Comparison of the Copan Swab to the BD Culturette and BD Port-a-Cul for the Collection and Transportation of Selected Aerobic and Anaerobic Bacteria

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ABSTRACT

Purpose:
The construction of a new core microbiology laboratory for our system provided us the opportunity to evaluate in parallel the impact of transport temperature and time on a group of clinically important aerobic and anaerobic bacteria.

For three selected aerobic strains (Neisseria gonorrhoeae, Haemophilus influenzae, Streptococcus pneumoniae) we compared Copan's Venturi Transystem Transport Swab (Amies agar gel without charcoal) to Becton Dickinson's (BD) Culturette (liquid Stuart). Similarly two anaerobic strains (Fusobacterium nucleatum, Peptostreptococcus anaerobius) were used to compare the same Copan system to the BD Port-a-Cul system.

Method:
Triplicate sets of transport swabs were dosed with 10^6 CFU/ml at the originating laboratory. Inoculated swabs were transported to the receiving laboratory at either ambient temperature or in a cooler with ice and held at room temperature for 6, 24, or 48 hours prior to processing. At the particular time point swabs were vortexed in 1ml or sterile saline. Serial 10-fold dilutions were made and 100 µl were plated to blood, chocolate, or CDC anaerobic blood agar plates and incubated as appropriate. The recovery rate was measured as the percentage of growth as compared to the initial 0-hour time point.

Results:
The Copan swab performed equally to or slightly better than the BD Culturette and Port-a-Cul in the recovery of the selected bacteria for both transport temperatures and for the various incubations time points. All swab systems demonstrated a dramatic decrease in recovery following a holding period of 24 hours.

Conclusion:
The Copan swab is a suitable choice for a single transport swab system in the merged hospital environment where microbiology services are consolidated. As demonstrated by our parallel studies this transport swab is notable for its ease of use and suitability for the recovery of both aerobic and anaerobic bacteria.

INTRODUCTION

In this study we compared the recovery efficiencies for three fastidious aerobes and two anaerobes for the various transport swabs currently used within Baptist Health Systems of South Florida. The impetus for the study is goal of procedure and reagent standardization and the eventual consolidation of the microbiological services of the System's two largest hospitals. Specimen integrity and clinical staff assurance are critical components to the success of this and any consolidation. Additional factors affecting the recovery of potential pathogens from patient specimens include the collection materials as well as the actual transport conditions. All of these factors must be evaluated in context of the new facility's physical design.

While it is generally accepted that tissues (biopsies, exudates, aspirates, etc.) are the specimens of choice for culture, transport swabs are frequently used due to their convenience and ease of use. Therefore, selection of an appropriate transport swab is a major factor that must be carefully evaluated. Several types of transport swabs (Copan's Venturi Transport System, BD Culturette, and BD Port-a-Cul) are used within our System. Additionally, the time spent and temperature during transport of the transport swabs can also affect the viability of fastidious and anaerobic bacteria.

The success of our consolidation depends upon the careful evaluation of all these external factors. This consolidation provides the Microbiology Laboratory the opportunity to evaluate the efficiencies of the various transport swabs used within the System and the transportation parameters potentially affecting specimen quality.
MATERIALS AND METHODS

BACTERIAL STRAINS

Aerobic

- Neisseria gonorrhoeae (ATCC 43069)
- Haemophilus influenzae (ATCC 10211)
- Streptococcus pneumoniae (ATCC 6305)

Anaerobic

- Fusobacterium nucleatum (ATCC 25586)
- Peptostreptococcus anaerobius (ATCC 27337)

TRANSPORT MEDIA

Aerobic Transport System Challenge

- Culturette with liquid modified Stuart's transport medium (Becton Dickinson Microbiology Systems, Sparks, MD)
- Copan's Venturi Transystem Transport Swab with Amies agar without charcoal flushed with nitrogen, contains oxygen scavengers (Copan Diagnostics, Inc., Corona, CA)

Anaerobic Transport System Challenge

- BBL Port-a-Cul medium with Amies gel and resazurin in a buffered medium (Becton Dickinson Microbiology Systems, Sparks, MD)
- Copan's Venturi Transystem Transport Swab (as described above)

PROTOCOL

1. Originating Laboratory
   a. Lyophilized ATCC cultures were reconstituted and cultured onto TSA with 5% sheep blood, chocolate agar, or CDC anaerobic blood agar.
   b. Following 18 hours (aerobes) or 24 hours (anaerobes) of growth suspensions were prepared for each bacterial isolate in saline equivalent to a 0.5 McFarland standard (1.5 x 10^8 CFU/ml).
   c. The 0.5 McFarland suspension was diluted in 1:10 in saline to create the inoculum suspension.
   d. Test swabs (3) were prepared for each time point (0, 6, 24, and 48 hours) and transport condition (ambient and 4ºC). Each test swab was dosed with 100 µl of the inoculum suspension.
   e. For time point 0 the process proceeded to Step 2.
   f. For time point 6, 24, and 48 hours the technologists prepared inoculated swabs for transport at ambient temperature using a routine courier box. For refrigerated transport an insulated courier box with frozen cold packs (<10ºC) was purchased. Temperatures were monitored with a continuous recording thermometer.

2. Receiving Laboratory
   a. Following each time point designated swab sets were removed and placed in tubes containing 1 ml of sterile saline.
   b. Each swab was vortexed vigorously for 10-15 seconds and the inoculum was thoroughly expressed by pressing against the side of the test tube. The swab was discarded.
   c. 100 µl of the vortexed suspension was removed and serially diluted in 0.9 ml to form 10^-1 and 10^-2 dilutions. Each dilution was thoroughly vortexed.
   d. 100 µl of each original suspension and each dilution was spread evenly over the entire surface of an appropriate culture plate using a cell spreader. This step was performed in duplicate.
   e. The inoculated plates were incubated at 37ºC using the appropriate atmospheric conditions required by each bacterial strain.
   f. Each plate was examined following 24 to 48 hours of incubation for sufficient growth. Colonies on each plate were counted. The results for the duplicate sets of each sterile dilution were averaged.
   g. The recovery rate was measured as the percentage of growth compared to the initial 0-hour time point.

RESULTS

COMPARISON BETWEEN TRANSPORT SYSTEMS AT AMBIENT TEMPERATURE

1. After a transport period of 6 hours the Copan swab recovered significantly more organisms (H. influenzae, 9%; N. gonorrhoeae, 10%; S. pneumoniae, 7%; F. nucleatum, 13%; P. anaerobius, 10%) than the BD Port-a-Cul transported at ambient temperature. For longer time periods, transport conditions of 4ºC appeared to be superior.

2. After 24 hours the recovery efficiencies for both transport systems for all organisms except H. influenzae were approximately equal (~1%). H. influenzae had a >21% recovery with the Copan swab.

3. Recovery efficiencies for either transport system were not significantly different following 48 hours of transport for S. pneumoniae, F. nucleatum, and H. influenzae. At this time point the Copan swab yielded only 5% of the original colony count for N. gonorrhoeae, while the BD Culturette was culture negative. The Copan swab and BD Port-a-Cul were culture negative for P. anaerobius.

COMPARISON BETWEEN TRANSPORT SYSTEMS AT 4ºC

1. After 6 hours the differences between recovery efficiencies of all test strains in both systems were <8%.

2. These differences decreased to 4% at 24 hours for all strains with the notable exception for H. influenzae where the Copan swab yielded 29% more than BD Culturette.

3. Recovery rates at 48 hours for all transport swabs mirrored the rates obtained from those held at ambient temperatures.

COMPARISONS BETWEEN TRANSPORT TEMPERATURES

1. Most significantly at 6 hours the BD Port-a-Cul transported at 4ºC recovered 16% more F. nucleatum than the BD Port-a-Cul transported at ambient temperature.

2. At 6 hours the recovery rates for the Copan swab system were higher at ambient temperatures than for all organisms except for N. gonorrhoeae (<1%). For longer time periods, transport conditions of 4ºC appeared to be superior.
DISCUSSION AND CONCLUSIONS

Potential efficiencies achieved by the consolidation of microbiology laboratories demand that institutions evaluate their specimen transport systems to assure specimen integrity. Previous studies have indicated that factors such as transport systems and courier time prior to culture planting can have significant impact on the recovery rates of various microbes. The present study was conducted during August through the end of September. Typically during this time of year the highest temperatures for South Florida are recorded. Extra precautions must be taken when transporting specimens between various laboratories to assure specimen integrity.

A continuous recording thermometer was used to monitor the internal temperature of the transport containers carrying test swabs. It was determined that on the average the trip between facilities took less than 1 hour to complete. During this study the ambient temperature of the non-insulated container did not rise above 30°C. Transport temperatures in the insulated container incorporating the coolant pack did not decrease below 4°C nor rise above 10°C during transport.

CONCLUSIONS:

Performance: The Copan swabs performed equally or slightly better than the BD Culturette and the BD Port-a-Cul transport swabs for all strains tested.

Standardization: System-wide standardization upon a single transport swab for bacterial culture eliminates confusion and potential reduces collection errors.

Savings: The System can realize significant cost savings adapting the Copan swab. Although pricing is usually controlled by national or local contract agreements the following provide a rough estimate of savings.

a. Copan swab = $0.25 – 0.35
b. Culturette = $0.30 – 0.35
c. Port-a-Cul = $1.20 – 1.30

CHARTED RESULTS