in the first year of life and 2 - 3 % of all infants require admission to hospital.<sup>1</sup> Consequently, it is a burden for the child and respective families and is very costly for the

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healthcare system.<sup>3-4</sup>

The diagnosis of bronchiolitis is a clinical one. The condition occurs in infants less than 2 years of age and is characterised by a viral upper respiratory tract prodrome followed by increased respiratory effort and is commonly associated with decreased feeding.<sup>1-2</sup> Apnoea may be the presenting symptom particularly in those infants with a history of prematurity.<sup>5</sup> Several viruses are responsible for causing bronchiolitis, respiratory syncytial virus (RSV) being the most common. In vulnerable children, such as those with underlying chronic conditions, bronchiolitis may cause significant morbidity and mortality.<sup>2</sup> However, the number of deaths from respiratory failure in bronchiolitis remains low.<sup>6-7</sup>

Clinicians should diagnose bronchiolitis and assess disease severity based on history and physical examination.<sup>2</sup> Chest X-rays should not be taken indiscriminately as they carry a small but significant exposure to radiation and are rarely useful in the diagnosis.

The NICE and AAP Guidelines on bronchiolitis have specific indicators on when to perform chest X-rays, as shown in Table I. According to the NICE Guidelines 'Fever in under 5s: assessment and initial management' a chest X-ray is indicated in children aged < 3 months presenting with fever if respiratory signs are present.<sup>8</sup> The latter was included as an indication for performing a chest X-ray in this audit.

The aim was to assess the local practice on performing a chest X-ray in infants aged less than 6 months presenting with viral bronchiolitis and compare this to the recommendations of the National Institute for Health and Care Excellence (NICE)<sup>1</sup> and American Academy of Paediatrics (AAP)<sup>2</sup> clinical practice guidelines for bronchiolitis. The secondary aim was to quantify how many of the chest X-rays performed were abnormal, and whether these were indicated or not.

**Table I:** Indicators for performing a chest X-ray in infants with bronchiolitis according to the NICE<sup>1</sup> and AAP guidelines.<sup>2</sup>

Indicators for performing a Chest X-ray	NICE Guidelines <sup>1</sup>	AAP Guidelines <sup>2</sup>
Fever $\geq 39^{\circ}\text{C}$	✓	
Persistent focal crackles	✓	
Signs of airway complication		✓
Signs of unexpected worsening disease		✓
Need for NPICU admission	✓	✓
Respiratory signs and fever in infant aged < 3 months	✓	

## Methodology

Approval was obtained from the Audit Committee and Data Protection Act Committee. All patients aged less than 6 months attending the Paediatric Accident and Emergency Department between January to April 2016 and October 2016 to February 2017, with bronchiolitis, were included in the audit. The data was retrieved retrospectively from the patients' medical records and compared to a set of indications from the aforementioned NICE and AAP guidelines.

For the purpose of this audit, a diagnosis of bronchiolitis was based on a coryzal prodrome lasting 1 - 3 days followed by persistent cough,

tachypnoea and/or chest recessions and the presence of wheeze and/or crackles. Patients aged less than 6 weeks presenting solely with apnoea were also included.<sup>1</sup>

Picture Archiving and Communication System was utilised to view chest X-rays and obtain radiologists' reports.

The overall percentage compliance to the guidelines was calculated using the following formula:

Percentage Compliance = (Number of patients for whom chest X-ray not taken and not indicated + Number of patients for whom Chest X - ray taken and indicated/ Total number of patients) x 100.

**Results**

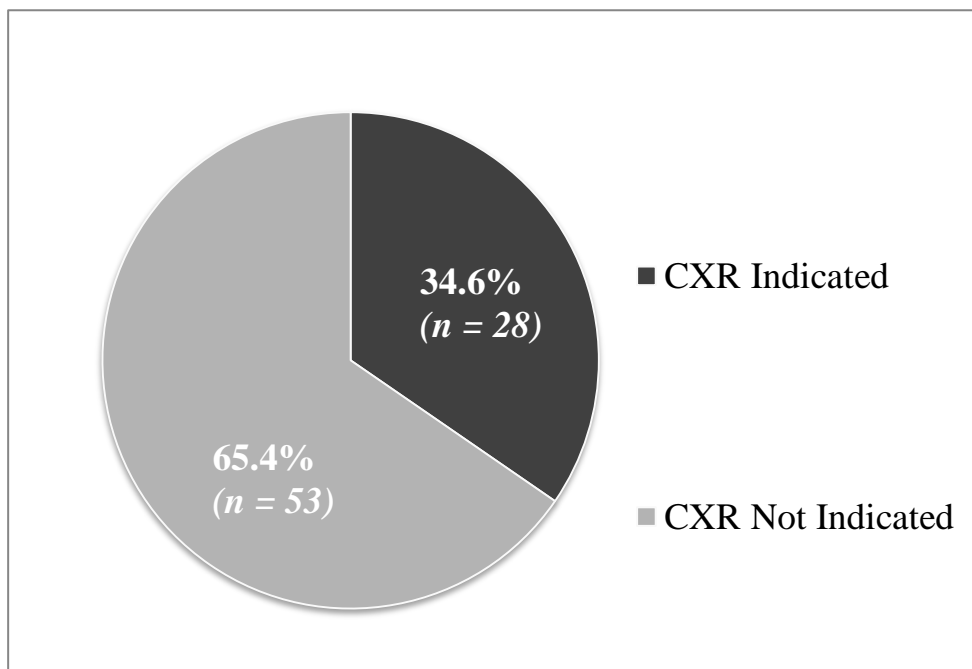
A total of 148 patients had the necessary inclusion criteria for the diagnosis of bronchiolitis. 81 (54.7%) had a chest X-ray performed. Only 28 (34.6%) of the chest X-rays were indicated according to guidelines<sup>1-2</sup> (Figure I). Out of the 67 patients who did not have a chest X-ray performed, 2 had a fever  $\geq 39^{\circ}\text{C}$ . The overall percentage compliance to the guidelines was 64.2%.

The main indications for imaging were the need for a chest X-ray as part of a sepsis screen in febrile infants below the age of 3 months, the presence of signs of an airway complication and

severe respiratory distress requiring admission to the Neonatal Paediatric Intensive Care Unit (NPICU) (Figure II). Table II demonstrates the number of indications present for those chest X-rays that were taken as per guidelines.

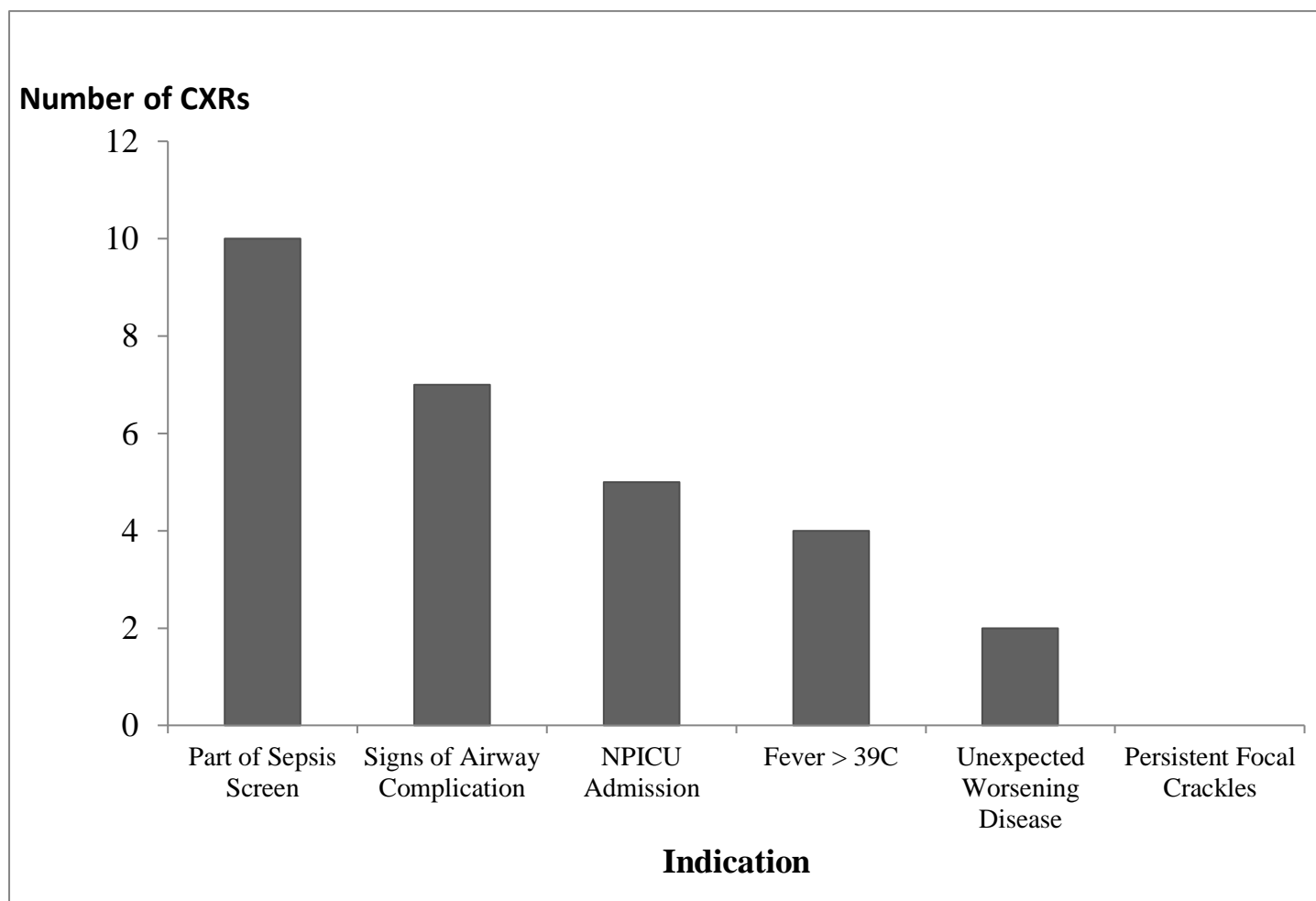
67 (82.7%) of the chest X-rays performed were normal or reported as showing peribronchial cuffing and 14 were abnormal. From the latter, 13 showed the presence of consolidation and 1 showed an incidental finding of dextrocardia. 8 (57.1%) of these 14 abnormal chest X-rays were performed according to the guidelines.

*Figure I: Percentage of chest X-rays indicated.*



*Table II: Number of indicators present in the patients for whom a chest X-ray was performed according to guidelines.*

Number of Indicators for CXR	Number of Patients
1	24
2	4
$\geq 3$	0

*Figure II: Hierarchy of indications for chest X-ray.*

### Discussion

During the study period, 82.7% of the chest X-rays performed for infants presenting with bronchiolitis were reported as normal or as showing peribronchial cuffing, in keeping with a diagnosis of bronchiolitis. A study by Nazif et al, showed that 84% out of 553 chest X-rays taken on infants with bronchiolitis were normal, a figure which is comparable to the results of this audit.<sup>9</sup>

This highlights the importance of clinicians diagnosing bronchiolitis and assessing disease severity based on history and physical examination.<sup>2</sup> Recent guidelines and evidence-based reviews suggest that no diagnostic tests are used routinely, as they do not have a substantial impact on the clinical course of bronchiolitis.<sup>2-10</sup> There is no correlation between chest X-ray changes and disease severity in infants presenting with bronchiolitis.<sup>2</sup>

81 chest X-rays were performed in this audit but 65.4% of these were not indicated. Clinicians must keep in mind the harmful effects of ionizing

radiation associated with imaging procedures such as chest radiography. These may result in high cumulative effective doses of radiation.<sup>12</sup> In a 5 year old child, a single PA film chest X-ray is equivalent to 3 days of natural background radiation. The typical effective dose is that of 0.02 millisieverts. The risk of developing cancer from low-level radiation such as with diagnostic imaging procedures is uncertain. It is assumed that a linear relationship exists between exposure and cancer risk, and that there is no threshold value below which this risk is zero. As a result of these assumptions, the probability of developing cancer is presumed to increase with radiation dose even for low dose medical imaging procedures.<sup>13-18</sup> A precautionary approach should be taken so as to assure that the radiation dose used to perform the procedure does not exceed the dose required to obtain an image of adequate diagnostic quality.<sup>19</sup> Imaging modalities such as chest X-rays should therefore be used sparingly in children.

In addition to the adverse effects of radiation,

performing chest X-rays that are not indicated also unnecessarily delays patient transition from the emergency department to the inpatient ward and is an extra financial burden on the health service.

Parental requests and anxiety, as well as relative unfamiliarity of the foreign guidelines, are possible reasons for the low adherence to NICE and AAP recommendations. Despite guidelines, the clinician's acumen must be taken into consideration and performing a chest X-ray, if justified, supersedes the aforementioned drawbacks.

In this audit, 6 of the 14 abnormal chest X-rays were not indicated. These were all reported as showing a consolidation. The NICE guideline on bronchiolitis states that findings on chest X-ray may mimic pneumonia and lead to the unnecessary use of antibiotics, thus increasing antimicrobial resistance, without improving outcomes.<sup>1</sup>

In a study by Breakell R. et al, a simple educational intervention in the form of sessions to raise awareness of appropriate and inappropriate management of bronchiolitis amongst clinicians and nursing staff, held after the publication of the NICE bronchiolitis guideline, led to a fivefold reduction in the number of chest radiographs and enhanced compliance with the NICE guideline.<sup>20</sup>

A retrospective cohort study by Parikh K. et al showed that there was a statistically significant decrease in the use of diagnostic tests including chest X-rays following the publication of the AAP guidelines and that this may have reduced costs associated with bronchiolitis.<sup>21</sup> In another similar study which compared the use of diagnostic imaging in patients presenting with bronchiolitis before and after publication of the AAP practice guidelines, it was found that the use of radiography decreased from 65.3% to 48.6% after publication of the guidelines. Patient visits after publication of the guidelines had 59% lower odds of receiving a chest X-ray than those visits occurring before.<sup>22</sup>

Some studies suggest that local clinical guidelines are what truly drive change at the local level and that these have been found to be effective in increasing adherence to the bronchiolitis guidelines. Nationally developed guidelines may also reduce variations in care and unnecessary financial costs.<sup>21</sup>

The main limitation of this audit was the dependence on clear and reliable documentation in the patients' medical records. Inaccuracies may have led to underestimations of indicated chest X-

rays.

## Conclusion

The results of this audit indicate that there is room for improvement in abiding by the AAP and NICE guidelines with regards to the practice of performing chest X-rays in patients presenting with bronchiolitis. 53 out of 81 chest X-rays taken in this audit could have been avoided. Out of these non-indicated chest X-rays, 6 showed a consolidation. It is, however, debatable whether these radiographs were ultimately useful, since bronchiolitic changes on imaging may mimic a consolidation and thus lead to inappropriate antibiotic prescription. Hence abnormal chest X-rays in bronchiolitic patients should be interpreted with caution. In practice, it is difficult to eliminate all 'extra' chest X-rays and the clinician's acumen must be taken into consideration. Knowledge of the guidelines may be increased amongst medical staff from juniors up to consultants by means of simple educational sessions. Development of a local guideline on the diagnosis and management of bronchiolitis may also improve adherence to the NICE and AAP recommendations as local guidelines have been shown to be more effective in driving changes in local practice. These recommendations may help to decrease unnecessary radiation exposure and its adverse effects, reduce the financial burden of bronchiolitis on the health services and avoid unnecessary administration of antibiotics and the subsequent development of antibiotic resistance.

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