


**Biography**

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**‘Swabs’ then and now: cotton to flocked nylon**

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Microbiological sample collections using cotton-tipped swabs (with or without serum), Dacron™, rayon and calcium alginate, with shafts of wood, plastic and various thicknesses and types of metal have all been used over the years. The swabs have been contained in glass or plastic tubes with and without various types of transport media. Swabs are an easy and popular method of sample collection, although microbiology laboratories traditionally prefer tissue, body fluids or aspirates ahead of swabs. As microbiology laboratories increasingly adopt near patient testing and molecular detection methods to reduce test turnaround times, new sample collection methods are required to maximise the sensitivity of these expensive tests and reduce the possibility of failed tests due to sample inhibitors or poor collection techniques.

Flocked nylon swabs have been developed by Copan in the last decade and are produced using a technique of spraying nylon fibres onto a rigid core. This has the effect of increasing the surface area for sample collection and also provides easy elution of the collected material. These swabs are polymerase chain reaction (PCR) inhibitor-free, RNase-negative and DNase-free and there is in addition a range of flocked swabs, specifically intended for forensic DNA investigations that are certified human DNA-free. The advantages, disadvantages and appropriate use of swab collections for microbial detection in the 21st century will be presented.

Sterile swabs are a popular and convenient method of collecting samples for microbiological analysis. A review of any standard microbiological textbook from the early decades of the 20th to the 21st century provide lists of swab samples that are acceptable for analysis and some have details of recommended swab types.

Swabs have always been considered inferior to fluid, aspirates or tissues but their low cost, convenience and ease of use have made them popular amongst clinical staff responsible for specimen collection.
Sterile swabs are an important historical and current method for the collection of microbial samples for analysis. Typically they have a slender stem with absorbent material on one end to dip into exudative pus or cavities. Traditional swabs had a stem of wood and a pledget of cotton wool at one end. The swab was then packed in an individual container, labelled, dated and sterilised, ready for use.

Unfortunately, cotton contains fatty acids which inhibited some bacteria and the wooden stems were also found to contain inhibitory substances. These swab sticks were also too thick to pass into narrow cavities such as the external auditory meatus or urethra and too rigid to reliably enter and sample the nasopharynx.

Calcium alginate tips and twisted metal or flexible metal or plastic were a welcome introduction as collecting options but calcium alginate dissolved in liquids and inhibited detection of herpes viruses and chlamydia. Metal shafts could not be broken into transport medium requiring sterile scissors or reusable transport tubes.

Dacron™ is a registered trademark for a polyester fibre filament, rayon is the generic term for manufactured regenerated cellulose fibre and nylon is a family of synthetic fibres known as polyamides. All of these products have also been used on swab tips.

With the increasing use of PCR detection of microbes, swab sticks needed to be free of extraneous DNA and DNases and inhibitors that were known to be present in cotton and alginate swabs and Stuarts and other transport media.

In 2003, the first reports of a new collection swab were published. Instead of wrapping the end of the shaft as had been done previously, inert nylon fibres were sprayed onto a base, providing an enormously improved surface area for collection, easy removal of material and an inert base. These swabs were named “Flocked swabs”. The short nylon fibre strands were

<table>
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<th>Swab tip</th>
<th>Shaft</th>
<th>Use</th>
<th>Disadvantages</th>
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<tr>
<td>Cotton</td>
<td>Wood</td>
<td>Non-fastidious bacteria genital, respiritory, gut, fistulae, wounds. Tip may be too bulky for some orifices</td>
<td>Fatty acids toxic to some fastidious bacteria and chlamydia. Serum tipped toxicity</td>
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<tr>
<td>Cotton</td>
<td>Plastic</td>
<td>Can be bulky</td>
<td>Not easily broken into transport media</td>
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<tr>
<td>Cotton</td>
<td>Wire (rigid)</td>
<td>Fine tips for NPA, EAM, urethra, cervix</td>
<td>Require sterile wire cutters or another tube for transport</td>
</tr>
<tr>
<td>Cotton</td>
<td>Wire (woven/flexible)</td>
<td>As above</td>
<td>As above</td>
</tr>
<tr>
<td>Dacron™ &amp; rayon</td>
<td>Wood, plastic, wire (rigid), wire (woven)</td>
<td>Increased isolation of S. pyogenes because of inert and absorptive capacity. Used for detection of viruses. Small tip useful for genital swabs, fungi</td>
<td>Toxic to ureaplasma, lipid-enveloped viruses, cell cultures, M. gonorrhoeae</td>
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<tr>
<td>Calcium alginate</td>
<td>Can be useful to detect Chlamydia</td>
<td></td>
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<tr>
<td>Flocked nylon swabs i.e. medical-grade polyamide.</td>
<td>Plastic with moulded break point</td>
<td>Respiratory viruses PCR Bacteria viruses</td>
<td>Cost higher than cotton-tipped swabs but surface area collects more sample which is easily eluted</td>
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attached to moulded plastic with a hydrophilic layer of nylon pile that allowed efficient collection and release of particulate matter, including cells.

**Sample collection**

Clinicians should be discouraged from sending swabs from burn wounds, colostomy discharge, decubitus ulcers, skin, periodontal or perirectal abscesses and varicose ulcers because of the rich normal and contaminating flora in these areas and the difficulty of deciding which of the many organisms present may be associated with a disease process.4,5

**Swab testing**

**Chlamydia**

When chlamydia cultures were used to confirm infection with this organism, cotton, Dacron™ or rayon tips and metal or plastic shafts were used. Each lot of swab needed to be tested for chlamydia replication and toxicity because it was known that calcium alginate or wooden shaft swabs were inhibitory to chlamydia recovery.5

The need for the swab toxicity technique has been superseded by the use of molecular methods to detect chlamydia but may still be needed if culturing for chlamydia is undertaken.

**Viruses**

Cotton, Dacron™ or rayon swabs for detection of viruses used to be placed in 1–2ml of viral transport medium and vortexed to release the cells but the cell yield was often low and the test thus insensitive for virus detection. There have been a number of published papers documenting the poor sensitivity of nasopharyngeal swabs10,11 for the detection of respiratory viruses such that some virology laboratories did not accept nasopharyngeal swabs for testing for respiratory viruses.12

In 2006 Daley et al.13, reported a comparison of epithelial cell recovery from flocked and rayon swabs in nasopharyngeal and nasal swabs from patients with upper respiratory tract symptoms and asymptomatic volunteers. They showed a significantly greater number of respiratory epithelial cells were collected by the flocked swabs compared to the rayon swabs, with 58.6 (mean) cells/hpf compared to only 23.9 cells/hpf from the rayon swabs.

Flocked swabs for collection of upper respiratory tract samples for detection of respiratory viruses are easy to collect, cheaper than nasopharyngeal aspirates and safer for the collector as fewer aerosols are produced.

With a two- to threefold increase in cell yield, this means that the sensitivity of the test is also increased, resulting in fewer false negative results, earlier introduction or cessation of antiviral treatment and decreased risk of cross-infection to other patients and staff.

**Fungi**

Swab specimens for detection of fungi should be eluted into a small volume of sterile water and this should be used to inoculate culture media. Direct application of swabs to culture media is also appropriate.5

**Anaerobic bacteria**

Collection of swabs for anaerobic culture should be discouraged and swab collections rejected.4 The specimen volume is small, organisms adhere to the swab fibres and the likelihood of recovery of anaerobes is reduced.

**Flocked swabs**

The flocked swabs available in Australia are produced by Copan and distributed by Interpath Services Pty Ltd or rebranded as “BD” under an agreement with Copan by Becton Dickinson (BD). They are described (www.copanusa.com accessed 23/4/2010) as:

> *Copan’s Patented*® Flocked Swabs comprised of a solid moulded plastic applicator shaft with a tip that can vary in size and shape. The tip of the applicator is coated with short Nylon ® fibres that are arranged in a perpendicular fashion. This perpendicular arrangement results from a process called flocking, where the fibres are sprayed onto the tip of the swab, while it is held in an electrostatic field ... The perpendicular Nylon ® fibres act like a soft brush and allow improved collection of cell samples. Capillary action between the fibre strands facilitates strong hydraulic uptake of liquid sample, and the sample stays close to the surface allowing easy elution.

Copan flocked swabs are versatile and ideal for bacteriology samples, virology culture, DFA testing, rapid direct testing, EIA, PCR and molecular-based assays, as well as for forensic applications14-18.

Flocked swabs are human DNA-free, PCR inhibitor-free, RNase-negative and DNase-free.

**In summary**

Swabs provide a convenient method of sample collection for all aspects of microbial detection. The cotton-tipped swabs are cheap and easy to use and still have a place in routine bacteriology and surveillance cultures. They have been superseded by Dacron and Rayon and now flocked nylon swabs for specific samples and microbial detection.
Flocked nylon swabs provide a sensitive collection method for culture, rapid, near patient testing and molecular detection of a variety of bacteria and viruses because of their ability to absorb cells then release them effectively to increase the sensitivity of detection of infecting microbes. Flocked swabs are more expensive than cotton or Dacron™-tipped swabs but their dual application for culture and molecular testing can reduce handling and storage costs and test turnaround times.

The move to molecular detection of microbes requires use of optimal collection techniques to maximise their accuracy and sensitivity.

References

Biography
Joan Faoagali is a medical microbiologist Princess Alexandra hospital Brisbane Queensland.

Recent advances in molecular and non-PCR-based platforms for the rapid diagnosis of invasive candidiasis in the ICU

Definite shift towards non-C. albicans species (especially Candida glabrata) infections, which has been attributed to the increased use of fluconazole prophylaxis in some centres. Early antifungal therapy significantly reduces IC-related mortality but is often delayed because ‘gold standard’ diagnosis by culture and/or histology is insensitive (for example, 50% candidemia cases not detected by blood culture) and slow (at least 48–96 hours required for species detection and identification). This article highlights a number of recent advances in molecular and non-PCR-based technologies that have enabled more rapid diagnosis of IC in the ICU (a recent review 4 provides a comprehensive summary of molecular and serological methods in diagnostic mycology).

Rapid diagnosis from positive blood cultures

Numerous real-time polymerase chain reaction (PCR) assays to rapidly identify yeasts from positive blood cultures have been described with mostly high sensitivities and specificities 5–7. These are generally simple and easily adapted into the routine workflow with results typically available within three hours of blood