Chapter 9

Experiences with Antimicrobial Utilisation Surveillance and Benchmarking

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1. INTRODUCTION

An antimicrobial utilisation surveillance programme was established in Adelaide, South Australia (SA), in November 2001 as an initiative of the Infection Control Service, Communicable Disease Control Branch (CDCB) of the South Australian Department of Human Services. This voluntary surveillance programme incorporates antimicrobial usage data submitted on a monthly basis by major Adelaide metropolitan public and private hospitals. The aim of the programme is to provide SA hospitals with an ongoing overview of their antimicrobial usage rates over time, to enable intervention programmes or policy changes to be planned and implemented where high or increasing rates are identified, and to assess the effectiveness of such programmes or policy changes. Concomitant surveillance of multiresistant organisms within the same institutions is also conducted by the CDCB and when sufficient data are available, links between antimicrobial usage rates and the incidence of particular organisms will be examined. Published data suggests that concomitant surveillance of both antibiotic resistance and antimicrobial use is helpful in interpreting resistance patterns within a particular unit or hospital (Monnet *et al*., 1998) and may assist in the development of programmes to complement improved infection control procedures in reducing infection rates.

Antibiotic Policies: Theory and Practice. Edited by Gould and van der Meer
Kluwer Academic / Plenum Publishers, New York, 2005

This programme was initiated in response to recommendations arising from a report prepared by the Joint Expert Technical Advisory Committee on Antibiotic Resistance (JETACAR), formed by the Australian Government in 1997, in response to the increasing incidence of antimicrobial resistance. The JETACAR made 22 recommendations and, in response, the Commonwealth supported surveillance of both antibiotic resistant organisms and antibiotic utilisation (Commonwealth Department of Health and Aged Care, Commonwealth Department of Agriculture, Fisheries and Forestry—Australia, 1999 and 2000). To date, the SA programme is the only state programme within Australia conducting surveillance of antimicrobial usage. No national programme has yet been established, although preliminary discussions have taken place.

During 2002, 11 SA metropolitan hospitals were involved in the programme. Complete 2002 usage data are available for eight of the eleven hospitals, with three commencing data contribution during the 12-month period. One additional hospital joined the programme in 2003, with at least one more to join in 2004. The hospitals contributing data in 2002 included six public and five private hospitals, ranging in size from approximately 100–650 beds. Stratification by case-mix, size, or other parameter has been avoided due to the limited number of institutions involved; however, submitted data are stratified to provide separate usage rates for intensive care units (ICUs) where applicable, provided these data can be accurately provided by the pharmacy service provider. Intensive care usage data were submitted by six hospitals during 2002, involving four public and two private hospitals.

The pooling of data for hospital areas other than ICUs has some disadvantages, and the reporting of usage rates for particular clinical services or units would assist in identifying units with high antimicrobial usage rates within individual hospitals, and enable more appropriate comparison between similar hospitals. This level of stratification, however, is not currently possible, although antimicrobial consumption by some specialised services or units such as haematology or transplant units, where there is a high usage of antimicrobials, is a future target for collection and analysis where the usage data can be accurately provided. In most Australian hospitals, however, accurate usage data for many wards or units, such as general surgical or medical wards, is difficult to obtain due to patient mix within these areas and the lack of pharmacy resources to enable identification of use by individual patients. No hospital participating in the SA programme is currently able to provide complete, accurate data for antimicrobial consumption at individual patient level.

A survey of contributing hospitals during 2002 found that eight have a hospital formulary which limits to some extent the choice of antimicrobial agents which can be routinely prescribed; however, specific restrictions on antimicrobial use for various indications or patient groups apply in only six of the eleven institutions. These restrictions vary considerably with respect to both the range

of agents involved and the limitations imposed. Comprehensive restriction programmes, with the requirement for prior authorisation by infectious diseases staff for some agents, currently operate only in large teaching hospitals. The extent to which these policies are enforced, however, varies significantly between institutions. Restrictions applying to the intensive care setting also vary widely between the contributing hospitals, with these units subject to fewer restrictions or unrestricted use in most cases. Restriction programmes requiring prior authorisation, although labour-intensive, can have major impact on antimicrobial usage patterns and also expenditure. One study has demonstrated no compromise to clinical outcomes from a prior authorisation requirement for a range of antimicrobials which was applied throughout the hospital, including the ICU (White, 1997).

One difficulty encountered during establishment of the SA surveillance programme was the diversity of computer systems used by hospital pharmacy departments or pharmacy service providers for contributing hospitals. Antimicrobial consumption data is submitted to the Infection Control Service in a variety of formats, necessitating the design of a computer program to centrally accept and analyse these data. This programme has the facility to produce automated monthly reports for each hospital, detailing antimicrobial usage density rates within that hospital. Corresponding rates calculated from aggregation of all contributed data are also supplied for comparison, although hospitals are encouraged to use caution when making such comparisons, and should consider inter-institutional differences in multiresistant organism burden and case-mix complexity. All details relating to individual hospital usage rates are kept confidential and only provided to that hospital, unless specific approval is obtained for publication of data. Currently, individual hospital and aggregate usage rates for six antimicrobial classes, and individual agents within those classes, are routinely reported to each contributor. Separate rates for ICU usage are provided where appropriate. Usage rates for other classes or agents can be calculated as required.

Usage data contributed by Adelaide's specialist paediatric hospital are not included in the automated reporting programme, as consumption by a paediatric population cannot be translated into a standard usage density rate. Consumption data is collected, however, and reported separately. The establishment of a national network of paediatric hospitals is planned to allow benchmarking between these institutions, with a particular focus on antimicrobial use in neonatal ICUs, using an agreed unit of measurement.

The establishment of a rural hospital antimicrobial utilisation surveillance network is currently underway, with approximately 30 rural hospitals expected to be involved in this programme. The range of antimicrobials reported routinely in this programme will differ from the current metropolitan network and may provide information on usage patterns in rural areas as a focus for programmes aimed at general practitioner prescribing.

2. DEFINITIONS USED IN ANTIMICROBIAL SURVEILLANCE

Defined daily dose (DDD) has been used as the unit for measurement of antimicrobial consumption in this surveillance programme. The DDD for any drug is defined as the average dose per day to treat an average adult patient. The World Health Organisation (WHO) has determined standard DDDs for most drugs (WHO Collaborating Centre for Drug Statistics Methodology, 2002), and these values have been used in calculating all displayed usage rates. Use of this internationally accepted standard enables the consumption of antimicrobial agents with differing doses to be compared, aggregation of data to assess usage of antimicrobial classes, and comparisons with data from other surveillance programmes or studies. Because DDDs are based on adult dosing, this parameter cannot be used to measure antimicrobial usage in paediatric populations.

The number of DDDs used is calculated as follows:

$$\text{No. of DDDs} = \frac{\text{Total grams used}}{\text{WHO assigned DDD value}}$$

The usage density rate used in the SA surveillance programme is defined as the number of DDDs used per 1,000 occupied bed-days (OBDs). This rate has been widely used as an appropriate measurement of usage in the non-ambulatory setting, and has been adopted by a number of international programmes (DANMAP, 2003; Fridkin *et al*., 1999), although to ensure comparability of data with other centres, the WHO DDD values should always be used. Antimicrobial usage data for outpatient areas, including hospital-in-the-home, day treatment centres, day surgery, and dialysis clinics are excluded from the SA programme to ensure that the denominator corresponds to that used by the concomitant multiresistant organism surveillance programmes conducted by the Infection Control Service.

The rate is calculated as follows:

$$\text{Usage density rate} = \frac{\text{No. of DDDs/time period} \times 1{,}000}{\text{OBD/time period}}$$

3. DATA COLLECTION AND REPORTING

Numerator data representing antimicrobial consumption, in terms of number of units or packs of individual antimicrobial formulation, are submitted by

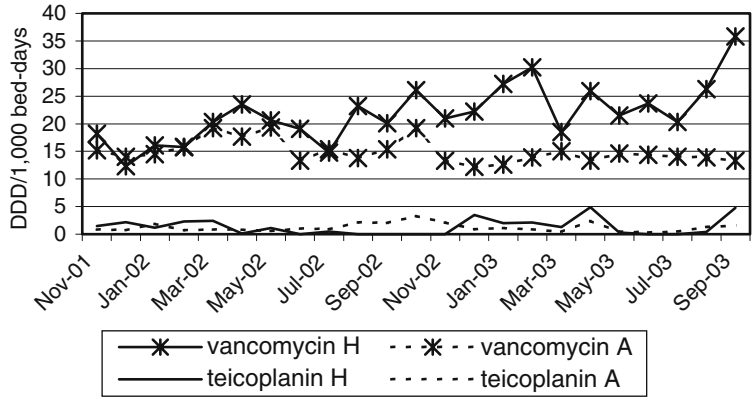

Figure 1. Example of reporting to individual hospitals showing hospital (H) and aggregate (A) rates.

pharmacies on a monthly basis. In the case of public hospitals, this information is supplied by hospital pharmacy departments, while for private hospitals this may be provided by either a contracted individual community pharmacy or a larger hospital pharmacy service provider. Data are stratified into "Intensive Care Unit" (ICU) and pooled usage by other hospital areas (non-ICU), or "total hospital" if there is no ICU, or if ICU data cannot be provided separately. Denominator data representing OBDs are supplied by contributing hospitals.

All contributed datasets are loaded into a custom written database with the facility to calculate usage density rates and produce automated monthly reports for individual hospitals, as well as a report based on aggregate data from all contributors. Rates are routinely calculated for six antimicrobial classes and the individual antimicrobial agents within those classes. Routine reports include charts showing both the usage rate for the institution and the aggregate rate. An example is shown in Figure 1.

4. OVERALL TRENDS IN ANTIMICROBIAL USAGE RATES

Analysis of aggregate SA data for 2002 suggests a slight overall increasing trend in total antimicrobial usage; however, trends for individual hospitals usage over the year varied considerably. Ongoing monitoring and analysis over a longer time period is required to confirm changes in utilisation rates.

The overall antimicrobial usage rates in contributing SA metropolitan hospitals, for both total hospital use and ICU use, are shown in Figure 2.

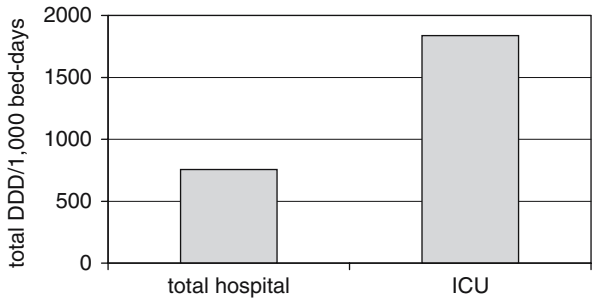

Figure 2. Aggregate antimicrobial usage for all classes and all contributors for 2002 (total hospital and ICU).

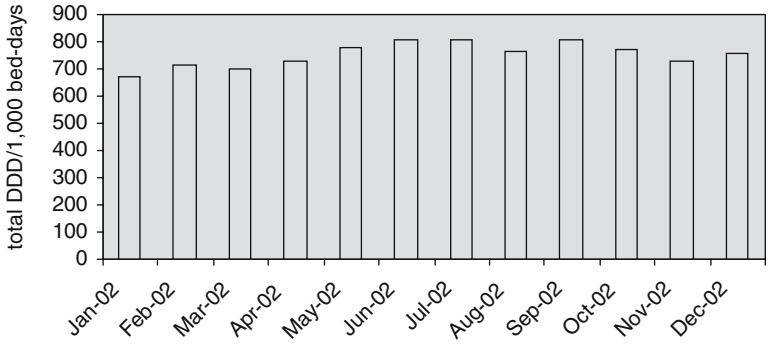

Figure 3. Total monthly aggregate antimicrobial usage for all classes and all contributors.

Aggregate data has been used to calculate these rates. The aggregate rate for total antimicrobial usage in the contributing hospital group for 2002 was 757 DDD/1,000 OBDs. For individual hospitals, total antimicrobial usage ranged from 455 to 966 DDD/1,000 OBDs, with a median rate of 686. For ICU use, the aggregate rate was 1,838 DDD/1,000 OBDs, with a range 1,545–2,252 and a median rate of 1,837.

Monthly rates for aggregate total hospital use are shown in Figure 3. This chart suggests a small upward trend in usage; however, this may be attributable to normal monthly variation, with increased usage of many antimicrobial agents during the winter months. Detailed analysis of usage rates for each contributor and antimicrobial class has demonstrated a seasonal increase in the use of a range of agents, particularly in public hospitals. These include third generation cephalosporins, fluoroquinolones, tetracyclines, amoxicillin and amoxicillin/clavulanate, and particularly macrolides, although significant variation

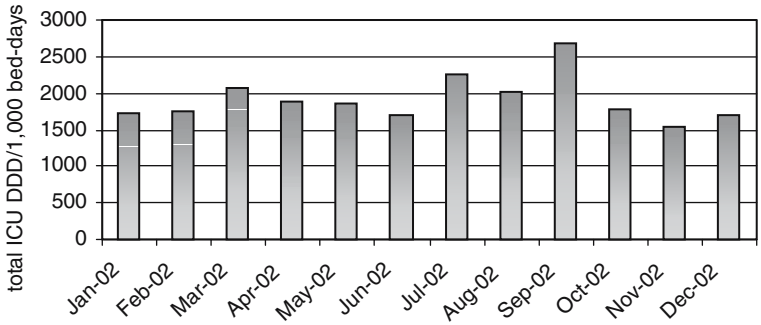

Figure 4. ICU monthly aggregate antimicrobial usage for all classes and all ICU contributors.

was noted between individual hospitals. Only two hospitals demonstrated an increase in benzylpenicillin usage during this time. Analysis of monthly total antimicrobial usage rates for the eight contributors with complete data for the 12-month period demonstrates a seasonal increase in usage for four of these hospitals. Analysis of data collected over a longer time period will be necessary to fully assess both seasonal changes and annual trends in utilisation rates.

Corresponding aggregate monthly usage rates for intensive care units are shown in Figure 4 and do not demonstrate any obvious trend. Analysis of usage for individual units has demonstrated large variations in usage rates, both between and within individual units. Although an increase in usage rates during the winter months was noted for a number of antimicrobial classes, including third generation cephalosporins, macrolides, and fluoroquinolones in some hospitals, this pattern was not consistent for all ICUs. This may reflect the differing proportion of surgical and medical patients within the small number of ICUs submitting data to this surveillance programme.

5. ANALYSIS OF USAGE BY ANTIMICROBIAL CLASS

Data have been analysed by antimicrobial class to allow assessment of relative use of particular classes, as well as changes occurring over time, to provide aggregate class-specific antimicrobial usage rates as benchmarks for comparison by individual contributing hospitals, and for comparison with other Australian and international data.

Routine monthly reports distributed to contributing hospitals currently include six antimicrobial classes: third/fourth generation cephalosporins, glycopeptides, carbapenems, fluoroquinolones, aminoglycosides, and anti-pseudomonal penicillin/β-lactamase inhibitor combinations. The third and

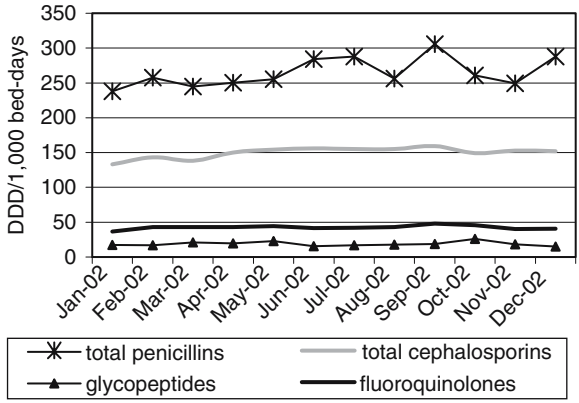

Figure 5. Total hospital usage by antimicrobial class.

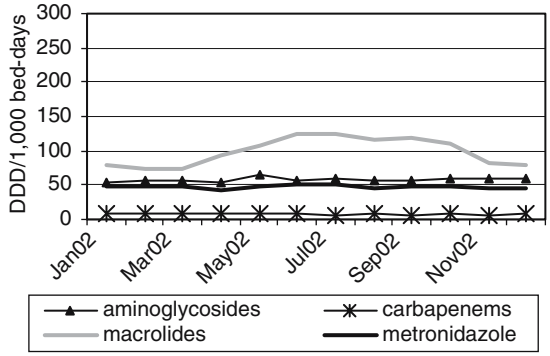

Figure 6. Total hospital usage by antimicrobial class.

fourth generation cephalosporins have been grouped together to simplify reporting; however, usage details for individual agents are also identified. For this summary, total penicillin, total cephalosporin, macrolide, and metronidazole use has also been analysed. These rates for monthly total hospital use are displayed in Figures 5 and 6, using the same scale to allow comparison of relative usage. Corresponding monthly rates for ICU use are shown in Figures 7 and 8. The relative frequency of total hospital and ICU usage of the various antimicrobial classes for 2002 are shown in Figure 9. A breakdown of usage of penicillin and cephalosporin classes into smaller groups is provided in Figures 10 and 11.

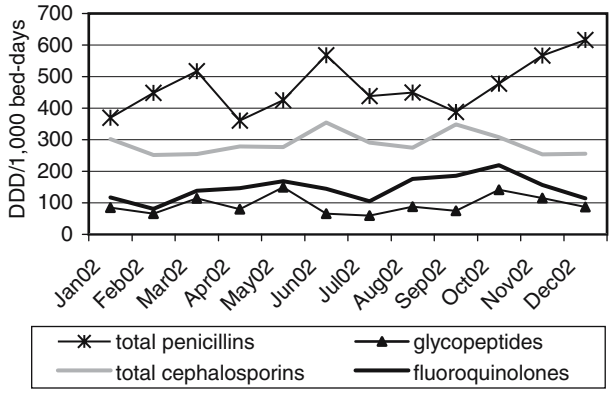

Figure 7. Total ICU use by antimicrobial class.

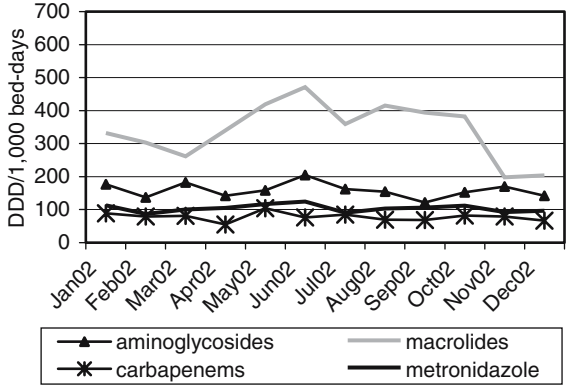

Figure 8. Total ICU use by antimicrobial class.

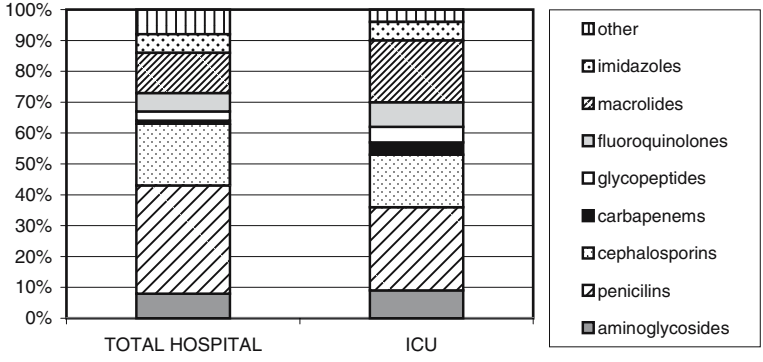

Figure 9. Total hospital and ICU usage by antimicrobial class.

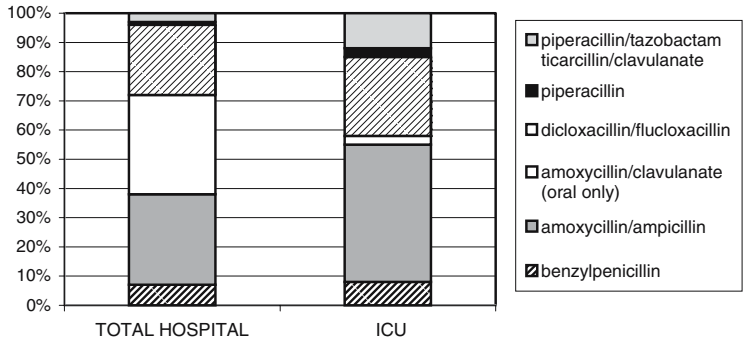

Figure 10. Total hospital and ICU penicillin usage.

Note: The parenteral form of amoxicillin/clavulanate is not available in Australia.

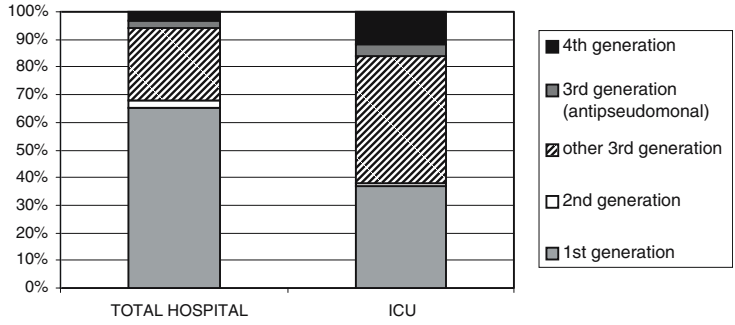

Figure 11. Total hospital and ICU cephalosporin usage.

6. ANALYSIS BY INDIVIDUAL ANTIMICROBIAL AGENT

The utilisation rates for various individual antimicrobial agents within classes are displayed below in Figures 12–27. Both total hospital and ICU rates are displayed.

6.1. Cephalosporins

Overall total hospital use of the routinely reported cephalosporins (ceftriaxone/cefotaxime, ceftazidime, cefepime) showed no significant trends during

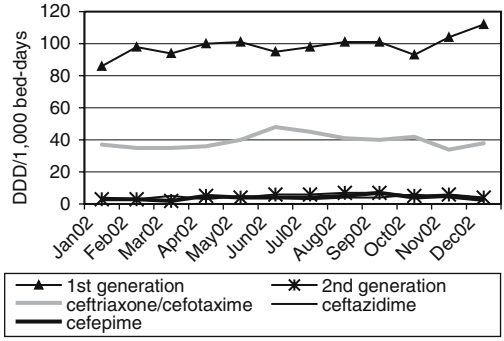

Figure 12. Total hospital cephalosporin use.

Note: First and second generation agents have been grouped to simplify these charts.

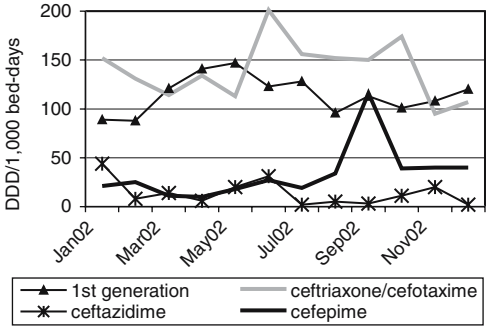

Figure 13. ICU cephalosporin use.

Note: First and second generation agents have been grouped to simplify these charts.

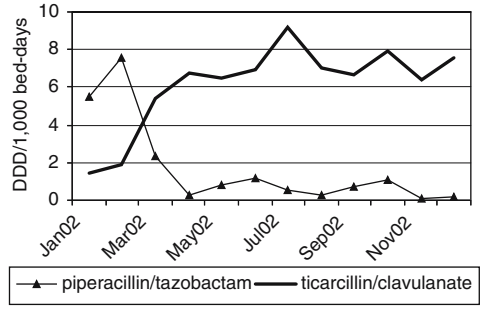

Figure 14. Total hospital use.

Note: These are the only penicillins included in routine monthly reports to contributing hospitals.

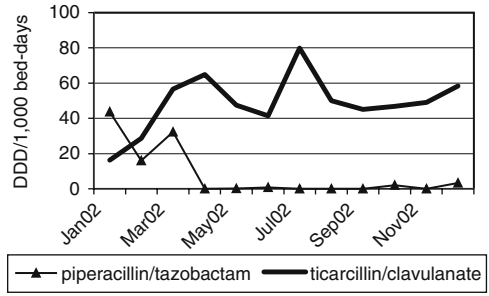

Figure 15. ICU use.

Note: These are the only penicillins included in routine monthly reports to contributing hospitals.

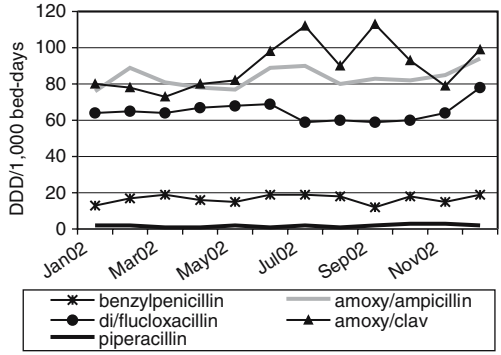

Figure 16. Total hospital use—other penicillins.

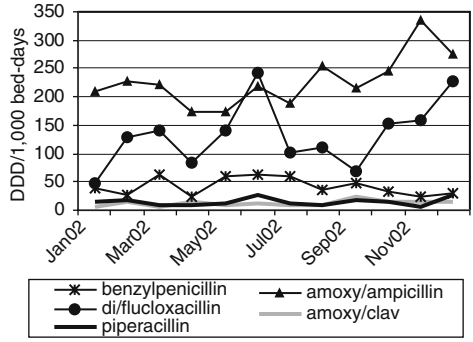

Figure 17. ICU use—other penicillins.

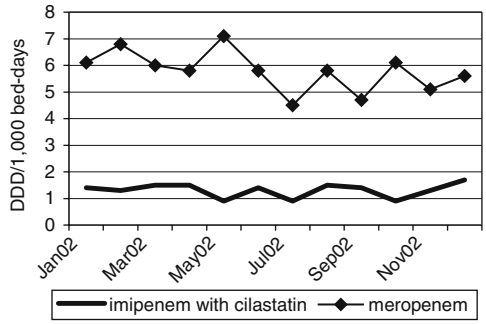

Figure 18. Total hospital carbapenem use.

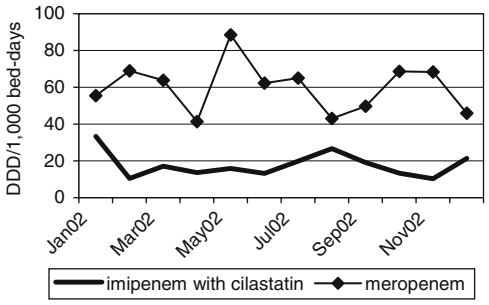

Figure 19. ICU carbapenem use.

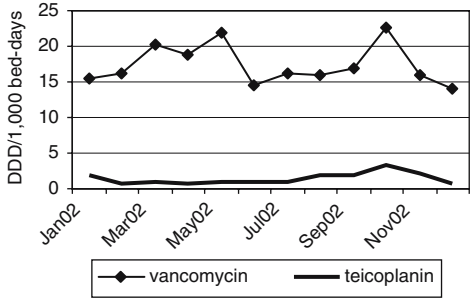

Figure 20. Total hospital glycopeptide use.

2002, although use of ceftriaxone during the latter part of the year may have been influenced by stricter control policies instituted at one teaching hospital during July. Assessment of trends with such limited data is complicated by the normal seasonal increase in usage for the treatment of respiratory infections

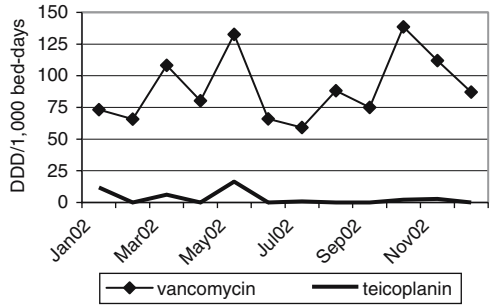

Figure 21. ICU glycopeptide use.

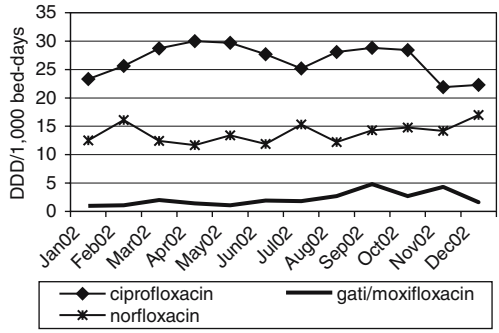

Figure 22. Total hospital fluoroquinolone use.

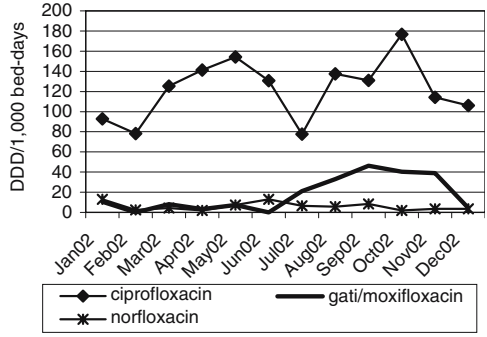

Figure 23. ICU fluoroquinolone use.

during the winter months and ongoing surveillance may show a greater change in use of this agent over time. In the ICU setting, ceftriaxone also displayed the expected seasonal variation. An unexpected peak in cefepime use in three of the six contributing ICUs during September is currently being investigated to

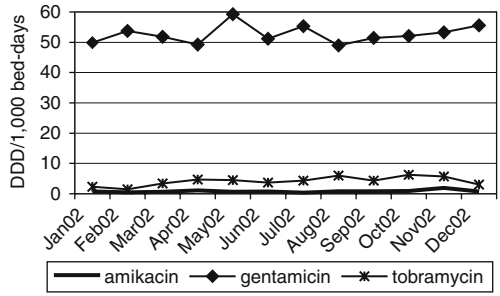

Figure 24. Total aminoglycoside use.

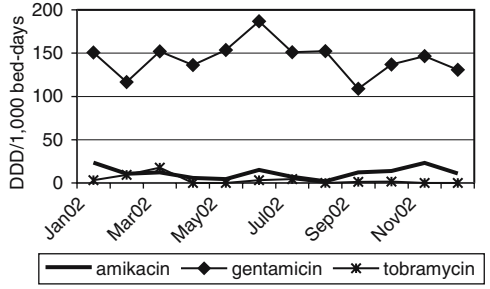

Figure 25. ICU aminoglycoside use.

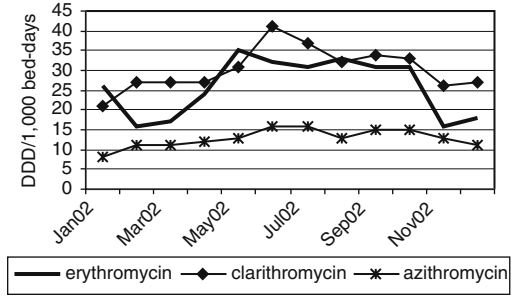

Figure 26. Total hospital macrolide use.

determine whether this was related to an outbreak of a multiresistant organism within these units or a change in prescribing patterns. A slight increasing trend in the use of first generation cephalosporins was noted during the year. Usage of second-generation agents was minimal, with negligible use in the ICU setting.

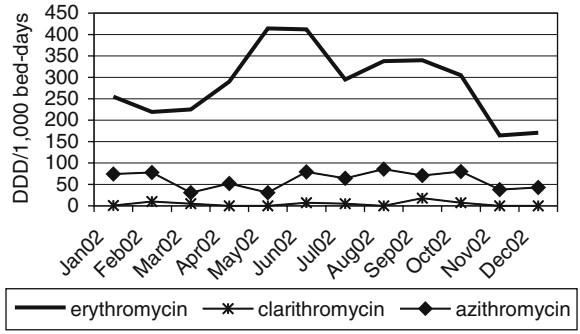

Figure 27. ICU macrolide use.

Use of these agents was predominantly in the private hospital sector, with formulary restriction limiting use in the larger public hospitals. Cefoxitin and cefotetan are the only second-generation agents currently available in a parenteral form in Australia.

6.2. Penicillins

6.2.1. Antipseudomonal penicillin/β-lactamase inhibitor combinations

Overall usage of these two agents remained stable during 2002, although there are wide variations in usage between individual institutions contributing to the programme. In most hospitals, ticarcillin/clavulanate has replaced piperacillin/tazobactam due to the variable availability of the latter agent within Australia.

6.2.2. Other penicillins

Of the other agents in the penicillin class, total hospital amoxicillin/clavulanate usage has increased during 2002; however, ICU use of this combination is low as the IV form is not marketed in Australia. Both amoxicillin/ampicillin and dicloxacillin/flucloxacillin have shown an increasing trend in ICU usage. The use of other agents in this class has remained relatively stable (Figures 16 and 17).

6.3. Carbapenems

A slight downward trend in total hospital meropenem use was noted during 2002, with no significant change in imipenem use. As expected, ICU use was variable for both of these agents which would normally be limited to use for severe or difficult to treat infections. Most contributing hospitals have made a formulary change to meropenem in recent years. Usage of the newer carbapenem, ertapenem, was negligible overall, with limited use in the private sector.

6.4. Glycopeptides

Total hospital and ICU use of vancomycin was variable during 2002, with no definite trend in usage shown. A number of hospitals, particularly in the private sector, demonstrated various peaks in teicoplanin usage during the period. Prolonged treatment of a single patient intolerant of vancomycin was involved in most cases, with ensuing discussion with pharmacists to ensure that appropriate vancomycin administration protocols are in place to minimise adverse reactions to this agent. Teicoplanin use in the public hospitals was low.

6.5. Fluoroquinolones

Use of ciprofloxacin and norfloxacin remained relatively stable during 2002, although high use of norfloxacin in the private setting compared to public hospitals use warrants further investigation and intervention. ICU ciprofloxacin use varied considerably over the period. An increase in use of gatifloxacin and moxifloxacin was noted during the later months, with likely seasonal use for the treatment of community-acquired pneumonia. A significant increase occurred in one public hospital ICU in particular, with a corresponding fall in ceftriaxone use.

6.6. Aminoglycosides

Total hospital and ICU usage of gentamicin showed no significant trend over 2002. While amikacin use remains very low outside the intensive care setting, ICU use has shown a slight increase, although this is variable between hospitals. This may reflect increasing resistance to gentamicin or altered prescribing patterns within some units, particularly where no antimicrobial restriction policies are in place. Although the aggregate rate is low, tobramycin usage increased over the period, with almost all use contributed by one public hospital with an adult cystic fibrosis unit.

6.7. Macrolides

Seasonal variation is evident in the monthly usage rates for all macrolides, although no significant overall trend is evident for the period. There is significant variation in usage between hospitals, reflecting individual hospital protocols for the treatment of respiratory infections, in particular, community-acquired pneumonia. As predicted, a fall in macrolide use was noted during 2003. Using of this class fell by 20% overall during this period, with a 33% fall in erythromycin use and a 23% fall in azithromycin use. The other macrolides used, clarithromycin and roxithromycin, also showed a fall in use during 2003. A 73% increase in doxycycline use occurred. Usage of this agent had previously been low. Parenteral azithromycin was introduced into most hospitals during late 2003, and has replaced parenteral erythromycin in some hospital formularies.

7. BENCHMARKING WITH OTHER ANTIMICROBIAL UTILISATION DATA

While SA is the first Australian state to develop an antimicrobial utilisation surveillance network involving individual public and private hospitals, a number of individual hospitals throughout Australia have been monitoring and analysing their own antimicrobial usage rates for a number of years. Some of these data are available for comparison with SA rates. A number of large programmes conducting surveillance of antimicrobial consumption have been established in Europe and the United States during the last decade, and some of these also provide suitable data for comparison with SA rates. In particular, the DANMAP programme in Denmark has published antimicrobial usage rates for both the primary healthcare sector and hospitals since 1997. A number of charts have been included below to provide an overview of utilisation rates within SA in 2002 compared to rates published in the DANMAP 2002 report.

Figure 28 shows comparative total antimicrobial usage rates for the 11 adult hospitals that contributed data during 2002. Also shown is the total usage rate for the group of contributing SA hospitals calculated from aggregate data (total DDDs and total bed-days) from the 11 hospitals, and the comparative rate for Denmark for 2002. Higher usage is demonstrated for SA overall and for 10 of the 11 hospitals contributing data to the SA surveillance programme.

Comparison with Danish data, and some recently released data from other European countries (European Surveillance of Antimicrobial Consumption, ESAC, 2003), also highlights differences in relative frequency of usage of particular antimicrobial classes. Although limited ESAC data is available relating to hospital use, the frequency of use of various cephalosporin groups has been shown to vary considerably between European countries. For most countries,

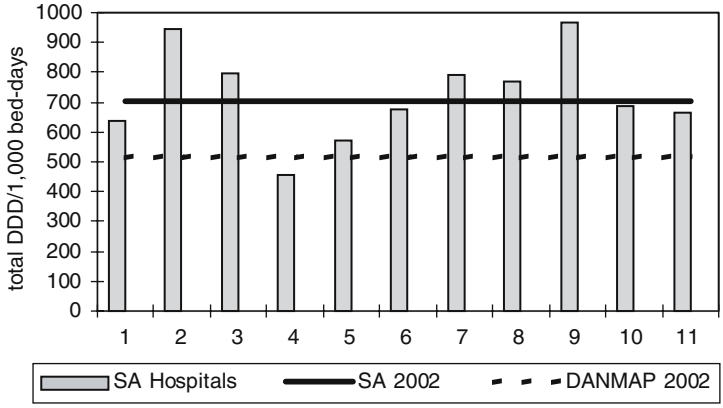

Figure 28. Total antimicrobial usage for 2002 for 11 contributing hospitals.

the significant use of second-generation agents is notable in comparison with SA data. This reflects the difference in availability of these agents, with the parenteral form of cefuroxime not currently marketed in Australia. Danish data (Monnet, July 2003, personal communication. Usage rates for 1st, 2nd, 3rd, and 4th generation cephalosporins) however, suggests that while the low use of third and fourth generation cephalosporins may partly reflect the availability of second generation formulations not available in Australia, use of the cephalosporin class overall is significantly lower than in Australia. Higher total penicillin usage rates are also seen in some European countries, as shown by the Danish data below, with significantly higher use of β-lactamase sensitive penicillins. The Danish usage rate for the extended spectrum penicillin group is slightly higher than that for SA, with a wider range of agents available in Europe. Of this group, only piperacillin, amoxicillin and ampicillin are available in Australia. There is negligible use of β-lactamase inhibitor combinations in Denmark, while these agents are widely used in Australia.

Figures 29 and 30 show comparative usage of the four "generations" of cephalosporins and the different penicillin groups in Denmark and SA.

Figure 31 shows comparative Danish and SA usage rates for glycopeptides, fluoroquinolones, aminoglycosides, macrolides, imidazoles, and carbapenems. For each class, except carbapenems, the SA rate is significantly higher than the corresponding Danish rate.

There are at present limited opportunities for benchmarking between Australian hospitals. Figure 32 shows comparative usage of different antimicrobial classes in the 11 contributing adult SA hospitals and one other teaching hospital located in New South Wales (NSW), another Australian state. Although high use of the penicillin class at the NSW hospital is evident compared to SA

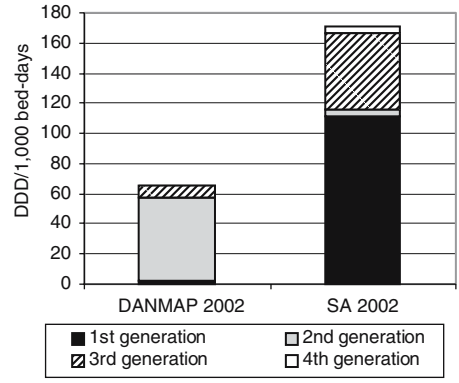

Figure 29. Comparative use of cephalosporins.

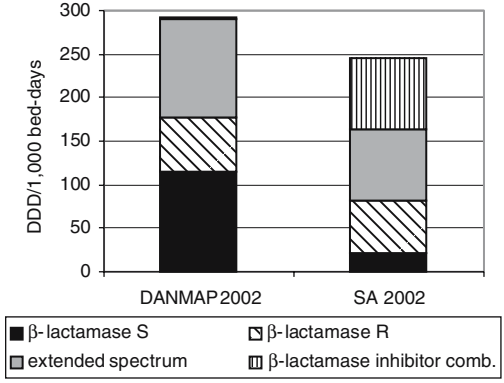

Figure 30. Comparative use of penicillins.

hospitals, usage rates for cephalosporins, particularly for the third generation agents, are lower.

ICU usage rates for parenteral antimicrobial use for the above NSW teaching hospital, one Queensland teaching hospital, and the six SA hospitals with ICUs are displayed in Figure 33. There is a significant variation in the rates for the SA hospitals, partly explained by the diversity of these six units, as previously mentioned. This small number of contributors unfortunately prevent stratification into groups with similar case-mix. Both interstate hospitals show lower usage rates for third generation cephalosporins than most SA hospitals. Fluoroquinolone usage is also significantly lower in the two interstate hospitals. For the penicillin class, usage rates are higher for the NSW hospital than the other Australian centres presented here.

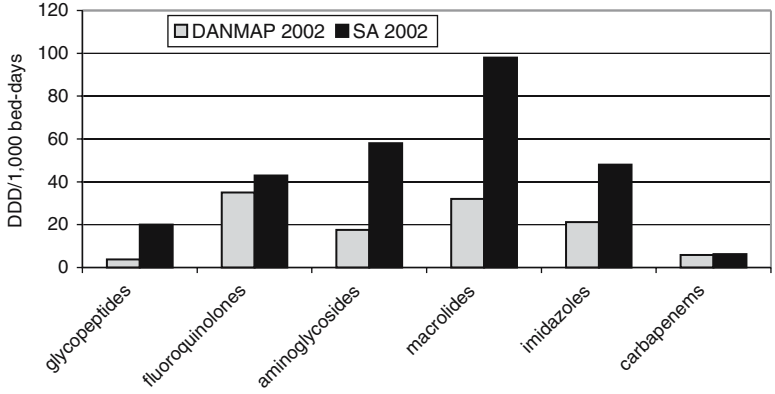

Figure 31. Comparative usage rates for other classes.

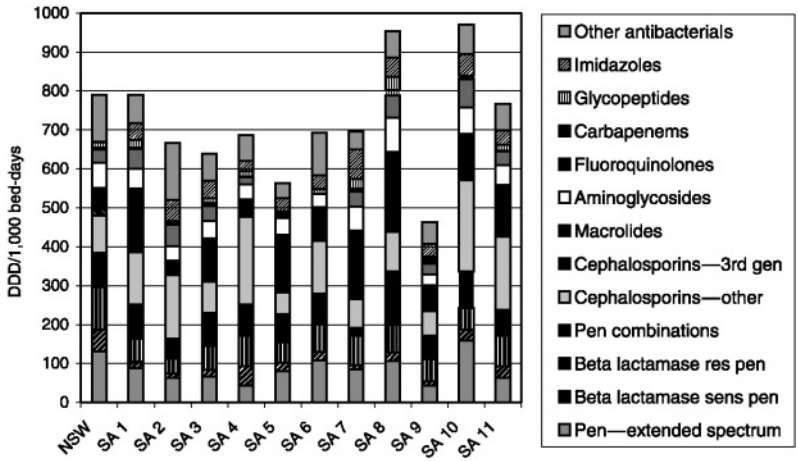

Figure 32. Comparative usage rates for SA hospitals and one NSW hospital.

While there is limited ICU data available for benchmarking locally and internationally using standard WHO DDDs, rates for most of these Australian units appear to be high in comparison with rates published from Scandinavian studies (Petersen *et al*., 1999; Walther *et al*., 2002) involving 38 Swedish units and 30 Danish units.

Benchmarking with DANMAP data, as well as that from other Scandinavian countries, clearly demonstrates the high comparative usage rates in SA for many antimicrobial classes and sets a goal for reduction in usage

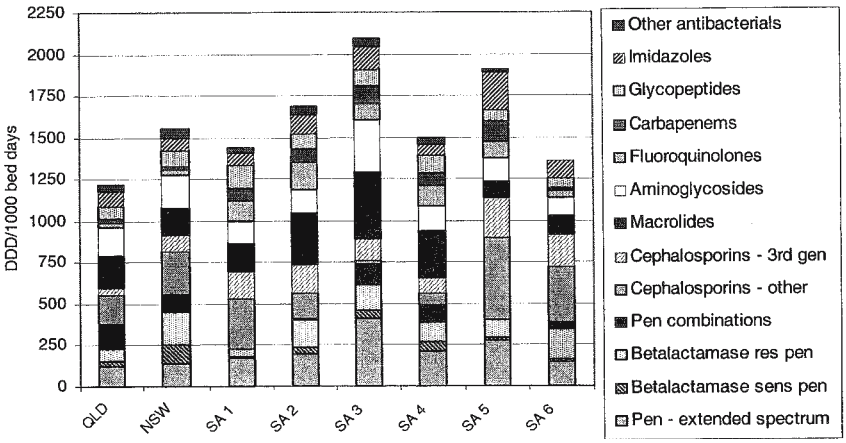

Figure 33. Comparative intensive care usage rates for SA hospitals and 2 other Australian hospitals.

Note: includes parenteral use only.

through improved prescribing and infection control procedures. The wider availability of Australian antimicrobial utilisation surveillance data in future, however, will enable comparison between centres where a similar range of antimicrobial agents is available, and may lead to the sharing of successful intervention models or the development of large-scale intervention programmes. Stratification of a larger pool of contributors by hospital size, case-mix, or other parameter may enable more appropriate benchmarking than currently possible. The availability of comparative data from ICUs and other specialised units of larger hospitals throughout Australia may also provide an opportunity to identify and investigate high antimicrobial use and institute programmes to improve antimicrobial prescribing and infection control within these areas.

8. ADDENDUM

Subsequent to the surveillance period covered by the preceding report, Flinders Medical Centre, a 430-bed metropolitan teaching hospital contributing to the SA surveillance programme, has implemented a successful programme aimed at promoting a more rational, evidence-based approach to antimicrobial prescribing. This programme has involved the introduction of a reserved antibiotic policy in conjunction with the implementation of revised

treatment algorithms based on nationally accepted guidelines (Therapeutic Guidelines Ltd, 2003). Antimicrobial agents are divided into three categories involving either unrestricted use, the requirement for prior Infectious Diseases approval for all use, or use restricted to a range of specified exempt indications. In the last case, use for other indications requires Infectious Diseases approval. Restrictions apply to all hospital areas excluding the ICU. Close cooperation between Infectious Diseases and Pharmacy staff, both before and since the policy implementation, has seen significant changes in antimicrobial usage across a range of agents.

Modification of prescribing patterns for ceftriaxone, the most widely used third generation cephalosporin, was a particular focus of the new policy, with a high rate of inappropriate use demonstrated by a review of ceftriaxone use conducted during late 2002. This agent is widely used for the treatment of respiratory infections in hospitalised patients in many Australian hospitals, and this was shown to be the most common inappropriate indication for ceftriaxone use during the review period. This agent was previously available without Infectious Diseases approval for the treatment of community-acquired pneumonia; however, under the new restriction policy, prior approval is required. Figures 34 and 35 show some changes in ceftriaxone usage rates since the introduction of the restricted antibiotic policy and revised treatment algorithms at this hospital in February 2003.

A significant and sustained fall in ceftriaxone use has been successfully achieved through this policy change. Seasonal variation in ceftriaxone usage rates, suggesting high use for the treatment of respiratory infection during the winter period, has not been evident during 2003. Usage rates for benzylpenicillin

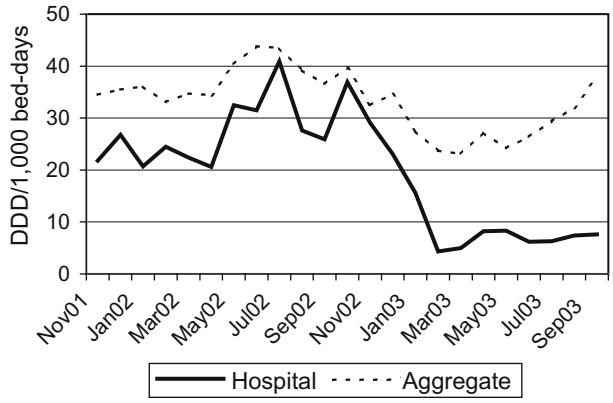

Figure 34. Changes in ceftriaxone use since surveillance commenced in November 2001.

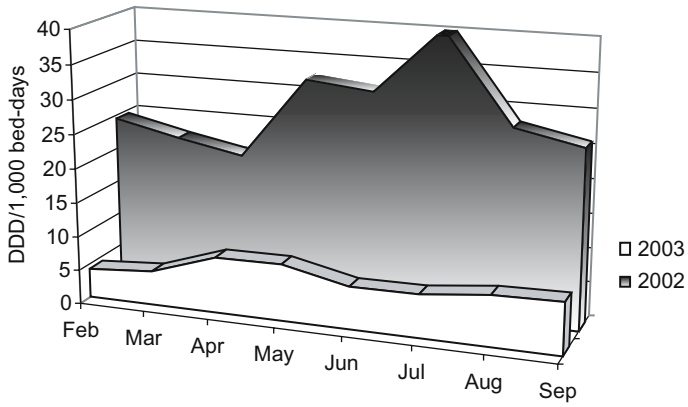

Figure 35. Comparative ceftriaxone usage during the 8-month period February–July 2002 and 2003.

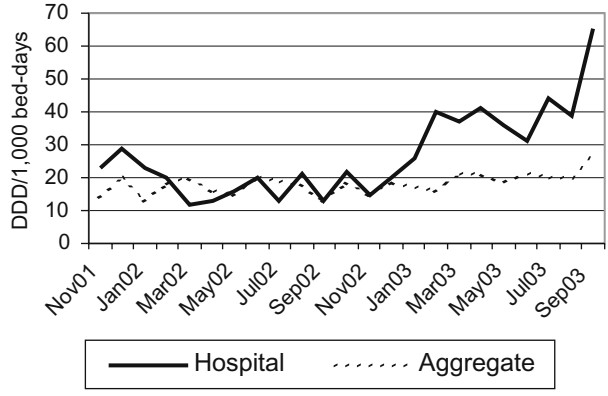

Figure 36. Changes in benzylpenicillin usage since the introduction of antimicrobial restrictions and revised treatment algorithms.

have increased correspondingly in accordance with the hospital algorithm for the treatment of community-acquired pneumonia. A smaller and less sustained increase in gentamicin use has also been noted since the introduction of the policy.

Significant changes in the usage of oral agents have also been noted, in line with the policy changes. Azithromycin usage rates have fallen significantly since this agent was replaced by doxycycline as first line therapy for mild community-acquired pneumonia. All azithromycin use now requires prior Infectious Diseases approval.

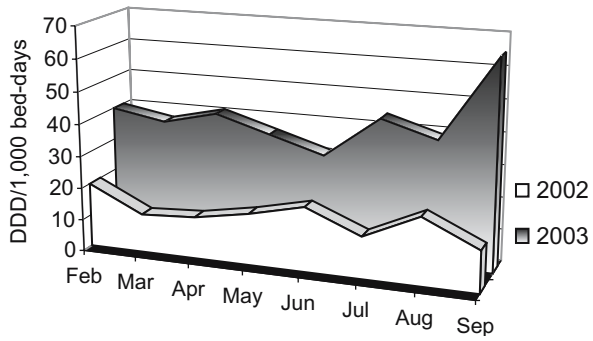

Figure 37. Comparative benzylpenicillin usage during the 8-month period February–July 2002 and 2003.

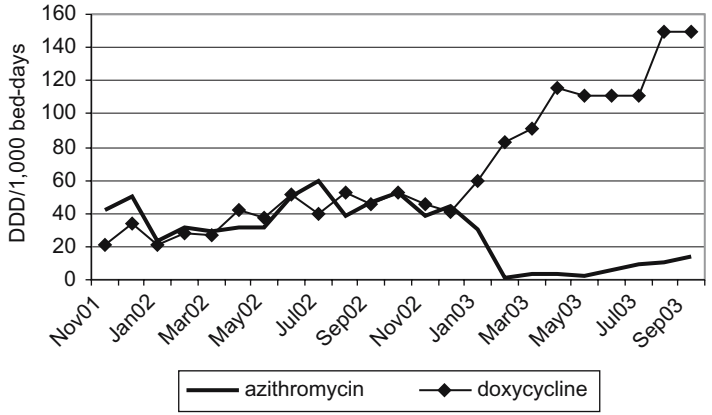

Figure 38. Changes in azithromycin and doxycycline usage since the introduction of antimicrobial restrictions and revised treatment algorithms.

Although limited data are available to date, the concurrent implementation of a reserved antimicrobial policy and revised treatment algorithms has been successful in significantly altering prescribing patterns, particularly for the treatment of community-acquired pneumonia.

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