The Therapeutics Agents Committee of the Surgical Infection Society updated its guidelines in 2002 regarding antimicrobial therapy for intra-abdominal infections. These guidelines cover selection of patients needing therapeutic antimicrobials, duration of antimicrobial therapy, acceptable antimicrobial regimens, and identification and treatment of high-risk patients. The guidelines for duration of antimicrobial therapy relied more on expert opinion than Class I evidence due to the paucity of randomized, controlled trials assessing duration of treatment. The lack of data can be explained by the heterogeneity of patient populations with intra-abdominal infections, the need for large numbers of patients, and the lack of incentive for an antibiotic manufacturer to fund a study that might suggest less use of antibiotics.

According to the guidelines, Class II evidence suggests that clinical evidence of ongoing infection (e.g., fever, leukocytosis) can be used to determine the success of antimicrobial treatment of intra-abdominal infections and therefore duration of treatment. Also, the presence of continued evidence of infection in patients already treated once should trigger renewed diagnostic evaluation. Re-evaluation does not necessarily imply prolonging antibiotic use or broadening antibiotic coverage; it is necessary to determine if other factors are involved in continued infection. Class II evidence also shows that 5 days of antimicrobial therapy is sufficient for the treatment of established intra-abdominal infection in the setting of adequate source control (i.e., adequate removal of infected material). (Note: Established intra-abdominal infections include a broad range of conditions, ranging from a periappendiceal abscess to infected pancreatic necrosis. These infections cannot be treated with antibiotics for 24 hours or less, as with brief contamination [e.g., peptic gastroduodenal perforations or traumatic bowel injuries less than 12 hours old] or significant intra-abdominal contamination [e.g., phlegmonous/gangrenous appendicitis or cholecystitis; resection of necrotic, non-perforated bowel]). Class III evidence suggests that a fixed duration of antibiotic therapy from 2 to 5 days should be decided upon at the time of initial intervention in the setting of adequate source control; as such, lack of adequate source control (e.g., a pancreatic infection) dictates a longer duration of therapy.

At the University of Virginia, 1343 consecutive intra-abdominal infections treated on the general surgery services were catalogued between December 1996 and July 2003. During this time, there were no established in-house guidelines on antibiotic treatment of established intra-abdominal infections. Of the 1343 infections, 1052 were treated without recurrence, with 291 (22%) having recurrence. The data were analyzed to look for factors that might predict risk of recurrence. The mean duration of antibiotic treatment was 14.5 ± 0.4 days. The most common duration of treatment was 11 to 15 days in 358 patients. Two hundred twenty-six patients were treated for 0 to 5 days. A total of 52 patients were treated with the longest duration, 25 to 30 days. The origin of infection also appears to play a role in duration of antibiotic therapy; liver/biliary, pancreatic, and urologic infections and infections with unknown origin were treated longer than those that were treated with other infections.

*Based on a presentation given by Robert G. Sawyer, MD, at the 43rd Interscience Conference on Antimicrobial Agents and Chemotherapy.
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originating from the stomach, duodenum, small bowel, appendix, and colorectum, as well as those classified as "other." The longer durations of treatment overall may be due to the availability of easily administered, highly active oral agents, which are given at discharge.

Based on these data, there also appears to be a direct, linear relationship between treatment duration and recurrence rate, approaching an exponential relationship with treatment longer than 25 days (Figure). Although these data are difficult to interpret, they do suggest that shorter duration of therapy is better.

Not surprisingly, the most commonly isolated organism from the entire study cohort was Candida albicans. Organisms least associated with recurrence were Candida species. One reason may be the higher number of patients taking proton pump inhibitor or H₂ blockers, which alkalinize the stomach.

The ultimate goal is to predict which patients will most likely have a recurrent infection. When analyzing these infections by organism isolated, Candida species, Escherichia coli, Streptococcal species, and Bacteroides species infections were associated more with no recurrences than with recurrence, while infections by Enterococcus faecium and E faecalis were associated more with recurrence. The reason for this may be found in the anatomic distribution of recurring versus nonrecurring infections. The sites more often associated with no recurrence than recurrence were colorectal, stomach, and small bowel. Sites of origin with more recurrent infections than no recurrences were liver/biliary, duodenal, and pancreatic. Why the difference in recurrence rate among anatomic origins? Colonic infections would likely be more severe due to their higher bacterial burden, large number of anaerobic bacteria, and larger proportion of mixed infections. However, if the colon is perforated, it can be resected or removed. The liver, pancreas, and duodenum cannot be resected. So, there is a mechanical limitation in source control. This also shows that infection recurrence is a product of both microbiologic (ie, antibiotic choice and duration) and mechanical failure (ie, source control).

Source control in intra-abdominal infections is particularly challenging because of the location of the abdomen. Intra-abdominal infections have sources in any of 10 or more different organs, each with its own set of pathologies. Intra-abdominal infections are heterogeneous compared with infections in specific organs. To illustrate, the Table compares the differences in characteristics between intra-abdominal infections and ventilator-associated pneumonia. Besides the involvement of 10 or more organs, intra-abdominal infections are more complicated in that they are usually due to a structural abnormality, are polymicrobial, and can also involve fungal pathogens. Antibiotics are used as adjuncts to invasive interventions (which are usually not standardized) in intra-abdominal infections rather than as primary therapy with ventilator-

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**Figure. Antibiotic Treatment Duration Versus Infection Recurrence Rate at the University of Virginia**

![Graph showing antibiotic treatment duration versus infection recurrence rate](image)


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**Table. Ventilator-Associated Pneumonia vs Intra-abdominal Infections**

<table>
<thead>
<tr>
<th>Ventilator-Associated Pneumonia</th>
<th>Intra-abdominal Infections</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 organ</td>
<td>10+ organs</td>
</tr>
<tr>
<td>Bacteria in wrong place</td>
<td>Structural abnormality</td>
</tr>
<tr>
<td>Usually monomicrobial</td>
<td>Usually polymicrobial</td>
</tr>
<tr>
<td>Fungi not pathogens</td>
<td>Fungal pathogens</td>
</tr>
<tr>
<td>Antibiotics primary therapy</td>
<td>Antibiotics are adjuncts</td>
</tr>
<tr>
<td>Invasive interventions generally not used</td>
<td>Invasive interventions commonly used but not standardized</td>
</tr>
<tr>
<td>Intensivists rely heavily on dogma</td>
<td>Surgeons rely heavily on dogma</td>
</tr>
</tbody>
</table>
associated pneumonia. Unfortunately, one area of commonality is that both surgeons and intensivists rely heavily on dogma with antimicrobial treatment. So, if they were taught as residents that 3 days of inpatient antibiotic therapy followed by 10 days of outpatient therapy is standard, it will be very difficult to convince them otherwise without randomized, controlled trials— which are unlikely to occur.

**CONCLUSION**

Although we do not have Class I evidence to support recommendations of antibiotic therapy duration for established intra-abdominal infections, the data strongly suggest that a limited time frame of about 5 days of therapy appears to be optimal, assuming adequate source control. Implementing these guidelines will require effort to get past the mindset of “longer is better.” Our experience at the University of Virginia support the data on more limited duration of antibiotic therapy and suggest that anatomic site of infection and causative organism may affect recurrence rate. This clearly requires further study, but these types of data can be used to promote change in hospital practice for antibiotic therapy.

**QUESTIONS**

**ASiM:** In using the clinical information to make a decision about when to stop antimicrobial therapy, does the presence or previous removal of drains have any impact on your decision?

**Dr. Sawyer:** Yes. Whether it should, I am not really sure. There are several different situations where drains are important. A drain that has stopped draining or does not appear to be draining purulent material should probably be removed and have no effect on what you do with antibiotics. We occasionally see drains that continue to put out material that looks infected; in those cases we tend to treat with antibiotic therapy longer. I am not sure if that is the best approach. Sometimes we also have enteric contents coming out through the drain, and that is a whole different discussion. In the intensive care unit, in patients for whom I am not satisfied with the recovery, or in those who are getting worse, I occasionally will culture drains that have been in for more than a couple of days to look for resistant organisms. I may also get a CT [computed tomography] scan and look for another site of infection. The CT scan and culture are done not because I think they are more accurate indices of infection, but if the patient is colonized with *Pseudomonas* in the abdomen, he or she is likely to have undiagnosed *Pseudomonas* as a pneumonia. So, every once in awhile, I use that information to change antibiotic regimens.

**ASiM:** If the drain is still putting out too much fluid for it to be removed— in other words there is intra-abdominal fluid, but the fluid does not look infected— how does that influence your decision?

**Dr. Sawyer:** If it is still draining material that is particularly serous or cloudy, I will stop antibiotics and leave the drain in. That is a drainage problem. If it is draining succus from the gastrointestinal tract, the clinician has to decide whether the infection has most likely turned into a fistula, which can influence the decision on antibiotics. I will leave drains in that are still draining more than 25 cc or 50 cc a shift, or 75 cc or 100 cc a day, as long as it does not look grossly infected. I stop antibiotics with the drains in. I do not think you need to leave antibiotics on until the drains come out.

**ASiM:** You talked about the challenges of implementing evidenced-based guidelines that counter established practice, particularly when intensivists and surgeons are slaves to dogma. Do you have any suggestions as to how to make these recommendations standard practice within a hospital?

**Dr. Sawyer:** I am at ground zero for that in my own institution. The best answer, of course, is always education. If you can get people to understand that they do not need to treat for a long time, that is the best approach, but it is difficult. If you have trainees at your institution, you are training a whole new group of residents every single year. The older faculty are harder to train. I can get the residents to buy into treating for 5 to 7 days, but their attending will come by and say, “Send him home on antibiotics.” We are not draconian in making people stop their antibiotics yet, but I want to decrease our mean duration of treatment.

**REFERENCES**