Evaluation of Chromogenic Media for the Work-up of Urine Specimens: Comparison of chromID™ CPS®, BBL™ CHROMagar™ and Colorex Orientation™ to Conventional Urine Culture Method

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ABSTRACT

Objectives: Chromogenic media offer the potential for more rapid identification of urinary pathogens while improving workflow by rapid elimination of contaminated culture. The purpose of this study was to compare the performance of three different chromogenic media (CHROM); chromID™ CPS® (CPS), BBL™ CHROMagar™ (BBL) and Colorex Orientation™ (CLX) to conventional urine culture (CUC) methods. **Methods:** A total of 580 routine urine samples were planted using CUC method (blood agar plates [BAP] and MacConkey agar [MAC]), the three study CHROM and a colistin-naladixic acid (CNA) plate. CHROM and CNA were incubated for 18-24h, and read by the same person who was blinded to the results of the CUC until the study was completed. Each CHROM result was compared to the CUC result and categorized as total agreement (TA), minor disagreement-mD (no change in report), major disagreement-MD (change in report, not clinically significant), very major disagreement- VMD (clinically significant change in report) and overall agreement (OA). **Results:** For all 3 CHROM tested, there was 100% (262/262) correlation with "no growth" result on CUC. CPS had 68.7% TA (399/580), 17% mD (97/580), 14% MD (82/580) and 0.3% VMD (2/580). CNA plate resolved 21% of MD (17/82) for an 88% OA (513/580). BBL had 70.2% TA (407/580), 20.5% mD (119/580), 9% MD (52/580) and 0.3% VMD (2/580). CNA plate resolved 21% of MD (11/52) for a 93% OA (537/580). CLX had 74.5% TA (432/580), 18.8% mD (109/580), 6.7% MD (39/580) and no VMD. CNA media resolved 20.5% of MD (8/39) for a 95% OA (549/580). **Conclusions:** (1) CLX outperformed both CPS and BBL in terms of overall agreement with the CUC and had no VMD. (2) The performance of all three CHROM was enhanced by including a CNA plate. (3) Despite the higher cost of CHROM/CNA combination compared to BAP/MAC, the CHROM/CNA combination will reduce overall laboratory costs by improving turn-around time to reporting, decreasing utilization of both manual and automated testing, and reducing technologist workload.

INTRODUCTION and OBJECTIVES

Urine cultures are a common and time-consuming test in microbiology laboratories. Processing urine cultures requires multiple steps, including inoculation of multiple media, as well as manual and automated identification tests. The work-up required to identify contaminated cultures can be significant in terms of resources and technologist time.

Chromogenic agars facilitate the identification of bacteria, but have previously been cost prohibitive. Increased use of these media has made pricing more competitive. Chromagar plates for urine samples have been developed to isolate, enumerate and directly identify the most common uropathogens associated with community acquired urinary tract infections (including *E.coli, Proteus spp , Enterococci spp, S.saprophyticus, P.aeruginosa, S. aureus, C.albicans* as well as the Klebsiella , Enterobacter, Serratia and Citrobacter group (KESC)). The plates can be inoculated directly from a urine sample for rapid detection, isolation and identification.

The purpose of this study was to compare conventional urine culture method to three different commercial urine chromagar (CHROM) plates in terms of accuracy and cost savings.

METHODS

For 30 consecutive days, the first 20 urine cultures were set up daily to routine urine culture plates (Blood Agar [BAP-Oxoid] and MacConkey [MAC-Oxoid] plates) as well as to three CHROM plates (chromID™ CPS® [CPS-bioMerieux], BBL CHROMagar® [BBL-BD] and Colorex Orientation [CLX-Alere]) and a Colistin-Naladixic Acid (CNA-Oxoid) plate. Each specimen was given a study number and reading of CHROM plates was blinded to routine urine culture results.

After 18-24 hour incubation CHROM plates were examined for growth and interpreted using colour and morphology to provide a preliminary identification. Plates were also evaluated for colour intensity and colonial discernability.

Each CHROM result was compared to the conventional result and categorized as total agreement (TA), minor disagreement (mD)- no change in report , major disagreement (MD) - non-clinically significant change in report, very major disagreement (VMD) - clinically significant change in report and overall agreement.

RESULTS

Of the 600 urine samples tested, 580 were deemed evaluable and included in the results. Twenty samples were discarded due to inadequate documentation or incomplete set-up.

By conventional method 262/580 urine samples had no bacterial growth and exhibited no growth on all 3 CHROM plates. Growth was observed on 318/580 of conventional cultures representing contamination, mixed growth, or predominant growth of one or more urinary tract pathogens.

The CHROM results (Table 1) are compared with the conventional culture result, and classified as TA, mD, MD or VMD. Discrepancies resolved with the CNA plate are also included

Table 1. Comparison of Study CHROM Plates to Conventional Culture Results

	chromID™ CPS®		BBL CHROMagar®		Colorex Orientation™	
	n	%	n	%	n	%
Total Agreement	399	68.8	407	70.2	432	74.5
Minor Disagreement	97	16.7	119	20.5	109	18.8
Major Dis. resolved w/ C.N.A.	17	2.9	11	1.9	8	1.4
Major Disagreement	65	11.2	41	7.1	31	5.3
Very Major Disagreement	2	0.3	2	0.3	0	0
Overall Agreement	513	88.4	537	92.6	549	94.7

The majority of discrepancies involved mixed cultures by conventional culture results that had differing colony counts. All three CHROM plates missed 1 *Aerococcus* spp. and 1 Coagulase negative *Staphylococcus* (both detected on CNA plate). All 3 CHROM plates missed *Lactobacillus spp* - (4 with CLX and 5 with BBL and CPS). The CNA plate did not resolve these disagreements.

Very major disagreements were observed only for BBL (n=2) and CPS (n=2).

- Conventional results -10^7 *E.coli*, BBL - <10 mixed growth x 2
- Conventional results -10^7 *S.anginosus group*, CPS – mixed growth x 3.
- Conventional results – mixed growth x 3, BBL and CPS -10^8 *Enterococcus* spp.

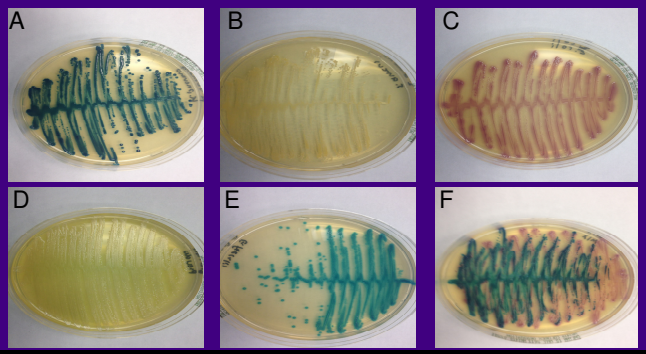

Figure 1. Colonies of *Klebsiella pneumoniae* (A), *Staphylococcus aureus* (B), *Escherichia coli* (C), *Pseudomonas aeruginosa* (D), *Enterococcus faecium* (E) and Mixed Organism Growth x3 (F) Grown on CHROM (CLX).

DISCUSSION

All three CHROM plates demonstrated excellent recovery of significant urinary tract pathogens, and similar colour intensity and discernability of bacterial colonies. However, based on study results Colorex Orientation™ Agar performed the best of the three CHROM tested, in terms of correlation with conventional results. (CLX- 95%, BBL-93%, CPS-88%). ChromID™ CPS® has a slight advantage over the other CHROM plates in differentiating *S. agalactiae* (Group B *Streptococcus)* from *Enterococcus* spp., but it was the only CHROM plate to miss Group B *Streptococcus* in the study (1/580). The disadvantages of all 3 CHROM is the decreased detection of *Lactobacillus spp.* which in most instances can be resolved with addition of a CNA plate. Although lack of *Lactobacillus* spp detection did not result in any major disagreements and hence clinical relevance, addition of CNA plate would nevertheless detect more *Lactobacillus spp* positive cultures, making it easier to identify contamination or mixed cultures.

Based entirely on acquisition costs (CAD) a CHROM plate with a CNA plate (~$1.00) will be almost twice the cost of a conventional urine culture using BAP and MAC plates ($0.56). The cost advantage is that CHROM requires no further work-up of *E.coli.* This study identified that 9.6% of cultures grew a significant colony count of *E.coli* . At our institution, based on *E.coli* alone, a $34,000/year cost savings can be achieved by switching to CHROM + CNA (based on 200 urine cultures/day using manual and automated identification tests- average cost $5.91). Although other urine cultures would be more expensive to process, technologist work-up time for identifying non-*E.coli* urinary tract pathogens, mixed cultures and contaminated specimens can be greatly reduced with a CHROM + CNA combination as colony colour makes it easy to differentiate organisms in mixed cultures in addition to providing rapid preliminary identification of important uropathogens.

CONCLUSION

Although all three CHROM plates performed well in terms colour intensity, colony count and ultimately identification of uropathogens compared to conventional urine culture work-up, the Colorex Orientation™ Agar and CNA combination performed the best with an overall agreement of 95% with conventional method. Addition of a CNA plate for better Gram positive recovery is recommended. Easy colour differentiation of uropathogens, along with rapid identification of mixed urine cultures result in significant cost savings both in identification tests as well as technologist time and will improve time to reporting.

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