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Laboratory Diagnosis of HCV Infection

ABSTRACT & COMMENTARY

Synopsis: *Either a sensitive test for HCV RNA or a recombinant immunoblot assay (RIBA) may be used to confirm the presence of HCV infection in an individual with a positive screening test.*

Source: CDC. Guidelines for laboratory testing and result reporting of antibody to hepatitis C virus. *MMWR Morb Mortal Wkly Rep*. 2003;52:1-16.

THE CDC HAS UPDATED THEIR GUIDELINES REGARDING THE PERformance and interpretation of testing for the presence of hepatitis C virus (HCV) infection. Although primarily directed at laboratories, their recommendations are also useful to the clinician.

Two enzyme immunoassays (Abbott HCV EIA 2.0 and ORTHO HCV Version 3.0 ELISA) and 1 enhanced chemiluminescence immunoassay (VITROS Anti-HCV assay) have received FDA approval for use as screening tests in the detection of HCV infection. Although the specificity of these screening tests is > 99%, when applied to immunocompetent populations with anti-HCV prevalences < 10%, the false-positivity rate averages 35%. As a consequence, positive results with these tests require confirmation by a supplementary test—either a strip immunoblot assay (Chiron RIBA HCV 3.0 SIA) or a nucleic acid test (AMPLICOR Hepatitis C Virus Test, version 2.0 or COBAS AMPLICOR Hepatitis C Virus Test). Both nucleic acid tests have a lower limit of detection of approximately 50 IU/mL.

Falsely negative RIBA tests may occur during the first weeks after infection (the "window period"), and seroconversion rarely can be delayed for months. Persistent false-negative tests may occur in some immunocompromised patients. Indeterminate RIBA results may occur during the process of seroconversion and also in an occasional patient with chronic HCV infection. The meaning of an indeterminate RIBA may be clarified by repeating the test after an interval of at least 1 month or by testing for the presence of HCV RNA.

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INSIDE

A positive screening test may also be confirmed by HCV RNA testing. Patients with a positive screening assay and a negative assay for HCV RNA should undergo testing by RIBA. If the latter is also negative, the patient is considered to not be HCV-infected. If the RIBA is positive and HCV RNA is undetectable, the patient may have resolved the infection. Alternatively, this pattern may represent a temporary result in some patients during acute, as well as during chronic, infection. Thus RIBA-positive, HCV RNA-negative patients should have follow-up testing.

COMMENT BY STAN DERESINSKI, MD, FACP

These recommendations provide a straightforward set of guidelines for the interpretation of laboratory testing in suspected HCV infection. Perhaps the most difficult areas in clinical practice are dealing with the delay in seroconversion after acute infection and the recognition of false-positive antibody tests in some immunocompromised patients.

The average window period from infection to seroconversion is reported to be approximately 70 days.[1] One nucleic acid assay (not one of those mentioned above) reduced that period by an average of 26 days.[1] An ELISA test for HCV core antigen is reported to have similar benefit.[2]

Patients undergoing maintenance hemodialysis may have falsely negative HCV antibody tests. This was true of 5% of 238 seronegative patients in a German study.[3] In another study, 22% of HCV RNA patients were antibody negative.[4]

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Disappearing Antibiotics

ABSTRACTS & COMMENTARY

Synopsis: *The discontinuation of manufacture of cefixime has implications for the treatment of gonorrhea and for the future of antibiotic therapy in general.*

Sources: CDC. Notice to Readers: Discontinuation of Cefixime Tablets—United States. *MMWR Morb Mortal Wkly Rep*. 2002;51:1052; CDC. Oral alternatives to cefixime for the treatment of uncomplicated *Neisseria gonorrhoeae* urogenital infections. http://www.cdc.gov/std/treatment/Cefixime.htm.

IN ANTICIPATION OF THE EXPIRATION OF ITS PATENT ON November 10, 2002, Wyeth Pharmaceuticals discontinued the manufacture of cefixime. Since no company has elected to manufacture cefixime as a generic, the drug is no longer available. Should we care?

The answer is YES!

Uncomplicated *N gonorrhoeae* infections may be treated with single-dose regimens of cefixime 400 mg orally, ceftriaxone 125 mg intramuscularly, or an oral fluoroquinolone (ciprofloxacin 500 mg, levofloxacin 250 mg, or ofloxacin 400 mg).

Cefixime was the only CDC-recommended oral antimicrobial agent to which *Neisseria gonorrhoeae* has not developed significant resistance. The only recommended remaining orally administered agents for now are fluoroquinolones. However, resistance to fluoroquinolones is increasing, and this class of antibiotics should not be used for treatment of gonorrhea if the infection was acquired in Asia, the Pacific Islands (including Hawaii), or California because the prevalence of fluoroquinolone-resistant *N gonorrhoeae* is high in those areas.

In the absence of cefixime, the primary recommended treatment option for gonorrhea in Hawaii and California, as well as in young children and pregnant women, is ceftriaxone. Fluoroquinolones can continue to be used for treating gonorrhea in areas of the United States with low prevalence of fluoroquinolone-resistant *N gonorrhoeae*, but antimicrobial susceptibility monitoring should routinely be performed.

The CDC states that to be considered as a recommended treatment for uncomplicated gonorrhea, an antimicrobial regimen should cure > 95% of urogenital infections. Studies documenting efficacy should have sufficient sample size so that the lower limit of the confidence interval (CI) of the cure rate is also > 95%. The available data do not demonstrate that any single-dose oral antimicrobial regimen, other than cefixime or the fluoroquinolones, meet these efficacy criteria for gonococcal urogenital infection; published data on efficacy of alternative oral regimens in treating pharyngeal gonococcal infection are even more limited.

Azithromycin 2 g, as a single oral dose, has demonstrated an efficacy of 99.2% (95% CI, 97.2-99.9%) for urogenital infections and treatment efficacy of 100% for pharyngeal infection (95% CI, 82.3-100%) but has not been recommended because of expense and frequency of gastrointestinal intolerance. Nonetheless, this regimen may be considered (although not CDC-recommended) when IM ceftriaxone is not available or acceptable in circumstances in which fluoroquinolones cannot be used. Unfortunately, resistance to azithromycin has already been described.[1]

COMMENT BY STAN DERESINSKI, MD, FACP

Why the "YES!" answer above? While the unavailability of cefixime is an annoyance, its disappearance has broader implications in a world of increasing microbial resistance to antibiotics. We are already faced with reduced efficacy and repeated shortages of existing antibiotics, as well as limited new development of new agents.[2-4] Now we have an example of the unwillingness of a pharmaceutical company to continue the manufacture of an existing approved antibiotic for which there is an important need. Perhaps we are sliding into the "post-antibiotic era" much faster than we thought. ■

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M chelon Keratitis After LASIK Surgery

ABSTRACT & COMMENTARY

Synopsis: *Ten patients undergoing LASIK procedures at a single laser surgery center in Sao Paulo, Brazil, suffered corneal infection due to* Mycobacterium chelonae.

Source: Freitas D, et al. An outbreak of *Mycobacterium chelonae* infection after LASIK. *Ophthalmology*. 2003;110:276-285.

Freitas and colleagues report on 10 patients undergoing laser in situ keratomileusis (LASIK) for correction of refractive errors performed by a single surgeon at a laser surgical center during a 2-week period. At an average of 10 days after the procedure (range, 3-25), the patients returned with blurred vision, tearing, erythema, and photophobia. One patient had infection of both eyes. Examination of the cornea showed white infiltrates. Initial cultures done by the surgeon were reported as growing *Nocardia* species. He initiated treatment with multiple topical antimicrobial agents, topical corticosteroids, and oral trimethoprim-sulfamethoxazole. When the patients' symptoms worsened, they were referred to the University of Sao Paulo for further treatment. Corneal cultures there revealed *Mycobacterium chelonae*. Based on susceptibility studies, the patients were treated with an intensive topical regimen consisting of tobramycin, clarithromycin, and ofloxacin every hour until there was clinical improvement. The frequen-

cy of administration was then tapered to every 3 hours. All patients developed recurrent episodes (range, 1-4), which were treated by intensification of the topical regimen, addition of oral clarithromycin, and surgical debridement. Although all patients were eventually cured, most suffered permanent loss of vision due to corneal scarring, with best corrected vision of 20/25 to 20/100 (median, 20/50). Five patients also had uncorrectable astigmatism due to corneal scarring.

Water samples from the portable steamer used to clean the microkeratome, as well as from the air conditioning system of the surgical center, grew *M chelonae*.

COMMENT BY ROBERT MUDER, MD

LASIK is an increasingly popular surgical procedure used to correct visual refractive errors. The procedure involves cutting a flap in the corneal epithelium with a laser. The laser is then used to remove tissue from the corneal stroma, thus changing the refractive characteristics of the cornea. These procedures are often performed at free-standing laser surgical centers. Although infection is an uncommon complication, a variety of pathogens, including *Staphylococcus aureus*, *S epidermidis*, streptococci, *Nocardia* spp., and fungi have been reported.

Nontuberculous mycobacterial infection following LASIK may occur as sporadic cases or as outbreaks; implicated mycobacterial species include *M chelonae*, *M fortuitum*, *M gordonae*, and *M szulgai*. A previous cluster in California involved 7 patients infected with *M chelonae*.[1] Infection was highly associated with use of a soft contact lens as a corneal mask during the procedure; the source of the organism was not identified. As in the cluster reported by Freitas et al, patients required protracted courses of antimicrobial therapy, with several undergoing debridement procedures. All had some uncorrectable loss of visual acuity, with best corrected vision ranging from 20/25 to 20/200.

Nontuberculous mycobacteria are widely distributed in soil and water. Hospital water supplies, or devices using nonsterile water, are potential reservoirs of nosocomial infection. Mycobacterial infection following LASIK surgery may be more common than previously appreciated. A recent survey by the American Academy of Ophthalmologists of its membership identified 35 cases occurring over a 10-month period; thirty-one of these were part of 2 outbreaks not previously reported to the CDC.[2] One of the outbreaks, due to *M szulgai*, was traced to contaminated ice, made with tap water that was used to chill the saline solution used in the procedure.

These reports illustrate several important points. The first is that novel surgical procedures are often followed by novel surgical site infections. The second is that nonsterile water should not be used in invasive procedures. Tap water, and devices using tap water, harbor a variety of potential pathogens, including mycobacteria, nonfermentative Gram-negative bacilli, fungi, and *Legionella*. Introduction of these organisms into a critical site such as the eye can have disastrous consequences. Finally, an increasing number of surgical procedures are being performed in free-standing surgical facilities that may not come under the supervision of an effective infection control program. Whether or not this trend will be followed by an increase in nosocomial infection remains to be determined. ■

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Deflecting the Post-Antibiotic Era

MEETING COVERAGE

Synopsis: *The lack of new antibiotic development necessitates novel regulatory approaches.*

Source: www.fda.gov.

IT HAS BEEN SUGGESTED THAT WE MAY BE ENTERING into a "post-antibiotic era." Disaster has so far been averted by the continuing development of new antimicrobial agents. It is now, however, clear that this flow of new agents, especially ones directed at resistant Gram-negative pathogens, has slowed to a trickle. In response to this and other related issues, representatives of the Infectious Disease Society of America (IDSA), the Pharmaceutical Research and Manufacturers Association (PhRMA), and the FDA recently met in a 2-day public workshop to discuss new antimicrobial drug development.

A major reason for this limited development of novel antibacterial agents is economic. Simply put, it costs a pharmaceutical company as much to develop an antihypertensive as it does an antibiotic, but a patient may take the former for the rest of their lives, while they may take

an antibiotic for only a few days. Furthermore, the target population for a drug such as an antihypertensive is very large, while that aimed at a resistant Gram-negative pathogen is small. This small target population also directly affects drug development since FDA approval currently requires successful completion of 2 large, randomized, controlled trials. In the development of an antibiotic for an indication that affects a relatively small population, the small target population makes patient accrual difficult and, therefore, prolonged and costly. Also affecting sample size is the degree of required demonstrated "non-inferiority" (the "delta") in comparisons of test agents with standard therapy, an issue that was discussed at length. The major focus of the meeting was to address means of overcoming these interrelated regulatory and economic disincentives to novel antibiotic development.

The discussions also covered a number of related topics. The need for a placebo-controlled trial in future trials of acute exacerbations of chronic bronchitis was addressed, given the uncertain benefit of such therapy. The need for quantitative bacteriology in the diagnosis of ventilator-associated pneumonia was also discussed. The acceptance of bacteriologic end points as sufficient for approval in order to increase the statistical power of clinical trials was also addressed. The acceptance of bacteriologic end points in lieu of clinical end points would thus markedly reduce the number of patients required for completion of clinical trials. This would be especially beneficial in relatively low frequency infections such as bacterial meningitis. There was agreement that the use of pharmacokinetic and pharmacodynamic (PK/PD) data could be used to reduce required sample sizes. Expedited review of selected agents could also be considered, as was the possibility of requiring only a single phase 3 randomized trial or of noncomparative trials, using historical matched controls. The development of a federally funded consortium for clinical trials of critical drugs active against agents on a priority list was also discussed.

Perhaps the most novel suggestion was "wild card exclusivity." Patents for prescription drugs are normally issued for 20 years, but various laws grant pharmaceutical companies a patent extension or market exclusivity period beyond the normal patent period. All patent extensions and periods of market exclusivity effectively delay the introduction of generic versions of the prescription drugs. For instance, in return for agreeing to do pediatric testing of a specific drug, a manufacturer is given a 6-month extension of the patent on that drug—meaning the pharmaceutical company can continue to set the market price and generic forms of the drug cannot enter the market. Straightforward application of this exclusivity would, however, provide limited incentive when applied to a critical antibiotic with a limited market and, therefore, limited economic return during the extension period. If, however, wild card exclusivity were awarded for the development of a novel antibiotic, the exclusivity could be applied to any pharmaceutical in the company's portfolio, thus potentially increasing its economic value. Such a change would, however, require legislation.

It has been pointed out that antimicrobial agents are the only class of drugs with built-in obsolescence. The very use of such agents exerts a selective pressure that inevitably leads to the emergence of resistant microbial strains. The effect of this resistance is to render the antimicrobial progressively less effective. Optimal use strategies can only slow, but not prevent, this progression. As a consequence, we are dependent on the continued development of novel antimicrobials, in an attempt to keep ahead of the evolutionary curve. The continuation of the dialog that took place at this meeting and the implementation of some of these strategies provide hope that the post-antibiotic era never occurs. ■

Another Test to Consider in Evaluating Fever of Unknown Origin?

ABSTRACT & COMMENTARY

Synopsis: *Random skin biopsies may be helpful in establishing an etiology of fever of unknown origin.*

Source: Gill S, et al. Use of random skin biopsy to diagnose intravascular lymphoma presenting as fever of unknown origin. *Am J Med*. 2003;114:56-58.

GILL AND ASSOCIATES REPORT USING RANDOM SKIN biopsies to establish a diagnosis of intravascular lymphoma in 2 patients with fever of unknown origin (FUO).

In the first case, a 63-year-old woman had fever, night sweats, malaise, and weight loss for 6 weeks. A leukoerythroblastic peripheral blood smear accompanied an increased leukocyte count and anemia (hemoglobin 7.8 g/dL). The erythrocyte sedimentation rate was increased to 88 mm/hr. An extensive diagnostic work-up was unrevealing. Finally, because of a suspected medication-asso-

ciated erythematous macular rash, a skin biopsy was performed. In addition to a perivascular inflammatory infiltrate that confirmed the probability of a drug rash, the biopsy revealed intravascular malignant B lymphocytes.

The second case was that of a 60-year-old man with a 3-month history of fever, night sweats, weight loss, and lethargy. Physical examination was unremarkable. Anemia (hemoglobin 10.3 g/dL) was the only significant laboratory abnormality. Cerebrospinal fluid analysis, gallium radionuclide scanning, echocardiography, and biopsies of temporal artery, liver, and bone marrow were nondiagnostic. Random skin biopsies from normal-appearing skin yielded the diagnosis of intravascular lymphoma, and the patient completely recovered after intensive chemotherapy.

COMMENT BY JERRY D. SMILACK, MD

Gill et al emphasize that the diagnosis of intravascular lymphoma—a rare form of extranodal non-Hodgkin's lymphoma—can be exceedingly difficult and is usually not made before autopsy. The histology is that of an intravascular proliferation of monoclonal B-cell lymphocytes, although occasionally T-cell lymphocytic disease occurs. Neurologic and cutaneous involvement predominates. Generalized or localized symptoms can herald neurologic involvement. Cutaneous disease can result in tender nodules, indurated plaques, or ulceration. Involvement of seemingly unaffected skin has been rarely reported, but this paper suggests the possibility that the disease may be more common than presently realized.

Will I consider obtaining random skin biopsies in my patients with FUO? Gill et al advocate doing so, especially when one factors in the simplicity of the procedure. It remains to be seen how useful skin biopsies will be in the evaluation of patients with FUO. ■

Cosmic Radiation and Frequent Flyers

ABSTRACT & COMMENTARY

Synopsis: *Data suggest a cancer risk associated with exposure of airline crews to cosmic radiation.*

Source: Aw JJ. *J Travel Med*. 2003;10:19-28.

This intriguing article explores the issue of occupational exposure of airline crews and the risk of cancer. Various programs attempt to estimate the radiation equivalence dose of cosmic radiation (the naturally occurring galactic ionizing radiation) on skeletal tissue and bone marrow. While most cosmic radiation comes from outside the solar system, periods of solar flare can also significantly contribute to cosmic radiation by a factor of 100. Cosmic radiation was officially deemed an occupational risk for airline crews in 1991; that year, a landmark decision established recommended limits of 20 mSV units per year for airline crews and 2 mSV units per year for pregnant workers. The general public, it was suggested, should receive no more than 1 mSV unit per year. Current estimates of mean annual exposure are 0.2 to 9.1 mSV for 950 hours of flight time; higher flying crews may be exposed to up to 9 mSV annually. NASA was previously using the Concorde as a model for exposure data.

A few studies have examined the cancer risk of air line crews with variable, but not statistically significant, results, although larger epidemiological studies of US military aircraft crews have found excess risks of cancer. Aw and associates examined a group of 1690 cabin attendants from 1955 to 1997, comparing their rates of cancer to the Iceland Cancer Registry. The mean employment time was 8 years, the mean age at start of employment was 23, and the mean age at the time of follow-up in 1997 was 40. Cancers among men were infrequent (n = 2), and there were too few male flight attendants to draw any statistical conclusions. However, women had a statistically significant increased risk of malignant melanoma, as well as a trend toward an increased risk of breast cancer and other cancers. There was no increased risk for leukemia, and lung cancers were absent. This association was strongest in women employed after 1971, when new long-haul higher-flying aircraft were introduced (there was also a period of solar flare in 1974). A dose relationship was identified when the woman was employed for more years and the lag time to assessment was 20 years or more.

COMMENT BY CAROL A. KEMPER, MD, FACP

Ongoing monitoring of radiation effects and air travel is continuing. It was suggested that frequent flyer business travelers who log more than 200 hours per year of flight time take note of this data and should be classified as radiation workers. Women who are in their childbearing years, or who are pregnant and travel frequently, should also be aware of the potential risks. One potential factor overlooked by this study was the effect of irregular working hours or more frequent nighttime flights on cancer risk. Recent data suggest that nurses who work more night shifts have an increased risk of breast cancer, possibly as the result of an adverse effect on daily hormonal shifts. Airlines might wish to review these data for relevance to female cabin attendants. ■

Ebola Of Apes and Men

ABSTRACT & COMMENTARY

Synopsis: *An outbreak of human Ebola virus infection in Congo was preceded by a die-off of great apes, with the virus having been recovered from some ape carcasses.*

Source: http://www.promedmail.org.

As of March 16, 2003, a total of 120 cases, including 108 deaths, of Ebola hemorrhagic fever had been reported in the districts of Mbomo and Kelle in the Cuvette Ouest Region of the Republic of Congo. While the Congoles Ministry of Health, WHO, and the international team from the Global Outbreak Alert and Response Network, as well as the national Red Cross Society, have responded, their activities are limited in some areas by the belief of many villagers that occult forces were at work. Residents of some villages ran from health care workers and a local official reported that villagers had stoned and beaten to death 4 teachers accused of casting an evil spell that caused the outbreak.

COMMENT BY STAN DERESINSKI, MD, FACP

At least 73 deaths were caused by Ebola during an outbreak in this same region of northern Congo and adjacent areas of Gabon that occurred from October 2001 to February 2002. A contemporaneous die-off of great apes occurred in the same area, and Ebola virus was recovered from one carcass. It was established that some affected humans had handled fresh ape carcasses prior to becoming ill.

The die-off of great apes appears to have been a continuation of an event that had been going on for a decade and which has devastated the population of lowland gorillas and chimpanzees in the Lossi Gorilla Sanctuary. Prior to the current human outbreak of Ebola, it was reported that 8 families, comprised of 139 individual gorillas that had been monitored since 1994, had disappeared from the study area. Dead apes were detected beginning on November 26, 2002, and Ebola virus was identified in samples obtained in mid-December from carcasses of all 4 gorillas and 2 chimpanzees studied.

Many people, including approximately 3000 pygmies in the area, live by hunting monkeys and apes in this area that is believed to be home to 80% of the world's remaining lowland gorillas. Transmission to humans is speculated to occur by exposure to infected carcasses and preparation of the primate meat as food.

The evidence is thus accumulating that Ebola infection may be a zoonosis, transmitted by contact with the infected blood and flesh of chimpanzees and gorillas. It is likely, however, that both are accidental hosts and that the virus is maintained in an as yet undetermined reservoir. Identification of that reservoir remains critical to dealing effectively with this disease. ■

CME Question

Effective with this testing period, Infectious Disease Alert *is changing its testing procedure. You will no longer need to return a Scantron answer sheet to earn credit for the activity. Please review the text, answer the following questions, check your answers against the key on the following page, and then review the materials again regarding any questions answered incorrectly.* ***To receive credit for this activity, you must return a CE/CME evaluation at the end of the testing term.***

This testing procedure has proven to be an effective learning tool for adults. If you have any questions about the new testing method, please contact Customer Service at 1-800-688-2421.

15. Which of the following is correct?

a. An ELISA test for antibody can be used to confirm the presence of HCV infection.
b. Tests for HCV antibody may be falsely negative in chronic hemodialysis patients.
c. The average "window" period for appearance of HCV antibody is > 6 months.
d. A repeatedly positive test for HCV RNA requires RIBA confirmation.

Answer: 15(b)

In Future Issues:

Avian Influenza Returns to Humans

UPDATES

By Carol A. Kemper, MD, FACP

Adefovir Dipivoxil for Hepatitis B

Source: Marcellin P, et al. *N Engl J Med*. 2003;348:808-816.

ADEFOVIR DIPIVOXIL (AD) HAS potent in vitro activity against hepatitis B virus (HBV) and has been shown to reduce viremia in preliminary studies. In this large, multi-center study, 515 patients with chronic HBV infection, all of whom were positive for hepatitis B antigen, were randomly assigned to receive AD 10 mg or 30 mg or blinded placebo daily for 48 weeks.

The primary end point of the study was histologic improvement, which was determined in 329 patients for whom pretreatment liver biopsy specimens were available. Compared with 25% spontaneous histologic improvement in the placebo group, histologic improvement was observed in 53% of patients receiving a 10-mg dose of AD and 59% of patients receiving a 30-mg dose of AD (both comparisons, $P < .0001$). A statistically significant reduction was also observed in serum HBV DNA levels, the proportion of patients achieving undetectable HBV DNA, and normalization of alanine aminotransferase. In patients receiving either 10 or 30 mg of AD for 48 weeks, 21% and 39%, respectively, had undetectable levels of HBV DNA in serum (< 400 copies/mL), compared with none of the placebo recipients. Remarkably, 12% and 14% of patients receiving 10 and 30 mg, respectively, had seroconversion of Hbe Ag during treatment. Seven different novel substitutions were found in the reverse transcriptase gene of virus from 4 patients receiving AD and 3 receiving placebo, but virus from all 7 remained susceptible.

Adverse events were more frequent in the group receiving the higher dose of AD, although the incidence of severe events (grade 3 or 4) was similar. Drug was discontinued in only 2% of the lower dose group and 3% of the higher dose group. Renal impairment and hypophosphatemia did not appear to occur with any significant frequency; only 1 patient had a maximal increase in serum creatinine, by 1.8 mg/dL.

AD appears to be well tolerated with an efficacy profile similar to lamivudine (3TC), with no evidence to suggest the evolution of resistance during therapy. ■

Let's Have a Carpet Picnic at Your House?

Source: Rice EH, et al. *Emerg Infect Dis*. 2003;9:1-6.

MANY CASES OF NONTYPHOIDAL salmonellosis are believed to result from household contamination with *Salmonella enterica*, which increases with occupational exposure to the organisms (eg, cattle and dairy farmers, laboratory workers, and veterinarians). Rice and colleagues cultured vacuum cleaner bags from 55 households with occupants with known occupational exposure to salmonella and 24 households without known exposure.

In households with occupants with known occupational exposure to infected cattle, 8 of 26 (30.8%) vacuum bags were positive for *S typhimurium*. Similarly high levels of contamination were found in households of people who worked with salmonella in the field or the laboratory, where 4 of 13 (30.8%) of vacuum bags where positive. In the homes of 16 people who had been exposed to an outbreak of feline salmonellosis at the veterinary clinic at which they worked, 3 (18.8%) of the bags were positive. In contrast, only 1 of 12 (8.3%) vacuum bags from the homes of people working with livestock without known infection were positive. (The single positive culture was for serovar Dublin.)

In order to reduce household contamination, Rice et al attempted various methods of carpet cleaning. Shampooing without disinfectant resulted in a modest decrease in colony counts. Chlorhexidine added to carpet shampoo had no effect, whereas phenolic disinfectants had the greatest effect but did not totally eliminate colonization. Phenolic compounds, which are hazardous, may not be suitable for residential dwellings.

Carpet, it turns out, is a common source of household contamination with salmonella organisms, and it is nearly impossible to decontaminate. Rice et al proposed that individuals who work with potentially infected animals limit the carpets and rugs in their homes, increase the noncarpeted spaces, and remove their shoes before entering the home, as well as any potentially contaminated clothing. ■