EPIDEMIOLOGY SURVEILLANCE SYSTEM
2001 REPORT

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Preface

Multiple antibiotic-resistant bacteria have been recognized as a serious threat to the nation's public health since the early 1990s. The tremendous therapeutic advantage afforded by antibiotics is now jeopardized by the increasing resistance of microbes. In an effort to develop a resource to measure antibiotic resistance in New Jersey and to provide a basis for the development of cost-effective measures to reduce further development of antibiotic resistance, the New Jersey Department of Health and Senior Services (NJDHSS) launched an initiative in 1991 to collect information about these organisms. Under this initiative, a statewide hospital laboratory-based **Epidemiology Surveillance System** was established which monitors: 1) methicillin-resistant *Staphylococcus aureus* (MRSA); 2) Gram-positive cocci resistant to vancomycin; 3) penicillin-resistant streptococci / enterococci; 4) Gram-negative rods resistant to imipenem; and 5) Gram-negative rods resistant to amikacin, gentamicin, and tobramycin.

Methodology

A New Jersey **Epidemiology Surveillance Record** form is submitted monthly by each acute-care hospital in New Jersey (Attachment 1). These records are checked for completeness upon receipt by staff in the NJDHSS Infectious and Zoonotic Diseases Program. Follow-up telephone calls are made as needed to ensure that all forms are submitted each month and that all isolates are sent to the NJDHSS Public Health and Environmental Laboratories.

Eighty-seven New Jersey acute-care hospitals participated in the surveillance program in 2001. The overall number of organisms, annual trend, geographic distribution and specific drug-resistant profile in each class of organism were computed. All rates by facility are normalized by each facility's reported number of occupied beds in 2001, while rates by county are normalized by each county's 2001 resident population. Individual hospital data are collected confidentially and cannot be released to the public. Figures presented in this report are summary statistics. Data from any county that contains only one hospital were aggregated with a neighboring county's data for county-based analysis. Therefore, no individual hospital's rate can be identified from this report.

Summary

(1) Methicillin-resistant *Staphylococcus aureus*

The data collected by the New Jersey **Epidemiology Surveillance System** indicates that a total of 3,903 MRSA blood isolates was reported in 2001, representing a 1.1 percent increase from 3,860 in 2000. Although the increase of incidence rate has leveled off in 2001(46 blood isolates per 100,000 population vs. 45.9 blood isolates per 100,000 population in 2000) in New

Jersey, the mortality rates (20 to 40 percent)[1] and the incidences of complication (11 to 53 percent)[2] in *S. aureus* bacteremia remained high. *S. aureus* is the most significant cause of bacterial blood stream infections in North America, and accounts for 25.3 percent of all bacterial pathogens associated with these infections[3]. The emergence of vancomycin-resistant *S. aureus* (VRSA) (minimum inhibitory concentration [MIC] $\geq$ 32 μg/ml, *van*A genotype) in Michigan[4] and Pennsylvania[5] as well as the linezolid-resistant *S. aureus* in Ohio (MIC = 4 μg/ml)[6] and Massachusetts (MIC = 64 μg/ml)[7] in recent years further exacerbated the problem.

The epidemiology of MRSA and the factors driving resistance bear strong similarities to those occurring with penicillin-resistant strains of *S. aureus* in the 1940s and 1950s. Soon after nosocomial penicillin-resistant *S. aureus* rates exceeded 40-50 percent, an upswing of community rates followed. The two rates reached virtually the same level by the 1970s[8]. Recent MRSA studies in the Midwest[9], Connecticut[10] and California[11] indeed suggest that MRSA has emerged as a community-acquired pathogen. Outbreaks of severe skin infections in correctional facilities in Mississippi[12] and Los Angeles[13] as well as gastroenteritis in Tennessee[14] had been reported recently to be associated with community-acquired MRSA (CA-MRSA). Similar outbreaks of skin infections that affected people in younger age groups in prisons and a high school have been reported in New Jersey since late 2002[15].

Unlike nosocomial MRSA isolates, CA-MRSA isolates from patients without known MRSA risk factors are generally resistant to fewer non-beta-lactam antibiotics. They grow significantly faster than the nosocomial strains[16] and can be highly virulent to cause serious and often fatal disease in otherwise immunocompetent individuals[17]. The evolution of CA-MRSA is believed to be a recent event due to the acquisition of a novel SCC*mec* IV cassette with methicillin-resistant gene[16,18] by an otherwise susceptible *S. aureus*. Unlike SCC*mec* I-III, the characteristic cassettes carried by hospital-acquired MRSA, SCC*mec* IV is smaller in size and do not carry multiple non-beta-lactam antibiotic-resistant determinants[18]. The total pathogenic potential of CA-MRSA isolates is likely to be determined by the contribution of many virulence factors such as staphylococcal enterotoxin[19], superantigens[20] and Panton-Valentine leukocidin (PVL)[20,21,22] as well as the regulation and expression of these proteins in the appropriate genetic background[23]. PVL-producing *S. aureus* strains cause rapidly progressive, hemorrhagic, and necrotizing pneumonia with a high lethality rate[19,24], and are also associated with primary skin infections[24].

Due to the limited scope of this surveillance system's data collection, the extensiveness of MRSA circulation beyond nosocomial settings in New Jersey is largely unknown. To gain a preliminary insight, regression and variance analyses of factors affecting MRSA bacteremia rates were attempted. Factors analyzed include a hospital's reported number of occupied beds, vancomycin-resistant enterococci (VRE) and penicillin-resistant *Streptococcus pneumoniae* (PRSP) blood isolates rates. To evaluate the possible influence of community characteristics, population density, per capita income, percentage of resident nonwhite and Hispanic, percentage of residents with college degrees, and percentage of elderly population in the community were also included in the analyses. In this analysis, a community is defined as an area with a ten-mile radius surrounding the municipality where the hospital is located.

Based on the 2001 data, the rate of MRSA bacteremia varied significantly by VRE rate (P=0.004) and the region (P=0.02), but not by hospital size (P=0.592) or rural-urban location

(P=0.947). The MRSA bacteremia rate in facilities with higher VRE rate (greater then 4 blood isolates / 100 occupied beds) is significantly higher than in facilities with less then 4 blood isolates / 100 occupied beds. The rate in facilities in Central New Jersey (Middlesex, Mercer, Hunterdon and Somerset Counties) was significantly higher than that in other regions (P<0.05). Communities with more nonwhite (P=0.004), college graduate (P=0.009), or elderly (P=0.01) residents tend to have higher MRSA rates. The rate of PRSP bacteremia also correlated positively with the MRSA rates (P=0.009).

(2) Vancomycin-resistant Enterococci

A total of 575 VRE blood stream isolates was reported in 2001, representing a 1.6 percent increase from 566 in 2000. *Enterococcus faecium* isolates accounted for 68.2 percent of the VRE isolates, while *Enterococcus faecalis* accounted for another 16.9 percent. A significant 48.3 percent increase in the VanC type VRE (*Enterococcus gallinarum* and *Enterococcus casseliflavus*) was reported in 2001, and this type represents another 7.5 percent of the total VRE reports. VRE bacteremia had an attributable mortality rate approaching 40 percent[25], owing to treatment limitations. A regimen of drug therapy for clinically important VRE infections was summarized in a recent publication by Dr. Murray[26].

In the United States, VRE are predominantly acquired within hospitals. However, several recent studies have shown that patients in long-term care facilities[27] or from the community[28] can also be colonized with VRE and serve as reservoirs. The prevalence of VRE among nonhospitalized patients varied by geographic region[29]. According to the 2001 data, the rate of VRE bacteremia was associated with (1) hospital size (VRE rates in hospitals with 300 or more occupied beds were significantly higher than in facilities with less than 100 occupied beds (P<0.05)), (2) MRSA rates (VRE rates in facilities with MRSA rates greater than 24 blood isolates / 100 occupied beds were significantly higher than in facilities with lower MRSA rates (P=0.013)) and (3) rural-urban location (VRE rates in inner city facilities are significantly higher than the rates in suburban facilities (P<0.05)). VRE rates in Central New Jersey facilities were significantly higher than in facilities located in Coastal and Southern regions (P<0.05).

A recent study by Safdar et al.[30] had shown that common risk factors for nosocomial infection with MRSA, VRE, extended-spectrum β-lactamase-producing Gram-negative bacilli, *Clostriudum difficile*, and *Candida* include: advanced age; severity of illness; inter-institutional transfer of the patient; prolonged hospital stay; gastrointestinal surgery; organ transplantation; exposure to medical devices, especially central venous catheters; and heavy exposure to broad-spectrum antimicrobial drugs, especially cephalosporins. Restricted use of antibiotics, use of catheters coated with antimicrobial agents, and preemptive isolation of all high-risk patients are recommended to prevent the spread of these multiresistant organisms.

(3) Penicillin-resistant *Streptococcus pneumoniae*

With 102 isolates reported, sterile-site infections of PRSP in New Jersey acute-care hospitals decreased 7.3 percent from 2000 to 2001. A decreasing trend in both the invasive disease cases and rates of penicillin resistance was also revealed in a CDC surveillance report in

2001[31], due mainly to the availability of a new *S. pneumoniae* conjugate vaccine for children[32]. However, in a study of nonmeningeal isolates, the SENTRY Antimicrobial Surveillance Program reported that the penicillin non-susceptible isolates increased from 24.4 percent in 1997 to 46.8 percent in 2002[33]. Even with appropriate antimicrobial therapy, case-fatality rates for high-risk patients can be as high as 40 percent for bacteremia and 55 percent for meningitis[34]. Vancomycin-tolerance among clinical isolates of pneumococci that results in treatment failure have been reported recently[35]. These isolates were of serotype 9V and had reduced susceptibility to penicillin[35]. Although rare, resistance to fluoroquinolones among *S. pneumoniae* ranges from 0.3 to 0.5 percent[36]. In New Jersey, the infection pattern of PRSP appears to be seasonal with a peak in the winter and a trough in the summer. This is consistent with findings from nationwide studies and suggests that photoperiod-dependent variation in host susceptibility may underlie pneumococcal seasonality[37].

As mentioned in several studies[34,38], inappropriate antibiotic usage in treating respiratory viral infections and unnecessary prescribing of broad spectrum agents are thought to be major factors contributing to the increasing PRSP rates. The CDC's Drug-Resistant *S. pneumoniae* Therapeutic Working Group has recently issued treatment recommendations as well as new guidelines regarding penicillin MIC for the definition of PRSP[39]. *S. pneumoniae* is one of the most common pathogens for community-acquired pneumonia in otherwise healthy children[40] and adults[41]. Due to considerable geographic variation in susceptibility[42] and in the rates of development of antimicrobial resistance, consensus guidelines for management and treatment of drug-resistant *S. pneumoniae* infections should be developed and refined over time, based on regionally collected data[40]. The majority of drug-resistant *S. pneumoniae* occurred within serogroups 6A, 6B, 9V, 14, 19A, 19F and 23F, which all commonly infect young children. Although the administration of the 7-valent conjugate vaccine elicits 78 percent protection against invasive infections in young children[32], the emergence of a novel penicillin-nonsusceptible, invasive serotype 35B clone in children is of concern[43]. For older adults, the 23-valent polysaccharide vaccine prevents bacteremia but not nonbacteremic pneumonia[44].

(4) Gram-negative bacilli resistant to imipenem or amikacin

Among Gram-negative bacilli, important causes of resistance include extended-spectrum β-lactamases (ESBLs) in *Klebsiella pneumoniae*, *Escherichia coli*, and *Proteus mirabilis*; high-level third-generation cephalosporin resistance among *Enterobacter* spp. and *Citrobacter freundii*; and multidrug-resistance in *Pseudomonas aeruginosa, Acinetobacter* spp. and *Stenotrophomonas maltophilia*[45]. These infections are primarily nosocomial. The frequency of infection with *E. coli* ranked second, *Klebsiella* spp. fifth, *P. aeruginosa* seventh and *Enterobacter* spp. ninth among pathogens that caused blood stream infections[3]. *E. coli*, *Enterobacter* spp. and *K. pneumoniae* accounted for 32 percent of all hospital-acquired infections[46]. The crude mortality rates associated with *K. pneumoniae* and *E. coli* bloodstream infections are 24 and 27 percent, respectively[47], while the mortality rate for *S. maltophilia* varied greatly, ranging between 0 and 38 percent[48]. Nationally, the incidence of ESBLs-producing organisms, specifically *Enterobacteriaceae* and *P. aeruginosa*, has increased to an alarming rate in recent years, resulting in difficult-to-treat infections[47].

In New Jersey, a total of 129 amikacin-resistant Gram-negative bacilli was reported in

2001, a 15.2 percent increase from 112 in 2000. The most frequently reported organisms were *K. pneumoniae* (24.8 percent), *S. maltophilia* (18.6 percent), *Acinetobacter calcoaceticus - Acinetobacter baumannii* complex (17.8 percent) and *P. aeruginosa* (14 percent). The number of amikacin-resistant *P. aeruginosa* isolates increased 125 percent from 2000 to 2001.

A total of 190 imipenem-resistant Gram-negative bacilli was reported in 2001, a 12.4 percent increase from 169 in 2000. Within this group of organisms, *P. aeruginosa* accounted for 37.4 percent, *S. maltophilia* 24.7 percent, and *A. calcoaceticus-A. baumannii* complex 21 percent. The number of *P. aeruginosa* and *S. maltophilia* increased 11 and 23.7 percent, respectively, from 2000 to 2001.

A steady increase of imipenem-resistant *A. calcoaceticus-A. baumannii* complex isolates in New Jersey acute-care hospitals was observed: 3 in 1996, 20 in 1998, 35 in 1999 and 40 in 2001. In 2001, these cases were distributed among 23 hospitals in New Jersey. Similar increasing trends in both bacteremia[49] and nosocomial pneumonia[50] have also been observed in other states in recent years. *A. calcoaceticus-A. baumannii* complex infection is significant in ventilator-dependent patients, with mortality rates ranging from 30 to 75 percent[49]. The infection is also associated with prior use of ceftazidime, usually used for treating resistant *Pseudomonas* spp[50]. To lower the rates, improving compliance with hand-washing[50] as well as evaluating antibiotic formulations and treatment outcomes[48] are recommended.

MRSA Isolates in New Jersey Hospitals

S. aureus remains the most prevalent cause of bloodstream, skin and soft-tissue infections and pneumonia in the United States[51]. Nationally, the percentage of methicillin-resistance in this organism has reached 55.3 percent in 2000[52].

The bar chart in **Exhibit 1** presents the trend of the annual number of MRSA isolates reported during the 1991 to 2001 period in New Jersey. Of the 23,282 MRSA isolates reported in 2001, 7,586 isolates (33 percent) were from wound cultures, 6,316 isolates (27 percent) from sputum cultures, 3,903 isolates (17 percent) from blood cultures, 2,563 isolates (11 percent) from urine cultures and 2,912 isolates (12 percent) from cultures of other body sites. The total number of inpatient isolates was virtually unchanged between 1994 and 1996, followed by a steep increase from 1997 to 2000, which then leveled off in 2001.

Exhibit 2 shows the MRSA blood isolates per 100,000 population per year from 1991 to 2001. The MRSA blood isolates rate increased sharply during 1997 (27.6 per 100,000 population), 1998 (32.2 per 100,000 population), 1999 (40.3 per 100,000 population) and 2000 (45.9 per 100,000 population). However, only a slight increase (46 per 100,000 population) was observed in 2001.

Exhibit 3 displays the number of reported total MRSA isolates per 100 occupied beds per month for each facility in 2001. Facilities were ranked by their 2001 rates in descending order. For comparison, the 2000 rates were also included. A decreasing trend is observed in the State total in 2001, with a somewhat lower average rate in 2001 (11.7 isolates per 100 occupied beds per month) than in 2000 (12.3 isolates per 100 occupied beds per month). The distribution of

these isolates and rates by county in descending order are highlighted in **Exhibit 4**. Mercer and Essex Counties continued to have the highest rates, with 422.9 and 386.4 isolates per 100,000 population, respectively. Noticeable increases in Cumberland, Atlantic, Cape May and Salem Counties were also observed.

Antibiotic-Resistant Bacteria - Bloodstream Infections in New Jersey Hospitals

A total of 1,073 antibiotic-resistant blood isolates was reported in 2001, representing a 0.7 percent increase from 1,066 in 2000 (**Exhibit 5**). The frequency of antibiotic-resistant blood isolates in each facility, ranked in descending order by number of isolates per 100 occupied beds, is illustrated in **Exhibit 6**. The State's average rate decreased slightly to 7.4 for every 100 occupied beds in 2001, down from 7.6 in 2000. Distribution of these isolates and the rates by county in descending order are highlighted in **Exhibit 7**. The State average rate (12.7 isolates per 100,000 population) remained unchanged from 2000 to 2001. Essex and Mercer Counties had the highest rates of 34.6 and 22.4 per 100,000 populations, respectively. The rate in Morris County more than doubled in 2001 (14.8 isolates per 100,000 population) in comparison to 2000 (6.2 isolates per 100,000 population).

Vancomycin-Resistant Gram-Positive Cocci in New Jersey Hospitals

Enterococci have been documented as the fourth most prevalent isolates from blood cultures in the United States and Canada[3]. The occurrence of VRE in the nation has increased from less than one percent among all enterococci isolates in 1990 to 6 percent in 1992, 8 percent in 1994, 16 to17 percent in 1996, 18 percent in 1997, and 26.3 percent in 2000[52]. The occurrence of new patterns of resistance in clinical isolates, such as VRSA[4,5] and vancomycin-tolerant *S. pneumoniae*[35] has been documented recently. Because of the increasing concern of VRSA strain emergence and the apparent heterogeneity of vancomycin-intermediate-resistant *S. aureus* (VISA) strains[53], all *S. aureus* isolates with vancomycin MICs of $\geq$ 4 µg/ml should be re-confirmed with CDC recommended methods[54]. Methods that would not identify VISA isolates include disk diffusion with no additional method, Microscan^{R} Walkaway Rapid* panels (which provide less than 24 hours incubation), and Vitek systems with a vancomycin MIC of greater than or equal to 8 µg/ml as the indicator for additional testing[54]. Primary testing of *S. aureus* against vancomycin requires 24 hours of incubation time[54]. An MIC susceptibility testing method should be used to confirm vancomycin test results[54].

Exhibit 8 summarizes the variety and number of vancomycin-resistant Gram-positive cocci collected in New Jersey from 1995 to 2001. VRE accounts for 99.8 percent of the 576 isolates collected in 2001. The majority (68.2 percent) of the VRE isolates was *E. faecium*; *E. faecalis* accounted for another 16.9 percent. An increasing trend in VanC type resistance was observed: a total of 34 and 9 isolates in *E. gallinarum* and *E. casseliflavus*, respectively, were reported in 2001, representing a 48.3 percent increase from the 2000 number.

The temporal trend of the number of VRE blood isolates from 1992 to 2001 is presented in **Exhibit 9**. The number of VRE isolates more than quadrupled during this period, from an average of 12.4 isolates per month in January 1992 to 54.7 isolates per month in December 2001.

Exhibit 10 depicts the frequency of VRE blood isolates in each hospital facility, ranked in descending order by number of isolates per 100 occupied beds. The 2000 rates are also included for comparison. The average State rate per 100,000 population reached 6.8 in 2001, up from 6.7 in 2000 (**Exhibit 11**). Essex and Mercer Counties had the highest rates of 17.7 and 13 isolates per 100,000 populations, respectively.

Exhibit 12 summarizes the drug resistance profile of VRE, collected from 1995 to 2001. *E. faecium* is the most frequently isolated organism. In 2001, a high level of resistance to penicillin (98.1 percent), ampicillin (98.2 percent), erythromycin (97 percent), ciprofloxacin (99.5 percent), levofloxacin (99.2 percent) and high-concentration streptomycin (71.1 percent) continued. An increasing trend of resistance to tetracycline (72.3 percent) was also observed. A complete susceptibility to linezolid was observed in *E. faecium*. However, out of 57 isolates tested, 2 were complete-resistant and 3 were intermediate-resistant to quinupristin-dalfopristin. In comparison to *E. faecium*, *E. faecalis* isolates displayed a very different drug resistance pattern to penicillin (22.4 percent), ampicillin (6.2 percent), high concentration gentamicin (82.8 percent), chloramphenicol (35.1 percent) and quinupristin-dalfopristin (100 percent). According to the SENTRY Antimicrobial Surveillance Program, resistant rates in enterococci tested from 1998 to 2000 in North America are 0 percent to linezolid, 12.4 percent to vancomycin, 20.8 percent to ampicillin, 30.8 percent to gentamicin, 39.3 percent to streptomycin, 44.2 percent to ciprofloxacin, and 72 percent to quinupristin-dalfopristin[55].

Penicillin-Resistant Streptococci / Enterococci in New Jersey Hospitals

S. pneumoniae have been documented to be the sixth most prevalent organism isolated from blood cultures in the United States, while viridans streptococci ranks tenth[3]. The rate of invasive *S. pneumoniae* infections is 17.2 cases per 100,000, with a case-fatality ratio of 13.2 percent in the United States in 2001[31]. The national rate of *S. pneumoniae* nonsusceptible to penicillin has increased from 23.6 percent in 1994-1995 to 29.5 percent in 1997-1998 and 34.2 percent in 1999-2000 which parallels the increases in multiple antibiotic resistance rates of 9.1 percent in 1994-1995, 16 percent in 1997-1998 and 22.4 percent in 1999-2000[56].

Exhibit 13 lists the variety and the number of penicillin-resistant streptococci and enterococci sterile-site isolates reported between 1995 and 2001 from New Jersey hospitals. The most frequently reported organism is *E. faecium* (59.3 percent in 2001), followed by *S. pneumoniae* (22.7 percent in 2001). Although the number seems to fluctuate between 1992 and 2001, **Exhibit 14** shows an estimated 140 percent increase in the number of penicillin-resistant streptococci and enterococci sterile-site isolates, from 16.8 per month in January 1992 to 40.3 per month in December 2001. The rate and the distribution of these isolates by county are demonstrated in **Exhibit 15**. An increase in the State total rate was observed in 2001 (5.3 per 100,000 population), in comparison to 2000 (5.1 per 100,000 population).

Exhibit 16 shows the increasing trend of PRSP sterile-site isolates between December 1991 and February 2002. A substantial increase of 353 percent in PRSP sterile-site isolates was estimated, comparing December 1991 (6.4 isolates per quarter) with February 2002 (29 isolates per quarter). The number of PRSP sterile-site isolates fluctuated by season with a peak in the winter (December, January, and February) and a trough in the summer (June, July, and August).

Exhibit 17 displays the rate and the distribution of PRSP sterile-site isolates by county. With 2.1 isolates per 100,000 population, Union County had the highest rate in New Jersey.

Exhibit 18 summarizes the drug-resistant profile of PRSP and penicillin-resistant viridans streptococci. Vancomycin is effective against PRSP. However, resistance to erythromycin among invasive *S. pneumoniae* isolates increased nationwide, from 13.3 percent in 1997 to 29.7 in 2001[33]. Similar to the national trend, PRSP blood isolates in New Jersey also displayed an increasing rate of resistance to erythromycin with 18.2 percent reported in 1995, 28.6 in 1996 and 1997, 53 percent in 1999, and 62.1 percent in 2001. The same pattern was observed in third-generation cephalosporins. A total of 29.2 percent complete-resistance and 58.3 percent intermediate-resistance to cefotaxime, and 11.3 percent complete-resistance and 49.3 percent intermediate-resistance to ceftriaxone were reported in the 2001 PRSP collection. For comparison, the reported national rates of resistance among PRSP in 1999-2000 were macrolides, 76-78 percent; ceftriaxone, 65.7 percent; clindamycin, 25.8 percent; tetracycline, 48 percent; and chloramphenicol, 27.7 percent[56]. PRSP remain fully susceptible to vancomycin, quinupristin-dalfopristin, gatifloxacin and moxifloxacin but developed a low level resistance to rifampim (0.3 percent), ofloxacin (1.2 percent) and levofloxacin (0.3 percent)[56].

Amikacin-Resistant Gram-Negative Bacilli in New Jersey Hospitals

Exhibit 19 displays the variety and the number of amikacin-resistant Gram-negative bacilli reported from 1995 to 2001 in New Jersey hospitals. A total of 129 isolates were reported in 2001, representing a 15.2 percent increase from 2000 when 112 isolates were reported. The most frequently reported Gram-negative organisms in 2001 were *K. pneumoniae* and *S. maltophilia* which accounted for 24.8 and 18.6 percent, respectively, of the total collection. Isolates of *A. calcoaceticus-A. baumannii* complex and *P. aeruginosa* accounted for another 17.8 and 14 percent, respectively, in 2001. The number of isolates within the *Enterobacteriaceae* family accounted for 34.9 percent of the total collection in 2001. **Exhibits 20** and **21** illustrate the ten-year trend and the distribution of these isolates by county, respectively. A 121 percent growth, from 5 isolates per month in January 1992 to 11 isolates per month in December 2001 is demonstrated in **Exhibit 20**. Essex and Mercer Counties had the highest rates (7.7 and 2.8 per 100,000 population, respectively). Essex County alone accounted for 47.3 percent of the isolates reported in the State (**Exhibit 21**).

Imipenem-Resistant Gram-Negative Bacilli in New Jersey Hospitals

Exhibit 22 depicts the number and variety of imipenem-resistant Gram-negative bacilli reported from 1995 to 2001. A total of 190 isolates were reported in 2001, up from 169 in 2000. *P. aeruginosa* (37.4 percent) was the most frequently reported isolate, followed by *S. maltophilia* (24.7 percent). *A. calcoaceticus -A. baumannii* complex accounted for another 21.1 percent of the 2001 submission. As shown in **Exhibit 23,** a 133 percent increase was observed in the ten-year trend; in January 1992, 6.3 isolates per month were reported, in contrast to 14.7 isolates per month in December 2001. **Exhibit 24** displays the rate and the distribution of these organisms by county. Essex and Morris Counties had the highest rate of 5.3 per 100,000 population. Together, these two Counties accounted for 35.3 percent of the isolates reported in the State.

Drug Resistance Profile in Gram-Negative Bacilli in New Jersey Hospitals

Exhibit 25 displays the drug resistance profile of major *Enterobacteriaceae* blood isolates. A high percentage of resistance to penicillins and aminoglycosides in *K. pneumoniae* was observed. The resistance in *K. pneumoniae* to ciprofloxacin (60 percent), ceftazidime (92.3 percent) and ceftriaxone (61.1 percent) also tended to increase over time. Among the isolates collected in 2001, the overall resistance rate of *E. coli* was 31.8 percent to ceftazidime, 93.1 percent to ampicillin, 69.2 percent to piperacillin, 91.7 percent to tobramycin and 80 percent to trimethoprim/sulfamethoxazole. It is important to note that isolates collected in our system represent blood isolates that are resistant to either imipenem or amikacin. The overall multiple drug resistance in this group is much higher than random isolates. In comparison, the 2000 meropenem yearly susceptibility test information collection (MYSTIC) results showed that among all *Klebsiella* spp. collected from 15 U.S. centers, the susceptibilities were 98 percent to meropenem and imipenem, 97 percent to cefepime, 96 percent to piperacillin/tazobactam, 95 percent to gentamicin, and 94 percent to ceftazidime and ciprofloxacin[57]. In the United States, 5.9 and 5 percent of the *Klebsiella* spp. and *E. coli* isolates, respectively, had demonstrated a phenotype consistent with ESBLs production[58]. However, the SENTRY Antimicrobial Surveillance Program reported a low incidence (0.3 percent) of resistance of cefepime among the *Enterobacteriaceae* in 2001[59].

Exhibit 26 demonstrates the drug resistance profile of major Gram-negative bacilli that do not belong to *Enterobacteriaceae*. Imipenem resistance was high in *S. maltophilia* (100 percent), *P. aeruginosa* (79.8 percent) and *A. calcoaceticus -A. Baumannii* complex (70.2 percent), according to the 2001 data. High frequency of aminoglycosides resistance was also observed in *A. calcoaceticus-A. baumannii* complex (ranging from 81.7 percent for gentamicin to 43.4 percent for amikacin). Multiple drug resistance was very common in *S. maltophilia, A. calcoaceticus-A. baumannii* complex and *P. aeruginosa*. In the United States, *P. aeruginosa* isolates that were resistant to more than three drugs had increased from 12.8 percent in 1997 to 20.8 percent in 2000[60]. For reference, the MYSTIC 2000 data showed that the susceptibility of *P. aeruginosa* in 15 U.S. centers were 84 and 81 percent to meropenem and imipenem respectively; 81 percent to cefepime; 83 percent to ceftazidime; 86 percent to piperacillin/ tazobactam; 74 percent to ciprofloxacin; and 82 percent to gentamicin[57]. From 1999 to 2000, a significant reduction in ciprofloxacin susceptibility in *P. aeruginosa* (83 to 74 percent) and *Acinetobacter* spp. (72 to 63 percent) were reported, which suggest that fluoroquinolones may no longer provide assured empiric monotherapy for serious infections nor provide a spectrum as a co-drug equivalent to aminoglycosides[57].

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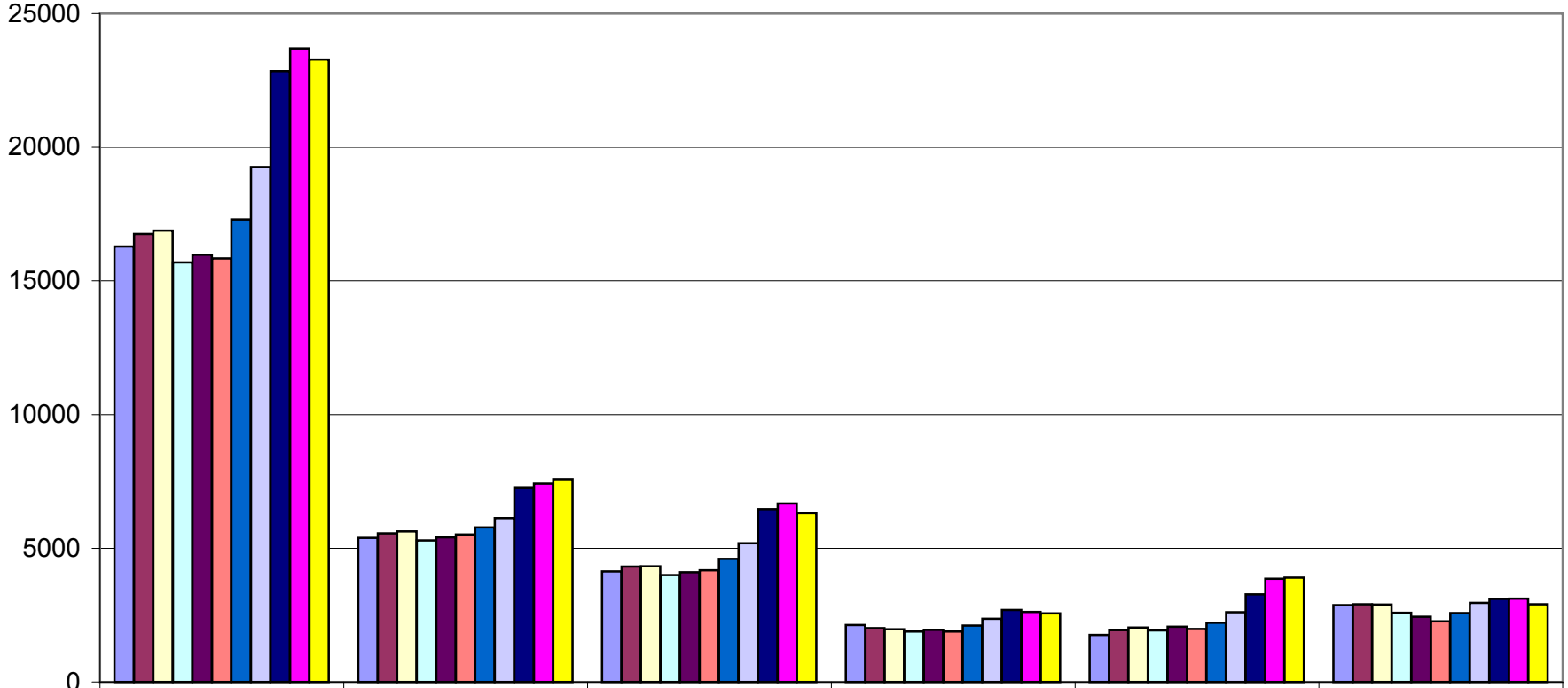
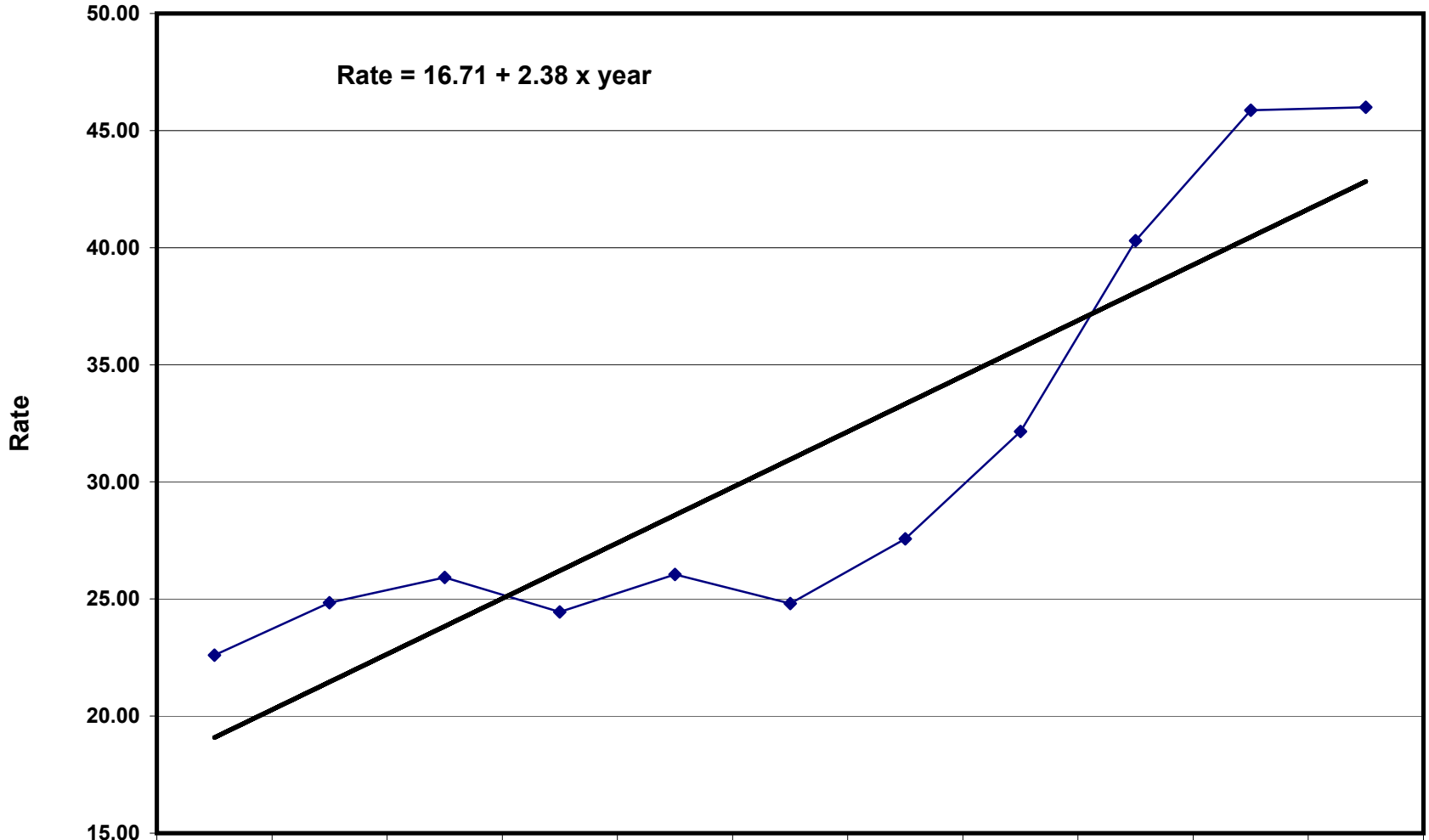
Exhibit 1 : MRSA Isolates by Body Sites, 1991-2001



	Total	Wound	Sputum	Urine	Blood	Other
1991	16286	5388	4136	2128	1759	2875
1992	16750	5559	4324	2013	1944	2910
1993	16885	5635	4331	1978	2041	2900
1994	15691	5290	3997	1884	1935	2585
1995	15977	5407	4107	1952	2074	2437
1996	15842	5520	4176	1889	1986	2271
1997	17299	5780	4610	2113	2222	2574
1998	19256	6132	5188	2363	2609	2964
1999	22841	7284	6464	2698	3282	3113
2000	23699	7413	6675	2626	3860	3125
2001	23282	7586	6316	2563	3903	2912

Exhibit 2 : MRSA Rate by Year (Blood Isolates per 100,000 Population)



	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
Rate	22.598031	24.83947	25.922503	24.443722	26.047897	24.800494	27.573767	32.150295	40.302517	45.874013	46.001906

Exhibit 3 : Frequency of MRSA by Facility, 2001
All Hospitals Ranked (from Highest to Lowest) by MRSA Rate
(Total MRSA Isolates / 100 Occupied Beds / Month)

Rank	Facility Code	# Iso. / Month	Rate (2001)	Rate (2000)
1	71	30.75	22.97	30.82
2	103*	19.92	21.42	16.03
3	76	52.25	21.27	21.51
4	119	11.58	21.20	26.16
5	117	36.00	20.66	18.14
6	55	23.67	20.45	21.26
7	19*	8.50	20.24	15.10
8	98	20.33	19.97	25.88
9	25	42.58	19.47	17.35
10	79**	20.00	19.12	29.23
11	54	24.67	18.58	18.91
12	36	85.00	18.47	22.41
13	26*	27.00	18.24	14.95
14	91	40.42	18.14	15.48
15	33	80.92	17.78	18.36
16	73	26.17	17.69	18.21
17	21*	22.92	17.10	19.45
18	116	15.17	16.47	26.91
19	47	24.58	16.05	12.56
20	59	47.83	15.91	17.36
21	3	24.42	15.90	15.77
22	112	65.83	15.37	20.61
23	75	10.92	15.34	10.59
24	18	12.58	15.02	15.39
25	20*	17.42	14.89	18.35
26	96	17.58	14.82	9.20
27	38	9.50	14.61	7.47
28	108	20.92	14.54	13.19
29	43	31.67	14.40	14.23
30	48	17.67	14.13	13.85
31	45	16.33	13.99	17.95
32	41	26.00	13.87	9.57
33	60	35.67	13.42	13.47
34	102	32.00	13.36	14.59
35	46	18.33	13.05	14.85
36	56	14.33	12.91	14.96
37	66	13.25	12.67	12.05

Rank	Facility Code	# Iso. / Month	Rate (2001)	Rate (2000)
38	82	23.67	12.63	15.34
39	109	5.25	12.60	9.59
40	72*	6.75	12.50	15.22
41	118*	10.00	12.50	5.89
42	51*	11.50	12.23	13.15
43	90	41.50	12.04	9.67
44	12	19.25	12.03	15.37
45	28	23.08	11.93	14.36
46	87	11.08	11.81	15.12
47	120*	21.00	11.80	7.72
48	17*	11.50	11.73	13.13
49	13	35.08	11.50	11.75
50	97	24.67	11.43	11.98
51	86	19.75	11.30	8.78
52	61*	14.75	11.09	8.74
53	15	25.83	10.67	10.28
54	23	20.08	10.61	9.88
55	101	15.50	10.01	8.17
56	100*	18.92	9.90	11.81
57	78**	16.33	9.90	8.45
58	31	38.00	9.69	9.25
59	81	51.00	9.69	8.63
60	80	14.58	9.52	5.67
61	35	13.50	9.33	9.37
62	95	38.42	9.30	12.83
63	77	5.08	9.02	9.84
64	74*	13.45	8.79	12.08
65	50	24.83	8.62	12.50
66	49	17.92	8.55	8.17
67	29	5.08	8.50	8.96
68	114	13.08	8.45	8.85
69	27	11.67	8.37	9.81
70	52	15.83	8.35	12.22
71	94	32.42	7.72	8.91
72	4	45.92	7.64	8.34
73	88**	25.25	7.42	7.31
74	122	6.75	7.39	8.83
75	67	8.33	7.35	8.84
76	44*	5.00	6.76	9.84
77	83*	15.58	6.72	7.58
78	64*	22.67	6.53	10.33
79	8	25.33	5.89	5.89
80	34	5.00	5.64	4.01

Rank	Facility Code	# Iso. / Month	Rate (2001)	Rate (2000)
81	53	24.92	5.61	5.42
82	42**	6.33	5.28	13.24
83	92	8.42	5.23	6.96
84	9	12.92	4.53	6.68
85	62	10.17	4.44	4.06
86	84	4.25	4.31	3.87
87	6	3.67	2.12	2.52
	State Total	**1945.54**	**11.69**	**12.27**

* Estimated based on the assumption that each facility maintains the same proportion of occupied beds within the merged hospital group before they were merged.

** 2000 Occupied bed number was used for 2001.

Note : Rate = number of total MRSA isolates per 100 occupied beds per month.

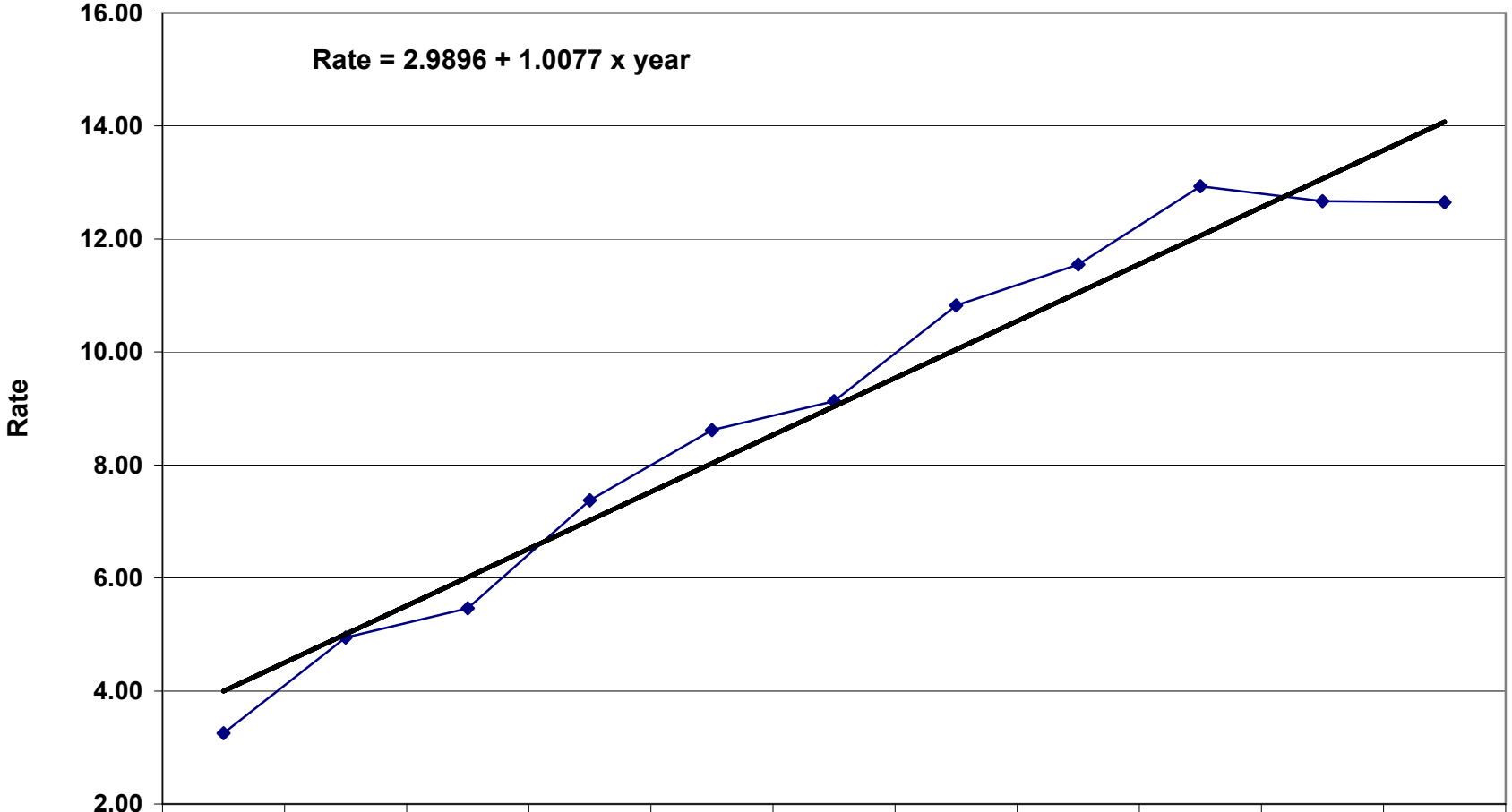
Exhibit 4 : Number and Rate of Total MRSA Isolates by County, 2001
In Descending Order of Number of Isolates per 100,000 Population

County	Num. Isolates	Percentage	Isolates / 100,000 Population	
			2001	2000
Mercer	1495	6.42%	422.88	485.80
Essex	3065	13.16%	386.44	378.01
Cumberland	541	2.32%	369.82	299.79
Morris	1627	6.99%	344.08	349.84
Ocean	1790	7.69%	339.53	355.05
Atlantic-Cape May*	1183	5.08%	330.60	271.08
Union	1560	6.70%	298.05	348.30
Camden	1472	6.32%	289.00	270.37
Middlesex	2163	9.29%	285.66	341.66
Salem	177	0.76%	275.00	163.34
Bergen	2208	9.48%	249.02	247.93
Passaic	1185	5.09%	241.31	242.10
Monmouth	1411	6.06%	226.49	214.20
Hudson	1346	5.78%	221.54	217.41
Burlington	866	3.72%	200.41	205.25
Sussex-Warren*	487	2.09%	192.92	272.10
Gloucester	310	1.33%	119.53	118.19
Hunterdon-Somerset*	396	1.70%	92.72	98.22
State Total	**23282**	**100.00%**	**274.41**	**281.65**

Rate = Number of isolates per 100,000 resident population in each county.

* Data for these two neighboring counties were aggregated according to guidelines of confidentiality disclosure.

Exhibit 5 : Rate of Antibiotic-Resistant Blood Isolates by Year
(Total Isolates per 100,000 Population)



	Year 1991 # Iso. 253	Year 1992 # Iso. 387	Year 1993 # Iso. 430	Year 1994 # Iso. 584	Year 1995 # Iso. 686	Year 1996 # Iso. 731	Year 1997 # Iso. 872	Year 1998 # Iso. 937	Year 1999 # Iso. 1053	Year 2000 # iso. 1066	Year 2001 # iso. 1073
Rate	3.2503137	4.9448945	5.4613799	7.3773301	8.6156497	9.1284799	10.821028	11.546503	12.930698	12.67	12.65

Exhibit 6 : Frequency of Antibiotic-Resistant Blood Isolates by Facility, 2001
In Descending Order of Number of Isolates per 100 Occupied Beds

Rank	Fac. Code	Num. Isolates	Percentage	Rate (2001)	Rate (2000)
1	73	45	4.19%	30.43	12.25
2	100*	45	4.19%	23.56	17.11
3	117	39	3.63%	22.38	13.73
4	54	29	2.70%	21.85	17.58
5	48	26	2.42%	20.80	12.03
6	60	45	4.19%	16.93	10.57
7	56	18	1.68%	16.22	17.09
8	59	48	4.47%	15.97	18.38
9	36	66	6.15%	14.34	6.58
10	88**	46	4.29%	13.52	22.14
11	66	14	1.30%	13.39	13.87
12	112	56	5.22%	13.08	17.92
13	28	24	2.24%	12.40	15.71
14	53	55	5.13%	12.38	10.24
15	103*	10	0.93%	10.75	9.62
16	29	6	0.56%	10.03	0.00
17	25	21	1.96%	9.60	5.47
18	8	40	3.73%	9.30	10.78
19	62	21	1.96%	9.17	12.39
20	76	22	2.05%	8.95	6.74
21	67	10	0.93%	8.82	7.07
22	81	44	4.10%	8.36	13.18
23	41	15	1.40%	8.00	1.17
24	91	16	1.49%	7.18	5.62
25	3	11	1.03%	7.16	3.90
26	90	24	2.24%	6.96	4.30
27	97	15	1.40%	6.95	5.91
28	50	19	1.77%	6.59	7.24
29	116	6	0.56%	6.52	3.27
30	61*	8	0.75%	6.02	6.45
31	45	7	0.65%	6.00	8.08
32	4	32	2.98%	5.33	6.54
33	17*	5	0.47%	5.10	5.43
34	12	8	0.75%	5.00	8.08
35	109	2	0.19%	4.80	0.00
36	26*	7	0.65%	4.73	2.21
37	47	7	0.65%	4.57	3.10
38	31	17	1.58%	4.34	2.83
39	87	4	0.37%	4.26	1.01

Rank	Fac. Code	Num. Isolates	Percentage	Rate (2001)	Rate (2000)
40	51*	4	0.37%	4.26	8.89
41	75	3	0.28%	4.21	4.24
42	15	10	0.93%	4.13	0.82
43	33	17	1.58%	3.73	6.03
44	72*	2	0.19%	3.70	0.00
45	27	5	0.47%	3.59	0.00
46	108	5	0.47%	3.48	0.00
47	96	4	0.37%	3.37	2.74
48	94	14	1.30%	3.33	3.79
49	82	6	0.56%	3.20	2.13
50	84	3	0.28%	3.04	4.04
51	83*	7	0.65%	3.02	6.06
52	64*	10	0.93%	2.88	12.40
53	46	4	0.37%	2.85	5.77
54	74*	4	0.37%	2.61	2.36
55	101	4	0.37%	2.58	1.93
56	43	5	0.47%	2.27	6.58
57	120*	4	0.37%	2.25	1.85
58	98	2	0.19%	1.96	1.01
59	49	4	0.37%	1.91	2.78
60	119	1	0.09%	1.83	0.00
61	23	3	0.28%	1.58	2.69
62	71	2	0.19%	1.49	2.56
63	44*	1	0.09%	1.35	11.11
64	114	2	0.19%	1.29	0.66
65	102	3	0.28%	1.25	3.10
66	78**	2	0.19%	1.21	3.04
67	95	5	0.47%	1.21	2.78
68	34	1	0.09%	1.13	0.00
69	79**	1	0.09%	0.96	3.83
70	55	1	0.09%	0.86	0.00
71	92	1	0.09%	0.62	9.49
	Total	**1073**	**100.00%**	**7.43**	**7.64**

* Estimated based on the assumption that each facility maintains the same proportion of occupied beds within the merged hospital group before they were merged.

** 2000 Occupied bed number was used for 2001.

Note : Rate = number of total MRSA isolates per 100 occupied beds per year.

Exhibit 7 : Number and Rate of Antibiotic Resistant Blood Isolates by County, 2001
In Descending Order of Number of Isolates per 100,000 Population

County	Num. Isolates	Percentage	Isolates / 100,000 Population	
			2001	2000
Essex	274	25.54	34.55	38.05
Mercer	79	7.36	22.35	17.39
Middlesex	132	12.3	17.43	24.79
Passaic	79	7.36	16.09	13.50
Morris	70	6.52	14.80	6.17
Camden	72	6.71	14.14	11.59
Union	73	6.8	13.95	12.44
Cumberland	15	1.4	10.25	7.51
Bergen	85	7.92	9.59	8.37
Hudson	52	4.85	8.56	12.64
Monmouth	51	4.75	8.19	5.69
Atlantic-Cape May*	23	2.15	6.43	3.38
Hunterdon-Somerset*	25	2.33	5.85	4.77
Ocean	26	2.42	4.93	7.24
Sussex-Warren*	8	0.75	3.17	1.62
Salem	2	0.19	3.11	4.67
Burlington	7	0.65	1.62	5.43
Gloucester	0	0	0.00	0.79
State Total	**1073**	**100**	**12.65**	**12.67**

Rate = Number of isolates per 100,000 resident population in each county.

* Data for these two neighboring counties were aggregated according to guidelines of confidentiality disclosure.

Exhibit 8 : Vancomycin-Resistant Gram-Positive Cocci Isolated from Blood Cultures, 1995-2001

	1995		1996		1997		1998		1999		2000		2001	
Organism Name	**Frequency**		**Frequency**		**Frequency**		**Frequency**		**Frequency**		**Frequency**		**Frequency**	
VRE	**337**	**97.40%**	**404**	**97.12%**	**477**	**98.75%**	**510**	**97.51%**	**570**	**99.48%**	**566**	**99.12%**	**575**	**99.83%**
Enterococcus faecium	254	73.41%	296	71.15%	333	69.38%	329	62.91%	401	69.98%	396	69.35%	392	68.06%
Enterococcus faecalis	30	8.67%	36	8.65%	48	10.00%	80	15.30%	101	17.63%	114	19.96%	97	16.84%
Enterococcus spp.	43	12.43%	63	15.14%	73	15.21%	84	16.06%	54	9.42%	24	4.20%	38	6.60%
Enterococcus avium	2	0.58%	3	0.72%	5	1.04%	4	0.76%	1	0.17%	2	0.35%	2	0.35%
Enterococcus durans	7	2.02%	6	1.44%	2	0.42%	2	0.38%	1	0.17%	1	0.18%	1	0.17%
Enterococcus raffinosus	0	0.00%	0	0.00%	0	0.00%	0	0.00%	3	0.52%	0	0.00%	2	0.35%
Enterococcus gallinarum	1	0.29%	0	0.00%	10	2.08%	9	1.72%	8	1.40%	27	4.73%	34	5.90%
Enterococcus casseliflavus	0	0.00%	0	0.00%	3	0.63%	2	0.38%	1	0.17%	2	0.35%	9	1.56%
Streptococcus pneumoniae	1	0.29%	1	0.24%	1	0.21%	0	0.00%	1	0.17%	0	0.00%	0	0.00%
Viridans streptococci	3	0.87%	5	1.20%	2	0.42%	0	0.00%	0	0.00%	0	0.00%	0	0.00%
Streptococcus equinus	2	0.58%	0	0.00%	0	0.00%	0	0.00%	1	0.17%	1	0.18%	1	0.17%
Streptococcus spp.	0	0.00%	1	0.24%	1	0.21%	2	0.38%	1	0.17%	0	0.00%	0	0.00%
Staphylococcus aureus	0	0.00%	2	0.48%	0	0.00%	1	0.19%	0	0.00%	0	0.00%	0	0.00%
Staphylococcus epidermidis	0	0.00%	0	0.00%	0	0.00%	0	0.00%	0	0.00%	1	0.18%	0	0.00%
Staphylococcus auricularis	0	0.00%	0	0.00%	0	0.00%	1	0.19%	0	0.00%	0	0.00%	0	0.00%
Staphylococcus coag. neg.	1	0.29%	0	0.00%	0	0.00%	1	0.19%	0	0.00%	1	0.18%	0	0.00%
Micrococcus spp.	0	0.00%	0	0.00%	0	0.00%	4	0.76%	0	0.00%	0	0.00%	0	0.00%
Leuconostoc spp.	1	0.29%	2	0.48%	0	0.00%	2	0.38%	0	0.00%	0	0.00%	0	0.00%
Pediococcus spp.	1	0.29%	1	0.24%	2	0.42%	2	0.38%	0	0.00%	2	0.35%	0	0.00%
Total	**346**	**100.00%**	**416**	**100.00%**	**480**	**100.00%**	**523**	**100.00%**	**573**	**100.00%**	**571**	**100.00%**	**576**	**100.00%**