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Restroom Cleaning: Using Science in the Fight Against Design Flaws

By Dr. Jay Glasel

CATEGORIES: SCHOOLS, HEALTHCARE, COMMERCIAL BUILDINGS, CLEANING MEASUREMENT, IEQ MEASUREMENT, HEALTH & HYGIENE

A basic guiding principle in understanding restroom cleaning is that almost all public restrooms have used designs and been constructed with methods and materials that embody flaws that work against easy removal of microbial contamination. These flaws include: non-mitered wall and floor intersections, walls that are coated with hard-to-clean coatings, grouted tiling on floors and walls, porcelain fixtures with irregular fittings to walls and/or floors, hand operated faucets, and hand operated towel dispensers or hot air hand dryers without high-efficiency or HEPA filters. This list could be extended.

I once worked in a very strikingly modern-looking research building where the research spaces that the building had been built for were not designed nor constructed to be workable for modern scientific research. I had a chance to ask one of the architects of the large firm that was responsible for the building how they designed the research spaces. His answer was that basically they looked at previously built buildings with research spaces and copied the design of those spaces.

It appears that architects of the restrooms in most modern schools and office buildings do the same thing—copy designs that should have been eliminated a long time ago. That's something that will not change anytime soon and therefore cleaning supervisors and their crews need to understand how best to deal with the problems created by design and construction flaws in restrooms.

Hospital and Non-hospital Cleaning and Infections

Hospital acquired infections (HAIs, also called "nosocomial infections") include almost all clinically evident infections that do not originate from a patient's original admitting diagnosis. In the United States, the incidence of HAIs is more than 2 million cases per year and result in an additional 26,250 deaths [1, 2]. This is a worldwide phenomenon and in recent years HAIs caused by so-called "superbugs" have seen a rapid increased incidence. In response, hospitals have placed increasing focus on the cleaning procedures used in patients' rooms.

Unfortunately, what has happened is that some pathogenic microbial species, including superbug species, are no longer confined to hospitals and have spread to the general population. For example, the highly publicized microorganism, methicillin-resistant Staphylococcus aureus (MRS), has developed into species called "community-associated MRSAs" (CA-MRSAs) that are microbiologically and clinically different from the species most familiar in a hospital setting.

It is not widely appreciated by the general public (and by persons in charge of cleaning public facilities like restrooms) that individuals can carry CA-MRSA within their bodies asymptomatically for many months [3]. We also know that other pathogens than CA-MRSA may be carried asymptomatically by members of the general population. Therefore, individual carriers of pathogens, who give no sign of being infected, act as reservoirs of infectious disease for the general population.

Given the situation just described, it seems clear that cleaning and disinfection procedures in public facilities such as school restrooms need to be developed along the same lines as hospital procedures—perhaps not as rigorous as in hospitals—but at least following the same trends. Those trends are: increased professionalism by environmental directors and the workers they supervise including development of written cleaning and disinfection protocols, adequate training of personnel to carry out the protocols, and quantitative monitoring of results.

Cleaning and Disinfection are Separate Processes But May Be Combined

Cleaning is defined [4] as removal of foreign material such as dirt and organic matter from objects and it is normally done using water to which is added detergents. Thorough cleaning is essential because microbials may adhere tenaciously to dirt particles, organic matter (e.g., fingerprints), and surfaces. Proper cleaning procedures loosen particle adhesion surfaces via agitation of detergent solutions to bring the particles into suspension so that they can be removed easily. This means that a cleaning step does remove some

- Swine Flu
- H1N1
- MRSA
- Staph
- Norovirus
- Flu
- E. Coli
- C. Difficile
- Salmonella
- Green Cleaning
- Cleaning for Health
- Nosocomial Infections
- Disinfection
- Bacteria
- Viruses
- Indoor Air Quality
- Asthma
- Allergies
- Allergen
- Mold

MDROs (Multidrug-resistant organisms) and Cleaning

"A common reason given for finding environmental contamination with an MDRO (Multidrug-resistant organism) was the lack of adherence to facility procedures for cleaning and disinfection ... monitoring for adherence to recommended environmental cleaning practices is an important determinant for success in controlling transmission of MDROs and other pathogens in the environment."

Infection Control Education Institute - Jan. 30, 2007 bacteria (those attached to dirt particles or only loosely attached to surfaces) and therefore accomplishes partial disinfection. It must be understood, however, that cleaning solutions normally have little or no disinfection power. In fact, some microbials can live and prosper in detergent solutions.

Microbials—especially some bacteria that attach strongly to surfaces—may not be removed by normal cleaning procedures, even ones that employ a great deal of agitation. These microbials should be eliminated by a disinfection procedure. Disinfection involves the use of an Environmental Protection Agency (EPA)-registered product with proven effectiveness. This is a deceptively simple statement. In practice, the selection of a disinfectant depends on what microbial species are present in the particular facility (each single disinfectant is only effective against a certain range of microbial species), what concentration of disinfectant needs to be used (somewhat a question of cost), and how much time must the disinfectant reside on a surface to be effective (a question of throughput for the cleaning crew).

The conclusion is that planning and designing a cleaning and disinfection program for a restroom facility must be done in a highly systematic way and be based on effectiveness for that facility. For example, it would be useful to gain quantitative data on the level of microbial contamination of each facility before cleaning is done. This may be done by contracting with any one of a number of commercial microbiological testing firms to take samples and determine species and levels of contamination (the level of microbial contamination is called the “bioburden”) that exist on surfaces. The surfaces that need to be tested (and later cleaned and disinfected) include not only floors and walls, but highly touched objects (HTOs) such as faucets, door handles, etc.

Provided that the bioburden in the restroom to be cleaned is fairly low, combining disinfectants with cleaning solutions can be done provided it can be proven by actual microbial counting procedures in the facility that the combined cleaning-disinfection effort is effective. Protocols that work may be established with the help of monitoring tools such as fluorescent dyes that can reveal general cleaning effectiveness [5] and instruments that measure total levels of microbial contamination [6].

Special Problems with Tiled Restrooms

The quantitative cleanability of ceramic tiles has been studied extensively with the not very surprising major conclusion that rough surfaces are harder to clean than smooth ones [7]. A quantitative standard for judging the effectiveness of a cleaner for soap scum on ceramic tile surfaces has been established [8] but has limited practical use because it specifically does not deal with cleanability of the grout between tiles. Depending on the tile size, type of grouting, and installation method, the total area of grout may be a sizable fraction of the total floor and/or wall area and grout lines harbor the hardest to remove soil and microbials [9-11].

HTOs and Restroom Contamination

HTOs such as faucets, light switches, doorknobs, towel or hand drier actuators, etc. have been shown to be efficient in transferring microbials from hands to the objects and then from objects to hands [12, 13].

Almost all of us are taught as children to wash our hands after using a urinal or toilet (although surveys show that only about 75% of grownups still do this). But even if individuals take this step they often cannot avoid contamination because of the design flaws in public restrooms, described previously in this article. For example, even though touchless water faucets are becoming more frequent, hand operated restroom sink faucets are still common. Also, in some cases where touchless faucets are installed, soap dispensers are still hand operated. Consequently, when we go to wash our hands, we turn the water faucet handle with our hand—efficiently transferring any hand contamination to the handle, wash our hands, then we turn the water off with a wet hand—efficiently transferring any contamination that we deposited on the handle (plus any still there from previous users) back to our hand. We then proceed to the towel dispenser and deposit contamination to the towel dispenser actuator or to the actuator button on the air blower hand drier (if it is not turned on by a touchless actuator). The air blowers normally used in hand driers efficiently take in restroom air with all the aerosolized contamination present in a highly used restroom air and deposit it efficiently on our drying hands.

Some new products have appeared that may help to break these inevitable cycles of contamination. For example, the defects in the familiar blow driers just described have been removed in the Dyson AirBlade (www.dysonairblade.co.uk). This touchless device uses a HEPA filter to remove aerosolized contamination while drying hands efficiently, and its housing is coated with an antimicrobial finish to avoid passing on contamination from accidental touches.

Conclusion

Along with esthetic reasons, the purpose of cleaning and disinfecting restrooms is to help minimize the spread of infections by dangerous pathogens. The relatively recent recognition that asymptomatic individuals who carry pathogens are reservoirs for the spread of their infections makes effective science-based cleaning and disinfection of places such as restrooms where mis-design, high use rates, presence of many HTOs, and dissemination of contaminated body wastes are all present mandatory.

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About Dr. Jay Glasel

Dr. Jay Glasel is the Managing Member and Founder of Global Scientific Consulting, LLC. He is a Professor Emeritus in the Department of Microbial, Molecular and Structural Biology at the University of Connecticut Medical/Dental School in Farmington, Connecticut. He has lectured and done research in many countries in Europe and Asia. Dr. Glasel's scientific research has been in the fields of structural biochemistry, molecular immunology, pharmacology, and cell biology. Major portions of the research involved the structure and properties of water and aqueous solutions and on the structural chemistry and molecular biology of opiates and opiate peptides. He pioneered the uses of anti-morphine monoclonal antibodies and anti-opiate receptor anti-idiotypic antibodies in research on the cellular effects and actions of narcotics.

Dr. Glasel is co-editor and an author for the Academic Press textbook "Introduction to Biophysical Methods for Protein and Nucleic Acid Research" and many other contributed book chapters and original scientific research articles.

Dr. Glasel obtained a B.S. in chemistry and physics from Caltech. His Ph.D. from the University of Chicago was in chemical physics for work on chemical reactions on comets. He has served on active duty in the U.S.

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