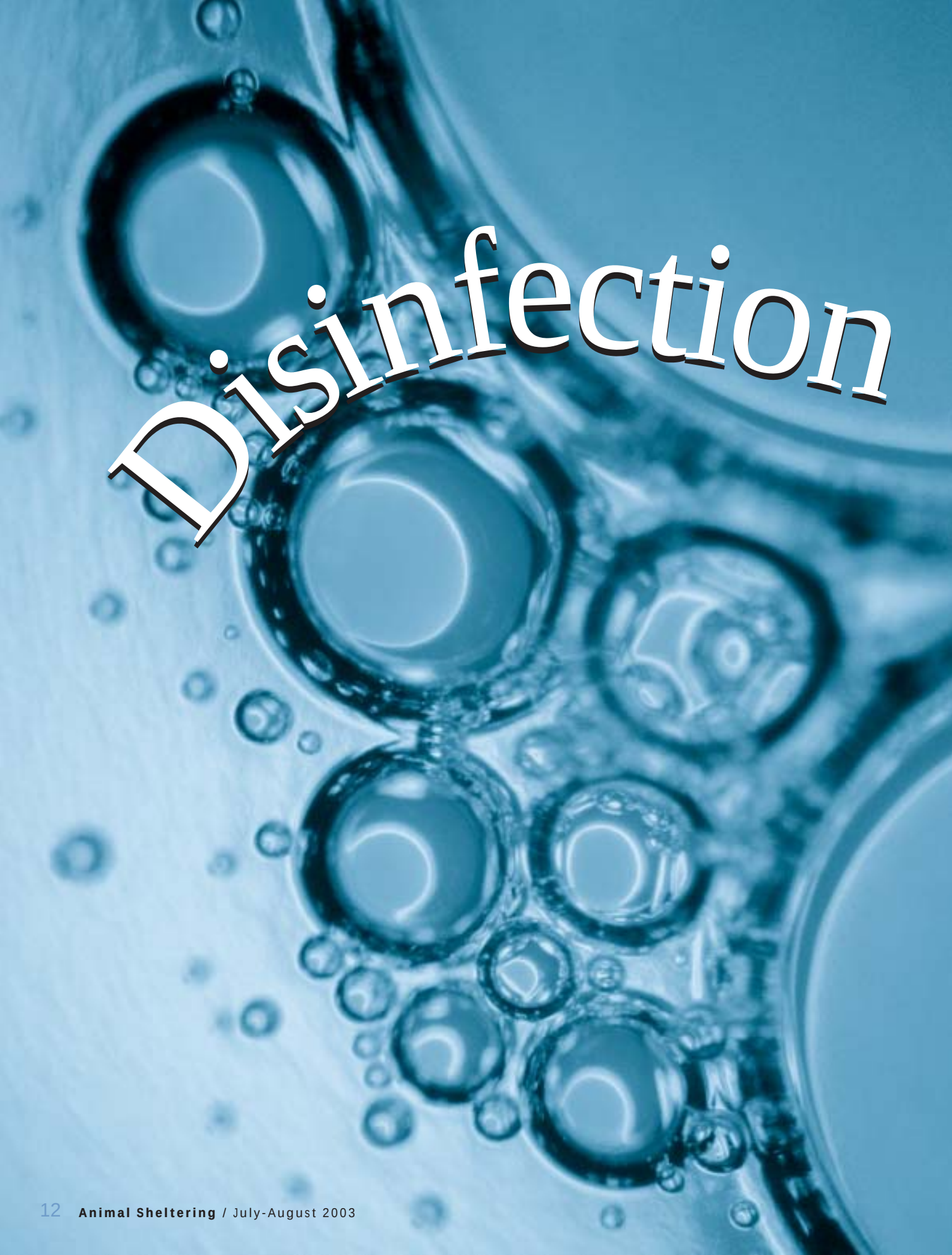

Disinfection

Connection

By Nancy Lawson

IS THE BOTTLE YOU'RE HOLDING 3-percent sodium hypochlorite or 5.25? What's the difference between a quaternary ammonium compound that's dilutable at 2 ounces per gallon and one that's dilutable at 18? How long is the required contact time? Does it need rinsing to reduce toxicity? And why does the manufacturer distinguish between "enveloped" and "nonenveloped" viruses?

If that's all Greek—or scientific babble—to you, you're not alone. Trying to find out whether a product is bactericidal, fungicidal, or parvocidal is enough to make you homicidal, especially if you're not well-versed in the intricacies of the periodic table of elements.

But you don't need a degree in chemistry or microbiology to learn how to choose the right disinfectants for your facility and implement an effective disease control program. What you do need is basic knowledge of the product registration process, an understanding of common terms used by manufacturers, and insight into safety and toxicity concerns—all of which we hope to pass along to you on the following pages.

You also need to implement adequate separation, isolation, ventilation, and vaccination practices, as well as simple but critical cleaning measures. After all, as some of the experts will explain in this feature section, product selection is only the beginning of your journey toward a clean and comfortable facility; you could pour whatever you want on a microbe, but if you're not using the right tools and the right methods to scrub and rinse, you'll be sending not the germs but your efforts down the drain.

Join us for a tour of the basics in the battle against the bugs—and find a whole host of resources you can refer to again and again in your quest for answers. Though it may be obscured by complicated references to chlorphenhexonaloxymonohypoalonines, the truth, in all its ever-evolving and mutating forms, is out there.

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The Product Claim Game

Navigating the world of disinfectants, one bottle at a time

THE MICROBIAL MONSTERS HAVE INVADED. You can't see them or hear them multiplying themselves into infinity, but you can sense them in the presence of the little sneezes starting in the cat room and the diarrhea showing up in the kennels. If your eyes possessed the power of an electron microscope, you might even be able to spy them flying out of the noses and mouths and other excreting extremities of your furry charges.

Just the idea of it is enough to make you want to turn to the bottle—the disinfectant bottle, that is.

But which one should you choose? Which one will be safe for you, your animals, and your equipment, while still remaining effective enough to stave off the army of bugs? After you've already mapped out consistent standard operating procedures that include important disease control measures—isolation of sick animals, separation of healthy ones, proper ventilation, and the like—you've still got another maze of questions to navigate.

Before actually attempting to select a product, however, it helps to know how a "disinfectant" officially earns its name in the first place. The Environmental Protection Agency categorizes disinfectants as pesticides that destroy or inactivate infectious fungi and bacteria; many disinfectants also kill viruses, but claims of virucidal activity "must be restricted to those viruses which have actually been tested," according to agency regulations. The EPA scrutinizes test results and other information to ensure labeling accuracy, weed out misleading statements, and clarify instructions for use; agency regulations dictate everything from minimum application times on surfaces to acceptable artwork on the bottle label.

Other government agencies have a hand in the registration, labeling, and production process of chemical cleaning solutions. Liquid chemical sterilants, which kill all microscopic life forms except prions (the infectious proteins responsible for mad cow disease), are used in food production facilities and on medical equipment—and are therefore under the purview of the Food and Drug Administration. The FDA also governs registration and approval of germicidal products that are used directly on animals for pest-control purposes. And to make matters even more confusing, even though the EPA registers hard-surface disinfectants, a third agency, the Occupational Health and Safety Administration, oversees the "materials safety data sheets" that advise product users of the hazards of certain chemicals and the precautions they should take.

It's a jungle out there, with enough acronyms and regulations and claims to make your head spin. But it's worth the trouble to try to sort through some of it; learning a little bit about how a product gets to the market will help you research whether you actually want to buy it.

Oh Where, Oh Where Did My Parvo Claim Go?

Besides, the maze is considerably more manageable when you realize that for the purposes of cleaning the shelter, products registered with the EPA are the only ones you need to concern yourself with. EPA-registered disinfectants include some kinds of bleach, quaternary ammonium compounds, and many things in between. And even if the manufacturer doesn't post enough information about its product on the Web or elsewhere for public consumption, chances are you'll be able to use EPA search engines to find labeling information and other documents before making a purchase. (See "Great Points in the Fine Print" on page 20 for more information.)

Undoubtedly, your most pressing question about a product will be: What does it kill? Shelters and other animal protection organizations have long used quaternary ammonium compounds and bleach—and those are still mainstays of the animal care environment. It's true that bleach is unstable and corrosive, and quats, as they are commonly called, are limited in their efficacy against the most resistant viruses. But most of the other available chemicals are not effective enough or simply too unsafe; products containing phenols, a synthetic chemical once derived from coal tar and now found in some Lysol disinfectants and other solutions, can be fatal to cats who ingest even a small amount.

In the search for an ideal solution—chemical and otherwise—to disease control, many people over the last 15 years have latched onto products claiming parvocidal qualities. Introduced in the late '80s, these disinfectants were hailed as the next great thing in shelter disinfection; the canine parvovirus had already shown an amazing ability to devastate kennel populations. Its virulence was something to be feared, and resistance often seemed futile. Disinfectant sellers who promised to change all that were, of course, a source of great hope.

But a few years later, the *Journal of the American Animal Hospital Association* (*JAAHA*) published a study countering some of the virucidal claims of quats. In "Virucidal Efficacy of the Newer Quaternary Ammonium Compounds" (May/June 1995, Vol. 31), researchers at the University of Tennessee's College of Veterinary Medicine tested several products and found that only two out of four quats completely inactivated feline herpesvirus, none completely inactivated feline calicivirus, and none even significantly inactivated canine parvovirus.

By 1997, parvocidal claims began to disappear from bottle labels, leaving a trail of confusion in their wake: while some companies were quick to react to the mounting body of literature questioning the efficacy of quats against parvoviruses, others were slower to back away from old promises. If you ask ten different people exactly what unfolded during that period, you get ten different answers, but essentially what happened is this: Huntington Laboratories, at the time one

DEFINING THE TERMS

BACTERIUM A single-celled organism that lacks a well-defined nucleus but contains all the genetic information and all the tools needed to reproduce itself. The only life form on earth for 2 billion years, bacteria make food out of everything from sunlight to sulfur; they also feed off nutrients within the living creatures that host them. Most bacteria perform necessary functions, helping with food digestion, nutrient absorption, and elimination of toxic substances. But pathogenic bacteria produce toxins or attack tissues directly. Examples of bacterial diseases in animals include leptospirosis, brucellosis, Lyme disease, E. coli, salmonellosis, and bordetellosis.

FUNGUS A single-celled or multicellular organism whose DNA is contained within a nucleus. Mushrooms and mold are fungi. Unlike plants, fungi contain no chlorophyll and therefore cannot make food from sunlight. Instead, they feed on living and dead organic matter after releasing chemicals that help them dissolve food sources for easy absorption. Like bacteria, fungi have a dual nature: While some have been employed as disease-fighting antibiotics, others actually cause disease. Fungi can spread through spores that are carried on the wind or in rain, or they can extend chains of fungal cells called hyphae. Fungi affecting animals include ringworm and cryptococcosis.

VIRUS A tiny piece of genetic material that can infect animals, plants, fungi, and bacteria. Viruses aren't exactly organisms, as they have no ability to reproduce on their own. Sitting on a surface or floating in the air, they might as well be dead material. But once they come into contact with a host cell, they take over that cell and commandeer its reproduction mechanisms. They are after only one thing: to make copies of themselves. And in so doing, they either leave the cell undamaged or cause the cell to burst (explaining why some species are simply carriers of viruses while others develop disease). Rabies, canine parvovirus, feline panleukopenia, canine distemper, feline leukemia, and feline immunodeficiency virus are examples of viral diseases in animals.

DETERGENT A cleansing agent that helps remove dirt and debris by emulsifying grease and suspending dirt particles. Detergents clean with the help of a good scrub, but they do not disinfect. Some disinfectants, such as quaternary ammonium compounds, have detergent qualities in them; bleach, however, does not. Removal of debris with the help of detergents should be done prior to disinfection, as disinfectants can be inactivated by the presence of organic matter.

DISINFECTANT A chemical solution that destroys microorganisms. What exactly a product will kill depends on its active ingredient and its strength. Some disinfectants are "low-level," while others are "intermediate"- or "high-level." Disinfectants must be registered with the Environmental Protection Agency, and specific efficacy claims must be tested in EPA-approved laboratories. Products labeled as "sanitizers" are not as strong as disinfectants and should not be used as disinfection agents in the shelter setting.

DEGREASER A strong detergent designed to cut through the filmy layers that other detergents often can't reach. Degreasers can penetrate the smeared body oils left behind on cage bars by sticky paws, wet noses, and other little greasy parts. Some shelters use degreasers every day, while others use them only once a week; frequency of use depends on intake, turnover, and the density of animal populations.

TRBfoto / Photodisc Green

of several quaternary ammonium makers, began to question whether it was wise to continue trying to substantiate its claims in light of new evidence that contradicted them. New practices were being introduced in EPA-approved testing laboratories around the country, and old testing standards had come under scrutiny industrywide.

At the same time, the EPA was undergoing a "reregistration process" of antimicrobial products that required manufacturers to submit new data, says Ruth Trager, manager of marketing and product development for Lonza Inc., the company that bought Huntington Labs in 1996. Retesting previously approved products to substantiate old claims would be expensive—prohibitively so for a product that was likely to fail the newer tests anyway. Even though the EPA hadn't even come near the quats yet (and still hasn't 15 years later, according to Trager), companies began anticipating the implications of reregistration and reconsidering their options.

And in the face of the new data, it probably wasn't worth the effort and expense to try to justify parvocidal claims that had already been disproven; thus, Huntington voluntarily pulled the parvovirus claim from its product. The move launched a domino effect among "subregistrants"—companies that had been selling the Huntington formula under their own brand names.

"Basically, all these companies, including us, in 1989 had put our name on a quat formulation that had a parvo claim," says Chris Quinlan of Animal Health Technology in Riverside, California. "So I used to go to the trade shows and say, 'Why do you pay so much for Parvosol? My product's the same thing.' And I could show them on the label that it was the exact same active ingredient."

But soon enough, Quinlan lost that selling point, when he and other subregistrants received letters from Huntington telling them to remove the claim from their bottles. The companies were forced to comply; by law, their labels had to be identical to that of the master registrant.

But if distributors like Quinlan were disappointed by the loss of the parvo claim, shelters were probably even more so, especially since that wasn't the end of the story. Parvocidal claims were disappearing only selectively; other companies that did not subregister but instead made their own formulas—or used those of other quat manufacturers—did not have to remove the claim.

And therein lay the confusion, with some quats claiming parvocidal qualities and others suddenly backing away from the subject altogether.

The Virus That Won't Die?

Unraveling the mystery and history of parvocidal claims—and exploring their current status—is easier if you understand why such emphasis is placed on the ability to deactivate parvovirus in the first place. In a nutshell, parvovirus is *like* a nutshell: difficult to crack with common disinfectants.

All viruses consist of a piece of nucleic acid, or genetic material, usually surrounded by a protein coat. But some, such as canine distemper, have yet another layer—a fatty "envelope" that makes them more vulnerable to common disinfectants, says virologist Leon Potgieter, a professor at the University of Tennessee who co-authored the 1995 *JAAHA* study of quats and has conducted other research on disinfectants.

Once that layer breaks down in the face of chemicals, the virus's genetic material might still be intact, but it has lost its ability to do damage, says Potgieter. That's because the fatty layer houses the mechanisms that allow the virus to attach itself to a host cell and wreak havoc. Without that layer, the virus can no longer replicate.

Attachment mechanisms for parvovirus and calicivirus, on the other hand, are contained inside the protein coat, which is much more resistant to disinfectants. These are "nonenveloped" viruses that can stand their ground in the presence of typical quaternary ammonium compounds diluted at the usual two-ounce-per-gallon rate.

"In our results—we've [tested] this several times—there is no single quaternary ammonium compound that does much against parvoviruses or caliciviruses, both quite resistant viruses," says Potgieter, whose need to completely disinfect in the lab is critical to the integrity of his experiments. "So we stayed with bleach."

A study led by one of Potgieter's graduate students and published last year in *JAAHA* compared several different disinfectants and found again that the quaternary ammonium compound was not effective against feline calicivirus or feline panleukopenia, a kind of parvovirus ("Virucidal Efficacy of Four New Disinfectants," May/June 2002, Vol. 38). Sodium hypochlorite, or bleach, served as a control and killed all the viruses tested, including calicivirus, panleukopenia, and feline herpesvirus. Chlorine dioxide, a difficult-to-mix chemical that's not recommended for the shelter environment, and potassium peroxymonosulfate, a potentially promising new import used during England's foot-and-mouth disease epidemic, completely inactivated all three viruses.

But if quats don't kill parvo at 2 ounces per gallon, how did the parvocidal claims ever come about in the first place? Potgieter suspects they were the result of testing that didn't adequately mimic a real-life situation. "To be able to grow parvovirus, you need very healthy cells," he says. "And if you don't get rid of all the disinfectant in your test material, the cells are not growing very well, and the virus won't grow either. So I'm sure that's what happened."

A chapter of the reference manual *Kirk's Current Veterinary Therapy* that describes testing methods reaches a similar conclusion ("Disinfection and Antiseptic Use in Small Animal Practice," Volume XIII): "There are many variables that may affect the test outcome, including the test organism used, the method of preparation of the organism, and the subculture method used," wrote Brenda C. Love and Dwight C. Hirsh. "Test organisms may undergo spontaneous inactivation on certain carriers, making the disinfectant appear more effective than it is."

Where Does That Leave Us?

But there is hope for the parvocidal abilities of quats, which have long been used because they are relatively safe for animals and staff and because, in spite of their inability to kill the strongest microorganisms at low dilution rates, they carry broad-spectrum effectiveness against

Steer Clear of Phenols

DISINFECTANTS CONTAINING PHENOLS ARE EXTREMELY TOXIC TO SOME ANIMALS, INCLUDING CATS AND REPTILES. First isolated from coal tar in the 1800s, phenols are now manufactured synthetically and are included in many products, including some Lysol disinfectants. Colorless to white when pure, phenol has a strong, sweet odor. It is corrosive and requires extra precautions when handling. To ensure the disinfectants you're considering purchasing don't contain phenols, check with manufacturers and avoid products that list any of the following ingredients, which are synonyms for "phenol," according to the Occupational Health and Safety Adminstration: carbolic acid; monohydroxybenzene; hydroxybenzene; benzenol; phenylic acid; phenyl hydroxide; benzophenol; phenyl hydrate; phenylic alcohol; monophenol; phenic acid; and oxybenzene. To learn more about the hazards of phenol, visit the OSHA website at www.osha.gov/SLTC/healthguidelines/phenol/.

many likely contaminants.

In fact, ready-to-use sprays carry EPA-registered parvocidal claims, though their high levels of active ingredient make them more expensive to use than products that are dilutable with water. But in recent years, manufacturers have begun retesting those dilutable solutions and have discovered that just increasing the amounts poured into a bucket of water makes all the difference. "We found that, historically, quats have not been effective against parvovirus in the published literature," says Trager. "But at high enough levels, [they are]."

The idea makes sense; after all, as an article in the April 2001 issue of *Infection Control Today* noted, "The more concentrated the germicide, the greater its killing capacity." The higher concentration levels sometimes introduce a new set of problems, the article notes—namely, increased safety risks and a greater likelihood that surfaces will be damaged by repeated exposure to the disinfectant.

But Trager dismisses those concerns, noting that the quat Lonza is planning to sell at a higher ounce-per-gallon ratio is strong enough to kill parvo but not even as concentrated as the ready-to-use sprays that are already on the market. Lonza's dilutable parvo-killer is pending approval at the EPA, she says.

Animal Health Technology is already selling a similar product, Kennel Kare—and has been for several years. To kill parvo, users must dilute it at 18 ounces per gallon; the higher dilution rate ensures there is more active ingredient in the mixture, says Quinlan.

There is a drawback, he adds. The less you dilute a product, the more you're paying per gallon, and Kennel Kare runs about $1.70 per gallon when diluted—considerably more than Animal Health Technology's less concentrated product, Triple Two, which uses only two ounces per gallon and costs about 20 cents a gallon when diluted.

Ready-to-use products are even more expensive—often prohibitively so for some shelters. Depending on the company you buy it from, a ready-to-use spray can cost between $350 and $500 for a 55-gallon drum, or $6 to $9 a gallon, says Lori Todd, kennel supervisor of the Charlotte-Mecklenburg Animal Control Bureau in North Carolina. But given the options, some facilities would rather pay the price than use bleach routinely. "It has been an acceptable expense," says Todd, whose staff uses ready-to-use TB-Cide Quat in spray bottles for cleaning cat cages. "I prefer it over the bleach because I have asthma. ... The bleach irritates my lungs, so I knew it was going to irritate [the cats' and the staff's] lungs."

Exploring the Unknown

The bright side of bleach, of course, is that it irritates the microorganisms far more than it irritates the macro ones, killing even the most resistant viruses (see "The Bleach Niche" on page 18). But the corrosive, staining, and irritating qualities of sodium hypochlorite have had many people searching for years for an alternative.

And the staff at Pharmacal Research Laboratories, a Connecticut-based company, think they've found one in England. As another former subregistrant of Huntington, Pharmacal was disappointed when it could no longer offer a dilutable parvocidal quat. But the company recently began importing Virkon S, a disinfectant made of potassium peroxymonosulfate, because of its parvocidal claims and safety assurances. According to company literature, the chemical is not as caustic as bleach, doesn't stain clothing, and does its disinfecting job even in the presence of feces and other organic matter.

Used by a few shelters, the product has become increasingly popular in veterinary schools, says Potgieter, whose test results confirmed the chemical's effectiveness against parvovirus and calicivirus (*JAAHA,* May/June 2002). In fact, Potgieter is considering converting to Virkon S in his own laboratory.

Like the high-concentrate quats, however, Virkon S also comes at a bit of a price: Buying it in ready-to-use packets of powder that can be dumped into a gallon of water will cost you $1.95 a pop. Buying it in 10-pound pails makes it much cheaper—about 40 or 50 cents a gallon, says Pharmacal Quality Assurance Lab manager Tammy Marotta Fleischer.

While she hasn't tested it out herself yet, veterinarian Kate Hurley is intrigued by the fact that Virkon S has been shown by company testing to inactivate bacteria and viruses on wood and other difficult surfaces. "Bleach is the thing that kills everything reliably, but it does not work on something wood, on cracked concrete, on gravel, or in any of those circumstances where you really might need to disinfect—you [could] just spray bleach all day long, but it's not going to do a bit of good," says Hurley, who is director of the Maddie's Shelter Medicine Program at the University of California, Davis, School of Veterinary Medicine.

In those circumstances, if it's not possible yet to take the ideal course of action and eliminate wooden surfaces, it might be prudent to try scrubbing and then disinfecting with Virkon S, says Hurley.

But, she adds, "Shelters [should] keep in mind to have disinfectable surfaces because, for surfaces that you can't spray bleach on, ultimately, there's just really no other good answer for decontaminating them with one of these really durable [pathogenic] agents."

The Bleach Niche

Is the old standby, sodium hypochlorite, still the gold standard?

REACH FOR THE BLEACH—that's the first thing most shelters do when facing an outbreak, and the instinct is not unfounded. Sodium hypochlorite is still the biggest bang for your buck, and it's still the best tried-and-true solution in shelter disease control.

"Hypochlorite is really still the kind of gold standard that people are using," says Colin Parrish, a Cornell University virologist who studies parvoviruses. "The big problem is that it's corrosive on steel and metal. ... Chlorine isn't that great either in terms of breathing it, except that we're all used to that."

Though bleach may be the closest thing to disinfection's golden child, its reputation is a bit tarnished by its bad-boy qualities—qualities that might make you think twice before you pledge your undying allegiance to it. Chris Quinlan of Animal Health Technology thought about it for years, in fact, before finally breaching his ban on bleach and deciding to sell a sodium hypochlorite product.

"If you asked me two years ago, we wouldn't even sell bleach," he says. "We do now."

It was veterinarian Kate Hurley, director of the Maddie's Shelter Medicine Program at the University of California, Davis, who convinced Quinlan of the benefits of bleach. It's not just one of the only parvovirus inactivators; it's also important in URI control. In fact, bleach played a critical role in helping to quell severe calicivirus outbreaks among rescue cats at several veterinary clinics, says Hurley, who investigated the cases.

"Because calicivirus is really significant in cats and the quats don't reliably inactivate it," she says, "I tend to recommend using bleach, depending on the level of turnover in cats, on a routine basis—daily in a place with high cat turnover, maybe less often in a place with low cat turnover."

While still not charmed by the wonders of bleach, Quinlan has conceded—in light of the evidence—that it may be one of the only user-friendly products that's effective against even the most curmudgeonly and intractable germs a shelter is likely to encounter.

But, he advises, the merits of bleach could be eroded by its pitfalls if not used properly. What follows is a discussion of three common mistakes bleach users make—and how you can avoid them in your shelter.

MISTAKE #1
Stockpiling an arsenal.

It may not result in total breakdown, but storing bleach is likely to lessen the effectiveness of the product. Sodium hypochlorite solutions have been shown to decompose rapidly, so much so that the EPA requires manufacturers of bleaches with 5.25 to 12.5 percent sodium hypochlorite to add special language to their label: "Degrades with age. Use a test kit and increase dosage as necessary to obtain the required level of available chlorine."

The staff at Pharmacal Research Laboratories use chlorine test strips to measure the strength of their solutions, says Quality Assurance Lab Manager Tammy Marotta Fleischer. The extra precaution is not, they discovered, extraneous. When they conducted a test on just how quickly bleach solutions decompose, Fleischer and her colleagues began by storing a simple solution of 18-percent sodium hypochlorite in a capped opaque bottle on a countertop in their laboratory. The idea was to simulate a real-life situation at room temperature, with lights coming on in the morning and going off at night during the workweek. In analyzing daily samples from the bottle and recording the percentage of active ingredient, the staff found that after only five days, the level of sodium hypochlorite fell to 15.68 percent; at 20 days it was 13.72 percent. By day 35, it had plummeted to 12.74 percent—only two-thirds its initial strength.

Quinlan has seen this—or, more accurately, smelled it—for himself in shelter settings. Recently on a visit to a local humane society in Arizona, he spotted a bottle of bleach on a cart, opened it, and lifted it to his nose. "I couldn't smell any chlorine," he says. "So I put the cap back on, I shook it up, opened it up again. Still no chlorine. Bleach dissipates very quickly, even if it's in a sealed bottle."

"What's happening across the country is people are buying bleach in gallon jugs and even in some places stockpile it," says Quinlan, "and basically what you have is a pallet full of water after it sits there for a month or two."

Once the bleach is diluted for daily routines, of course, the degradation occurs even more quickly, he says, using the analogy of a swimming pool that's fit to dunk into almost immediately after chlorine has been added to it. "When you mix bleach and water together to make your disinfectant," says Quinlan, "the chlorine's only present for anywhere from around a half an hour to an hour, depending on how much you started with." For routine use, fresh buckets of diluted bleach should be prepared daily or each time you disinfect. As long as your surfaces are already clean, cool water is best; hot-water bleach solutions release more chlorine gas into the environment, putting more irritants in the air and leaving less disinfecting power in the bucket.

MISTAKE #2
Pouring before scrubbing.

Maybe it's all those childhood summers in the pool or those days spent at the laundromat, but somehow the human mind seems to have been wired to associate the smell of bleach with cleanliness. Cleaning and disinfecting are not one and the same, however, and sodium hypochlorite has the power to do only the latter. It may whiten and inactivate the algae on a wall, says University of Tennessee virologist Leon Potgieter, but it's going to leave a trail of dead residue in its wake. While bleach is rather shallow in its activ-

A Change in Recommendations:

Because the Clorox Company marketed its Ultra Clorox as 25 percent stronger and advised users to use 25 percent less, The HSUS and others have previously advised that Ultra Clorox be diluted at a 1:43 ratio. But further examination of the active ingredients and of the science behind dilution rates has revealed that Ultra Clorox is not as strong as it first appeared. At only 6 percent, this product should be diluted at about the same level—or only slightly less—as the brands with 5.25 active ingredient. Dividing 21 by 6 (see "Following the Formula" at right) gives you 3.5 ounces, or slightly less than half a cup.

Measuring Up

Use the following chart to determine ounce-to-cup conversions in bleach dilutions

If you need ...	Use ...
4 oz./gallon of water	1/2 cup of bleach per gallon
3 oz./gallon of water	3/8 cup of bleach per gallon
2 oz./gallon of water	1/4 cup of bleach per gallon
1 oz./gallon of water	2 tablespoons of bleach per gallon

See www.cloroxbleach.com for more conversions.

ity and never moves past the surface of things, the inherent cleaning abilities of some disinfectants are enhanced by detergent additives that lift and remove residue. Quaternary ammonium compounds are "cationic surfactants," meaning that they reduce the surface tension and actually attract negatively charged surfaces, including microorganisms. Detergents penetrate the outer layers, helping the dirt and germs float up to be encapsulated and dispersed.

But bleach is less adventurous; it kills the germs it comes into contact with on the surface but doesn't explore the cracks and crevices. Dirt, feces, and other organic matter act like conspirators in this anti-cleaning campaign, not only reducing the activity of sodium hypochlorite but also protecting the germs from coming into contact with the solution. The combination of bleach and organic materal can even release a toxic gas and produce potentially carcinogenic compounds, says Fleischer.

Precleaning, therefore, is a necessary step, though the temptation to skip it and hope for the best is understandable: whether you use a quat and then bleach or just a straight quat, the process requires two applications of solution—one to help clean and one to disinfect—and that's only after complete removal of leftover food, crumbs, feces, litter, and any other items requiring disposal. (See "Being Chemically Balanced Is No Guarantee" on page 22 for tips on basic cleaning.) Rinsing between steps is critical; mixing products can create toxic fumes or inactivate the effectiveness of both solutions.

MISTAKE #3
Buying any old bottle you see.

For years, veterinarians and other animal care experts have been recommending dilution of bleach at a rate of 1 part chemical to 32 parts water. But that assumes that the product you're using contains 5.25 percent sodium hypochlorite.

In fact, says, Fleischer, the percentage of active ingredient in household bleach can vary tremendously, even going as low as 2 percent. And if it's not an EPA-registered product, the formulators don't have to follow the same criteria as do manufacturers of solutions intended for disinfection; thus, a product sitting in a hot warehouse in Florida could decompose before it ever makes it to the shelves.

While a few household bleach manufacturers are EPA-approved, many are not, wrote Fleischer and co-author Amy Ingraham in an article on disinfection that was published in *Lab Animal:* "The other companies are manufacturing a product that will clean and brighten your clothes, but may not disinfect your facility. In fact, the percentage of active ingredients in these products may be too low for effective sanitizing."

On its new website, www.cloroxbleach.com, the Clorox Company even makes this distinction, advising potential buyers that not all of its bleach products are created equal. Only Ultra Clorox is EPA-registered and made for industrial use: "Our fragranced and Advantage Clorox Bleaches are not sold as registered disinfectants. If you need a registered disinfectant, you can purchase EPA-registered Ultra Clorox Bleach at almost any store that sells laundry products."

Some companies sell EPA-registered bleach that's about twice as concentrated as Ultra Clorox. Animal Health Technology's bleach product comes in a black drum to prevent any exposure to light, which contributes to decomposition. "We start out with 12 and a half percent, and we run it through a mixing station that dilutes it correctly for the user," says Quinlan.

Whatever the concentration of the product you're applying, you need to add enough water to match the level of sodium hypochlorite you'd achieve with a 1:32 dilution of bleach that lists its active ingredient at 5.25 percent. While this mixture is generally safe enough to be used around people and animals when properly applied and rinsed, it's also strong enough to kill even feline panleukopenia and feline calicivirus, according to a study published in the *American Journal of Veterinary Research* ("Virucidal disinfectants and feline viruses," F.W. Scott, Vol. 41, No. 3, 1980).

Since there is so much variation in product formulations, Hurley has devised a formula for figuring out how many ounces to use in each gallon of water no matter what brand you're using: Simply divide the number 21 by the percentage of sodium hypochlorite. See "Following the Formula" below for a complete explanation.

There's yet another wrinkle in the bleach use recommendations. Although the 1:32 dilution of 5.25-percent solutions has been proven sufficient to kill almost everything likely to lurk in the shelter environment, it won't kill ringworm, says Hurley. Repeated applications of 1:10 solutions are required to do the job, she says. "The only thing that kills ringworm in one application is undiluted bleach, but we don't recommend that just because it's too caustic and bad for staff and bad for kitties to breathe," she says. "If you already know of a case or you're having repeated occurrences of ringworm in your facility and you're just not sure where the contamination is, it would be worth going through and cleaning with that higher concentration, taking appropriate precautions with masks and ventilation."

There is no benefit to using higher-than-recommended concentrations for anything else, she says. In fact, it could be dangerous (see "Great Points in the Fine Print" on page 20).

Following the Formula:

To make sure you're using enough bleach to disinfect but not so much that you're creating an unsafe environment, you need to create a mixture that matches the concentration you'd achieve by diluting a 5.25 percent sodium hypochlorite solution at a ratio of 1 part chemical to 32 parts water.

No matter what product you're using, you can match that level by following this simple formula provided by Kate Hurley, DVM, director of the Maddie's Shelter Medicine Program at the University of California, Davis: Take the number 21 and divide it by the percentage of sodium hypochlorite in the product you're using. This will give you the number of ounces per gallon you should use. Written out in short form, the formula would be:

21 ÷ (percentage of active ingredient) = ounces per gallon of water.

For example, by following this formula when using a bleach product that lists the active ingredient at 5.25 percent, you would come up with an answer of 4 ounces per gallon. When using a bleach product that lists the active ingredient at 12 percent, you would come up with 1.75 ounces per gallon.

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Great Points in the Fine Print

Learning how to glean important information from a bottle label can help you narrow your choices of available products. Here are a few tips on learning the lingo.

HOW A BOTTLE LABEL IS BORN: You won't see a lot of exclamatory language on a disinfectant because the government tightly controls the labeling (right down to making sure manufacturers don't put pictures of candy or playing children on the bottle). If it's strong enough to be called a disinfectant, it's strong enough to require registration with the Environmental Protection Agency, which issues detailed regulations governing product descriptions, claims, and directions for use. Manufacturers submit results from experiments that attempt to mimic worst-case scenarios; if a product works even in the presence of organic matter, which can decrease the activity of disinfectants, it is usually listed as effective when tested with 5-percent blood serum added to the mix.

When a "master registrant," or the maker of a formula, gains approval for its product from the EPA, other companies can "subregister" the formula. But the label on the subregistrant's product must exactly match the language already approved for the master registrant; the only thing that can vary is the brand name.

WHAT THE NUMBERS MEAN: If you can't find an EPA registration number on the bottle, don't trust the product claims. If you do find a number, you can glean a lot of information from it—as long as you know what you're looking at.

For example, let's say you've just purchased Scrubby Scrub Kennel Disinfectant/Cleaner from the Scrubby Scrub Company, and you spot the following line on the label: EPA REG. NO. 4321-56-89101. The three components of that number each represent something different, and the very existence of three parts already gives you a good clue: that Scrubby Scrub is not the maker of the product—just a distributor.

Here's why: The first section of an EPA registration number, in this case, 4321, is always the company number of the master registrant. The second number, 56, is the product number. And the last number, 89101, is the company number of the subregistrant. Armed with this information, you can research a product's active ingredients, find label information, and view correspondence from the EPA to the manufacturer at http://oaspub.epa.gov/pestlabl/ppls.home. Even if you don't have a product registration number but want to search by active ingredient or by company, the site will guide you through the links required to do that. (Once you do finally get to the point of viewing labels, you can use the arrow buttons in the toolbar provided to flip through pages.)

WHAT'S BEHIND THE CLAIMS: Any claims of disinfection activity must be supported by test results from an EPA-approved laboratory. Disinfectants range from low-level to high-level, with the lowest killing mainly bacteria, fungi, and the least resistant viruses and the highest killing most of the resistant microbes but not necessarily spores. Many products are labeled as bactericidal, fungicidal, and virucidal; even if they don't kill all the bugs out there, it's a good bet they'll help you do away with many. For each level of disinfection, explains Tammy Marotta Fleischer of Pharmacal Research Laboratories, the EPA requires products to be tested against certain organisms. For example, a disinfectant generally has to be effective against the salmonella or staphylococcus bacteria; if it's labeled as a hospital- or medical-grade disinfectant it needs to be effective against the bacterium pseudomonas aeruginosa. Virucidal claims are often based on the ability to kill poliovirus; products are also commonly tested against herpes simplex virus type 2. Claims about efficacy against other microorganisms, ranging from the easy-to-kill HIV to the more resistant parvovirus, need to be supported with specific test results.

Occasionally when reading a label, you might notice the product is labeled to kill only a specific strain of a virus or bacterium. That's because it's not possible to test against all

the strains of disease-causing organisms, says Fleischer. "If you went out and you tested every single virus that was out there, you'd be spending millions and millions of dollars on these things, and the EPA is very strict as far as what you're allowed to put on your labels," she says. "And if you have it tested against certain strains, you have to put that on your label."

For basic cleaning in the shelter, it's a good idea to choose a product that kills bacteria, fungi, and viruses. If the product is not labeled to kill parvovirus, consider using bleach routinely (every other day or twice a week) or using one of the newer high-concentrate quaternary ammoniums as resources allow. (See "The Product Claim Game" on page 14 for more information.)

WHY THE RECIPE MATTERS: In a culture where every restaurant meal has reached Hungry Man-sized portions and $70,000 mini-tanks are the latest fad in vehicles, it's no surprise that people want to supersize everything, even disinfectant solutions. "I've watched people waste entirely too much because [they think] a little is good but a lot's better," says Lori Todd, kennel supervisor of the Charlotte-Mecklenburg Animal Control Bureau. "They think, 'Well, it says an ounce, but if I use two ounces, it'll be better.' Or they think they can look at it and just pour some in and go, 'That's an ounce.' And you go, 'No, that was a cup!' "

More is not only not better; it could even be dangerous, creating fumes that irritate the mucous membranes and lungs of animals and staff. But the temptation to stray from manufacturer's recommendations is so great that Fleischer often receives questions from clients wondering if it would be okay to heighten the concentration of the solution.

Residues can give animals mouth ulcers and scrotal dermatitis; floor surfaces can also be a casualty of improper dilution, says Fleischer. "You can actually change what the product does by adding more," she says. "With some of our products, you can actually make the floors sticky. And if you don't rinse off the surface, that floor will actually hold organisms, and it will contaminate your floor."

Todd has solved the problem of overuse by purchasing dispensers that deliver precise measurements for every chemical in the shelter—even the ones used in the commercial-grade dishwasher and the washing machine. "All they have to do is push a button and it fills the bottles," says Todd, who buys the dispensers from local disinfection product suppliers. "And when they load the washing machine, they shut it, turn it on, and then they push two buttons and that loads the correct amount of detergent and the correct amount of bleach. ... So we take out the human element."

Precision in following recommended contact times is no less important to ensuring the efficacy of the product, says UC Davis Maddie's Shelter Medicine Program director Kate Hurley, who has seen some shelter staff just apply the product and rinse it right off. That sort of drive-by cleaning is understandable given all the tasks to be done in a shelter, she says, "but just swiping it on and swiping it off is kind of a big waste of time."

And though some quaternary ammonium products carry the claim of being a one-step cleaner/disinfectant, reading the fine print usually elicits a recommendation to apply the product twice if a surface is soiled: once to clean and then once again to disinfect. (See "Being Chemically Balanced Is No Guarantee" on page 22.)

WHERE TO GET MORE SAFETY INFO: It took centuries of risk-taking and experimentation to develop solutions that kill deadly germs without killing people and animals in the process. But even today, anything that disinfects is still a potential source of injury. "The stronger the chemical, the less user-friendly it is," says Chris Quinlan of Animal Health Technology. "We're organisms, too."

Before using any product, research its effect on animals and people by combing through product literature or consulting with the manufacturer. Quaternary ammoniums and sodium hypochlorite are relatively safe when used correctly, but they still carry precautions. Phenols, the chemical used in Lysol, are effective germ-killers but are toxic to cats and reptiles and should always be avoided.

You can usually identify the kind of strength you're dealing with by the warnings and directions for handling on the bottle label. But the best way to really get a grip on the dos and don'ts of chemical usage is to check out the materials safety data sheets (MSDS), which are overseen by the Occupational Safety and Health Administration. These sheets should be posted in your facility or kept in notebooks for staff reference; in addition, staff should be supplied with the necessary protection equipment. Manufacturers often post MSDS on their websites, but you can also find them through general database searches, using many of the links listed at www.ilpi.com/msds/index.html#What.

When you're examining safety information, think about the creatures in your shelter who won't be able to don masks or gloves in the face of the harshest chemicals or strongest dilutions, and choose your products accordingly. Remember that rinsing well is key to preventing irritations on the sensitive parts of animals who tend to lick whatever's in their path, whether it's the bars of the cage or the belly that has rubbed up against them.

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Being Chemically Balanced Is No Guarantee

A cleaning a day keeps the bugs at bay, but the question is, how much cleaning should you do—and how frequently?

DISEASE PROBLEMS IN THE ANIMAL CARE FACILITY can't be controlled by magic potions. Solutions, unfortunately, are only part of the solution.

"Just basic cleaning is really as effective as anything you can do," says Colin Parrish, a Cornell University virologist who studies parvoviruses. "It may not remove the very last particle, but I think that's very difficult in a shelter situation anyway. ... Your main goal, I think, is to sort of reduce the viral load in the environment. So normal hygiene and cleanliness are 90 percent of the battle."

Even those who peddle the products agree. "Picking your product is, quite frankly, the easiest part of the whole thing if somebody knows what they're looking for," says Chris Quinlan of Animal Health Technology. "The other part to infection control is employees—the protocol that they use to clean and disinfect, but also their eyes. They need to be taught to recognize the clinical signs of a sick animal and then isolate."

The more people understand how germs are transmitted, the more conscientious they tend to be in the way they handle animals, apply disinfectants, and follow other recommended disease control practices. The attention to such details is critical; the range of products used by shelters that report success in their disease control measures is testament to the fact that the bug battle involves far more than what's in the bottle. An informal survey of shelters regarding their cleaning protocols yielded as many answers as there were respondents, including among them the following:

- a humane society in Arizona that steam-cleans once a week and rotates disinfectants every three months, using ZEP Micronex, Top Performance Wintergreen, and Envirocide;
- an animal control agency in North Carolina that uses a hypochlorite product in the kennels and Ready-to-Use TB-Cide Quat in the cat area;
- a humane society in California that uses a degreaser and bleach in the dog runs and NutraQuat in the cat area;
- a private shelter in Rhode Island that uses KennelSol regularly and a degreaser and bleach only occasionally;
- and a humane society/animal control agency in Maryland that uses a quaternary ammonium product called Sentricide throughout the facility.

Probably more important than what these shelters are using, though, is how they are using it. And there's no defined formula for disinfection that will apply to every facility and every situation. Cleaning protocols depend on many variables, including staffing levels, facility size, construction materials, animal intake numbers, and differences in disease prevalence from region to region. Depending on the conditions, some shelters "detail-clean" every day, cleaning first with a detergent and then disinfecting with bleach. Others clean and disinfect with a quaternary ammonium each day, degrease once a week, and use bleach only in the isolation or quarantine areas. Still others employ a combination of all three throughout the shelter—scrubbing with a quaternary ammonium every day and degreasing and bleaching weekly.

However you decide to detail-clean, your regular regimen should follow these basic principles:

HELP THE ANIMALS TAKE COVER. What makes cleaning in the shelter so difficult is the very fact that it's a shelter for live beings, not a building full of inanimate objects. Trying to do right by those beings includes both giving them a clean space and ensuring their comfort—and the cleaning process can make these two goals seem like competing notions. But they don't have to be. As long as you are ensuring you have a safe spot in which to place animals while you clean, whether it's a temporary carrier or a bank of clean, empty cages, you can minimize the stress that cleaning would otherwise present.

Your furry charges should never be in a kennel or cage while you are spraying or hosing, but there are other options. You can put animals on the other side of a double-sided kennel or cage if you're lucky enough to have such a setup. You can use carriers for animals while you clean, but you have to designate a carrier for each animal to use throughout his stay or else disinfect between each use—a process that can be fairly labor-intensive if you do it thoroughly. (Some shelters simplify this process by using cardboard carriers, labeling them with the names of cats, and sending cats home in their own carriers when they get adopted.) Or you can clean out a few kennels and cages at a time and transfer animals from dirty kennels into clean ones—a common practice but not a particularly efficient one.

The practice of moving animals from cage to cage daily is potentially problematic in another way: it has sometimes been blamed for the spread of disease. For that reason, and because of understaffing, some shelters without much space choose to spot-clean cat cages during an animal's stay, each day providing fresh newspapers, towels, food bowls, and litter and gently wiping down surfaces with paper towels. Thorough cleaning and disinfection is saved for later, when the cage has become dirty or when the cat is adopted, euthanized, or moved to another holding area.

In the best-case scenario, two spaces are reserved for each animal—an idea that many people tend to shy away from, fearing backlash from

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members of the public who won't understand why the shelter euthanizes even when half the cages are empty. But in the grand scheme of disease control, keeping reasonably sized populations in the shelter is going to save more lives in the long term, not only making the cleaning process faster but lessening the chances for cross-contamination.

"The more cats you have in a given space, the more upper respiratory infection you have also," says Kate Hurley, director of the Maddie's Shelter Medicine Program. "So I think decreasing the density of cats is a very, very important tool to keep them healthy as well as to make cleaning more efficient and more humane for the cats. It's really traumatic if you think about how much cats tend to hate getting grabbed and put in a cage and taken to the vet. And these cats are already stressed out, and imagine being grabbed every single day, packed in a carrier and stacked in a wobbly stack or out in the hall, where it's stinky and dogs are barking, and then having your cage cleaned and then getting crammed back in it.

"It's just really problematic for cats. And even apart from that, just getting cat density down to half the level—and having the cats be healthy and less stressed—is going to make them get adopted out faster, and ultimately allow the shelter to help just as many if not more cats and have the cats be happier in the process."

TAKE OUT THE TRASH AND SOAK THE IMPLEMENTS. Putting litter—and other soiled material—in its place is the first step in proper disinfection. The presence of organic material can reduce or negate the effectiveness of disinfectants by neutralizing its killing power or by surrounding the pathogen and preventing contact with the solution.

Food crumbs, spilled litter, newspaper liners, and towels should all be removed from cages and kennels. Hosing debris down the drain risks splattering invisible microbes on the walls and ceilings, so even feces must be removed by hand before the spraying begins.

Tricks for speeding up the cleaning process or controlling an outbreak include turning cardboard sandwich boats into food bowls and using cardboard soda flats, shirt boxes, or food trays as litter pans. Easily disposed of and easily replaced, these items just need to be large enough for a cat to move around in; no kitty likes to have to do yoga to try to do his bathroom duties.

Cafeteria-style steam table pans can also serve as litter boxes. Made of stainless steel, they are available from cafeteria supply companies or through Animal Care & Equipment Services (ACES). Because they are easy to disinfect, stainless steel food bowls are also the dish of choice; plastic dishes and litter boxes are too easily nicked by little toenails and teeth, creating secret bunkers for germs in the cracks and crevices.

A commercial dishwasher can help disinfect these items, but it won't clean them. Dishes and pans should be scrubbed first before taking the plunge into the machine, says veterinarian Bing Dilts of San Francisco Animal Care and Control. Shelters not lucky enough to possess a dishwasher can mimic the process by turning large drums into a makeshift scrubbing and soaking system. Using one pair of drums for litter pans and another pair for reusable bowls and toys, shelter staff can first scrub items in a drum filled with a detergent/degreaser, then rinse them, and then place them in another drum full of disinfectant for ten minutes before rinsing again.

Toys and soft comfort items should be disinfectable; they can either be washed before being placed with a new animal or sent home with adopters.

PUT DISPOSABLE—OR DISINFECTABLE—TOOLS AT YOUR DISPOSAL. Sponges and rags are a microbe's idea of heaven; they are porous and inviting to infectious agents. "Contaminated cleaning tools can be a common cause of poor results with germicides and sanitizers," wrote Tom Bach in the October 2001 issue of *Infection Control Today* ("Chemical Management Involves Worker Safety and Economics"). "Clean tools not only must be free of visible soil, they must be free of bacteria."

For general surface cleaning, Bach recommends disposable cloths or paper towels that reduce the opportunity for cross-contamination. Tools with smoother, harder surfaces, including stiff-bristled brushes, help with more heavily soiled areas and can be easily cleaned between uses.

Keeping several brushes in a bucket of diluted disinfectant allows you to scrub out one cage with the first brush; you can dip the brush back into the bucket to disinfect while you use the second brush on the second cage; and so on. Using a hose-end sprayer to apply detergents and disinfectants reduces the time it takes to spread the solution around, but you still need to scrub all surfaces, including the doors, floors, walls, resting boards, and cage ceilings.

If you spot-clean during the day or if your shelter just changes the litter boxes, liners, and food of feral cats during their holding periods, you should clean litter scoopers between boxes by using the same bucket-dipping process as described above. Otherwise, moving straight from one box to another will serve as a surefire way to spread contaminants among cats, since many pathogens are shed through feces.

LEARN THE RUB ON HOW TO SCRUB. The products in your chemical arsenal need to do battle with three things: dirt, germs, and grease. And no one product will take care of it all, except those that are too expensive or too unsafe. Quaternary ammoniums are good cleaners and good disinfectants, but only the pricey high-concentrate products are capable of killing or inactivating most germs a shelter has to contend with. Bleach is cheap and kills even the most resistant microorganisms like parvovirus, but it doesn't have the surfactant properties necessary to lift dirt and residue. And degreasers cut through the filmy layers that disinfectants can't touch.

Don't Let the Fomites Get You Down

You may have had a hand in cross-infection in the past—without even knowing it

THEY EXIST IN OUR EYELASHES, ON OUR SKIN, in our hair, and everywhere in between. In the grand scheme of the biological universe, we and the animals in our care are veritable breeding grounds for parasites—and we exist at their pleasure more than we'd like to admit.

If that imagery is too hard to conjure, try envisioning all the little microbes that set up camp in the crumb on your countertop, in the water droplet on your doorknob, or under the lip of an empty food bowl.

It's not a pretty picture. Unless, of course, you're a mad scientist who finds critters at the molecular level life-affirming—the kind of person who examines these things for a living, as researchers in the human health care setting have been doing for years in their quest to learn more about the process of disease transmission.

In fact, the existence of germs on inanimate objects—or "fomites," as those objects are called—has been the subject of much debate. Examining everything from pagers to stethoscopes to determine what lives on the surface of things, medical researchers have gleaned results that are not for the faint of heart. In one hospital study, two species of infectious bacteria lived on countertops for about a week, on bed rails for about 24 hours, and on phone handpieces and gloved and ungloved hands for an hour.

And that's nothing compared to parvovirus, which has been known to live for a year or more on surfaces. But as Kelly Pyrek points out in the August 2002 issue of *Infection Control Today* ("Fomites' Role in Disease Transmission is Still Up for Debate"), figuring out the role of these surface dwellers in disease transmission is a chicken-and-egg scenario. Are the microorganisms that are found on surfaces after human hands shed them no longer as viable as those that remain on the hands themselves, or do human hands pick up the fomites from those surfaces and go on to infect a live being?

One thing is certain, according to the Centers for Disease Control: there's nothing quite like washing your hands to help prevent the spread of infection. In a fact sheet about its new "Hand Hygiene Guidelines" released last October, the CDC advised, "Improved adherence to hand hygiene (i.e. hand washing or use of alcohol-based hand rubs) has been shown to terminate outbreaks in health care facilities, to reduce transmission of antimicrobial resistant organisms ... and reduce overall infection rates."

Disinfecting Those Dirty Digits

Alcohol-based hand rubs "significantly reduce the number of microorganisms on skin," according to the CDC, which decided to recommend the use of such products because they are powerful, fast-acting, and convenient for health care workers on the go. In the animal care field, alcohol is not active against parvovirus, but a gel made of 70-percent alcohol inactivates some caliciviruses, says Kate Hurley, director of the Maddie's Shelter Medicine Program at UC Davis. Ethanol has been found to be the most effective of the alcohols against calicivirus, she says.

But like hospitals, shelters often have trouble persuading staff and visitors to make use of hand-sanitizing dispensers designed to be used between the handling of each animal. Running across the room to a dispenser on the wall might indeed take a prohibitively long time when you're moving cats into carriers or clean cages during the morning routine. But

So what is a poor kennel tech to do? Inevitably, you'll have to use more than one product to get the job done. Because bleach is corrosive to equipment and irritating to humans and animals alike, some experts recommend reserving it for critical situations. "Bleach is a great disinfectant, but it doesn't clean well and will eventually eat through your cages," writes Bilts in a presentation she compiled on cleaning and disinfection. "The fumes are also harmful to employees and animals if it is used in high concentrations. This said, I don't recommend getting rid of bleach, but using it in certain areas only: isolation wards and on cages that were contaminated with a known problem (like parvo, kennel cough, panleukopenia)."

Some shelters choose to use bleach in all areas, perhaps twice a week instead of every day. Either way, a bleach treatment must be preceded by a detergent scrubdown and a thorough rinsing, wrote Michael McCagg in the March 2003 issue of *Cleaning & Maintenance Management Online:* "Bleach can make some soil transparent, leading a cleaner to think he/she has actually cleaned a surface when in fact the soil remains." If you choose not to use bleach at all, it's critical to buy a product with high disinfection properties to use at least in the isolation areas and in areas you know have been contaminated by parvovirus or something similarly resistant. (See "The Product Claim Game" on page 14.)

"Some shelters use quats daily and then once a week degrease and bleach, and I think that would be a very reasonable protocol in a dog ward in a shelter that didn't have a lot of parvo problems," says Hurley. "And then if you started having trouble with parvo, that would be when you'd want to move over to more routine use of bleach—or to a quat that has parvocidal activities."

Even though quaternary ammonium products are often sold as pocket versions may alleviate the problem; they are small enough to whip out whenever needed and save valuable time.

Just as with surface disinfectants, though, hand rubs can be inactivated by the presence of organic material; when hands are covered in dirt, saliva, or other debris, there's no substitute for washing them with soap and water. "Just for people to be aware, [hand sanitizers] are certainly better than nothing," says Hurley. "But they shouldn't give you a false sense of security, and mechanical washing of hands with soap and water is still preferable—or using gloves when you're handling something like a known parvo or ringworm animal."

Hand washing is considered "one of the mainstays" for controlling cross-infection in the hospital environment, write Brenda C. Love and Dwight C. Hirsh in "Disinfectant and Antiseptic Use in Small Animal Practice" (*Kirk's Current Veterinary Therapy*, Volume XIII): "However, some studies have shown that hand washing itself may contribute to the spread of infections ... because mechanical scrubbing of the skin results in the shedding of squames, which carry with them the resident bacteria. Also, frequent hand washing can result in irritation, which can change the ecology of the skin, resulting in an increase of gram-negative bacteria."

The authors therefore recommend a combination approach that involves using an antimicrobial soap when trying to control the spread of infection, followed by the use, between patients, of alcohol-based solutions—products that proponents say are generally less irritating to the skin than soap anyway.

Beyond disinfecting their "dirty digits," healthcare workers should keep nails trimmed, wrote infection control consultant Nancy B. Bjerke in the July 2002 issue of *Infection Control Today* ("Disinfecting Those Digits Is Critical to Good Handwashing"). Artificial nails or nails more than a quarter-inch long can serve as a reservoir for germs, so the CDC recommends against them in the healthcare setting. "The most noted link of these adornments and their accompanying nail extension to a major *Pseudomonas aeruginosa* outbreak was published by the ... CDC in February 2000, where the causal links to 16 neonate deaths were a nurse with long natural nails and a nurse with long artificial nails," wrote Bjerke.

Taking a Bite Out of the Fomite

Avoiding transmittal altogether is practically impossible in most shelters; for some, it's simply not realistic to change disposable gloves or wash hands between the handling of every cat, says Hurley. During an outbreak or in the isolation room, such measures are critical, but in routine situations, there are other ways to at least reduce the levels of cross-contamination without losing too much time in the process.

For one thing, you can start by examining how you remove and replace cage and kennel items. In the picture Hurley paints of a normal routine, imagine you have the eagle eyes to see even the smallest particles: "You pick up a cat and put it in a carrier and then pull out its litter box and then dump that and pull out the dirty newspapers and dirty towels and bedding and whatever else. By the time you've done that with a few cats, you're very coated with germs," she says. "And with all the cats that you subsequently handle and pull out, you're going to be transmitting the germs from all the previous cats, including all the stuff that sort of becomes airborne when you're cleaning litter boxes—and you get coated with a fine dusting of coronavirus."

While there's no way to prevent partial contamination in these situations, it's certainly possible to reduce the levels—and that's something to aspire to, since some germs need to be present in a fairly sizable number to infect a new host. If two people are cleaning, one can pull out all the dirty materials from each cage and the other can insert clean materials into clean cages. If only one person is handling the job, she can remove all the dirty items first and then change smocks before replacing clean items. "It's not ideal," says Hurley. "There's still some potential for disease transfer in taking the cats out and putting the cats in, but it's going to be much less so when you haven't also then coated your hands and arms and front with litter."

Natalie Raciopa / Photodisc Green

one-step detergent/disinfectants, they will not adequately disinfect in the presence of a heavy soil load. Dirt and debris will turn disinfection with a quat into a two-step process. "The quats can be applied as a one-step cleaner for a very lightly soiled cage," says Hurley, "but for a heavily soiled cage, they really need to be cleaned first and then disinfected either with a quat or a bleach."

Degreasing on a regular schedule—whether twice a week, once a week, or once a month, depending on the conditions—will help remove the slimy films that little wet noses and sticky paws leave behind. Detergents often don't remove these layers, which can serve as substrates for breeding microorganisms.

GIVE IT A GOOD RINSE. Some labels carry the claim that no rinsing is required, and technically that may be true in the mock testing situations set up by product researchers. But it's better to be safe than sorry, for the sake of both people and animals. Animals may develop mouth ulcers, scrotal dermatitis, or other irritations if they lick or lie on disinfectant residue.

Rinsing is necessary for another reason: if you don't do it, your whole disinfection process may be a wash. Not only can chemicals react with each other to create noxious fumes; certain combinations may also negate the overall effect you're trying to achieve. Some detergent products can inactivate quaternary ammoniums and reduce the activity of bleach solutions, so it's smart to wash away one product completely before applying another.

Quinlan provides another perspective—one from a more macroscopic level than is usually accorded to microbes. For the very reason that the invisible beasts are invisible, disinfectant users often forget they're there. But while scrubbing brings germs to the surface, and disinfecting kills many or most of them, the dirt may cling for dear life until squirted down the drain. "People ask me all the time, 'Does your product need to be rinsed away?' And I tell them, 'Well, no, it doesn't need to be rinsed away, but it's designed to be rinsed away—that's part of the physical action of the dirt and germs,' " says Quinlan. "If the germs were as big as cockroaches, they wouldn't be asking me."

Virologist Colin Parrish of Cornell University agrees. "My attitude, frankly, is that I think that hot water and plenty of it is probably most effective—[as well as] detergent," he says, adding that vigorous cleaning can help wash away parvovirus. "Once it goes down the drain, then it's not a concern for you."

Some shelters might prefer not to use water that is steaming hot, for fear of burning staff or animals. But as long as animals are moved away from areas that are being cleaned and staff are properly equipped with protective gear, a weekly or monthly steam-clean can't hurt and may help dislodge the hardiest remaining bugs from their hiding places.

Experts on the HSUS Animal Services Consultation (ASC) team sometimes recommend that shelters consider purchasing an electric hot-water pressure-washing system, which can hasten cleaning as well as reduce filmy buildup on cage surfaces. But there's still no substitute for elbow grease. "Pressure washers do not ... eliminate the need for the weekly degreasing of cage surfaces," wrote ASC team members in a recent report. "All degreasing agents should be used in conjunction with some type of mechanical action, either scrubbing or pressure washing."

Whatever system you use, you should always ensure housing areas are dry before putting animals back into their clean quarters.

FOR MORE INFORMATION ...

Here are just a few of the websites that can provide you with free information on cleaning and disinfection practices

www.animalsheltering.org: The HSUS's website devoted to animal sheltering issues includes many back issues of this magazine in their entirety as well as a "Shelter Library." Click on the "Animal Health" section of the library to find articles on controlling URI, kennel cough, parvo, and panleukopenia; click on "Animal Sheltering Magazine" to find links to the How-to series, which includes step-by-step instructions for cleaning cages, kennels, and kennel items.

www.vetmed.ucdavis.edu/CCAH/ProgShelterMed/ShelterMedicine.htm: Maddie's Shelter Medicine Program at the University of California, Davis, School of Veterinary Medicine has a wealth of information on disease control in the shelter. The program's new director, Kate Hurley, DVM, recently compiled a list of cleaning protocols that answer questions such as "What needs to be cleaned?" and "Who gets cleaned first?" The document also provides advice on choosing and applying disinfectant products. If it's not up by the time you're reading this, keep checking back for the new posting.

www.infectioncontroltoday.com: Written for the human healthcare field, this publication nonetheless contains a wealth of information helpful to animal care and control professionals. *Infection Control Today* covers everything from hand hygiene guidelines to disinfection of scrub brushes. While not all of the information applies to animal care, much of it can be extrapolated for the purposes of shelter cleaning. The site is educational and helpful in understanding the reasons behind certain disinfection practices.

www.epa.gov: The Environmental Protection Agency registers and approves disinfectant products. Click on the "antimicrobial pesticides" section of this site and you'll find lengthy explanations of the registration process, the labeling system, and the classifications assigned to different kinds of disinfectants. (See "Great Points in the Fine Print" on page 20 to learn how to track down labels for specific disinfectants on this site.)

www.ilpi.com/msds/index.html#What: At this site you'll find links to many databases containing Materials Safety Data Sheets, which must be kept in an accessible spot in the workplace. If you are trying to research products, these sheets will provide information helpful to your search.

Neutersol®

(Zinc Gluconate Neutralized by Arginine)

Injectible Solution • Chemical Sterilant

Caution: Federal Law restricts this drug to use by or on the order of a licensed veterinarian.

Description

Sterile intratesticular injectable aqueous solution containing 0.2 M zinc gluconate neutralized to pH 7.0 with 0.2 M L-arginine (13.1 mg zinc per milliliter).

Indications

Neutersol® Injectable Solution is indicated for chemical sterilization in 3 to 10 Month old male dogs.

Contraindications

Do not use Neutersol® in dogs with:

- Undescended testicles (cryptorchid).
- A disease or malformation of the testicle (including fibrosis of the testicles or epididymides).
- A history of allergic reaction to any of the components of the drug.
- Pre-existing scrotal irritation or dermatitis.

Precautions

1. To avoid irritation to the scrotal skin, do not shave or clip the scrotal hair. Use a nonalcoholic disinfectant as an aseptic agent.
2. Use this product only in healthy male dogs following a thorough examination of the scrotum to ensure the scrotum is free of skin irritation and ulceration and that both testicles are descended and normal as determined by digital palpation by the examining veterinarian.
3. The safety and effectiveness of Neutersol® has not been established in dogs less than 3 months of age or in dogs greater than 10 Months of age.
4. Do not use if the testicular width is less than 10 mm or greater than 27 mm.
5. Obtain an accurate measurement of testicular widths by using the caliper provided and the dose corresponding to testicular measurement. Both testicles must be injected with the appropriate dose using the correct procedure in order to minimize adverse reactions and achieve sterility.
6. In dose determination and field studies, the most serious cases of scrotal irritation and ulceration occurred as a result of improper injection technique or were associated with the dog biting or licking the injection site after release to the owner. Detailed instructions on proper care post-injection should be provided to the owner via the attached Client Information Sheet (CIS).

Information for Dog Owners

Transient testicular swelling is an expected reaction to the injection. Field and dose determination data indicate that the swelling begins 24 hours post-injection and peaks at 48 hours post-injection. By 1 Month post-injection, most testicles will be atrophied. However, the degree of atrophy will vary individually and there may be variability between the left and right testicles of the same dog. This should be considered an expected response to the injection. Neutersol® may not kill sperm present at the time of injection. Therefore, keep treated dogs away from females in heat for at least 60 days post-injection. Unlike surgical castration, dogs treated with Neutersol® become sterile without removal of the testicles and, therefore, testosterone is not completely eliminated. Diseases which occur as a result of or in conjunction with testosterone hormones (prostatic disease, testicular or perianal tumors) may not be prevented. As with surgical castration, secondary male characteristics (roaming, marking, aggression, or mounting) may be displayed.

Warnings

Human Warnings: Keep this and all drugs out of the reach of children. Not for human use. Wash the skin with soap and water and flush eyes with copious amounts of water if contact occurs. Flush mouth with water and drink plenty of water if accidental ingestion occurs. Contact a physician in cases of accidental exposure by any route (oral, dermal, or injection).

Animal Safety Warnings: Proper injection technique and post injection care are critical to the safe use of Neutersol®.

Do not inject Neutersol® into the scrotal sac or scrotal skin. Contact between the drug and the scrotal skin activates collagenase enzymes, which may result in scrotal irritation, dermatitis, ulceration or necrosis. Chemical restraint should be used, if necessary, to prevent the dog from moving during the injection. To avoid leakage of drug from the injection site use only a 28 gauge ½-inch needle, inject slowly and immediately stop the injection if you feel resistance. Do not attempt to re-inject Neutersol® if you feel resistance to the injection. If you suspect that the drug was injected improperly into the scrotal sac or has contacted the scrotal skin, the dog should be closely monitored for up to 7 days post-injection for local adverse reactions.

Do not allow dogs to bite or lick the scrotum after injection. Monitor dogs closely while in the veterinary facility and for at least 7 days following release from the veterinary facility for signs of scrotal inflammation. Leash walk only and do not allow the scrotum to contact hard, wet surfaces as this may result in irritation, dermatitis, ulceration or necrosis. Distribute the Client Information Sheet to each client for proper care post-injection.

Do not inject Neutersol® more than once into each testicle.

Adverse Reactions

In a field study with 270 dogs, Neutersol® caused both local adverse reactions at the injection site and systemic reactions (See Table 2).

Neutersol® injection was observed to be painful in 2.6% of 270 treated dogs. Six dogs vocalized and one dog kicked following injection. Apparent scrotal pain post-injection was the most commonly reported local reaction (6.3%), most frequently seen during the first two days post-injection. The most commonly reported systemic reactions to the Neutersol® injection were neutrophilia (6.3%), vomiting (4.4%), anorexia (4.1%) and lethargy (2.2%). These reactions were typically seen within 7 days of the injection. However, vomiting was most commonly seen on the day of the injection, between 1 minute and 4 hours post-injection. Six of 10 dogs that vomited did so more than once during this period. Withholding food for 12 hours prior to injection may prevent this from occurring. The most severe reactions occurred when dogs bit or licked the scrotum following injection (See **Warnings**). These severe reactions were seen in < 1% of 270 dogs. One dog was returned to the clinic on Day 3 for an ulcerated scrotum. The wound healed with medical therapy. The second dog was reported with a perforated scrotum and a severe scrotal infection on Day 17 post-injection. The dog had licked and chewed through the scrotum down to the testicle. Surgical castration and scrotal ablation were performed.

Table 2: Adverse Reactions

Adverse Reactions	No. of Animals (n = 270)	Percent (%)
Reaction Upon Injection		
Vocalization	6	2.2%
Kicking	1	0.4%
Local Reactions		
Scrotal Pain*	17	6.3%
Scrotal Irritation	3	1.1%
Biting and Licking	2	0.7%
Scrotal Swelling	2	0.7%
Scrotal Irritation and Dermatitis	2	0.7%
Scrotal Ulceration	1	0.4%
Scrotal Infection	1	0.4%
Dry Scrotal Skin	1	0.4%
Scrotal Bruising	1	0.4%
Preputial Swelling	1	0.4%
Scrotal Sore	1	0.4%
Systemic Reactions		
Neutrophilia	17	6.3%
Vomiting**	12	4.4%
Anorexia	11	4.1%
Lethargy	6	2.2%
Diarrhea	5	1.9%
Leukocytosis	2	0.7%

**Most scrotal pain was reported on the first two days after injection.*
***Ten of the 12 dogs vomited within 1 minute and 4 hours after the injection.*

Resistance Is Futile If You Clean Properly

Rotation of similar products won't make much difference in the end result, but rotating quats with bleach is still recommended

DOES ROTATION OF DISINFECTANT products reduce the potential for antimicrobial resistance? Or is the whole premise of that question questionable?

No one seems to know for sure, and that's one reason some shelters stay on the safe side by using several different disinfectants, alternating products biweekly or bimonthly.

But while the misuse of antibiotics has been implicated in the development of resistant bacterial strains, there is little evidence to support the theory that disinfectants play a similar role. Unlike antibiotics, which either break down cell walls of bacteria or interfere with reproduction by blocking different biochemical pathways, surface disinfectants absorb onto microbial cells, writes *OSHA Review* publisher Rodney Stine in the November 2001 issue of *Infection Control Today*. "According to research ... such absorption increases the permeability of the cell membrane, ultimately leading to rupture and leakage of the contents of the cell," he writes. "The cell dies. There is no chance for mutation."

Viruses suffer a similar fate. Even if its genetic material survives, in the face of a strong enough disinfectant a virus will lose its ability to reproduce. "[Parvovirus] mutates very occasionally, but it's not like a bacteria which is mutating to escape antibiotic treatment," says Cornell University virologist Colin Parrish. "It's more like it mutates because it's host-adapting, and that's something that happens over a very long period of time. We've seen nothing in the virus genome sequence that says that there are any changes that would be induced by a detergent or a disinfectant."

Moreover, chemical concentrations in disinfectants are much higher than those of anything that's ingested internally. "The thing about antibiotics is that they have to be a little gentler because the organism has to be able to take them in and not suffer toxic side effects," says Kate Hurley, director of the Maddie's Shelter Medicine Program at UC Davis. "So they can't just trash the viruses and bacteria in the way that a disinfectant can get away with."

"We've been using disinfectants for, in the case of bleach, a long time—pretty much since we knew about germs," she says. "And we don't see the kind of evolution or resistance that we do to antibiotics."

Rotating a quat and a bleach is best, since bleach is effective against more microbes but quats can clean—and you'll have a better chance of attacking your microbial enemies from all sides.

While some shelters rotate quaternary ammonium compounds, the quats are too similar in their mechanisms to make a difference, says Hurley. "It's just like rotating two penicillin antibiotics is not really going to help you that much in terms of antibiotic resistance," she says.

The mechanisms of disinfectants are not well enough understood, concluded a 1999 article in *Clinical Microbiology Reviews* ("Antiseptics and Disinfectants: Activity, Action, and Resistance," Vol. 12, No. 1). The issue deserves more study, noted authors Gerald McDonnell and A. Denver Russell, and there may be other reasons behind anecdotes of acquired resistance to disinfectants. "Many ... reports of resistance," they wrote, "have often paralleled issues including inadequate cleaning, incorrect product use, or ineffective infection control practices, which cannot be underestimated."

And therein lies the real reason a shelter might want to use a couple of different products: What one scrub job hasn't killed, the other just might. Rotating a quat and a bleach is best, since bleach is effective against more microbes but quats can clean—and you'll have a better chance of attacking your microbial enemies from all sides. ●