Evaluation of Carriage and Environmental Spread of Carbapenem-Resistant *Acinetobacter baumannii*

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Background

- **Carbapenem-resistant *Acinetobacter baumannii* (CRAB)** is a rapidly emerging nosocomial pathogen.
- Early identification of carriers is important for infection control[1], however active surveillance is limited because:
  - Test sensitivity is low.
  - Optimal anatomic sites for sampling are uncertain.

Purpose

- To evaluate the sensitivity of a novel technique to detect CRAB in patients and in the patient environment.

Methods

- This study was performed at Tel-Aviv Sourasky Medical Center, a 1,450 bed, academic acute-care hospital in Israel.
- Patients with a clinical culture growing CRAB were sampled within 7 days.
- Swabs were taken from the mouth (buccal mucosa) and rectum.
- Pre-moistened sterile sponges (Polywipe™ sponge swab; Medical Wire & Equipment) were used to collect cultures from the patient's skin (one sponge was used to swipe both arms and legs) and surrounding environment (bedrail, bed sheet, cabinet, monitor, ventilator, feeding pump and infusion pump).
- Specimens were inoculated onto CHROMagar MDR *Acinetobacter* plates[2] (Hylabs, Israel) both directly and after overnight incubation in BHI broth for enrichment.
- MALDI-TOF was used for *A. baumannii* identification.
- Patient colonization load and environmental contamination load were scored semi-quantitatively.

Results

- Study sample characteristics are presented in Table 1.
- Growth of red colonies on CHROMagar (Figure 1) had 98% PPV for CRAB (of 221 positive cultures, 2 were identified as *Chryseobacterium indologenes*, and 2 were identified as *Pseudomonas putida* by MALDI-TOF).
- Table 2 presents overall screening sensitivity (by direct inoculation and/or after overnight enrichment in BHI broth).
- Table 3 presents screening sensitivity by direct inoculation only.
- Screening had 100% sensitivity for carrier detection in sputum positive patients, and 80% sensitivity in sputum negative patients.
- The site with the highest yield was mouth for sputum positive patients and skin for sputum negative patients.
- Active antibiotic treatment did not reduce screening sensitivity.
- CRAB contaminates the environment heavily, all patients had at least one positive environmental site (Table 4).
- Patient colonization score was positively correlated with environmental contamination score r=0.63 (p<0.001); r=0.4 (p=0.036) for mouth, r=0.7 (p<0.001) for skin, and r=0.46 (p=0.14) for rectum.

Figure 1: Growth of *Acinetobacter baumannii* red colonies on CHROMagar™ MDR *Acinetobacter* plate.

Table 1: Study sample characteristics (N=34)

Variable	Result
Age (years), mean (SD)	68.7 (17.8)
Male Sex, n (%)	24 (71)
In ICU when sampled, n (%)	13 (38)
Ventilated when sampled, n (%)	20 (59)
Clinical culture source:	
Sputum, n (%)	24 (71%)
Urine, n (%)	12 (35%)
Wound, n (%)	7 (21%)
Drain, n (%)	5 (15%)
Blood, n (%)	4 (12%)
Time to screening (days), median (range)	4 (1-7)

Table 2: Overall sensitivity of CRAB screening (direct inoculation or enrichment) by anatomic site and patient characteristics

Population		N	Mouth	Skin	Rectum	Any
			n (%)	n (%)	n (%)	n (%)
All		34	28 (82)	30 (88)	25 (74)	32 (94)
Positive sputum culture	Yes	24	24 (100)	22 (92)	20 (83)	24 (100)
	No	10	4 (40)	8 (80)	5 (50)	8 (80)
Antibiotic treatment	None	12	11 (92)	9 (75)	8 (67)	11 (92)
	Non-active against CRAB	10	6 (60)	10 (100)	7 (70)	10 (100)
	Active against CRAB (≥ 48h)	10	9 (90)	9 (90)	8 (80)	9 (90)

Table 3: Sensitivity of CRAB screening, direct inoculation, by anatomic site and patient characteristics

Population		N	Mouth	Skin	Rectum	Any
			n (%)	n (%)	n (%)	n (%)
All		28	23 (82)	21 (75)	20 (71)	25 (89)
Positive sputum culture	Yes	20	20 (100)	16 (80)	15 (75)	20 (100)
	No	8	3 (38)	5 (63)	5 (63)	5 (63)
Antibiotic treatment	None	12	11 (92)	7 (58)	7 (58)	11 (92)
	Non-active against CRAB	8	5 (63)	7 (88)	7 (88)	7 (88)
	Active against CRAB (≥ 48h)	7	6 (86)	6 (86)	5 (71)	6 (86)

Table 4: Proportion of carriers with CRAB detected in their immediate environment, by laboratory method and surveillance site

Surveillance site	Positive by Direct Inoculation or after Enrichment n/total N (%)	Positive by Direct Inoculation n/total N (%)
Sheet	31/34 (91)	17/28 (61)
Bedrail	30/34 (88)	20/28 (71)
Cabinet	14/24 (58)	6/18 (33)
Monitor	12/23 (52)	4/21 (19)
Ventilator	11/19 (58)	5/17 (29)
Feeding Pump	18/24 (75)	10/23 (44)
Infusion Pump	16/22 (73)	9/21 (43)
Any site	34/34 (100)	25/28 (89)

Conclusions

- Our methods were highly sensitive for detecting CRAB, especially in patients with CRAB isolated in sputum.
- We attribute the higher detection rates in our study as compared to previous studies to the combination of improved sampling technique and the use of CHROMagar plates.
- Our study has important implications for infection control:
  1. The high sensitivity and rapid turnaround time afforded by direct plating allows timely identification and isolation of CRAB carriers in an outbreak setting, as well detecting environmental sources of contamination.
  2. Screening results could be used to guide empiric antibiotic treatment for patients with symptoms of infection.
  3. This is to first study to show a positive correlation between patient colonization and environmental spread.

References

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