

Prospective Two-Center Comparison of Three Chromogenic Agars for Methicillin-Resistant *Staphylococcus aureus* Screening in Hospitalized Patients

Magali Dodémont,^a Carlo Verhulst,^b Claire Nonhoff,^a Carole Nagant,^a Olivier Denis,^a Jan Kluytmans^b

National Reference Centre-*Staphylococcus aureus*, Department of Microbiology, Hôpital Erasme, Université Libre de Bruxelles, Brussels, Belgium^a; Amphia Hospital, Breda, The Netherlands^b

Three chromogenic media, chromID MRSA SMART (SMART), chromID MRSA first generation (chromID), and Brilliance MRSA (OX2), were evaluated for methicillin-resistant *Staphylococcus aureus* (MRSA) screening using 1,220 samples. The sensitivity at 24 h was significantly better with the SMART agar (66.4%) than that with chromID agar (50.5%). Enrichment and incubation until 48 h are still needed for an optimal yield.

Methicillin-resistant *Staphylococcus aureus* (MRSA) is a major cause of nosocomial infections (1, 2). Asymptomatic carriers in the nose, throat, or on the skin represent the major reservoirs for MRSA transmission in hospitals (3, 4). Rapid identification of MRSA colonization is of utmost importance to identify carriers in order to implement infection control procedures and reduce patient-to-patient transmission (5–7). Several chromogenic agars have been specifically developed for MRSA screening. These media show superior sensitivity and specificity compared to those of conventional selective plates (8–10). The purpose of this study was to compare the performance of the new bioMérieux chromID MRSA SMART (SMART) agar with bioMérieux chromID MRSA first generation (chromID) and Oxoid Brilliance MRSA version 2 agar (OX2) with and without enrichment broth (EB).

This prospective study was conducted between January and May 2014 at Hôpital Erasme, Brussels, Belgium, and Amphia Hospital, Breda, The Netherlands. Screening samples were collected from patients admitted to both hospitals using ESwab transport medium (Copan Diagnostics). The swabs were inoculated into EB supplemented with 6.5% NaCl (bioMérieux) and directly on the SMART, chromID, and OX2 agars, and a Colombia agar plate with 5% sheep blood (SBA) (growth control) at 35 to 37°C. EB was subcultured after 24 h onto secondary selective plates. Primary plates were examined at 24 h and 48 h, and secondary plates were examined after 24 h. The assessments included comparative amounts of growth of presumptive MRSA/sample and the amount of background flora able to grow on the three media. All suspected MRSA colonies were identified by matrix-assisted laser desorption ionization–time of flight mass spectrometry (MALDI-TOF MS), and methicillin susceptibility was determined by the cefoxitin disk method, as recommended by EUCAST (11).

Each new MRSA isolate per patient and discrepant results between the three media were tested for the presence of the *mecA* gene by in-house PCR (Erasme) (12) or GeneXpert (Xpert SA nasal G3 kit version 4; Cepheid) (Amphia). Discrepant results (typical MRSA colonies and *mecA* negative) were further analyzed for the presence of the *mecC* gene, and the MICs to cefoxitin and oxacillin were determined (11, 13). The presence of MRSA recovered from at least one of the media (primary chromogenic agar or after enrichment) was considered the gold standard. True-positive

results were defined as MRSA isolates showing characteristic colonies (color and morphology) confirmed by PCR, false-positive results as isolates with typical colonies not confirmed by PCR (methicillin-susceptible *S. aureus* [MSSA] or a member of another taxon), and false-negative results as MRSA isolates confirmed by PCR not showing typical colonies or not growing on one of the media. The selectivity was assessed by the growth of noncharacteristic colonies (annex flora), which was evaluated by recording its abundance using a semiquantitative method (streaking method). High selectivity was defined as the absence of growth in the first quadrant. The statistical significance ($P < 0.05$) of inter-medium disagreement was estimated by the McNemar test (Stata 12 software).

Five hundred eighty-nine patients (385 from Erasme and 204 from Amphia) were screened for MRSA carriage by sampling swabs from the nares ($n = 605$), throat ($n = 206$), perineum ($n = 199$), and skin ($n = 27$), as well as pooled samples ($n = 154$) and other samples ($n = 29$). Thirty-four samples (2.7%) were excluded because the growth control was negative. Some patients were sampled more than once (1 to 15 samples/patient). MRSA strains were isolated from 107 specimens (~9% in both hospitals) either from the SMART ($n = 101$), OX2 ($n = 99$), or chromID ($n = 98$) agars. Ninety-three strains were recovered from all three media, 5 from two media, and 9 from only one of the media tested. After 24 h of incubation, 79 of 107 MRSA strains (73.8%) were detected, 15 additional MRSA strains (14.0%) were isolated at 48 h, and 13 strains (12.2%) were isolated only after the enrichment step. The

Received 20 April 2015 Returned for modification 20 May 2015

Accepted 15 June 2015

Accepted manuscript posted online 24 June 2015

Citation Dodémont M, Verhulst C, Nonhoff C, Nagant C, Denis O, Kluytmans J. 2015. Prospective two-center comparison of three chromogenic agars for methicillin-resistant *Staphylococcus aureus* screening in hospitalized patients. J Clin Microbiol 53:3014–3016. doi:10.1128/JCM.01006-15.

Editor: S. S. Richter

Address correspondence to Magali Dodémont, magali.dodemont@erasme.ulb.ac.be.

Copyright © 2015, American Society for Microbiology. All Rights Reserved. doi:10.1128/JCM.01006-15

Direct culture at incubation time of

^a Total number of samples, 1220; no. of MRSA isolates, 107.

In conclusion, the SMART agar has substantially improved sensitivity, particularly at 24 h of incubation, compared to that of the previous version, but enrichment before inoculation and prolonged incubation for 48 h are needed for an optimal yield. This

study shows that the new bioMérieux SMART agar provides a viable alternative to the OX2 and chromID agars for MRSA culture screening.

ACKNOWLEDGMENTS

We thank Judith Racapé for the statistical analysis, Slavka Penickova for her technical assistance, and bioMérieux and Oxoid, which kindly provided the agars used in this study.

This study was supported by funding from bioMérieux.

Jan Kluytmans is a consultant for bioMérieux.

REFERENCES

1. von Eiff C, Becker K, Machka K, Stammer H, Peters G. 2001. Nasal carriage as a source of *Staphylococcus aureus* bacteremia. *N Engl J Med* 344:11–16. <http://dx.doi.org/10.1056/NEJM200101043440102>.
2. Köck R, Becker K, Cookson B, van Gemert-Pijnen JE, Harbarth S, Kluytmans J, Mielke M, Peters G, Skov RL, Struelens MJ, Tacconelli E, Navarro TA, Witte W, Friedrich AW. 2010. Methicillin-resistant *Staphylococcus aureus* (MRSA): burden of disease and control challenges in Europe. *Euro Surveill* 15:19688.
3. Kluytmans JA, Wertheim HF. 2005. Nasal carriage of *Staphylococcus aureus* and prevention of nosocomial infections. *Infection* 33:3–8. <http://dx.doi.org/10.1007/s15010-005-4012-9>.
4. Weidenmaier C, Goerke C, Wolz C. 2012. *Staphylococcus aureus* determinants for nasal colonization. *Trends Microbiol* 20:243–250. <http://dx.doi.org/10.1016/j.tim.2012.03.004>.
5. Rubinovitch B, Pittet D. 2001. Screening for methicillin-resistant *Staphylococcus aureus* in the endemic hospital: what have we learned? *J Hosp Infect* 47:9–18. <http://dx.doi.org/10.1053/jhin.2000.0873>.
6. Wertheim HF, Vos MC, Ott A, van Belkum A, Voss A, Kluytmans JA, van Keulen PH, Vandenbroucke-Grauls CM, Meester MH, Verbrugh HA. 2004. Risk and outcome of nosocomial *Staphylococcus aureus* bacteraemia in nasal carriers versus non-carriers. *Lancet* 364:703–705. [http://dx.doi.org/10.1016/S0140-6736\(04\)16897-9](http://dx.doi.org/10.1016/S0140-6736(04)16897-9).
7. Boyce JM. 2001. MRSA patients: proven methods to treat colonization and infection. *J Hosp Infect* 48(Suppl A):S9–S14.
8. Veenemans J, Verhulst C, Punselie R, van Keulen PH, Kluytmans JA. 2013. Evaluation of *Brilliance* MRSA 2 agar for detection of methicillin-resistant *Staphylococcus aureus* in clinical samples. *J Clin Microbiol* 51:1026–1027. <http://dx.doi.org/10.1128/JCM.02995-12>.
9. Nahimana I, Francioli P, Blanc DS. 2006. Evaluation of three chromogenic media (MRSA-ID, MRSA-Select and CHROMagar MRSA) and ORSAB for surveillance cultures of methicillin-resistant *Staphylococcus aureus*. *Clin Microbiol Infect* 12:1168–1174. <http://dx.doi.org/10.1111/j.1469-0691.2006.01534.x>.
10. Nonhoff C, Denis O, Brenner A, Buidin P, Legros N, Thiroux C, Dramaix M, Struelens MJ. 2009. Comparison of three chromogenic media and enrichment broth media for the detection of methicillin-resistant *Staphylococcus aureus* from mucocutaneous screening specimens: comparison of MRSA chromogenic media. *Eur J Clin Microbiol Infect Dis* 28:363–369. <http://dx.doi.org/10.1007/s10096-008-0637-9>.
11. European Committee on Antimicrobial Susceptibility Testing. 2015. Breakpoint tables for interpretation of MICs and zone diameters. Version 4.0. European Committee on Antimicrobial Susceptibility Testing, Basel, Switzerland. http://www.eucast.org/fileadmin/src/media/PDFs/EUCAST_files/Breakpoint_tables/Breakpoint_table_v_4.0.pdf.
12. Maes N, Magdalena J, Rottiers S, De Gheldere Y, Struelens MJ. 2002. Evaluation of a triplex PCR assay to discriminate *Staphylococcus aureus* from coagulase-negative staphylococci and determine methicillin resistance from blood cultures. *J Clin Microbiol* 40:1514–1517. <http://dx.doi.org/10.1128/JCM.40.4.1514-1517.2002>.
13. Deplano A, Vandendriessche S, Nonhoff C, Denis O. 2014. Genetic diversity among methicillin-resistant *Staphylococcus aureus* isolates carrying the *mecC* gene in Belgium. *J Antimicrob Chemother* 69:1457–1460. <http://dx.doi.org/10.1093/jac/dku020>.
14. Tacconelli E, De Angelis G, De Waure C, Cataldo MA, La Torre G, Cauda R. 2009. Rapid screening tests for methicillin-resistant *Staphylococcus aureus* at hospital admission: systematic review and meta-analysis. *Lancet Infect Dis* 9:546–554. [http://dx.doi.org/10.1016/S1473-3099\(09\)70150-1](http://dx.doi.org/10.1016/S1473-3099(09)70150-1).
15. Gardam M, Brunton J, Willey B, McGeer A, Low D, Conly J. 2001. A blinded comparison of three laboratory protocols for the identification of patients colonized with methicillin-resistant *Staphylococcus aureus*. *Infect Control Hosp Epidemiol* 22:152–156. <http://dx.doi.org/10.1086/501882>.