Evaluation of Four Urine Culture Chromogenic Agars Including Time and Cost Savings Analysis

Capistran E[1], Lévesque S[1,2], Martin P[1], Girard D[2], Papirakis M-E[2], Cloutier C[2], Cameron M[2], Brown N[2], LeBlanc L[1]

[1] Department of Microbiology and Infectious Diseases, Faculty of Medicine and Health Sciences, Université de Sherbrooke, Sherbrooke, Québec, Canada

[2]Centre Intégré Universitaire de Santé et des Services Sociaux de l'Estrie, Sherbrooke, Québec, Canada

E-mail: eve.capistran@usherbrooke.ca

Introduction

- Following laboratories centralisation, we observed an increase in volume of urine culture specimens from 39 600 specimens per year to 70 000 specimens per year in our tertiary-care university hospital.

Objective: Evaluate methods to improve workflow and potentially overall cost without decreasing global performance.

Advantages of chromogenic agars:
- Only one agar and decrease in lab work time
- Easier to interpert (ex: mixed cultures)
- Less additional tests needed with confirmatory identification on agar
- Potential decrease in turnaround time

Disadvantages of chromogenic agars:
- Cost per agar
- Possible diminution in sensitivity for fastidious gram positive pathogens

Methodology

- 310 urine specimens inoculated on 4 chromogenic agars + reference method (Blood agar + MacConkey)
  - ***Brillance*™ UTI *Clarity*™ agar Biplate (Oxoid)**
  - **BD™ CHROMagar™ Orientation (BD)**
  - **UriSelect™ 4 (Bio-Rad)**
  - **CHROMID ® Elite (bioMérieux)**
- Cloudy specimens chosen preferentially to increase rate of positivity
- Addition of 30 specimens spiked with *A. urinae* (26) and *C. urealyticum* (4)

Outcomes
- Global performance and recovery of Gram positive pathogens
- Appreciation by technicians
- Number of additional biochemical tests needed

Sub-analysis
- Time to inoculate and read 50 consecutives specimens for each agar
- Estimation of possible economy with implementation of chromogenic agar

Results

Global performance (positive and negative results) was BA + MAC 83,5%, Oxoid 81,3%, BD 89,1%, Bio-Rad 90% and bioMérieux 87,6%.

- Culture result was considered positive if ≥ 1 agar identified a pathogen and negative if most of the agars showed no growth or mixed flora.
  - Ex: one agar positive for *Staphylococcus* spp, while all others reporting mixed flora, was considered incorrect.
- Results of pathogen recovery presented in **Table 1**, with good and bad performances highlighted in green and red respectively.
- Time for inoculation + interpretation of 50 consecutive specimens, including rapid benchside tests, and estimation of required annual work time per agar presented in **Table 2.**
- Estimation of potential economy for each agar: calculation based on agar cost and required work time per agar, presented in **Table 3** .

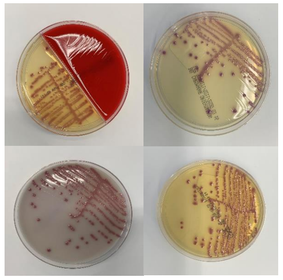

Figure 1. *E. coli* identified on Oxoid, BD, Bio-Rad and bioMérieux plates

Results (continued)

Table 1. Pathogen recovery: 4 chromogenic agars and reference method

Pathogen	Total	BA + MAC	Oxoid	BD	Bio-Rad	bioMérieux
Patient's specimens (n = 310)						
E. coli	67	54	52	62	55	60
Enterococcus spp	29	7	8	16	22	14
Klebsiella spp	18	18	11	17	16	15
Gr B *Streptococcus*	12	5	4	5	5	9
Proteus spp	6	6	4	6	6	5
P. aeruginosa	5	3	1	3	2	3
Staphylococcus spp	4	4	4	4	4	4
A. urinae	4	2	4	1	2	2
S. saprophyticus	3	3	3	3	3	3
Yeast	2	1	2	2	2	2
C. koseri	1	1	1	1	1	1
A. baumanii	1	1	1	1	1	1
C. jeikeium	1	1	1	0	1	1
S. aureus	1	0	0	1	1	0
Other nonfermenting bacteria	1	0	0	1	0	0
Mixed flora	-	132	134	101	106	106
Subtotal (excluding mixed flora)	155	106 (68%)	96 (62%)	119 (77%)	121 (78%)	120 (77%)
Selected specimens						
A. urinae	26	26	24	6	5	22
C. urealyticum	4	2	2	0	0	3
Subtotal	30	28 (93%)	26 (87%)	6 (20%)	5 (17%)	25 (83%)
Total	**185**	**134 (72%)**	**122 (66%)**	**125 (68%)**	**126 (68%)**	**145 (78%)**

Table 2. Inoculation and reading time for 50 consecutive specimens for each agar and estimated annual work time

Time (min)	BA + MAC	Oxoid	BD	Bio-Rad	bioMérieux
Inoculation (min)	32 :21	22 :02	17 :12	17 :12	17 :12
Interpretation (min)	61 :16	25 :20	29 :55	34 :03	24 :09
Total (min)	**93 : 37**	**47 : 22**	**47 : 07**	**51 : 15**	**41 : 21**
Estimated required work time per year (h)*	2185	1105	1100	1196	965

* Based on the number of specimens in 2018-2019 (70 000 specimens)

Table 3. Estimation of potential annual economy based on local 2018-2019 data and proposed agar cost

Annual Cost	BA + MAC	Oxoid	BD	Bio-Rad	bioMérieux
Annual cost per agar	35 490 $	63 350 $	42 000 $	66 500 $	39 900 $
Work time	63 675 $	32 171 $	31 821 $	34 902 $	28 074 $
Total	99 165 $	95 521 $	73 821 $	101 402 $	67 974 $
Economy	-	**3 644 $**	**25 344 $**	**-2 237 $**	**31 191 $**

Discussion

- Each of the 4 chromogenic agars performed well in different aspects. Scores were attributed to different criteria judged important to orient final decision. Strenghts and weaknesses of the 4 agars are summarized in **Table 4**.
- bioMérieux and Oxoid had a slight advantage in growth of the Gram positive pathogens, while bioMérieux retained satisfactory gram-negative growth.
- Monoplates were appreciated by lab technicians compared to the biplate.
- BD and bioMérieux showed better time and cost economy, due in part to possibility of direct identification and agar cost.

Table 4. Strenghts and weaknesses of agars based on pre-established criterias

	Oxoid	BD	Bio-Rad	bioMérieux
+	• Performance for rare Gram positive identification • Work time saved	• Global performance • Appreciated by lab technicians • Cost • Work time saved • Direct identification for *E. coli* and *Enterococcus* spp • Validated for Bruker • Less mixed flora	• Global performance • Appreciated by lab technicians • Work time saved • Less mixed flora	• Global performance • Appreciated by lab technicians • Cost • Work time saved • No supplemental test needed for *E. Coli* • Performance with rare Gram positive and Gr B *Strep* • Less mixed flora • Validated for Vitek-2 AST and Vitek-MS
-	• Performance for certain groups • Interpretation more difficult, less appreciated • Cost	• Performance with rare Gram positive and Gr B *Strep* identification	• Performance with rare Gram positive et Gr B *Strep* • Cost • Additional tests needed for *E. coli*	• Prior backorder in other chromogenic agars used in our lab

Conclusion

- CHROMID® CPS® Elite by bioMérieux was chosen based on good global performance as while as for more fastidious pathogens, best time and cost economy and for compatibility with identification and antimicrobial susceptibility testing platforms currently used in our lab (Vitek-MS and Vitek-2)
- The 4 chromogenics agars showed equivalent or superior performance compared to reference method. The use of chromogenic agar should be considered for cost and labor improvement.

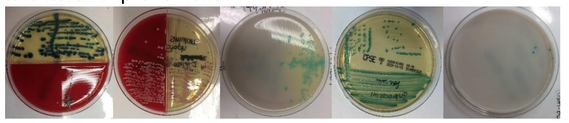

Figure 2. Different pigments on chromogenic agars