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Comparative evaluation of conventional toilets with a rim (and non-cyclone flush) with the rimless wall-hung toilet from TOTO (combination of rimless ceramic toilet bowl, CEFIONTECT glaze and Tornado Flush), with a special focus on the spread of germs

1. Task

The task involves checking whether the TOTO toilet is especially suitable for areas in which hygiene is especially important, such as hospitals and health care facilities, due to its construction and features. The focus is on examining the issues involving aerosol droplets produced by different types of flushes. The trial will also see how difficult it is to clean the toilet, and if there is a difference in the spread of nosocomial pathogens.

2. Test objects

- WC RP, wall-hung
  #CW552Y with CEFIONTECT glaze and TORNADO FLUSH
- WC RP, wall-hung
  #CW542EY (WASHLET™) with CEFIONTECT glaze and TORNADO FLUSH
- WC SP, wall-hung
  #CW532Y with CEFIONTECT glaze and TORNADO FLUSH
- WC SP, wall-hung
  #CW522EY (WASHLET™) with CEFIONTECT glaze and TORNADO FLUSH
- Conventional toilet with a rim

3. Test substance/methods

Using a cotton swab, the researchers applied the test substance (semolina) containing the germs listed below to seven different points inside the toilet bowl.
Four of the most important nosocomial pathogens were used as test germs:

- Escherichia coli K12 NCTC 10538
- Enterococcus faecium ATCC 6057
- Pseudomonas aeruginosa ATCC 15442
- Acinetobacter baumanii

The researchers looked for any signs of residual soil after

- A single flush immediately following application
- A single flush after allowing one hour of drying time
- One to four flushes after allowing two hours of drying time.

4. Results

WC RP, wall-hung
#CW552Y with CEFIONTECT glaze and TORNADO FLUSH

- After a single flush immediately following application: no visible residual soil
- One hour of drying time/single flush: no visible residual soil
- Two hours of drying time/single flush: little residual soil visible in three test areas
- Two hours of drying time/two flushes: no visible residual soil

WC RP, wall-hung
#CW542EY (WASHLET™) with CEFIONTECT glaze and TORNADO FLUSH

- After a single flush immediately following application: no visible residual soil
- One hour of drying time/single flush: no visible residual soil
- Two hours of drying time/single flush: little residual soil visible in two test areas
- Two hours of drying time/two flushes: no visible residual soil

WC SP, wall-hung
#CW532Y with CEFIONTECT glaze and TORNADO FLUSH

- After a single flush immediately following application: no visible residual soil
- One hour of drying time/single flush: no visible residual soil
- Two hours of drying time/single flush: little residual soil visible in one test area
- Two hours of drying time/two flushes: no visible residual soil

WC SP, wall-hung
#CW522EY (WASHLET™) with CEFIONTECT glaze and TORNADO FLUSH

- After a single flush immediately following application: no visible residual soil
- One hour of drying time/single flush: little residual soil visible in one test area
- Two hours of drying time/single flush: little residual soil visible in one test area
- Two hours of drying time/two flushes: no visible residual soil

Results for conventional toilet with a rim and classic gravity or washdown flush

- After a single flush immediately following application: visible residual soil in four test areas
- One hour of drying time/single flush: visible residual soil in six test areas
- Two hours of drying time/single flush: visible residual soil in seven test areas
- Two hours of drying time/two flushes: little residual soil visible in five test areas
- Two hours of drying time/three flushes: little residual soil visible in five test areas
- Two hours of drying time/four flushes: minimal residual soil visible in five test areas

The test germs listed above were detected in all test areas with residual soil. Test areas without any residual soil did not contain any test germs.

5. Antibacterial effect of ceramic surfaces

Suspensions containing the following test germs were applied to the dry ceramic surfaces.

- Escherichia coli K12 NCTC 10538 = 2.1×10^3
- Enterococcus faecium ATCC 6057 = 2.8×10^3
- Pseudomonas aeruginosa ATCC 15442 = 4.7×10^3
- Acinetobacter baumanii = 2.6×10^3

After allowing the germs to react for one hour and two hours, RODAC blood agar plates were dabbed on the test surfaces. The incubation took place at 37°C over a 48-hour period.

- Was there a reduction in germs after one hour?
- Was there a reduction in germs after two hours?

6. Results

All surfaces used in the testing showed signs of the applied germs.
There was a significant difference in the growth of KBE on the RODAC blood agar plates after one as well as two hours of reaction time on the ceramic surface of the TOTO toilet and the surface of the conventional toilet with rim.

7. At which contact points were the applied test germs still found following the flush?

The test organisms were <u>not</u> found on the underside of the TOTO toilet seat or its surroundings.
The test organisms were found on the underside of the seat of the conventional toilet with a rim and its surroundings.

8. Were test bacteria detected in the area surrounding the toilet following the flush?

Conventional toilet

The applied microorganisms were found on the floor under the conventional toilet as well as nearby areas to the sides.

TOTO toilet

The test organisms were not found outside the TOTO toilet.
Aerosol droplets were also not detected outside of the TOTO toilet.

9. Tolerance of cleaning and disinfection products

The concentration and application of the scour-wipe disinfectant correspond to the RKI “Anforderungen an die Hygiene bei der Reinigung und Desinfektion von Flächen” (“Hygiene Requirements when Cleaning and Disinfecting Surfaces”) guidelines.

10. How does the ceramic surface tolerate the use of disinfectants? Do the disinfection processes cause visible changes or damage?

The tolerance of ceramic surfaces from TOTO and surfaces of the conventional toilet were tested using different surface disinfectants from various manufacturers from the VAH list.

11. Results

The ceramic surfaces of the tested TOTO wall-hung toilet and the surface of the conventional toilet with a rim were not discoloured or altered by the disinfectants used.

Surface disinfectant	Concentration	Surface changes	
		Discolouration	Damage
Incidin® Perfekt	0.5%	no	no
Incidin® Rapid	0.5%	no	no
Incidin® Plus	0.5%	no	no
Incidin® Active	0.5%	no	no
Optisept®	0.5%	no	no
Optisal® N	0.5%	no	no
Biguanid Fläche N	0.5%	no	no
Milizid	Concentrate	no	no

	Active ingredient(s)	Aldehyde-free
Incidin® Perfekt	Glyoxal, formaldehyde, glutaral, benzalkonium chloride, polyhexametyhlene biguanide	no
Incidin® Rapid	Glutaraldehyde, benzalkonium chloride, didecyldimethylammonium chloride	no
Incidin® Plus	Glucoprotamin	yes

Incidin® Active	Peracetic acid	yes
Optisept®	Methanal, ethandial, glutaraldehyde, didecyldimethylammonium chloride	no
Optisal® N	N-(3-aminopropyl)-N-dodecylpropan-1.3-diamin	yes
Biguanid Fläche N	Benzylalkyldimethylammonium chloride	yes
Alcohol 60%	Ethanol	yes
Milizid	Non-ionic surfactants	yes

12. Cleaning effort required with cleansers/disinfectants

The researchers were to evaluate how easily and quickly the surfaces of the TOTO and conventional toilets could be cleaned with disinfectants from the VAH list.

Result:

It was possible to clean and disinfect the ceramic surfaces of the tested TOTO wall-hung toilet very easily and quickly.
It was not necessary to use a toilet brush to clean off the test substance, even after an hour of drying time.

Summary of results

It was possible to thoroughly clean the ceramic surface and eliminate all soiled areas from the ceramic surfaces of the TOTO toilets quickly, easily and without great effort. For this reason, only very little time is needed for cleaning.
No aerosol droplets or test germs were detected in the areas directly surrounding the TOTO toilets.
As such, using a rimless toilet equipped with TOTO technology essentially rules out the spread of gram-negative bacteria (intestinal germs).
When considering the special issues with MRGN, the technology of TOTO's wall-hung toilet completely meets the standards of hospital hygiene and infection prevention, and is superior to the conventional toilet with a rim and non-cyclone flush.

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