

Title: Efficacy and acceptability of rectal and perineal sampling for identifying gastrointestinal colonisation with ESBL-Enterobacteriaceae

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Running title: Comparing rectal and perineal sampling for ESBL

Abstract

Objectives: We evaluated 'pre-laboratory' factors associated with the detection of ESBL-producing Enterobacteriaceae (ESBL-E) colonisation including anatomical site, and staff and patient factors.

Methods: All admissions to a large London hospital over three months were approached to provide rectal and perineal specimens, which were cultured for ESBL-E using chromogenic media. The ESBL-E detection rates for patient or staff-collected rectal or perineal specimens were compared using McNemar Tests. Binary logistic regression was used to explore factors associated with patients declining to provide a rectal specimen. The impact of simplifying the message to patients in order to improve the participation rate was evaluated.

Results: ESBL-E carriage was significantly higher in rectal vs. perineal specimens (7.8% of 4006 vs. 3.8% of 4006, $p < 0.001$), whether collected by staff or patients. 31.9% of 869 patients did not provide a rectal specimen before the change in message compared with 7.6% of 3690 patients afterwards ($p < 0.001$). In multivariable analysis, factors associated with patients declining to provide a rectal specimen were younger age (odds ratio (OR) 0.99, 95% confidence interval (CI) 0.99-1.00), female gender (OR 1.26, CI 1.04-1.52), transfers from other hospitals (OR 1.77, CI 1.07-2.93) or an unknown admission route (OR 1.61, CI 1.09-2.37), being admitted before the change in message (OR 0.39, CI 0.31-0.48), and the staff member who consented the patient ($p < 0.001$); ethnicity was not a significant factor..

Conclusions: Rectal specimens are recommended for the detection of ESBL-E colonisation. Staff and patient factors influence whether patients participate in prevalence studies, which may skew their findings.

Introduction

Few studies have evaluated the sensitivity and acceptability of collecting gastrointestinal screening specimens from different anatomical sites for the detection of ESBL-E [1-3]. There is evidence that rectal swabs are as sensitive as stool specimens for detecting ESBL-E, and more sensitive than other anatomical sites, including external swabbing round the anus, although there is limited data from large studies [1-3]. There are also potential staff and patient acceptability barriers with efficient collection of microbiology surveillance specimens [4-6].

A previous study has reported a low carriage rate of carbapenemase-producing organisms at Guy's and St. Thomas' Hospitals (GSTT) in London over a three month period where general admissions were screened [7]. Using this same dataset, in this study, we evaluate the practicality, efficacy, and acceptability of rectal and perineal sampling for identifying gastrointestinal colonisation with ESBL-E.

Methods

A period of universal admission screening for ESBL-E and carbapenemase-producing organisms was performed between January and March 2015 with results of the carbapenemase-producing organisms study already published [7] and microbiological analysis of the identified ESBL-Es to be published separately. Each patient was approached within the first 72 hours of admission and verbal consent obtained. Patients were asked to consent to the collection of both a perineal and rectal swab, or a perineal swab only, and were given the option of either staff or patient-collection. Staff and patients were not given guidance on the order of specimen collection. Specimens were collected using Eswabs™ (Copan, Brescia, Italy) and plated onto chromogenic agar (chromID™ ESBL, BioMerieux). Presumptive colonies were identified using MALDI-TOF (Bruker, Coventry, UK) and

antimicrobial susceptibility tested using the Vitek 2 (bioMérieux). ESBL-E were defined by the Vitek result.

The rate of ESBL-E carriage from perineal vs. rectal samples was compared using McNemar's test. Binary logistic regression (SPSS v23, IBM) was used to evaluate factors associated with declining to provide a rectal specimen.

The proportion of patients who provided a rectal specimen was reviewed during the fourth week of the study. In response to a high rate of decline, a new verbal explanation of the study was introduced during week five. The new message focussed on potential benefits to the individual (ensuring appropriate antibiotics if treatment was required) and other patients (through instituting infection control precautions to prevent transmission).

The study was approved by the Camberwell St Giles NHS Research Ethics Committee (14/LO/2085).

Results

A total of 4567 patients were approached to participate in the study of which 4006 (87.7%) consented to providing both rectal and perineal specimens, 158 (3.5%) provided only a perineal specimen, and 403 (8.8%) did not provide any specimen. ESBL-E were identified in 334 of 4164 (8.0%) rectal or perineal specimens, of which 265 (79.3%) were *Escherichia coli* and 25 (7.5%) *Klebsiella pneumoniae*. Overall, less than half of patients positive by rectal swabbing were also detected by the paired perineal swab collected at the same time (314/4006 (7.8%) vs. 156/4006 (3.8%); odds ratio (OR) 2.1, 95% confidence interval (CI) 1.7-2.6, $p < 0.001$) (Table 1). This difference was more pronounced in patient collected specimens than in staff-collected specimens (OR 2.6, CI 1.9-3.3) and in patient-collected

specimens (OR 1.6, CI 1.2-2.2), but rectal specimens were more sensitive than perineal specimens whether collected by patients or staff ($p < 0.01$ for all comparisons).

In multivariable analysis, factors associated with patients declining to provide a rectal specimen were younger age (OR 0.99, CI 0.99-1.00), female gender (OR 1.26, CI 1.04-1.52), transfers from other hospitals (OR 1.77, CI 1.07-2.93) or an unknown admission route (OR 1.61, CI 1.09-2.37), being admitted before the change in message (OR 0.39, CI 0.31-0.48), and the staff member who consented the patient ($p < 0.001$) (Table 2). The proportion of patients declining by individual staff member ranging from 0-83% (data not shown). The change in message made a marked impact on the rate of patients declining to provide a rectal specimen, from 31.9% of 869 patients to 7.6% of 3690 patients ($p < 0.001$). Ethnicity was not associated with whether patients provided a rectal specimen.

Discussion

Overall, ESBL-E carriage was 7.8% in this unselected patient population around the time of hospital admission, increasing to 9% if analysis is confined to the optimal screening method (staff-collected rectal swabs). This is comparable to levels identified other European studies, but lower than most recent studies from elsewhere in the world [6, 8].

Rectal or perineal swabs have been proposed as the most appropriate specimens for detecting gastrointestinal carriage when a stool specimen is not considered feasible [6]. Perineal specimens may overcome some of the patient acceptability and practical barriers associated with collecting rectal specimens. However, we found that perineal specimens would miss around half of ESBL-E carriers, so cannot be considered suitable for surveillance purposes. The lower sensitivity of perineal swabs compared with rectal swabs may be due to the higher concentration of bacteria in the rectum compared with perineal skin. Interestingly, only a further 3.5% of patients agreed to participate by providing a perineal

specimen only, so declines were predominantly for any sample collection from that part of the body, rather than related to the more invasive rectal site. Approximately two thirds of patients chose to self-collect their specimens. Patient collected samples are commonly used in maternity and sexual health [4, 5]. Our evidence suggests that patient-collected specimens may be less sensitive than staff-collected specimens, but we did not collect both patient- and staff-collected specimens from the same patients, so further work is required to confirm this.

Younger, female patients were less likely to agree to provide a rectal specimen. Both age and gender have been associated with ESBL-carriage in previous studies [9, 10]. The individual staff member was significantly associated with whether the patient provided a rectal specimen suggesting that staff education or perhaps gender matching may improve compliance with rectal sampling. We are not aware of other studies investigating the association between individual staff members and the message to the patient and the participation in such prevalence studies.

Our study has several important strengths. The patient group was large (more than 4000 patients) and unselected, with associated patient-level data available. Limitations include lack of molecular analysis. We did not evaluate risk factors for ESBL carriage, which fell beyond the scope of the current study, focussing on the practicalities of collecting specimens for determining carriage rates. We did not explore any patient outcomes in this study. We did not account for staff changes in our analysis of staff-related factors.

The findings of our study argue against the use of perineal specimens for detecting ESBL-E, due to poor sensitivity compared with rectal specimens. The study highlights the importance of developing a clear message to patients around the importance and benefits of surveillance cultures for antibiotic-resistant Enterobacteriaceae. Both staff and patient factors

are associated with patient choice around whether to participate in prevalence studies, which may skew findings from this and other studies.

Transparency declaration

Conflict of interest statement: JAO serves as a consultant to GAMA Healthcare. All other authors have no conflict of interest to declare.

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Table 1: ESBL carriage by specimen type (rectal or perineal) and whether specimen was collected by patients or staff.

			Perineal swab		Total
			ESBL-	ESBL+	
Staff-collected	Rectal swab	ESBL-	1103	7	1110
		ESBL+	48	68	116
	Total		1151	75	1226
Patient collected	Rectal swab	ESBL-	2568	14	2582
		ESBL+	133	65	198
	Total		2701	79	2780
Total	Rectal swab	ESBL-	3671	21	3692
		ESBL+	181	133	314
	Total		3852	154	4006

180 Table 2: Factors associated with patients declining to provide a rectal swab.

		Provided rectal swab		Did not provide rectal swab		Univariable				Multivariable			
		n	%	n	%	p	OR	Lower	Upper	p	OR	Lower	Upper
Median age (range)		59.1 (16.2-104.3)		53.3 (16.5-100.4)		.012	.994	.990	.999	.007	.993	.988	.998
Gender	F	1868	86.4%	294	13.6%	.010	1.260	1.056	1.504	.021	1.257	1.036	1.525
	M	2138	88.9%	267	11.1%	Ref							
Ethnic Group						.557							
	Asian or Asian British	127	87.6%	18	12.4%	.912	1.029	.620	1.709				
	Black or Black British	528	87.0%	79	13.0%	.538	1.086	.835	1.414				
	Mixed	31	77.5%	9	22.5%	.052	2.108	.994	4.467				
	Not Stated	683	88.6%	88	11.4%	.602	.935	.728	1.202				
	Other Ethnic Groups	160	86.5%	25	13.5%	.572	1.134	.733	1.757				
	Unknown	132	87.4%	19	12.6%	.862	1.045	.637	1.714				
	White	2345	87.9%	323	12.1%	Ref							
Admission Method						.000				.022			
	Elective	1767	89.9%	199	10.1%	Ref				Ref			
	Emergency	1889	86.6%	292	13.4%	.001	1.373	1.133	1.662	.107	1.189	.963	1.467
	Transfer from other hospital	152	86.4%	24	13.6%	.145	1.402	.890	2.209	.027	1.769	1.068	2.930
	Unknown	198	81.1%	46	18.9%	.000	2.063	1.450	2.935	.017	1.607	1.089	2.370
Consented by	Staff member code					.000				.000			
	1	291	86.1%	47	13.9%	.000	.555	.399	.772	.027	.679	.482	.957
	2	168	70.6%	70	29.4%	.021	1.431	1.057	1.939	.057	1.355	.991	1.852
	3	509	97.7%	12	2.3%	.000	.081	.045	.145	.000	.132	.073	.241
	4	221	75.9%	70	24.1%	.575	1.088	.811	1.460	.000	1.842	1.332	2.545
	5	560	99.1%	5	.9%	.000	.031	.013	.075	.000	.050	.020	.122
	6	1072	98.9%	12	1.1%	.000	.038	.021	.069	.000	.064	.035	.116
	Other	1185	77.5%	345	22.5%	Ref							
New message	No	592	68.1%	277	31.9%	Ref							
	Yes	3411	92.4%	279	7.6%	.000	.175	.145	.211	.000	.387	.311	.481

181 Ref = reference. OR = odds ratio. Upper = upper 95% confidence interval. Lower = lower 95% confidence interval. While study week, which was the raw data for the 'New
182 Message' variable, is an ordinal variable, it was introduced into the model as a binary variable to evaluate the impact in the change of message.

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