

Risk factors for colonization with extended-spectrum cephalosporin resistant and carbapenem resistant Enterobacterales among community adults, Bangladesh: An Antibiotic Resistance in Communities and Hospitals (ARCH) study

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Introduction

- Antimicrobial resistant (AMR) organisms are an increasing global health threat that are spreading within communities
- Understanding the risk factors for colonization with AMR organisms is critical for implementing prevention and control strategies, particularly in resource-limited settings such as Bangladesh

Objective

To identify factors associated with colonization of two clinically important multi-drug resistant Enterobacterales among healthy community participants:

- Extended-spectrum cephalosporin-resistant Enterobacterales (ESCrE)
- Carbapenem-resistant Enterobacterales (CRE)

Methods

Study design: Population-based observational study

Study period: April 15 to October 30, 2019

Study site: An urban community surveillance site of icddr,b in Dhaka, Bangladesh

Study population: Individuals aged 18 years and above without fever, diarrhea, or cough, and who slept overnight in the household for at least 4 weeks before enrollment

Enrollment and sample collection: Households were selected by two-stage cluster sampling at the community level. After obtaining informed written consent, participants completed demographic surveys assessing household and individual level factors. Stool samples were collected from one randomly selected adult per household and tested for ESCrE and CRE using selective chromagar media followed by VITEK-2 confirmation

Analysis: We developed a conceptual framework (Fig: 1) based on biological plausibility and reports from the literature. Based on this conceptual framework the multivariate logistic regression model was constructed, adjusting for potential confounders and clustering

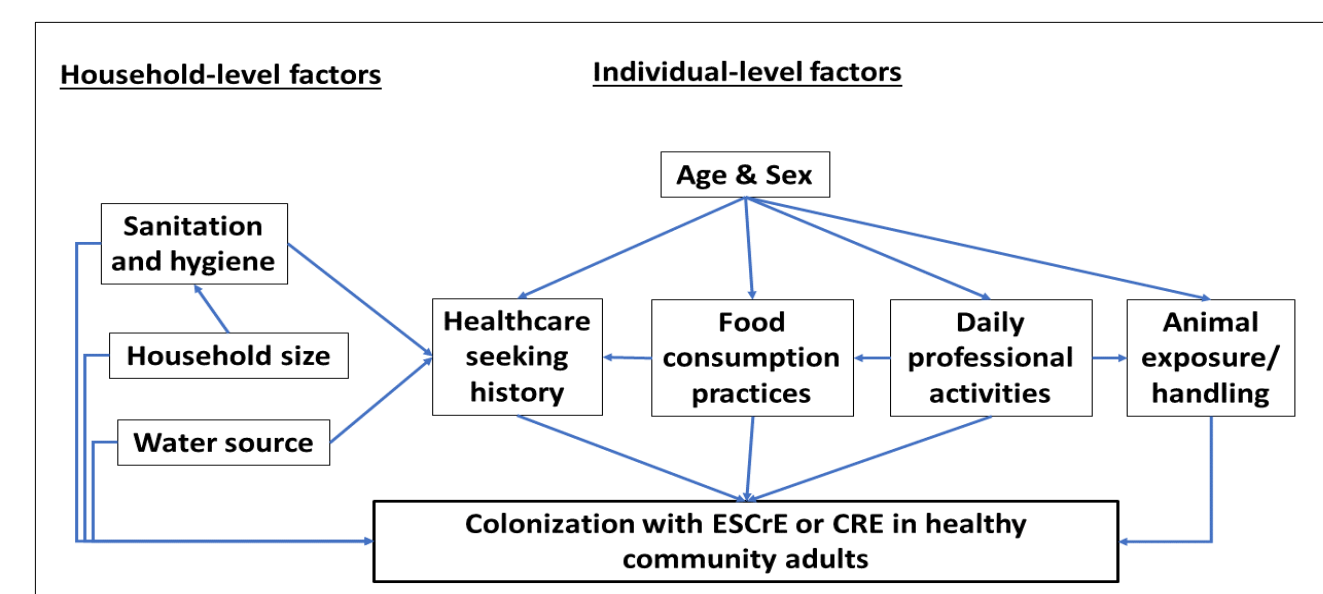


Figure 1: Conceptual framework for colonization with ESCrE and CRE among community participants

Results

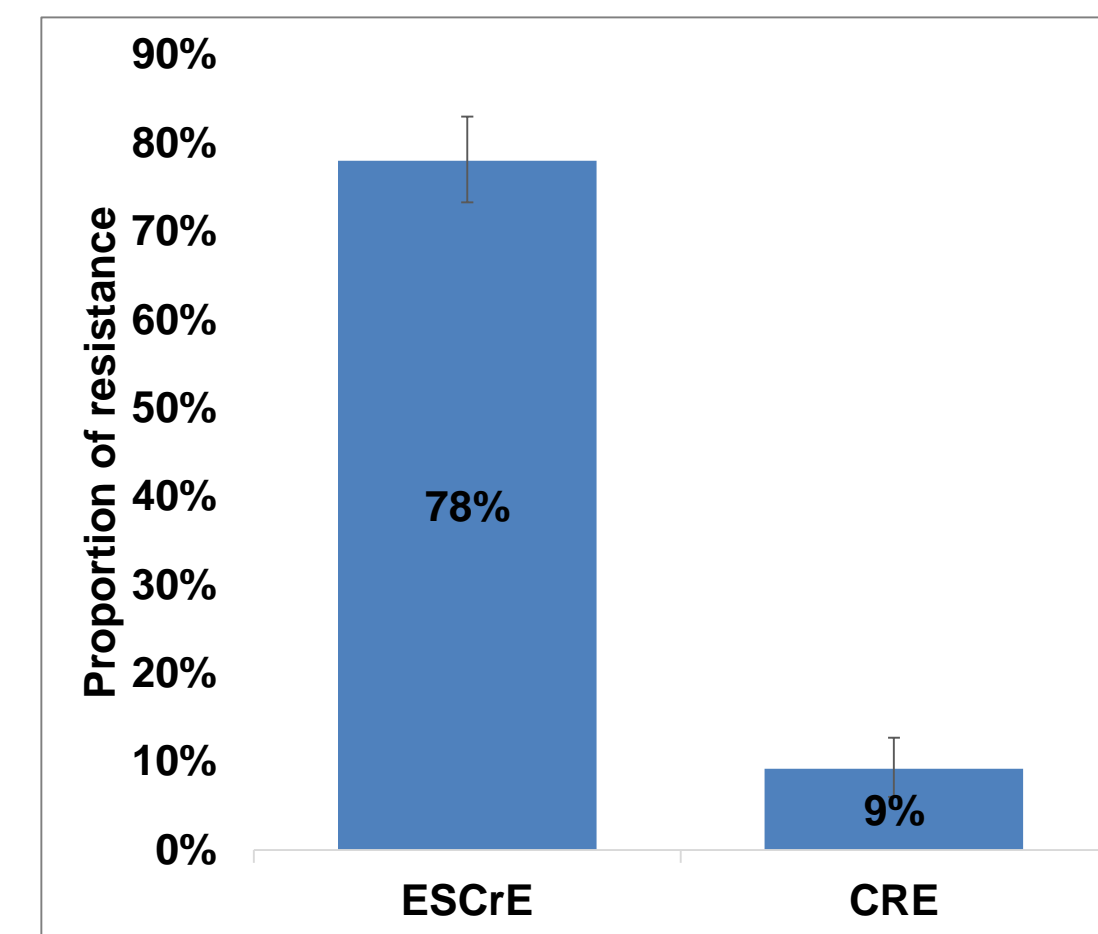


Figure 2: Prevalence of ESCrE and CRE colonization among community participants confirmed through VITEK® 2

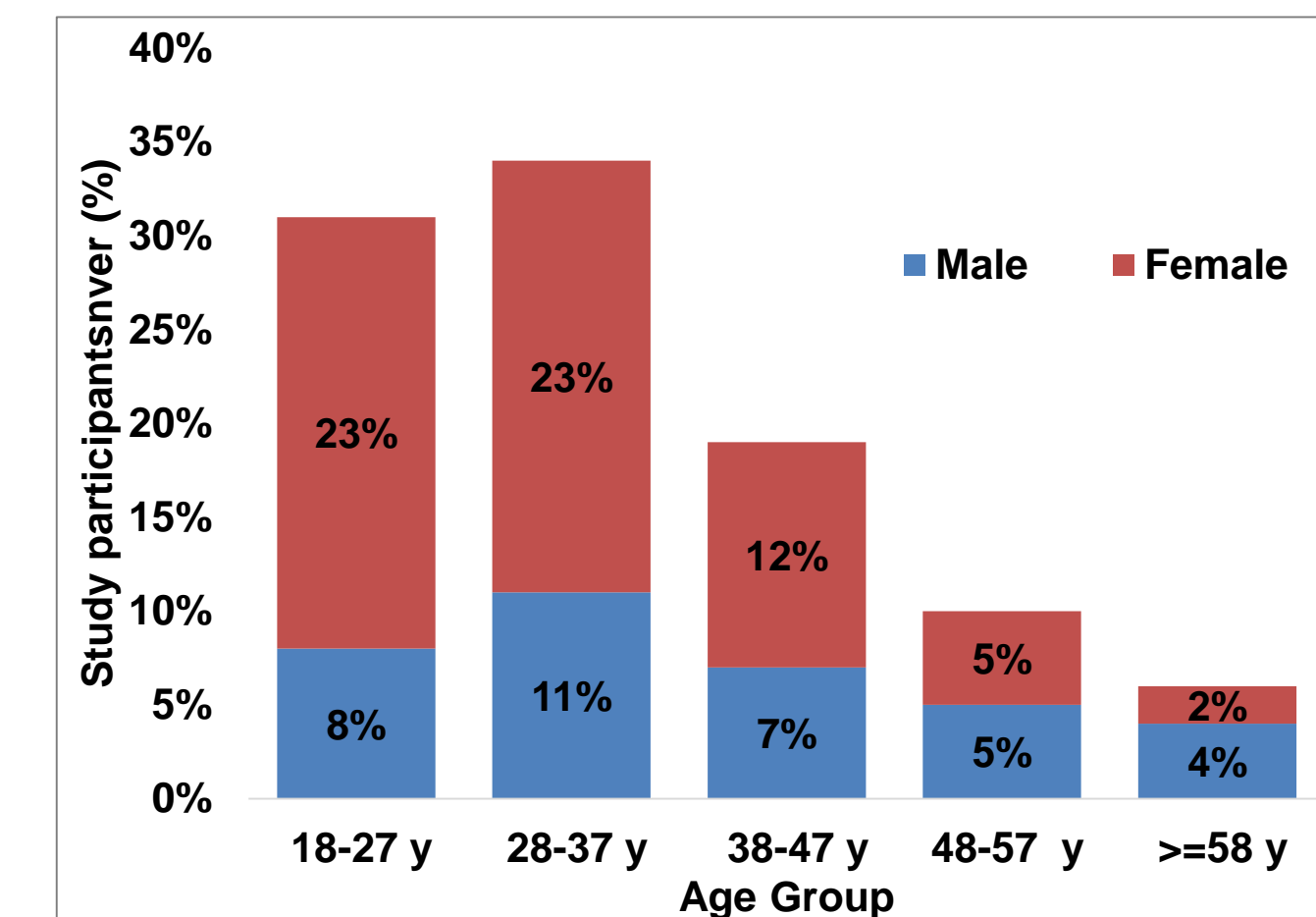


Figure 3: Age and sex distribution among community participants

- Of 714 enrolled adults:
 - 68% visited a hospital/clinic in the last 6 months
 - 3% were hospitalized overnight in past 3 months
 - 21% had taken antibiotics in the last 3 months
 - 5% had unimproved toilet facilities
 - 50% shared a toilet with other households
 - 5% had limited or no handwashing facility
 - 89% ate fresh fruits in past week
- Variables that were tested in bivariate analyses but not found to be significant include consumption of meat (lamb, goat, cattle, buffalo), poultry (chicken, duck, turkey), seafood, eggs, milk, yogurt, and cheese in the past week

Table 1: Factors associated with colonization with ESCrE and CRE among community participants

Factors	ESCrE		CRE	
	Bivariate OR (95% CI)	Multivariate aOR (95% CI)	Bivariate OR (95% CI)	Multivariate aOR (95% CI)
Individual-level factors				
Age in year	1.1 (1.0-1.1)		1.0 (0.9-1.0)	
Sex (Female)	0.9 (0.6-1.3)		0.9 (0.6-1.5)	
Visited hospital/clinic in last 6 months	1.1 (0.7-1.6)		1.2 (0.7-1.9)	
Hospitalized overnight in last 3 months	2.7 (0.6-13.1)		3.2 (1.2-8.6)	3.0 (1.0-8.7)**
Taken antibiotic in the last 3 months	1.1 (0.8-1.5)		1.4 (0.8-2.6)	
Consumed fresh fruit in past week	1.8 (1.2-2.9)	2.0 (1.3-3.2)*	0.6 (0.3-1.4)	
Grew or tend livestock/poultry/bird at home in last 6 months	0.9 (0.5-1.6)		0.5 (0.1-1.6)	
Prepared fish/chicken/meat in last 6 months	0.7 (0.5-1.1)		0.9 (0.6-1.6)	
Handled/treated/disposed waste other than from household	3.4 (0.9-13.4)		1.9 (0.6-5.9)	
Interacted with chicken in past week	0.8 (0.4-2.0)		1.2 (0.4-3.3)	
Interacted with turkeys/ducks/pigeon/bird in past week	1.3 (0.7-2.1)		0.8 (0.3-2.0)	
Household-level Factors				
Household size/ Family member	1.1 (1.0-1.2)		1.1 (0.9-1.3)	
Main source of drinking water				
At least basic/improved source		1		1
Public tap	3.3 (1.0-11.0)		1.6 (0.8-3.2)	
Sanitation ladder				
At least basic: improved ¹ toilet facility not shared with other households (Ref)		1		1
Limited: improved ¹ toilet facility shared with other households	1.1 (0.7-1.8)		2.0 (1.0-3.8)	
Unimproved: unimproved ² toilet facility	11.0 (2.9-42.2)		1.8 (0.5-6.4)	
Hygiene ladder				
Basic: handwashing facility with soap and water (Ref)		1		1
Limited: handwashing facility without soap or water	0.6 (0.3-1.4)		3.3 (1.4-7.7)	
No facility: no handwashing facility on household-premises	0.6 (0.1-6.2)		5.4 (0.5-60.8)	

Variables listed in bold are significant at p<0.05
*adjusted by age, sex, handling waste, source of drinking water, household size, and sanitation ladder
**adjusted by age, sex, sanitation ladder and hygiene ladder
¹flush/pour flush to piped sewer system, septic tank, pit latrine
²flush/pour flush to an open drain, pit latrine without slab

Conclusions

- While ESCrE colonization is common in urban communities, hospitals may be contributing to community spread of CRE
- Fresh fruit may be a vehicle for exposure to ESCrE
- Although not significant in multivariable models, hygiene and sanitation factors may be contributing to ESCrE and CRE colonization
- Targeted interventions focused on healthcare facilities may be needed to mitigate the transmission of AMR organisms

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- Community participants