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Canadian Nosocomial Infection Surveillance Program

Annual Summary
June 1984 - May 1985

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CANADIAN NOSOCOMIAL INFECTION SURVEILLANCE PROGRAM

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PREFACE

Information received from the hospitals participating in the Canadian Nosocomial Infection Surveillance Program was collated, analyzed and summarized for this report by P.D. Riben, M.D., G.A. Wells, Ph.D., and M. Trotman, B.Sc.

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INTRODUCTION

In June 1984, the Bureau of Infection Control initiated the Canadian Nosocomial Infection Surveillance Program (CNISP). The objectives of this program included determining rates of nosocomial infections, determining pathogens responsible for the infections, monitoring the pathogens for changes in resistance profiles, and determining characteristics of the patients that acquire infections to assist in developing profiles of those at risk.

This report outlines some of the results using the data accumulated between June 1984 and May 1985.

METHODS

Participating hospitals used standard definitions for the identification of infections. The definitions were modified from those used by the Centers for Disease Control (CDC) in their National Nosocomial Infections Study (NNIS). Definitions for the more common infection sites are summarized in Table 1.

A standard reporting form, which is provided in the appendix, was used by all hospitals. Along with demographic data, information was collected on acute and chronic co-existing events, the site of infection, and the responsible pathogen(s).

The approach to surveillance was left to the discretion of the individual hospitals. Most frequently, hospitals carried out facility-wide surveillance followed by surveillance of patients or services which were considered to be at high risk of acquiring an infection. Surveillance for infections at specific sites was employed by some hospitals.

Hospitals also submitted the number of patient discharges and the number of patient days at risk for each of the services under surveillance.

Data from the hospitals were submitted to the Bureau on a monthly basis, either by mailing the completed forms or by entering the information into a microcomputer at the hospital and transmitting the data electronically to the Bureau.

To try and achieve uniformity in infection identification and data collection, the hospitals were visited at least once during the year. In addition, because of the variation in surveillance methods, data were tested for time trends to identify potential artifacts which might affect analysis and to assess the consistency of data collection.

As a result of the variation in the approach to surveillance, overall rates were not calculated. In determining the rates that are reported, the

Table 1. Definitions for the common sites of infections

SITE	DEFINITION
Urinary Tract	Symptomatic or asymptomatic infection of any part of the urinary tract
Wound	Infection of surgical wounds involving skin or deeper tissue
Cutaneous	Any infection of epithelium, subcutaneous tissue, conjunctiva, or decubitus ulcers
Pneumonia	Infection of pulmonary parenchyma with alveolar involvement
Lower Respiratory	Infection of large airways, pleural space, mediastinum, or a localized necrotizing infection of pulmonary parenchyma
Obstetrical	Amnionitis, endometritis
Primary Bacteremia	Isolation of pathogen from blood without isolation of the same pathogen from any other site at the same time
Gastrointestinal (GIT)	Infection of any portion of gastrointestinal tract, peritoneal cavity, or retro-peritoneum. Does not include gastroenteritis

infections and population at risk (given in units of patient discharges or patient days) were selected from only those infections and/or hospitals where the data were reported as being available. Statistical comparisons were made using various chi-square test procedures. In particular, for fourfold tables, the chi-square with Yate's continuity correction was used. The reported p-values were adjusted (using Bonferroni correction) to accommodate for the multiple testing performed.

RESULTS and INTERPRETATION

DESCRIPTION of the POPULATION

By the end of May 1985, a total of nine hospitals were part of the program. They were located in six provinces and were grouped, to control for severity of underlying illness, as follows: teaching(4), community(3), extended care(1), and pediatric(1).

The reported total number of patients discharged from the surveyed portions of the hospitals, with the exception of the extended care institution, was 102,698.

A total of 3489 nosocomial infections were reported over the course of the year. The number of patients with an infection was 2768. Four hundred and sixty-six patients had more than one infection. The frequency with which multiple infections occurred by hospital type is outlined in Table 2. As expected, the patients in the extended care hospital tended to have multiple infections more frequently than those in the teaching and community hospitals ($p<.005$).

Table 2. Proportion of patients with multiple infections in each hospital category

	HOSPITAL TYPE									
NUMBER OF INFECTIONS	COMMUNITY (n=461)		TEACHING (n=1679)		EXT. CARE (n=187)		PEDIATRIC (n=441)		CNISP SAMPLE (n=2768)	
	n	%	n	%	n	%	n	%	n	%
1	435	94.4	1354	80.7	125	66.8	389	88.2	2303	83.2
2	23	5.0	218	13.0	34	18.2	43	9.8	318	11.5
3	2	0.4	14	0.8	13	6.9	9	2.0	38	1.4
>=4	1	0.2	93	5.5	15	8.1	-	-	109	3.9

ABBREVIATIONS: EXT. CARE, Extended Care; CNISP, Canadian Nosocomial Infection Surveillance Program

Twenty percent of the patients were under the age of 16, 40% were between 16 and 65 and 40% were over 65 years of age. The male:female ratio was 49:51.

Most of the infections were associated with clinical manifestations. The most frequent signs were fever and evidence of inflammation which were noted in 41% and 20% of the infections, respectively. However, 30% of the urinary tract infections were asymptomatic.

The diagnosis of infection was made by a physician in 1575 (45%) of the infections. In the remaining infections, the diagnosis was made by fulfilling the criteria that were supplied as part of the definitions.

INFECTIONS

Sites of Infection

The nine most frequent sites of infection are displayed in Figure 1. Urinary tract infections, as would be expected from other reports, were the most frequent. The relative frequencies of infections at the various sites are similar but not identical to that found in the NNIS group of hospitals.

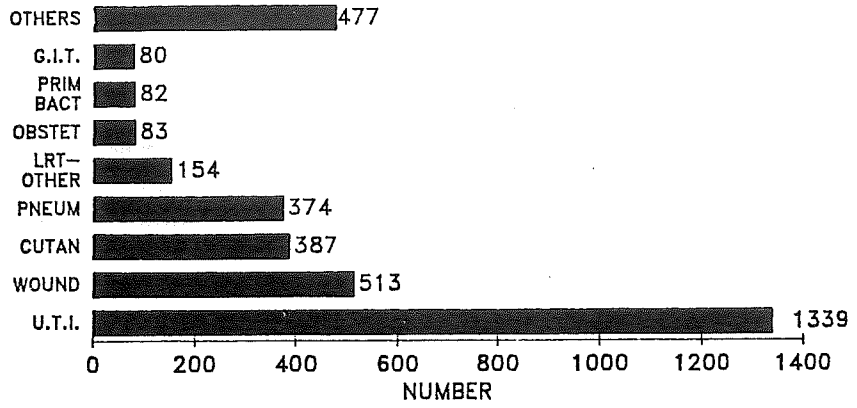

Figure 1. Number of nosocomial infections by site of infection

ABBREVIATIONS: U.T.I., urinary tract infection; CUTAN, cutaneous; PNEUM, pneumonia; LRT–OTHER, lower respiratory tract – other; OBSTET, obstetrics; PRIM BACT, primary bacteremia; G.I.T., gastrointestinal

Reversal in the order of cutaneous and lower respiratory infections in CNISP was due to differences in definitions. In NNIS, all lower respiratory infections, including pneumonia, belong to a single category. Two categories, pneumonia and lower respiratory tract infections, are used to classify these infections in CNISP.

Another difference in the two studies is the relative frequency with which primary bacteremias were reported. In the 1983 NNIS sample, 7.3% of the nosocomial infections were classified as primary bacteremia, making it the fourth most common infection. The comparable numbers in the CNISP sample were 2.3% of all infections and the ninth most frequent infection. Interestingly, while the proportion of infections classified as primary bacteremia was lower in CNISP than NNIS, the proportion of infections that were bacteremic (primary plus secondary) was greater in CNISP (6.6%) than the 4.8% reported by the Study on the Efficacy of Nosocomial Infection Control (SENIC Project).

While the overall ranking of infections from the most to least frequent is a common practice, it should be noted that the results might be misleading. As illustrated in Figure 2, the ranking is dependent on the age of the patients under surveillance. Urinary tract infections, which are consistently reported as the most frequent nosocomial infection, are of lesser importance in patients less than 16 years of age than in the older population.

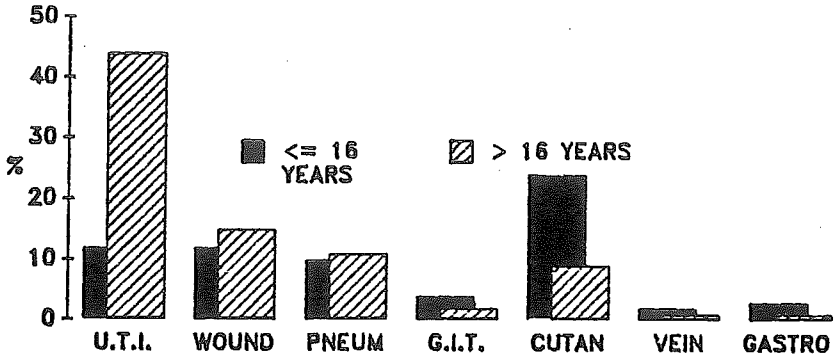

Figure 2. Percentage distribution of selected sites of nosocomial infections in patients <= 16 years compared to patients > 16 years of age

ABBREVIATIONS: U.T.I., urinary tract infection; PNEUM, pneumonia; G.I.T., gastrointestinal; CUTAN, cutaneous; GASTRO, gastroenteritis

Service-Specific Infection Rates

Since the type of surveillance and the services surveyed varied from hospital to hospital, the overall infection rates were not calculated. The results of the pediatric and extended care hospitals are omitted as they are not representative of a group of hospitals.

The infection ratio, calculated by dividing the number of infections by the total number of patient discharges and multiplying by 100, for specific site-service combinations are reported for the teaching hospitals in Table 3. On the adult services, the most frequent site was the urinary tract, with an infection ratio ranging from 4.4 on ophthamology/neurology to 0.8 on obstetrics.

The second most frequent infection on medicine was pneumonia followed by cutaneous infections. The types of infection and the rates with which they were reported to occur are similar to those reported by NNIS.

It is not surprising that wound infections were the second most common infection on the surgical services of the teaching hospitals. This is in keeping with other reports.

Cutaneous infections were the most frequent infection in the pediatric sample in the teaching hospitals. As was seen in Figure 2, and as can be seen from Table 3, urinary tract infections were not as common a problem in the nursery or pediatric wards as they were on adult wards. The probable reason for the difference is the infrequent use of indwelling urinary catheters in the pediatric population.

Table 3. Infection ratio* by hospital service and infection sites in teaching hospitals

SERVICE	INFECTION SITE						
	U.T.I.	WOUND	CUTAN	PNEUM	L.R.T.	PRIM BACT	OTHERS
MEDICINE	3.3	0.2	0.5	0.6	0.3	0.2	1.1
SURGERY	3.0	1.8	0.2	1.1	0.3	0.2	0.6
GYNECOL.	2.5	0.3	0.1	0.09	0.1	0.05	0.05
OBSTET.	0.8	0.2	0.3	0.03	0.03	0.07	0.1
NURSERY	0.2	-	0.6	0.6	0.05	0.5	1.1
PEDIAT.	0.4	0.2	0.5	0.15	0.1	0.2	0.7
OPHTH./ NEURO	4.4	0.6	0.4	0.7	0.5	-	0.1

* Infection Ratio = number of nosocomial infections/100 discharges

ABBREVIATIONS: CUTAN, Cutaneous; PNEUM, Pneumonia; PRIM BACT, Primary Bacteremia; GYNECOL., Gynecology; OBSTET., Obstetrics; PEDIAT., Pediatrics; OPHTH./NEURO, Ophthalmology/ Neurosurgery; U.T.I., Urinary Tract Infection; L.R.T., Lower Respiratory Tract

The incidence density (calculated by dividing the number of infections by the total number of patient days and multiplying by 1000), and the infection ratios are given for the community hospitals in Table 4. Contrary to what was found in the teaching hospitals, the most frequently reported infection for the surgical and gynecological services in the community hospitals was that of wound infections. The rates, given as incidence density, were 1.5 and 1.2 infections per 1000 days at risk, respectively.

As in the teaching hospitals, urinary tract infections were the most frequent infection on medicine with an incidence density of 0.4 and an infection ratio of 0.5. Also, as in teaching hospitals, the most frequent infection in the nurseries was cutaneous infection.

Table 4. Infection ratio* and incidence density+ by hospital service and infection sites in community hospitals

SERVICE	INFECTION SITE						
	U.T.I.	WOUND	CUTAN	PNEUM	L.R.T.	PRIM BACT	OTHERS
MEDICINE	0.5*	0.2	0.2	0.1	-	0.05	0.3
	0.4+	0.1	0.2	0.05	-	0.03	0.2
SURGERY	0.6	1.1	0.2	0.1	0.03	0.1	0.5
	0.7	1.5	0.3	0.2	-	0.1	0.7
GYNECOL.	-	0.7	0.2	-	-	-	0.5
	-	1.2	-	-	-	-	0.6
OBSTET.	0.3	0.3	0.03	-	-	-	1.4
	0.6	0.6	0.1	-	-	-	2.8
NURSERY	-	-	0.9	0.1	-	-	0.4
	-	-	1.6	0.3	-	-	0.8
PEDIAT.	-	0.03	0.03	-	-	-	0.03
	-	0.1	0.1	-	-	-	0.1

* Infection ratio = number of nosocomial infections/100 discharges
\+ Incidence density = number of nosocomial infections/1000 patient days at risk

ABBREVIATIONS: CUTAN, Cutaneous; PNEUM, Pneumonia; PRIM BACT, Primary Bacteremia; GYNECOL., Gynecology; OBSTET., Obstetrics; PEDIAT., Pediatrics; U.T.I., Urinary Tract Infection; L.R.T., Lower Respiratory Tract

The rates reported for the community hospitals in CNISP are lower than those reported for the non-teaching hospitals in NNIS. The probable reason is a combination of the following : admission of less severely ill patients to CNISP hospitals, under-reporting of infections, and more efficient infection control. Preliminary results of a prevalence survey, which was conducted in a single hospital after this study period, indicate that the patients did not have many risk factors for acquiring an infection. It was also found that approximately one half of the infections were not identified, suggesting that under-reporting is occurring. Studies such as these will be repeated prior to the calculation of a sensitivity index.

Co-existing Conditions

The more commonly reported chronic co-existing conditions for selected sites of infection are listed in Table 5. Vascular insufficiency, which was defined as any abnormality resulting in ischemia (except myocardial), or abnormal blood flow, was a common co-existing condition. Infections where vascular insufficiency was noted varied from a low of 18% for the wound infections to a high of 27% for pneumonias. Other common chronic co-existing conditions were neurological deficiency, pulmonary insufficiency, diabetes mellitus, renal insufficiency, and obesity. As these conditions are associated to varying degrees with altered defense mechanisms, their relatively common occurrence is not surprising.

Table 5. Frequency of reported chronic co-existing conditions by selected nosocomial infection sites

	INFECTION SITE							
CONDITION	U.T.I. (n=1339)	WOUND (n=513)	CUTAN (n=387)	PNEUM (n=374)	L.R.T. (n=154)	PRIM BACT (n=82)	OTHER (n=640)	OVERALL (n=3489)
DIAB. MELL.	116*	46	25	37	5	8	34	271
NEURO	235	17	68	42	13	4	67	446
PULM.	105	23	32	77	33	13	46	329
RENAL	103	8	19	15	6	2	49	202
U.T.I.	66	5	12	9	1	2	15	110
VASC.	219	73	75	76	31	16	78	568
OTHER	339	143	124	101	23	13	200	943
NONE	278	188	143	70	39	23	252	993
NO DATA	333	103	50	96	31	10	90	713

* The column totals may exceed the number of infections (n) as more than 1 condition could be reported for each infection.

ABBREVIATIONS: CUTAN, Cutaneous; PNEUM, Pneumonia; PRIM BACT, Primary Bacteremia; DIAB. MELL., Diabetes Mellitus; NEURO., Neurological Deficiency; PULM., Pulmonary; U.T.I., Urinary Tract Infection; VASC., Vascular; L.R.T., Lower Respiratory Tract

Individuals with malignancies (particulary those affecting the hemopoietic system) are at increased risk for acquiring an infection. Some form of malignacy was reported as being present in 377 of 2690 (14%) infections.

The most common acute co-existing condition was that of a previous infection (Table 6), which was defined as any infection that occurred within two weeks of the current infection. These infections may have been either community or hospital-acquired. It does appear that the occurrence of one infection at least identifies, if not predisposes, those at risk for acquiring another infection.

Table 6. Frequency of reported acute co-existing conditions by selected nosocomial infection sites

	INFECTION SITE							
CONDITION	U.T.I. (n=1339)	WOUND (n=513)	CUTAN (n=387)	PNEUM (n=374)	L.R.T. (n=154)	PRIM BACT (n=82)	OTHER (n=640)	OVERALL (n=3489)
NEURO	47*	6	10	22	4	1	22	112
PULM.	30	15	31	38	11	7	36	168
RENAL	17	9	2	11	2	6	5	52
PREV. INF.	358	117	136	116	60	22	195	1004
OTHER	27	27	35	24	8	15	102	238
NONE	484	220	151	106	39	35	250	1285
NO DATA	409	138	52	90	39	12	113	853

* The column totals may exceed the number of infections (n) as more than 1 condition could be reported for each infection.

ABBREVIATIONS; CUTAN, Cutaneous; PNEUM, Pneumonia; PRIM BACT, Primary Bacteremia; PULM., Pulmonary; PREV. INF., Previous Infections; U.T.I., Urinary Tract Infection; L.R.T., Lower Respiratory Tract; NEURO., Neurological Deficiency

The other more common acute co-existing conditions were pulmonary (pulmonary edema of any etiology, oxygen toxicity, or aspiration), neurological deficiency (decreased level of consciousness with an impaired gag reflex), acute renal insufficiency, and any form of hepatitis or acute liver failure. The relatively common occurrence of these is not unusual as they are associated with altered defense mechanisms.

It has been demonstrated on many occasions that invasive procedures used in the investigation or management of the patient's underlying condition are frequently associated with hospital-acquired infections. The best example of

this is the relationship between urologic instrumentation and urinary tract infections. This is summarized in Figure 3. Information was submitted for 1259 of the 1339 urinary tract infections. An invasive procedure occurred in 1029 (82%) infections. The most common procedure was the insertion of an indwelling catheter followed by straight -in and -out catheterization. In 54 (4%) of the urinary tract infections, two or more urologic procedures preceded the infection.

Procedures or devices which bypass normal defense mechanisms were also common in patients who acquired a pneumonia or other lower respiratory tract infection (Figure 3). An endotracheal tube was present prior to the development of 48% of the nosocomial pneumonias. Respiratory assistance was reported in 44% of the pneumonias. Lower respiratory infections were associated with respiratory assistance (41%) and with the presence of an endotracheal tube (40%).

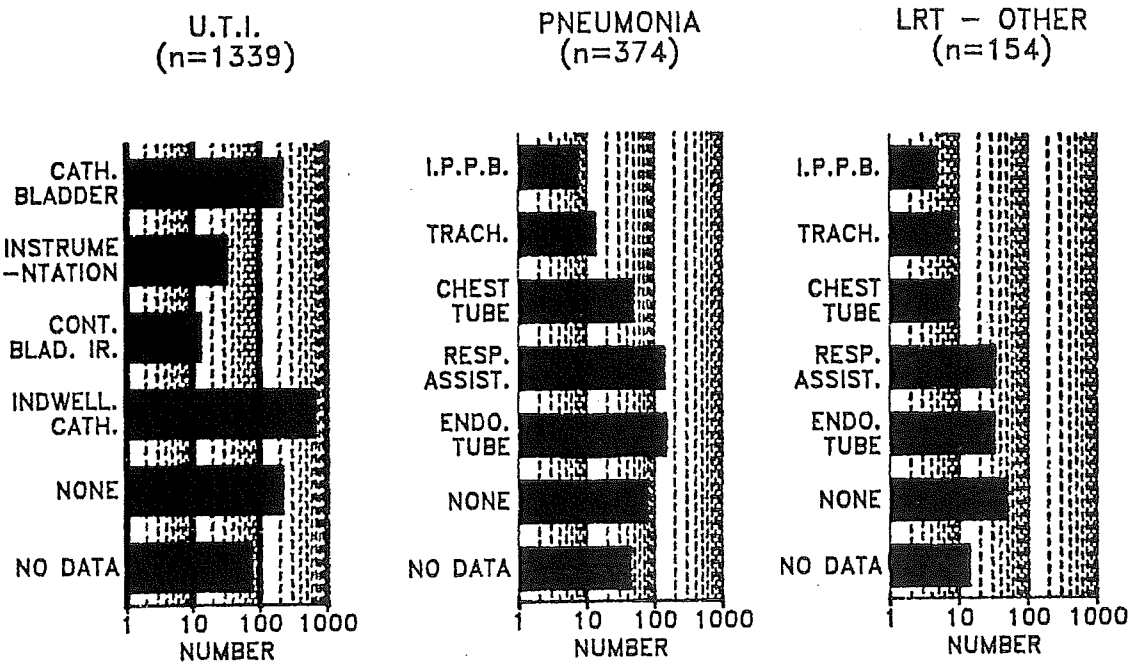

Figure 3. Frequency with which specific procedures/devices were reported at selected sites of infection. Note the semi-logarithmic scale on the horizontal axis.

ABBREVIATIONS: U.T.I., urinary tract infection; LRT – OTHER, lower respiratory tract-other; CATH. BLADDER, straight catheterization of bladder; CONT. BLAD. IR., continuous bladder irrigation; INDWELL. CATH., indwelling catheter; I.P.P.B., intermittent positive pressure breathing; TRACH., tracheostomy; RESP. ASSIST., respiratory assistance; ENDO. TUBE, endotracheal tube

The information was also reviewed to determine the extent with which multiple co-existing conditions were associated with infections (Figure 4). To keep the number of possible combinations of conditions at a workable level, all of the co-existing conditions were placed into one of the following categories: acute, chronic, cancer, 'specific treatment', and 'other treatment'. 'Specific treatment' consisted of those procedures/devices that are normally associated with a specific infection and 'other treatment' was defined as those procedures devices that are either infrequently employed or are not directly associated with the specific type of infection.

At least one co-exisitng condition was present in 343 of the 374 cases of pneumonia. One hundred of the 343 were associated with a single category, 121 with two categories, 87 with three categories, 28 with four categories and four infections were associated with conditions from all of the categories.

Multiple co-existing conditions were also associated with urinary tract infections. Co-existing conditions from two or more categories were identified in 794 of the 1339 (59%) urinary tract infections.

From this information it is apparent that the patients with hospital acquired infections, either as a consequence of their underlying illness or its investigation and/or treatment are compromised. While the severity of the impairment of the defense system varies, conditions are present in the vast majority which predispose patients to infections.

Cultures

Out of the total 3489 infections, cultures were reported to have been taken on 3111 (89%) infections, and 96% of these were reported as being positive. This extremely high rate of culturing, and the similarly high positivity rate are indicative of the method used to identify infected patients. That is, the decision as to whether or not a patient would be reviewed for acquisition of infection was dependent on whether or not a culture was taken and, most importantly, whether or not the culture was positive.

The lowest rate for culturing infections occurred in the extended care hospital where 73% were cultured. The positivity rate in this centre was 85%. In the teaching hospitals, 97% of the infections were reported to have been cultured with a positivity rate of 98%.

The rates of culturing by infection site varied from a high of 99% for urinary tract infections to a low of 82% for lower respiratory infections. The extremely high rate of culturing urinary tract infections along with the high rate with which pathogens were identified (98%) reflects the emphasis given to laboratory criteria in the definition for urinary tract infections.

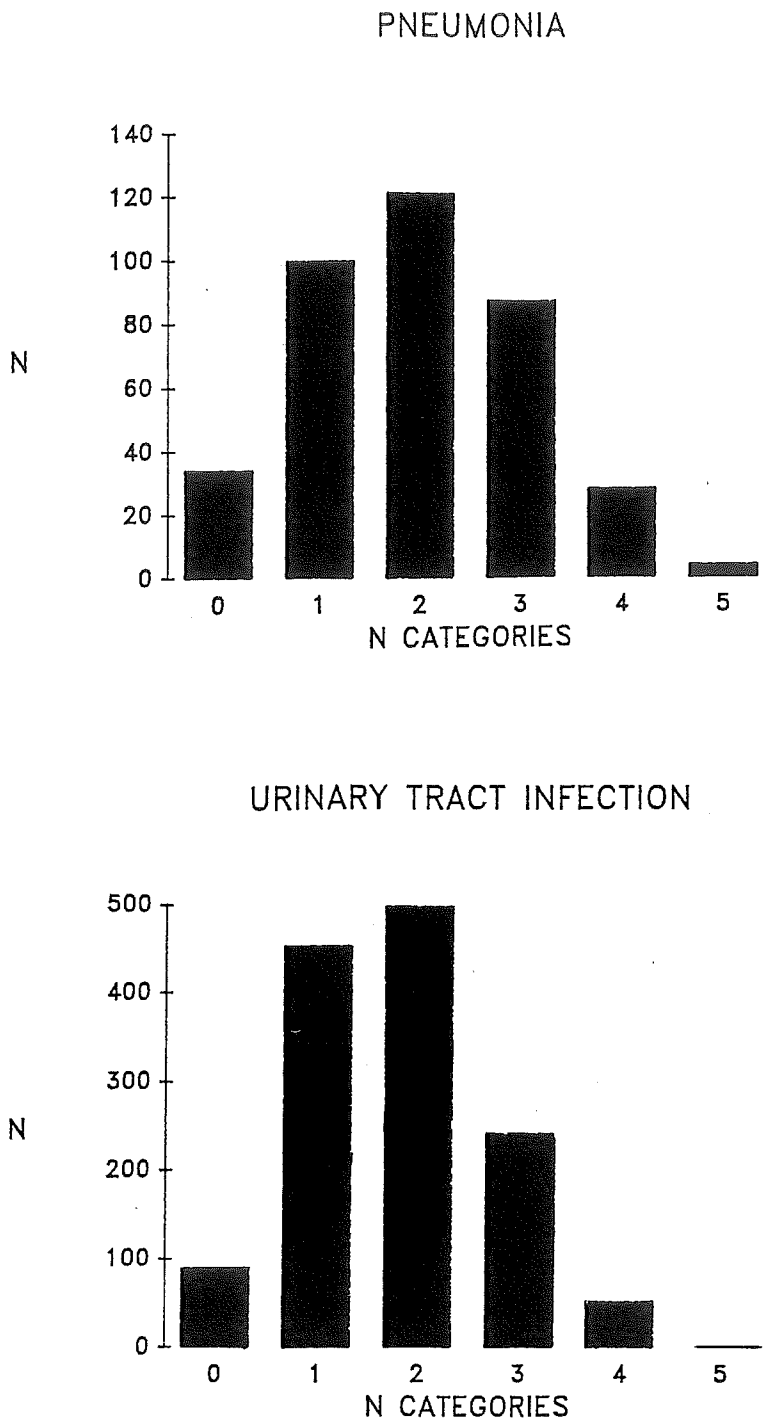

Figure 4. Number of cases of pneumonia and urinary tract infections associated with co-existing conditions from multiple categories. The categories are acute, chronic, cancer, 'specific treatment', and 'other treatment'.

Note: N. categories refers to the total number of categories from which conditions were reported for each infection

Pathogens

The more frequently isolated pathogens are reported in Table 7. E. coli was the most frequent isolate reported followed by S. aureus. The gram negative bacilli, as a group, were still the most frequently isolated pathogen. However, with the appearance of the coagulase-negative staphylococci this may not continue to be the case. The coagulase-negative staphylococci are becoming increasingly important, especially in reference to cannula-related bloodstream infections.

Table 7. More frequently isolated pathogens from all nosocomial infections

Pathogen	FREQUENCY
E. coli	702
S. aureus	563
Enterococcus	303
P. aeruginosa	231
K. pneumoniae	193
S. epidermidis	128
P. mirabilis	123
H. influenzae-B	89
E. cloacae	73
All others	1252

Organisms were not isolated with equal frequency in the various hospital types (Table 8). As would be expected, given the frequency of cutaneous infections in pediatric patients, S. aureus was the most frequent bacterial isolate reported in the pediatric hospital.

Table 8. Organisms isolated from patients with only one infection by the various types of hospitals

ORGANISM	HOSPITAL TYPE									
	TEACHING (n=1095)		COMMUNITY (n=218)		EXT. CARE (n=34)		PEDIATRIC (n=168)		TOTAL (n=1515)	
	n	%	n	%	n	%	n	%	n	%
E. CLOACAE	38	3.5	3	1.4	-	-	3	1.8	44	2.9
E. COLI	356	32.5	41	18.8	9	26.5	39	23.2	445	29.4
ENTEROCOCCUS	153	14.0	31	14.2	2	5.9	10	6.0	196	12.9
H. INFLUEN-B	50	4.6	6	2.8	1	2.9	8	4.8	65	4.3
K. PNEUMONIAE	82	7.5	14	6.4	5	14.7	8	4.8	109	7.2
P. MIRABILIS	47	4.3	5	2.3	8	23.5	4	2.4	64	4.2
PSEUD. UNSP.	17	1.6	3	1.4	5	14.7	3	1.8	28	1.8
P. AERUGINOSA	88	8.0	18	8.3	-	-	11	6.5	117	7.7
S. AUREUS	212	19.4	93	42.7	3	8.8	66	39.3	374	24.7
S. EPIDERM.	52	4.7	4	1.8	1	2.9	16	9.5	73	4.8

ABBREVIATIONS: EXT. CARE, Extended Care;
H. INFLUEN-B, H. influenzae-B;
PSEUD. UNSP., Pseudomonas Unspecified
S. EPIDERM., S. epidermidis

Site-Pathogen Combinations

The more frequently reported pathogens for selected sites of infection are outlined in Figure 5. As expected, E. coli and enterococcus were the two most common pathogens responsible for urinary tract infections.

S. aureus was the most common pathogen associated with wound infections.

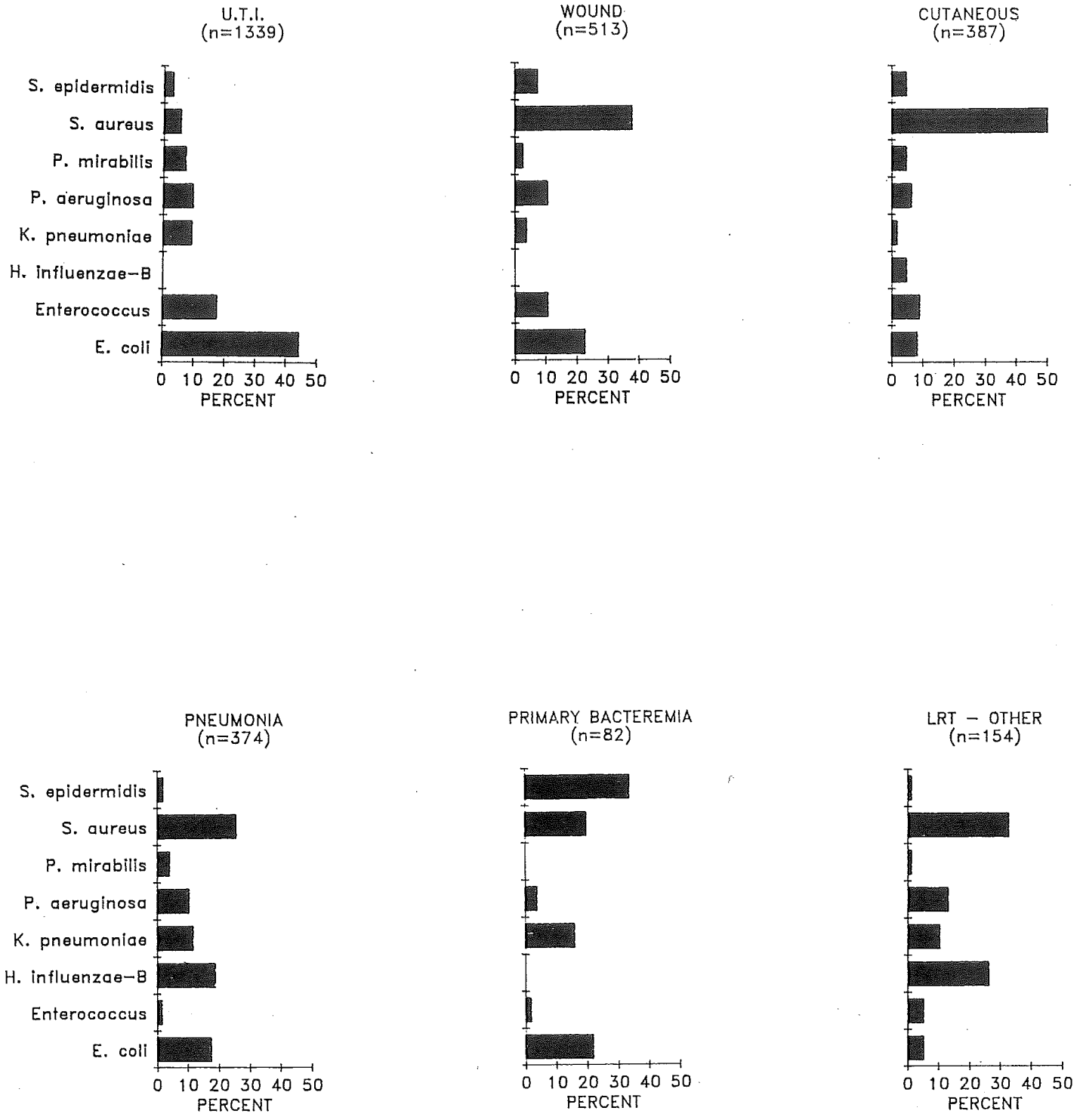

Figure 5. Percentage distribution of nosocomial infections by pathogen at the major sites of infection

ABBREVIATIONS: U.T.I., urinary tract infection; LRT - OTHER, lower respiratory tract - other

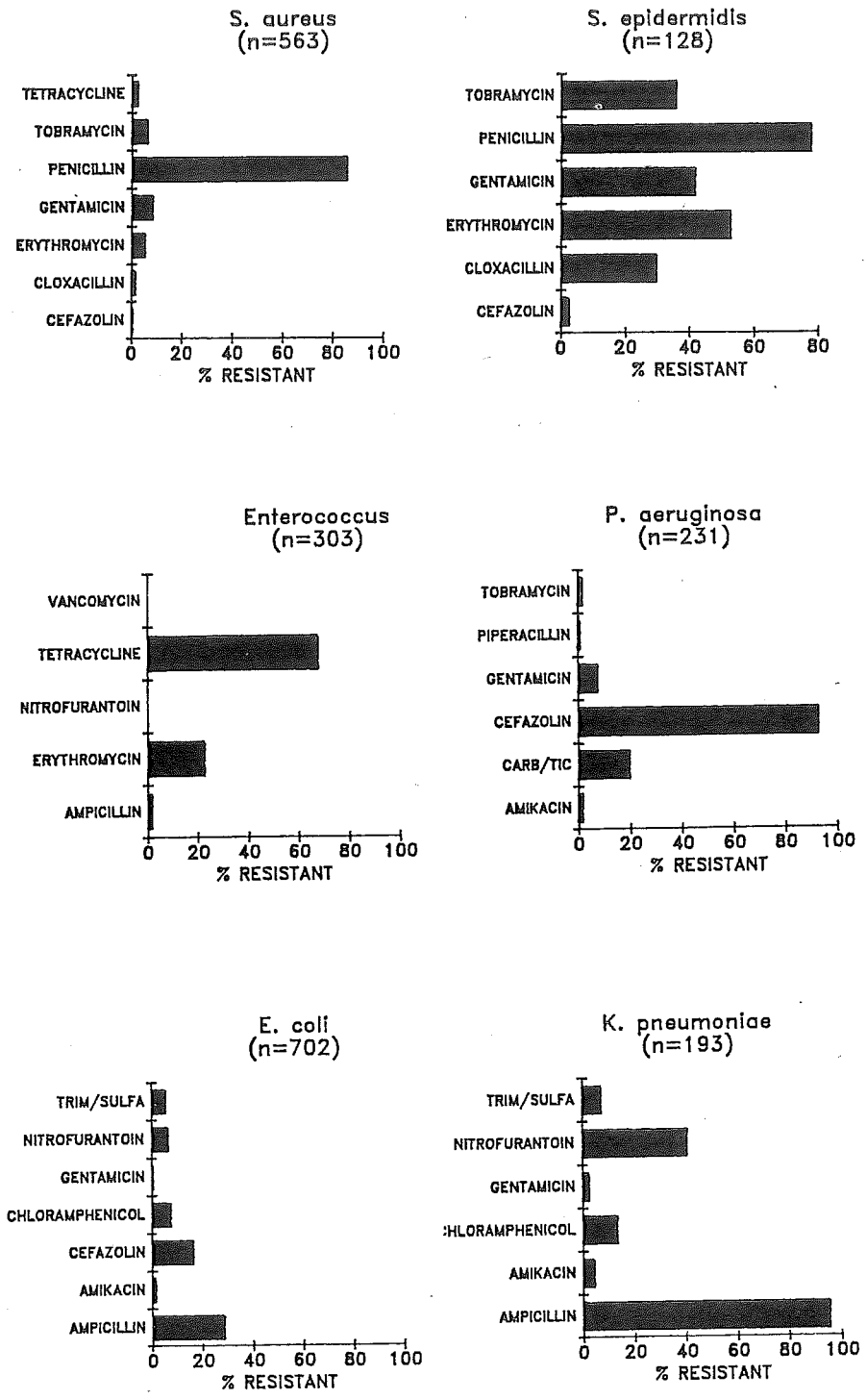

Figure 6. Sensitivity profiles of common bacterial isolates from nosocomial infections to selected antimicrobial agents

ABBREVIATIONS: CARB/TIC, carbenicillin/ticarcillin; TRIM/SULFA, trimethoprim/sulfamethoxazole

While S. aureus was reported as the most common pathogen associated with pneumonia, in all likelihood, this is an artifact. The frequent reporting of this organism more accurately reflects the frequency with which it colonizes the respiratory tract rather than actual infections.

Sensitivity Profiles

The sensitivity profiles of the more common pathogens to selected antimicrobial agents are summarized in Figure 6. It is noteworthy that 29% of the E. coli were resistant to ampicillin. This should be considered when prescribing empirical therapy for the treatment of hospital-acquired urinary tract infections.

The sensitivity profile of P. aeruginosa is of interest because such a low proportion of isolates were resistant to the aminoglycosides. The trend in resistance to gentamicin and tobramycin observed in other centres is not evident in the results obtained thus far.

The frequency with which S. aureus was reported to be resistant to cloxacillin or methicillin is still low. However, it is being isolated.

Coagulase-negative staphylococci are resistant to a wide variety of antimicrobial agents. Cefazolin was the only agent which was consistently reported as being active against this organism. The number of isolates tested against vancomycin was too small to report.

Antibiotic Use

It was possible to determine antibiotic use prior to first infection in 2089 patients. Antibiotics were used in 381 or 26% of the patients prior to the onset of the hospital-acquired infection. In 21% of the patients where an antibiotic was used prior to an infection, a previous infection was reported as being present. It is probable that the antibiotics were being used to treat the community-acquired infection.

In the remaining patients who did receive antibiotics prior to infection, the reason could not be determined. Possibly the antibiotics were being used as a means of prophylaxis or for the treatment of some other infection which was not reported. This latter possibility is less likely than the former.

MULTIPLE INFECTIONS

The sites of the first infection in patients who acquired more than one infection are summarized in Figure 7. For comparison, the same attribute of the patients who acquired only one infection is included. It should be noted that 105 patients who had multiple infections were not included since their first infection occurred prior to the study period.

The proportion of patients in the multiple infection group acquiring a pneumonia or a lower respiratory infection was greater (20%) than it was in the single infection group (13%). The difference in distribution was significant ($p<.001$).

Individuals who acquired multiple infections were more likely to have acute and chronic co-existing conditions than were the individuals who acquired only one infection. Conditions in the treatment category, specifically 'respiratory' and 'other', were also more common in the multiple infection group. These findings are not surprising. Individuals with conditions in the acute, chronic, and treatment categories all have altered defense mechanisms which could predispose them to infection.

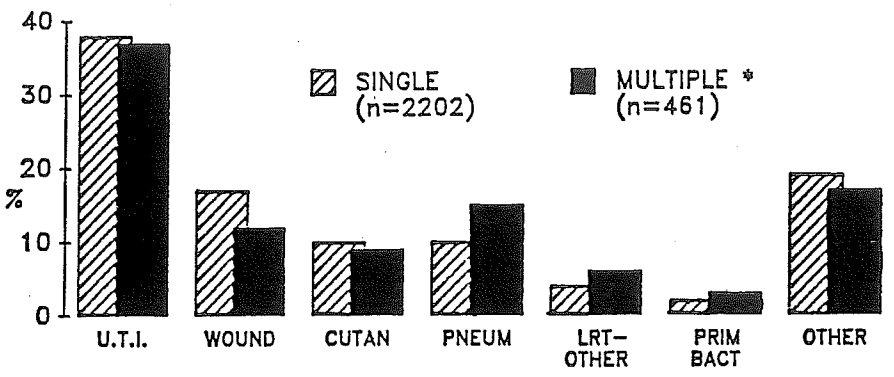

Figure 7. Percentage distribution of selected sites of nosocomial infections in patients that acquired single or multiple infections

* Only the first infection is included in the analysis

ABBREVIATIONS: U.T.I., urinary tract infection; CUTAN, cutaneous; PNEUM, pneumonia; LRT-OTHER, lower respiratory tract - other; PRIM BACT, primary bacteremia

SPECIAL CARE UNITS

The distribution of the sites of infection in patients greater than 16 years of age and cared for in an ICU (medical, surgical, trauma or coronary care unit) is compared to similarly aged non-ICU patients in Figure 8. The percentage distribution is significantly different ($p<.0001$). Pneumonia and primary bacteremia were relatively more frequent in the ICU patients.

Most likely, a variety of factors such as severity of underlying illness, co-existing conditions, and the performance of invasive procedures contributed to establishing the difference. While the contribution of each factor cannot

be determined, it should be noted that acute co-existing conditions were reported more frequently in the ICU group (62%) than in the 'ward' group (35%) ($p<.0001$). Similarly, with the exception of uncomplicated coronary care patients, invasive procedures/devices are commonplace in an intensive care unit. Procedures/devices were reported more frequently in the ICU-acquired infections (82%) than non-ICU acquired infections (55%) ($p<.0001$). This difference remained even when the site of infection was controlled. For example, respiratory 'specific treatment' conditions were reported more frequently in the ICU-acquired pneumonias and other lower respiratory infections (83%) than in the non-ICU acquired infections (47%) ($p<.0001$).

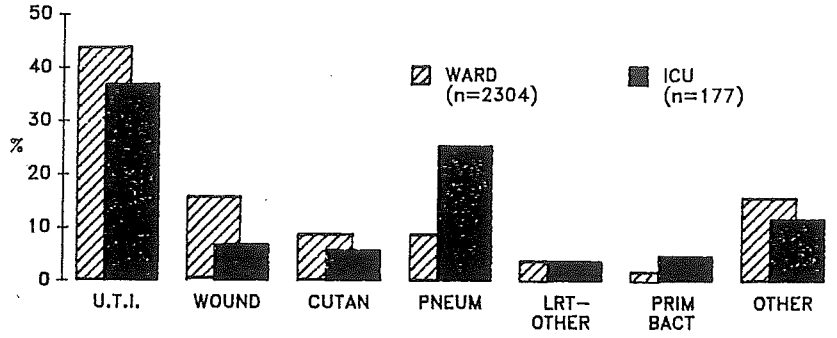

Figure 8. Percentage distribution of selected sites of nosocomial infections in patients > 16 years of age and cared for either in the intensive care unit or on the ward

ABBREVIATIONS: U.T.I., urinary tract infection; CUTAN, cutaneous; PNEUM, pneumonia; LRT-OTHER, lower respiratory tract - other; PRIM BACT, primary bacteremia

The sites of infection in the pediatric population were also compared by ICU status (Figure 9). All the patients were 16 years of age or less. The ICU patients were divided into two groups, those less than or equal to 6 months and those greater than 6 months of age. Even though the severity of underlying illness, as reflected by the frequency of reporting acute, chronic, and 'treatment' conditions, was greater in the ICU population, the percentage distribution of the infection sites was not altered by ICU status.

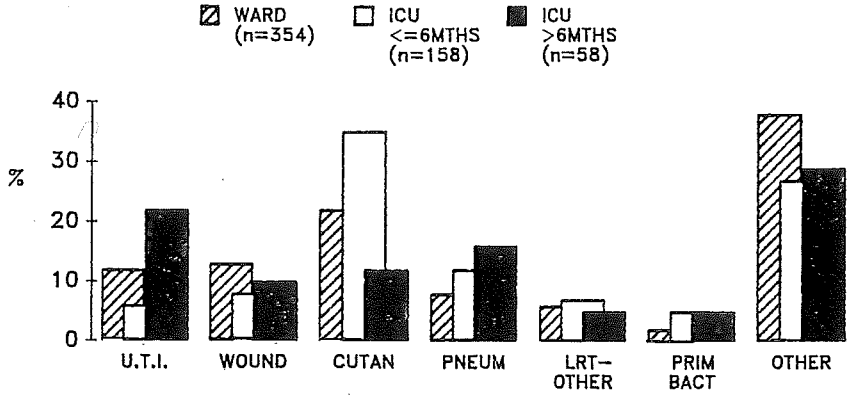

Figure 9. Percentage distribution of selected sites of nosocomial infections in patients <= 16 years of age and cared for either in the intensive care unit or on the ward

ABBREVIATIONS: U.T.I., urinary tract infection; CUTAN, cutaneous; PNEUM, pneumonia; LRT-OTHER, lower respiratory tract - other; PRIM BACT, primary bacteremia

SECONDARY BACTEREMIA

Secondary bacteremia (which was defined as the concurrent isolation of a pathogen from the blood and another site of infection) was reported in 4% of the infections, which is slightly lower than the 5% reported by NNIS in 1983. It should be noted that the proportion of infections in which secondary bacteremia was reported as present is highly dependent on the population considered to be at risk. Considering the population at risk to be only those patients with infections where a blood culture was obtained, the percentage increased to 5%. When the population at risk was the number of patients with infections that were cultured, the percentage increased to 16%.

Characteristics such as site of primary infection, presence of acute conditions, and the presence of invasive devices are summarized for the cultured and non-cultured patients in Figures 10, 11 and 12.

Obtaining a blood culture was, in part, dependent on the primary site of infection. Pneumonia was the only primary site of infection for which blood cultures were taken in the majority of cases (63%). The lowest rate of blood culturing was with cutaneous infections where 22% of such infections were cultured. This range is probably indicative of the perceived severity of the infection.

Symptomatic individuals were cultured more frequently than those who were asymptomatic (35% v. 20%, $p<.0001$) (Figure 11). Most of the blood cultures (92%) were taken from symptomatic patients (Figure 12).

The presence of acute co-existing conditions was also associated with obtaining blood cultures. Surprisingly, those patients who had chronic co-existing conditions were cultured less frequently than those who did not have chronic co-exisiting conditions reported.

Blood cultures were obtained more frequently from individuals in whom invasive devices were present compared to those without such devices (37% v. 29%) ($p<.0001$). Individuals with 'respiratory', 'urinary', 'IV', and 'other' treatment conditions were all cultured more frequently than those who did not have such conditions.

Infections which were identified while the patient was in an ICU were cultured more frequently (58%) than those that were identified while the patient was on the regular wards (31%) ($p<.0001$).

From these comparisons it appears that the selection of infections or patients for culturing was not a random process. In general, it seems that the patients who were cultured were perceived as having a more serious infection or underlying illness.

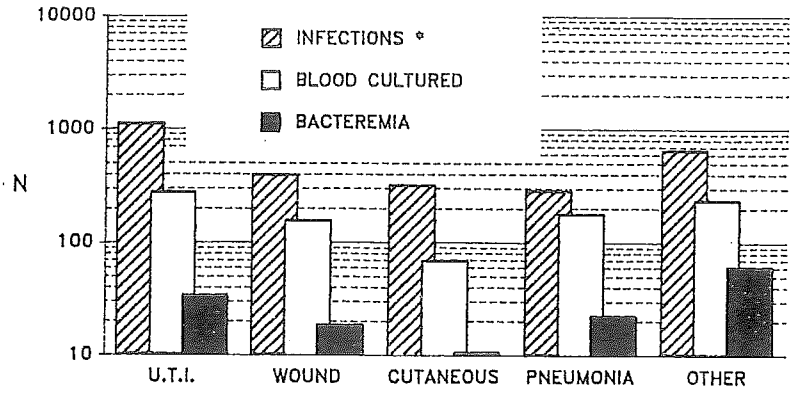

Figure 10. Number of nosocomial infections at selected sites where blood cultures were obtained and secondary bacteremia was reported. Note the semi-logarithmic scale on the vertical axis.

* Only those infections where information on culturing was available are included

ABBREVIATIONS: U.T.I., urinary tract infection

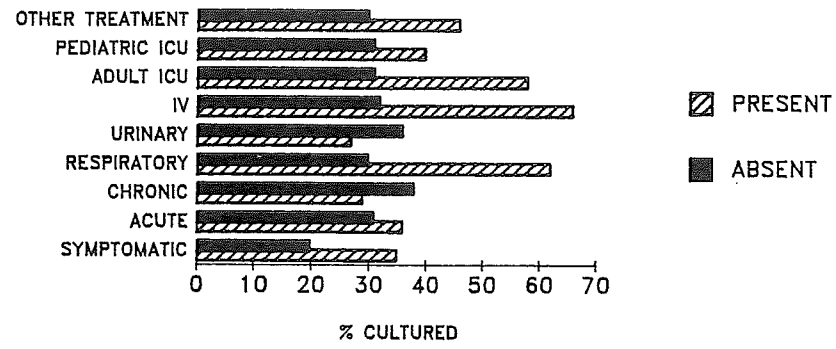

Figure 11. Percent distribution of nosocomial infections that were blood cultured in the presence or absence of selected characteristics

* Note : IV, URINARY, RESPIRATORY, CHRONIC, ACUTE and OTHER TREATMENT refer to co-existing conditions and categories

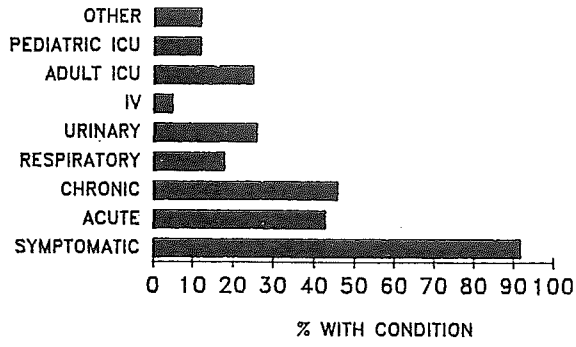

Figure 12. Percent of blood cultured nosocomial infections where selected co-existing conditions were present

* Note : IV, URINARY, RESPIRATORY, CHRONIC, ACUTE and OTHER TREATMENT refer to co-existing conditions and categories

Given that culturing blood is an appropriate procedure in the investigation of an infection, it is surprising that it was so infrequently reported. Even with what could be considered a most serious combination (pneumonia in an ICU patient) and where determining the most likely pathogen is difficult, blood was cultured in only 70% of the instances.

DISCUSSION

This is the first summary of the data which have been collected by CNISP. Given the similarites in the practice of medicine, it is understandable that the results are similar to other multicentre surveillance programs. This similarity suggests that the CNISP methods are comparable to the methods used elsewhere.

Interpretation of the results would be markedly simplified if the hospitals used a uniform approach to surveillance. Given the SENIC Project's findings, it is probable that hospitals will start to adopt more uniform methods.

As this is the first summary, it is impossible to state whether changes have occurred over time in terms of pathogens or patient profiles. These, however, will be reviewed in subsequent summaries.

Even though the program is still very new, it is in the process of evolution. Efforts are currently underway to develop a software program which hospitals will be able to use without direct input from the Bureau. When this is developed, the size of the sample will be increased.

When increasing the sample size, efforts will be made to increase the number of chronic care, pediatric, and small hospitals to allow for the pooling of results and intrahospital comparisons.

The sensitivity and specificity of the surveillance will be examined. Prevalence studies have been conducted and will be continued to assist in the development of the sensitivity index.

The emphasis of the program will be undergoing modifications. The current activity of obtaining information on only those patients who are infected will decrease in importance as long as the similarity of results between this and other programs exist. It is hoped that multicentre trials capable of looking at specific problems can be established. The goal of such activity would be to either determine risk factors associated with infection or to determine the efficacy of specific control activities.

APPENDIX

Government of Canada / Gouvernement du Canada

CANADIAN NOSOCOMIAL INFECTION SURVEILLANCE REPORT

No.

A. ADDRESSOGRAPH

HOSPITAL

4. DATE OF BIRTH M D Y 5. SEX M F

6. INFECTION 1 2 3 Other

B.

1. ADMISSION DATE M D Y
2. INFECTION DATE
3. DISCHARGE DATE
4. UNIT
5. SERVICE

C.

1. ISOLATION: NO DATA 1; NOT IN ISOLATION 2
   - 3 Strict Isol.
   - 4 Respiratory Isol.
   - 5 Protective Prec.
   - 6 Contact
   - 7 Enteric
   - 8 Blood/Body Fluid
   - 9 Other
2. PRI. DX
3. SEC DX
4. STAFF MD
5. CONSULT MDS
6. SURGERY DATE: 1 M D Y 2 M D Y
7. PROCEDURE
8. OR SUITE
9. CLASSIFICATION: 1 Clean; 2 C. Cont.; 3 Cont.; 4 Dirty; 5 Not class.; 6 N.A.

D. ACUTE PREDISPOSING FACTORS:

01 NO DATA 02 NO FACTORS

03 Liver; 04 Neuro; 05 Pulm.; 06 Renal; 07 Prev. Inf.; 08 Gran < .5 × 10^9/L; 09 Labor > 24 hours; 10 R.O.M. > 24 hours; 11 WBC < 1.5 × 10^9/L; 12 Other

E. CANCER PREDISPOSING FACTORS:

01 NO DATA 02 NO FACTORS

03 A.L.L.; 04 A.N.L.L.; 05 Chron. Leuk.; 06 Hodgkins; 07 Lung; 08 Mult. Myel.; 09 Non-Hodgkins; 10 Other

F. CHRONIC PREDISPOSING FACTORS:

01 NO DATA 02 NO FACTORS

03 Alcohol Abuse; 04 Diabetes Mell.; 05 Drug; 06 Immunodef.; 07 WBC < 1.5 × 10^9/L; 08 Malnour; 09 Neuro; 10 Obese; 11 Prosth.; 12 Pulm.; 13 Renal; 14 U.T.I.; 15 Vasc.; 16 Liver; 17 Skin; 18 Other

G. INFECTION TYPE:

1 Community; 2 Nosocomial; 3 Trans.; 4 Readmit.; 5 Surg. Rel.; 6 Proc. Rel.

H. INFECTION SITE:

01 U.T.I.; 02 U.T. Other; 03 Wound; 04 U.R.T.-Diffuse; 05 U.R.T.-Other; 06 Pneumonia; 07 L.R.T.-Other; 09 Gastro.; 09 G.I.T.; 10 Nec; 11 Burn; 12 Cutaneous; 13 Gyne; 14 Oba.; 15 M.S.; 16 C.N.S.; 17 Vein; 18 C.V.; 19 1° Blood; 20 Site not localized; 21 Other

Comment:

2° BACTEREMIA PRESENT: 1 Y; 2 N; 3 ND; 4 NO BLOOD CULTURE

I. INFECTION SIGNS AND SYMPTONS:

01 NO DATA 02 ASYMPTOMATIC 03 OTHER

GENERAL: 04 Chills; 05 Dr's OX; 06 Fever; 07 Inflamm.; 08 Pus; 09 WBC > 4 × 10^9/L

RESPIRATORY: 10 Cough; 11 Chest X-Ray; 12 Signs; 13 Sputum

URINARY: 14 Dysuria/Frequency/Urgency; 15 Flank Pain/CVA/S.P./Tender; 16 Hematuria; 17 Pyuria

NEONATES: 18 Alter. Resp.; 19 Diarrhea; 20 Poor Feed; 21 WBC < 4 × 10^9/L

GI: 22 Diarrhea

J. TREATMENT PREDISPOSING FACTORS:

01 NO DATA 02 NO FACTORS

RESPIRATORY: 03 Endo. Tube; 04 I.P.P.B.; 05 Resp. Ass.; 06 Trach.; 07 Chest Tube

URINARY: 08 Cont. Bladder Irrg.; 09 Indwelling; 10 Ileo Conduit; 11 Instrumentation; 12 Straight Cath. of Bladder; 13 Subrapubic Cath.

IV: 14 Art. Cannula; 15 Central Line; 16 Cut Down; 17 Exchange Trans; 18 Hédann Lock; 19 Steel Needle; 20 Silastic Cath.; 21 Teflon Cath.; 22 T.P.N.

OB: 23 Int. Mont.

OTHER: 24 Anti Cancer Chemo.; 25 Drain; 26 Emerg. RM RX; 27 Hemodialysis; 28 Immunosup. RX; 29 ICU — RX; 30 Intracranial Pressure Screw; 31 Intracranial Shunt; 32 Peritoneal Dialysis; 33 Vas. Pros.; 34 Wound Foreign Body; 35 Other

DATE TREATMENT INSTITUTED: 36 M D Y

TB/CT REG. 314079

CANADIAN NOSOCOMIAL INFECTION SURVEILLANCE REPORT

No.

K. ANTIBIOTIC THERAPY AND ANTIBIOGRAM: ☐ NO DATA ☐ NO THERAPY		PRIOR TO INFECTION	CURRENT					
AMIKACIN	01							
AMPICILLIN/AMOXICILLIN	02							
CARB/TIC	03							
CEFAMANDOL	04							
CEFAZOLIN (CEPHALOSPORIN)	05							
CEFOPERAZONE	06							
CEFOTAXIME	07							
CEFOXITIN	08							
CHLORAMPHENICOL	09							
CLINDAMYCIN	10							
CLOXACILLIN (METHICILLIN)	11							
ERYTHROMYCIN	12							
GENTAMICIN	13							
KANAMYCIN	14							
METRONIDAZOLE	15							
MOXALACTAM	16							
NALIDIXIC ACID	17							
NETILMICIN	18							
NITROFURANTOIN	19							
PENICILLIN	20							
PIPERACILLIN	21							
RIFAMPIN	22							
SULFISOXAZOLE	23							
TETRACYCLIN	24							
TOBRAMYCIN	25							
TRIMETHOPRIM	26							
TRIM-SULFA	27							
VANCOMYCIN	28							

L. VIRAL DX: 1 ☐ Y 2 ☐ N 3 ☐ ND

IF YES, SPECIFY _____ 4 ☐☐☐☐

5 ☐ Culture 6 ☐ Serology 7 ☐ EM 8 ☐ Other

M. CULTURE:

1 ☐ Y 2 ☐ N 3 ☐ ND 4 ☐ NEG. 5 ☐ RESULTS NOT AVAILABLE

SITE CULTURED: _____ 6 ☐☐☐

DATE OF CULTURE: 7 M ☐☐ D ☐☐ Y ☐☐

N. OUTCOME:

1 ☐ No Data
2 ☐ Infection Resolved
3 ☐ Acquired another infection
4 ☐ Follow-up discontinued
5 ☐ Discharged
6 ☐ Transferred
7 ☐ Death

FILLED BY

DATE