National Nosocomial Infections Surveillance (NNIS) System Report, Data Summary from October 1986-April 1998, Issued June 1998

A report from the NNIS System*

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*See Appendix D.

This report is a summary of the data collected and reported by hospitals participating in the National Nosocomial Infections Surveillance (NNIS) System from October 1986 through April 1998 and updates previously published data. [1,2,3,4,5,6]

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 276 hospitals currently participating in the NNIS System is confidential.

All NNIS data are collected using four standardized protocols, called surveillance components: hospital-wide (the only component until October 1986), adult and pediatric intensive care unit (ICU), high-risk nursery (HRN), and surgical patient.[7,8,9] The components may be used singly or simultaneously, but once selected, they must be used for a minimum of one calendar month. All infections are categorized into major and specific infection sites using standard CDC definitions that include laboratory and clinical criteria. [8]

Hospital-wide surveillance component. Infection control professionals (ICPs) following this component collect data on all sites of nosocomial infection for all patients. Infection rates are calculated by service by using hospital discharges or, optionally, patient-days as a denominator.

Adult & pediatric ICU surveillance component. ICPs collect data on all sites of nosocomial infection in patients located in ICUs, as well as 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 HRN, as well as HRN-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 umbilical catheter/central line use or ventilation for each of four birth weight categories ($\leq$1000 gm, 1001 to 1500 gm, 1501 to 2500 gm, and >2500 gm).

Surgical patient surveillance component. ICPs select from the NNIS operative procedure list those procedures they wish to follow 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,[10] duration of operation, and American Society of Anesthesiology (ASA) score.[11] Using a composite index for predicting the risk of SSI after surgery, ICPs can calculate rates by the number of risk factors present.[6]

The time periods for the data contained in this report vary depending on the table. In general, if the rates have not changed from October 1986, when the surveillance components were first introduced, data from the entire time period were used in the table. If there was evidence of a change in the rates that are used for interhospital comparisons, a more recent, yet arbitrary, time period was selected. For example, some ICU rates were higher in the late 1980s than in the 1990s. Therefore, the earlier data were not included in the tables.

Each table represents NNIS data from one of the surveillance components. There are no data solely from the Hospital-wide component in this report. Table 1 from the ICU component updates previously published device-associated rates.[1-4] Note that the number of units reporting data from the burn, respiratory and trauma ICUs is still insufficient to provide percentile distributions of the rates. Note also that a new type of ICU has been added, cardiothoracic ICU.

Previously, data from units that provided intensive care to cardiac and thoracic surgery patients were included in the surgical ICU category. However, recent analyses suggested that cardiothoracic ICU data should be separated from surgical ICU data when rates are calculated and compared.[12] Therefore, in December 1997, cardiothoracic was designated as a separate ICU where at least 80% of the patients have undergone cardiac or thoracic surgery.

Table 2 provides information on device utilization (DU) by type of ICU. For the adult and pediatric 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.[4] 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. Each of the analyses of NNIS ICU (and HRN) data excluded rates or DU ratios for units that did not report at least 50 device-days or patient-days. Because of this, the number of units contributing data in the tables is not exactly the same.

Figure 1 and Tables 3 and 4 show data reported by NNIS hospitals from the coronary care unit. In the NNIS System, a coronary care unit is a unit where at least 80% of the patients receive intensive care for medical cardiac problems. Figure 1 shows the infection site distribution of nosocomial infections. Table 3 shows the distribution of the specific sites of infection within five selected major infection site categories and Table 4 shows the most common pathogens isolated from the same five major sites of infection in coronary care unit patients.[13] The data in Figure 1 and Tables 3 and 4 are provided as a general overview but should not be used for interhospital comparison purposes because the data are not adjusted for infection risks in the patients. Similar data for the medical ICU have been published.[14]

Table 5 from the HRN component updates the previously published, device-associated rates.[1,2,3,5] In 1992, CDC subdivided the smallest birth weight category into two groups: $\leq$ 1000 grams and 1001 to 1500 grams. The rates for these birth weight categories are derived from data from January 1990 through April 1998. In addition, unlike the earliest published rates, the rates for the four birth weight groups are no longer combined since the distribution for each rate differs by birth weight category. Table 6 provides information for hospitals' HRN device utilization. For the HRN component, device-days consist of the total number of ventilator-days and umbilical or central line-days. Percent distributions of infections by major site of nosocomial infection and pathogens by major site, as well as other HRN analyses, have been published.[15]

Table 7 from the Surgical Patient component does **not** update the last published rates.[1] As before, when the SSI rates for adjacent risk categories for a particular procedure were not significantly different, we combined them into a single risk category. For example, because SSI rates for appendectomies with 2 or 3 risk factors were not significantly different, we combined the data into a new category *2,3* and reported one rate.

Table 8 from the Surgical Patient component contains the percentile distributions of SSI rates by operative procedure and risk index category and does **not** update the last published rates.[1] For a hospital to be represented in this distribution, it must have reported sufficient data, that is, at least 30 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**.**

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.[7,8,9] You should also refer to Appendices A and B for further instructions. Appendix A discusses the calculation of infection rates and DU ratios for the ICU or HRN surveillance components. Appendix B 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. Appendix C provides a detailed explanation of how the cholecystectomy (CHOL) risk category was developed. The CHOL risk category differs from the NNIS risk index in that the use of the laparoscope has been added as the fourth risk factor.

Table 1. Pooled means and percentiles of the distribution of device-associated infection rates, by type of ICU, ICU component, January 1992 - April 1998

Urinary catheter-associated UTI rate*

Type of ICU	No. of Units	Urinary Catheter-Days	Pooled Mean	Percentile				
				10%	25%	50% (median)	75%	90%
Coronary	104	319,187	6.8	1.4	3.5	6.3	9.9	13.9
Cardiothoracic	45	308,847	3.3	0.0	0.8	2.1	3.9	5.5
Medical	124	647,638	7.8	1.7	4.5	7.0	9.3	12.1
Medical/Surgical	220	1,309,176	5.2	1.3	3.0	5.1	7.1	9.6
Neurosurgical	42	171,136	8.5	2.0	5.0	7.8	10.1	15.4
Pediatric	61	153,165	5.2	0.9	2.7	4.8	7.7	11.4
Surgical	142	889,043	5.7	1.0	3.2	4.9	8.0	9.5
Burn	16	25,513	10.0	.	.	.	.	.
Respiratory	7	24,361	6.5	.	.	.	.	.
Trauma	19	114,421	7.9	.	.	.	.	.

Central line-associated BSI rate**

Type of ICU	No. of Units	Central Line-Days	Pooled Mean	Percentile				
				10%	25%	50% (median)	75%	90%
Coronary	105	199,108	4.9	0.0	1.7	4.7	6.7	10.0
Cardiothoracic	45	285,207	2.8	0.0	1.0	1.8	3.1	4.3
Medical	124	462,000	6.1	0.0	3.6	5.3	7.3	10.2
Medical/Surgical	220	828,642	4.5	1.0	2.4	4.6	6.3	7.9
Neurosurgical	41	91,985	5.4	1.5	2.7	4.4	7.8	9.3
Pediatric	63	216,095	8.0	1.8	4.6	7.1	10.1	13.6
Surgical	142	717,788	5.7	1.2	2.5	4.9	7.0	9.0
Burn	16	19,433	12.8	.	.	.	.	.
Respiratory	7	12,528	4.1	.	.	.	.	.
Trauma	19	83,951	7.0	.	.	.	.	.

Ventilator-associated Pneumonia rate***

Type of ICU	No. of Units	Ventilator-Days	Pooled Mean	Percentile				
				10%	25%	50% (median)	75%	90%
Coronary	100	133,278	9.5	0.6	3.6	7.1	12.7	17.1
Cardiothoracic	45	169,090	11.7	3.4	6.6	11.3	14.1	18.6
Medical	121	438,381	8.5	1.4	4.1	7.6	10.4	15.6
Medical/Surgical	220	663,886	11.3	3.4	6.5	10.1	13.4	17.5
Neurosurgical	41	80,714	17.3	2.5	6.6	13.8	18.2	24.2
Pediatric	62	227,519	5.7	0.0	1.2	4.2	7.2	11.3
Surgical	142	492,414	14.9	5.4	8.5	12.7	16.9	26.1
Burn	16	15,036	21.1	.	.	.	.	.
Respiratory	7	20,008	5.6	.	.	.	.	.
Trauma	19	74,332	17.0	.	.	.	.	.

* Number of urinary catheter-associated UTIs x 1000
Number of urinary catheter-days

** Number of central line-associated BSIs x 1000
Number of central line-days

***Number of ventilator-associated pneumonias x 1000
Number of ventilator-days

Table 2. Pooled means and percentiles of the distribution of device utilization ratios, by type of ICU, ICU component, January 1992-April 1998

Urinary catheter utilization*

Type of ICU	No. of Units	Patient-Days	Pooled Mean	Percentile				
				10%	25%	50% (median)	75%	90%
Coronary	106	711,004	0.45	0.22	0.35	0.46	0.55	0.65
Cardiothoracic	45	360,235	0.86	0.70	0.83	0.89	0.94	0.97
Medical	127	928,471	0.70	0.45	0.61	0.73	0.82	0.88
Medical/Surgical	222	1,750,279	0.75	0.52	0.65	0.76	0.84	0.89
Neurosurgical	42	216,562	0.79	0.50	0.67	0.82	0.90	0.93
Pediatric	67	485,218	0.32	0.12	0.19	0.28	0.41	0.49
Surgical	142	1,070,636	0.83	0.66	0.78	0.85	0.90	0.95
Burn	16	47,221	0.54	.	.	.	.	.
Respiratory	7	40,363	0.60	.	.	.	.	.

Central line utilization**

Type of ICU	No. of Units	Patient-Days	Pooled Mean	Percentile				
				10%	25%	50% (median)	75%	90%
Coronary	107	711,004	0.28	0.12	0.18	0.26	0.35	0.50
Cardiothoracic	45	360,235	0.79	0.60	0.73	0.84	0.87	0.94
Medical	126	928,471	0.50	0.29	0.35	0.48	0.61	0.72
Medical/Surgical	222	1,750,279	0.47	0.23	0.34	0.47	0.59	0.69
Neurosurgical	42	216,562	0.42	0.24	0.36	0.46	0.54	0.60
Pediatric	67	485,218	0.45	0.22	0.31	0.43	0.54	0.65
Surgical	142	1,070,636	0.67	0.47	0.58	0.69	0.78	0.87
Burn	16	47,221	0.41	.	.	.	.	.
Respiratory	7	40,363	0.31	.	.	.	.	.

Ventilator utilization***

Type of ICU	No. of Units	Patient-Days	Pooled Mean	Percentile				
				10%	25%	50% (median)	75%	90%
Coronary	105	711,004	0.19	0.08	0.11	0.16	0.24	0.32
Cardiothoracic	45	360,235	0.47	0.30	0.38	0.50	0.55	0.63
Medical	126	928,471	0.47	0.21	0.31	0.46	0.58	0.68
Medical/Surgical	222	1,750,279	0.38	0.20	0.28	0.37	0.47	0.59
Neurosurgical	42	216,562	0.37	0.21	0.25	0.38	0.45	0.56
Pediatric	67	485,218	0.47	0.20	0.33	0.44	0.52	0.60
Surgical	142	1,070,636	0.46	0.24	0.35	0.46	0.56	0.65
Burn	16	47,221	0.32	.	.	.	.	.
Respiratory	7	40,363	0.50	.	.	.	.	.

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

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

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

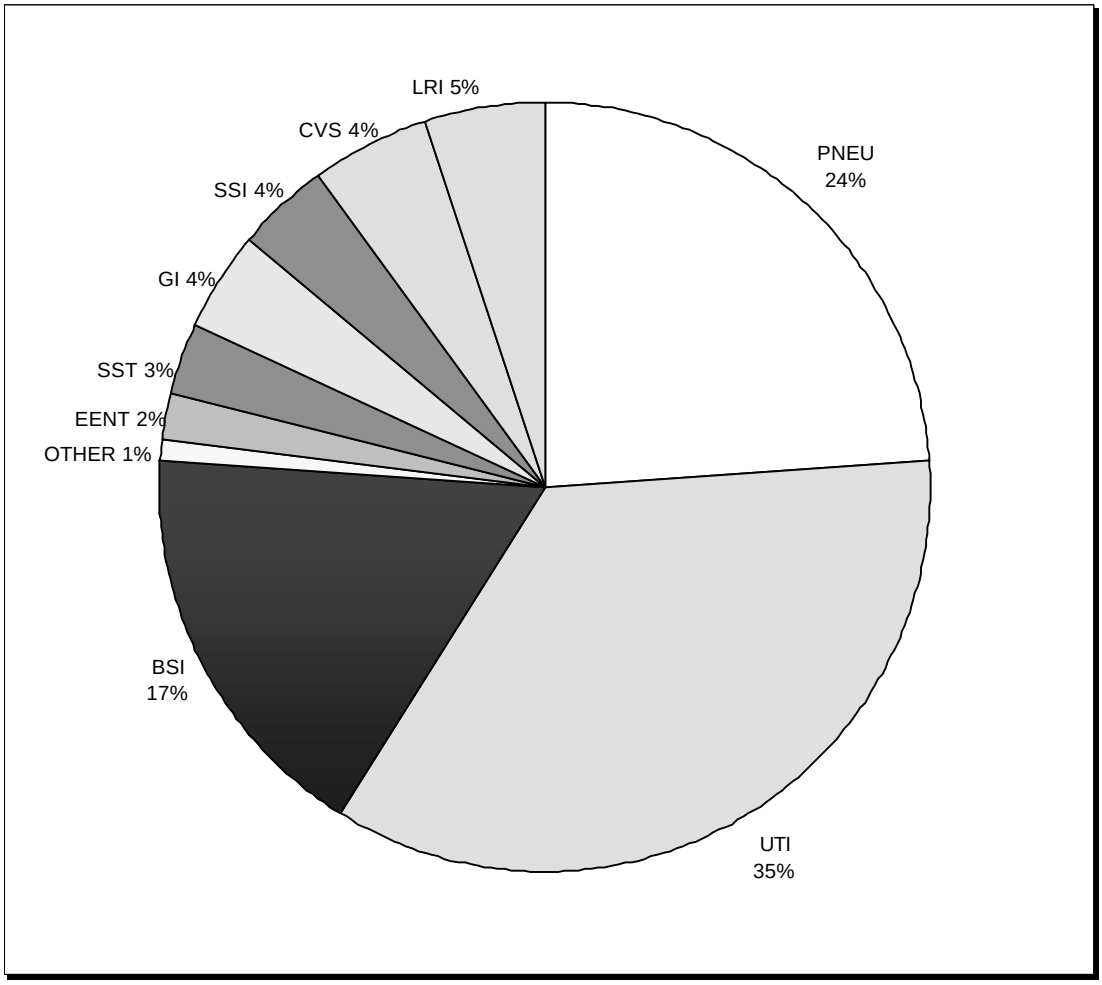


Figure 1. Site distribution of 2,321 nosocomial infections in coronary care units, NNIS System, 1992-1997. PNEU, pneumonia; UTI, urinary tract infection; BSI, primary bloodstream infection; EENT, eye, ear, nose, and throat infection; SST, skin and soft tissue infection; GI, gastrointestinal infection; SSI, surgical site infection; CVS, cardiovascular system infection; LRI, lower respiratory tract infection other than pneumonia; OTHER, other.

Table 3. Distribution of specific sites of infection within selected major infection site categories in the coronary care unit[†], 1992-1997

Major Site	Specific Site	No. of Infections	%
Bloodstream infection (BSI)	Laboratory-confirmed BSI	1085	94
	Clinical sepsis	74	6
Pneumonia		1635	100
Urinary tract infection (UTI)	Symptomatic UTI	1282	55
	Asymptomatic bacteriuria	1024	44
	Other	15	1
Cardiovascular infection	Vascular	300	97
	Endocarditis	8	3
Eye, Ear, Nose, and Throat	Sinusitis	79	54
	Oral	30	20
	Conjunctivitis	27	18
	Other	11	8

[†]Includes all coronary care unit infections reported from hospitals performing the ICU and/or hospital-wide surveillance components during the time period.

Table 4. Percent distribution of the most common nosocomial pathogens isolated from selected major infection sites in the coronary care unit[†], 1992-1997

Pathogen	Major Infection Site				
	Bloodstream Infection	**Pneumonia**	**Urinary Tract Infection**	**Cardiovascular Infection**	**Eye, Ear, Nose and Throat**
	n=1159	n=1635	n=2321	n=300	n=147
CoNS*	37	2	3	46	18
S. aureus	24	21	3	20	17
Enterococcus spp.	10	2	14	11	5
E. coli	3	4	28	2	3
Enterobacter spp.	3	9	4	2	6
C. albicans	2	6	10	4	5
K. pneumoniae	2	8	6	2	3
S. marcescens	2	4	1	1	2
P. aeruginosa	2	14	7	2	8
Other *Candida* spp.	2	0.2	4	2	12
*C. glabrata***	2	3	3	0.3	0
Acinetobacter spp.	1	3	0.2	1	0
Other fungi	1	2	5	1	3
P. mirabilis	0.6	2	4	1	1
S. pneumoniae	0.4	2	0	0	0
H. influenzae	0.1	3	0	0	0
Other	7	16	8	5	17

[†]Includes all coronary care unit infections reported from hospitals performing the ICU and/or hospital-wide surveillance components during the time period.

*CoNS=coagulase-negative staphylococci

**Previously called *Torulopsis glabrata*

Table 5. Pooled means and percentiles of the distribution of device-associated infection rates, by birth weight category, HRN component, January 1990 - April 1998

Umbilical and Central Line-associated BSI Rate*

Birth weight Category	No. of HRNs	Central-Line Days	Pooled Mean	Percentile				
				10%	25%	50% (median)	75%	90%
≤1000 grams	117	294,329	12.4	4.5	6.8	12.1	16.4	19.8
1001-1500 grams	117	138,769	7.6	0.0	3.1	6.4	11.8	16.6
1501-2500 grams	117	120,589	5.2	0.0	1.0	4.0	7.1	11.4
>2500 grams	115	174,044	4.5	0.0	1.4	3.9	6.2	11.1

Ventilator-associated Pneumonia Rate**

Birth weight Category	No. of HRNs	Ventilator-Days	Pooled Mean	Percentile				
				10%	25%	50% (median)	75%	90%
≤1000 grams	118	320,601	4.9	0.0	1.2	3.6	6.8	9.6
1001-1500 grams	115	103,366	4.0	0.0	0.0	2.3	6.2	10.9
1501-2500 grams	113	81,435	3.5	0.0	0.0	1.8	4.7	8.7
>2500 grams	110	117,702	2.9	0.0	0.0	1.3	3.9	7.2

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

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

Table 6. Pooled means and percentiles of the distribution of device utilization ratios, by birth weight category, HRN component, January 1990-April 1998

Umbilical and Central Line Utilization Ratio*

Birth weight Category	No. of HRNs	Patient-Days	Pooled Mean	Percentile				
				10%	25%	50% (median)	75%	90%
≤1000 grams	121	749,429	0.39	0.18	0.27	0.37	0.53	0.64
1001-1500 grams	122	531,654	0.26	0.09	0.13	0.22	0.40	0.56
1501-2500 grams	127	593,187	0.20	0.05	0.09	0.16	0.28	0.47
>2500 grams	127	570,886	0.30	0.07	0.12	0.23	0.39	0.53

Ventilator Utilization Ratio**

Birth weight Category	No. of HRNs	Patient-Days	Pooled Mean	Percentile				
				10%	25%	50% (median)	75%	90%
≤1000 grams	121	749,429	0.43	0.24	0.32	0.40	0.53	0.65
1001-1500 grams	122	531,654	0.19	0.07	0.11	0.16	0.27	0.42
1501-2500 grams	127	593,187	0.14	0.03	0.06	0.10	0.17	0.33
>2500 grams	127	570,886	0.21	0.05	0.07	0.15	0.25	0.38

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

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

Table 7. Surgical site infection rates[‡], by operative procedure and risk index category, Surgical Patient component, October 1986 - July 1996

Operative Procedure Category		Duration Cutpoint (hrs)	Risk Index Category	N	Rate	Risk Index Category	N	Rate	Risk Index Category	N	Rate	Risk Index Category	N	Rate
CARD	Cardiac Surgery	5	0	848	0.71	1	9829	1.83	2,3	2933	3.55		.	
CBGB	CABG-Chest & Leg*	5	0	830	0.84	1	65595	3.29	2	14178	5.56	3	28	17.86
CBGC	CABG-Chest Only**	4	0,1,2,3	4343	3.73		.	.		.	.		.	.
OCVS	Other Cardiovascular	2	0,1	4890	0.74	2,3	1275	1.41		.	.		.	.
ORES	Other Respiratory System	2	0,1,2,3	1245	3.61		.	.		.	.		.	.
THOR	Thoracic Surgery	3	0	1197	0.50	1	3028	1.59	2,3	1060	3.49		.	
APPY	Appendectomy	1	0	4472	1.30	1	4177	3.11	2,3	1664	6.25		.	.
BILI	Liver/Pancreas Surgery	4	0	357	2.80	1	689	6.10	2,3	343	10.20		.	.
CHOL	Cholecystectomy†	2	0	16477	0.54	1	5893	0.81	2	5554	2.25	3	2010	3.98
COLO	Colon Surgery	3	0	5606	4.32	1	9352	6.51	2	4171	10.53	3	518	13.90
GAST	Gastric Surgery	3	0	1469	2.79	1	2461	5.57	2,3	1067	12.37		.	.
OGIT	Other Digestive Tract Surgery	3	0	1068	2.06	1	1555	3.99	2,3	489	9.00		.	.
SB	Small Bowel Surgery	3	0	758	5.28	1	1519	7.70	2,3	1005	10.65		.	.
XLAP	Laparotomy	2	0	4030	1.94	1	4151	3.32	2	1966	6.92	3	283	9.89
NEPH	Nephrectomy	3	0,1,2,3	1785	1.68		.	.		.	.		.	.
OGU	Other Genitourinary	2	0	12185	0.53	1	4747	1.29	2,3	1025	4.29		.	.
PRST	Prostatectomy	4	0	1524	1.05	1	1134	2.56	2,3	211	5.21		.	.
HN	Head and Neck Surgery	5	0	804	1.99	1	816	4.17	2,3	369	12.74		.	.
OENT	Other ENT Surgery	3	0	1883	0.27	1	945	0.85	2,3	181	4.97		.	.
HER	Herniorrhaphy	2	0	7307	0.93	1	3941	2.06	2,3	743	3.10		.	.
MAST	Mastectomy	2	0,1	9486	1.72	2,3	665	4.96		.	.		.	.

Table 7 - continued

Operative Procedure Category		Duration Cutpoint (hrs)	Risk Index Category	N	Rate	Risk Index Category	N	Rate	Risk Index Category	N	Rate	Risk Index Category	N	Rate
CRAN	Craniotomy	5	0	2029	0.99	1,2,3	5992	1.55		.	.		.	.
ONS	Other Nervous System Surgery	3	0,1,2,3	2140	1.50		.	.		.	.		.	.
VSHN	Ventricular Shunt	2	0	1289	3.57	1,2,3	2918	4.80		.	.		.	.
CSEC	Cesarean Section	1	0	45441	3.36	1	16610	4.45	2,3	1221	7.21		.	.
HYST	Abdominal Hysterectomy	2	0	16035	1.60	1	8445	2.84	2,3	1633	6.12		.	.
OOB	Other Obstetric Surgery	1	0,1,2,3	455	0.44		.	.		.	.		.	.
VHYS	Vaginal Hysterectomy	2	0	6497	1.02	1,2,3	3235	1.70		.	.		.	.
AMP	Limb Amputation	1	0,1,2,3	6260	4.57		.	.		.	.		.	.
FUSN	Spinal Fusion	4	0	5995	1.33	1	3625	3.06	2,3	994	7.85		.	.
FX	Open Reduction of Fracture	2	0	8309	0.81	1	11558	1.44	2,3	2615	2.91		.	.
HPRO	Hip Prosthesis	2	0	4504	0.69	1,2,3	10873	1.70		.	.		.	.
KPRO	Knee Prosthesis	2	0	5601	0.87	1	7510	1.23	2,3	2314	1.77		.	.
OPRO	Other Joint Prosthesis	3	0,1,2,3	836	0.72		.	.		.	.		.	.
LAM	Laminectomy	2	0	9702	0.67	1	6686	1.36	2,3	1919	2.40		.	.
OMS	Other Musculoskeletal	3	0,1	18176	0.71	2,3	1598	2.13		.	.		.	.
OBL	Other Hematologic/ Lymphatic Surgery	3	0	583	0.86	1,2,3	526	2.85		.	.		.	.
OES	Other Endocrine Surgery	3	0	1423	0.14	1,2,3	988	1.11		.	.		.	.
OEYE	Other Eye Surgery	2	0,1,2,3	1417	0.14		.	.		.	.		.	.
OSKN	Other Integumentary System Surgery	2	0,1	5652	1.45	2,3	1113	2.52		.	.		.	.

Table 7 - continued

Operative Procedure Category		Duration Cutpoint (hrs)	Risk Index Category	N	Rate	Risk Index Category	N	Rate	Risk Index Category	N	Rate	Risk Index Category	N	Rate
SPLE	Splenectomy	2	0,1	777	2.32	2,3	250	5.60		.	.		.	.
TP	Organ Transplant	7	0,1	1449	4.90	2	958	9.92	3	202	21.29		.	.
VS	Vascular Surgery	3	0	3819	1.34	1	24031	2.01	2	9649	5.15	3	283	8.83
SKGR	Skin Graft	2	0	924	1.19	1	1521	2.96	2	785	4.97	3	164	9.15

‡per 100 operative procedures

*CBGB: CABG-Chest & Leg = Coronary artery bypass graft with both chest and leg (or other donor site) incisions

**CBGC: CABG-Chest Only = Coronary artery bypass graft with chest incision only (example: internal mammary artery graft)

†Risk categories for CHOL are defined as:
0 if the risk index = 0;
1 if the risk index = 1 and SCOPE (use of laparoscope) = Yes;
2 if the risk index = 1 and SCOPE = No or risk index = 2,3 and SCOPE = Yes;
3 if the risk index = 2,3 and SCOPE = No. See Appendix C for further discussion of CHOL risk index.

Table 8. Percentiles of the distribution of surgical site infection rates[‡], by operative procedure and risk index category[§], Surgical Patient component, October 1986 - July 1996

Operative Procedure Category		Risk Index Category	No. Hospitals	Pooled Mean Rate	Percentile				
					10%	25%	50% (median)	75%	90%
CARD	Cardiac Surgery	1	57	1.83	0.00	0.00	1.31	2.39	3.12
CARD	Cardiac Surgery	2,3	38	3.55	0.00	1.29	2.94	5.39	7.96
CBGB	CABG-Chest & Leg*	1	104	3.29	1.23	1.92	3.08	4.15	6.34
CBGB	CABG-Chest & Leg	2	84	5.56	0.00	2.90	4.90	8.00	10.66
CBGC	CABG-Chest Only**	0,1,2,3	42	3.73	0.00	0.00	0.00	3.81	4.93
OCVS	Other Cardiovascular	0,1	28	0.74	0.00	0.00	0.00	0.90	2.22
THOR	Thoracic Surgery	1	33	1.59	0.00	0.00	0.00	2.16	3.37
APPY	Appendectomy	0	34	1.30	0.00	0.00	0.71	2.01	3.58
APPY	Appendectomy	1	38	3.11	0.00	0.00	2.48	5.32	5.89
APPY	Appendectomy	2,3	25	6.25	0.00	1.87	5.03	8.03	9.53
CHOL	Cholecystectomy†	0	64	0.54	0.00	0.00	0.00	0.76	1.27
CHOL	Cholecystectomy†	1	47	0.81	0.00	0.00	0.46	1.31	1.92
CHOL	Cholecystectomy†	2	53	2.25	0.00	0.00	2.06	4.30	5.58
CHOL	Cholecystectomy†	3	36	3.98	0.00	1.15	2.94	6.67	9.09
COLO	Colon Surgery	0	55	4.32	0.00	1.81	3.39	6.02	9.04
COLO	Colon Surgery	1	66	6.51	0.00	3.41	5.56	8.08	10.10
COLO	Colon Surgery	2	45	10.53	4.50	6.64	9.31	16.19	17.50
GAST	Gastric Surgery	0	23	2.79	0.00	0.00	1.75	5.18	6.96
GAST	Gastric Surgery	1	29	5.57	1.53	2.33	4.90	8.35	10.19
SB	Small Bowel Surgery	1	23	7.70	3.48	4.84	7.33	13.19	15.91
XLAP	Laparotomy	0	31	1.94	0.00	0.00	1.51	2.54	4.41
XLAP	Laparotomy	1	35	3.32	0.00	1.41	3.38	5.10	7.85
XLAP	Laparotomy	2	23	6.92	0.32	2.30	6.31	9.29	14.51
NEPH	Nephrectomy	0,1,2,3	22	1.68	0.00	0.00	1.11	2.16	4.58
OGU	Other Genitourinary	0	33	0.53	0.00	0.00	0.26	1.13	2.51
OGU	Other Genitourinary	1	28	1.29	0.00	0.00	0.53	1.95	3.30
PRST	Prostatectomy	0	23	1.05	0.00	0.00	0.00	1.70	3.63
HER	Herniorrhaphy	0	36	0.93	0.00	0.00	0.54	1.52	2.44
HER	Herniorrhaphy	1	37	2.06	0.00	0.00	1.10	3.11	5.10

Table 8 - continued

Operative Procedure Category	Risk Index Category	No. Hospitals	Pooled Mean Rate	Percentile				
				10%	25%	50% (median)	75%	90%
MAST Mastectomy	0,1	45	1.72	0.00	0.00	1.33	2.02	4.27
CRAN Craniotomy	0	23	0.99	0.00	0.00	1.17	2.40	3.93
CRAN Craniotomy	1,2,3	41	1.55	0.00	0.00	1.03	1.99	3.35
VSHN Ventricular Shunt	1,2,3	27	4.80	0.00	0.00	3.63	4.93	7.49
CSEC Cesarean Section	0	80	3.36	0.38	1.30	2.76	5.00	7.77
CSEC Cesarean Section	1	75	4.45	0.00	1.31	3.66	6.83	9.50
HYST Abdominal Hysterectomy	0	60	1.60	0.00	0.36	1.41	2.65	5.00
HYST Abdominal Hysterectomy	1	55	2.84	0.00	0.00	1.79	3.20	4.78
HYST Abdominal Hysterectomy	2,3	28	6.12	0.00	2.78	4.88	8.16	10.84
VHYS Vaginal Hysterectomy	0	34	1.02	0.00	0.00	0.00	1.63	2.54
VHYS Vaginal Hysterectomy	1,2,3	32	1.70	0.00	0.00	1.32	2.47	4.85
AMP Limb Amputation	0,1,2,3	36	4.57	0.00	0.86	2.92	4.78	7.77
FUSN Spinal Fusion	0	35	1.33	0.00	0.00	0.27	1.93	2.33
FUSN Spinal Fusion	1	35	3.06	0.00	0.00	2.22	4.10	5.59
FX Open Reduction Fracture	0	51	0.81	0.00	0.00	0.00	1.19	2.37
FX Open Reduction Fracture	1	60	1.44	0.00	0.00	1.01	1.64	2.94
FX Open Reduction Fracture	2,3	35	2.91	0.00	0.00	2.40	4.38	8.70
HPRO Hip Prosthesis	0	51	0.69	0.00	0.00	0.00	1.18	1.77
HPRO Hip Prosthesis	1,2,3	84	1.70	0.00	0.00	0.99	2.63	3.70
KPRO Knee Prosthesis	0	59	0.87	0.00	0.00	0.00	1.46	2.69
KPRO Knee Prosthesis	1	72	1.23	0.00	0.00	1.00	1.71	3.39
KPRO Knee Prosthesis	2,3	36	1.77	0.00	0.00	1.37	3.33	5.38
LAM Laminectomy	0	57	0.67	0.00	0.00	0.00	0.98	1.85
LAM Laminectomy	1	53	1.36	0.00	0.00	0.58	2.39	3.10
LAM Laminectomy	2,3	30	2.40	0.00	0.00	1.68	3.19	5.77
OMS Other Musculoskeletal	0,1	38	0.71	0.00	0.00	0.49	1.13	1.72
OMS Other Musculoskeletal	2,3	20	2.13	0.00	0.00	0.49	2.94	4.11
OSKN Other Integumentary System	0,1	27	1.45	0.00	0.00	1.06	1.72	2.50

Table 8 - continued

Operative Procedure Category		Risk Index Category	No. Hospitals	Pooled Mean Rate	Percentile				
					10%	25%	50% (median)	75%	90%
VS	Vascular Surgery	0	40	1.34	0.00	0.00	0.00	1.75	2.94
VS	Vascular Surgery	1	76	2.01	0.00	0.00	1.54	2.60	3.51
VS	Vascular Surgery	2	65	5.15	0.00	2.34	4.82	7.10	9.16

‡ per 100 operative procedures

[§]Includes only those procedure-risk categories for which at least 20 hospitals have reported at least 30 operations

*CBGB: CABG-Chest and Leg = Coronary artery bypass graft with chest and leg (or other donor site) incisions

**CBGC: CABG-Chest Only = Coronary artery bypass graft with chest incision only (example: internal mammary artery graft)

[†]Risk categories for CHOL are defined as:
0 if the risk index = 0;
1 if the risk index = 1 and SCOPE (use of laparoscope) = Yes;
2 if the risk index = 1 and SCOPE = No or risk index = 2,3 and SCOPE = Yes;
3 if the risk index = 2,3 and SCOPE = No. See Appendix C for further discussion of CHOL risk index.

Appendix A. How to calculate a device-associated infection rate and device utilization ratio with ICU and HRN component data

Calculation of Device-associated Infection Rate

Step 1: Decide upon 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, i.e., the type of ICU or a birthweight 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 which 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 one or more central lines in place; five on day 2; two on day 3; five on day 4; three on day 5; four on day 6; and four 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:

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 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 Device Utilization (DU) Ratio

Steps 1,2,4: Same as device-associated infection rates plus determine the number of patient-days which 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 is simply 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-days 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, i.e., <50 device-days 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 B for interpretation of the percentiles of the rates/ratios.

Appendix B. Interpretation of percentiles of infection rates or device utilization 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 if your hospital's rate (ratio) is above or below this median.

Determining whether your hospital's rate or ratio is a HIGH outlier

Step 4: If it is above 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 above the 75th percentile, determine whether it is above the 90th percentile. If it is, then the rate (ratio) is a high outlier which *may* indicate a problem.

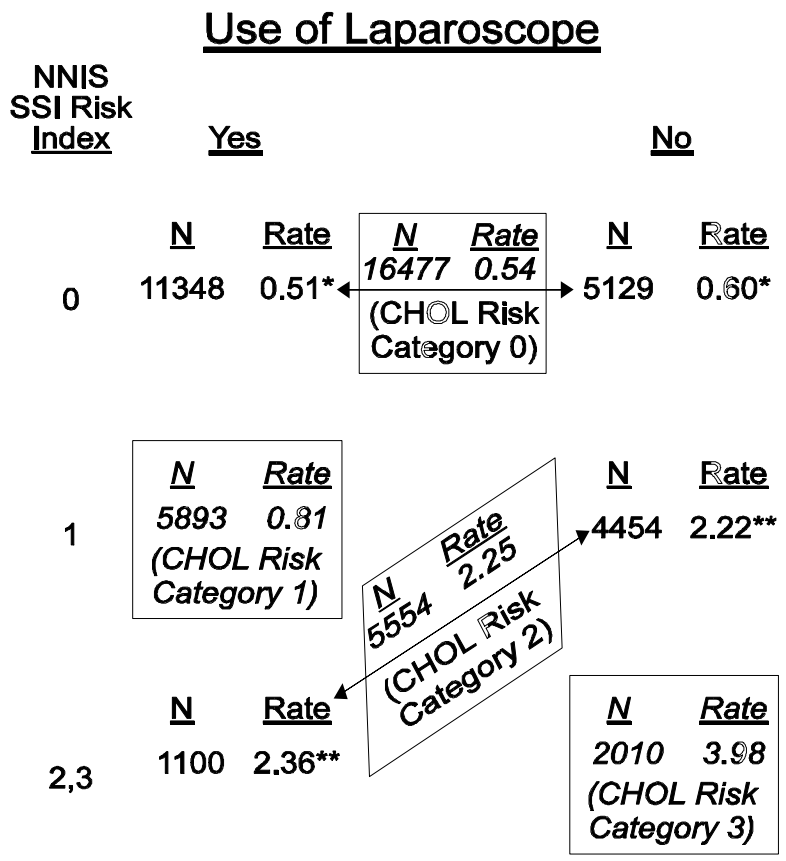
Determining whether your hospital's rate or ratio is a LOW outlier

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 which may be due to underreporting of infections. If the ratio is below the 10th percentile, it is a low outlier and may be due to infrequent and/or short duration of device use.

Note: Device-associated infection rates and device utilization 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 utilization ratio is routinely between the 75th and 90th percentile. Since 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 in order to lower the ventilator-associated pneumonia rate in the unit.

Appendix C. SSI rates for cholecystectomy, by NNIS SSI risk index and use of laparoscope, Surgical Patient component, January 1992-July 1996



*no significant difference between these rates (p=0.26); hence, these cells were combined to form risk category 0.
**no significant difference between these rates (p=0.42); hence these cells were combined to form risk category 2.

This table helps to explain how the SSI risk categories (0,1,2,3) were formed for cholecystectomies. Use of a laparoscope (yes/no) has been collected in the NNIS system for all procedures since January 1992. Sixty-one percent of cholecystectomies done since then have been done using a laparoscope. In addition to the three factors incorporated into the risk index, use of a laparoscope is often an important factor in determining the risk of a SSI following cholecystectomies. Use of a laparoscope did not significantly alter the risk of a SSI when the risk index was zero; hence category 0 indicates a very low pooled rate of 0.54%. Risk category 1 consists of those procedures that had a risk index of 1 and were performed laparoscopically (SSI rate = 0.81%). Since there was no significant difference between the SSI rates of procedures with a risk index = 2,3 that were done laparoscopically (2.36%) and those with a risk index = 1 that used an open approach (2.22%), these procedures were combined to form risk category 2 (2.25%). Finally, procedures with a risk index value of 2,3 that used an open approach had the highest SSI rate (3.98%) and formed risk category 3.

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