British Thoracic Society
National Audit Report: Adult Community Acquired Pneumonia Audit 2018-2019
National Audit Period: 1 December 2018 – 31 January 2019
Professor Wei Shen Lim and Dr Hannah Lawrence

Number of participating institutions and records submitted:

Part 1: 10196 clinical records from 153 hospitals (121 trusts)
Part 2: 138 organisational records

Summary/Abstract

This report summarises the results of the 6th British Thoracic Society (BTS) national audit in community acquire pneumonia (CAP) in adults. The audit period was between 1 December 2018 and 31 January 2019. The audit had two parts: Part 1 collected data on adult CAP admissions that met inclusion criteria; Part 2 collected information on the case identification process, organisational factors and the audit processes within participating institutions.

Part 1 data were collected from 154 participating institutions; 10196 records were submitted. This represents the largest national audit of adult CAP conducted by the BTS. Part 2 data were collected from 138 institutions.

National Improvement Objectives:

1. Demonstrate continued improvement in the proportion of adults with CAP who receive the first dose of antibiotic therapy within 4 hours of admission. (Target in 3 years: 85%)
2. Demonstrate improvement in the proportion of adults with high severity CAP administered combination β-lactam and macrolide antibiotic therapy. (Target in 3 years: 85%)
3. Demonstrate an improvement in the proportion of coded cases of pneumonia, who have CXR confirmed pneumonia. (Target in 3 years: 85%)

Timeframe: to be achieved by the next re-audit

Key findings:

1. Mortality has decreased further; now at the lowest level (10.4%) for the last 10 years.
2. Delivery of BTS CAP care bundle elements is improving, especially time to first antibiotics.
3. Readmissions 30-days post-discharge have risen steadily over the last 3 audit cycles; now occurring in 14.3% of cases that survive to discharge.
4. Admissions via ED have continued to increase; now comprising 85% of cases.
5. Wide inter-hospital variation in the proportion of cases eligible for the BTS CAP Audit (ie. meeting the case definition of CAP) out of those with a primary discharge diagnosis code of pneumonia was observed. Of patients ineligible, most were excluded (55%) because of a lack of CXR features of pneumonia.

On-going work will be presented in a further report. This will include analyses of inter-hospital variation for selected process of care and outcome measures, using HES-linked data.

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Background

The 2018/19 British Thoracic Society (BTS) audit in adult community acquired pneumonia (CAP) was conducted from 1 December 2018 to 31 January 2019. Data capture was closed in May 2019. Previous audits had been conducted over the same periods in 2009/10, 2010/11, 2011/12, 2012/13 and 2014/15. (Table 1) The 2018/19 BTS National Adult CAP Audit was included in the list of national audits for inclusion in Trusts' Quality Accounts in England.

Table 1 –Participation in BTS CAP audit, by year of audit.

Year	Number of institutions	Total number of submitted records
2009/2010	64	2749
2010/2011	76	3570
2011/2012	129	5435
2012/2013	132	5652
2014/2015	158	6786
2018/2019	154	10196

Standards/Guidelines/Evidence base

The audit examines the patient profile, processes of care and outcomes relating to hospitalisation with an episode of CAP in the UK. The audit standards were derived from the 2009 BTS guidelines for the management of CAP in adults and the 2014 NICE Adult Pneumonia guidelines.(1, 2)

Aims and Objectives

The aim of the 2018/19 audit was to examine the quality of care and outcomes in a nationally representative cohort of patients admitted to hospital with a diagnosis of CAP and compare it to the national standards.

The key objectives were:

1) To examine baseline demographics of patients hospitalised with a primary diagnosis of CAP.
2) To examine processes of care and outcome measures associated with the management of CAP.
3) To identify key areas for improvement in the management of CAP.
4) To assess the magnitude of regional variation in mortality for patients hospitalised with CAP.

Methodology

Data were acquired for patients admitted to participating sites between 1 December 2018 and 31 January 2015. Data entry via the secure BTS audit system website was open between 1st December 2018 and 31st May 2019. There were two parts to the audit:

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Part One

Participating institutions were requested to include all eligible cases of CAP hospitalised during the audit period where possible. This would provide an accurate reflection of a participating institution's performance against audit standards.

Participating institutions were requested to retrospectively identify all adult cases admitted during the audit period with a primary discharge code mapping to a clinical diagnosis of pneumonia. Acute admission areas were defined as Emergency Departments, acute medical units, specialty admission and critical care areas.

The following codes were recommended to identify cases aged >16 years with a primary discharge diagnosis of pneumonia:

1. J12 Viral pneumonia
2. J13 Pneumonia due to S. Pneumoniae
3. J14 Pneumonia due to H. Influenzae
4. J15 Bacterial pneumonia not elsewhere classified
5. J16 Pneumonia due to other infectious organism
6. J17 Pneumonia in diseases classified elsewhere
7. J18 Pneumonia: organism unspecified

Inclusion and exclusion criteria were applied to identify cases eligible for the BTS CAP audit.

Inclusion Criteria were:

- New infiltrates on chest x-ray performed within 24 hours of admission, AND
- Acute onset of symptoms and signs of lower respiratory tract infection (LRTI)

Exclusion Criteria were (any of):

- Hospital admission within the 10 days prior to index admission
- Immunocompromised
- Treated for aspiration pneumonia only
- Transfer from another hospital

Case data were entered via the BTS online audit system on individual electronic case report forms. Identifiable information in the form of unique patient NHS numbers were collected to allow linkage of audit data with Hospital Episode Statistics (HES) data. Legal permission to collect patient identifiable information without individual consent was granted in advance under the Section 251 act (CAG reference number 18/CAG/0147).

For the purpose of this report, missing data were censored and are not included in the presented results.

Part Two

Institutions were requested to complete a single organisational audit that included questions on: i) case screening and exclusion process ii) organisational factors and iii) change arising from previous audit participation.

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Results

(A) PART 1 - Patient-level data

Patient Demographics

A total of 154 institutions contributed data from 10196 cases. The median age of admitted patients was 75 (IQR 61-85; Range 16-109); over half of the cohort were female (n=5338, 52.4%). The most common co-morbid illnesses were COPD (n=2588, 25.4%), chronic heart disease excluding hypertension (n=2709, 26.6%) and diabetes (n= 1786, 17.5%). Admission from a residential home occurred in 5% (n=513) and from a nursing home in 7.6% (n=781). At presentation to hospital, pneumonia severity (based on CURB65 criteria) was classified as low, moderate and high in 45.5% (n=4213), 29.7% (n=2804) and 24.9% (n=2291) of cases respectively in those with available data.

Processes of Care

Key findings were:

- CXR performed within four hours of admission: 85.2%, n=7746
- Supplementary oxygen administered: 53.6%, n=5462 (note hypoxia on admission (oxygen saturations <94% or <88% in COPD patients) recorded in 45.5%, n=4328)
- First dose of antibiotic therapy within 4 hours of admission: 74.4%, n=6264
- Antibiotics in line with local guidelines: 58.4%, n=5958
- Antibiotics administered before CXR: 37.3% (n=3416) of which 78.7% had a CXR within four hours of admission.

One fifth of patients had received antibiotic therapy prior to arrival in hospital. A large majority of patients were admitted via the emergency department (85% of whole cohort (n=8575); 81.1%, 85.6% and 89.4% of patients by low, moderate and severe CURB65 categories respectively). For individuals with moderate and high severity disease, dual therapy with β-lactam and macrolide antibiotics were administered in 44.8% (n=1252) and 47.4% (n=1085) respectively.

Critical care admission occurred in 5.2% (n=518) of cases. Of the whole cohort; 3.5% (n=352) patients received NIV, 0.8% (n=83) received invasive ventilation and 1.3% (n=132) received inotropic support. High flow nasal oxygen was used in 8.4% (n=852) of the whole cohort; 28.3% (n=241) of these patients were admitted to critical care.

Microbiology

Respiratory viral testing, sputum cultures and blood cultures were performed in 29.1% (n=2977), 23.6% (n=2406) and 58.6% (n=5973) of all cases respectively. In cases with moderate and high severity CAP, urinary antigen testing was performed for pneumococcal antigen in 17.5% (n=882) of which 18.5% were positive and legionella antigen in 18.7% (n=950) of which 1% were positive.

Outcomes

Overall 10.4% (n=1059) of inpatients died during their admission (2.8% n=118, 10.9% n=304 and 22% n=504 by CURB65 severity low, moderate and high); 13.6% (n=1389) of patients died within 30 days of admission. The median length of stay of surviving cases was 5 days. Outcomes and process of care measures presented by severity category are shown in Table 2.

14.3% (n=1305) of individuals were re-admitted within 30 days of discharge from their index admission with CAP (11.0% n=441, 16.2% n=398 and 19.0% n=333 by CURB65 category low,

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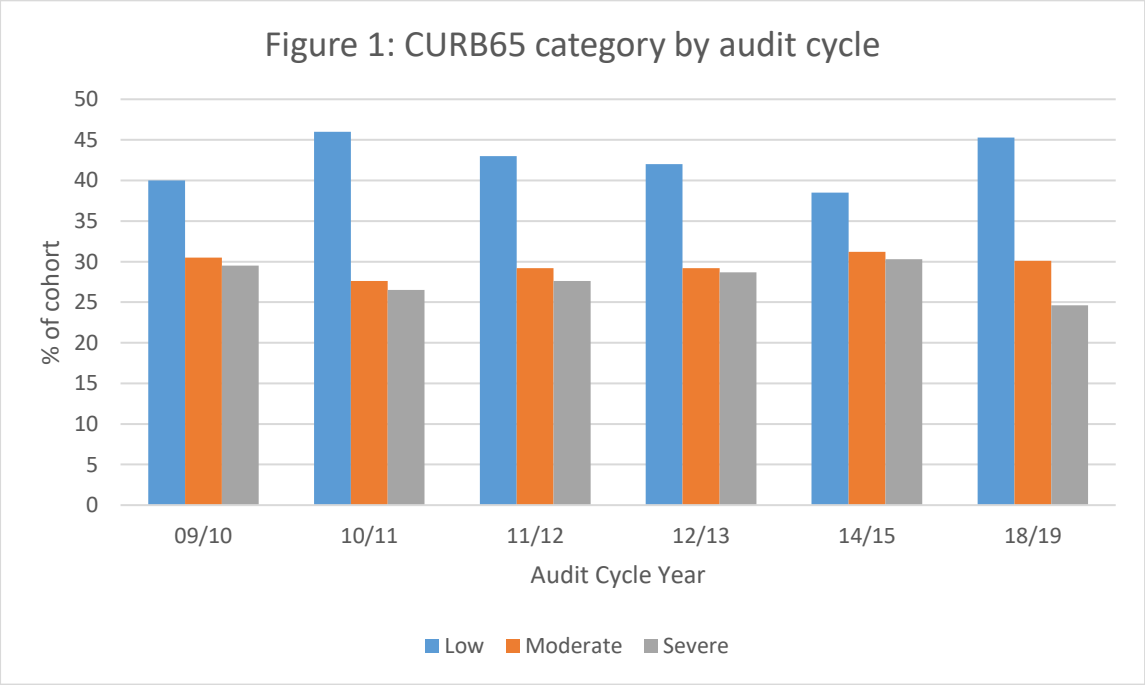
moderate and high). Follow up was arranged in 66.8% (n=6106) and a post discharge CXR in 47.6% (n=4347) of surviving cases.

Table 2 – Outcomes and key process of care measures by CURB65 category			
	Low % (n)	Moderate % (n)	Severe % (n)
Cases in category	45.3 (4213)	30.1 (2804)	24.6 (2291)
Median Age (IQR)	61 (49-74)	80 (72-87)	83 (76-89)
Admitted via ED	81.1 (3382)	85.7 (2387)	89.4 (2036)
Inpatient death	2.8 (118)	10.9 (304)	22.0 (504)
Readmission	11.0 (441)	16.2 (398)	19.0 (333)
Critical care admission	4.0 (168)	4.9 (136)	6.8 (153)
LOS (Median & IQR)	4 (2-6)	5 (3-9)	6 (4-11)
CXR within 4 hours	84.5 (3175)	85.1 (2118)	87.0 (1828)
Antibiotics within 4 hours	72.7 (2507)	73.7 (1713)	80.1 (1586)
Guideline concordant antibiotics	53.6 (2223)	58.8 (1622)	70.4 (1596)

(B) Comparison with previous audit cycles

Severity of Disease

Compared to the previous 2 audit cycles, in 2018/19 the proportion of patients with high severity CAP was lower (24.6%), with a corresponding increase in low severity CAP (45.3%). (Figure 1). A steady increase in the proportion of cases admitted via ED is evident: 68.7% in 2009/10 rising to 84.9% in 2018/19. This trend is sustained across groups when subdivided by CURB65 category (Figure 2). The proportion of cases admitted during 'out of hours' (first presenting between 18:30 Friday to 07:59 Monday or on a bank holiday) has varied between 38% and 45% over the audit cycles but shows no specific trend.



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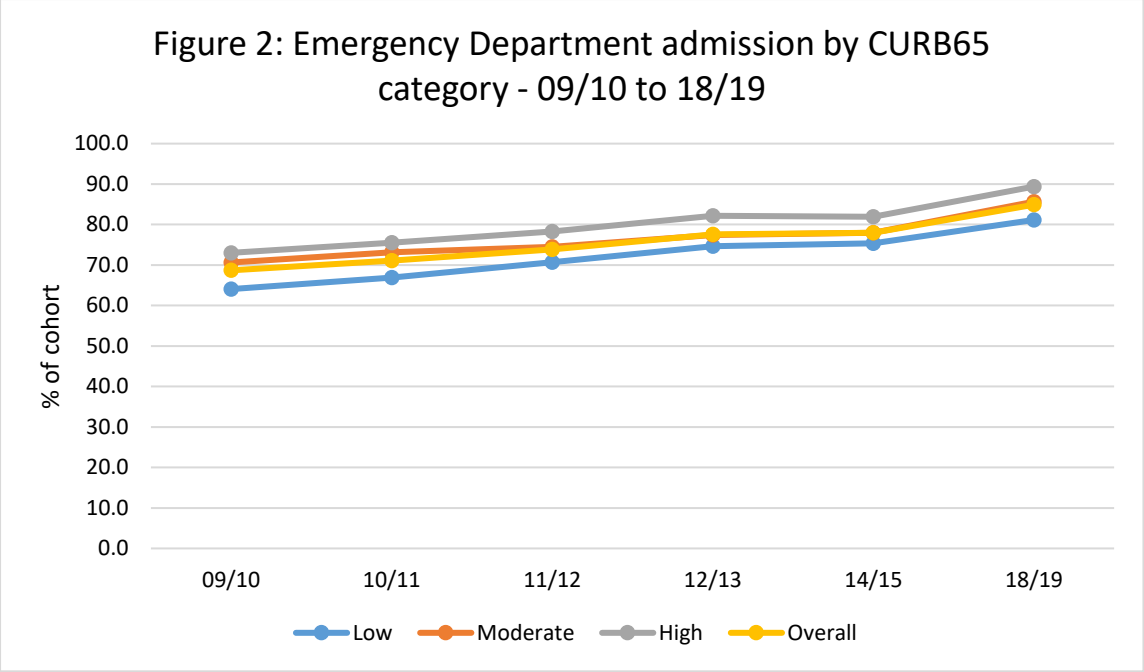

Processes of care

The general trend across BTS CAP Care Bundle related processes of care has been of sustained performance or improvement (Figure 3). Key findings are:

- CXR within four hours: 87% to 85% (2009/10 to 2018/19)
- Time to first hospital antibiotics: 60% to 74% (2009/10 to 2018/19)
- Guideline concordant antibiotics: 54% to 58% (2009/10 to 2018/19).

Related to these trends, there has been an increase in the proportion of cases where antibiotics were given prior to CXR; from 17% to 34% (2009/10 to 2018/19). Senior review with 12 hours of admission has also improved; from 45% to 66% (2009/10 to 2018/19). There has been a steady increase in the proportion of patients with moderate or severe disease in whom pneumococcal and legionella urinary antigen testing were performed; from 6.8% to 17.8% and 7.9% to 19.3% respectively (2009/10 to 2018/19). The proportion of those with positive pneumococcal disease has varied between 14.2% and 23.4% with no trend.

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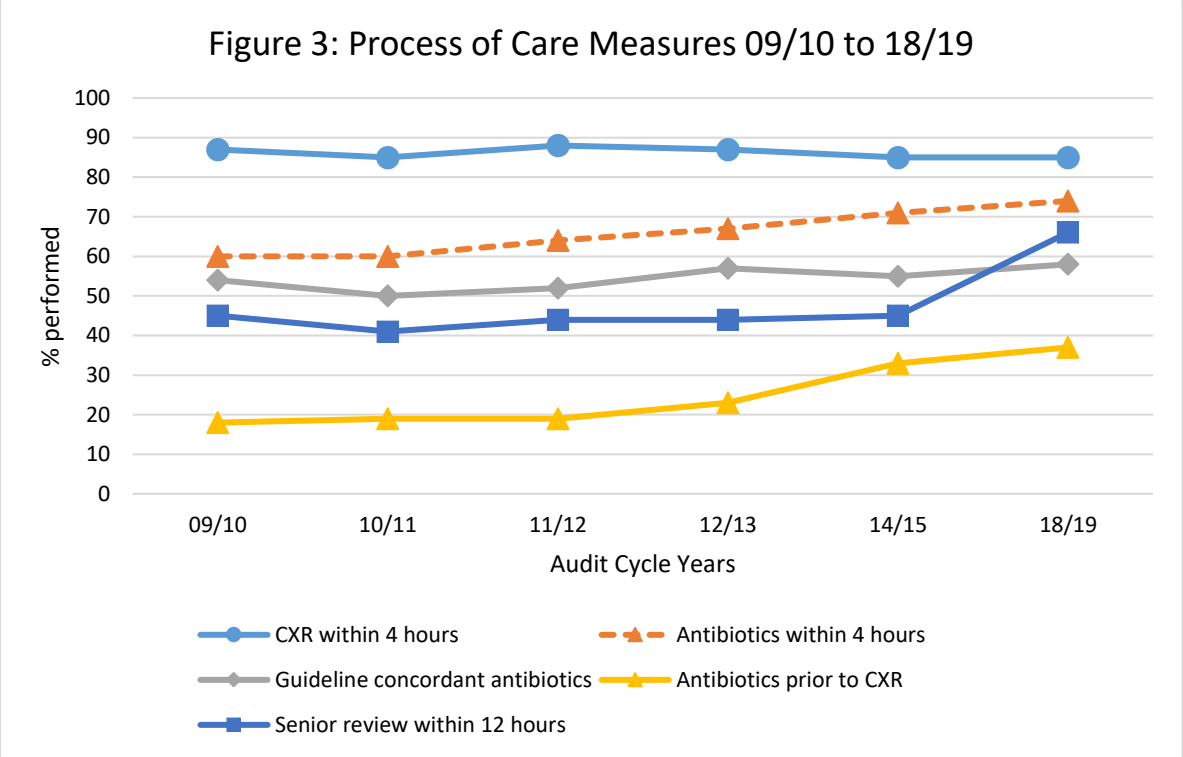

Outcomes

Between 2009 and 2014 audits, a steady decline in inpatient mortality from 20.2% to 17.7% was observed. Mortality in this audit (2018/19) has decreased further to 10.4%. This trend is sustained when the cohort is divided by severity (Figure 4). The largest percentage reduction between 14/15 and 18/19 audits is in the high severity category; 3.7%, 5.4% and 12.5% reduction in low, moderate and high respectively.

Thirty-day readmission figures have increased; from 10.5% in 2009/10 to 14.6% in 2018/19 (Figure 5). Compared to 14/15 figures, this increase is most pronounced in high severity disease; 1.2%, 0.5% and 4.4% increase in low, moderate and high categories respectively .

Since the 2014 audit, the LOS in those surviving to discharge has decreased from a median of 5.5 days (IQR 3-10) to 5 days in 2018 (IQR 2-8). The proportion of cases from the surviving cohort with a LOS of one day or less (a proxy for early discharge) has increased from 11.5% in 2014/15 to 14.0% in 2018/19.

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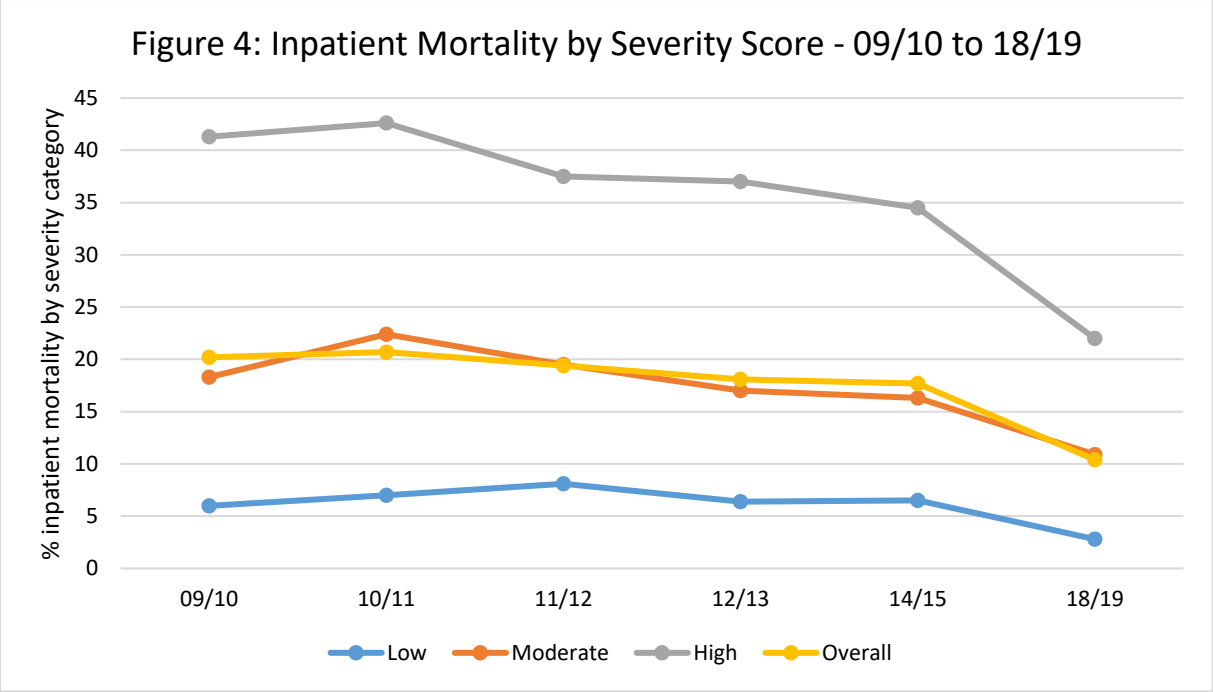

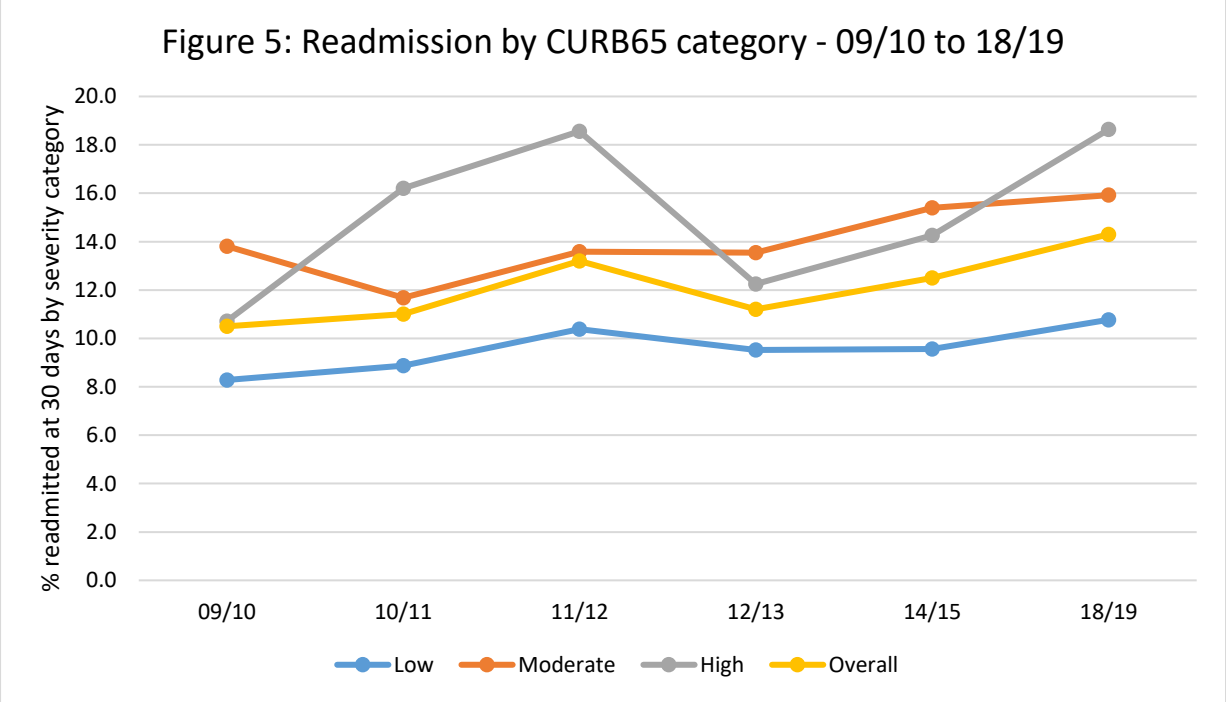

Critical Care Admission

The proportion of patients admitted to critical care remains stable at 5.2%. Of cases admitted to a critical care area in 18/19, 15.6% (n=81) received invasive ventilation whilst 38.6% (n=200) received non-invasive ventilation or CPAP. This has decreased since 2014/15 where 28.6% and 49.0% respectively received invasive and non-invasive ventilation. The use of inotropes has decreased from 31.5% to 20.7% over the same time period. (Figure 6).

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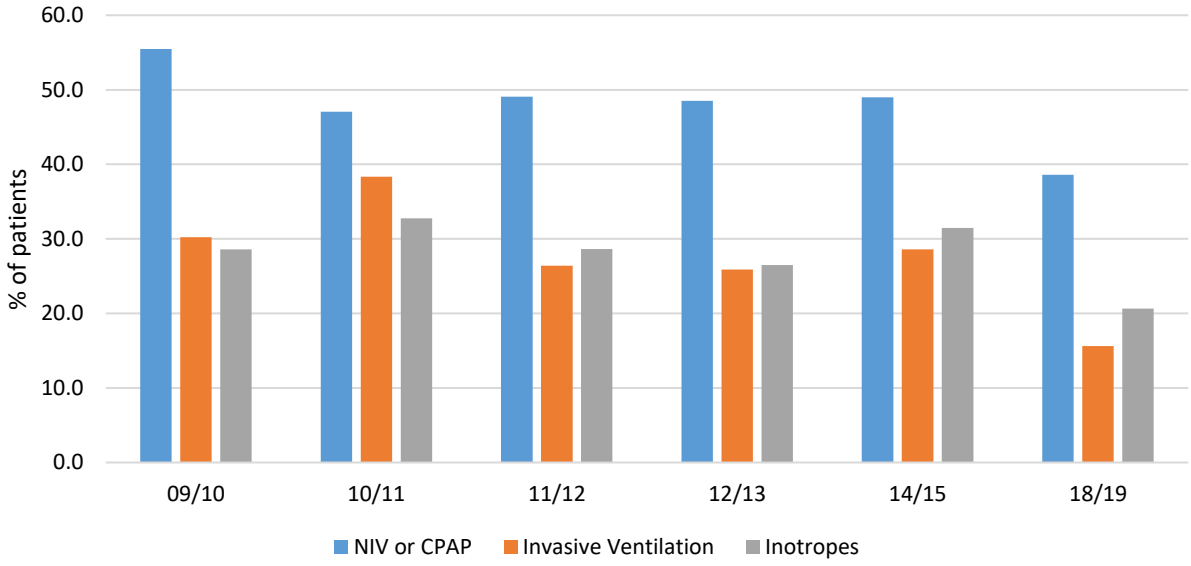
Usage of NIV or CPAP in those not admitted to a critical care area remains unchanged between the 14/15 and 18/19 audits at 2.8% and 2.6% respectively.

Figure 6: Ventilation and Inotrope usage in those admitted to Critical Care - 09/10 to 18/19



(C) PART 2 - Institutional-level data

Accuracy of coding (measured against primary discharge code)

138 individual hospitals entered data for part 2 of the audit; 124 hospitals reported the total cases identified by discharge coding, the total cases screened and of those, the total cases eligible for inclusion into Part 1 of the audit.

The median number of cases identified by J12-18 codes was 276.5 (IQR 190-386) per institution. Of cases coded J12-18 at each hospital, the average proportion screened for inclusion into the BTS CAP Audit was 60.9% (IQR 33.3%-100%). Of screened cases, the median proportion of cases deemed eligible for inclusion in the Audit (ie. with a confirmed clinical and radiological diagnosis of CAP) was 54.1% (IQR 44.8-64%) (excluding outliers of <5% and >95% to allow for data errors). (Figures 7 and 8).

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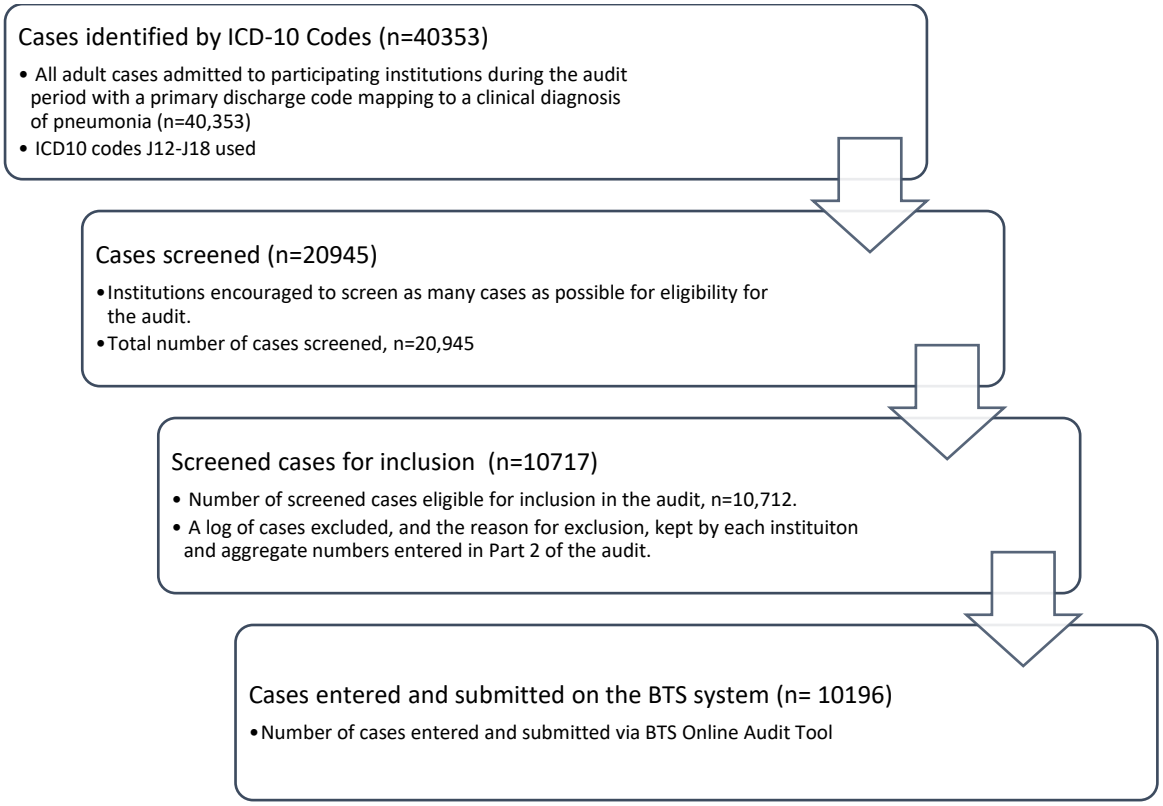

Figure 7: Flow chart of cases eligible for inclusion in the Audit

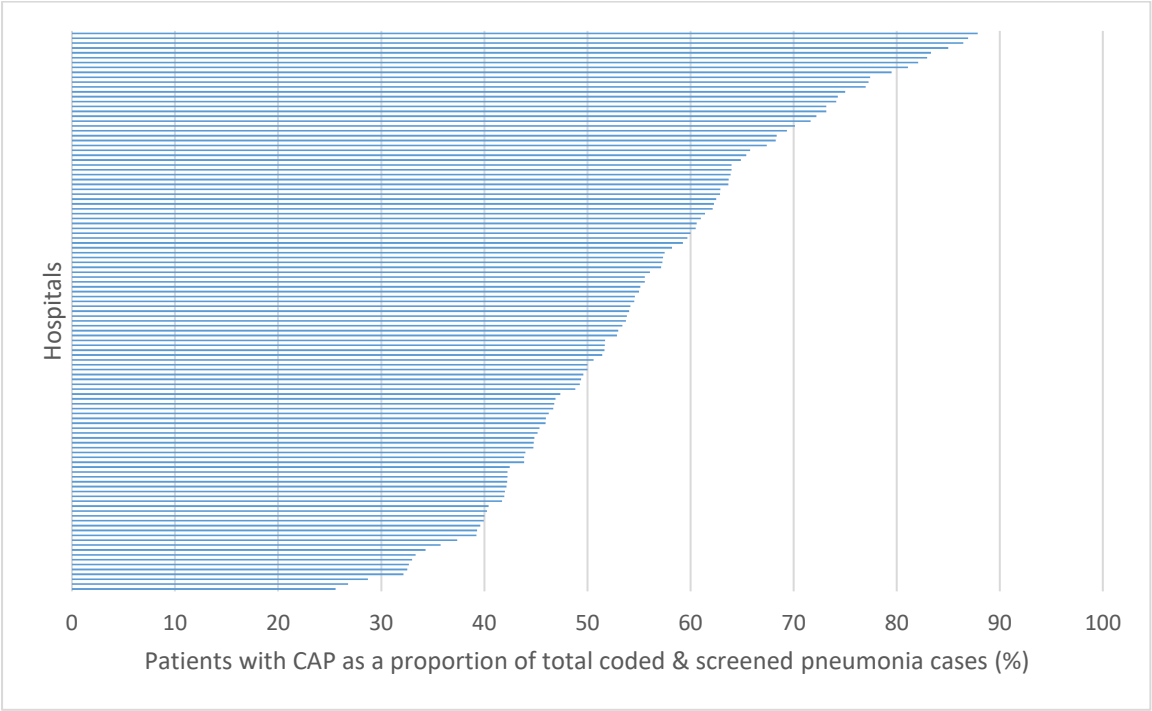

Figure 8: Percentage of patients with confirmed CAP of all screened cases of 'pneumonia' according to primary discharge code, by institution.

Reasons for ineligibility/exclusion

The commonest reason for ineligibility was an absence of new radiographic change on CXR (Table 3).

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Table 3: Reasons for failing to meet the inclusion criteria for Part 1		
Reason	% by hospital (median)	IQR
No new infiltrates on CXR	55.5	37.8-73.0
No symptoms of LRTI	2.5	0-9.7
Recent discharge within 10 days	12.5	5.6-20.5
Transfer from another institution	1.3	0-3.4
Immunocompromised	3.3	0-9.1
Aspiration	4	2.1-7.5
Other	5.3	0-20

The accuracy of a diagnosis of CAP at national level was estimated as the proportion of cases eligible for the audit; denominator = immunocompetent cases with a primary discharge diagnosis of pneumonia and who were not hospitalised in the 10 days prior to the index admission. This was calculated for the whole 2018/19 cohort as: no. eligible for the audit (n=10717) / (number eligible for audit (n=10717) + number excluded due to lack of CXR evidence of pneumonia (n=5666) + number excluded due to lack of symptoms of LRTI (n=545))*100 = 63.3%. Calculated per institution, the median accuracy across all participating institutions was 65.6% (IQR 52.8%-79.3%).

Institutional Practice and previous Audit Participation

Based on self-reports of the 138 institutions that completed Part 2:

- 91.3% have CAP specific treatment guidelines (n=126)
- 30.4% use a pneumonia care bundle (n=42)
- 13.7% have a dedicated respiratory admission take (n=19)
- 58% have a respiratory in reach service to the acute medical unit (n=80)

Ninety-nine participating institutions had previously participated in the BTS National CAP audit of which 63.6% report making changes to hospital practice following the last audit.

Regarding the provision of written information on discharge, 5.8% of institutions reported routinely giving this to patients, 34.1% ‘never’ and 60.1% ‘not routinely’.

Conclusions/Observations

The main findings of the audit are:

1. Mortality has decreased further; now at the lowest level (10.4%) for the last 10 years.
2. Delivery of BTS CAP care bundle elements is improving, especially time to first antibiotics.
3. Readmissions 30-days post-discharge have risen steadily over the last 3 audit cycles; now occurring in 14.3% of cases that survive to discharge.
4. Admissions via ED have continued to increase; now comprising 85% of cases.
5. Wide inter-hospital variation in the proportion of cases eligible for the BTS CAP Audit (ie. meeting the case definition of CAP) out of those with a primary discharge diagnosis code of pneumonia was observed. Of patients ineligible, most were excluded (55%) because of a lack of CXR features of pneumonia.

On-going work to be presented in a further report include:

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1. Analyses using HES-linked data
2. Geographical variation for selected process of care and outcome measures.

The relatively large decrease in mortality observed in the 2018/19 audit cycle is welcomed. Several factors are likely to have contributed to this decrease:

a) Continued improvements in the delivery of care for CAP, as evidenced by improvements in process of care measures such as time to first antibiotics. The last audit in 2014/15 coincided with the release of the NICE Pneumonia Guideline (Dec 2014). Implementation of the NICE Pneumonia Guideline recommendations, coupled with the invigorated emphasis in recent years on Sepsis management may have conjoined to drive these improvements. It is also encouraging that a third of hospitals report having or using a CAP care bundle.
b) Change in the case-mix of patients being admitted to hospital with CAP. In 2018/19, for the first time since 2009, the proportion of cases presenting to hospital with high severity CAP decreased. It is unclear whether this is due primarily to an increase in the proportion of cases admitted with low severity CAP, or whether cases of high severity CAP have switched to being given Primary Diagnosis codes relating to 'Sepsis' rather than 'Pneumonia' and hence elude being captured by the audit. In support of the former is the increase in the proportion of cases being admitted via ED (2018/19 saw the greatest proportionate increase compared to earlier years) suggesting a diversion of patients from primary care to ED attendance; such diversion may have a greater impact on patients with low severity CAP. In support of the latter is the increase in the number of cases coded as having 'sepsis' nationally.(3) Overall, it is likely that both these factors play a part. Further work is required to investigate the contributions of each. Future audits should consider capturing cases in which 'Sepsis' is the primary discharge diagnosis and 'pneumonia' is the secondary diagnosis.

The increase in readmissions at 30-days post-discharge raises concerns. The planned linkage of the 2018/19 dataset to corresponding HES records, which includes details of readmission spells, will provide further information on the reasons for readmission. In the meantime, it is disappointing to note that of only 5.8% of institutions reported routinely giving written patient information regarding pneumonia recovery to patients upon discharge, despite NICE Pneumonia recommendations in this regard.

The continued increase in the proportion of cases admitted via ED runs against the objectives of the NHS England Long Term Plan (LTP) This increase is not due to any corresponding increase in the number of 'out-of-hours' admissions. This may reflect increasing pressures on primary care in the management of patients with pneumonia.

In many cases with a primary diagnosis code of pneumonia, a lack of CXR features consistent with pneumonia was identified. It is recognised that when compared against CT chest findings, the CXR may be both 'falsely negative' and 'falsely positive' in a proportion of cases.(4) In a French study of adults admitted via the ED with suspected CAP but excluding those with high severity illness (CRB65 score ≥3), of 319 adults studied, 188 (59%) had CXR features of pneumonia. Of those with a "negative" CXR, 30% had an infiltrate on CT. In a Swiss study of patients aged >65 years admitted with suspected CAP (n=200), 113 (57%) had high a high probability of CAP based on initial CXR and clinical findings. Of those with initial intermediate and low probabilities of CAP (n=87), 30% were considered to have a high probability of CAP following review of CT chest findings. (4, 5). The BTS CAP Audit finding of ~63% with CXR-confirmed pneumonia (of those with a primary discharge diagnosis of pneumonia) compares favourably with the proportions reported in the studies cited

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above (59% and 57%). However, the *variation* in the proportion of cases eligible for the BTS Audit (of those with a primary discharge diagnosis of pneumonia) is striking (25% to 85%, Figure 8); overall, the commonest reason for ineligibility was a lack of CXR features of pneumonia (55%). This wide variation suggests that in some institutions, improvements in the amount of misclassification or misdiagnosis of pneumonia may be attained. Overtreatment of cases of non-pneumonic lower respiratory tract infection (LRTI) as pneumonia may promote inappropriate antibiotic use.

Concordance of antibiotic use with local guidelines remains around 60%. This analysis is based on the initial antibiotic given, which in about a third of cases is prior to a CXR being obtained. It is likely that the initial antibiotic is administered within ED where the vast majority of cases (85%) are first seen. Whether antibiotic prescriptions are subsequently revised to be concordant with guidelines is not known. Future audits will need to consider capturing more detailed data on antibiotic use.

National Improvement Objectives

1. Demonstrate *continued* improvement in the proportion of adults with CAP who receive the first dose of antibiotic therapy within 4 hours of admission. (Target in 3 years: 85%)
2. Demonstrate improvement in the proportion of adults with *high severity CAP* administered combination β-lactam and macrolide antibiotic therapy. (Target in 3 years: 85%)
3. Demonstrate an improvement in the proportion of coded cases of pneumonia who have CXR confirmed pneumonia. (Target in 3 years: 85%).

Timeframe: to be achieved by the next re-audit

NOTES:

Items (1) and (2) are part of the BTS CAP Care Bundle.

Item (3) relates to the accuracy of diagnosis of CAP. Reducing the number of cases of non-pneumonic LRTI/acute bronchitis treated as pneumonia will contribute towards the wider objectives of antimicrobial stewardship.

References

1. Lim WS, Baudouin SV, George RC, Hill AT, Jamieson C, Le Jeune I, et al. BTS guidelines for the management of community acquired pneumonia in adults: update 2009. Thorax. 2009;64 Suppl 3:iii1-55.
2. NICE. Pneumonia in adults: diagnosis and management 2014 [Available from: https://www.nice.org.uk/guidance/cg191.
3. Trust TUS. The Sepsis Manual 2017-18 September 2019. Available from: https://sepsistrust.org/wp-content/uploads/2018/06/Sepsis_Manual_2017_web_download.pdf.
4. Claessens YE, Debray MP, Tubach F, Brun AL, Rammaert B, Hausfater P, et al. Early Chest Computed Tomography Scan to Assist Diagnosis and Guide Treatment Decision for Suspected Community-acquired Pneumonia. American journal of respiratory and critical care medicine. 2015;192(8):974-82.
5. Prendki V, Scheffler M, Huttner B, Garin N, Herrmann F, Janssens J-P, et al. Low-dose computed tomography for the diagnosis of pneumonia in elderly patients: a prospective, interventional cohort study. The European respiratory journal. 2018;51(5):1702375.