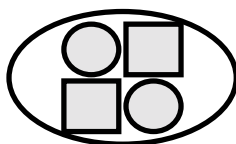


ANTIBIOTIC TREATMENT OF LOWER RESPIRATORY TRACT INFECTION IN EMERGENCY DEPARTMENTS

**Report to
the National Prescribing Service and
the Victorian Drug Usage Advisory Committee**

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Prepared by the Victorian Drug Usage Evaluation Group



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Executive summary

Background

Antibiotic use in the Australian community is high compared with other OECD countries but appears to have peaked and may be now decreasing in correlation with major educational campaigns. Studies in Australian hospitals have identified low concordance with national prescribing guidelines for antibiotic use in emergency departments. While little is known regarding how antibiotic use in the emergency department impacts on antibiotic prescribing by general practitioners, it is believed that general practitioners' prescribing of antibiotics is influenced by what is prescribed in emergency departments.

Aims

- To determine patterns of antibiotic use for the treatment of lower respiratory tract infection in emergency departments in a number of large hospitals in Victoria and New South Wales and Queensland.
- To describe the previous antibiotic use, severity and characteristics of presentation, and comorbidities for patients treated for respiratory tract infections and correlate with antibiotic use.
- To compare antibiotic use with recommendations in national prescribing guidelines.
- To determine the destination for patients on leaving the emergency department eg ward, home etc.
- To describe antibiotic policies and access to guidelines in the emergency departments.

Methods

We carried out a retrospective audit during April – July 2001 of patients treated with antibiotics for lower respiratory tract infection in the emergency departments of 12 hospitals in Victoria, New South Wales and Queensland. Patients were divided into indication groups according to the results of chest X-rays and the severity of the illness as assessed according to the criteria in Therapeutic Guidelines: Antibiotic version 11 (AG11). The antibiotic or antibiotic combination prescribed as initial treatment was assessed for concordance with the recommendations in AG11 for these indications.

As a secondary analysis, the chest X-ray (CXR) reports written by emergency department doctors in the emergency notes were compared with the corresponding radiology reports.

Results

The 12 participating hospitals enrolled a total of 603 patients. The patients had a median age of 73 years and 250 (41%) were female. Almost all patients were admitted from home or a nursing home.

One third of patients (202) had been treated with 247 courses of 34 different antibiotics in the seven days prior to presentation at the emergency department.

More than 40% of the patients were classified as having severe CAP. The other major indication groups were exacerbations of chronic bronchitis (22%), mild – moderate CAP (15%) and other LRTI (15%).

The most frequently prescribed antibiotics were ceftriaxone/cefotaxime (prescribed for 44% of all patients) and roxithromycin (prescribed for 36% of all patients). These antibiotics were also the most frequently prescribed for those patients admitted as inpatients.

The overall rate of concordance with AG11 was very low (7%); there was no specific recommendation in AG11 for 29% of courses; the overall rate of nonconcordance with AG11 was 63%.

The main reasons for nonconcordance with AG11 for severe CAP were the prescription of ceftriaxone/cefotaxime with and without other antibiotics for patients who didn't have a contraindication to penicillin, the omission of intravenous erythromycin and/or its replacement with roxithromycin and the prescription of oral antibiotics where intravenous antibiotics were indicated on severity criteria.

The main reason for nonconcordance with AG11 for mild – moderate CAP was the prescription of ceftriaxone/cefotaxime with and without other antibiotics.

The main reason for nonconcordance with AG11 for exacerbations of chronic bronchitis and other non-pneumonia lower respiratory tract infection was that antibiotics were not indicated; ceftriaxone/cefotaxime were prescribed for 42% and 26% of these patients respectively.

There were large variations between hospitals in the antibiotics prescribed to treat each of the indications.

Emergency department doctors over-diagnosed pneumonia on chest X-ray by 18% compared with radiologists.

It was noted that some hospitals were still using the 10th version of the Therapeutic Guidelines: Antibiotic as the basis of their antibiotic policy 5 months after the publication of the 11th version.

Recommendations

1. This report should be disseminated to all participating hospitals and to other hospitals and organisations on request.
2. This report should be forwarded to Therapeutic Guidelines Limited.
3. Hospitals should be encouraged to develop and implement policies to promote optimal antibiotic prescribing for lower respiratory tract infection in the emergency department. This should include restricting the use of ceftriaxone and cefotaxime consistent with the recommendations in the current edition of the Therapeutic Guidelines: Antibiotic.
4. Hospitals should be encouraged to adopt methods for changing antibiotic prescribing that have been proven effective. These include multi-faceted educational programs, distribution of local hospital guidelines on a card that can be attached to a hospital identification card, an antimicrobial approval system that requires prescribers to write approval numbers on prescriptions for restricted antibiotics or computer-assisted decision support for antibiotic prescribing.
5. The hospitals that have developed and tested these systems or programs to improve antibiotic prescribing should be supported to develop and promote their systems to other hospitals.
6. Funding should be provided to undertake interventions to improve antibiotic prescribing and audit the effectiveness of the interventions.

Background

Antibiotic use in the Australian community is high compared with other OECD countries but appears to have peaked and may be now decreasing in correlation with major educational campaigns.¹ Much less is known about overall hospital antibiotic use but individual studies have identified a range of antibiotic use issues, some of relevance to emergency departments.

One drug usage evaluation (DUE) found low concordance with national prescribing guidelines for antibiotic use in the emergency departments of three large hospitals in New South Wales.² A survey of emergency department doctors regarding preferred treatment for severe community acquired pneumonia found low concordance with national prescribing guidelines.³

Our 1999 multisite DUE study showed that over one-third of courses of cefotaxime or ceftriaxone in 51 Victorian hospitals were commenced in the emergency departments.⁴ The most frequent indication for use of these antibiotics was respiratory tract infection, of which 75% were not concordant with national antibiotic prescribing guidelines.

Hospital emergency departments are a critical interface between community and hospital care. Lower respiratory tract infections are a frequent cause of presentation to emergency departments. From this point in the continuum of care, patients may be sent home or to their general practitioner, have an outpatient visit arranged, be admitted to Hospital in the Home or a ward in the hospital. In the emergency department, often antibiotics are commenced but the ongoing course may be managed by ward-based clinicians, the general practitioner or the patient alone. The choice of treatment will be dependent on the severity and course of the presentation, other comorbidities and previously administered antibiotics. For the hospital, it can be difficult to determine what antibiotic therapy was taken prior to presentation. For the general practitioner it can be difficult to determine what antibiotic therapy was administered during the hospital stay.

While little is known regarding how antibiotic use in the emergency department impacts on antibiotic prescribing by general practitioners, it is believed that general practitioners' prescribing of antibiotics is influenced by what is prescribed in emergency departments. Therefore it is especially important that emergency department prescribing is better studied and improved.

Aims

The aims of this study were:

- To determine patterns of antibiotic use for the treatment of lower respiratory tract infection in emergency departments in a number of large hospitals in Victoria, New South Wales and Queensland.
- To describe the previous antibiotic use, severity and characteristics of presentation, and comorbidities for patients treated for respiratory tract infections and correlate with antibiotic use.
- To compare antibiotic use with recommendations in national prescribing guidelines.
- To determine the destination for patients on leaving the emergency department eg ward, home etc.
- To describe antibiotic policies and access to guidelines in the emergency departments.

Methods

Hospitals with large emergency departments in Victoria, New South Wales and Queensland were invited to participate. Twelve participating sites were each set a target of enrolling 60 consecutive adult patients who were treated with antibiotics in the emergency department for lower respiratory tract infection starting from 30 April 2001. Enrolment of patients ceased on 31 July 2001.

Patients who presented at emergency departments were identified as having lower respiratory tract infection if they had one of the following diagnoses:

- bronchitis, acute
- bronchopneumonia, aspiration
- chronic obstructive pulmonary disease
- lower respiratory infection, chest

- pneumonia, lobar.

Data were collected retrospectively and included patient demographics and parameters used to determine severity of disease, antibiotics prescribed prior to ED presentation, and antibiotics ordered in the ED or prescribed upon discharge from hospital. (See Appendix 1 for the data collection form.)

Patients were divided into the following indication groups according to the results of chest X-rays (CXRs) and the severity of the illness.

- Severe community-acquired pneumonia (severe CAP)
- Mild – moderate community-acquired pneumonia (mild – moderate CAP)
- Community-acquired aspiration pneumonia (aspiration CAP)
- Hospital-acquired pneumonia (HAP)
- Exacerbations of chronic bronchitis
- Other lower respiratory tract infection (other LRTI)

The antibiotic or antibiotic combination prescribed as initial treatment was assessed for concordance with the recommendations in Therapeutic Guidelines: Antibiotic 11th edition (AG11)⁵ for these indications. Antibiotic regimens prescribed as initial treatment for severe CAP were also assessed for concordance with the recommendations in Therapeutic Guidelines: Antibiotic 10th edition.⁶ A proportion of concordance assessments were checked by a second investigator to ensure that the original assessor had not made systematic errors in either assigning patients to diagnostic groups or in assessing concordance with Therapeutic Guidelines: Antibiotic.

Antibiotic courses were assessed as “Concordant for drug” if the antibiotics prescribed were the same as those recommended in Therapeutic Guidelines: Antibiotic; they were assessed as “Fully concordant” if the doses and routes of administration were the same as those recommended in the Guidelines. If the antibiotics prescribed differed to those recommended in the Guidelines the course was assessed as “Nonconcordant”. If there were no recommendations for the indication in the Guidelines, eg severe CAP in patients who were at increased risk of aminoglycoside toxicity (aged > 70 years and/or renal disease documented as a comorbidity and/or a serum creatinine of > 0.12 mmol/L), severe CAP in patients who had a history of immediate hypersensitivity to penicillins, severe CAP in patients who had a history of adverse reaction to a macrolide antibiotic, or non-pneumonia infection in an immunosuppressed patient, the course was classified as “No specific recommendation in AG11”. Courses were classified as “Specific” if the infecting organism was known and was sensitive to the prescribed antibiotic. The algorithms used in assessment of concordance are shown in Appendix 3.

As a secondary analysis, the chest X-ray (CXR) reports written by emergency department doctors in the emergency notes were compared with the corresponding radiology reports. Patients were said to have pneumonia if either the ED doctor or the radiologist made a comment of pneumonia, pulmonary infiltrates, opacity or consolidation in the CXR reports. Patients were said to have chronic obstructive pulmonary disease (COPD) if either the ED doctor or the radiologist made a comment of COPD or chronic obstructive airways disease in the CXR reports. Similarly patients were said to have pleural effusion if either the ED doctor or the radiologist made a comment of pleural effusion in the CXR report.

Results

The 12 participating hospitals enrolled a total of 603 patients. Three regional hospitals enrolled fewer patients than the target.

The patients had a median age of 73 years and 250 (41%) were female. None of the patients was pregnant or breast-feeding.

Almost all patients were admitted from home or a nursing home (Table 1).

Table 1: Pre-admission location

Admitted from	Number of patients (% of 603)
Home	488 (81%)
Nursing home	82 (14%)
Other hospital	9 (1%)
Other	24 (4%)
Total	603 (100%)

The following signs, symptoms or tests were documented and/or carried out in emergency departments as part of the assessment of patients (Table 2). Microbiological testing of blood and sputum was also carried out but this information was not routinely recorded as for most patients antibiotic treatment was started before the results of tests became available.

Table 2: Assessment of patient

Parameter	Number of patients (% of 603)
Temperature	597 (99%)
Cough or dyspnoea or sputum production or purulence	577 (96%)
Pulse rate	575 (95%)
Respiratory rate	575 (95%)
Pulse oximetry	567 (94%)
Chest X-ray	565 (94%)
White blood cell count	535 (89%)
Serum sodium	535 (89%)
Serum creatinine	530 (88%)
Blood pressure	503 (83%)
Arterial blood gases	267 (44%)

One third of patients (202) had been treated with 247 courses of 34 different antibiotics in the seven days prior to presentation at the emergency department (Table 3). Complete information (antibiotic name, date started, date stopped, dose and route of administration) was recorded for 46 of the 202 patients (23%).

Table 3: Prior antibiotic use

Antibiotic	Number of patients* (% of 603)
Roxithromycin	51 (8%)
Amoxicillin/clavulanate	40 (7%)
Amoxicillin	29 (5%)
Cephalexin	16 (3%)
Cefaclor	14 (2%)
Doxycycline	13 (2%)
Unspecified	11 (2%)
Clarithromycin	11 (2%)
Erythromycin	10 (2%)
Chloramphenicol (eye 4; unspecified 1)	5 (1%)
Ciprofloxacin	5 (1%)
Penicillin	5 (1%)
Cotrimoxazole	4 (1%)
Ceftriaxone	4 (1%)
Other	29 courses
Total number of courses	247

* many patients were prescribed more than one antibiotic

More than 40% of the patients were classified as having severe CAP. The other major diagnostic groups were exacerbations of chronic bronchitis, mild – moderate CAP and other LRTI (Table 4).

Table 4: Diagnoses

	Number of patients treated (% of 603)
Radiological evidence of pneumonia	378 (63%)
Severe CAP	263 (44%)
Mild - moderate CAP	90(15%)
Aspiration CAP	19 (3%)
HAP	6 (1%)
No radiological evidence of pneumonia	225 (37%)
Exacerbations of chronic bronchitis	133 (22%)
Other LRTI	92 (15%)
Total patients	603 (100%)

For 324 patients (54%) it was documented that the emergency department doctor discussed the case with a medical registrar or consultant.

Five hundred and thirty three patients (88%) had antibiotics administered in the emergency department and the remainder [70 patients (12%)] were prescribed antibiotics to be taken following discharge outside the hospital. Roxithromycin and ceftriaxone were the most frequently prescribed antibiotics (Table 5). Ceftriaxone and cefotaxime were prescribed for 92/202 (46%) of patients who had been treated with antibiotics in the week prior to presentation in ED and for 175/401 (44%) who had not.

The median time from admission to the emergency department to administration of the first dose of antibiotic was 3.1 hours (based on 487 patients with complete information).

Table 5: Antibiotics prescribed by emergency department doctors

Drugs	Number of patients* (% of 603)
Roxithromycin oral	217 (36%)
Ceftriaxone IV	180 (30%)
Benzympenicillin IV	99 (16%)
Cefotaxime IV	87 (14%)
Gentamicin IV	74 (12%)
Ampicillin IV	61 (10%)
Erythromycin IV	49 (8%)
Amoxycillin/clavulanate oral	39 (6%)
Doxycycline oral	39 (6%)
Amoxycillin oral	20 (3%)
Cephazolin IV	17 (3%)
Metronidazole IV	16 (3%)
Ticarcillin/clavulanate IV	11 (2%)
Other	61 courses
Total number of courses	970

* many patients were prescribed more than one antibiotic

Four hundred and seventy-four patients (79%) were admitted to a hospital on leaving the emergency department, including 13 who were admitted to Hospital in the Home (Table 6).

Table 6: Discharge location

Discharged to	Number of patients (% of 603)
Ward	399 (66%)
Home	107 (18%)
Other hospital	50 (8%)
HITH	13 (2%)
ICU	12* (2%)
Other	9 (1%)
Nursing home	8 (1%)
Other - hostel	1 (<1%)
Homeless	1 (<1%)
Died	1 (<1%)
Not recorded	2 (<1%)
Total	603 (100%)

* includes 10 patients with severe CAP and 2 with non-pneumonia respiratory tract infections

Plans for review of the patient after discharge from the emergency department were documented for 577 patients (96%) (Table 7).

Table 7: Review of treatment after discharge from the emergency department

Treatment reviewed	Number of patients (% of 603)
Admitting unit	381 (63%)
LMO	121 (20%)
Other hospital	45 (7%)
Private specialist	16 (3%)
ED	12 (2%)
Outpatient clinic	2 (<1%)
Not documented	26 (4%)
Total	603 (100%)

The antibiotics prescribed after the initial antibiotic treatment in ED (i.e. antibiotics prescribed by the admitting unit or antibiotics prescribed on discharge home from the ED) was documented for 491 patients (Table 8). There were many changes of treatment made for individual patients. The initial treatment was changed for 263 patients (54% of 491); antibiotics were ceased for 13 patients; ceftriaxone/cefotaxime was ceased for 55 patients and started for 29 patients.

There was a significant increase in the proportion of patients prescribed roxithromycin when they were admitted to the ward or discharged from the ED compared with the initial treatment in the ED (46% compared with 36%, $P = 0.0357$). The 38 patients who were prescribed roxithromycin on discharge home from the ED accounted for 8% of the increase. The proportions of patients treated with ceftriaxone/cefotaxime, benzylpenicillin and erythromycin remained the same.

Table 8: Antibiotics prescribed on admission to ward and on discharge from ED

Antibiotic	Number of patients (% of 491)
Roxithromycin	224 (46%)
Ceftriaxone	136 (28%)
Benzylpenicillin	82 (17%)
Cefotaxime	65 (13%)
Erythromycin	59 (12%)
Ampicillin	50 (10%)
Doxycycline	45 (9%)
Amoxicillin/clavulanate	40 (8%)
Gentamicin	39 (8%)
Metronidazole	20 (4%)
Amoxicillin	16 (3%)
Ciprofloxacin	13 (3%)
Cephazolin	9 (2%)
Ticarcillin/clavulanate	9 (2%)
Other	53
Total number of courses	860*

* many patients were prescribed more than one antibiotic

Concordance with AG11

The antibiotic or antibiotic combination prescribed as initial treatment for each of the 603 patients by emergency department doctors, was assessed for concordance with the recommendations in AG11. In presentation of the results in this section 'course' is used to describe the antibiotic or antibiotic combinations prescribed as initial treatment for the 603 patients.

The overall rate of concordance with AG11 was 7% with 29 courses (5%) being fully concordant with AG11 for drugs, doses and routes of administration and a further 16 courses (3%) being concordant with AG11 for drugs but not for doses and/or routes of administration (Table 9). More than one-quarter of courses were prescribed for indications for which there were no specific recommendations in AG11. Two courses were prescribed antibiotics for specific treatment of infections with known micro-organisms with known antibiotic sensitivities. The overall rate of nonconcordance with AG11 was 63%.

Table 9: Overall concordance of antibiotics prescribed with AG11

Concordance with AG11	Number of courses (%)
Concordant for drug with AG11	16 (3%)
Fully concordant with AG11	29 (5%)
No specific recommendation in AG11	177 (29%)
Not concordant with AG11	379 (63%)
Specific treatment	2 (<1%)
Total	603 (100%)

The results of concordance checking by a second investigator are shown in Appendix 4. Errors in the assignment of patients to the diagnostic groups and in the assessment of concordance have been corrected.

Severe CAP

In AG11 the antibiotics recommended for empirical treatment of severe community-acquired pneumonia (non-tropical Australia) are erythromycin 1g intravenously 6-hourly plus benzylpenicillin 1.2g IV 4 to 6-hourly plus gentamicin 4 to 6mg/kg IV daily. If no direct evidence of a Gram-negative pathogen is obtained after 48 hours, gentamicin may be ceased. There is no recommendation if the patient is elderly or has significant renal impairment. For patients hypersensitive to penicillin (excluding immediate hypersensitivity) the antibiotics recommended are erythromycin 1g intravenously 6-hourly plus cefotaxime 1g intravenously 8-hourly or ceftriaxone 1g intravenously daily. No recommendations are given for patients who have a history of immediate hypersensitivity to penicillin, a history of hypersensitivity to cephalosporins, or a history of adverse drug reaction to macrolides. In AG10 the erythromycin plus cefotaxime/ceftriaxone regimen was recommended as a first line treatment of severe CAP.

The sample of 263 patients with severe community-acquired pneumonia has been subdivided into the following groups for presentation of the overall results.

- Severe CAP,
- Severe CAP, increased risk of aminoglycoside toxicity
- Severe CAP, penicillins contraindicated,
- Severe CAP, beta lactams contraindicated,
- Severe CAP, macrolides contraindicated,
- Severe CAP, specific comorbidities.

Overall 94 (36%) of the 263 patients with severe CAP had been treated with antibiotics in the week prior to presentation in ED. Twenty-six different antibiotics were prescribed before presentation, the most frequently prescribed being amoxicillin/clavulanate, roxithromycin and cefaclor. (Table 10)

One hundred and ninety-two patients (73%) in the severe CAP group had a contraindication to the use one or more of the recommended antibiotics. Six patients had specific comorbidities including neoplastic disease, immunosuppression and history of a recent pseudomonal infection.

The antibiotics most frequently prescribed in ED for severe CAP are also shown in Table 10. Ceftriaxone/cefotaxime were the most frequently prescribed antibiotics followed by roxithromycin. There were no significant differences in the antibiotics prescribed, including gentamicin, for patients in the severe CAP group compared with the severe CAP, increased risk of aminoglycoside toxicity group.

Eleven patients with severe CAP in whom penicillin was contraindicated had been prescribed antibiotics before presentation at ED including 3 who had been prescribed a penicillin. Thirty-two of the 33 patients were treated with cephalosporins and/or macrolides in ED. One patient was treated with doxycycline.

Eight patients in the severe CAP group had a contraindication to the use of beta-lactam antibiotics (angioedema with penicillin [3]; collapse and rash with penicillin [1]; swollen face with cephalixin [1]; rash with penicillin and cephalixin [2]; rash with cephalixin [1]). Five of these patients were prescribed ceftriaxone/cefotaxime in ED.

Of the five patients with severe CAP in whom macrolides were contraindicated, four were prescribed ceftriaxone/cefotaxime in ED. One patient with an ADR to erythromycin was prescribed roxithromycin.

The patients with specific comorbidities accounted for all but two of the courses for anti-pseudomonal beta-lactam antibiotics.

Table 10: Antibiotics prescribed for severe CAP

Indication	Antibiotics prescribed before presentation at ED (descending order)	Number of courses* (% of patients)	Antibiotic prescribed by ED (descending order)	Number of courses* (% of patients)
Severe CAP 65 patients [25 (38%) prescribed antibiotics before presentation at ED]	Roxithromycin	6 (9%)	Ceftriaxone/cefotaxime	32 (49%)
	Amoxycillin/clavulanate	5 (8%)	Roxithromycin	21 (32%)
	Cefaclor	3 (5%)	Benzylpenicillin	20 (31%)
	Clarithromycin	3 (5%)	Erythromycin	16 (25%)
	Other	11	Gentamicin	15 (23%)
			Ampicillin/amoxycillin	11 (17%)
			Doxycycline	6 (9%)
		Other	6	
Severe CAP, increased risk of aminoglycoside toxicity 146 patients [48 (33%) prescribed antibiotics before presentation at ED]	Amoxycillin/clavulanate	13 (9%)	Ceftriaxone/cefotaxime	80 (55%)
	Roxithromycin	10 (7%)	Roxithromycin	48 (33%)
	Cefaclor	6 (4%)	Benzylpenicillin	28 (19%)
	Other	26	Ampicillin/amoxycillin	25 (17%)
			Erythromycin	19 (13%)
			Gentamicin	16 (11%)
			Doxycycline	7 (5%)
		Other	20	
Severe CAP, penicillins contraindicated 33 patients [11 (33%) prescribed antibiotics before presentation at ED]	Clarithromycin/erythromycin/ roxithromycin	4 (12%)	Ceftriaxone/cefotaxime	20 (61%)
	Amoxycillin+/- clavulanate	3 (9%)	Roxithromycin	15 (45%)
	Cefaclor/Cephalexin	3 (9%)	Erythromycin	5 (15%)
	Other	3	Cephazolin	4 (12%)
			Other	3
Severe CAP, beta- lactams contraindicated 8 patients [5 (63%) prescribed antibiotics before presentation at ED]	Erythromycin/roxithromycin	3 (38%)	Ceftriaxone/cefotaxime	5 (63%)
	Cephalexin	1 (13%)	Erythromycin	3 (38%)
	Chloramphenicol	1 (13%)	Roxithromycin	3 (38%)
	Ciprofloxacin	1 (13%)	Ciprofloxacin	1 (13%)
			Gentamicin	1 (13%)
Severe CAP, macrolides contraindicated 5 patients [2 (40%) prescribed antibiotics before presentation at ED]	Erythromycin	1 (20%)	Ceftriaxone/cefotaxime	4 (80%)
	Zanamivir	1 (20%)	Benzylpenicillin	1 (20%)
			Roxithromycin	1 (20%)
Severe CAP, specific comorbidities** 6 patients [3 (50%) prescribed antibiotics before presentation at ED]	Amoxycillin	1	Gentamicin	3
	Cotrimoxazole	1	Cefepime	2
	Colistin	1	Ticarcillin/clavulanate	2
	Itraconazole	1	Cefpirome	1
			Ceftriaxone/cefotaxime	1
			Cotrimoxazole	1
			Doxycycline	1
			Flucloxacillin	1
		Metronidazole	1	

* many patients were prescribed more than one antibiotic

** including 3 patients with neoplastic disease and immunosuppression, 1 with suspected *Pneumocystis carinii* pneumonia, 1 with a recent *Pseudomonas* infection, 1 immunosuppressed patient with chronic lung disease due to ammonia exposure who had multilobar cavitating lesions

Table 11 shows the results for concordance with the recommendations of AG11 for treatment of severe CAP. The overall rate of concordance (fully concordant and concordant for drug) was 6% (16/263). The overall rate of nonconcordance was 35%. Some of the reasons why courses were assessed as concordant

or nonconcordant are shown in Table 11, but the information for the larger indication groups (patients with no antibiotic contraindications and patients with contraindications to penicillins) are shown in Table 12.

Table 11: Concordance of antibiotics prescribed for severe CAP with AG11

Indication	Number of courses (%)				
	Fully concordant	Concordant for drug	Nonconcordant	Specific treatment	No recommendation in AG11
Severe CAP (n = 65)	9 (14%)	1 (2%)	55 (85%)	0	0
Severe CAP, increased risk of aminoglycoside toxicity (n = 146)	0	0	0	0	146 (100%)
Severe CAP, penicillins contraindicated (n = 33)	2 (6%)	0	31 (94%)	0	0
Severe CAP, beta lactams contraindicated (n = 8)	0	0	5 (63%) (all given ceftriaxone or cefotaxime)	0	3 (38%) (Erythromycin IV alone; roxithromycin alone x 2 patients)
Severe CAP, macrolides contraindicated (n = 5)	0	0	0	0	5 (100%) (Benzylpenicillin alone; CEFX and roxithromycin [unspecified ADR to erythromycin]; CEFX alone x 3 patients)
Severe CAP, specific comorbidities* (n = 6)	3 (50%) (Cefpirome and gentamicin*; Tic/clav and gentamicin*; Cefepime and gentamicin [†])	1 (17%) (lower dose of cotrimoxazole [†])	1 (17%) (Cefepime alone*)	0	1 (17%) (Ceftriaxone, metronidazole, flucloxacillin, ticarcillin/clavulanate followed by doxycycline [§])
Totals	14 (5%)	2 (1%)	92 (35%)	0	155 (59%)

* neoplastic disease and immunosuppression,

† suspected *Pneumocystis carinii* pneumonia,

‡ recent *Pseudomonas* infection,

§ immunosuppressed patient with chronic lung disease due to ammonia exposure who had multilobar cavitating lesions

For the patients without antibiotic contraindications, prescription of ceftriaxone/cefotaxime with and without other antibiotics was the main reason for nonconcordance occurring in 30 (46%) of patients. Oral instead of IV antibiotics were prescribed for 18% of patients and IV ampicillin/amoxycillin for 11% of patients. For the patients with contraindications to penicillins the main reason for nonconcordance was omission of erythromycin or its replacement with roxithromycin.

Table 12: Reasons for nonconcordance with AG11 recommendations for severe CAP

Severe CAP	Number of patients (%)
All patients	65 (100%)
Patients with nonconcordant courses	55 (85%)
Reason for nonconcordance	
Ceftriaxone/cefotaxime + other antibiotics	19 (29%)
Ceftriaxone/cefotaxime + roxithromycin	9 (14%)
Ceftriaxone/cefotaxime + doxycycline	4 (6%)
Ceftriaxone/cefotaxime + IV erythromycin	3 (5%)
Oral instead of IV antibiotics	12 (18%)
Roxithromycin +/- other antibiotics	6 (9%)
Ceftriaxone/cefotaxime alone	11 (17%)
IV Amoxicillin/ampicillin +/- other antibiotics	7 (11%)
Other	6 (9%)
Severe CAP, penicillins contraindicated	
All patients	33 (100%)
Patients with nonconcordant courses	31 (94%)
Reason for nonconcordance	
Roxithromycin instead of erythromycin	12 (36%)
Oral instead of IV antibiotics	8 (24%)
Erythromycin omitted	6 (18%)
Moderate spectrum cephalosporins +/- other antibiotics	4 (12%)
Ceftriaxone omitted	1 (3%)

Antibiotic prescriptions for severe CAP were also assessed for concordance with the previous edition (10th) of the Therapeutic Guidelines: Antibiotic (Table 13). The overall rate of concordance (fully concordant and concordant for drug) was 12% (31/263), which is not significantly higher than concordance with AG11. The overall rate of nonconcordance was 85%. The reasons for nonconcordance with AG10 were the same as the reasons for nonconcordance with AG11 with the exception of prescription of ceftriaxone/cefotaxime and IV erythromycin, which was a first-line recommended combination in AG10 and accounted for 15 courses.

Table 13: Concordance of antibiotics prescribed for severe CAP with AG10

Concordance with AG10	Number of courses (%)
Concordant for drug with AG10	8 (3%)
Fully concordant with AG10	23 (9%)
No specific recommendation in AG10	8 (3%)
Not concordant with AG10	224 (85%)
Specific treatment	0
Total	263 (100%)

Ten patients treated in ED for severe CAP were admitted from ED to ICU. The antibiotics prescribed for these patients were ceftriaxone/cefotaxime (7 patients), benzylpenicillin (3 patients), gentamicin (3 patients), erythromycin (3 patients), ampicillin IV (2 patients), metronidazole IV (2 patients) and roxithromycin (2 patients).

Table 14 shows the inter-hospital comparison of treatment of the 263 patients with severe CAP. The proportion of patients treated with antibiotic regimens that were nonconcordant with AG11 ranged from 67% to 100%. There was inter-hospital variation with the proportion of patients treated with each of the commonly prescribed drugs ranging from 0% to at least 50%.

Table 14: Inter-hospital comparison of treatment of severe CAP

Hospital	A	B	C	D	E	F	G	H	I	J	K	L	All
Number of patients													
Total	58	57	20	18	58	56	38	59	60	60	59	60	603
Severe CAP	23	22	6	6	30	23	6	28	21	43	30	25	263
Nonconcordance – severe CAP													
Number of patients	7	11	1	2	8	6	3	10	11	16	14	5	94
%	30%	50%	17%	33%	27%	26%	50%	36%	52%	37%	47%	20%	36%
% severe CAP treated with													
CEFX	43%	82%	50%	0%	33%	4%	67%	89%	52%	74%	77%	20%	54%
Benzylpenicillin	17%	0%	0%	67%	23%	35%	0%	14%	5%	12%	3%	60%	19%
Erythromycin	13%	23%	17%	50%	7%	22%	0%	11%	5%	26%	7%	28%	16%
Gentamicin	13%	9%	17%	50%	10%	52%	0%	0%	14%	2%	7%	24%	14%
Amoxycillin/ampicillin	22%	14%	50%	17%	33%	26%	33%	0%	19%	5%	7%	12%	16%
Roxithromycin	43%	41%	0%	0%	60%	17%	33%	25%	33%	60%	7%	20%	34%

Mild - moderate CAP

In AG11 the antibiotics recommended for empirical treatment of mild - moderate CAP are amoxycillin 1g orally 8-hourly OR doxycycline 200mg orally initially then 100mg 12-hourly OR roxithromycin 300mg orally daily. The antibiotics recommended where parenteral therapy is required are benzylpenicillin 1.2g intravenously 6-hourly OR procaine penicillin 1.5g intramuscularly daily. For patients hypersensitive to penicillin (excluding immediate hypersensitivity) the recommended antibiotics are cephalothin 1g intravenously 6-hourly OR cephazolin 1g intravenously 8-hourly.

The sample of 90 patients with mild - moderate community-acquired pneumonia has been subdivided into the following groups for presentation of the prescription and concordance results.

- Mild - moderate CAP
- Mild - moderate CAP, penicillins contraindicated
- Mild - moderate CAP, beta lactams contraindicated
- Mild – moderate CAP, specific comorbidities

Approximately one-third of the patients had been treated with antibiotics before presentation at ED, the most frequently prescribed drugs being roxithromycin and amoxycillin (Table 15). The recommended antibiotic benzylpenicillin was prescribed for approximately one-fifth of patients with mild – moderate CAP whereas ceftriaxone/cefotaxime and roxithromycin were prescribed for more than one-third. None of the patients in whom penicillins were contraindicated were prescribed the recommended drugs cephalothin or cephazolin. One patient with a previous ADR to penicillin was prescribed ticarcillin/clavulanate and two patients with previous ADRs to cephalosporins were prescribed ceftriaxone.

Table 15: Antibiotics prescribed for mild - moderate CAP

Indication	Antibiotics prescribed before presentation at ED (descending order)	Number of courses* (% of patients)	Antibiotic prescribed by ED (descending order)	Number of courses* (% of patients)
Mild - moderate CAP 77 patients [27 (35%) prescribed antibiotics before presentation at ED]	Roxithromycin	10 (13%)	Ceftriaxone/cefotaxime	28 (36%)
	Amoxicillin	6 (8%)	Roxithromycin	27 (35%)
	Doxycycline	2 (3%)	Benzympenicillin	16 (21%)
	Penicillin	2 (3%)	Ampicillin/amoxicillin	11 (14%)
	Other	17 courses	Amoxicillin/clavulanate	8 (10%)
			Gentamicin	7 (9%)
			Doxycycline	4 (5%)
			Erythromycin	4 (5%)
		Other	4 courses	
Mild - moderate CAP, penicillins contraindicated 8 patients (1 patient prescribed antibiotics before presentation at ED)	Roxithromycin	1 (13%)	Roxithromycin	6 (75%)
			Ceftriaxone	3 (38%)
			Cephalexin	1 (13%)
			Erythromycin oral	1 (13%)
			Gentamicin	1 (13%)
			Metronidazole IV	1 (13%)
			Ticarcillin/clavulanate	1 (13%)
Mild - moderate CAP, beta-lactams contraindicated 2 patients (No patients prescribed antibiotics before presentation at ED)			Ceftriaxone	2 (100%)
Mild - moderate CAP, specific comorbidities				
1 patient being treated before presentation with tobramycin by inhalation for Pseudomonas infection	Tobramycin	1	Ceftazidime + gentamicin	1
1 patient with neoplastic disease and immunosuppression			Ticarcillin/clavulanate + gentamicin	1
1 patient with liver disease			Ceftriaxone + ampicillin + roxithromycin	1

* many patients were prescribed more than one antibiotic

Table 16 shows the results for concordance with the recommendations of AG11 for treatment of mild - moderate CAP. The overall rate of concordance (fully concordant and concordant for drug) was 24% (22/90). The overall rate of nonconcordance was 74%.

Table 16: Concordance of antibiotics prescribed for mild - moderate CAP with AG11

Indication	Number of courses (%)				
	Fully concordant	Concordant for drug	Nonconcordant	Specific treatment	No recommendation in AG11
Moderate CAP (n = 77)	12(16%)	7 (9%)	58 (75%)	0	0
Moderate CAP, penicillins contraindicated (n = 8)	1 (13%)	1 (13%)	6 (75%)	0	0
Moderate CAP, beta-lactams contraindicated (n = 2)	0	0	2 (100%)	0	0
Moderate CAP, specific comorbidities (n = 3)	1 (33%)	0	1 (33%)	0	1 (33%)
Total (n = 90)	14 (16%)	8 (9%)	67 (74%)	0	1 (1%)

Prescription of ceftriaxone/cefotaxime alone or in combination with other antibiotics was the reason for nonconcordance in 38% of courses (Table 17).

Table 17: Reasons for nonconcordance with AG11 recommendations for mild - moderate CAP

Moderate CAP	Number of nonconcordant patients (%)
All patients	90
Patients with nonconcordant courses	67 (74%)
Reason for nonconcordance	
Ceftriaxone/cefotaxime + other antibiotics	22 (24%)
Ceftriaxone/cefotaxime + roxithromycin	15
Ceftriaxone/cefotaxime + erythromycin	3 (1 oral)
Ceftriaxone/cefotaxime and doxycycline	2
Ceftriaxone/cefotaxime alone	12 (13%)
Other antibiotics given as well as benzylpenicillin	10 (11%)
Amoxicillin/clavulanate +/- other antibiotics	9 (10%)
Amoxicillin/ampicillin IV +/- other antibiotics	7 (8%)
Other	7 (8%)

Table 18: Inter-hospital comparison of treatment of mild - moderate CAP

Hospital	A	B	C	D	E	F	G	H	I	J	K	L	All
Number of patients													
Total	58	57	20	18	58	56	38	59	60	60	59	60	603
Mild to moderate CAP	6	12	1	2	6	6	12	8	11	6	11	9	90
Nonconcordance - mild to moderate CAP													
Number of patients	2	11	1	0	6	3	9	8	8	5	8	6	67
%	33%	92%	100%		100%	50%	75%	100%	73%	83%	73%	67%	74%
% mild - moderate CAP treated with													
Roxithromycin	33%	67%	0%	50%	67%	33%	50%	38%	64%	67%	0%	11%	42%
Ceftriaxone/cefotaxime	17%	42%	0%	0%	33%	0%	42%	75%	45%	50%	64%	0%	38%
Benzylpenicillin	17%	33%	0%	50%	0%	17%	8%	25%	0%	17%	0%	56%	18%
Ampicillin/amoxycillin	17%	17%	0%	0%	67%	0%	8%	0%	27%	0%	0%	11%	13%
Gentamicin	0%	17%	0%	0%	17%	33%	8%	0%	9%	0%	0%	33%	11%

Aspiration CAP

AG11 states that minor degrees of aspiration do not require antibiotic therapy. The recommended antibiotics for severe aspiration pneumonia or lung abscess are shown in the Table 19.

Table 19: Antibiotics recommended for aspiration pneumonia in AG11

<i>Aspiration pneumonia</i>	<i>Benzylpenicillin 1.2g intravenously 4- to 6-hourly PLUS metronidazole 500mg intravenously 12-hourly.</i>	<i>OR</i>	<i>Clindamycin 1.2g intravenously 8-hourly OR lincomycin 1.2g intravenously 8-hourly.</i>		
<i>Suspected gram negative aspiration pneumonia eg, in alcoholic patients</i>	<i>Benzylpenicillin 1.2g intravenously 4- to 6-hourly PLUS metronidazole 500mg intravenously 12-hourly PLUS gentamicin 4-6mg/kg intravenously daily.</i>	<i>OR</i>	<i>Clindamycin 1.2g intravenously 8-hourly OR lincomycin 1.2g intravenously 8-hourly PLUS gentamicin 4-6mg/kg intravenously daily.</i>	<i>OR</i>	<i>Ticarcillin/clavulanate 3.1g intravenously 4- to 6-hourly</i>
<i>Suspected Staphylococcal aspiration pneumonia</i>	<i>Flucloxacillin 2g intravenously 6-hourly OR dicloxacillin 2g intravenously 6-hourly</i>	<i>OR</i>	<i>Cephalothin 2g intravenously 6-hourly OR cephazolin 1g intravenously 8-hourly</i>		
<i>Suspected Staphylococcal aspiration pneumonia, severe penicillin hypersensitivity OR suspected MRSA</i>	<i>Vancomycin 1g intravenously 12-hourly</i>				

The 19 patients with aspiration CAP are divided into 2 groups.

- Minor aspiration CAP
- Severe aspiration CAP

The antibiotics that were prescribed before presentation at the ED and in the ED are shown in Table 20. Overall 32% of patients in the aspiration CAP group had been treated with antibiotics before presentation at the ED. The antibiotics most frequently prescribed for aspiration CAP were ceftriaxone/cefotaxime and metronidazole.

Table 20: Antibiotics prescribed for aspiration CAP

Indication	Antibiotics prescribed before presentation at ED (descending order)	Number of courses* (% of patients)	Antibiotic prescribed by ED (descending order)	Number of courses* (% of patients)
Minor aspiration CAP 4 patients [2 (50%) treated with antibiotics before presentation at ED]	Amoxicillin/clavulanate	2 (50%)	Ceftriaxone	3 (75%)
			Benzylpenicillin	1 (25%)
			Gentamicin	1 (25%)
Severe aspiration CAP 15 patients [4 (27%) treated with antibiotics before presentation at ED]	Amoxicillin oral	1 (7%)	Ceftriaxone/cefotaxime	7 (47%)
	Cefaclor	1 (7%)	Metronidazole IV	7 (47%)
	Clarithromycin	1 (7%)	Ampicillin IV	4 (27%)
	Dicloxacillin oral	1 (7%)	Gentamicin	4 (27%)
			Flucloxacillin IV	2 (13%)
			Amoxicillin oral	1 (7%)
			Benzylpenicillin	1 (7%)
			Erythromycin oral	1 (7%)
			Erythromycin IV	1 (7%)
			Roxithromycin	1 (7%)
		Ticarcillin/clavulanate	1 (7%)	

*many patients were prescribed more than one antibiotic

One course was fully concordant with AG11. The other 18 were nonconcordant, the main reasons for nonconcordance being prescription of ceftriaxone/cefotaxime with and without other antibiotics, prescription of ampicillin/amoxicillin and prescription of antibiotics for minor aspiration CAP (Tables 21 and 22).

Table 21: Concordance of antibiotics prescribed for aspiration CAP with AG11

Indication	Number of courses (%)				
	Fully concordant	Concordant for drug	Nonconcordant	Specific treatment	No recommendation in AG11
Minor aspiration CAP (n = 4)	0	0	4 (100%)	0	0
Severe aspiration CAP (n = 15)	1 (7%)	0	14 (93%)	0	0
Totals (n = 19)	1 (5%)	0	18 (95%)	0	0

Table 22: Reasons for nonconcordance with AG11 recommendations for aspiration CAP

Aspiration CAP	Number of patients (%)
All patients	19
Patients with nonconcordant courses	18 (95%)
Reason for nonconcordance	
Ceftriaxone/cefotaxime +/- other antibiotics	7 (37%)
Ampicillin/amoxicillin + other antibiotics	4 (21%)
Antibiotics not indicated (minor aspiration CAP)	4 (21%)
Oral instead of IV for severe pneumonia	2 (11%)
Metronidazole omitted	1 (5%)

HAP

Details of the clinical history, antibiotic treatment and concordance with AG11 for the six patients classified as having HAP are shown in Table 23.

Table 23: Patients with HAP

Clinical summary	Diagnostic group	Antibiotics prescribed	Antibiotics recommended	Concordance with AG11	Reason for nonconcordance
Discharged from hospital 6 days pre-presentation on roxithromycin and amoxicillin/clavulanate. Sputum from 7 days pre-presentation grew <i>Klebsiella ozaenae</i> sensitive to cefotaxime.	Severe HAP, late onset	Cefotaxime 1g IV Roxithromycin 150mg orally		Specific prescribing for microbial sensitivity results	
Past history of asthma. Admitted from another hospital with pneumonia and pleural effusion. No prior antibiotics.	Mild-moderate HAP, no specific risk factors, not post-operative	Ampicillin 1g IV		No specific recommendation in AG11	
Past history of COPD, heart failure, cerebrovascular disease, respiratory arrest on erythromycin, anaphylaxis to penicillin. Admitted from a rehabilitation facility with post-operative pneumonia, possibly aspiration. Se creatinine of 159 µmol/L. No prior antibiotics.	Severe HAP, late onset, C/I penicillins C/I erythromycin ? C/I gentamicin	Ceftriaxone 1g IV Gentamicin 180mg IV	Gentamicin 4-6mg/kg IV daily PLUS clindamycin 600mg IV 8-hourly OR lincomycin 1.2g IV 8-hourly	Not concordant with AG11	Ceftriaxone prescribed.
Homeless person with neoplastic disease admitted from another hospital with aspiration pneumonia.	Resolving RML/ RLL pneumonia	Continued amoxicillin/clavulanate and roxithromycin started by transferring hospital.		No specific recommendation in AG11	
Past history of COPD and renal disease. Se creatinine not documented. No prior antibiotics.	Severe HAP, late onset, ?C/I gentamicin	Ticarcillin/clavulanate 3.1g IV Erythromycin 500mg IV	Ticarcillin/clavulanate Ciprofloxacin Erythromycin	Not concordant with AG11	Ciprofloxacin omitted.
70 yo. Past history of neoplastic disease, CHF. Se creatinine normal. No prior antibiotics.	Mild-moderate HAP, no specific risk factors, not post-operative, C/I penicillins,	Ceftriaxone 1g IV Roxithromycin 300mg orally		No specific recommendation in AG11	

Exacerbations of chronic bronchitis

In AG11 the antibiotics recommended for empirical treatment of exacerbations of chronic bronchitis are amoxicillin 500mg orally 8-hourly OR doxycycline 200mg orally initially, then 100mg orally daily. Antibiotics are indicated in patients who have increased cough and dyspnoea **together with** increased sputum volume and/or purulence.

There were 133 patients in this diagnostic category, 35% of whom had been treated with antibiotics before presentation at ED (Table 24). The antibiotics prescribed most frequently before presentation were roxithromycin, amoxicillin and amoxicillin/clavulanate.

The recommended drugs, oral amoxicillin and doxycycline, were prescribed in ED for small numbers of patients. The most frequently prescribed antibiotics in ED however were ceftriaxone/cefotaxime and roxithromycin, often in combination.

Table 24: Antibiotics prescribed for exacerbations of chronic bronchitis

Indication	Antibiotics prescribed before presentation at ED (descending order)	Number of courses* (% of patients)	Antibiotic prescribed by ED (descending order)	Number of courses* (% of 133 patients)
Exacerbations of chronic bronchitis 133 patients [47 (35%) treated with antibiotics before presentation at ED]	Roxithromycin	12 (9%)	Ceftriaxone/cefotaxime	56 (42%)
	Amoxicillin	11 (8%)	Roxithromycin	53 (40%)
	Amoxicillin/clavulanate	8 (6%)	Ampicillin/amoxicillin IV	18 (14%)
	Doxycycline	3 (2%)	Benzylpenicillin	16 (12%)
	Clarithromycin	3 (2%)	Gentamicin	16 (12%)
	Cephalexin	3 (2%)	Amoxicillin/clavulanate	8 (6%)
	Other	16	Doxycycline	8 (6%)
			Amoxicillin oral	7 (5%)
			Cephazolin	5 (4%)
			Erythromycin IV	4 (3%)
		Other	12	

* many patients were prescribed more than one antibiotic

The rate of concordance with AG11 was very low with 6 courses (5%) being concordant for drug, no courses being fully concordant and 127 (95%) courses being nonconcordant. More than half the courses (68) were assessed as nonconcordant because antibiotic treatment was not indicated; 33 of these patients were treated with ceftriaxone/cefotaxime alone or in combination with other antibiotics. Antibiotic treatment was indicated in the remaining 59 patients but the antibiotics prescribed, including another 22 courses of ceftriaxone/cefotaxime, were not recommended by AG11 (Table 25).

Table 25: Reasons for nonconcordance with AG11 recommendations for exacerbations of chronic bronchitis

Exacerbations of chronic bronchitis	Number of patients (%)
All patients	133
Patients with nonconcordant courses	127 (95%)
Reason for nonconcordance	
Antibiotics not indicated	68 (51%)
Ceftriaxone/cefotaxime + other antibiotics	13 (10%)
Ceftriaxone/cefotaxime + roxithromycin	11 (8%)
Benzylpenicillin +/- other antibiotics	10 (8%)
Ceftriaxone/cefotaxime alone	9 (7%)
Roxithromycin	7 (5%)
Ampicillin/amoxicillin IV +/- other antibiotics	6 (5%)
Amoxicillin/clavulanate	4 (3%)
Other	10 (8%)

Table 26: Inter-hospital comparison of treatment of exacerbations of chronic bronchitis

Hospital	A	B	C	D	E	F	G	H	I	J	K	L	All
Number of patients													
Total	58	57	20	18	58	56	38	59	60	60	59	60	603
Exacerbations of chronic bronchitis	15	15	6	7	13	9	13	11	15	3	11	15	133
Nonconcordance – exacerbations of chronic bronchitis													
Number of patients	14	15	6	6	13	8	12	11	13	3	11	15	127
%	93%	100%	100%	86%	100%	89%	92%	100%	87%	100%	100%	100%	95%
% treated with													
CEFX	67%	47%	17%	0%	31%	0%	54%	82%	27%	67%	100%	7%	42%
Roxithromycin	40%	80%	17%	0%	54%	44%	31%	55%	40%	67%	9%	20%	39%
Benzylpenicillin	13%	13%	17%	0%	15%	22%	0%	0%	0%	0%	0%	47%	12%
Ampicillin	7%	0%	0%	14%	31%	33%	0%	9%	33%	0%	0%	0%	11%
Gentamicin	0%	13%	50%	29%	0%	56%	0%	9%	0%	0%	0%	20%	12%
Amoxicillin	0%	13%	17%	14%	0%	0%	0%	0%	20%	0%	0%	20%	8%
Amoxicillin/clavulanate	0%	0%	0%	29%	15%	0%	8%	0%	13%	0%	0%	7%	6%
Doxycycline	13%	0%	0%	0%	8%	0%	15%	0%	0%	0%	18%	7%	6%

Other LRTI

In this study patients who did not have radiological evidence of pneumonia or COPD and/or a history of COPD were classified as other LRTI. This category included the AG11 diagnostic group Acute bronchitis. AG11 states that in an immunocompetent adult or child, acute bronchitis is most often viral and does not require antibiotic therapy.

Twenty of the 92 patients in the other LRTI group had immunosuppression and/or neoplastic disease documented on the data collection form and/or were being treated with immunosuppressive drugs, most commonly corticosteroids. Thirty percent of these immunosuppressed patients had been treated with antibiotics in the week before presentation at the ED compared with 25% of those with no documented immunosuppression (Table 27). Ceftriaxone/cefotaxime and roxithromycin were the antibiotics most frequently prescribed for both groups. AG11 does not give any specific recommendations for treatment of immunosuppressed patients with LRTI who do not have pneumonia or COPD so the 20 regimens used to treat the immunosuppressed group have been classified as “No specific recommendation in AG11”. One patient who was not immunosuppressed and who had a Haemophilus sensitive to amoxicillin/clavulanate cultured from sputum taken 9 days before presentation in the ED was classified as “Specific” treatment. The remaining 71 (77%) regimens have been classified as “Not concordant with AG11” on the grounds that antibiotics were not indicated.

Table 27: Antibiotics prescribed for other LRTI

Indication	Antibiotics prescribed before presentation at ED (descending order)	Number of courses* (% of patients)	Antibiotic prescribed by ED (descending order)	Number of courses* (% of patients)
Other LRTI 72 patients [18 (25%) treated with antibiotics before presentation at ED]	Amoxicillin/clavulanate	6 (8%)	Roxithromycin	34 (47%)
	Roxithromycin	6 (8%)	Ceftriaxone/cefotaxime	19 (26%)
	Cephalexin	3 (4%)	Amoxicillin/clavulanate	18 (25%)
	Amoxicillin oral	2 (3%)	Benzylpenicillin	16 (22%)
	Erythromycin oral	2 (3%)	Doxycycline	6 (8%)
	Clarithromycin	1 (1%)	Ampicillin IV	5 (7%)
	Other	2 (3%)	Ampicillin/amoxicillin oral	5 (7%)
			Cephalexin	4 (6%)
			Erythromycin oral	5 (7%)
			Gentamicin	5 (7%)
		Other	8	
Other LRTI, immunosuppressed 20 patients [6 (30%) treated with antibiotics before presentation at ED]	Cephalexin	2 (10%)	Roxithromycin	7 (35%)
	Amoxicillin/clavulanate	2 (10%)	Ceftriaxone/cefotaxime	5 (25%)
	Erythromycin oral	1 (5%)	Amoxicillin/clavulanate	3 (15%)
	Amoxicillin oral	1 (5%)	Doxycycline	3 (15%)
	Doxycycline	1 (5%)	Ampicillin IV	2 (10%)
			Other	4

* many patients were prescribed more than one antibiotic

Table 28: Inter-hospital comparison of treatment of other LRTI

Hospital	A	B	C	D	E	F	G	H	I	J	K	L	All
Number of patients													
Total	58	57	20	18	58	56	38	59	60	60	59	60	603
Other LRTI	11	6	6	1	7	11	7	11	11	7	6	8	92
Nonconcordance - other LRTI													
Number of patients	7	5	3	1	7	11	7	9	7	5	5	4	71
%	64%	83%	50%	100%	100%	100%	100%	82%	64%	71%	83%	50%	77%
% treated with													
Roxithromycin	18%	67%	0%	0%	29%	27%	43%	55%	27%	57%	33%	25%	34%
Ceftriaxone/cefotaxime	27%	67%	17%	0%	14%	0%	29%	36%	18%	43%	33%	0%	24%
Benzylpenicillin	18%	33%	17%	100%	14%	27%	0%	9%	0%	0%	0%	63%	17%
Amoxicillin/clavulanate	27%	0%	0%	0%	43%	9%	29%	9%	36%	14%	17%	0%	17%

Protocols and access to guidelines

Table 29 summarises the level of restriction that each hospital's antibiotic policy places on the 13 antibiotics most frequently prescribed by ED doctors in this study and describes any protocols for treatment of lower respiratory tract infection that are in use in each hospital's emergency department. The restricted and unrestricted antibiotics were the same for those hospitals that submitted lists of restricted antibiotics, with narrow-spectrum antibiotics being unrestricted and broad-spectrum antibiotics, specifically ceftriaxone, cefotaxime and ticarcillin/clavulanate, being restricted. Some hospitals were using AG10 as the basis of their antibiotic policy and treatment protocols; one hospital had adopted AG11

as the basis of the hospital antibiotic policy but the “Pneumonia protocol” in use in the emergency department reflected AG10. Five hospitals had fully adopted AG11.

Table 29: Summary of antibiotic policies and LRTI treatment protocols

Hospital	Antibiotic policy	Protocols for treatment of LRTI	Overall concordance with AG11*
A	Unrestricted Ampicillin/amoxycillin, amoxicillin-clavulanate, benzylpenicillin, cephazolin, doxycycline, erythromycin, gentamicin, metronidazole, roxithromycin Restricted by unit and/or ID approval number Cefotaxime, ceftriaxone, ticarcillin/clavulanate	Benzylpenicillin or cephazolin recommended for mild or moderately severe cases of community-acquired pneumonia. Cefotaxime recommended for severe pneumonia (pneumonia requiring ICU admission) of unknown aetiology including nosocomial pneumonia. Cefotaxime is not available for exacerbations of COAD in the absence of pulmonary infiltration.	8/58 (14%)
B	Recommends adherence to the most recent edition of Therapeutic Guidelines: Antibiotic.	“Pneumonia pathway” which mirrors AG11.	2/57 (4%)
C	Recommends adherence to the most recent edition of Therapeutic Guidelines: Antibiotic. Section on third generation cephalosporins in Medication Manual mirrors AG11.	None.	0/20
D	Unrestricted Ampicillin/amoxycillin, amoxicillin-clavulanate, benzylpenicillin, cephazolin, doxycycline, erythromycin, gentamicin, metronidazole, roxithromycin, ticarcillin/clavulanate Unrestricted but reported to infectious diseases service 3 rd generation cephalosporins	Clinical Protocols for community acquired pneumonia and hospital acquired pneumonia mirror the recommendations in AG11.	6/18 (33%)
E	Unrestricted Ampicillin/amoxycillin, amoxicillin-clavulanate, benzylpenicillin, cephazolin, doxycycline, erythromycin, gentamicin, metronidazole, roxithromycin Restricted by unit and/or ID approval number Cefotaxime, ceftriaxone, ticarcillin/clavulanate	None.	0/58
F	Unrestricted Ampicillin/amoxycillin, amoxicillin-clavulanate, benzylpenicillin, cephazolin, doxycycline, erythromycin, gentamicin, metronidazole, roxithromycin Restricted by indication and/or ID approval Cefotaxime, ceftriaxone ID or respiratory consultant approval for CAP or for > 3days Ticarcillin/clavulanate	“Prescribing Guidelines Online” mirrors the recommendations of AG11 for community-acquired pneumonia, acute bronchitis and exacerbations of chronic bronchitis.	8/56 (14%)
G	None submitted	None submitted	4/38 (11%)

Hospital	Antibiotic policy	Protocols for treatment of LRTI	Overall concordance with AG11*
H	Recommends adherence to the most recent edition of Therapeutic Guidelines: Antibiotic. Unrestricted Ampicillin/amoxycillin, amoxycillin-clavulanate, benzylpenicillin, cephazolin, doxycycline, erythromycin, gentamicin, metronidazole, roxithromycin Restricted by indication (AG11) Ceftriaxone Restricted by unit and/or ID approval Cefotaxime, ticarcillin/clavulanate	None.	0/59
I	None submitted	None submitted	7/60 (12%)
J	Unrestricted Ampicillin/amoxycillin, amoxycillin-clavulanate, benzylpenicillin, cephazolin, doxycycline, erythromycin, gentamicin, metronidazole, roxithromycin Restricted by unit and/or ID approval number Cefotaxime, ceftriaxone, ticarcillin/clavulanate	None.	1/60 (2%)
K	Unrestricted Ampicillin/amoxycillin, amoxycillin-clavulanate, benzylpenicillin, cephazolin, doxycycline, erythromycin, gentamicin, metronidazole, roxithromycin Restricted to AG10 recommendations or infectious diseases/ medical microbiology approval Cefotaxime Restricted to specific units or infectious diseases/ medical microbiology approval Ceftriaxone, ticarcillin/clavulanate	None.	5/59 (8%)
L	Recommends adherence to the most recent edition of Therapeutic Guidelines: Antibiotic. Unrestricted Ampicillin/amoxycillin, amoxycillin-clavulanate, benzylpenicillin, cephazolin, doxycycline, erythromycin, gentamicin, metronidazole, roxithromycin Restricted to ID approval number or ICU Cefotaxime, ceftriaxone Restricted to ID consultation or ICU Ticarcillin/clavulanate	"Pneumonia protocol" which is based on AG10.	6/60 (10%)

* "Concordant for drug", "Fully concordant" and "Specific"

Interpretation of chest X-rays by emergency department doctors and radiologists

The number of patients who had a CXR performed was 566 but only 288 had a written report of the CXR by both the ED doctor and a radiologist (Table 30). The concordance between ED doctors and radiologists in diagnosis of pneumonia on chest X-ray was 74% (Table 31). ED doctors over-diagnosed pneumonia on chest X-ray by 18% compared with radiologists. The concordance between ED doctors and radiologists in the diagnosis of chronic obstructive pulmonary disease and pleural effusion on chest X-ray was 84% and 86% respectively (Tables 32 and 33).

Table 30: Reporting of chest X-rays

	Number of patients (%)
Total in study	603
CXR performed	566 (94%)
No report by ED doctor	135 (22%)
No radiology report	119 (20%)
No radiology or ED doctor report	23 (4%)
Patients with CXR and report by ED doctor and radiology report	288 (48%)

Table 31: CXR finding of pneumonia

	Radiologist positive	Radiologist negative	
ED doctor positive	147	51	198
ED doctor negative	23	67	90
	170	118	288

Sensitivity 86% (80-91) 95% CI Specificity 57% (47-66)
 Positive Predictive Value 74% (67-80) Negative Predictive Value 74% (64-83)
 Concordance Rate 74% (69-79)

Table 32: CXR finding of chronic obstructive pulmonary disease

	Radiologist positive	Radiologist negative	
ED doctor positive	34	23	57
ED doctor negative	24	207	231
	58	230	288

Sensitivity 59% (45-71) 95% CI Specificity 90% (85-93)
 Positive Predictive Value 60% (46-72) Negative Predictive Value 90% (85-93)
 Concordance Rate 84% (79-88)

Table 33: CXR finding of pleural effusion

	Radiologist positive	Radiologist negative	
ED doctor positive	23	9	32
ED doctor negative	32	224	256
	55	233	288

Sensitivity 42% (29-56) 95% CI Specificity 96% (93-98)
 Positive Predictive Value 72% (53-86) Negative Predictive Value 88% (83-91)
 Concordance Rate 86% (81-89)

Discussion

This study identified 603 patients treated with antibiotics for lower respiratory tract infection in emergency departments, in 12 public hospitals located in three eastern states during autumn-winter 2001. Participation in the study was voluntary. Participating hospitals were paid a small data collection fee for each patient enrolled. The invitation to participate was limited to hospitals with large emergency departments, nevertheless three regional hospitals contributed fewer than the target of 60 patients.

One of the main limitations of the study was that the data collection was carried out retrospectively and so was dependent on the quality of documentation in the medical history by the ED staff. Incomplete documentation of antibiotics used before presentation in the ED reduced the usefulness of this information. Incomplete documentation of the findings of chest X-rays by both ED doctors and radiologists reduced the number of patients for whom comparisons could be made of the ED doctor findings with the radiologist findings from a potential 566 to 288. Another potential limitation was the use of a limited set of parameters derived from prescribing guidelines to assess the illness and the indication for use of antibiotics. The data collected may not have accurately represented the condition of the patient or the

reason for prescription of antibiotics. A third limitation of the study is that it did not look at the clinical outcomes of the patients and the effect of nonconcordant prescribing on patient outcome.

As expected almost all the patients in the sample had community-acquired infections. Overall the patients were seriously ill – to be eligible for inclusion they had to be treated with antibiotics in the ED. Seventy-nine percent were admitted to a hospital after assessment and treatment in the emergency department including 10 patients admitted to ICUs. This compares with overall admission rates of 25% - 40% from ED attendances. Ceftriaxone and cefotaxime (prescribed for 44% of patients) were the most frequently prescribed antibiotics followed by roxithromycin (30%). Patients were divided into the indication groups used by AG11 according to the results of chest X-rays and the severity of the illness as assessed by specified signs and symptoms. Approximately half the patients met the AG11 criteria for severe CAP and one-fifth was suffering an exacerbation of COPD. This proportion of patients with severe CAP is high compared with the commonly quoted figure that approximately 10% of presentations of CAP are severe.⁷ Possible reasons for this are that patients attending the ED were indeed severely ill (and that patients with less severe illness were adequately treated in the community and did not attend the ED) or that the AG11 criteria did not sufficiently stratify the different severities of pneumonia.

The antibiotic courses first prescribed in the ED were assessed for concordance with the recommendations of AG11. The level of concordance of antibiotic treatment with AG11 was very low (7%).

The main reason for nonconcordance was the prescription of the broad-spectrum cephalosporins ceftriaxone and cefotaxime, for lower respiratory tract infection where there was no radiological evidence of pneumonia, for mild - moderate pneumonia and for patients with severe community-acquired pneumonia who did not have a contraindication to the use of benzylpenicillin. These reasons for nonconcordance were similar to the findings of another study carried out by the VDUEG in 1999 that evaluated the concordance with AG10 of prescriptions for ceftriaxone and cefotaxime for all indications.⁴

The other major area of nonconcordance with AG11 was around the decision of whether or not antibiotics were indicated for treatment of patients with non-pneumonia respiratory tract infections (exacerbations of chronic bronchitis and other LRTI). Approximately 50% of the patients treated with antibiotics in the ED for exacerbations of chronic bronchitis did not meet the AG11 criteria for antibiotic treatment while the corresponding figure for patients with other LRTI was 77%.

Possible explanations for the low concordance with AG11 include:

- Lack of access to AG11 and/or ignorance of the recommendations in AG11.
Some hospitals provide all doctors with copies of the current version of the Therapeutic Guidelines: Antibiotic as part of the hospital antibiotic policy. In addition all Victorian doctors potentially have access to most of the Therapeutic Guidelines titles through the Victorian Government supported health information portal, Clinicians Health Channel.
- Low acceptance of the AG11 recommendations by emergency department doctors.
The national guidelines for antibiotic prescribing in Australia (Therapeutic Guidelines: Antibiotic) are prepared by a multi-disciplinary Writing Group that is independent of government and licensing authorities, and of any form of commercial sponsorship, including the pharmaceutical industry.⁵ They were first published in 1978 and have been revised regularly with the 11th edition (AG11) published in November 2000. The Guidelines are evidence-based. The manuscript is widely reviewed before publication. Nevertheless some clinicians disagree with some of the recommendations of the Guidelines while others may be familiar with guidelines produced by overseas organisations. The Therapeutic Guidelines: Antibiotic are well-recognised^{8,9} but nevertheless audits of prescribing have demonstrated low levels of concordance with some recommendations.^{2,4}
- Delay in implementation of AG11, i.e. delay in incorporating AG11 recommendations into local hospital policies and protocols.
AG11 was published in September 2000, approximately 7 months before the beginning of the data collection period for this study, nevertheless some hospitals in this study were still using protocols based on AG10.

- Issues relating to the pharmacology of the drugs.
These include for example, frequency of administration of ceftriaxone and cefotaxime versus benzylpenicillin, tolerability of oral roxithromycin versus IV erythromycin, toxicity of gentamicin and need for monitoring of blood levels versus low toxicity of ceftriaxone/cefotaxime.
- Over-diagnosis of pneumonia on chest X-ray.
In this study the rate of over-diagnosis (ED doctors compared with radiologists) was 18%.
- Failure to respond to previous antibiotic treatment.
One-third of the patients in this study had been treated with antibiotics in the week before presentation at the ED. The information about prior antibiotic use was recorded from the notes made by ED staff and ambulance paramedics and was incomplete for approximately three-quarters of the patients. Nevertheless ceftriaxone/cefotaxime was not prescribed more frequently if patients had been treated with antibiotics before presentation at the ED, so it is unlikely that failure to respond was an important factor in ED prescription of ceftriaxone/cefotaxime.

Some of the recommendations in AG11 have been controversial, particularly the removal of ceftriaxone and cefotaxime as first-line drugs for the treatment of severe community-acquired pneumonia.¹⁰ In AG11 ceftriaxone and cefotaxime were reserved for patients who were hypersensitive to penicillin (excluding immediate hypersensitivity). The Writing Group stated, "Penicillin and gentamicin are preferred to broad-spectrum cephalosporins as the combination covers a wider spectrum." The gentamicin dose was to be tailored to the age and renal function of the patient and stopped after 48 hours if there was no direct evidence of a Gram-negative pathogen. No recommendation was made for patients who were at increased risk of aminoglycoside toxicity eg the elderly or patients with renal impairment. However in this study ceftriaxone or cefotaxime were prescribed for 112 patients (53%) with severe CAP who did not have a history of hypersensitivity to penicillin, 59 of whom were elderly and/or had some degree of renal impairment. It could be that ED doctors had chosen to prescribe ceftriaxone/cefotaxime for Gram-negative cover for these patients in the absence of any recommendation in AG11. The level of concordance of courses for severe CAP with AG10 and AG11 was not different however at 12% and 7% respectively as the reasons for nonconcordance were essentially the same; use of ceftriaxone/cefotaxime as a single agent, omission of IV erythromycin and/or its replacement with another drug, and prescription of amoxicillin/ampicillin.

The recommendations for treatment of severe CAP in the recently published 12th version of the Therapeutic Guidelines: Antibiotic (AG12)¹¹ are different again to AG10 and AG11 in that they use a Pneumonia Severity Index to grade the severity of the pneumonia and recommend ceftriaxone and cefotaxime as first line drugs for treatment of pneumonia of Grade V severity, i.e. pneumonia requiring intensive care admission. In this study 10 patients with severe CAP were admitted to ICU; 7 were treated with ceftriaxone/cefotaxime but only 3 were treated with the AG12 recommended combination of IV erythromycin and ceftriaxone or cefotaxime.

Nonconcordance with antibiotic guidelines does not mean that the antibiotics prescribed are inappropriate for the indications. For example courses used to treat severe and mild - moderate community acquired pneumonia that included intravenous ampicillin/amoxicillin were classified as nonconcordant with AG11, as were courses that included doxycycline or roxithromycin. These are appropriate antibiotics for treatment of LRTI in that they provide cover against likely infecting organisms such as *Streptococcus*, *Haemophilus influenzae* or *Chlamydia* and are now recommended antibiotics in AG12. Prescribers who ordered one of these antibiotics in combination with the antibiotics recommended in AG11 could be seen as more up-to-date with expert opinion than AG11.

The link between use of broad-spectrum antibiotics and the emergence of resistant bacteria including vancomycin resistant enterococci (VRE), methicillin-resistant *Staphylococcus aureus* (MRSA) and *Clostridium difficile* is well established. MRSA heterogeneously resistant to vancomycin has now been reported in two Australian states.^{12, 13} Organisations including the World Health Organisation¹⁴ and the Australian Department of Health and Ageing through the Joint Expert Advisory Committee on Antibiotic Resistance (JETACAR)¹⁵ report are promoting prudent use of antibiotics to control antibiotic resistance.

The principles that underpin all editions of Therapeutic Guidelines: Antibiotic include use of antibiotics only where the benefits are scientifically demonstrable and substantial, and use of the narrowest spectrum agent to cover known or likely pathogens.⁵ The results of this study show that there is widespread divergence from these principles in the antibiotic treatment of LRTI in EDs and that this continues in the use of antibiotics on the wards.

Improvements in antibiotic prescribing can be achieved. This has been demonstrated overseas by Pestotnik et al¹⁶ and Shojania et al¹⁷ who have used computer-assisted decision support systems linked to electronic prescribing to implement antibiotic practice guidelines. This has also been demonstrated in Australia. MacDonald and Ferguson reported a reduction of third generation cephalosporin use from an average of 40.9 defined daily doses (DDDs) per 1000 patient days to 27.9 DDDs/1000 patient days following a multi-faceted educational campaign.¹⁸ The reduction in cephalosporin use was sustained over a three-year period and was accompanied by a fall in the number of nosocomial *Clostridium difficile* infections. South, Royle and Starr reported that distribution of specific hospital antibiotic guidelines on a laminated card suitable to be clipped to a hospital identification badge led to an increase in the proportion of patients being treated with an appropriate antibiotic.¹⁹ Richards et al reported a decrease in the non-intensive care use of broad-spectrum cephalosporins from an average 38.3 DDDs/1000 beddays to 17.6 DDDs/1000 beddays following the introduction of an approval system for these drugs that uses a web-based form to generate approval numbers for indications for which they are recommended in Therapeutic Guidelines: Antibiotic.²⁰

Conclusions

- The antibiotics most frequently prescribed to treat lower respiratory tract infection in the emergency departments involved in the study were ceftriaxone/cefotaxime and roxithromycin (44% and 36% of patients respectively).
- The overall rate of concordance with Therapeutic Guidelines: Antibiotic 11th version was very low (7%).
- The main reason for nonconcordance was the prescription of ceftriaxone and cefotaxime for lower respiratory tract infection where there was no radiological evidence of pneumonia, for mild - moderate pneumonia and for patients with severe community-acquired pneumonia who did not have a contraindication to the use of benzylpenicillin.
- The other major area of nonconcordance with AG11 was around the decision of whether or not antibiotics were indicated for treatment of patients with non-pneumonia respiratory tract infections (exacerbations of chronic bronchitis and other LRTI).

Recommendations

Feedback to hospitals

Feedback to hospitals has already commenced with presentation of the results at the “Seminar on the findings of a 12 hospital audit on the treatment of lower respiratory tract infection (LRTI) in emergency departments” sponsored by the Victorian Drug Usage Advisory Committee (VDUAC). The Workshop was attended by representatives of the infectious diseases clinicians, emergency physicians and hospital pharmacy, as well as VDUAC, the Department of Human Services (Acute Health), Therapeutic Guidelines Limited, the National Prescribing Service and the National Institute of Clinical Studies.

This report should be disseminated to all participating hospitals and to other hospitals and organisations on request.

Feedback to Therapeutic Guidelines Limited

This report should be forwarded to Therapeutic Guidelines Limited.

It should be noted that a new version of Therapeutic Guidelines: Antibiotic has already been published (April 2003) that addresses many of the issues raised in the study. There is a new evaluation of the place of ceftriaxone and cefotaxime in the treatment of CAP, where ceftriaxone and cefotaxime are recommended for classes III and IV pneumonia if the patient is hypersensitive to penicillin (excluding immediate hypersensitivity), if gentamicin is contraindicated or if the patient is to be treated in Hospital in the Home (class III), and for treatment of class V pneumonia. Amoxycillin/ampicillin IV is recommended as a second-line drug in the treatment of classes III and IV CAP and there are also recommendations for antibiotic cover for atypical organisms in treatment of classes III and IV CAP.

Policy development

The VDUEG has now carried out two separate studies that have demonstrated widespread inappropriate prescribing of the broad-spectrum antibiotics ceftriaxone and cefotaxime.

The VDUEG recommends that hospitals should be encouraged to develop and implement policies restricting the use of ceftriaxone and cefotaxime that are consistent with the current edition of the Therapeutic Guidelines: Antibiotic, paying particular attention to the treatment of lower respiratory tract infection, surgical prophylaxis and prescribing in emergency departments.

A number of Australian hospitals have developed a range of systems to improve antibiotic prescribing that have been proven effective in the hospital in which they have been developed. The VDUEG recommends that hospitals should be encouraged to adopt one of these proven effective methods for changing antibiotic prescribing, including but not limited to multi-faceted educational programs, distribution of local hospital guidelines on a card that can be attached to a hospital identification card, an antimicrobial approval system that requires prescribers to write approval numbers on prescriptions for restricted antibiotics or computer-assisted decision support for antibiotic prescribing. The VDUEG believes that these systems should be actively promoted to other hospitals and the computer-based systems should be supported to develop open operating systems.

Support for Drug Usage Evaluation (DUE)

The multi-site drug usage evaluation process is a relatively inexpensive method of reviewing drug use in a variety of clinical settings and has raised a number of issues relating to the diagnosis and treatment of LRTI in the EDs including diagnosis, chest X-ray interpretation, awareness and availability of antibiotic prescribing protocols and antibiotic approval systems.

Audits are the first step of the DUE cycle. The VDUEG through its relationships with Victorian groups [VDUAC and Victorian Therapeutics Assessment Group (VicTAG)] and corresponding groups in other states has the networks necessary to implement interventions to improve prescribing in hospitals of all sizes including regional, suburban and metropolitan teaching hospitals.

The VDUEG would now like to develop strategies to address the issues in conjunction with Emergency Department and Infectious Diseases physicians and appropriate government committees such as the Victorian Quality Council (VQC), Infection Control Working Group, the Victorian Advisory Committee on Infection Control (VACIC) and Victorian Nosocomial Infection Surveillance Service (VICNISS). The strategies developed would need to be easily applicable in a wide range of healthcare settings. A routine audit mechanism also needs to be developed in order to provide feedback to the prescribers and to evaluate the outcome of the strategies and allow on-going refinement. An essential step in this process is for the VDUEG to source adequate funding to undertake the project.

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Appendices

- Appendix 1: Data collection form
- Appendix 2: Explanatory notes for data collection
- Appendix 3: Algorithms for assessing concordance with AG11
- Appendix 4: Concordance checking

APPENDIX 1: DATA COLLECTION FORM FOR MINIMUM DATA SET
MULTI-CENTRE DUE OF ANTIBIOTIC TREATMENT OF LOWER RESPIRATORY
INFECTION IN EMERGENCY DEPARTMENTS
(please circle or write an answer in each box)

PATIENT NO
 «Patient_
 number»

Demographic details (delete patient name/URN before forwarding this form)

Patient name/UR No		Hospital code	«Hospital_code
Date of birth		Gender	Male / Female
Pregnant?	Not documented / Yes	Breast-feeding?	Not documented / Yes
Documented previous adverse reactions to antibiotics	None documented / Yes (describe)		
Date of admission to emergency department		Time of admission to emergency department	
Date of discharge from emergency department		Time of discharge from emergency department	
Admitted from:	Home / Nursing home / Other hospital / Homeless / Other (specify)		
Discharged to:	Home / Nursing home / Other hospital / Ward / ICU / HITH / Homeless / Died / Other (specify)		
Treatment to be reviewed by:	None / LMO / ED / Admitting Unit / Other hospital / Private specialist / Other (specify)		
Diagnosis (from doctor's notes)			
Diagnosis (from computer generated Daily List)			
Seen by or discussed with medical registrar?	Not documented / Yes		

Antibiotic use

Were antibiotics used in the 7 days prior to attendance at the emergency department? Not documented / Yes

Antibiotic	Dosage	Route	Start date	Finish date	Indication

Were antibiotics given in the emergency department? No / Yes

Antibiotic	Dosage	Route	Start date	Start time	No of doses given

Were antibiotics prescribed for discharge? No / Yes / Not applicable (record below)

Were antibiotics prescribed on admission to ward? No / Yes / Not applicable (record below)

Antibiotic	Dosage	Route

General comments

--

Patient's usual medication and other drugs given in the emergency department (list names or write 'None')

Drug	Drug	Drug	Drug

Comorbidities (circle an answer for each one)

Neoplastic disease	Not documented / Yes	Liver disease	Not documented / Yes
Congestive heart failure	Not documented / Yes	Cerebrovascular disease	Not documented / Yes
Renal disease	Not documented / Yes	Immunosuppression	Not documented / Yes
Diabetes	Not documented / Yes	Alcohol abuse	Not documented / Yes

Details of lower respiratory tract infection (circle or write an answer on every line)

Aspiration	No / Yes / Not documented			
Underlying lung disease	Asthma / COPD / emphysema / fibrosis / other / none			
Cough, increased	No / Yes / Not documented			
Dyspnoea, increased	No / Yes / Not documented			
Sputum volume, increased	No / Yes / Not documented			
Sputum purulence, increased	No / Yes / Not documented			
Maximum temperature (° C)	<i>Not documented / result</i>	Maximum pulse rate	<i>Not documented / result</i>	
Maximum respiratory rate	<i>Not documented / result</i>	Minimum arterial pH	<i>Not documented / result</i>	
Minimum pO ₂ (mmHg)	<i>Not documented / result</i>	Maximum pCO ₂ (mmHg)	<i>Not documented / result</i>	
Minimum O ₂ sat (%)	<i>Not documented / result</i>	Maximum FIO ₂ (%)	<i>Not documented / result</i>	
Minimum systolic BP (mmHg)	<i>Not documented / result</i>	Minimum diastolic BP (mmHg)	<i>Not documented / result</i>	
White blood cell count	<i>Not documented / result</i>			
Serum sodium	<i>Not documented / result</i>	Serum creatinine	<i>Not documented / result</i>	
Recent deterioration in renal function	No / Yes / Not documented			
Chest X-ray done	No / Yes			
Evidence of COPD or emphysema	Doctor's notes	No / Yes / Not documented	Radiology report	No / Yes / Not documented
Evidence of opacity, consolidation or pulmonary infiltrates consistent with pneumonia	Doctor's notes	No / Yes / Not documented	Radiology report	No / Yes / Not documented
Evidence of bilateral involvement or involvement of multiple lobes	Doctor's notes	No / Yes / Not documented	Radiology report	No / Yes / Not documented
Increase in size of chest X-ray opacity by 50% or more in 48 hours	Doctor's notes	No / Yes / Not documented	Radiology report	No / Yes / Not documented
Evidence of pleural effusion	Doctor's notes	No / Yes / Not documented	Radiology report	No / Yes / Not documented

Microbiology (for specimens taken within 2 weeks prior to this presentation at the emergency department)

Date	Specimen	Organism	Sensitive to:	Resistant to:
	Sputum / Blood			
	Sputum / Blood			

APPENDIX 2:

MULTI-CENTRE DUE OF ANTIBIOTIC TREATMENT OF LOWER RESPIRATORY TRACT INFECTION IN EMERGENCY DEPARTMENTS

EXPLANATORY NOTES FOR DATA COLLECTION

Enrolment period

The starting date of the study is Monday 30/4/2001. All patients who attend the Emergency Department after midnight on Sunday 29/4/2001 are potentially eligible for enrolment. The enrolment period continues until a quota of 60 consecutive patients treated with antibiotics for lower respiratory tract infection is reached.

Identification of patients

<p>Step 1. Examine the emergency department computer records starting from 30/4/2001 to identify all patients who were</p> <ul style="list-style-type: none">• aged \geq 18 years and had a diagnosis of• bronchitis, acute• bronchopneumonia, aspiration• chronic obstructive pulmonary disease• lower respiratory infection, chest pneumonia, lobar. <p>Record the date, name, UR number, diagnosis and whether prescribed antibiotics for each of these patients on the list form (Irtipatlist2.doc).</p>	<p>Step 2. If the patient was prescribed antibiotics in the emergency department (ie administered antibiotics in the emergency department or prescribed antibiotics to be taken after discharge from the emergency department) fill out a data collection form for this patient.</p> <p>If a patient attends the emergency department and is prescribed antibiotics for a lower respiratory infection more than once during the study period, fill out a data collection form for each attendance.</p>
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Forms

Each participating hospital has been provided with 60 data collection forms that have been coded for the hospital and numbered for the patient. Some blank forms have also been provided for you to photocopy as needed.

Glossary

ICU = Intensive Care Unit
HITH = Hospital in the Home
LMO = Local Medical Officer
ED = Emergency Department

Data

The data collection will be retrospective. Record data from the emergency department records, ambulance records, letters from referring doctors or institutions, the first medication chart for admitted patients, pathology and radiology reports. Record information relating to the current attendance at the emergency department. Do not record information from previous admissions/attendances unless the notes for the current attendance refer to an earlier admission/attendance.

PLEASE CIRCLE OR WRITE AN ANSWER IN EACH BOX.

Patient name/UR No

Only fill this box in if you find it useful for identifying forms. Delete this information before forwarding the form to the coordinating centre.

Date and time of discharge from emergency department

If the patient was admitted as an inpatient, record the date and time of the admission even if the patient was still physically located in the emergency department.

Antibiotic use

Only fill in a numbered and coded data collection form if the patient was given an antibiotic in the emergency department or prescribed an antibiotic in the emergency department to be started following discharge from the emergency department.

Prior antibiotics

If the antibiotic has not been named write 'Unspecified' in the box.

If details of dose and frequency, route, starting and stopping dates have not been documented write 'ND' in the appropriate boxes.

Antibiotics prescribed for discharge

If the patient was admitted to a ward, circle 'Not applicable'.

If the patient was prescribed antibiotics on discharge from the emergency department to home, a nursing home or another hospital etc record the information in these boxes.

Write 'ND' if details of the prescription have been omitted.

Antibiotics prescribed on admission to ward

If the patient was discharged from the emergency department to home, a nursing home or another hospital etc circle 'Not applicable'.

If the patient was prescribed antibiotics on admission to a ward (including Hospital in the Home) record the information in these boxes.

General comments

Use this box to record information about factors that might have influenced the choice of antibiotic such as contraindications to antibiotics, potential drug interactions or severity of illness etc and additional microbiology results.

Patients usual medication and other drugs given in the emergency department

Record names only. Use generic names if possible.

Comorbidities

Immunosuppression. Record as Yes if the patient has had an organ transplant, is being treated with cytotoxics, significant doses of corticosteroids or other immunosuppressants or is infected with HIV.

Details of lower respiratory tract infection

Please record if the measurements of arterial pH, pO₂, pCO₂ and SaO₂ were taken while the patient was being treated with oxygen.

White blood cell count, serum sodium and serum creatinine

Record results on the day of attendance.

Sending information to the coordinating centre

Data may be submitted to the coordinating centre on a data collection form or electronically via a Microsoft Access 97 database.

Sending in data collection forms

Make a photocopy of each completed form, delete or black out the patient's name or UR Number and send the photocopies of all completed forms to the coordinating centre. Keep all original data collection forms at your hospital.

The postal address is:

MULTI-CENTRE DUE OF ANTIBIOTIC TREATMENT OF LRTI IN EMERGENCY DEPARTMENTS
DEPT OF CLINICAL PHARMACOLOGY AND THERAPEUTICS
C/- POST OFFICE
THE ROYAL MELBOURNE HOSPITAL
PARKVILLE VIC 3050

Sending the data electronically

Each hospital will be sent a customised copy of the database in Microsoft Access 97.

Email this database to Marion.Robertson @mh.org.au when data entry is complete.

Notes on use of the database

Everything works from the Demographics form, which extends across the page.

The other forms about antibiotic use, other drug use and microbiology results are linked by the Patient number. The Patient number should always be the same across all the forms.

Use the Tab key to move between fields.

To open the Demographics form, open the database, click on Forms then double click on Demographics.

To start a new patient record, click the button with the arrow head and asterisk at the bottom of the screen.

To enter a second or subsequent antibiotic or drug for the same patient, click the button with the arrow head and asterisk within the subform box.

Date of birth is entered as dd/mm/yyyy. All other dates are entered as ddmmyy.

Times are entered as hhmm.

Most of the fields are text fields and have drop down lists from which to choose to make data entry easy and consistent. Explanations of abbreviations used for each field are displayed at the bottom of the screen.

For oxygen saturations and partial pressures of O₂ and CO₂ please also enter if the patient was being treated with oxygen at the time of the measurement.

Antibiotic doses - this is a text field so enter as 100mg daily or 150mg bd or 1g tds etc.

You can add more antibiotics into the Antibiotic lookup table if something isn't on the list. Similarly you can add more drugs to the Other drugs lookup table as needed. Just open the tables, type in the generic names and close the tables.

Problems

Please contact the coordinator if you foresee or experience any problems in filling out the form or using the database

Coordinator

Marion Robertson

My telephone number is:

The Royal Melbourne Hospital
email

Tel: 03-9342-7612

Fax: 03-9342-7898

Marion.Robertson@mh.org.au

APPENDIX 3a: ASSESSMENT OF CONCORDANCE OF LOWER RESPIRATORY TRACT INFECTION WITH AG11.

Was the patient treated empirically?	No →	Specific
↓ Yes		
Did the patient have CXR evidence of pneumonia?	No →	Go to: Assessment of concordance of bronchitis.
↓ Yes		
Was the patient admitted from another hospital?	Yes →	Go to: Assessment of concordance of HAP
↓ No		
Was aspiration suspected and documented?	Yes →	Go to: Assessment of concordance of aspiration CAP
↓ No		
Did the patient meet at least 1 criterion for severe pneumonia?	No →	Go to: Assessment of concordance of mild - moderate CAP
↓ Yes		
Go to: Assessment of concordance of severe CAP		

APPENDIX 3b: ASSESSMENT OF CONCORDANCE OF BRONCHITIS WITH AG11

Bronchitis				No recommendation in AG11
↕ Yes				Yes
Any mention of COPD, COAD, CAL?*	No →	Other LRTI	→	Was the patient immunosuppressed?
↓ Yes				No
Antibiotic treatment indicated**?	No →	Not concordant with AG11. (Describe difference with AG11 – Antibiotic treatment not indicated.)		Not concordant with AG11. (Describe difference with AG11 – Antibiotic treatment not indicated.)
↓ Yes				
Was the patient treated with: amoxicillin (A) OR doxycycline (D)	No →	Not concordant with AG11. (Describe difference with AG11.)		
↓ Yes				
Concordant for drug with AG11				
↓				
Were the doses: A – 500 mg orally OR D – 200mg orally (initially)	No →	Describe difference with AG11, eg D 100mg as an initial dose.		
↓ Yes				
Fully concordant with AG11				

* Check all diagnosis fields, the Underlying lung disease field, the Comments field and the chest X-ray fields

** Increased cough AND increased dyspnoea AND increased sputum volume AND/OR increased purulence

APPENDIX 3c: ASSESSMENT OF CONCORDANCE OF MILD - MODERATE COMMUNITY-ACQUIRED PNEUMONIA (CAP) WITH AG11.

Mild - moderate CAP?		Fully concordant with AG11				
Yes ↓		↑ Yes				
		Was the dose given 1g IV?	No →	Describe difference with AG11 eg given 2g.		
		↑				
		Concordant for drug with AG11				
		↑ Yes				
		Was the patient treated with cephalothin or cephalosporin?	No →	Not concordant with AG11. (Describe difference with AG11 eg ceftriaxone given instead of cephalothin.)		
	↑ Yes		↑ No			
Was the patient treated orally?	No →	Did the patient have a previous ADR to penicillins?	No →	Was the patient treated with: benzylpenicillin (BP) OR procaine penicillin (PP)?		
↓ Yes				↓ Yes		
Was the patient treated with: roxithromycin (R) OR amoxicillin (A) OR doxycycline (D)?	No →	Not concordant with AG11. (Describe difference with AG11 eg ciprofloxacin given instead of recommended drugs.)		Concordant for drug with AG11		
↓ Yes				↓		
Concordant for drug with AG11				Was the dose given: BP – 1.2g IV OR PP - 1.5g IM?	No →	Describe difference with AG11 eg BP given 0.6g IV.
Was the dose given: R – 150 or 300 mg orally, OR A – 1g orally, OR D – 200mg orally initially?	No →	Describe difference with AG11, eg A given 500mg.		↓ Yes		
↓ Yes				Fully concordant with AG11		
Fully concordant with AG11						

APPENDIX 3d: ASSESSMENT OF CONCORDANCE OF SEVERE COMMUNITY-ACQUIRED PNEUMONIA (CAP) WITH AG11.

Severe CAP?		Not concordant with AG11. (Describe difference with AG11 eg E omitted.)		
↓ Yes		↑ No		
Did the patient have a previous ADR to penicillins?	Yes →	Was the patient treated with: erythromycin (E) PLUS cefotaxime or ceftriaxone (CEFX)?		
No ↓		↓ Yes		
		Concordant for drug with AG11		
		↓		
		Were the doses: E – 0.5 to 1g IV PLUS CEFX – 1g?	Yes →	Fully concordant with AG11
		↓ No		↑ Yes
		Describe difference with AG11 eg E given orally.		
Was the patient treated with: erythromycin (E) AND benzylpenicillin (BP) AND gentamicin (G)?	Yes →	Concordant for drug with AG11	→	Were the doses: E - 0.5 to 1 g IV, AND BP – 1.2 g IV AND G – 4 to 6 mg/kg*.
↓ No				↓ No
Not concordant with AG11. (Describe difference with AG11 eg E omitted.)				Describe difference with AG11 eg E given orally.

* We didn't record the patients' weights so assume the gentamicin doses were correct.

APPENDIX 3e: ASSESSMENT OF CONCORDANCE OF ASPIRATION COMMUNITY-ACQUIRED PNEUMONIA WITH AG11.

Aspiration CAP and/or lung abscess from aspiration?					
↓ Yes					
Did the patient meet at least 1 criterion for severe pneumonia?	No →	Not concordant with AG11. (Describe difference with AG11 – Antibiotic treatment not indicated.)			
↓ Yes					
Did the patient have a previous ADR to penicillins?	Yes →	Was the patient treated with: clindamycin (C) OR lincomycin (L)? Gentamicin (G) may also be included*.	No →	Not concordant with AG11. (Describe difference with AG11,)	
↓ No		Not concordant with AG11. (Describe difference with AG11,)	Yes ↓		
		↑ No	Concordant for drug with AG11.		
Was the patient treated with: benzylpenicillin (BP) AND metronidazole (M)? Gentamicin (G) may also be included*.	No →	Was the patient treated with tic/clav (T/C) OR pip/taz (P/T)?	↓ Yes		
↓ Yes		↓ Yes	Were the doses: C – 600 mg IV OR L – 1.2g IV (AND G – 4 to 6mg/kg**)?	No →	Describe difference with AG11, eg C dose 300 mg IV.
Concordant for drug with AG11.		Concordant for drug with AG11.	↓ Yes		
↓		↓	Fully concordant with AG11.		
Were the doses: BP – 1.2 g IV AND M – 500 mg IV? (AND G – 4-6mg/kg**)		Were the doses: T/C – 3.1g IV OR P/T – 4.5g IV?	↑ Yes		
↓ Yes		↓ No			
Fully concordant with AG11.		Describe difference with AG11.			

* If Gram-negative pneumonia is suspected eg alcoholic patients.

** We didn't record the patients' weights so assume the gentamicin doses were correct.

APPENDIX 3f: ASSESSMENT OF CONCORDANCE OF HOSPITAL-ACQUIRED PNEUMONIA (HAP) WITH AG11.

HAP?				
↓ Yes				
Did the patient meet at least 1 criterion for severe pneumonia?	No →	Go to: Assessment of concordance of mild - moderate HAP		
↓ Yes				
Did the illness start > 5 days after admission to hospital?*	No →	Early onset severe HAP	→	Go to: Assessment of concordance of severe CAP
↓ Yes				
Go to: Assessment of concordance of late onset severe HAP				

* Assume patients admitted from other hospitals had been in the hospital for ≥ 5 days unless there is documentary evidence otherwise.

APPENDIX 3g: ASSESSMENT OF CONCORDANCE OF SEVERE LATE ONSET HOSPITAL-ACQUIRED PNEUMONIA (HAP) WITH AG11.

Severe late-onset HAP?		Not concordant with AG11 (Describe difference with AG11.)				Fully concordant with AG11.
↓ Yes		↑ No				↑ Yes
Were aminoglycosides contraindicated?	→ Yes	Was the patient treated with: ciprofloxacin (CIP) PLUS tic/clav (T/C) OR pip/taz (P/T)? Vancomycin (V) and erythromycin (E) may also be included.	→ Yes	Concordant for drug with AG11	→	Were the doses: CIP – 400mg IV OR CIP – 500-750mg orally PLUS T/C – 3.1g IV OR P/T – 4.5g IV? (AND V – 1g IV, AND/OR E – 0.5-1g IV)
↓ No		↑ No				↓ No
		Not concordant with AG11 (Describe difference with AG11.)				Describe difference with AG11.
		↑ No				↑ No
Were penicillins contraindicated?	→ Yes	Was the patient treated with gentamicin (G) and cefepime (CEF)? Vancomycin (V) and erythromycin (E) may also be included.	→ Yes	Concordant for drug with AG11	→	Were the doses: G – 4 to 6mg/kg IV* AND CEF – 2g IV? (AND V – 1g IV, AND/OR E – 0.5-1g IV)
↓ No						↓ Yes
						Fully concordant with AG11.
Was the patient treated with: gentamicin (G) PLUS tic/clav (T/C) OR pip/taz (P/T)? Vancomycin (V) and erythromycin (E) may also be included.	→ Yes	Concordant for drug with AG11	→	Were the doses: G – 4-6mg/kg IV* PLUS T/C – 3.1g IV OR P/T – 4.5g IV? (AND V – 1g IV, AND/OR E – 0.5-1g IV)	→	Fully concordant with AG11.
↓ No				↓ No		
Not concordant with AG11 (Describe difference with AG11.)				Describe difference with AG11.		

* We didn't record the patients' weights so assume the gentamicin doses were correct.

APPENDIX 3h: ASSESSMENT OF CONCORDANCE OF MILD - MODERATE HOSPITAL-ACQUIRED PNEUMONIA (HAP) WITH AG11.

Mild HAP?				
↓ Yes				
Aspiration or recent thoraco-abdominal surgery?	Yes →	Go to: Mild - moderate HAP (aspiration or recent thoraco-abdominal surgery)		
↓ No				
Diabetes, coma, renal failure or head injury?	Yes →	Go to: Mild - moderate HAP (diabetes, coma, renal failure or head injury)		
↓ No		Mild HAP		
		↑ No		
Mild illness?	Yes →	Were penicillins contraindicated?	Yes →	Mild HAP (post-operative, penicillins contraindicated)
↓ No				
Moderate HAP (post-operative)				Not covered in AG11
↓				
Are penicillins or gentamicin contraindicated?	No →	Moderate HAP (post-operative)		
↓ Yes				
Moderate HAP (post-operative, penicillins or gentamicin contraindicated)				

APPENDIX 3i: ASSESSMENT OF CONCORDANCE OF MILD HAP WITH AG11

Mild HAP?				Fully concordant with AG11
↓ Yes				↑ Yes
Was the patient treated with amoxy/clav (A/C)?	Yes →	Concordant for drug with AG11	→	Was the dose A/C 875/125mg orally?
↓ No				↓ No
Not concordant with AG11 (Describe difference with AG11)				Describe difference with AG11

APPENDIX 3j: ASSESSMENT OF CONCORDANCE OF MODERATE HAP WITH AG11

Moderate HAP?				
↓ Yes				
Were penicillins or aminoglycosides contraindicated?	No →	Was the patient treated with benzylpenicillin (BP) PLUS gentamicin (G)?	No →	Not concordant with AG11 (Describe difference with AG11)
↓ Yes		↓ Yes		
		Concordant for drug with AG11		
		↓		
		Were the doses: BP – 1.2g IV and G – 4 to 6mg/kg IV?	No →	Describe difference with AG11
		↓ Yes		
		Fully concordant with AG11		Fully concordant with AG11
				↑ Yes
Was the patient treated with ceftriaxone or cefotaxime (CEFX)?	Yes →	Concordant for drug with AG11	→	Was the dose: CEFX - 1g IV?
↓ No				↓ No
Not concordant with AG11 (Describe difference with AG11)				Describe difference with AG11

* We didn't record the patients' weights so assume the gentamicin doses were correct.

APPENDIX 3k: ASSESSMENT OF CONCORDANCE OF MILD - MODERATE HOSPITAL-ACQUIRED PNEUMONIA WITH AG11.

(WITNESSED ASPIRATION OR RECENT THORACO-ABDOMINAL SURGERY)

Mild - moderate HAP (aspiration or recent thoracoabdominal surgery)		Not concordant with AG11				Fully concordant with AG11
↓ Yes		↑ No				↑ Yes
Were penicillins contraindicated in this patient?	Yes	Was the patient treated with: gentamicin (G) PLUS clindamycin (C) OR lincomycin (L)?	Yes	Concordant for drug with AG11		Were the doses: G – 4 to 6mg/kg IV* PLUS C – 600mg IV OR L – 1.2g IV?
↓ No						↓ No
Was the patient treated with: benzylpenicillin (BP) PLUS gentamicin (G) PLUS metronidazole (MET)?	No	Was the patient treated with tic/clav (T/C) OR pip/taz (P/T)?	No	Not concordant with AG11		Describe difference with AG11.
↓ Yes		↓ Yes				
Concordant for drug with AG11		Concordant for drug with AG11				
↓		↓				
		Were the doses: T/C – 3.1g IV OR P/T – 4.5g IV?	Yes	Fully concordant with AG11		
		↓ No				
Were the doses: BP – 1.2g IV PLUS G – 4 to 6 mg/kg* IV PLUS MET – 500mg IV?	No	Describe difference with AG11.				
↓ Yes						
Fully concordant with AG11						

* We didn't record the patients' weights so assume the gentamicin doses were correct.

APPENDIX 3: ASSESSMENT OF CONCORDANCE OF MILD - MODERATE HOSPITAL-ACQUIRED PNEUMONIA WITH AG11. (DIABETES, COMA, RENAL FAILURE OR HEAD INJURY).

Mild - moderate HAP (diabetes, coma, renal failure or head injury)						Fully concordant with AG11
↓ Yes						↑ Yes
Were penicillins or gentamicin contraindicated in this patient?	No →	Was the patient treated with di(flu)cloxacillin (D/F) PLUS gentamicin?	Yes →	Concordant for drug with AG11	→	Were the doses: D/F – 2g IV PLUS G – 4 to 6mg/kg IV*?
↓ Yes		↓ No				↓ No
Not covered in AG11 but would accept treatment with vancomycin (V) as Concordant for drug		Not concordant with AG11 (Describe difference with AG11.)				Describe difference with AG11.
↓						
Was the dose: V – 1g IV?	No →	Describe difference with AG11.				
↓ Yes						
Fully concordant with AG11	No →	Describe difference with AG11 (eg BP dose 0.6 g instead of 1.2g)				

* We didn't record the patients' weights so assume the gentamicin doses were correct.

APPENDIX 4: Concordance checking

Original diagnosis	Number of patients checked (%)	Number of patients with errors in assigning diagnostic group	Number of patients with errors in assigning concordance
Radiological evidence of pneumonia	292/377 (77%)		
Severe CAP	263/263 (100%)	1	3
Mild - moderate CAP	16/88 (18%)	2	0
Aspiration CAP	6/19 (32%)	1	0
HAP	7/7 (100%)	1	0
No radiological evidence of pneumonia	160/226 (71%)		
Exacerbations of chronic bronchitis	131/131 (100%)	0	0
Other LRTI	29/95 (31%)	3	21
Total patients	452/603 (75%)		