Comparing Two Methods of Reducing Hospital Toilet Aerosols

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BACKGROUND: When flushed, uncovered hospital toilets have been shown to generate aerosols potentially containing bacteria, viruses, and hazardous drugs, which can be inhaled by healthcare workers and contaminate surfaces. Guidelines recommend placing a plastic-backed absorbent pad (PBP) over the toilet, although no studies have evaluated the effectiveness of this intervention.

OBJECTIVES: The purpose of this study was to evaluate the effectiveness of using a PBP versus the Splashblocker®, a solid, reusable engineering barrier control, to reduce post-flush aerosol particles.

METHODS: Aerosol measurements were taken with an optical particle counter in a bathroom testing chamber equipped with a commercial hospital toilet and flushometer valve. Three tests were performed at a height of 16 inches above the floor and 40 inches above the floor.

FINDINGS: Both the PBP and the Splashblocker significantly reduced the number of post-flush particles by more than 99% at 16 inches above the floor and 40 inches above the floor. The results indicate that both interventions are equally beneficial in reducing aerosols after flushing a hospital toilet.

KEYWORDS
toilet; hazardous drugs; Splashblocker; plastic-backed absorbent pad; aerosol

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STUDIES HAVE CONFIRMED THAT FLUSHING UNCOVERED HOSPITAL TOILETS after patient use can generate airborne microbial particles (Aithinne et al., 2019; Johnson, Lynch, et al., 2013; Johnson, Mead, et al., 2013; Knowlton et al., 2018). These tiny aerosol particles, sometimes referred to as a plume, consist of toilet bowl water that can serve as a vehicle or container for bacteria, bacterial spores, fungal spores, viruses, or hazardous drugs (HDs). Many of these HDs are excreted in urine and stool as hazardous or active drug metabolites (National Institute for Occupational Safety and Health, 2004) for which safety precautions should be followed for at least 48 hours, although considerable variation exists between drugs and administration routes (Polovich & Olsen, 2018). Based on criteria established by the National Institute for Occupational Safety and Health (Connor et al., 2016), chemotherapy agents are classified as HDs. Studies have demonstrated HD contamination on surfaces in the bathrooms of patients receiving chemotherapy, at home and in clinical areas (Eisenberg et al., 2021; Walton et al., 2020; Yuki et al., 2013, 2015).

Background

The mechanism of aerosol production by commercial toilets, referred to as bubble bursting (Cai et al., 2022), can be compared to that of medication nebulizers (Alsved et al., 2020) (see Figure 1). Nebulizers work by forcing compressed air or oxygen into a container of liquid medication, producing drug-containing aerosols that are inhaled through the mouthpiece. These devices are intentionally designed to create a high number of small particles and to allow the larger particles to hit the interior walls of the nebulizer chamber and fall back into the medication reservoir. Although significantly less efficient, commercial hospital toilets also generate aerosols using a flushometer valve that can be identified by a vertical chrome pipe and horizontal flush handle. These toilets force high-pressure water into a partially open container of liquid, and the resulting turbulence releases aerosols that escape through the top of the bowl (Gormley et al., 2021; Hu et al., 2019; Lou et al., 2021). High-pressure commercial toilets produce more aerosols than low-pressure toilets commonly found in residential settings (Knowlton et al., 2018), which presents a challenge regarding airborne microbial particles because commercial toilets rarely have lids. Flushometer valve toilets can produce 17 times more particles than standard low-pressure residential toilets (Johnson, Mead, et al., 2013).

Hospital toilets used by patients have been shown to generate particles ranging from 0.02 mcm to 10 mcm in diameter (Knowlton et al., 2018). Particles smaller than 5 mcm remain airborne for long periods of time unless removed by ventilation or other air disturbances. Defined as respirable, they can be inhaled deep into the lungs (Fennelly, 2020). Particles larger than 5