STUDIES & ARTICLES

Dilution dysfunction:

Evaluation of automated disinfectant dispenser systems in 10 hospitals demonstrates a need for improved monitoring to ensure that correct disinfectant concentrations are delivered

CLOROX HEALTHCARE

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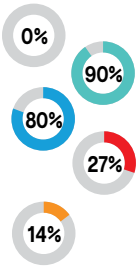
Overview

Several research studies have shown that automated dilution systems can deliver inaccurate levels of disinfectant concentrations.[1,2,3] In this study, Dr. Curtis Donskey and his research group conducted a point-prevalence product evaluation of automated dispensing systems in several hospitals. The researchers collected disinfectant samples from dispensers and buckets of in-use disinfectant. The disinfectants included quaternary ammonium disinfectant cleaners and a peracetic acid/hydrogen peroxide product.

When dispensers delivered lower-than-expected disinfectant concentrations, the efficacy of those samples was evaluated against methicillin-resistant *Staphylococcus aureus* (MRSA) strain for the quaternary ammonium product and *Clostridioides difficile* (*C. diff*) for the peracetic acid product.

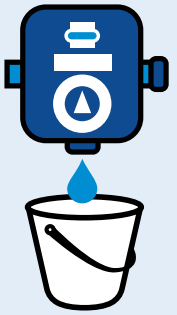
The researchers found that nine of the 10 hospitals had at least one dispenser delivering lower-than-expected disinfectant concentrations, and 14% of all dispensed solutions had no detectable disinfectant (Figure 1). Failure to dispense any disinfectant was usually attributable to human error, suggesting there is an urgent need for improved monitoring of automated disinfectant dispensers.

Key Findings



- None of the hospitals reported routine monitoring of disinfectant dispensers.
- 9 of 10 hospitals had 1 or more systems dispensing lower-than-expected disinfectant concentrations.
- 8 hospitals had dispensers that delivered product with no detectable disinfectant.
- Approximately 27% of all automated dispensers delivered product with lower-than expected disinfectant concentrations.
- 14% of all dilution systems contained no detectable disinfectant.

- Samples with lower-than-expected levels of disinfectant resulted in inefficient disinfection of *C. difficile* spores and MRSA.
- Absence of disinfectant was usually attributable to human error.
- With enhanced monitoring, all dispensers in one hospital using quaternary ammonium achieved proper disinfectant levels.

DILUTION SYSTEM	107 automated dispensers tested		80 in-use disinfectants tested	
				
	49% had **correct dilution**	**51%** had **too high or too low dilution, or no disinfectant**	**61%** had **correct dilution**	**39%** had **too low dilution, no disinfectant,** or the **wrong disinfectant**

Methods

The researchers evaluated automated disinfectant dispensing systems in 10 hospitals from 4 healthcare systems throughout 5 states. Ten mL disinfectant samples were collected from dispensers and from buckets of in-use disinfectant. The disinfectants included quaternary ammonium disinfectant cleaners (Virex Plus, Diversey, Fort Mill, SC; 3M HB Quat Disinfectant Cleaner Concentrate, 3M, St. Paul, MN), and a peracetic acid/hydrogen peroxide product (OxyCide Daily Disinfectant Cleaner, Ecolab, St. Paul, MN).

For one hospital using the quaternary ammonium product, additional collections were taken after EVS increased monitoring of disinfectant concentrations of the dispensed product.

When dispensers delivered lower-than-expected disinfectant concentrations, testing of disinfectant efficacy was conducted according to the American Society for Testing and Materials (ASTM) standard quantitative carrier disk test method with 5% fetal calf serum as soil load.[4] For the quaternary ammonium products, the exposure time was 10 minutes and the test organism was a methicillin-resistant *Staphylococcus aureus* (MRSA) strain. For the peracetic acid product, the test organism was *Clostridioides difficile* American Type Culture Collection (ATCC) strain 43598 and the exposure time was 5 minutes.

Results

In a convenience sample of 10 hospitals, disinfectant dispensers revealed a lack of routine monitoring, with 90% of hospitals reporting at least one system dispensing inaccurate disinfectant concentrations. Specifically, 27.1% of systems were found to dispense lower-than-expected concentrations, including 14.0% with no detectable disinfectant. In contrast, over half of the peracetic acid samples tested (57.8%) had higher-than-expected concentrations. Malfunctions of the 15 systems that dispensed undetectable levels of disinfectant were attributed to several reasons: the concentrate container not being connected correctly (N=7), damage to the concentrate container top (N=3), malfunctioning of the low product indicator resulting in use of an empty concentrate container (N=1), and personnel not changing the container when the low product indicator indicated that a change was due (N=1). In 3 cases, the reason for the malfunction was unclear.

For in-use disinfectant samples from EVS carts, 33.8% were below expected concentrations, with 17.5% having undetectable levels of disinfectant. Notably, some employees failed to report discrepancies in the disinfectant's appearance and odor, and in 4 cases, in-use products that EVS personnel erroneously identified as disinfectants were dilutable detergents intended for floors. ASTM testing indicated that samples with <900 ppm of peracetic acid and <400 ppm quaternary ammonium disinfectant were ineffective (<3 log10 colony-forming unit reductions) against *C. difficile* spores and MRSA, respectively. Following an intervention of increased EVS monitoring, one hospital using the quaternary ammonium product showed improvement, with all dispensers delivering expected disinfectant concentrations in subsequent assessments.

Conclusions

This study emphasizes the critical need for consistent checks on automated disinfectant dispensing systems to guarantee their proper operation and correct usage. The research found that the absence of disinfectant was usually attributable to human error, indicating a pressing requirement for enhanced oversight of these automated dispensers. Additional research is necessary to discover efficient methods to ensure that disinfectant dilution systems work as intended and are routinely supervised.

References:

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