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National Nosocomial Infections Surveillance (NNIS) System Report, data summary from January 1992 to June 2002, issued August 2002

A Report from the NNIS System*
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This report is a summary of the data collected and reported by hospitals participating in the National Nosocomial Infections Surveillance (NNIS) System from January 1992 through June 2002 and updates previously published data.[1-4]

The NNIS System was established in 1970 when selected hospitals in the United States routinely began reporting their nosocomial infection surveillance data for aggregation into a national database. Hospitals participating in the NNIS System provide general medical-surgical inpatient services to adults or children requiring acute care. Identity of the more than 300 hospitals currently participating in the NNIS System is confidential.

All NNIS data are collected using standardized protocols, called "surveillance components": adult and pediatric intensive care unit (ICU), high-risk nursery (HRN), and surgical patient.[5-7] The components may be used singly or simultaneously, but once selected, they must be used for a minimum of 1 calendar month. All infections are categorized into major and specific infection sites using standard Centers for Disease Control definitions that include laboratory and clinical criteria.[6]

In January 1999, the hospitalwide component was eliminated from the NNIS system. This was done for several reasons. The hospitalwide component required considerable time and resources in most hospitals, particularly those that have a large patient population at high-risk, resulting in inaccurate and inadequate case-finding. More importantly, the hospitalwide component did not yield rates that were meaningful for national comparison purposes because they were not risk-adjusted.

ADULT AND PEDIATRIC ICU SURVEILLANCE COMPONENT

Infection control professionals (ICPs) collect data on all sites of nosocomial infection in patients located in ICUs, and ICU-specific denominator data. Site-specific infection rates can be calculated by using as a denominator the number of patients at risk, patient days, and days of indwelling urinary catheterization, central vascular cannulation (central line), or ventilation.

HRN SURVEILLANCE COMPONENT

ICPs collect data on all sites of nosocomial infection in patients located in HRNs, and HRN-specific

*See Appendix D.

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Table 1. Pooled means and percentiles of the distribution of device-associated infection rates by type of ICU, ICU component, January 1995 to June 2002*

Urinary catheter-associated UTI rate†				**Percentile**				
Type of ICU	**No. of units**	**Urinary catheter-days**	**Pooled mean**	**10%**	**25%**	**50% (median)**	**75%**	**90%**
Burn	20	77,246	9	2.9	5.3	7.9	10.4	12.7
Coronary	108	501,709	5.5	0.9	2.6	5	8.5	10.8
Cardiothoracic	67	582,112	3.1	0.5	1.1	2.5	3.8	5.5
Medical	140	1,230,436	6.3	2.1	3.6	5.7	7.6	9.9
Medical-surgical								
Major teaching	127	1,145,790	5.6	1.9	3.2	5.3	7	9.6
All others	182	1,815,833	3.8	0.8	1.8	3.6	5.4	6.7
Neurosurgical	51	291,860	7.7	2	4.2	6.7	9.9	12.3
Pediatric	71	260,553	4.8	1	2.5	4.3	6.8	7.9
Surgical	156	1,449,784	5.1	1.3	2.9	4.4	7.2	9
Trauma	26	218,894	6.4	3.7	4.7	6.3	8	9.6
Respiratory	8	46,362	5.3	—	—	—	—	—

Central line-associated BSI rate‡				**Percentile**				
Type of ICU	**No. of units**	**Central line-days**	**Pooled mean**	**10%**	**25%**	**50% (median)**	**75%**	**90%**
Burn	19	67,622	8.8	—	—	—	—	—
Coronary	109	320,956	4.3	0	1.9	4	5.5	7.8
Cardiothoracic	67	528,814	2.9	0.5	1.2	2.3	3.6	4.6
Medical	141	856,119	5.8	2	3.2	5.2	7	9.7
Medical-surgical								
Major teaching	128	784,807	5.2	2.3	3.3	4.8	6.2	8.2
All others	183	1,118,845	3.8	0	1.9	3.2	5	7
Neurosurgical	51	159,413	4.7	0.1	2.4	4	7.2	9.4
Pediatric	74	363,198	7.4	1.3	3.8	6.4	8.7	11.9
Surgical	155	1,128,751	5.2	1.1	2.6	4.9	7	9.1
Trauma	26	156,286	7.9	1.1	3.6	6.6	9.1	11.8
Respiratory	8	28,699	3.3	—	—	—	—	—

Ventilator-associated pneumonia rate*§				**Percentile**				
Type of ICU	**No. of units**	**Ventilator-days**	**Pooled mean**	**10%**	**25%**	**50% (median)**	**75%**	**90%**
Burn	14	5365	8.9	—	—	—	—	—
Coronary	41	12,216	3.4	—	—	—	—	—
Cardiothoracic	34	15,581	8.2	—	—	—	—	—
Medical	66	46,993	4.4	—	—	—	—	—
Medical-surgical								
Major teaching	76	45,276	5.1	—	—	—	—	—
All others	83	54,991	5.3	—	—	—	—	—
Neurosurgical	23	8928	10.8	—	—	—	—	—
Pediatric	37	20,137	2.2	—	—	—	—	—
Surgical	77	46,633	8.3	—	—	—	—	—
Trauma	18	9682	14.7	—	—	—	—	—
Respiratory	5	3311	2.4	—	—	—	—	—

UTI, urinary tract infection; *BSI*, bloodstream infection.

*Ventilator-associated pneumonia data are for January to June 2002 only.

†$\frac{\text{Number of urinary catheter-associated UTIs}}{\text{Number of urinary catheter-days}} \times 1000$

‡$\frac{\text{Number of central line-associated BSIs}}{\text{Number of central-line days}} \times 1000$

§$\frac{\text{Number of ventilator-associated pneumonias}}{\text{Number of ventilator-days}} \times 1000$

Table 2. Pooled means and percentiles of the distribution of device utilization (DU) ratios by type of ICU, ICU component, January 1995 to June 2002

Urinary catheter utilization*				**Percentile**				
Type of ICU	**No. of units**	**Patient-days**	**Pooled mean**	**10%**	**25%**	**50% (median)**	**75%**	**90%**
Burn	21	134,498	0.57	0.24	0.33	0.55	0.7	0.9
Coronary	108	987,851	0.51	0.27	0.39	0.51	0.63	0.72
Cardiothoracic	67	664,998	0.88	0.7	0.8	0.9	0.95	0.97
Medical	140	1,677,292	0.73	0.54	0.64	0.75	0.82	0.87
Medical-surgical								
Major teaching	128	1,422,282	0.81	0.57	0.75	0.81	0.86	0.9
All others	182	2,410,514	0.75	0.57	0.67	0.76	0.82	0.88
Neurosurgical	51	357,220	0.82	0.52	0.72	0.83	0.91	0.94
Pediatric	77	790,890	0.33	0.13	0.19	0.29	0.39	0.45
Surgical	156	1,715,388	0.85	0.69	0.78	0.86	0.91	0.95
Trauma	26	245,454	0.89	0.73	0.84	0.92	0.96	0.98
Respiratory	8	63,505	0.73	—	—	—	—	—

Central line utilization†				**Percentile**				
Type of ICU	**No. of units**	**Patient-days**	**Pooled mean**	**10%**	**25%**	**50% (median)**	**75%**	**90%**
Burn	21	134,498	0.5	0.11	0.22	0.49	0.57	0.75
Coronary	110	987,851	0.32	0.13	0.21	0.28	0.42	0.59
Cardiothoracic	67	664,998	0.8	0.56	0.7	0.82	0.91	0.95
Medical	141	1,677,292	0.51	0.3	0.35	0.52	0.64	0.75
Medical-surgical								
Major teaching	128	1,422,282	0.55	0.34	0.45	0.55	0.63	0.73
All others	183	2,410,514	0.46	0.25	0.34	0.47	0.57	0.63
Neurosurgical	51	357,220	0.45	0.26	0.37	0.48	0.54	0.63
Pediatric	77	790,890	0.46	0.22	0.31	0.42	0.54	0.61
Surgical	155	1,715,388	0.66	0.45	0.56	0.67	0.76	0.87
Trauma	26	245,454	0.64	0.46	0.53	0.63	0.76	0.86
Respiratory	8	63,505	0.45	—	—	—	—	—

Ventilator utilization‡				**Percentile**				
Type of ICU	**No. of units**	**Patient-days**	**Pooled mean**	**10%**	**25%**	**50% (median)**	**75%**	**90%**
Burn	21	134,498	0.33	0.07	0.13	0.24	0.43	0.67
Coronary	108	987,851	0.22	0.08	0.13	0.21	0.29	0.37
Cardiothoracic	67	664,998	0.47	0.29	0.39	0.47	0.52	0.61
Medical	142	1,677,292	0.48	0.24	0.34	0.48	0.59	0.67
Medical-surgical								
Major teaching	128	1,422,282	0.47	0.26	0.35	0.42	0.54	0.64
All others	183	2,410,514	0.36	0.21	0.27	0.35	0.43	0.5
Neurosurgical	51	357,220	0.38	0.19	0.26	0.37	0.46	0.53
Pediatric	78	790,890	0.44	0.18	0.31	0.41	0.48	0.58
Surgical	155	1,715,388	0.47	0.26	0.35	0.46	0.55	0.66
Trauma	27	245,454	0.58	0.36	0.51	0.59	0.72	0.76
Respiratory	8	63,505	0.55	—	—	—	—	—

*$\frac{\text{Number of urinary catheter-days}}{\text{Number of patient-days}}$

†$\frac{\text{Number of central line-days}}{\text{Number of patient-days}}$

‡$\frac{\text{Number of ventilator-days}}{\text{Number of patient-days}}$

Table 3. Pooled means and percentiles of the distribution of device-associated infection rates by birth-weight category, HRN component, January 1995 to June 2002*

Umbilical and central line-associated BSI rate†				**Percentile**				
Birth-weight category	**No. of HRNs**	**Central line-days**	**Pooled mean**	**10%**	**25%**	**50% (median)**	**75%**	**90%**
≤1000 g	141	560,361	10.8	4.1	7.4	10.3	13.9	18
1001-1500 g	140	272,742	6.6	2.1	4.3	6.6	9.8	13.6
1501-2500 g	135	212,309	4.1	0	1.4	3.9	5.8	8.3
>2500 g	139	295,110	3.6	0	1	2.7	4.9	6.9
Ventilator-associated pneumonia rate*‡				**Percentile**				
Birth-weight category	**No. of HRNs**	**Ventilator-days**	**Pooled mean**	**10%**	**25%**	**50% (median)**	**75%**	**90%**
≤1000 g	77	33,497	2.4	—	—	—	—	—
1001-1500 g	77	8356	1.7	—	—	—	—	—
1501-2500 g	77	5893	2	—	—	—	—	—
>2500 g	77	8700	0.7	—	—	—	—	—

BSI, bloodstream infection.

*Ventilator-associated pneumonia data are for January to June 2002 only.

$$\frac{\text{†Number of umbilical and central line-associated BSIs}}{\text{Number of umbilical and central line-days}} \times 1000$$

$$\frac{\text{‡Number of ventilator-associated pneumonias}}{\text{Number of ventilator-days}} \times 1000$$

Table 4. Pooled means and percentiles of the distribution of device utilization (DU) ratios by birth-weight category, HRN component, January 1995 to June 2002

Umbilical and central line utilization ratio*				**Percentile**				
Birth-weight category	**No. of HRNs**	**Patient-days**	**Pooled mean**	**10%**	**25%**	**50% (median)**	**75%**	**90%**
≤1000 g	145	1,348,098	0.42	0.21	0.28	0.41	0.55	0.63
1001-1500 g	145	939,469	0.29	0.09	0.15	0.27	0.42	0.56
1501-2500 g	146	1,027,647	0.21	0.05	0.09	0.15	0.32	0.46
>2500 g	146	946,400	0.31	0.07	0.14	0.22	0.41	0.56
Ventilator utilization ratio†				**Percentile**				
Birth-weight category	**No. of HRNs**	**Patient-days**	**Pooled mean**	**10%**	**25%**	**50% (median)**	**75%**	**90%**
≤1000 g	145	1,348,098	0.41	0.25	0.3	0.41	0.49	0.62
1001-1500 g	145	939,469	0.17	0.07	0.1	0.15	0.24	0.37
1501-2500 g	146	1,027,647	0.12	0.03	0.05	0.09	0.17	0.32
>2500 g	146	946,400	0.19	0.04	0.07	0.13	0.24	0.34

$$\frac{\text{*Number of umbilical and central-line days}}{\text{Number of patient-days}}$$

$$\frac{\text{†Number of ventilator-days}}{\text{Number of patient-days}}$$

denominator data. Site-specific infection rates can be calculated by using as a denominator the number of patients at risk, patient-days, and days of umbilical catheter/central line use or ventilation for each of 4 birth-weight categories (≤1000 g, 1001 to 1500 g, 1501 to 2500 g, and > 2500 g).

Table 5. SSI rates,* by operative procedure and risk index category, Surgical Patient component, January 1992 to June 2002

Operative procedure category		Duration cut point (h)	Risk index category	N	Rate
CARD	Cardiac	5	0	1866	0.64
CBGB	CABG - chest and donor site	5	0	2196	1.28
CBGC	CABG - chest only	4	0,1	13,169	2.19
OCVS	Other cardiovascular	2	0,1	8933	0.62
ORES	Other respiratory	2	0,1,2,3	1594	2.57
THOR	Thoracic	3	0	1274	0.39
BILI	Liver/pancreas	4	0	382	3.14
OGIT	Other digestive	3	0,1	3252	3.08
SB	Small bowel	3	0	1443	5.06
XLAP	Laparotomy	2	0	5725	1.73
NEPH	Nephrectomy	4	0,1,2,3	2996	1.13
OGU	Other genitourinary	2	0	12,363	0.36
PRST	Prostatectomy	4	0	2476	0.85
HN	Head and neck	7	0	559	2.33
OENT	Other ENT	3	0	2567	0.08
HER	Herniorrhaphy	2	0	10,243	0.8
MAST	Mastectomy	3	0	13,623	1.86
CRAN	Craniotomy	4	0	3964	0.91
ONS	Other nervous system	4	0,1,2,3	2092	1.53
VSHN	Ventricular shunt	2	0	3331	4.17
CSEC	Cesarean section	1	0	127,324	2.83
HYST	Abdominal hysterectomy	2	0	39,735	1.4
OOB	Other obstetrical	1	0,1,2,3	1190	0.5
VHYS	Vaginal hysterectomy	2	0,1,2,3	23977	1.23
AMP	Limb amputation	1	0,1,2,3	9230	3.63
FUSN	Spinal fusion	4	0	35722	1.08
FX	Open reduction of fracture	2	0	13893	0.76
HPRO	Hip prosthesis	2	0	30463	0.89
KPRO	Knee prosthesis	2	0	43615	0.85
LAM	Laminectomy	2	0	57063	0.89
OMS	Other musculoskeletal	3	0	15363	0.64
OPRO	Other prosthesis	3	0, 1, 2, 3	3025	0.63
OBL	Other hem/lymph system	3	0, 1, 2, 3	973	2.06
OES	Other endocrine system	3	0	2097	0.14
OEYE	Other eye	2	0, 1, 2, 3	535	0.75
OSKN	Other integumentary system	2	0, 1, 2, 3	8037	1.26
SKGR	Skin graft	3	0	1049	0.86
SPLE	Splenectomy	2	0	340	1.18
TP	Organ transplant	6	0, 1	3881	4.48
VS	Vascular	3	0	6795	0.9

CBGB, Coronary artery bypass graft with chest and donor site incisions (eg, femoral or radial artery harvested as donor vessel for bypass graft); *CBGC*, coronary artery bypass graft with chest incision only (eg, use of internal mammary artery for bypass graft); *ENT*, ear, nose, and throat.
*per 100 operations.

SURGICAL PATIENT SURVEILLANCE COMPONENT

ICPs select from the NNIS operative procedure list those procedures they wish to follow-up and monitor the patients undergoing those procedures for all infections or surgical-site infections (SSI) only. A record on every patient undergoing the selected procedure is generated that includes information on risk factors for SSI such as wound class,[8] duration of operation, and American Society of Anesthesiology (ASA) score.[9] Using a composite index for predicting the risk of SSI after operation, ICPs can calculate rates by the number of risk factors present.[4]

The time periods for the data contained in this report vary depending on the table. Data from the 1980s are no longer included in any table. Each table represents NNIS data from one of the surveil-

Risk index category	N	Rate	Risk index category	N	Rate	Risk index category	N	Rate
1	37,452	1.54	2,3	11,315	2.25		—	—
1	301,715	3.51	2,3	62,625	5.62		—	—
2,3	5288	3.93		—	—		—	—
2	3242	1.42	3	129	3.88		—	—
	—	—		—	—		—	—
1	4340	1.11	2,3	1438	2.85		—	—
1,2,3	1429	7.63		—	—		—	—
2,3	577	7.11		—	—		—	—
1	3332	7.26	2,3	2024	9.09		—	—
1	6899	3.17	2	3697	5.03	3	767	7.3
	—	—		—	—		—	—
1	6564	0.9	2,3	1563	3.07		—	—
1	1748	2	2,3	288	4.17		—	—
1	799	5.13	2,3	354	13.28		—	—
1	1167	0.69	2,3	248	2.82		—	—
1	6367	2.03	2,3	1471	3.94		—	—
1	8509	2.33	2,3	835	3.59		—	—
1	11,696	1.56	2,3	3682	2.12		—	—
	—	—		—	—		—	—
1,2,3	9085	5.44		—	—		—	—
1	37,896	4.12	2,3	3826	6.69		—	—
1	19,041	2.34	2,3	3988	5.39		—	—
	—	—		—	—		—	—
	—	—		—	—		—	—
	—	—		—	—		—	—
1	20058	2.77	2, 3	5311	6.29		—	—
1	22496	1.34	2	4360	2.48	3	469	4.48
1	50566	1.53	2, 3	13841	2.38		—	—
1	49652	1.28	2, 3	12384	2.21		—	—
1	40859	1.4	2, 3	12972	2.51		—	—
1	10772	0.89	2, 3	3158	1.77		—	—
	—	—		—	—		—	—
	—	—		—	—		—	—
1, 2, 3	1599	0.81		—	—		—	—
	—	—		—	—		—	—
	—	—		—	—		—	—
1	1762	1.82	2, 3	1278	4.62		—	—
1, 2, 3	1050	3.52		—	—		—	—
2, 3	1511	15.09		—	—		—	—
1	58422	1.77	2, 3	23247	4.46		—	—

lance components. There are no data solely from the hospitalwide component in this report.

Tables 1 and 2 from the ICU component update previously published device-associated rates and device utilization (DU) ratios by type of ICU.[1,2] In these tables, the percentile distributions that display the infection rates and DU ratios require data from at least 20 different units. Each of the analyses of ICU data excluded rates or DU ratios for units that did not report at least 50 device or patient-days. Because of this, the number of units contributing data in the tables is not exactly the same.

For the first time, there were a sufficient number of burn ICUs to report the percentile distributions of infection rates and DU ratios. The number of units reporting data from respiratory ICUs is still not adequate to provide such distributions. The data for combined medical/surgical ICUs have been split into

Table 6. Percentiles of the distribution of SSI rates,* by operative procedure and risk index category,† Surgical Patient component, January 1992 to June 2002

Operative procedure category		Risk index category	No. hospitals	Pooled mean rate	Percentile				
					10%	25%	50% (median)	75%	90%
CARD	Cardiac	1	105	1.54	0.00	0.49	1.14	1.82	2.87
CARD	Cardiac	2,3	79	2.25	0.00	0.43	1.59	3.18	5.64
CBGB	CABG - chest and donor	0	25	1.28	0.00	0.00	1.26	2.26	3.85
CBGB	CABG - chest and donor	1	181	3.51	1.43	2.12	3.28	4.46	6.43
CBGB	CABG - chest and donor	2,3	170	5.62	2.27	3.74	5.41	7.51	9.59
CBGC	CABG - chest only	0,1	101	2.19	0.00	0.00	1.49	3.19	4.41
CBGC	CABG - chest only	2,3	54	3.93	0.00	0.49	2.78	4.84	6.98
OCVS	Other cardiovascular	0,1	31	0.62	0.00	0.00	0.00	0.70	2.03
OCVS	Other cardiovascular	2	21	1.42	0.00	0.00	0.16	2.21	2.74
THOR	Thoracic	0	20	0.39	0.00	0.00	0.00	0.00	0.93
THOR	Thoracic	1	34	1.11	0.00	0.00	0.54	1.87	2.75
THOR	Thoracic	2,3	21	2.85	0.00	0.00	1.65	3.72	5.92
APPY	Appendectomy	0-No	46	1.40	0.00	0.00	1.04	1.92	3.31
APPY	Appendectomy	1	54	2.87	0.00	1.02	2.30	4.22	5.85
APPY	Appendectomy	2	31	4.83	0.00	0.00	3.81	5.81	7.87
CHOL	Cholecystectomy	M	84	0.44	0.00	0.00	0.00	0.48	1.11
CHOL	Cholecystectomy	0	88	0.67	0.00	0.00	0.39	1.10	2.05
CHOL	Cholecystectomy	1	73	1.81	0.00	0.00	1.43	3.42	5.26
CHOL	Cholecystectomy	2	46	3.26	0.00	0.34	3.20	4.83	7.29
COLO	Colon operation	0	90	3.94	0.00	2.08	3.57	5.05	6.58
COLO	Colon	1	100	5.69	1.48	3.55	5.33	6.91	8.46
COLO	Colon	2	79	8.59	3.82	5.45	8.39	11.86	17.22
COLO	Colon	3	27	11.45	1.84	7.48	12.84	18.64	23.05
GAST	Gastric	0-No	24	2.69	0.00	0.00	1.35	3.77	6.29
GAST	Gastric	1	42	4.95	0.29	2.20	3.85	7.90	9.51
GAST	Gastric	2,3	25	10.03	1.00	4.45	10.05	17.41	21.92
OGIT	Other digestive	0,1	23	3.08	0.00	0.96	2.51	4.30	7.28
SB	Small bowel	0	22	5.06	0.00	1.14	4.49	6.01	10.63
SB	Small bowel	1	34	7.26	2.20	3.87	6.06	9.77	12.50
SB	Small bowel	2,3	26	9.09	5.74	6.58	8.16	13.42	18.89
XLAP	Laparotomy	0	36	1.73	0.00	0.00	1.30	2.33	3.21
XLAP	Laparotomy	1	42	3.17	0.00	1.24	2.34	4.30	6.73
XLAP	Laparotomy	2	33	5.03	0.00	1.25	3.27	6.48	10.28
NEPH	Nephrectomy	0,1,2,3	27	1.13	0.00	0.00	0.41	2.54	5.05
OGU	Other genitourinary	0	31	0.36	0.00	0.00	0.20	0.64	1.34
OGU	Other genitourinary	1	28	0.90	0.00	0.00	0.61	1.92	2.51
PRST	Prostatectomy	0	28	0.85	0.00	0.00	0.00	0.93	2.25
PRST	Prostatectomy	1	20	2.00	0.00	0.00	1.56	3.85	4.76
HER	Herniorrhaphy	0	45	0.80	0.00	0.00	0.68	1.72	2.29
HER	Herniorrhaphy	1	47	2.03	0.00	0.45	1.66	3.09	5.06
HER	Herniorrhaphy	2,3	24	3.94	0.00	0.00	3.70	4.76	6.42
MAST	Mastectomy	0	54	1.86	0.00	0.00	0.57	1.57	2.83
MAST	Mastectomy	1	49	2.33	0.00	0.14	2.09	3.97	6.68
CRAN	Craniotomy	0	38	0.91	0.00	0.00	0.00	1.69	3.22
CRAN	Craniotomy	1	60	1.56	0.00	0.00	1.02	2.28	3.67
CRAN	Craniotomy	2,3	42	2.12	0.00	0.00	1.06	2.97	5.22
VSHN	Ventricular shunt	0	29	4.17	0.00	0.00	2.70	4.54	6.73
VSHN	Ventricular shunt	1,2,3	41	5.44	0.00	1.10	3.55	6.71	8.44
CSEC	Cesarean section	0	128	2.83	0.37	1.22	2.19	4.55	6.55
CSEC	Cesarean section	1	116	4.12	0.00	1.26	2.98	5.35	7.42
CSEC	Cesarean section	2,3	44	6.69	0.00	2.78	5.26	9.27	12.54
HYST	Abdominal hysterectomy	0	98	1.40	0.00	0.00	1.01	2.45	3.34
HYST	Abdominal hysterectomy	1	92	2.34	0.00	0.65	1.69	3.33	5.20
HYST	Abdominal hysterectomy	2,3	49	5.39	0.00	2.21	4.55	7.93	11.56
VHYS	Vaginal hysterectomy	0,1,2,3	64	1.23	0.00	0.11	0.99	2.00	3.23
AMP	Limb amputation	0,1,2,3	38	3.63	0.00	1.45	2.86	5.32	7.01

Table 6. (continued)

Operative procedure category		Risk index category	No. hospitals	Pooled mean rate	Percentile				
					10%	25%	50% (median)	75%	90%
FUSN	Spinal fusion	0	96	1.08	0.00	0.00	0.76	1.35	2.43
FUSN	Spinal fusion	1	96	2.77	0.00	0.50	2.21	3.45	5.61
FUSN	Spinal fusion	2,3	65	6.29	0.00	2.01	4.67	8.29	11.56
FX	Open reduction of fracture	0	65	0.76	0.00	0.00	0.31	1.09	1.74
FX	Open reduction of fracture	1	74	1.34	0.00	0.00	0.90	1.71	2.49
FX	Open reduction of fracture	2	45	2.48	0.00	0.08	2.56	3.74	5.41
HPRO	Hip prosthesis	0	146	0.89	0.00	0.00	0.55	1.21	2.44
HPRO	Hip prosthesis	1	176	1.53	0.00	0.00	1.23	2.20	3.24
HPRO	Hip prosthesis	2,3	140	2.38	0.00	0.00	2.00	3.60	5.78
KPRO	Knee prosthesis	0	140	0.85	0.00	0.00	0.63	1.32	2.20
KPRO	Knee prosthesis	1	168	1.28	0.00	0.28	1.14	2.02	3.15
KPRO	Knee prosthesis	2,3	134	2.21	0.00	0.00	1.92	3.56	5.98
LAM	Laminectomy	0	124	0.89	0.00	0.00	0.55	1.27	2.67
LAM	Laminectomy	1	123	1.40	0.00	0.49	1.29	2.06	2.93
LAM	Laminectomy	2,3	99	2.51	0.00	0.95	2.06	3.58	5.77
OMS	Other musculoskeletal	0	40	0.64	0.00	0.00	0.39	0.81	1.28
OMS	Other musculoskeletal	1	40	0.89	0.00	0.00	0.45	1.37	1.92
OMS	Other musculoskeletal	2,3	20	1.77	0.00	0.00	1.56	3.45	4.00
OPRO	Other prosthesis	0,1,2,3	29	0.63	0.00	0.00	0.00	0.72	2.18
OSKN	Other integumentary	0,1,2,3	28	1.26	0.00	0.34	1.06	1.84	2.56
VS	Vascular	0	66	0.90	0.00	0.00	0.00	1.63	3.04
VS	Vascular	1	106	1.77	0.00	0.82	1.54	2.57	3.94
VS	Vascular	2,3	99	4.46	0.55	2.64	4.63	6.37	9.03

CBGB, Coronary artery bypass graft with chest and donor site incisions (eg, femoral or radial artery harvested as donor vessel for bypass graft); *CBGC*, Coronary artery bypass graft with chest incision only (eg, use of internal mammary artery for bypass graft).
*Per 100 operations.
†Includes only those procedure-risk categories for which at least 20 hospitals have reported at least 20 operations.

2 groups by type of hospital: "major teaching" and "all others." Major teaching status is defined as "a hospital that is an important part of the teaching program of a medical school and a major unit in the clinical clerkship program." The combined medical/surgical ICUs from major teaching hospitals had significantly higher infection rates and DU ratios than combined medical/surgical ICUs from all of the other hospitals, except for the ventilator-associated pneumonia rate. Teaching affiliation was not an important factor for any other type of ICU.

It is important to note that the ventilator-associated pneumonia rates include only data from January through June 2002, because in January 2002, NNIS hospitals began using new criteria for defining nosocomial pneumonia. These rates should be considered provisional and are subject to change as more data are accumulated. Hence, no percentile distribution of the rates is provided in Table 1 even when the number of contributing ICUs exceeded 20. Because the definitions of "ventilator-days " did not change, we used all data available during the period January 1995 through June 2002 to calculate the ventilator-use ratios shown in Table 2.

For the ICU component, device-days consist of the total number of ventilator-days, central-line days, and urinary catheter-days. The DU of an ICU is one measure of the unit's invasive practices that constitutes an extrinsic risk factor for nosocomial infection.[2] As such, DU may also serve as a marker for severity of illness of patients in the unit, that is, patients' intrinsic susceptibility to infection.

Site distributions of infections for coronary care, medical, pediatric, and combined medical-surgical ICUs have been published elsewhere.[10-13]

Tables 3 and 4 from the HRN component update the previously published, device-associated rates and DU ratios in each of 4 birth-weight categories.[1,3] For the HRN component, device-days consist of the total number of ventilator-days and umbilical-catheter- or central line-days. Each of the analyses of HRN data excluded rates or DU ratios for units that did not

Table 7. SSI rates,* by selected operative procedure and modified risk index category incorporating laparoscope use,† Surgical Patient component, January 1992 to June 2002

Operative procedure category	Duration cut point (h)	Risk index category	N	Rate	Risk index category	N	Rate
CHOL Cholecystectomy	2	M	29,710	0.44	0	24,058	0.67
COLO Colon	3	M	566	1.94	0	15,457	3.94
APPY Appendectomy	1	0-Yes	2116	0.57	0-No	6924	1.40
GAST Gastric	3	0-Yes	377	0.53	0-No	2341	2.69

*per 100 operations.

†This table uses a modified risk index that incorporates the influence of laparoscope on SSI rates. The influence of scope on SSI rates was different across the 4 procedures:

For cholecystectomy and colon operation, when the operation was done laparoscopically, 1 was subtracted from the number of risk factors present (ASA score of 3, 4, or 5; duration of operation > 75th percentile; or contaminated or dirty wound class) in the NNIS risk index. For example, when 2 risk factors were present and the procedure was done laparoscopically, the new modified risk index category was 1 (ie, 2-1=1). When no risk factors were present and the procedure was performed with a laparoscope, ie, 0-1=-1, we designated this new modified risk category as minus 1 or "M."

For appendectomy and gastric operation, the use of a scope was important only if the patient had no other risk factors. We split patients with no other risk factors into 2 groups: 0-Yes (laparoscope used) and 0-No (laparoscope not used). For gastric operation, because there was no difference in the rates when 2 or 3 risk factors were present, the rates for categories 2 and 3 were combined into a single category: 2,3.

Table 8. SSI rates* after coronary artery bypass graft operation (CBGB), by risk index category and specific site, Surgical Patient component, January 1992 to June 2002

Risk index category	0		1		2,3	
Infection site	No. SSIs	Rate	No. SSIs	Rate	No. SSIs	Rate
Donor site	17	0.77	4599	1.52	1621	2.59
Superficial incisional	12	0.55	3568	1.18	1263	2.02
Deep incisional	5	0.23	1031	0.34	358	0.57
Chest	11	0.50	6001	1.99	1896	3.03
Superficial incisional	6	0.27	2271	0.75	732	1.17
Deep incisional	2	0.09	1693	0.56	490	0.78
Organ/space	3	0.14	2037	0.68	674	1.08
Total	28	1.28	10,600	3.51	3517	5.62

*per 100 operations.

Denominators for the risk categories are as follows:

Category 0 = 2196
Category 1 = 301,715
Category 2, 3 = 62,625

report at least 50 device- or patient-days. Because of this, the number of units contributing data in the tables is not exactly the same. As in the ICUs, the ventilator-associated pneumonia rates for HRN include only data from January through June 2002 as a result of the definition changes, and no percentile distribution of the rates is provided even though the number of HRNs contributing data exceeded 20. Percent distributions of infections by major site of nosocomial infection and pathogens by major site, and other HRN analyses, have been published.[14]

Tables 5 through 8 from the surgical patient component update the most recent published rates.[1] Table 5 displays SSI rates by operative procedure and NNIS risk index category. When the SSI rates for adjacent risk categories for a particular operation were not statistically different, they were combined into a single risk category. For example, because the SSI rates for cardiac operation with 2 or 3 risk factors were similar, the data were combined into a new category, "2,3." Thus, the number of risk index categories in the tables will differ depending on the operation. The duration of operation cut points

Risk index category	N	Rate	Risk index category	N	Rate	Risk index category	N	Rate
1	11,164	1.81	2	3931	3.26	3	445	5.62
1	26,378	5.69	2	11,013	8.59	3	1554	11.45
1	8710	2.87	2	3087	4.83	3	360	8.06
1	4447	4.95	2,3	1995	10.03		—	—

Table 9. Pooled means and percentiles of the distribution of antimicrobial use rates (defined daily dose* rates†), by non-ICU inpatient areas and various types of ICU, ICARE/AUR, January 1998 to June 2002

Non-ICU inpatient areas (n = 68)			**Percentile**				
Antimicrobial agent	**No. DDD***	**Pooled mean**	**10%**	**25%**	**50% (median)**	**75%**	**90%**
Penicillin group	94,831	9.0	1.0	2.8	5.6	9.8	16.0
Ampicillin group	711,902	67.6	35.8	48.7	62.7	86.1	102.4
Antipseudomonal penicillins	202,727	19.2	2.6	7.8	17.1	29.6	46.7
Antistaphylococcal penicillins	160,083	15.2	2.7	4.4	11.8	18.5	26.9
First-generation cephalosporins	834,191	79.2	45.6	58.4	76.3	104.6	125.1
Second-generation cephalosporins	413,103	39.2	13.7	22.2	33.6	50.3	69.6
Third-generation cephalosporins	978,988	92.9	36.9	53.7	81.1	122.0	150.3
Carbapenem group	61,703	5.9	0.4	1.5	4.7	8.5	13.5
Aztreonam	27,168	2.6	0.1	0.5	1.6	3.7	6.3
Fluoroquinolones	705,711	67.0	24.9	40.4	62.3	114.1	203.1
Trimethoprim/sulfamethoxazole	489,426	46.5	3.0	17.2	26.7	41.7	85.5
Vancomycin (oral)	21,981	2.1	0.1	0.4	1.3	2.5	4.9
Vancomycin (parenteral)	312,081	29.6	12.7	17.0	23.8	40.3	60.0
Coronary care unit (n = 31)			**Percentile**				
Antimicrobial agent	**No. DDD***	**Pooled mean**	**10%**	**25%**	**50% (median)**	**75%**	**90%**
Penicillin group	593	4.6	0.0	0.2	1.6	8.6	17.6
Ampicillin group	4974	38.7	10.4	19.6	37.0	65.8	87.6
Antipseudomonal penicillins	3908	30.4	0.0	2.4	21.7	46.6	60.0
Antistaphylococcal penicillins	2292	17.8	0.0	2.8	12.0	34.1	49.2
First-generation cephalosporins	6753	52.6	9.0	27.8	37.5	54.8	104.9
Second-generation cephalosporins	4359	33.9	2.5	9.2	23.2	34.6	53.9
Third-generation cephalosporins	15,797	123.0	32.9	47.3	120.3	143.8	187.1
Carbapenem group	1067	8.3	0.0	0.0	6.1	10.2	26.7
Aztreonam	718	5.6	0.0	0.0	2.0	12.4	14.9
Fluoroquinolones	8977	69.9	9.7	16.3	39.9	87.2	136.7
Trimethoprim/sulfamethoxazole	4466	34.8	0.0	6.7	17.1	34.1	106.4
Vancomycin (oral)	468	3.6	0.0	0.0	0.0	1.1	6.7
Vancomycin (parenteral)	6,411	49.9	11.2	19.0	35.1	86.7	105.9
Cardiothoracic ICU (n = 20)			**Percentile**				
Antimicrobial agent	**No. DDD***	**Pooled mean**	**10%**	**25%**	**50% (median)**	**75%**	**90%**
Penicillin group	409	4.7	0.0	0.0	2.0	4.9	10.0
Ampicillin group	2794	31.9	3.7	7.8	27.1	37.2	57.0
Antipseudomonal penicillins	2275	26.0	0.7	4.4	16.7	37.5	51.8
Antistaphylococcal penicillins	1437	16.4	0.0	0.0	6.5	20.6	28.4

Table 9. (continued)

Cardiothoracic ICU (n = 20)			**Percentile**				
Antimicrobial agent	**No. DDD***	**Pooled mean**	**10%**	**25%**	**50% (median)**	**75%**	**90%**
First-generation cephalosporins	25,706	293.4	49.7	213.0	268.3	483.5	709.0
Second-generation cephalosporins	7104	81.1	3.5	10.6	33.3	102.3	562.9
Third-generation cephalosporins	10,625	121.3	18.4	44.5	87.6	137.3	207.7
Carbapenem group	1568	17.9	0.0	1.0	10.6	21.3	49.8
Aztreonam	686	7.8	0.0	0.4	1.4	5.6	17.9
Fluoroquinolones	5168	59.0	7.4	14.0	45.2	108.8	143.5
Trimethoprim/sulfamethoxazole	1175	13.4	0.0	0.8	7.8	14.0	69.5
Vancomycin (oral)	469	5.4	0.0	0.0	0.0	0.8	15.0
Vancomycin (parenteral)	11,198	127.8	23.8	60.0	104.1	179.9	277.2

Hematology/oncology/transplant wards (n = 17)			**Percentile**				
Antimicrobial agent	**No. DDD***	**Pooled mean**	**10%**	**25%**	**50% (median)**	**75%**	**90%**
Penicillin group	605	6.2	—	—	—	—	—
Ampicillin group	5204	53.2	—	—	—	—	—
Antipseudomonal penicillins	3134	32.0	—	—	—	—	—
Antistaphylococcal penicillins	1429	14.6	—	—	—	—	—
First-generation cephalosporins	4060	41.5	—	—	—	—	—
Second-generation cephalosporins	2709	27.7	—	—	—	—	—
Third-generation cephalosporins	30,937	316.2	—	—	—	—	—
Carbapenem group	1706	17.4	—	—	—	—	—
Aztreonam	816	8.3	—	—	—	—	—
Fluoroquinolones	13,802	141.1	—	—	—	—	—
Trimethoprim/sulfamethoxazole	3768	38.5	—	—	—	—	—
Vancomycin (oral)	442	4.5	—	—	—	—	—
Vancomycin (parenteral)	9416	96.2	—	—	—	—	—

Medical ICU (n = 34)			**Percentile**				
Antimicrobial agent	**No. DDD***	**Pooled mean**	**10%**	**25%**	**50% (median)**	**75%**	**90%**
Penicillin group	1244	7.0	0.0	1.5	5.6	9.4	20.3
Ampicillin group	16,126	90.6	37.6	56.2	71.3	96.9	127.8
Antipseudomonal penicillins	13,256	74.4	13.0	26.5	66.2	112.9	170.8
Antistaphylococcal penicillins	6490	36.4	0.0	3.8	20.4	39.2	58.5
First-generation cephalosporins	5635	31.6	10.7	20.2	30.5	40.5	63.0
Second-generation cephalosporins	6155	34.6	2.1	7.2	26.5	56.3	69.0
Third-generation cephalosporins	58,293	327.4	92.2	108.8	186.7	321.6	386.1
Carbapenem group	6363	35.7	0.0	6.0	23.9	37.2	98.3
Aztreonam	1693	9.5	0.0	1.1	6.6	13.4	17.6
Fluoroquinolones	22,864	128.4	29.5	56.8	86.5	146.3	256.8
Trimethoprim/sulfamethoxazole	13,059	73.3	1.9	14.6	29.8	58.7	123.0
Vancomycin (oral)	324	1.8	0.0	0.0	0.7	1.8	6.7
Vancomycin (parenteral)	21,489	120.7	42.9	55.7	72.9	153.4	219.5

Medical-surgical ICU (n = 55)			**Percentile**				
Antimicrobial agent	**No. DDD***	**Pooled mean**	**10%**	**25%**	**50% (median)**	**75%**	**90%**
Penicillin group	2336	5.9	0.0	0.5	2.1	6.4	24.8
Ampicillin group	31,295	79.6	18.5	34.7	72.6	124.3	139.7
Antipseudomonal penicillins	31,063	79.0	19.8	37.9	68.5	94.9	139.7
Antistaphylococcal penicillins	8065	20.5	1.0	4.3	11.7	22.7	52.2
First-generation cephalosporins	44,166	112.3	25.1	61.2	84.6	133.0	221.8

Table 9. (continued)

Medical-surgical ICU (n = 55)			**Percentile**				
Antimicrobial agent	**No. DDD***	**Pooled mean**	**10%**	**25%**	**50% (median)**	**75%**	**90%**
Second-generation cephalosporins	19,045	48.4	4.7	13.2	31.9	53.3	105.4
Third-generation cephalosporins	85,281	216.8	83.8	120.6	200.6	256.8	342.0
Carbapenem group	12,216	31.1	2.2	6.2	21.8	42.0	56.5
Aztreonam	4050	10.3	0.0	1.7	6.4	15.4	25.3
Fluoroquinolones	59,853	152.2	37.7	70.6	124.6	234.5	307.1
Trimethoprim/sulfamethoxazole	16,736	42.6	0.0	10.3	18.3	44.8	100.7
Vancomycin (oral)	2260	5.7	0.0	0.0	2.2	5.7	10.8
Vancomycin (parenteral)	31,510	80.1	30.0	53.2	67.0	120.2	137.4

Neurosurgical ICU (n = 11)			**Percentile**				
Antimicrobial agent	**No. DDD***	**Pooled mean**	**10%**	**25%**	**50% (median)**	**75%**	**90%**
Penicillin group	351	6.4	—	—	—	—	—
Ampicillin group	2664	48.9	—	—	—	—	—
Antipseudomonal penicillins	2462	45.2	—	—	—	—	—
Antistaphylococcal penicillins	3289	60.3	—	—	—	—	—
First-generation cephalosporins	6568	120.5	—	—	—	—	—
Second-generation cephalosporins	1162	21.3	—	—	—	—	—
Third-generation cephalosporins	11,709	214.8	—	—	—	—	—
Carbapenem group	1499	27.5	—	—	—	—	—
Aztreonam	82	1.5	—	—	—	—	—
Fluoroquinolones	3801	69.7	—	—	—	—	—
Trimethoprim/sulfamethoxazole	2399	44.0	—	—	—	—	—
Vancomycin (oral)	74	1.4	—	—	—	—	—
Vancomycin (parenteral)	5330	97.8	—	—	—	—	—

Surgical ICU (n = 32)			**Percentile**				
Antimicrobial agent	**No. DDD***	**Pooled mean**	**10%**	**25%**	**50% (median)**	**75%**	**90%**
Penicillin group	1715	8.7	0.0	0.8	3.7	10.6	20.7
Ampicillin group	18,902	96.3	28.5	50.6	82.6	143.3	157.7
Antipseudomonal penicillins	10,907	55.6	10.7	24.5	57.5	90.1	111.8
Antistaphylococcal penicillins	5484	28.0	0.7	2.7	14.2	35.6	55.3
First-generation cephalosporins	40,045	204.1	64.1	111.6	168.3	365.5	495.3
Second-generation cephalosporins	9408	48.0	3.7	27.0	50.5	84.6	97.6
Third-generation cephalosporins	39,132	199.5	73.3	110.7	142.0	173.5	222.8
Carbapenem group	9858	50.2	0.0	7.4	19.6	54.5	71.5
Aztreonam	1453	7.4	1.1	4.6	7.3	12.5	29.7
Fluoroquinolones	22,403	114.2	34.2	55.5	87.2	126.9	214.1
Trimethoprim/sulfamethoxazole	11,856	60.4	4.6	9.3	23.0	44.0	92.3
Vancomycin (oral)	1057	5.4	0.0	0.0	1.2	3.5	11.3
Vancomycin (parenteral)	35,709	182.0	51.6	65.9	104.3	156.6	190.0

Pediatric ICU (n = 16)			**Percentile**				
Antimicrobial agent	**No. DDD***	**Pooled mean**	**10%**	**25%**	**50% (median)**	**75%**	**90%**
Penicillin group	304	6.0	—	—	—	—	—
Ampicillin group	2190	43.5	—	—	—	—	—
Antipseudomonal penicillins	604	12.0	—	—	—	—	—
Antistaphylococcal penicillins	1356	27.0	—	—	—	—	—
First-generation cephalosporins	2430	48.3	—	—	—	—	—

Table 9. (continued)

Pediatric ICU (n = 16)			Percentile				
Antimicrobial agent	**No. DDD***	**Pooled mean**	**10%**	**25%**	**50% (median)**	**75%**	**90%**
Second-generation cephalosporins	1745	34.7	—	—	—	—	—
Third-generation cephalosporins	10,740	213.6	—	—	—	—	—
Carbapenem group	404	8.0	—	—	—	—	—
Aztreonam	90	1.8	—	—	—	—	—
Fluoroquinolones	457	9.1	—	—	—	—	—
Trimethoprim/sulfamethoxazole	685	13.6	—	—	—	—	—
Vancomycin (oral)	160	3.2	—	—	—	—	—
Vancomycin (parenteral)	3177	63.2	—	—	—	—	—

*Defined daily dose (DDD) of antimicrobial agent is calculated by dividing the total grams of the antimicrobial agent used in a hospital area by the number of grams in an average daily dose of the agent given to an adult patient.
†DDD per 1000 patient-days =

$$\frac{\text{DDD of specific agent used}}{\text{Total number of patient-days}} \times 1000$$

Table 10. Pooled means and percentiles of the distribution of antimicrobial resistance rates,* by all ICUs combined, non-ICU inpatient areas and by outpatients, ICARE/AUR, January 1998 to June 2002

All ICUs Combined				Percentile				
Antimicrobial-resistant pathogen	**No. units**	**No. tested**	**Pooled mean**	**10%**	**25%**	**50% (median)**	**75%**	**90%**
MRSA	147	18,397	51.3	21.4	30.5	45.2	59.1	66.7
Methicillin-resistant CNS	133	11,262	75.7	56.0	69.4	75.8	81.0	89.2
Vancomycin-resistant *Enterococcus* spp	129	11,623	12.8	0.0	3.6	13.5	24.5	37.5
Ciprofloxacin/ofloxacin-resistant *Pseudomonas aeruginosa*	125	11,232	36.3	7.7	16.7	28.9	41.5	55.2
Levofloxacin-resistant *P aeruginosa*	57	3921	37.8	7.4	18.2	29.4	40.3	55.1
Imipenem-resistant *P aeruginosa*	115	9850	19.6	2.9	8.2	13.7	26.8	38.5
Ceftazidime-reisistant *P aeruginosa*	121	10,538	13.9	0.0	4.8	10.5	16.3	25.0
Piperacillin-resistant *P aeruginosa*	110	9553	17.5	2.5	6.6	14.3	20.0	31.7
Cef3-resistant *Enterobacter* spp	101	4061	26.3	8.8	18.2	23.7	35.7	45.8
Carbapenem-resistant *Enterobacter* spp	84	3477	0.8	0.0	0.0	0.0	0.0	4.2
Cef3-resistant *Klebsiella pneumoniae*	110	6101	6.1	0.0	0.0	1.3	8.0	27.0
Cef3-resistant *Escherichia coli*	132	9891	1.2	0.0	0.0	0.0	2.3	6.7
Quinolone-resistant *E coli*	128	9696	5.8	0.0	0.0	2.5	5.8	13.8
Penicillin-resistant pneumococci	43	1040	20.6	0.0	5.6	14.3	28.6	52.6
Cefotaxime/ceftriaxone-resistant pneumococci	30	656	8.2	0.0	0.0	3.6	7.7	29.9
Non-ICU inpatient areas				**Percentile**				
Antimicrobial-resistant pathogen	**No. units**	**No. tested**	**Pooled mean**	**10%**	**25%**	**50% (median)**	**75%**	**90%**
MRSA	54	30,850	41.4	24.5	31.0	42.9	50.9	58.2
Methicillin-resistant CNS	51	18,191	64.0	52.2	57.0	65.1	70.5	75.1
Vancomycin-resistant *Enterococcus* spp	53	24,491	12.0	1.8	3.5	6.2	12.8	18.6
Ciprofloxacin/ofloxacin-resistant *Pseudomonas aeruginosa*	53	16,824	27.0	13.0	18.1	27.4	35.3	40.7
Levofloxacin-resistant *P aeruginosa*	28	6084	28.9	14.2	19.9	28.6	33.6	45.0
Imipenem-resistant *P aeruginosa*	51	13,037	12.7	5.2	6.6	9.8	14.4	20.6
Ceftazidime-reisistant *P aeruginosa*	51	15,149	8.3	1.6	3.6	6.6	11.2	14.1
Piperacillin-resistant *P aeruginosa*	50	12,977	11.5	3.4	6.0	9.4	14.3	18.5
Cef3-resistant *Enterobacter* spp	48	5534	19.8	5.4	13.4	20.1	25.7	28.6

Table 10. (continued)

Non-ICU inpatient areas				Percentile				
Antimicrobial-resistant pathogen	No. units	No. tested	Pooled mean	10%	25%	50% (median)	75%	90%
Carbapenem-resistant *Enterobacter* spp	44	4180	1.1	0.0	0.0	0.0	1.0	2.9
Cef3-resistant *Klebsiella pneumoniae*	53	10,733	5.7	0.0	0.0	1.5	4.4	17.6
Cef3-resistant *Escherichia coli*	53	30,585	1.1	0.0	0.0	0.6	1.7	3.0
Quinolone-resistant *E coli*	54	30,557	5.3	0.4	1.5	2.9	5.7	11.6
Penicillin-resistant pneumococci	39	2945	19.2	2.3	5.9	11.1	20.0	38.5
Cefotaxime/ceftriaxone-resistant pneumococci	30	1687	8.1	0.0	1.3	5.7	10.5	15.4
Outpatient areas				**Percentile**				
Antimicrobial-resistant pathogen	No. units	No. tested	Pooled mean	10%	25%	50% (median)	75%	90%
MRSA	48	26,162	25.7	13.3	18.2	24.0	29.4	48.4
Methicillin-resistant CNS	46	12,552	48.1	36.8	41.5	47.7	55.7	61.2
Vancomycin-resistant *Enterococcus* spp	44	18,670	4.7	0.4	1.2	3.7	6.0	7.3
Ciprofloxacin/ofloxacin-resistant *Pseudomonas aeruginosa*	44	11,886	23.1	13.0	17.1	23.7	30.1	39.0
Levofloxacin-resistant *P aeruginosa*	21	3913	23.3	12.8	15.2	20.7	28.0	37.0
Imipenem-resistant *P aeruginosa*	43	8953	7.6	2.1	3.4	5.9	9.4	13.0
Ceftazidime-reisistant *P aeruginosa*	43	10,384	4.6	0.0	2.2	3.7	6.2	7.9
Piperacillin-resistant *P aeruginosa*	39	8792	5.9	0.0	1.9	4.3	6.7	10.9
Cef3-resistant *Enterobacter* spp	41	4398	9.5	2.3	5.6	10.4	14.5	18.2
Carbapenem-resistant *Enterobacter* spp	37	2795	0.7	0.0	0.0	0.0	0.0	2.4
Cef3-resistant *Klebsiella pneumoniae*	44	12,059	1.8	0.0	0.0	0.8	1.8	6.0
Cef3-resistant *Escherichia coli*	47	71,448	0.4	0.0	0.0	0.2	0.6	1.1
Quinolone-resistant *E coli*	46	68,345	2.4	0.3	0.8	2.0	2.9	5.6
Penicillin-resistant pneumococci	39	3706	18.2	0.9	5.1	10.7	20.5	29.0
Cefotaxime/ceftriaxone-resistant pneumococci	35	2462	5.8	0.0	0.0	1.6	7.3	26.3

MRSA, Methicillin-resistant *Staphylococcus aureus*; *CNS*, coagulase-negative staphylococci; *Cef3*, ceftazidime, cefotaxime, or ceftriaxone; *Quinolone*, ciprofloxacin, ofloxacin, or levofloxacin; *Carbapenem*, imipenem or meropenem

*For each antimicrobial agent and pathogen combination, resistance rates were calculated as:

$$\frac{\text{Number of resistant isolates}}{\text{Number of isolates tested}} \times 100$$

have not changed from the last published report, except for "other ear, nose, and throat operation," which changed from 2 to 3 hours.[1]

For a hospital to be represented in Table 6, it must have reported sufficient data, that is, at least 20 operations in a given risk index category for the procedure. Note that the percentile distributions are not available for every operative procedure and risk index category because percentile distributions of the procedure-specific and risk index-specific rates required sufficient data from at least 20 hospitals.

Laparoscopes and endoscopes are being used with increasing frequency to perform operations. Table 7 lists 4 operations in which the use of a laparoscope has been incorporated into the SSI risk index. When other risk factors were controlled, cholecystectomy, colon operation, gastric operation, and appendectomy had lower SSI rates when a scope was used. However, there were some differences among these operations. For cholecystectomy and colon operation, the influence of scope use was captured by subtracting one from the number of risk factors (ASA score ≥ 3; duration of operation > 75th percentile; or contaminated or dirty wound class) present whenever the procedure was done laparoscopically. "M" indicates minus 1 (-1) in the modified-risk category, where no risk factors were present and the procedure was performed with a laparoscope (ie, 0-1 = -1). For appendectomy and gastric operation, the use of a scope was only important if the patient had no other risk factors. Therefore, we split the index value of 0 risk factors into 0-No and

0-Yes. The percentile distributions of the 4 operative procedures with modified SSI risk index categories have not been developed at this time.

Table 8 displays SSI rates by specific site after coronary artery bypass graft operations in which incisions are made at both the chest and the donor vessel harvest sites (CBGB).

The data in Tables 9 and 10 are from phases 2 and 3 (January 1996 to November 1999) of the Intensive Care Antimicrobial Resistance Epidemiology (ICARE) Project and the NNIS Antimicrobial Use and Resistance (AUR) component (December 1999 to June 2002) and update previously published reports.[1,15,16] For the purpose of analysis, grams of antimicrobial agents were converted into number of defined daily doses (DDD) used each month in each hospital area. A defined daily dose is the average daily dose in grams of a specific antimicrobial agent given to an average adult patient (Appendix A).[17] Table 9 shows use of selected oral and parenteral antimicrobial agents in defined daily doses. Antimicrobial use was stratified by route of administration and hospital area. Because outpatient antimicrobial use could not be estimated reliably from hospital pharmacy records, data on outpatient antimicrobial use were not collected. Finally, antimicrobial agents with similar spectrum or clinical indications were grouped in Appendix A. On the basis of detailed analysis, antimicrobial use rates were found to vary by type of ICU, so use rates and percentiles are shown for each type of ICU for which there were at least 20 units reporting data. The number of burn, respiratory, and trauma ICUs reporting data is insufficient to provide percentile distributions for these types of ICUs. The number of neurosurgical and pediatric ICUs and hematology/oncology/transplant wards is insufficient to provide percentile distributions; only pooled mean use rates are displayed. Table 10 shows ICARE/AUR resistance data for selected antimicrobial-resistant bacteria on the basis of reported antimicrobial susceptibility test results on all nonduplicate clinical isolates processed by the laboratory during each study month. A duplicate isolate was defined as "an isolate of the same species of bacteria with the same antimicrobial susceptibility pattern in the same patient in the same month, regardless of the site of isolation." All isolates, whether responsible for hospital- or community-acquired infection or for colonization, were reported to ICARE/AUR by participating hospitals. Hospitals used National Committee for Clinical Laboratory Standards interpretive standards for minimum inhibitory concentration, or zone diameter testing standards to report numbers of susceptible, intermediate, or resistant organisms. A minimum of 10 isolates must be tested in a hospital area for resistance rates to be calculated for that area. Resistance data have been combined for all ICU types because detailed analysis demonstrated that, in general, resistance rates (percent prevalence) did not differ by type of ICU. Also, these data show that for most antimicrobial-resistant bacteria, resistance rates are highest in the ICU areas, followed by non-ICU inpatient areas, with lowest rates in the outpatient areas.

If you would like to compare your hospital's rates and ratios with those in this report, you must first collect information from your hospital in accordance with the methods described for the NNIS System.[5-7] You should also refer to Appendices B and C for further instructions. Appendix B discusses the calculation of infection rates and DU ratios for the ICU or HRN surveillance components. Appendix C gives a step-by-step method for interpretation of percentiles of infection rates or DU ratios. A high rate or ratio (> 90th percentile) does not necessarily define a problem; it only suggests an area for further investigation. Similarly, a low rate or ratio (< 10th percentile) may be the result of inadequate infection detection.

Hospitals should use these data to guide local improvement efforts aimed at reducing infection rates as much as possible.

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Appendix A. Defined daily dose (DDD) of antimicrobial agents, by class and group

Class	Group	Antimicrobial agent	DDD
β-lactams	Penicillin group	Penicillin G	12×10^6 U
		Procaine penicillin G	2.4×10^6 U
		Penicillin G benzathine	1.2×10^6 U
		Penicillin V	1 g
	Ampicillin group	Ampicillin (parenteral)	4 g
		Ampicillin (oral)	2 g
		Ampicillin/sulbactam	6 g
		Amoxicillin (oral)	1.5 g
		Amoxicillin/clavulanic Acid (oral)	1.5 g
	Antistaphylococcal penicillins (Methicillin group)	Nafcillin	4 g
		Oxacillin	4 g
		Dicloxacillin (oral)	2 g
	Antipseudomonal penicillins	Piperacillin	18 g
		Piperacillin/tazobactam	13.5 g
		Ticarcillin	18 g
		Ticarcillin/clavulanic acid	12.4 g
	First-generation cephalosporins	Cefazolin	3 g
		Cephalothin	4 g
		Cefadroxil (oral)	2 g
		Cephalexin (oral)	2 g
	Second-generation cephalosporins	Cefotetan	2 g
		Cefmetazole	4 g
		Cefoxitin	4 g
		Cefuroxime	3 g
		Cefuroxime axetil (oral)	1 g
		Cefaclor (oral)	1 g
		Cefprozil (oral)	1 g
	Third-generation cephalosporins	Cefotaxime	3 g
		Ceftazidime	3 g
		Ceftizoxime	3 g
		Ceftriaxone	1 g
		Cefixime (oral)	0.4 g
		Cefipime	4 g
	Carbapenems	Meropenem	3 g
		Imipenem cilastatin	2 g
Other β-lactams		Aztreonam	4 g
Glycopeptides		Vancomycin (parenteral)	2 g
		Vancomycin (oral)	1 g

Appendix A. (continued)

Class	Group	Antimicrobial agent	DDD
Fluoroquinolones		Ciprofloxacin (parenteral)	0.8 g
		Ciprofloxacin (oral)	1.5 g
		Ofloxacin (parenteral)	0.8 g
		Ofloxacin (oral)	0.8 g
		Levofloxacin (parenteral)	0.5 g
		Levofloxacin (oral)	0.2 g
		Trovafloxacin (parenteral)	0.2 g
		Trovafloxacin (oral)	0.2 g
		Sparfloxacin (oral)	0.2 g
		Norfloxacin (oral)	0.8 g
		Lomefloxacin	0.4 g
Trimethoprim/Sulfamethoxazole		Trimethoprim component (oral)	0.32 g
		Trimethoprim compound (parenteral)	0.84 g

Adapted from Amsden GW, Schentag JJ. Tables of antimicrobial agent pharmacology. In: Mandell GL, Bennett JE, Dolin R, editors. Principles and practice of infectious diseases. 4th ed. New York: Churchill Livingstone; 1995. p. 492-528.

Appendix B.

HOW TO CALCULATE A DEVICE-ASSOCIATED INFECTION RATE AND DU RATIO WITH ICU AND HRN COMPONENT DATA

Calculation of Device-associated Infection Rate

Step 1: Decide on the time period for your analysis. It may be a month, a quarter, 6 months, a year, or some other period.

Step 2: Select the patient population for analysis, ie, the type of ICU or a birth-weight category in the HRN.

Step 3: Select the infections to be used in the numerator. They must be site-specific and must have occurred in the selected patient population. Their date of onset must be during the selected time period.

Step 4: Determine the number of device-days that is used as the denominator of the rate. Device-days are the total number of days of exposure to the device (central line, ventilator, or urinary catheter) by all of the patients in the selected population during the selected time period.

Example: Five patients on the first day of the month had 1 or more central lines in place; 5 on day 2; 2 on day 3; 5 on day 4; 3 on day 5; 4 on day 6; and 4 on day 7. Adding the number of patients with central lines on days 1 through 7, we would have $5+5+2+5+3+4+4=28$ central line-days for the first week. If we continued for the entire month, the number of central line-days for the month is simply the sum of the daily counts.

Step 5: Calculate the device-associated infection rate (per 1000 device days) using the following formula:

$$\text{device-associated infection rate} = \frac{\text{Number of device-associated infections for a specific site}}{\text{Number of device-days}} \times 1000$$

Example: Central line-associated bloodstream infection (BSI) rate per 1000 central line-days =

$$\frac{\text{Number of central line-associated BSI}}{\text{Number of central line-days}} \times 1000$$

Calculation of DU Ratio

Steps 1, 2, and 4: Same as device-associated infection rates plus determine the number of patient-days that is used as the denominator of the DU ratio. Patient-days are the total number of days that patients are in the ICU (or HRN) during the selected time period.

Example: Ten patients were in the unit on the first day of the month; 12 on day 2; 11 on day 3; 13 on day 4; 10 on day 5; 6 on day 6; and 10 on day 7; and so on. If we counted the patients in the unit from days 1 through 7, we would add $10+12+11+13+10+6+10$ for a total of 72 patient-days for the first week of the month. If we continued for the entire month, the number of patient-days for the month would simply be the sum of the daily counts.

Step 5: Calculate the DU ratio with the following formula:

$$\text{DU ratio} = \frac{\text{Number of device-days}}{\text{Number of patient-days}}$$

With the number of device- and patient-days from the examples above, DU = 28/72 = 0.39 or 39% of patient days were also central line-days for the first week of the month.

Step 6: Examine the size of the denominator for your hospital's rate or ratio. Rates or ratios may not be good estimates of the true rate or ratio for your hospital if the denominator is small, ie, < 50 device- or patient-days.

Step 7: Compare your hospital's ICU/HRN rates or ratios with those found in the tables of this report. Refer to Appendix C for interpretation of the percentiles of the rates/ratios.

Appendix C.

INTERPRETATION OF PERCENTILES OF INFECTION RATES OR DU RATIOS

Step 1: Evaluate the rate (ratio) you have calculated for your hospital and confirm that the variables in the rate (both numerator and denominator) are identical to the rates (ratios) in the table.

Step 2: Examine the percentiles in each of the tables and look for the 50th percentile (or median). At the 50th percentile, 50% of the hospitals have lower rates (ratios) than the median and 50% have higher rates (ratios).

Step 3: Determine whether your hospital's rate (ratio) is higher or lower than this median.

Determining Whether Your Hospital's Rate or Ratio is a High Outlier

Step 4: If it is greater than the median, determine whether the rate (ratio) is above the 75th percentile. At the 75th percentile, 75% of the hospitals had lower rates (ratios) and 25% of the hospital had higher rates (ratios).

Step 5: If the rate (ratio) is greater than the 75th percentile, determine whether it is above the 90th percentile. If it is, then the rate (ratio) is a high outlier that may indicate a problem.

Determining Whether Your Hospital's Rate or Ratio is a Low Outlier

Step 6: If it is below the median, determine whether the rate (ratio) is below the 25th percentile. At the 25th percentile, 25% of the hospitals had lower rates (ratios) and 75% of the hospitals had higher rates (ratios).

Step 7: If the rate (ratio) is below the 25th percentile, determine whether it is below the 10th percentile. If the rate is, then it is a low outlier that may be a result of underreporting of infections. If the ratio is below the 10th percentile, it is a low outlier and may be a result of infrequent duration of DU, short duration of DU, or both.

Note: Device-associated infection rates and DU ratios should be examined together so that preventive measures may be appropriately targeted. For example, you find that the ventilator-associated pneumonia rate for a certain type of ICU is consistently above the 90th percentile and the ventilator-use ratio is routinely between the 75th and 90th percentile. Because the ventilator is a significant risk factor for pneumonia, you may want to target your efforts on reducing the use of ventilators or limiting the duration with which they are used on patients to lower the ventilator-associated pneumonia rate in the unit.

Appendix D.

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