# PRACTICE MANAGEMENT: OPPORTUNITIES AND CHALLENGES

## The Study of a Contaminated Colonoscope

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Gastrointestinal (GI) endoscopy departments may sample their flexible endoscopes microbiologically, either after reprocessing or prolonged storage, as part of a comprehensive quality assurance program.[1] Although a controversial practice that generally is not recommended, except possibly during an outbreak investigation, the periodic monitoring of a GI endoscope may be performed to evaluate the effectiveness of an endoscope-reprocessing procedure, or to determine the cause of an identified infection. Although the lack of surveillance cultures to grow bacteria does not confirm the sterility of the endoscope, bacterial growth in any one of these collected samples likely indicates endoscope contamination and, therefore, the potential for disease transmission. Microbiological sampling of a GI endoscope can yield insightful data, but the shortcomings of this practice are significant and its applications and usefulness are limited. For example, the techniques used to collect microorganisms from an endoscope's internal channels and other sampled surfaces have not been standardized and their methodologies not validated, which can cause the results of surveillance cultures to be unreliable and inaccurate.

In accordance with its standard operating procedures, a GI endoscopy department in the southwest United States each month microbiologically samples for bacterial contamination one of its several models of reprocessed GI endoscopes. On one occasion in the winter of 2009, some of the cultures collected from the sampled surfaces of a stored (and randomly selected) colonoscope, known as the test colonoscope, yielded positive growth for both patient-borne and environmental bacteria—a finding that raised the specter of disease transmission. In response, this GI endoscopy department initiated an investigation to evaluate the risk of infection during GI endoscopy and assess whether this finding might harbinger a true or pseudo-infection or outbreak. This investigation included an inspection of this GI department's endoscope-reprocessing practices.

Although causally associating disease transmission with a specific GI endoscope and reprocessing breach can for a number of reasons be challenging, if rare, the medical records of patients nonetheless were examined during this investigation to evaluate whether any infections might be attributable to an improperly reprocessed GI endoscope. These records were reviewed, for example, to determine whether a patient with no other risk factors for infection and known previously not to have been infected with the hepatitis C virus had tested positive for this virus' antibodies after undergoing colonoscopy in this GI endoscopy department.[2] Because surveillance cultures collected from a colonoscope the previous month yielded no growth, only those patients on whom a GI endoscope was used during the past 4 weeks (during which time a new staff member was hired to reprocess endoscopes) were considered to be at an increased risk of infection. Although the potential for any of this GI endoscopy department's upper and lower GI endoscopes to be contaminated after reprocessing was not ruled out, this investigation focused on the reprocessing of its colonoscopes.

### Methods

The suction channel, suction valve, insertion tube's exterior surface, and water-jet (or auxiliary water) channel of the test colonoscope were sampled in accordance with published microbiological techniques and this GI endoscopy department's standard operating procedures.[3] The genus and, when possible, both species and strain of each of the cultured bacteria were determined, to evaluate their epidemiology, mode of transmission, pathogenicity and reservoir, or source. The same surfaces of a second randomly selected colonoscope, known as the positive control because it had just been used during a procedure but had not yet been reprocessed (and, therefore, would be expected to be contaminated), were similarly sampled using these same microbiological techniques and procedures. Providing a reference for contamination, a positive control shows the specific types of bacteria that may contaminate the colonoscope during a routine procedure. It also confirms that the sampling techniques effectively recovered microorganisms from the endoscope's surfaces. If samples collected from this positive con-

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*Abbreviations used in this paper:* GI, gastrointestinal; MAI, *Mycobacterium avium-intracellulare*.



1542-3565/$36.00
doi:10.1016/j.cgh.2010.04.025

trol were to yield no growth, however, then understanding that the colon's natural flora (or, indigenous microbiota) contain bacteria, this nil result would show, for example, that the sampling techniques are faulty, or, among other possible errors, that the culture media might have expired and no longer support bacterial growth invalidating the results.

The same respective surfaces of a third randomly selected colonoscope used by this GI endoscopy department, known as the negative control because it had been sterilized using ethylene oxide gas before this study and, therefore, as its name suggests, should yield no growth, were similarly sampled using these same microbiological techniques and procedures. A negative control shows, in part, whether the sampling, assay, and microbiological techniques, and the handling of the endoscopes by staff, are aseptic as required. If samples collected from the negative control yield growth, then, similarly, one or more of the microbiological techniques and procedures are faulty (eg, the collected samples were contaminated during handling in the microbiology laboratory or, alternatively, the sterilization process could be ineffective), a finding that also would invalidate the results. The samples collected from these 3 colonoscopes were assayed exclusively for bacteria, not viruses, because bacteria are easy to culture and their growth is often a reliable indicator of, in addition to an endoscope-reprocessing breach, contamination of the endoscope with other microorganisms, too, including viruses (and fungi).[4]

Several environmental surfaces, including the tap water and a sink's faucet aerator, both of which are used by this GI endoscopy department to rinse the colonoscope after high-level disinfection, which is performed manually, also were sampled microbiologically, as were the hands and fingernails of staff members, including a recently hired staff member who, along with others, handled the 3 colonoscopes sampled and studied during this investigation. The determination not only of a potentially infectious bacterium's specific genus and species (and strain), but also source (or potential reservoir) is important to identify the infection-control breach and to prescribe effective measures to prevent disease transmission.[5] (Not performed during this investigation, which is fictional, was an inspection of this GI endoscopy department's quality-assurance documentation. Such an audit is recommended, however, and should be conducted periodically to determine, for example, whether available for training and teaching are model-specific standard operating procedures instructing staff members how to reprocess each of the several models of GI endoscopes in inventory properly.)

## Results

The bacteria sampled from the test colonoscope and from the positive control are displayed in Table 1 and Supplementary Table 1, respectively. The insertion tube's exterior of both the negative control and the test colonoscope yielded *Staphylococcus aureus* (this result in not displayed in the Tables), the same strain of which also was cultured from the fingernails of the newly hired staff member. Samples from the sink's faucet aerator and tap water yielded *Pseudomonas aeruginosa*, *Mycobacterium avium-intracellulare* (MAI), and *Klebsiella pneumonia*; these same strains were also cultured from the test colonoscope (Table 1). None of these 3 bacteria was sampled from the positive control (Supplementary Table 1). No other environmental surfaces yielded growth of any of these 3 types of bacteria or of this specific strain of *S aureus*. Further, this investigation found that for the past month, although required by manufacturers' instructions, this GI endoscopy department had not been performing any of the following requisite practices: (1) routinely monitoring the concentration of the re-used high-level disinfectant; (2) leak testing the GI endoscope after each procedure; and (3) reprocessing the colonoscope's suction valve and water-jet channel after each procedure.

## Discussion

This GI department's active surveillance program detected the contamination of a colonoscope, which initiated an investiga-

**Table 1.** Bacteria Sampled From the Test Colonoscope, Examples of Common Sources of These Bacteria, the Sampled Surfaces Found to Be Contaminated, and the Likely Reprocessing Breach Responsible for the Contamination

| Bacterium | Examples of common sources | Sampled surfaces from the endoscope and environment found to be contaminated | Likely reprocessing breach responsible for the contamination of the colonoscope with bacteria |
|---|---|---|---|
| *S aureus* | Skin, hands | Exterior of colonoscope's insertion tube | Improper handling of the endoscope after reprocessing |
| | Moist environments: countertops, surfaces | Fingernails of staff member | Improper hand washing, hand hygiene |
| *P aeruginosa* | Skin, hands | Colonoscope's water-jet channel | Rinsing the reprocessed endoscope with contaminated water |
| | Moist environments: water, sinks, faucet aerators | Tap water, sink's faucet aerator | Inadequate drying of the endoscope |
| *K pneumonia* | Skin, hands | Exterior of colonoscope's insertion tube, suction channel | Rinsing the reprocessed endoscope with contaminated water |
| | Moist environments: water, sinks | Tap water, sink's faucet aerator | Inadequate drying of the endoscope |
| | Lower GI tract (normal flora) | | |
| MAI | Moist environments: water, sinks | Colonoscope's suction valve | Rinsing the reprocessed endoscope with contaminated water |
| | | Tap water, sink's faucet aerator | Inadequate drying of the endoscope |
| *E faecalis* | Lower GI tract (normal flora) | Exterior of colonoscope's insertion tube | Improper cleaning and high-level disinfection of the endoscope |
| | | Colonoscope's water-jet channel | |