Cholera – Laboratory perspectives on environmental sampling

What is a Moore pad/swab?
A Moore pad (a.k.a. Moore swab) consists of multiple layers of surgical gauze with a string/wire tied to one corner to allow the pad to be fixed in a flowing stream of sewage or water. A SOP on “Moore pad preparation for public health laboratory” can be accessed on Q-Pulse (GLCP0012v1).

The pad is left in the water stream for a period of 24-72 hours to "filter" microorganisms. Thereafter, it is removed (using a sterile technique) and immersed in double strength alkaline-peptone broth. Samples must be transported to, and arrive at the laboratory, the same day of collection. If delayed by >24 hours, the samples should not be processed. An SOP on "Testing of sewer pads for Vibrio cholerae", that also gives further information on specimen collection, may be accessed on Q-Pulse (NJHF0308v2).

Is a Moore pad a useful environmental sample?
Used correctly, and in specific situations, environmental sampling using Moore pads can be useful. However, there are many considerations and limitations that must be recognised when collecting these specimens and interpreting the laboratory findings.

Sewage and septic tank sampling:
Studies have demonstrated the Moore swab to be useful in isolating V. cholerae, specifically from septic tanks and sewage systems, when there is a strong suspicion of the presence of cholera. In these settings, Moore pad sampling can be fairly sensitive (up to 70%) if multiple specimens of each system are taken.

Sewer surveillance using Moore swabs may be an effective way to determine whether V. cholerae O1 infections are occurring in an area as there are many benefits:
- Sewer swab surveillance is typically under the control of the health department; therefore conducting surveillance does not require additional permission from private individuals, patients or organisations for sample collection.
- It is relatively inexpensive, since swabs can be made from locally available materials and sampling requires minimal human resources.
- It may lead to the detection of asymptomatic infections and mild disease that would otherwise be missed by conventional patient-based surveillance systems.

However, there are major disadvantages to this surveillance approach that reduce its usefulness in public health practice and informing timely disease control interventions:
- It is only useful in settings where the population is connected to a sewage system. Notably, cholera is a disease often associated with communities with poor sanitation infrastructures.
- In complex sewage systems, it is extremely difficult and time consuming to identify the infected person.
- Sample collection and laboratory analysis is time consuming, requiring a minimum of 48 hours for the entire process.

Nevertheless, an effective surveillance system for cholera, especially in endemic settings, could include periodic use of Moore swabs/pads in the influents of municipal sewage plants to determine whether V. cholera O1 infections are occurring and subsequent culture of stools from persons with diarrhoeal illness if the organism is found in sewage.
Water sampling:
The Moore swab can be used for sampling water as well as sewage, but it is useful only for rivers and flowing water sources and offers no particular advantage over other sampling methods (see below) for stationary water sources. Surveillance using Moore pads should only be done in high-risk areas where there is a definite chance of cholera being detected. Bacterial concentrations of V. cholerae when present in open water systems is significantly less (bacteria are more diluted) as compared to sewage systems; therefore, negatively affecting the sensitivity of this sampling technique. These bacterial concentrations may still be capable of spreading infection and disease when consumed, but one can expect frequent false-negatives when sampling water, which is often misleading to less educated health officials and the general public. Furthermore, the Moore pad sampling technique is not useful in sampling treated water supplies.

What other methods are available for sampling water for Vibrio cholerae?
The preferred method for sampling drinking water and other open water supplies is simply the collection of large quantities of water (typically 1,000 ml per sample) in sterilised containers. Generally, the larger the water sample, the greater the chance of isolating V. cholerae. Systematically collecting multiple samples from strategic sites can also enhance the chances of isolation. When sampling treated water supplies (e.g. municipal water) sodium-thiosulphate should be added to counteract the presence of oxidising agents (incl. chlorine). Because V. cholerae survives best in specimens held at 4˚C, specimens should be refrigerated during transport to the laboratory by placing them in an insulated box with frozen ice-packs. The specimen must not be frozen or be allowed to overheat. A SOP on “Receiving and processing of waters for Vibrio cholerae” can be accessed on Q-Pulse (TADM0103).

What are the public health implications in sampling water for V. cholerae?
While sampling of water systems for V. cholerae can play a role in surveillance and outbreak investigations (as discussed above), there are many pitfalls around this practice to keep in mind when interpreting the laboratory findings. The potential for the occurrence of false-negative results is high when one considers the many limitations, requirements for multiple, strategic, large volume samples, and the overall sensitivity of these sampling methods. In general, V. cholerae is isolated from only 1% of water samples analysed during epidemic periods and rarely during interepidemic periods, despite evidence of contamination.

During a cholera outbreak, negative laboratory results for V. cholerae must be approached with caution and should not be used frivolously to inform health officials about the safety of water sources. For example, if a negative water test result for cholera is utilised to inform the community that the water is “safe to drink”, and/or halt preventative interventions (e.g. practices for purification of water within household), the consequences could be dire. Rather, investigations of water supplies for cholera in endemic or epidemic situations must be collaborated by epidemiological investigations and patient-based surveillance. Furthermore, more sensitive laboratory analyses (e.g. the detection of coliforms and E. coli in water) can be used as proxies to indicate potential sewage contamination and the probable presence of multiple pathogens including V. cholerae O1 during outbreaks.

On the other hand, the positive finding of V. cholerae in environmental samples should also be approached with caution. All isolated of V. cholerae need to be analysed further to determine if it is a serogroup O1 or non-O1. V. cholerae non-O1 exists more freely within the environment and, although it can cause sporadic infections, the serogroup is not associated with epidemics; therefore, such findings do not warrant extensive and costly investigations.

Additional information: