Concise Communication

Detecting carbapenem-resistant Acinetobacter baumannii (CRAB) carriage: Which body site should be cultured?

Amir Nutman MD, MPH1,2, Elizabeth Temkin DrPH1, Jonathan Lellouche PhD1, Debby Ben David MD1,2, David Schwartz PhD1 and Yehuda Carmeli MD, MPH1,2

1National Institute for Antibiotic Resistance and Infection Control, Ministry of Health, Tel-Aviv Sourasky Medical Center, Tel-Aviv, Israel and 2Sackler Faculty of Medicine, Tel-Aviv University, Tel-Aviv, Israel

Abstract
We compared the yield of culturing various body sites to detect carriage of carbapenem-resistant Acinetobacter baumannii (CRAB). Culturing the skin using a premoistened sponge, with overnight enrichment and plating on CHROMagar MDR Acinetobacter, had the highest yield: 92%. Skin is satisfactory as a single site for active surveillance of CRAB.

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Acinetobacter baumannii is a multidrug-resistant pathogen causing severe infections in hospitals and long-term care facilities. Detecting carriers is a mainstay of controlling nosocomial spread of resistant organisms. Screening for carbapenem-resistant Acinetobacter baumannii (CRAB) has been recommended to control outbreaks, but no specific recommendations have been made regarding which body sites to culture.1 In 2007, we studied the yield of culturing the nose, throat, axilla, groin, rectum, open wounds, and tracheal aspirates, and no site or combination of sites had high enough sensitivity to be recommended for CRAB screening.2 Since then, improved culture media3 and a skin sampling technique using a premoistened sponge4 have increased test sensitivity. Recently, we used these methods on patients with clinical cultures positive for CRAB; compared to that gold standard, screening cultures from the buccal mucosa, skin, and the rectum combined achieved 94% sensitivity.5 That study was too small to determine whether screening a single body site is sensitive enough to detect carriers and which body site should be chosen. Here we summarize our cumulative experience of screening for CRAB carriage as an evidence base to assist in developing guidelines for CRAB screening.

Methods

Study setting and patients
In 2015–2019, patients were screened for CRAB as part of an ongoing infection control program in 2 settings: adult wards at a tertiary- acute-care hospital (ACH) and a chronic ventilation ward at a post–acute-care hospital (PACH). Chlorhexidine bathing is routinely performed at both institutions.

The primary outcome was screening yield for each body site sampled. Because there is no gold standard for CRAB screening, a patient was defined as a CRAB carrier if a culture from any of the sites sampled was positive.

Specimen collection methods
Buccal mucosa and rectal specimens were collected using swabs (Amies agar gel transport swab; Copan Italia S.P.A., Brescia, Italy). Tracheal aspirates were collected from ventilated patients using a suction catheter. Sponges premoistened with a phosphate buffer (Polywipe; Medical Wire & Equipment, Wiltshire, England) were used to sample the skin by swiping down both arms and legs from top to bottom (1 sponge for all 4 limbs).

Microbiological methods
Specimens were inoculated, after overnight enrichment in brain-heart infusion (BHI) broth (Hylabs, Rehovot, Israel), onto CHROMagar MDR Acinetobacter plates (Hylabs, Rehovot, Israel), and incubated overnight at 37ºC. Suspicious colonies were identified to the species level using VITEK-MS (bioMérieux, Marcy l’Etoile, France) followed by blaOXA-51-like gene PCR. Carbapenem resistance was determined using VITEK-2 (bioMérieux, Marcy l’Etoile, France).

Statistical analysis
We compared yield by body site and by setting using a test of proportions. Analyses were done using Stata version 14.2 software (StataCorp, College Station, TX).

Results
The sample consisted of 612 specimens from 201 patients who tested positive for CRAB in at least 1 body site: 100 from the ACH and 101 from the PACH. The yields from single body sites

Author for correspondence: Amir Nutman, E-mail: amirn@tlvmc.gov.il
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and combinations of body sites are presented in Table 1. The site with the highest yield was the skin (91.9%; 95% confidence interval [CI], 87%–95%), followed by the buccal mucosa (62.5%; 95% CI, 54%–71%). The yield was low for tracheal aspirate (49.1%; 95% CI, 39%–59%) and the rectum (47.3%; 95% CI, 40%–55%). Skin sampling had similar yield in the ACH (91.0%) and PACH (92.8%; P = .64) settings. The yield from buccal mucosa was higher in the ACH (68.7%) than in the PACH (45.9%; P = .01); the yield from the rectum was also higher in the ACH, but not significantly so (54.3% vs 42.2%; P = .13). Only the combination of skin and buccal mucosa sampling had a significantly higher yield than skin alone (P = .003). In carriers with a negative skin culture, the buccal mucosa cultures were positive in 9 of 10 of these carriers (90%), the rectal samples in 2 of 4 carriers (50%), and tracheal aspirates in 2 of 7 carriers (28.6%).

### Discussion

Culturing the skin using a premoistened sponge had a sensitivity of 92% to detect CRAB carriage. All other screening sites had low sensitivity; even combinations of 2 sites (excluding the skin) had a low yield in mucosa and skin was 99% sensitive. Tracheal aspirate, often used to reach a maximum of 69% sensitivity. The combination of buccal sensitivity; even combinations of 2 sites (excluding the skin) 92% to detect CRAB carriage. All other screening sites had low sensitivity. Culturing the skin using a premoistened sponge had a sensitivity of 95% (95% CI, 87%–95%).

**Table 1. CRAB Screening Yield Among 201 Patients Positive for CRAB by Body Site**

| Body Site          | No. Sampled | No. Positive | Yield, % (95% CI) |
|--------------------|-------------|--------------|-------------------|
| Buccal mucosa      | 136         | 85           | 62.5 (54–71)      |
| Tracheal aspirate  | 110         | 54           | 49.1 (39–59)      |
| Skin               | 197         | 181          | 91.9 (87–95)      |
| Rectum             | 169         | 80           | 47.3 (40–55)      |
| Buccal mucosa + skin | 136       | 135          | 99.3 (96–100)     |
| Buccal mucosa + rectum | 107     | 74           | 69.2 (59–78)      |
| Skin + rectum      | 165         | 159          | 96.4 (92–99)      |
| Sputum + rectum    | 99          | 62           | 62.6 (52–72)      |
| Sputum + skin      | 106         | 101          | 95.3 (89–98)      |

Note. CRAB, carbapenem-resistant *A. baumannii*; CI, confidence interval.

An important issue to consider before implementing a screening policy is the pretest probability of screening positive. When the prevalence in the screened population is <10%, <1 positive patient will be missed for every 100 patients screened using a test with 90% sensitivity. When prevalence is higher or when missing a case may have severe consequences, a test with a higher sensitivity should be chosen. Adding a buccal mucosa swab to skin sampling increased sensitivity from 92% to 99%; thus, screening both sites may be preferred in such circumstances.

In a previous study, CRAB active surveillance by rectal swabs and bronchial aspirates using a rapid molecular diagnostic assay that provided results “within a few hours after sample collection,” followed by prompt isolation of carriers, decreased CRAB acquisition by 35% compared to conventional cultures. Our methods, although sensitive, are not rapid; they provide a result of “suspected CRAB” in 36 hours and a final result after identification and susceptibility testing, which require an additional 24 hours.

This study has several limitations. Since there is no gold standard for screening, we measured sensitivity at each body site by comparing it to a standard of positivity at any body site. This may be an underestimation, in which case the sensitivities we calculated may be inflated. Also, our study was performed in only 2 centers.

In conclusion, our data support the notion that the skin is the main site of colonization by CRAB, and that culturing the skin using a premoistened sponge as a single site for active surveillance of CRAB is satisfactory. The sensitivity of screening the buccal mucosa, rectum, and tracheal aspirate was low, and a negative screening culture from these sites should not be taken as evidence of CRAB noncarriage.

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