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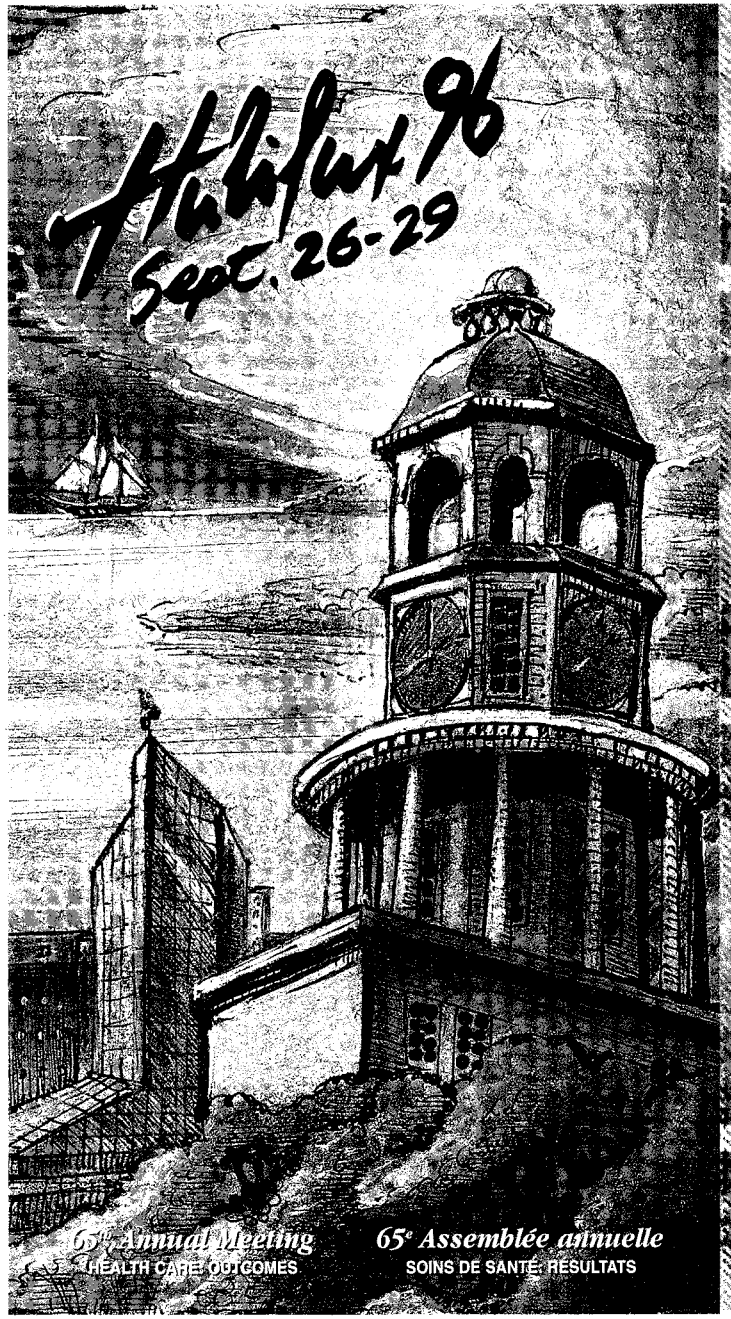

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146
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Comparison of ICU Antibiotic Use and Costs In Pneumonia Admissions in Two Urban Centres

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Abstract

We compared the ICU use of 19 antibacterial agents in different cities over an 11 month period. Hospital A (HospA) has a 12 bed combined ICU and Hospital B (HospB) has separate 10 bed medical and surgical units. HospB has a dedicated satellite pharmacy with pharmacists rounding daily. Both hospitals use computerized databases to collect pharmaceutical administration data on a per admission basis. HospA had complete pharmacy records on 901 admissions (mean APACHE 16.0 ± 8.4; 3103.3 ICU days) while HospB had complete records for 951 admissions (19.1 ± 8.2; 4038.5 days). A common cost list was used (average of reported costs at each hospital).

	Cost ($) per ICU day		% Admissions receiving	
	HospA	HospB	HospA	HospB
Imipenem	$9.15	$2.65	8%	3%
3rd Gen Cephalosporin	$9.33	$5.06	17%	11%
Cefuroxime	$0.89	$3.25	5%	20%
Clindamycin	$1.92	$1.89	6%	6%
Cefazolin	$1.16	$0.82	39%	25%
ALL ANTIBIOTICS	$39.99	$23.55		

Antibiotic costs were substantially less at HospB despite higher average APACHE II scores at this hospital. Much of the increased cost at HospA was due to imipenem and third generation cephalosporin use. This data suggests that antibiotic usage and costs differ between these two hospitals. It is possible that the organizational structure of HospB might account for some of the cost differences.

PURPOSE

To compare the use and costs of intravenous antibiotic administration in the intensive care units of two Canadian hospitals in different cities from March 1, 1994-Feb 1, 1995.

DATA COLLECTION

Demographic, length of stay, APACHE II score, TISS score, and diagnostic information were prospectively collected and entered in computerized ICU management databases at both hospitals. *(Critical Care Manager, TMS Inc, Chelmsford, Ontario)*
Both hospitals collect individual information on the medications administered to each patient, including total dose given, and cost of each medication.

HOSPITAL DESCRIPTIONS

HOSPITAL A
•12 bed combined medical/surgical ICU.
•No daily pharmacist involvement on rounds.
•No restrictive policies regarding ordering of antibiotics.

HOSPITAL B
• Separate 10 bed medical and 10 bed surgical ICU's.
•Satellite pharmacy located in proximity to ICU.
•Daily involvement by pharmacist on rounds.
•Ordering of Imipenem, Third generation cephalosporins, and intravenous Ciprofloxacin only after approval by infectious disease service.

METHODS

•Pharmacy lists used at each hospital were compared and intravenous antibacterial antibiotics examined. All agents in use at both hospitals were included.

•The use of these agents was compared by noting the total amount (in milligrams or grams) administered to all admisions during the study period, and the total number of admissions receiving any amount of these medications.

•Average unit dose cost was calculated as follows:

Average unit dose cost($)= $\frac{\text{Cost @ Hospital A + Cost @ Hospital B}}{2}$

(Agents used at a single hospital were assigned the unit cost used at that hospital.)

•Total costs = Average cost per dose x total dose
•All costs were normalized to an ICU day by dividing Total cost by length of ICU admission for all admissions.

•The following groups were compared:

1. All ICU admissions
2. Diagnosis of pneumonia
3. Diagnosis of septic shock.
4. Trauma admissions.

•All data with ranges are means±SD, all costs in 1995 Canadian dollars.

Primary Admission Diagnoses

		Hospital A		Hospital B		
		Incidence	% Total	Incidence	% Total	% Grand Tot
1	Coronary Bypass Graft	239	26.2	170	14.1	19.4
2	Cardiac Arrest	45	4.9	88	7.3	6.3
3	Congestive Heart Failure	34	3.7	68	5.7	4.8
4	Pneumonia	32	3.5	62	5.2	4.5
5	Craniotomy	56	6.2	22	1.8	3.7
6	Septic Shock	23	2.5	44	3.7	3.2
7	Abdominal Aortic Aneurysm Repair	24	2.6	43	3.6	3.2
8	Upper GI Bleed	25	2.7	23	1.9	2.3
9	Cardiogenic Shock	14	1.5	31	2.6	2.1
10	Chronic Obstructive Lung Disease	19	2.1	17	1.4	1.7
11	Bowel Resection	19	2.1	15	1.3	1.6
12	Aortic Valve Repair or Replacement	7	0.8	26	2.2	1.6
13	Post-op Respiratory Failure	7	0.8	22	1.8	1.4
14	Subarachnoid Hemorrhage	4	0.4	19	1.6	1.1
15	Head Injury - other bleeds, non post-op	2	0.2	20	1.7	1.0
	Total Percent		55.7		60.4	57.7

DEMOGRAPHICS FOR SEPTIC SHOCK DIAGNOSIS

	Hospital A	Hospital B	t test result
Admissions	30	87	
Mean age (years)	64.4±15.3	59.7±19.2	NS
Mean APACHE score	28.3±9.1	24.9±8.8	NS
Mean length of stay (days)	7.1±11.0	8.6±9.0	NS
Mean TISS score	37.5±10.3	40.2±9.9	NS
Total ICU stay (days)	212	745	

DEMOGRAPHICS FOR TRAUMA DIAGNOSIS

	Hospital A	Hospital B	t test results
Admissions	29	166	
Mean age (years)	50.2±23.9	44.8±21.3	NS
Mean APACHE score	11.3±6.5	17.1±6.8	p<0.001
Mean length of stay (days)	4.4±7.3	6.4±8.1	NS
Mean TISS score	27.0±11.7	32.6±11.0	p<0.05
Total ICU stay (days)	129	1051	

RESULTS

DEMOGRAPHICS FOR ALL ADMISSIONS

	Hospital A	Hospital B	t test result
Total admissions (number)	911	1203	
Mean age (years)	64.0±16.1	58.2±18.4	p< 0.001
Mean APACHE score	16.0±8.4	19.3±8.2	p< 0.001
Mean length of stay (days)	3.5±4.9	4.3±7.1	NS
Mean TISS score	34.8±13.0	34.9±12.5	NS
Complete pharmacy data	906	1181	
Total ICU stay (days)	3157.2	3060.2	

DEMOGRAPHICS FOR PNEUMONIA DIAGNOSIS

	Hospital A	Hospital B	t test result
Admissions	89	189	
Mean age (years)	69.4±13.0	58.6±18.1	p<0.05
Mean APACHE score	21.8±8.0	22.2±7.4	NS
Mean length of stay (days)	8.5±7.6	9.4±10.8	NS
Mean TISS score	32.2±11.5	34.7±12.3	NS
Total ICU stay (days)	739	1786	

ANTIBIOTIC ADMINISRATION AND COSTS PER DAY FOR ALL ADMISSIONS

	Cost per Day ($)		Percentage receiving drug		
ANTIBIOTIC NAME	HOSPITAL A	HOSPITAL B	HOSPITAL A	HOSPITAL B	p value
Ampicillin	$0.10	$0.13	3.5%	6.6%	0.0016
Cefazolin	$1.06	$0.99	38.4%	34.4%	NS
Cefotaxime	$0.00	$0.39	0.0%	8.7%	
Ceftazidime	$1.87	$2.23	3.6%	4.7%	NS
Ceftriaxone	$7.68	$3.61	13.1%	0.2%	
Third Gen Cephalosporins	$9.55	$6.23	16.7%	13.6%	0.05
Cefoxitin	$0.34	$0.05	2.3%	4.1%	0.02
Cefuroxime	$0.87	$4.06	5.0%	24.6%	<0.00001
Ciprofloxacin	$2.86	$1.80	3.2%	3.0%	NS
Cladamycin	$1.40	$1.65	5.6%	8.0%	0.03
Cloxacillin	$0.11	$0.21	2.1%	4.0%	0.01
Erythromycin	$0.64	$0.65	5.1%	5.1%	NS
Gentamycin	$1.30	$2.10	9.9%	14.1%	0.004
Imipenem	$9.98	$3.71	8.6%	4.4%	0.0001
Metronidazole	$0.46	$0.46	9.8%	12.0%	NS
Penicillin	$0.07	$0.07	1.3%	2.3%	NS
Piperacillin	$0.00	$2.12	0.0%	3.8%	0.002
Ticarcillin	$2.26	$0.00	6.8%	0.0%	
Vancomycin	$4.23	$2.41	14.7%	9.5%	0.0002
Total cost	$35.25	$36.44			

ANTIBIOTIC ADMINISTRATION AND COSTS PER DAY FOR ADMISSIONS DIAGNOSED WITH SEPTIC SHOCK

	Cost per Day ($)		Percentage receiving drug		
ANTIBIOTIC NAME	HOSPITAL A	HOSPITAL B	HOSPITAL A	HOSPITAL B	p value
Ampicillin	$0.10	$0.30	10.0%	24.1%	NS
Cefazolin	$0.00	$0.14	0.0%	4.6%	
Cefotaxime	$0.00	$5.02	0.0%	37.9%	
Ceftazidime	$6.47	$4.35	26.7%	21.8%	NS
Ceftriaxone	$1.28	$0.00	16.7%	0.0%	
All Third Gen Cephalosporins	$7.75	$9.37	43.3%	59.8%	NS
Cefoxitin	$0.00	$0.53	0.0%	3.4%	
Cefuroxime	$0.00	$2.04	0.0%	17.2%	
Ciprofloxacin	$7.77	$3.77	13.3%	14.9%	NS
Cladamycin	$1.68	$1.71	20.0%	16.1%	NS
Cloxacillin	$0.12	$0.09	3.3%	3.4%	NS
Erythromycin	$0.24	$0.91	6.7%	13.8%	NS
Gentamycin	$3.06	$4.03	46.7%	40.2%	NS
Imipenem	$19.48	$13.10	40.0%	29.9%	NS
Metronidazole	$1.18	$1.12	26.7%	44.8%	NS
Penicillin	$0.28	$0.07	3.3%	3.4%	NS
Piperacillin	$0.00	$2.65	0.0%	11.5%	0.007
Ticarcillin	$6.07	$0.00	33.3%	0.0%	
Vancomycin	$9.35	$4.31	46.7%	31.0%	NS
Total cost	$57.07	$44.14			

ANTIBIOTIC ADMINISTRATION AND COSTS PER DAY FOR ADMISSIONS DIAGNOSED WITH TRAUMA

	Cost per Day ($)		Percentage receiving drug		
ANTIBIOTIC NAME	HOSPITAL A	HOSPITAL B	HOSPITAL A	HOSPITAL B	p value
Ampicillin	$0.00	$0.16	0.0%	8.9%	
Cefazolin	$1.23	$1.40	37.9%	46.6%	NS
Cefotaxime	$0.00	$3.13	0.0%	9.2%	
Ceftazidime	$1.31	$2.08	3.4%	9.2%	NS
Ceftriaxone	$5.01	$0.23	10.3%	0.6%	NS
All Third Gen Cephalosporins	$6.32	$6.44	13.8%	19.0%	NS
Cefoxitin	$0.40	$0.33	3.4%	7.4%	NS
Cefuroxime	$0.82	$4.40	6.9%	34.4%	0.002
Ciprofloxacin	$0.00	$1.84	0.0%	3.1%	
Cladamycin	$2.35	$1.21	10.3%	9.2%	NS
Cloxacillin	$0.08	$0.23	3.4%	6.1%	NS
Erythromycin	$0.06	$0.02	6.9%	0.6%	0.001
Gentamycin	$0.62	$3.57	13.8%	25.2%	NS
Imipenem	$8.80	$3.22	6.9%	3.7%	NS
Metronidazole	$0.08	$0.48	6.9%	14.7%	NS
Penicillin	$0.01	$0.03	3.4%	2.5%	NS
Piperacillin	$0.00	$2.96	0.0%	4.9%	NS
Ticarcillin	$2.93	$0.00	6.9%	0.0%	
Vancomycin	$3.03	$3.28	13.8%	10.4%	NS
Total cost	$28.74	$29.54			

ANTIBIOTIC ADMINISTRATION AND COSTS PER DAY FOR ADMISSIONS DIAGNOSED WITH PNEUMONIA

	Cost per Day ($)		Percentage receiving drug		
ANTIBIOTIC NAME	HOSPITAL A	HOSPITAL B	HOSPITAL A	HOSPITAL B	p value
Ampicillin	$0.21	$0.14	13.5%	12.2%	NS
Cefazolin	$0.20	$0.24	12.4%	14.3%	NS
Cefotaxime	$0.00	$4.05	0.0%	22.2%	
Ceftazidime	$3.47	$2.68	15.7%	14.3%	NS
Ceftriaxone	$13.03	$0.00	42.7%	0.0%	
All Third Gen Cephalosporins	$16.50	$6.73	58.4%	36.5%	0.0007
Cefoxitin	$0.11	$0.12	2.2%	3.2%	NS
Cefuroxime	$0.00	$5.56	14.6%	86.1%	<0.00001
Ciprofloxacin	$1.55	$3.07	5.6%	7.9%	NS
Cladamycin	$2.96	$2.77	23.6%	22.2%	NS
Cloxacillin	$0.05	$0.25	3.4%	6.9%	NS
Erythromycin	$1.42	$1.22	24.7%	20.6%	NS
Gentamycin	$1.63	$2.45	25.8%	29.6%	NS
Imipenem	$18.62	$2.87	31.5%	6.3%	<0.00001
Metronidazole	$0.41	$0.49	16.9%	24.3%	NS
Penicillin	$0.23	$0.08	5.6%	6.3%	NS
Piperacillin	$0.00	$2.26	0.0%	9.5%	NS
Ticarcillin	$1.60	$0.00	14.6%	0.0%	
Vancomycin	$3.89	$2.48	28.1%	16.4%	0.03
Total cost	$49.39	$30.75			

BREAKDOWN OF TOTAL PHARMACY COSTS , AND PERCENTAGE OF TOTAL PHARMACY COSTS OF DIFFERENT DRUG CLASSES AT EACH HOSPITAL

	HOSPITAL A	HOSPITAL B
Total Pharmacy costs ($)	258,181	436,555
Total agents entered in database	98	86
ANTIBACTERIAL ANTIBIOTICS (%)	47%	31%
Vasoactive drugs (%)	28%	28%
Sedatives/Analgesics (%)	5%	7%
Neuromuscular blocker (%)	7%	6%
GI prophylaxis/motility (%)	4%	2%
TPN (%)	3%	9%
Other (%)	11%	22%

Costs were calculated using the drug list and unit costs for each of the two hospitals. Some drugs were followed at only one hospital. Some drug costs varied between institutions.

Vasoactive drugs include: inotropes, vasopressors, vasodilators, antihypertensives, etc

CONCLUSIONS

•Significant differences in antibiotic use were found between these hospitals in different Canadian cities.

• Cost per day for antibiotic administration was greater at Hospital A for all admissions, and for admissions diagnosed with Pneumonia or Septic shock.

• Increased antibiotic costs at Hospital A are related to more use of imipenem, Third generation cephalosporins, and Vancomycin at that centre.

• Antibiotic costs in patients diagnosed with Pneumonia were 1.6 times greater at Hospital A compared to Hospital B.

• Third generation cephalosporins (58%), Imipenem (31%), and Vancomycin (28%) were the most frequently used antibiotics for admissions diagnosed with pneumonia at Hospital A. At Hospital B these admissions usually received Cefuroxime (56%). Third generation cephalosporins were used in 36%, Vancomycin in 16%, and Imipenem in only 6% of pneumonia admissions at Hospital B.

• Hospital B had slightly higher antibiotic costs and higher mean APACHE II scores for Trauma admissions. Antibiotic costs for Trauma admissions were lower at both hospitals than costs for Pneumonia or Septic shock.

• We speculate that the presence of a pharmacist in ICU, and restrictive ordering policies for antibiotics in the ICU, might account for the differences in antibiotic use and costs between institutions. Additional data regarding endemic micro-organisms and sensitivities is needed to confirm this.