Automatic Digital Analysis of Chromogenic Media for Vancomycin Resistant Enterococci Screens using the WASPLab Interpretation Software

Matthew L. Faron[1,2], B. W. Buchan[1,2], T. Liebregts[3], A. Van Bree[3], A. Jansz[3], G. Soucy[4], J. Korver[5], and N. A. Ledeboer[1,2]

[1]Medical College of Wisconsin, Milwaukee, WI, [2]Wisconsin Diagnostic Laboratories, Milwaukee, WI, [3]PAMM Laboratory of Medical Microbiology, Veldhoven, Netherlands, [4] CHU de Quebec – Universite Laval, Quebec City, Canada, [5]Hamilton General Hospital, Ontario, Canada

Introduction

To aide in early detection of VRE, many clinical laboratories offer VRE screening for at risk patients, but even with the use of chromogenic agar manual reading is costly and labor intensive. Digital imaging can differentiate between colors of pixels and thus software that can identify and remove negative chromogenic plates prior to technologist reading, which could reduce laboratory cost. In this study we evaluated the performance of the Chromogenic Detection Module (CDM) (Copan, Brescia, IT) to detect pigmented colonies from a digital image and compared the results to manual reading using VRE chromogenic agar.

Method

Specimens submitted for VRE screening at three different laboratories were enrolled and inoculated onto either Colorex VRE (BioMed Diagnostics, White City, OR) or Oxoid VRE (Oxoid, Basingstoke, UK) using the WASPLab. Digital images were taken at 0 and 24 hours post inoculation and were scored by the CDM software and technologist for positive VRE growth. Technologists were blinded to the software's results and performed plate readings from digital images on a HD monitor. Specimens were reported as Manual Positive (MP) or Manual Negative (MN) based on presence or absence of chromogen color. Images of discrepant results were sent to the sites laboratory director/manager for review and separated into three categories: residual matrix/yeast, borderline colors and positive on second review.

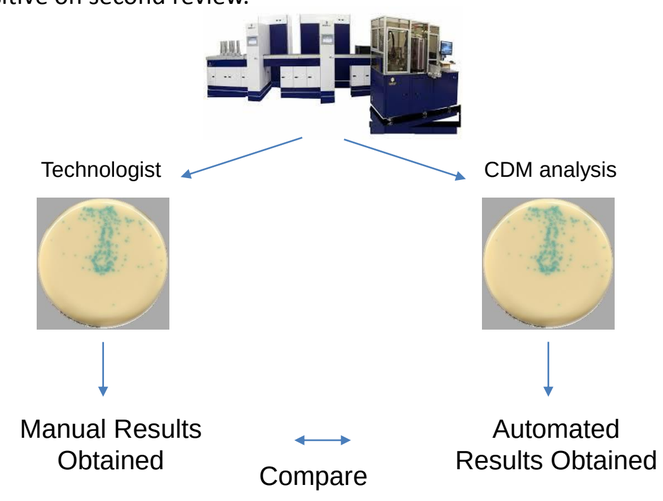

Figure 1. Modeling Chromogenic Detection

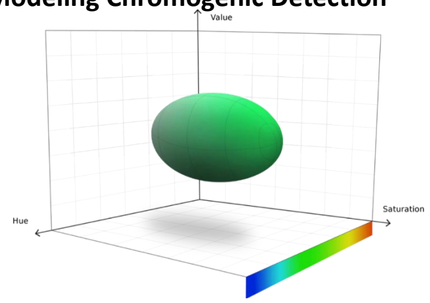

Figure 1: HSV Color Space, where H (Hue) represents the Type of color, S (Saturation) represents the Intensity of the color and V (Value) represents the Brightness of the color. The "bubble" is the visual representation of the threshold volume in this three-dimensional space.

Figure 2. Representative Images of VRE Plates

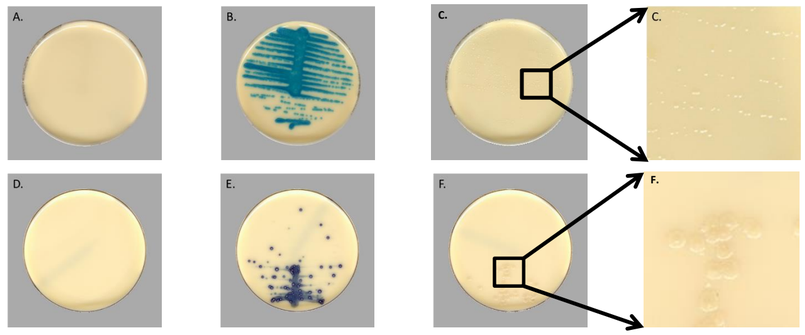

Figure 2. Representative digital images of Colorex VRE (top) chromogenic media and Oxoid VRE (bottom) captured by the WASPLab: no growth (A/D), Positive VRE (B/E) and breakthrough growth (C/F).

Table 1. Performance of the WASPLab digital imaging of VRE plates compared to manual reading

Clinical test site (Agar)	No. of specimens tested	Results (no.)[a]				Performance (% [95% CI])[b]	
		MP/AP	MN/AN	MN/AP	MP/AN	Sensitivity	Specificity
1 (Colorex VRE)	11,438	1,474	9,129	835	0	100 (99-100)	91.6 (91-92)
2 (Colorex VRE)	75,518	2,822	64,535	8,161	0	100 (99-100)	88.8 (88-89)
3 (Oxoid VRE)	17,774	2,107	14,315	1,352	0	100 (99-100)	91.4 (91-92)
Total	**104,730**	**6,403**	**87,979**	**10,348**	**0**	**100 (99-100)**	**89.5 (89-90)**

[a] MP/AP, Manual Pos, Automation Pos; MN/AN Manual Neg, Automation Neg; MN/AP, Manual Neg, Automation Pos; MP/AN, Manual Pos, Automation Neg
[b] CI, Confidence Interval

Figure 3. Discrepant analysis of MN/AP specimens N = 10,348

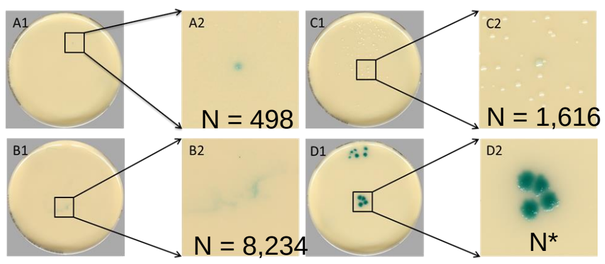

Figure 3. Examples of discrepant categories determined by a 2nd manual reading. Positive for growth (A1 and A2), residual matrix (B1 and B2), non-positive colorimetric growth, (C1 and C2) and yeast (D1 and D2). *Yeast and residual matrix could not always be differentiated using images so these results were combined.

Conclusions

- The CDM is highly sensitive in detecting relevant chromogenic color changes with 100% sensitivity and an average of 89.5% specificity. The software may help detect more TP specimens as 498 specimens were characterized as positive after a second review.
- Batching negatives to be viewed as 40 per screen is reliable and may improve workflow
- Previous studies measuring TAT estimated that a negative plate takes 9.6 minutes of technologist time from the time received to the time processed. The WASPLab would reduce hands on time to approximately 2 minutes a negative specimen
  - At an average of $40.00 an hour (w/benefits) the WASPLab could reduce labor cost of negative specimens from $6.40 a specimen to $1.33 a specimen.