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# Appropriate Antibiotics for Empyema at Starship Children's Hospital

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## BACKGROUND

- Empyema thoracis is an accumulation of infected fluid in the pleural space, usually as a consequence of pneumonia
- In developed countries *Streptococcus pneumoniae* is described as the most common pathogen in paediatric empyema, however *Staphylococcus aureus* – including methicillin-resistant *Staphylococcus aureus* (MRSA) – also plays a significant role in New Zealand
- Starship Children's Hospital updated clinical guidelines in 2011 recommending amoxicillin/clavulanic acid or cefuroxime as first-line empiric treatment for empyema

## METHODS

- Retrospective analysis was undertaken of all cases with clinical, radiological, and microbiological evidence of empyema thoracis at Starship Children's Hospital between June 2009 and March 2013 (3.8 years)
- Case finding was via hospital discharge coding data with search terms including key clinical diagnoses and associated surgical procedures
- Ethics approval was sought from Health and Disabilities Ethics Committees but was deemed unnecessary (ref 14/STH/124)

## RESULTS

150 children were treated for empyema at Starship Children's Hospital between June 2009 and March 2013. 145 cases were due to community-acquired infection with the remaining 5 secondary to surgical or malignant complications.

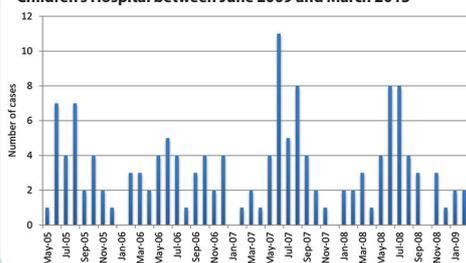
### Mode of infection

- Of the 145 community-acquired cases, pneumonia was the most common mode of infection (92%), followed by disseminated sepsis (6%), lung abscess (1%), and pulmonary tuberculosis (1%)

### Seasonal trends

- The incidence of empyema fluctuated over the course of the year, waxing in the winter months and waning in the summer

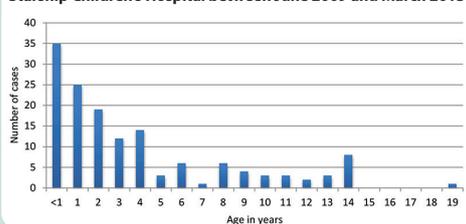
Seasonal trends in community-acquired empyema at Starship Children's Hospital between June 2009 and March 2013



### Demographics

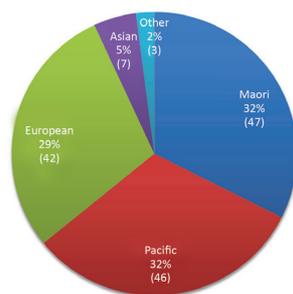
- 63% of cases came from greater Auckland (32% Counties-Manukau, 19% Waitemata, 12% Auckland) and 93% from the North Island
- The majority of cases occurred in those under 5 years of age with the most cases occurring in children aged less than 1 year

Age at presentation with community-acquired empyema at Starship Children's Hospital between June 2009 and March 2013



- Cases occurred more commonly in males than females (62% vs 38%)
- Incidence was highest in Māori, followed by Pacific peoples and Europeans

Ethnic distribution of cases of community-acquired empyema at Starship Children's Hospital between June 2009 and March 2013 (number of cases)



### Diagnosis

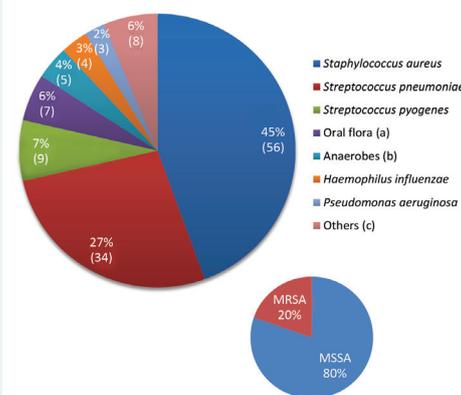
- Blood cultures were taken in 99% of patients. At least one blood culture was positive in 25% of patients. Of new positive cultures, 82% (27/33) were considered clinically relevant
- Streptococcus pneumoniae* pleural antigen testing was performed in 31% of patients who had pleural samples taken (40/127). Antigen was positive in 2 of 2 culture-proven pneumococcal cases and confirmed an additional 14 cases where all other sterile site cultures were negative

### Microbiology

- Of 145 community-acquired cases, 37 (26%) had no organism isolated from sterile sites
- Of the 123 organisms isolated from sterile sites<sup>1</sup> (via culture, antigen detection, or DNA analysis), *Staphylococcus aureus* was the most common organism isolated, followed by *Streptococcus pneumoniae*, then *Streptococcus pyogenes*
- Serology confirmed 3 further cases (2 *Mycoplasma pneumoniae*, 1 *Chlamydia pneumoniae*)

1. Excluding probable contaminants from blood culture

Organisms isolated from sterile sites presenting with empyema at Starship Children's Hospital between June 2009 and March 2014 (number of cases)



- Oral flora consisted of viridans streptococci (2), *Streptococcus anginosus* (2), *Streptococcus constellatus*, *Eikenella corrodens*, and mixed oral flora not otherwise specified
- Anaerobes consisted of *Fusobacterium necrophorum* (2) and mixed anaerobes not otherwise specified (3)
- Others consisted of *Mycobacterium* (2), *Mycoplasma pneumoniae* (2), *Chlamydia pneumoniae*, *Achromobacter*, and polymicrobial growth not otherwise specified

- Of the 56 *S. aureus* isolated, 45 (80%) were methicillin-sensitive while 11 (20%) were methicillin-resistant. Overall, MRSA was isolated in 7.6% of patients and comprised 8.7% of all organisms detected
- Cefuroxime covered 77% of pathogens. Using amoxicillin/clavulanic acid gave additional cover for anaerobes, increasing coverage to 81%

## DISCUSSION

- S. aureus* was the most common organism implicated in community-onset empyema managed at Starship – this is consistent with national data showing NZ rate of *S. aureus* sepsis to be amongst the highest in the world
- A 2003-2008 review of surgically-managed empyema at Starship (Wright et al) showed similar rates of *S. aureus* (24/46 positive cultures (52%) vs our data 56/126 (44%)). However, the total proportion of MRSA has doubled (2/46 (4.3%) vs our data 11/126 (8.7%)). This contrasts national data showing MRSA rates have remained stable at around 12% of all *S. aureus* infection
- Māori and Pacific ethnic groups were both over-represented (each 32% of cases). New Zealand 2013 census data showed Māori and Pacific ethnic distribution to be 15% and 7% respectively in New Zealand, and 11% and 14% respectively in the greater Auckland region

- Identification of causative organisms is important in determining the nature and duration of treatment. No organism was found in 26% of cases.
- Blood culture was valuable in diagnosis, in contrast to uncomplicated pneumonia where yield is poor
- Our results support the use of *S. pneumoniae* antigen testing on pleural fluid; others have previously shown this test to have >80% sensitivity and specificity for diagnosis of pneumococcal empyema
- Current antibiotic recommendations are appropriate for 77% of cases; this improves to 85% coverage if organisms of doubtful significance or those grown after multiple procedures are excluded
- Missed organisms were predominantly MRSA (9% of cases). MRSA empiric therapy may need to be added in children known to have disseminated infection or culture positive for *S. aureus*

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