

Multi-resistant *Escherichia coli* from Urinary Tract Infection in the Western Pacific: Results from SENTRY Western Pacific Plus (WP+) 1998-2000

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Abstract

Background: *Escherichia coli* (ECOL) is the commonest isolate from urinary tract infections in hospitalised patients. There is evidence that these strains are accumulating substantial additional resistances with time. **Methods:** ECOL isolated from the urine of hospital patients were tested against more than 25 antimicrobials by broth microdilution. NCCLS methods and breakpoints were used where available. Multi-resistant strains were defined as possessing resistance to 4 or more of the following agents: ampicillin, amoxicillin-clavulanate, cefazolin, ceftriaxone, ceftiofur, imipenem, trimethoprim-sulfamethoxazole, ciprofloxacin, nitrofurantoin or gentamicin. Resistance to ceftriaxone plus cefazolin was counted as a single resistance. **Results:** 127 (17%) of 739 ECOL strains were multi-resistant, ranging from 0.7% in Australia to 59% in China. In some countries, presumptive ESBL-producers were quite prevalent (China, 33%; Singapore, 24%). Over 40% of ESBL producing ECOL also had possible AmpC resistance, with this phenotype accounting for over 10% of all urinary tract ECOL isolates from China and Singapore. The highest incidence of ceftiofur resistance among ESBL phenotypes was seen in the Philippines (75%). There were very high numbers of multi-resistant ECOL that were ciprofloxacin resistant, ranging from 40% in Taiwan to 100% in China. The vast majority of multi-resistant strains were susceptible to cefepime (87%) and imipenem (100%).

Conclusions: Multi-resistant ECOL is a significant problem in hospital-associated urinary infection in the WP+ region.

Introduction

Escherichia coli is the commonest cause of urinary tract infection in both the community and in hospitalised patients. Although resistance in *E. coli* is known to be common world-wide, there has been little attention paid to the accumulation of resistances in this pathogen. We examined strains from the SENTRY surveillance program in the Asia-Pacific region to determine the frequency of multi-drug resistance

References

- National Committee for Clinical Laboratory Standards. Methods for Dilution Antimicrobial Susceptibility Testing for Bacteria That Grow Aerobically, 4th Ed. Approved Standard M7-A4. National Committee for Clinical Laboratory Standards, Wayne, Pa.
- NCCLS. Performance standards for Antimicrobial Susceptibility Testing; 11th Informational Supplement. M100-S11. NCCLS 2001; Wayne, Pa

Methods

Isolates

Clinically significant urinary tract strains of *Escherichia coli* from the SENTRY surveillance program were collected by 17 different hospitals from eight countries or locales over defined intervals between April 1998 and December 2000. All strains were sent to a central reference laboratory (Women's and Children's Hospital, Adelaide, Australia) for testing.

Susceptibility testing

All isolates were tested against more than 25 antimicrobials by the broth microdilution method using commercially prepared trays (TREK™ Diagnostic Systems Limited, UK), according to NCCLS standards [NCCLS, 2001]. Breakpoints for resistance were those recommended by the NCCLS.

Definition of multi-resistance

Multi-resistant *E. coli* were defined as those strains demonstrating resistance to 4 or more of the following agents: ampicillin, amoxicillin-clavulanate, cefazolin, ceftriaxone, ceftiofur, imipenem, trimethoprim-sulfamethoxazole, ciprofloxacin, nitrofurantoin or gentamicin. Resistant to cefazolin plus ceftriaxone was counted as a single resistance.

Results

- 127 of 739 (17%) of strains were multi-resistant, ranging from 0.7% in Australia to 59% in mainland China. (Table 1)
- Extended-spectrum β-lactamase (ESBL) producing *E. coli* were prevalent in some locations: 33% in mainland China, 24% in Singapore.
- Over 40% of ESBL-producing also had possible *ampC*-mediated resistance (were also ceftiofur resistant). This phenotype accounted for over 12% of all urinary tract *E. coli* isolates in mainland China and Singapore
- The highest incidence of ESBL strains that were also ceftiofur resistant was seen in the Philippines (75%)
- Ciprofloxacin resistance was common in multi-resistant *E. coli*: 43% of Taiwanese strains and 100% of mainland Chinese strains
- The vast majority of multi-resistant strains were susceptible to cefepime (85%) and imipenem (100%)

Table 1. Frequencies of Occurrence of Bacterial Pathogens causing Urinary Tract Infections in Hospitalised Patients by Country

	Australia	Mainland China	Hong Kong	Japan	Philippines	South Africa	Singapore	Taiwan
<i>E. coli</i>	47.4	<i>E. coli</i> 36.7	<i>E. coli</i> 50.0	<i>E. coli</i> 21.4	<i>E. coli</i> 44.5	<i>E. coli</i> 41.0	<i>E. coli</i> 49.5	<i>E. coli</i> 40.4
<i>Klebsiella</i> spp.	11.2	<i>Enterococcus</i> spp. 13.3	<i>Klebsiella</i> spp. 14.7	<i>Enterococcus</i> spp. 19.4	<i>Klebsiella</i> spp. 22.7	<i>Enterococcus</i> spp. 13.0	<i>Klebsiella</i> spp. 14.9	<i>Klebsiella</i> spp. 14.1
<i>P. aeruginosa</i>	9.2	CoNS 11.7	<i>Enterococcus</i> spp. 9.3	<i>P. aeruginosa</i> 14.2	<i>P. aeruginosa</i> 7.7	<i>P. aeruginosa</i> 11.0	<i>P. aeruginosa</i> 5.9	<i>P. aeruginosa</i> 11.1
<i>Enterococcus</i> spp.	8.5	<i>Klebsiella</i> spp. 10.6	<i>P. aeruginosa</i> 7.3	<i>Klebsiella</i> spp. 11.4	<i>Enterobacter</i> spp. 5.3	<i>Acinetobacter</i> spp. 7.0	<i>Enterococcus</i> spp. 5.9	<i>Serratia</i> spp. 7.1
<i>Proteus</i> spp.	7.0	<i>Citrobacter</i> spp. 6.4	<i>Proteus</i> spp. 6.7	<i>S. aureus</i> 6.3	<i>Pseudomonas</i> spp. 4.9	<i>S. aureus</i> 6.0	<i>Enterobacter</i> spp. 5.0	<i>S. aureus</i> 5.1
<i>Enterobacter</i> spp.	5.1	<i>Enterobacter</i> spp. 6.4	<i>S. aureus</i> 4.7	<i>Enterobacter</i> spp. 5.1	<i>Proteus</i> spp. 3.6	<i>Proteus</i> spp. 6.0	<i>Acinetobacter</i> spp. 5.0	<i>Enterococcus</i> spp. 5.1
CoNS	2.7	<i>P. aeruginosa</i> 4.8	<i>Morganella</i> spp. 2.7	CoNS 5.1	<i>Serratia</i> spp. 2.4	<i>Klebsiella</i> spp. 6.0	<i>S. aureus</i> 4.0	<i>Morganella</i> spp. 4.0
<i>Citrobacter</i> spp.	2.2	<i>Acinetobacter</i> spp. 3.7	<i>Serratia</i> spp. 1.3	<i>Citrobacter</i> spp. 3.7	<i>Enterococcus</i> spp. 2.4	CoNS 2.0	<i>Proteus</i> spp. 4.0	CoNS 3.0
<i>Serratia</i> spp.	1.7	<i>Morganella</i> spp. 1.6	<i>Acinetobacter</i> spp. 1.3	<i>Streptococcus</i> spp. 3.2	<i>Morganella</i> spp. 2.0	<i>Enterobacter</i> spp. 2.0	<i>Citrobacter</i> spp. 3.0	<i>Proteus</i> spp. 3.0
<i>Streptococcus</i> sp.	1.7	<i>Pantoea</i> spp. 1.1	<i>Streptococcus</i> spp. 0.7	<i>Proteus</i> spp. 2.0	<i>Acinetobacter</i> spp. 1.6	<i>Vibrio</i> spp. 1.0	<i>Streptococcus</i> spp. 3.0	<i>Citrobacter</i> spp. 3.0

Table 2. Multi-drug Resistant *Escherichia coli* Phenotypes

Country	Total	ESBL ^a		Multi-Drug Resistant ^b			
		N	(%)	N (%)	ESBL (%)	AmpC (%)	
Australia	279	1	(0.4)	2	(0.7)	0	0
Hong Kong	75	10	(13.3)	30	(26.7)	9	(20.0)
Japan	75	8	(10.7)	6	(6.7)	1	(12.5)
Mainland China	69	23	(33.3)	41	(59.4)	22	(43.5)
Philippines	110	12	(10.9)	31	(28.2)	10	(75.0)
Singapore	50	12	(24.0)	19	(38.0)	12	(50.0)
South Africa	41	1	(2.4)	2	(4.9)	1	(100.0)
Taiwan	40	3	(7.5)	7	(17.5)	2	(33.3)
Region	739	70	(9.5)	127	(17.2)	57	(42.9)

Table 3. Multi-drug Resistant *Escherichia coli*

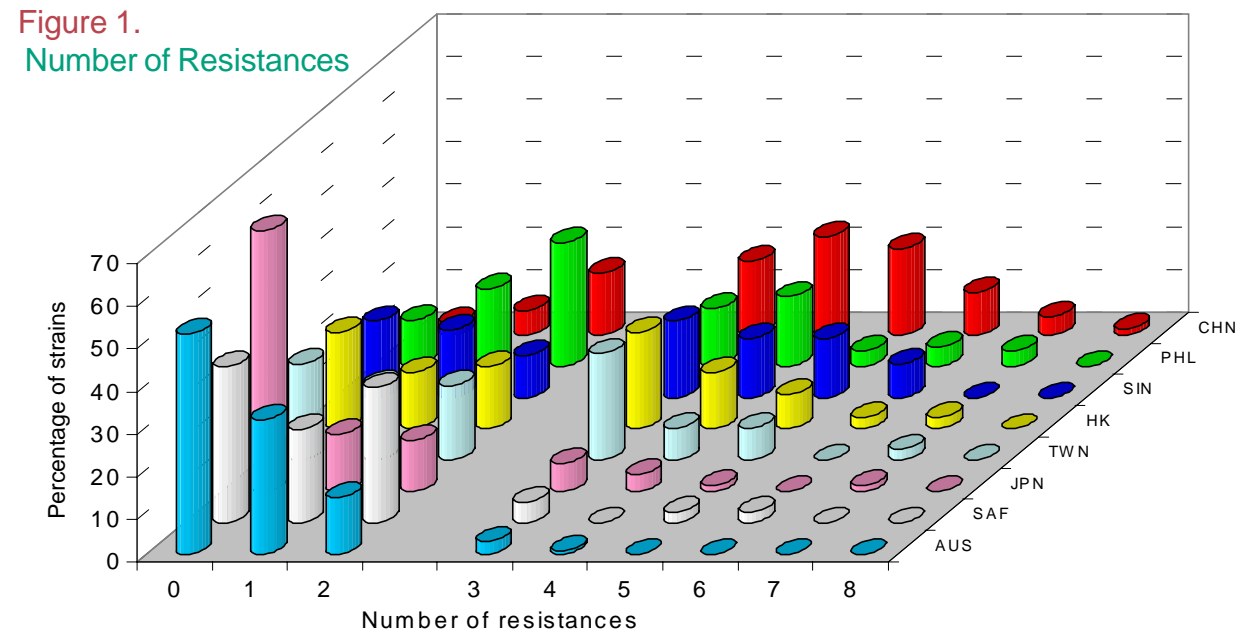
Country	Total	Percentage of MDR isolates resistant to ^a									
		AMP	AMC	CTR	CFT	CPM	IMI	SXT	CIP	NIT	GEN
Australia	2	100	0.0	0.0	0.0	0.0	0.0	100	50.0	50.0	100
Hong Kong	20	100	25.0	35.0	20.0	10.0	0.0	85.0	85.0	25.0	75.0
Japan	5	100	80.0	0.0	40.0	0.0	0.0	80.0	60.0	0.0	40.0
Mainland China	41	100	12.2	41.5	34.1	14.6	0.0	90.2	100	22.0	82.9
Philippines	31	100	48.4	0.0	45.2	0.0	0.0	93.5	74.2	9.7	64.5
Singapore	19	100	26.3	47.5	36.8	36.8	0.0	68.4	89.5	36.8	78.9
South Africa	2	100	0.0	50.0	100	0.0	0.0	100	50.0	50.0	100
Taiwan	7	100	57.1	14.3	14.3	14.3	0.0	100	42.9	0.0	85.7
Region	127	100	29.9	27.6	34.6	12.6	0.0	87.4	83.5	20.5	75.6

^a ESBL phenotype (ceftriaxone > 1 mg/L, ceftazidime > 1 mg/L or aztreonam > 1 mg/L)

^b Multi-drug resistant (> 4 resistances)

^c AMP ampicillin; AMC, amoxicillin-clavulanate (2:1); CTR, ceftriaxone, CFT, ceftiofur, CPM, cefepime; IMI, imipenem; SXT, trimethoprim-sulphamethoxazole; CIP, ciprofloxacin; NIT, nitrofurantoin; GEN, gentamicin

Figure 1. Number of Resistances



Discussion and Conclusion

- Multi-resistant *E. coli* are a very common problem in some countries in the Asia-Pacific region
- Ciprofloxacin resistance is frequent in some areas of our region and is often associated with multi-resistance
- All 31 MDR *E. coli* with cefepime MIC > 2 mg/L were ESBL producers

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