

1997 studies found even greater costs and longer hospital stays associated with infections from resistant bacteria than the 1995 studies.

2. Indirect Costs of Resistant Infections

a. *Morbidity.* In addition to direct medical costs, patients also incur indirect costs from lost productivity due to resistant bacterial infections. FDA does not know how long a typical hospital stay is extended due to antibacterial resistance. However, if just 1 extra day were needed for relatively simple cases, at an average hourly wage of \$16 including benefits, each case would cost about \$128 in lost productivity. For cases where few alternatives are effective against the disease-causing bacteria, as with *Pseudomonas*, patients might need an additional 3.5 days in the hospital, with lost productivity cost of about \$448 per patient. Assuming the mean of these two estimates, 150,000 cases of resistant bacterial infections would cost the economy about \$43 million per year in lost productivity.

b. *Mortality.* The threat of mortality appears to be greater from hospital-acquired infections than from community-acquired infections. According to the CDC, about 40 percent

of all community-acquired infections from *S. pneumoniae* are penicillin-nonsusceptible (includes both intermediate-susceptible and resistant strains). These bacteria can cause infections such as bacteremia, pneumonia, meningitis, and otitis media. Until the mid-1990s, surveillance data for *S. pneumoniae* included few cases of resistant bacteria. Current surveillance data, however, show the incidence of resistant bacteria has dramatically increased, surpassing the incidence of intermediate-susceptible bacteria (Ref. 18). Several studies have reported higher crude mortality rates with infections caused by drug-resistant *S. pneumoniae* (DRSP) (Refs. 19, 20, 21, 22, and 23). However, once adjusted for age and severity of illness, mortality rates for patients with community-acquired infections from DRSP and drug-sensitive *S. pneumoniae* strains are statistically similar. As the incidence of community-acquired infections from resistant bacteria increases, the differences in mortality rates may become statistically significant.

In a report released last year, the World Health Organization estimated that 14,000 people die in the United

States annually from drug-resistant infections acquired in hospitals (Ref. 24). Several published studies have reported higher crude mortality rates from hospital-acquired infections caused by resistant bacteria. However, direct comparison of the findings of these studies is difficult because of differences in definitions, base line mortality rates, and the characteristics of patients included in the studies. In most studies, age and severity of illness confound the mortality data. Furthermore, because the prevalence of resistant bacteria is not uniform throughout the United States, studies conducted in a specific hospital or region may not be representative of the whole country.

To develop a rough estimate of the mortality that might be attributable to resistant bacterial infections, FDA estimated base line in-hospital mortality rates by age cohort, using hospital discharge and diagnosis data from HCUP (table 4 of this document). The number of life-years lost due to resistant bacterial infections was then derived from this base line mortality rate and from a weighted measure of the deaths attributable to resistant bacteria (27.1 percent).

TABLE 4.—1997 IN-HOSPITAL MORTALITY RATES BY AGE COHORT

Age cohort	Population (000) ¹	Number of In-Hospital Deaths ²	In-Hospital Mortality as % of Population for Age Cohort
Birth–17	69,603	25,739	0.04%
18–44	108,553	49,687	0.05%
45–64	55,441	143,670	0.26%
65–84	30,272	462,465	1.53%
85+	3,913	185,868	4.75%
Total	267,782	867,429	

¹ U.S. Department of Commerce, Census Bureau, Statistical Abstract of the United States: 2000, Table 12.

² 1997 hospital discharge data from HCUPnet, Healthcare Cost and Utilization Project, Agency for Healthcare Research and Quality (AHRQ), Rockville, MD, <http://www.ahrq.gov/data/hcup/hcupnet.htm>.

Table 5 of this document shows the number and monetary value of the life-years lost from resistant bacteria. The monetary values shown in columns 6 and 7 are derived by amortizing the value of a statistical life of \$5 million⁸

over the average remaining life span of a 35-year-old, which is estimated to be 44.3 years. At zero discount rate, this would be the equivalent of receiving a payment of \$112,867 per year. However, applying discount rates of 3 percent and

7 percent⁹, to reflect more plausible rates of social time preference, results in life-year values equal to \$205,493 and \$368,404, respectively.

⁸ The \$5 million estimate is the aggregate amount society is willing to pay to save one life. Fisher, A., D. Violette, and L. Chestnut, "The Value of Reducing Risks of Death: A Note on New Evidence," *Journal of Policy Analysis and Management*, vol. 8, pp. 88–100, 1989.

⁹ The Panel on Cost-Effectiveness in Health and Medicine convened by the U.S. Public Health Service recommends using a discount rate of 3 percent to calculate health benefits (Weinstein, M. C. et al. "Recommendations of the Panel on Cost-Effectiveness in Health and Medicine," *Journal of*

the American Medical Association, vol. 276, p. 1253–1258). OMB requires agencies to use a discount rate of 7 percent when calculating regulatory impacts.