Poster: P596

CPHM03 –

Diagnostic Bacteriology: Automation, Digital Imaging and Artificial Intelligence

# Digital detection and the use of Artificial Intelligence to detect Group A Streptococcus using a chromogenic agar

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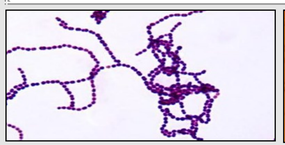
## ABSTRACT

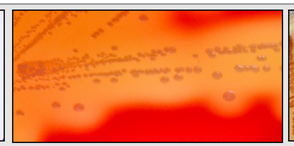
**Background:** Streptococcus pyogenes (Group A streptococci – GAS) is the major bacterial cause of pharyngitis occurring in people of all ages but seen most commonly among children 5 through 15 years of age. The use of antibiotics is recommended to treat GAS pharyngitis in children to shorten the duration of symptoms, reduce the likelihood of transmission to family members, classmates, and other close contacts, and prevent the development of complications, including acute rheumatic fever, peritonsillar abscess, and mastoiditis.

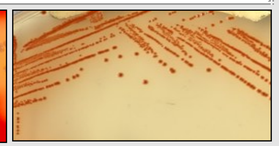
**Materials and Methods**: We studied the ability of a specialized Group A Strep chromogenic agar (Colorex Strep A agar – Chromagar) together with Copan's Phenomatrix artificial intelligence (AI) software (WASPLab chromogenic detection module) to detect GAS on this media. Results were compared to manual detection of the organism on standardized SXT-blood agar and visual reading. Potential GAS organisms from both types of media were confirmed as GAS by MALDI identification. Cultures were considered positive for GAS if MALDI confirmed GAS from either the chromogenic agar plates or the SXT-blood agar plates. A pyrrolidonyl arylamidase (PYR) test was performed to confirm positive cultures for GAS from the SXT-blood agar plates.

**Results**: A total of 252 specimens were tested from patients presenting to our medical centers, emergency rooms and clinics, as well as 25 samples spiked with S. pyogenes, which resulted in a total of 42 positive GAS cultures. The SXT -blood agar detected 40/42 (95.2% sensitivity, 100% specificity) of the positive cultures, while the Group A Strep chromogenic agar/PhenoMatrix AI algorithm software detected 42/42 (100% sensitivity, 97.45% specificity) of the positive cultures.

**Conclusions**: This study demonstrates that the utilization of Group A Strep chromogenic agar together with Copan's Phenomatrix artificial intelligence software was superior to the use of standard cultures on SXT-blood agar combined with manual reading. When undetected infections are left untreated the symptoms of Group A streptococcal pharyngitis are usually self-limited, however, patients, regardless of age, who have a positive test for GAS should receive antibiotics to prevent complications. The use of chromogenic agar together with AI software will more accurately detect these infections and allow for more appropriate patient therapy.







## INTRODUCTION

Group A Streptococcus (GAS; Streptococcus pyogenes) can cause both noninvasive and invasive disease, as well as nonsuppurative sequelae. Streptococcus pyogenes is the major bacterial cause of pharyngitis occurring in people of all ages but seen most commonly among children 5 through 15 years of age. It is rare in children younger than 3 years of age but when it does occur, it rarely manifests as acute pharyngitis; instead these children usually have a subacute picture of a mucopurulent rhinitis followed by fever (rarely high fever), irritability, and anorexia called "streptococcal fever". Patients older than 3 years of age may also present with a scarlatiniform rash called scarlet fever or scarlatina.

The most common risk factor for developing disease is close contact with another person with group A strep pharyngitis. Adults at increased risk for group A strep pharyngitis include parents of school-aged children and those who are often in contact with children. In addition, crowding, such as found in schools, military barracks, and daycare centers, increases the risk of disease spread.

The use of antibiotics is recommended to treat GAS pharyngitis in children to shorten the duration of symptoms, reduce the likelihood of transmission to family members, classmates, and other close contacts, and prevent the development of complications, including acute rheumatic fever, peritonsillar abscess, and mastoiditis. Thus, the raid and accurate diagnosis followed by appropriate therapy is necessary to avoid transfer and complications. We studied the ability of a specialized Group A Strep chromogenic agar (Colorex Strep A agar – Chromagar) together with Copan's PhenoMatrix artificial intelligence (AI) software (WASPLab chromogenic detection module) to detect GAS on the Colorex Strep A ChromAgar. This was compared to the use of our routine throat culture protocol using a blood agar-SXT (BAP-SXT) plate to determine if times of throat cultures could be shortened and if the BAP-SXT plate could be eliminated from our culture set up.

## MATERIALS AND METHODS:

252 patients presenting to our medical centers, emergency rooms and clinics had throat specimens collected in ESwabs and delivered to the laboratory processed on the WASPLab, planted on Colorex Strep A ChromAgar and read with the PhenoMatrix software. In addition, 25 spiked samples and 25 negative ESwabs were also processed on the WASPLab, planted on Colorex Strep A ChromAgar and read with the PhenoMatrix software. These same specimens/samples were processed on the WASP per our routine protocol using the BAP/SXT media, incubated offline and manually read. The spiked specimens were prepared by making a 0.5 McFarland suspension of a known Group A streptococcal isolate and placing 10uL into each of 25 ESwab vials.

The Colorex Strep A ChromAgar was incubated in the WASPLAB for 24 hours and then evaluated by the PhenoMatrix software for positive and negative cultures. The BAP/SXT plated cultures were incubated for 48 hours and read manually.

The Colorex Strep A ChromAgar/PhenoMatrix software results were compared to the results of manual detection of the organisms from the BAP/SXT agar with manual reading. Potential GAS organisms from both media were confirmed as GAS by MALDI identification. Cultures were considered true positives for GAS if MALDI confirmed GAS from either the chromogenic agar plates or the BAP/SXT agar plates. A pyrrolidonyl arylamidase (PYR) test was also performed to confirm positive cultures for GAS from the BAP/SXT agar plates.

## RESULTS

From the total 252 specimens that were tested from patients, the 25 samples spiked with S. pyogenes, and the 25 negative ESwabs (302 samples), a total of 42 (17 patient specimens and 25 spiked samples) were positive for GAS.

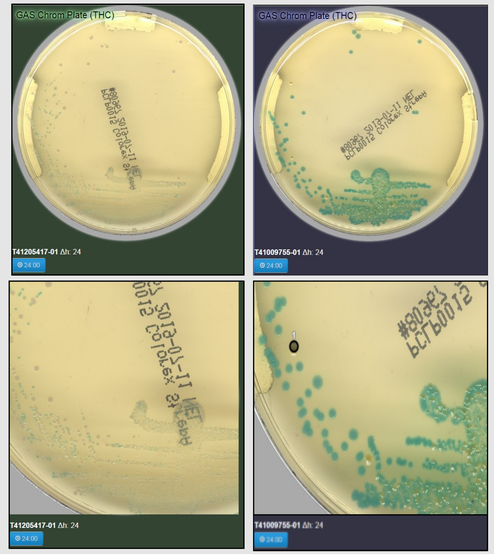
| Colorex Strep A ChromAgar/PhenoMatrix | |
|---|---|
| ***Positive*** | |
| True positive | 42 |
| False negative | 0 |
| ***Negative*** | |
| False positive | 0 |
| True negative | 260 |
| **Output** | |
| Sensitivity | 100.00% |
| Specificity | 100.00% |
| Positive predictive | 100.00% |
| Negative predictive | 100.00% |

| BAP/SXT Agar Manual Reading | |
|---|---|
| ***Positive*** | |
| True positive | 42 |
| False negative | 2 |
| ***Negative*** | |
| False positive | 0 |
| True negative | 260 |
| **Output:** | |
| Sensitivity | 95.45% |
| Specificity | 100.00% |
| Positive predictive | 100.00% |
| Negative predictive | 99.24% |

## RESULTS (cont'd)

**Positive images at 24 hours**


**Negative Images at 24 hours**




## CONCLUSIONS

The utilization of WASPLab and Copan's PhenoMatrix software combined with the Colorex Strep A ChromAgar out performed manual reading of routine BAP/SXT agar with regard to the detection of cultures positive for Group A Streptococcus. In addition, as the Colorex Strep A ChromAgar is designed to be read at 24 hours, we would not only be able to discontinue the use of the BAP/SXT agar in favor of the more accurate chromogenic media, but we would also be able to report out results for throat cultures sooner, decreasing our reporting time by 24 hours.

It is recommended that those who have a positive test for GAS should receive antibiotics to prevent complications. The use of chromogenic agar together with AI software will more accurately detect these infections and allow for appropriate patient therapy sooner.

As better and better chromogenic agars are developed which detect organisms of interest more accurately than current routine media, and as full laboratory automation in microbiology brings with it software algorithms that detect these organisms better than the ability of the naked eye, not only will we be able to detect pathogens more accurately, we will also be able to utilize software for discriminating between positive and negative chromogenic cultures. This will not only leave our technical staff the time necessary to perform other, more complex assignments, it will help fill the gaps we are currently seeing, and will continue to see, in microbiology technologist and technician positions

**ACKNOWLEDGEMENTS:**

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