British Thoracic Society

Quality Improvement Tool – Paediatric Community Acquired Pneumonia

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This work forms part of the BTS Respiratory Quality Improvement activities. We work with our members, healthcare professionals from other specialties and patients and carers to improve standards of care for people with respiratory diseases, and to support those who provide that care.

CONTENTS

PART 1 – INTRODUCTION

1.1 BACKGROUND

This toolkit has been prepared by a small sub-group on behalf of the British Thoracic Society. The purpose of this document is to help all healthcare professionals working in paediatric community acquired pneumonia to design and implement changes in order to drive up standards of care. The document is based on data from previous national audits, published Guideline and Quality Standards. Should you require additional general information on quality improvement methodology, please refer to our QI Methodology Tool https://www.brit-thoracic.org.uk/quality-improvement/clinical-resources/paediatric-community-acquired-pneumonia/.

Community acquired pneumonia (CAP) can be defined clinically as the presence of signs and symptoms of pneumonia in a previously healthy child due to an infection which has been acquired outside hospital. This tool is designed to help institutions instigate a quality improvement programme for paediatric CAP in line with the findings from the 2017 national BTS Paediatric CAP audit. The audit assessed current practice against the 2011 BTS guideline for paediatric CAP [1] to examine national adherence to the guideline and to identify any trends over time, both positive and negative. It involved a retrospective audit of the notes of over 7,000 patients from 144 institutions, as well as a survey of the organisation of services at each participating hospital.

1.2 ACKNOWLEDGEMENTS

A working group was convened in 2018. The Society would like to thank:

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Dr Malcolm Brodlie
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1.3 BTS AUDIT DATA 2017

The key findings from the BTS Paediatric CAP audit (2017) were:

1. 24% of children were given antibiotics prior to attending hospital and 60% of these children were given amoxicillin.

2. Where a causative organism was identified, the most common was respiratory syncytial virus (36% of organisms).

3. There had been an overall reduction in the number of blood investigations (45% in 2016/17; 63% in 2012/13) and chest x-rays (73% in 2016/17; 88% in 2012/13) that were performed.

4. More children had been prescribed oral amoxicillin as first line treatment (33% of prescribed oral antibiotics in 2016/17; 25% in 2012/13) and fewer children had been prescribed intravenous antibiotics (31% in 2016/17; 51% in 2012/13).

The audit demonstrated an overall improved compliance with the 2011 BTS Guideline[1] but also identified room for improvement in several important areas. Investigations continued to be performed more frequently than recommended including blood tests, CXRs and microbiological investigations. In addition, many children received IV fluids and antibiotics, when they would likely tolerate oral fluids and antibiotics and hospital follow-up occurred frequently in patients where there was no specific indication.

The audit report recognised that the assessment and management of children with suspected CAP was, in many cases, dictated by both the BTS Guideline[1] and the 2016 NICE Sepsis Guideline[2]. The NICE sepsis guideline provides an evidence-based approach to recognising and initiating treatment for suspected sepsis and has been widely employed nationally as a default pathway. It was evident that any improvement objectives should account for this overlap whilst recognising local variation in sepsis management[3].

1.4 NATIONAL IMPROVEMENT OBJECTIVES

The 4 key national improvement objectives identified were:

1. Children with community acquired pneumonia should not undergo blood investigations (e.g. white cell count or CRP) that are not indicated by either the BTS Community Acquired Pneumonia or NICE Sepsis Guidelines.

2. Children with community acquired pneumonia should not have a CXR performed where there is no clinical evidence of severe or complicated pneumonia.

3. Children with community acquired pneumonia who are able to tolerate oral fluids should not receive intravenous antibiotics where there is no evidence of septicaemia or complicated pneumonia.

4. Children with community acquired pneumonia should only have hospital follow-up where there is evidence of severe pneumonia, complications, round pneumonia or collapse.

Quality improvement methodology can be used to help achieve these aims prior to the next round of national audit. In the interim, the BTS on-line paediatric CAP audit tool is available to support data collection and allows users to measure changes in practice over time.

PART 2 – PAEDIATRIC CAP QUALITY IMPROVEMENT

For more general information about QI methodology please refer to our QI Methodology Tool https://www.brit-thoracic.org.uk/quality-improvement/clinical-resources/paediatric-community-acquired-pneumonia/.

2.1 APPLYING QI TECHNIQUES TO THE AUDIT FINDINGS

The 2017 BTS paediatric CAP audit identified that there is considerable opportunity to optimise the management of CAP in acute hospitals across the United Kingdom.

A more detailed consideration of how to approach each of the key improvement objectives is set out below. With each area it is important to consider the underlying principles in quality improvement, namely: understanding the problem, the processes, the elements of demand, capacity and flow, choosing the tools to bring about change and evaluating and measuring the impact of change. General principles that are relevant to all key improvement objectives are initially outlined, followed by specific guidance for each objective.

The processes outlined should not be regarded as a comprehensive list and are intended as a guide or starting point.

For any QI initiative it is important that adequate resources and expertise are allocated to enable the completion of the project. It is essential that this is considered at an early stage so that appropriate arrangements can be negotiated as necessary. It is also essential that appropriate leadership is identified to drive the process forward.

Throughout this document, it is recognised that the management of pneumonia is governed by both the BTS Guideline[1] and the 2016 NICE Sepsis Guideline[2].

General Principles

Process

A detailed process map of the patient pathway will enable a search for improvement opportunities by visualising how the whole patient journey currently works.

Process mapping should identify answers to the following questions:

- What diagnostic criteria are in use for the diagnosis of CAP?
- What diagnostic labels are used for coding?
- When and where are management decisions made?
- Who is responsible for making these decisions?
- Is each decision supported and reviewed by someone of appropriate seniority?
- Is each decision documented and, if so, is the rationale for that decision also documented?
- Are there systems in place to inform each decision such as a treatment pathway or guideline?
- Is training adequate for those involved with delivering care in the pathway or guideline?

Stakeholders who can help to process map the initial stages of the CAP pathway and obtain the background information that is required may include:

- Members of the MDT (e.g. doctors, nurses, pharmacists, other allied health professionals) from emergency departments, assessment units and paediatric wards.
- Patients/Carers.
- Clinical Leads.
- QI teams.
- IT and communication team.
- Clinical coders.
- Business analysts and general managers.

Demand, flow and capacity

Understanding demand, flow and capacity of a service is essential when planning improvement change. Assessing demand and flow of patients with CAP should form part of an acute hospital's routine data collection. Demand will depend on the accurate diagnosis and assessment of patients with CAP, which will rely on the use of an appropriate guideline/pathway and adequate training of staff. Accurate recording of clinical data is essential and robust systems will need to be in place to facilitate this. IT and information teams as well as clinical coders will be able to help collect this data.

The capacity of a service to match demand depends on the appropriate availability of work force, equipment and facilities. Process mapping will help identify specific factors and constraints that affect capacity.

Choosing the tools to bring about change

Multiple different QI tools may be employed to facilitate appropriate investigation and management of paediatric CAP. When initially planning a QI project, it may be helpful to produce a stakeholder map of those individuals within the hospital that may help further develop the programme.

Leadership is essential for quality improvement activities to succeed. It is critical to identify key individuals who have the motivation, time and support to lead the programme.

Where available, an early discussion with the hospital QI team will benefit initial planning. It is also important to ensure that robust QI training is available, and that adequate time is allocated for its completion by key individuals.

Repeated use of Plan Do Study Act (PDSA) cycles will enable a clearer understanding of the impact of any changes that are introduced (e.g. new guideline/flowchart). It is important from the start to specify the objectives of each change, establish robust data collection methods (see next section) and define a successful outcome.

A driver diagram can be a particularly powerful tool enabling a clear visual summary of the key factors that impact CAP investigation and management (Appendix 1). This is best produced through close consultation with local stakeholders and can succinctly capture an entire change programme.

Other factors to consider include:

- Are all key stakeholders involved including patients/carers and staff?
- Who is going to deliver the change?
- Are adequate resources available to deliver the change?
- How will the outcome of the change be measured? And by whom?

Evaluating the impact and measurement of change

As outlined above, accurate diagnosis and recording of paediatric CAP are essential elements for evaluating impact and change. It will be important to define suitable aims at the start of the QI programme although these may need to be altered as PDSA cycles proceed.

Statistical Process Control (SPC) charts can provide a useful visual representation of the investigation and management of CAP (Appendix 2). Accurate recording of the specific indication(s) for investigation and management decisions will enable SPC charts to depict the percentage of patients who are managed inappropriately. Regularly updated SPC charts will identify change over time as well as establishing periods where targets are not met.

By developing projected ranges of investigation and management nationally and by centre, tools for real-time (e.g. weekly/monthly) adherence can be developed to compare centre performance to the estimated ideal rate of investigation/management. Colour banding or visual tools such as those of a QI dashboard can be used to provide real-time feedback as to performance, perhaps integrated with other targets. This can be automated provided cases and investigations can be electronically identified using coding data or related metadata.

Example and resources:

Appendix 1: Example of a key driver diagram with the specific aim to reduce the percentage of children with CAP who have a CXR where there is no evidence of severe or complicated pneumonia.

Appendix 2: Example of a statistical process control (SPC) chart for paediatric CAP – produced using tools available at https://improvement.nhs.uk/resources/statistical-process-control-tool/

2.2 KEY IMPROVEMENT OBJECTIVES

2.2.1 BLOOD INVESTIGATIONS FOR CAP

Problem

Successive BTS audits of childhood pneumonia have continued to find that children with pneumonia undergo blood investigations which are painful and potentially avoidable (2016/17 - 45%). On many occasions these are avoidable through adherence to BTS Community Acquired Pneumonia and NICE Sepsis Guidelines[1,2]. Continued action to reduce the rate of these investigations, while avoiding any potential negative impacts of missing potential sepsis, will result in more efficient resource utilisation.

Process

Process mapping should include:

- Identifying robust strategies for determining where blood investigations are excessive or unwarranted.
- Measurement of rate and characteristics of cases where blood investigations are excessive or unwarranted.
- Perceptions of key stakeholders about benefits/risks of changing the rate of investigations.

Demand, flow and capacity

Defining demand for blood investigations will be dependent on extrapolating from the BTS CAP and NICE sepsis guideline[1,2] criteria. These data can be mapped to the previous audit results to determine estimates of rates of investigation, allowing projected targets for individual units to be set. This may be best done at the individual centre level to account for differences in case mix between centres. Capacity will depend on the availability of equipment and staff with appropriate venepuncture skills.

Choosing the tools to bring about change

A detailed driver diagram will help identify key drivers of excessive investigation and highlight potential interventions to tackle these drivers, e.g. publishing financial costs per investigation.

An easy to follow ‘flow chart’ may be employed to enable clinicians to navigate through the diagnosis and investigation of a child with pneumonia and recommended investigations (Appendix 3). A freely accessible education package, e.g. slide deck and leaflets, allied to this flow chart can be used to increase awareness (Appendix 4 and Appendix 5).

Evaluating the impact and measurement of change

As outlined previously, when embarking on a QI programme to improve the care of paediatric CAP, it is important to identify patients with CAP accurately. This is not an outcome measure but an essential process that will influence how impact and change are measured. Appropriate education regarding CAP diagnosis and accurate recording of relevant patients is crucial.

An accurate assessment of clinical features that would indicate the need for blood investigations (as outlined in the BTS CAP and NICE sepsis guidelines[1,2] is essential. The specific indication(s) for blood investigations should be recorded in the notes.

Performance measure -

Numerator: Total number of paediatric patients with CAP who have blood investigations performed as indicated by BTS CAP or NICE sepsis guidelines

Denominator: Total number of paediatric patients with CAP who have blood investigation performed

Example and resources:

Appendix 3: Early management of paediatric CAP flow-chart – adapted from BTS CAP Guideline. Two-sided document with age relevant NICE Sepsis Guideline flow-chart on reverse side. Word version also provided to enable adaptation to include local sepsis guideline if required.

Appendix 4: Paediatric CAP Slide deck – example PowerPoint presentation providing an overview of the BTS Paediatric CAP Guideline.

Appendix 5: Clinical vignettes slide deck highlighting specific areas of the BTS Paediatric CAP Guideline.

2.2.2 CXRs FOR CAP

Problem

Another key finding of the 2016-17 BTS Paediatric Community Acquired Pneumonia Audit was the high number of children who underwent a CXR during their admission to hospital (73%, down slightly from 88% in the 2012-13 audit). The BTS Paediatric Community Acquired Pneumonia Guideline[1] recommends that chest radiography should 'not be considered a routine investigation'. In the BTS Paediatric Pneumonia Audit Report (2016-17) an ambitious target of reducing the number of CXRs in children with no clinical evidence of severe or complicated pneumonia to 10% was set as one of four national improvement objectives.

Process

Process mapping should include:

- Accurate ascertainment of the number of CXRs being performed in children with non-clinically severe or complicated pneumonia.

- Collection of high-quality data about the clinical characteristics of children who are undergoing a CXR not recommended by the guidelines.

- Examination of any differences between individual centres in terms of rates of CXRs and similarly if there are other factors, e.g. experience of doctor ordering investigation, time of day or week, and clinical location.

- Perceptions of key stakeholders about benefits/risks of changing rate of investigations.

Demand, flow and capacity

Defining demand and capacity will be dependent on extrapolating criteria for CXR from the BTS CAP and NICE sepsis Guidelines[1,2] and mapping this to the previous audit results. It will then be possible to determine estimates of rates of investigation and therefore set projected targets for individual units to aim for. This may be best done at the individual centre level to account for differences in case mix between centres.

Specific information to be considered and allow targeted interventions may include:

- Are there particular groups and levels of seniority of clinicians ordering non-recommended CXRs?

- Are there specific clinical locations, e.g. Emergency Department versus Paediatric Ward where non-recommended CXRs are being performed?

Choosing the tools to bring about change

Effective education and improving knowledge and understanding are key to reducing the number of non-recommended CXRs being performed. Tools must be accessible to all relevant stakeholders and it is likely that a multi-pronged approach would be most effective.

A key driver diagram may prove helpful (Appendix 1). Consultation with local stakeholders is an important part of this process. Regular reassessment of the diagram is essential through successive PDSA cycles.

An easy to follow ‘flow chart’ may be employed to enable clinicians to navigate through the diagnosis and investigation of a child with pneumonia and recommended investigations (Appendix 3).

Evaluating the impact and measurement of change

An accurate assessment of clinical features that would indicate the need for a CXR (as outlined in the BTS CAP and NICE sepsis Guidelines) is essential. The specific indication(s) for a CXR should be clearly recorded in the notes.

Performance measure -

Numerator:	Total number of paediatric patients with CAP who have a CXR performed as indicated by BTS CAP or NICE sepsis Guidelines
Denominator:	Total number of paediatric patients with CAP who have a CXR performed

Example and resources:

Appendix 1: Example of a key driver diagram with the specific aim to reduce percentage of children with CAP who have a CXR where there is no evidence of severe or complicated pneumonia.

Appendix 3: Early management of paediatric CAP flow-chart – adapted from BTS CAP guideline. Two-sided document with age relevant NICE Sepsis guideline flow-chart on reverse side. Word version also provided to enable adaptation to include local sepsis guideline if required.

2.2.3 INTRAVENOUS ANTIBIOTICS FOR CAP

Problem

Oral antibiotic treatment is as effective as parenteral therapy even in severe CAP[4]. Oral antibiotics avoid the problems associated with IV treatment such as the pain of catheter placement, the risk of infiltration and the potential negative impact on mobility. In addition, oral therapy has been shown to have economic benefits with shorter hospital stays[5].

The BTS Paediatric CAP Guideline[1] recommends that IV antibiotics should only be used “when the child is unable to tolerate oral fluids or absorb oral antibiotics (e.g. because of vomiting) or presents with signs of septicaemia or complicated pneumonia”.

31% of children included in the 2017 BTS Paediatric CAP audit were treated with IV antibiotics. This was a significant reduction from the 2013 audit (51%) but still represented a higher proportion than would have been expected given that only 18% of children required IV fluids (presumably due to an inability to feed orally) and only 3% had complicated pneumonia.

Process

When considering the processes that lead to treatment with IV antibiotics, helpful background information will include:

- Accurate ascertainment of the number of children who receive intravenous antibiotics who are able to tolerate oral fluids and where there is no evidence of septicaemia or complicated pneumonia.

- High quality data about the clinical characteristics of children who are receiving IV antibiotics not recommended by the guidelines
- Perceptions of key stakeholders about benefits/risks of prescribing oral antibiotics

Demand, flow and capacity

Assessing demand relies on an accurate assessment of clinical features that would indicate the need for IV antibiotics (as outlined in the BTS CAP and NICE sepsis Guidelines[1,2]). The specific indication(s) for IV antibiotics should be recorded in the notes.

The capacity of the service to make the correct decision to treat with IV antibiotics will depend on the systems being in place to enable this. It is essential that appropriate training exists for those staff who determine the need for IV antibiotics. Process mapping will help identify specific factors affecting capacity.

Specific information to be considered to allow targeted interventions may include:

- Is there satisfactory recorded evidence that oral tolerance has been adequately assessed?
- Are there specific clinical locations, e.g. Emergency Department versus Paediatric Ward, where non-recommended IV antibiotics are being administered?
- Are there specific differences between clinician groups in the rate at which inappropriate IV antibiotics are prescribed?

Choosing the tools to bring about change

Many different QI tools will help resolve problems identified during process mapping (see General Principles above).

Education is a cornerstone and can be facilitated through the employment of a freely accessible education package (including slide decks and leaflets – Appendix 4 and Appendix 5). The use of a simple “flow chart” to indicate the appropriate use of intravenous antibiotics may prove helpful (Appendix 3).

Evaluating the impact and measurement of change

As outlined previously, accurate diagnosis and recording of paediatric CAP are essential elements for evaluating impact and change. It will be important to define a suitable target at the start of the QI programme although this may need to be altered as PDSA cycles proceed.

SPC charts provide a visual representation of the percentage of patients receiving IV antibiotics (Appendix 2). It is essential that the specific indication(s) for IV antibiotics are clearly recorded. This will enable SPC charts depicting percentage of patients inappropriately receiving IV antibiotics to be constructed.

Performance measure -

Numerator:	Total number of paediatric patients with CAP who receive IV antibiotics as indicated by BTS CAP or NICE sepsis Guidelines
Denominator:	Total number of paediatric patients with CAP who receive IV antibiotics

Example and resources

Appendix 2: Example of a statistical process control (SPC) chart for paediatric CAP – produced using tools available at https://improvement.nhs.uk/resources/statistical-process-control-tool/

Appendix 3: Early management of paediatric CAP flow-chart – adapted from BTS CAP guideline. Two-sided document with age relevant NICE Sepsis guideline flow-chart on reverse side. Word version also provided to enable adaptation to include local sepsis guideline if required.

Appendix 4: Paediatric CAP Slide deck – example PowerPoint presentation providing an overview of the BTS Paediatric CAP guideline.

Appendix 5: Clinical vignettes slide deck highlighting specific areas of the BTS Paediatric CAP guideline.

2.2.4 HOSPITAL FOLLOW UP AFTER AN ADMISSION FOR CAP

Problem

The BTS CAP Guideline[1] suggests that follow up is arranged for patients with severe pneumonia, complications (empyema or lung abscess), round pneumonia or collapse. The 2017 BTS audit found that 24% of patients had a hospital follow up after an admission with CAP despite specific indications being significantly lower (e.g. 1% of patients developed an empyema). This would ostensibly represent an inappropriate, inefficient use of scant resources.

People who may be able to help identify sources of data on follow up rates subsequent to admissions for CAP include:

- Clinical coders
- Electronic patients record IT specialists
- Radiology team data analyst

Process

Process mapping should identify answers to the following questions:

- What criteria is employed for follow up after discharge from hospital?
- How is the indication for follow-up recorded in the notes and discharge summary?
- Is there evidence that this indication is reviewed at follow up?
- Is the follow up arranged with the admitting team?
- Is there feedback/learning in place about follow up visits?
- What are the perceptions of key stakeholders about benefits/risks of reducing follow up rates?
- What are the principal components analysis or related technique to identify key drivers for organising a follow up appointment not recommended by the guidelines?

Demand, flow and capacity

Demand and flow of those CAP admissions requiring follow up should be straightforward to assess if accurate coding is in place. A system which identifies cases of CAP will be able to interrogate radiology and OPD systems automatically for follow up.

Absence of an accurate coding system will require manual identification of CAP cases as a first step.

Arranging a hospital follow up is primarily the responsibility of clinical staff and sufficient training of these staff is essential. A clear documentation of the specific indication(s) for hospital follow up should be recorded both in the notes and the discharge summary.

Other factors to consider are:

- What are the processes in place to ensure that the specific indication(s) for follow up are recorded clearly?
- Where will the indication(s) for follow up be documented (i.e. paper notes, electronic record, discharge summary)?
- Is the process robust for patients who are discharged out of hours?
- Are there clear guidelines in place regarding indications for hospital follow up?
- The type of training delivered to clinical staff (i.e. online, face to face, departmental meetings).

Choosing the tools to bring about change

Multiple tools may prove helpful to improve the appropriate use of follow up for patients with CAP. A specific driver diagram can identify the principal factors that result in the organisation of a follow up appointment and highlight those areas that need to be addressed.

It is paramount that those involved with the care for patients with CAP, and particularly those involved with patient discharge, are aware of the criteria for follow up. Education is crucial, and appropriate education packages are essential, e.g. a slide deck and leaflets are available at Appendix 4 and Appendix 5.

Identifying those key individuals that can facilitate change is important. For example, in some organisations follow up is organised by ward clerks who can be employed to ensure that an appropriate indication has been “ticked” in the case notes / electronic record before making arrangements.

Evaluating the impact and measurement of change

As detailed above, the clear identification of those with CAP is essential and this information will need to be collected alongside data regarding the rationale for follow up. These data can then be represented as an SPC chart which can depict longitudinal changes in the appropriate use of follow up.

Performance measure -

Numerator:	Total number of paediatric patients with CAP who have a hospital follow up arranged as indicated by the BTS CAP Guideline
Denominator:	Total number of paediatric patients with CAP who have a hospital follow up arranged

Examples and resources

Appendix 4: Paediatric CAP Slide deck – example PowerPoint presentation providing an overview of the BTS Paediatric CAP guideline.

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