

Efficacy of commercially available disinfectant wipes to remove, transfer and kill a surrogate human viral pathogen in vitro.

Rebecca Wesgate* and Jean-Yves Maillard

School of Pharmacy and Pharmaceutical Sciences, Cardiff University, Cardiff, UK



SIGNIFICANCE AND IMPACT

This is the first study that reports on the ability of commercially available universal (broad spectrum), sporicidal and detergent wipes to remove viruses from surfaces and to potentially transfer viruses between surfaces. All wipes showed limitations in removing viruses from surfaces. All commercially available wipes transferred viruses on to a surface post-wiping. Given that the cleaning of contaminated surfaces with commercially available universal, sporicidal and detergent wipe products is advocated in many national guidance documents it is imperative that such recommendations and guidance are based on appropriate data. The issue of virus transfer between surfaces need to be addressed.

BACKGROUND

Wipe products are extensively used in healthcare settings as part of cleaning/disinfection regimens. Many wipes claim to be effective against an array of bacteria and viruses. A 3-stage test that measures bacterial removal from, and bacterial transfer between, surfaces following wiping, and the antimicrobial efficacy of wipes, has been well reported in the literature and used by end users and manufacturers. This 3-stage test has not been used with viruses.

AIM

The aim of this study was to use a modified 3-stage test [1] to measure the ability of commercially available antimicrobial and detergent disinfectant wipes to remove, transfer and kill MS2 phage, a surrogate for small non-enveloped mammalian viruses.

WIPES USED

Wipe	Activity	Claims	Composition ^a
Wipe A	Broad spectrum	H1N1, H5N1, Hepatitis B&C, Norovirus	Aqua, Surfactant, <1% Cationic Biocides Preservatives, EDTA, Perfume.
Wipe B	Broad spectrum	Poliovirus, Adenovirus, Norwalk	Didecyltrimethylammonium chloride 0.450%w/w, Surfactants 0.3, 25%w.w, Auxiliary 0.520%w/w, Exipients 98.705%w/w
Wipe C	Broad spectrum	Adenovirus, Poliovirus	Benzalkonium chloride, Didecyltrimethylammonium chloride, Bronopol, Polyaminopropyl biguanide hydrochloride
Wipe D	Broad spectrum	Hepatitis C, HIV,	Amongst other ingredients <5% Cationic surfactants, Amphoteric Surfactants and EDTA
Wipe E	Sporicidal	Adenovirus, Poliovirus, Canine parvovirus, Rotavirus, Rhinovirus	>5400ppm Sodium Hypochlorite, < 1% Anionic Surfactants
Wipe F	Sporicidal	Denovirus, Poliovirus, Canine parvovirus	Inorganic peroxygen generator, Tetra acetylenediamine, pH modifying agents, Surfactants
Wipe G	Detergent	No virucidal claim	<5% non-ionic surfactants and preservatives
Wipe H	Detergent	No virucidal claim	Dimethyl Oxazolindine, Parfum

^a Composition noted from packaging

METHOD

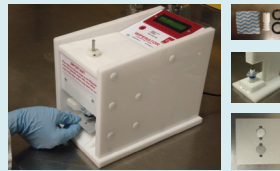
The eight wipes were tested against MS2 phage MS2 (NCIMB 10108). MS2 is well documented to have similar susceptibility to virucide as small non-enveloped viruses such as the poliovirus [2].

Virucidal

Initial virucidal activity was determined in the presence of an organic load (3 g/L BSA). All testing was conducted on fluid expressed from wipes.

Efficacy test protocol - 3-stages protocol

The 3-stage protocol [1] was adapted, utilizing the 'Wiperator' (<http://www.filtatflex.ca/wiperator.htm>)



Stage-1 - Efficacy of wipes to remove viruses from surfaces:

- Inoculum: 10 µL (7-8 log₁₀ viruses)
- Surface: magnetized and brush stainless sterile steel discs (AISI Type 430)
- Movement: orbital mechanical rotation for 10 sec
- Weight: 150 g

Stage-2 - Virus transfer from wipes:

- Transfer onto three consecutive stainless steel discs
- Mechanical action (10 s wipe, 150 g pressure).

Drying control: Prior to the use of wipes, the effect of drying viruses onto surfaces was evaluated.

RESULTS

Expressed wipe solution exposure

- Wipes D and E gave significantly higher reduction in viruses (7.62 log₁₀ and 6.07 log₁₀, respectively) than the other wipes (Fig. 1).
- Wipe F gave the lowest reduction in viruses (0.60 log₁₀) (Fig. 1).

Fig. 1: Virucidal activity of expressed wipe solutions (n=3)

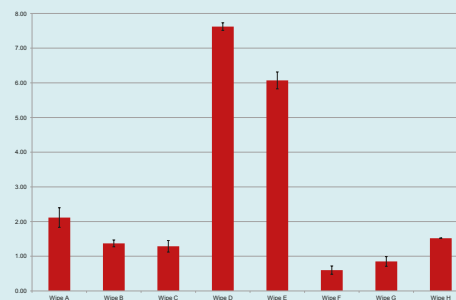
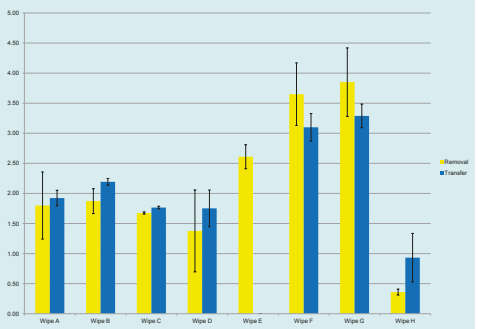


Fig. 2: Virus removal from disks and virus transfer from wipes to disks. (n=3) Removal (yellow) Transfer (blue)



- Wipe G removed significantly more viruses ($p < 0.05$) from the stainless steel disk than the other wipes.
- Wipe H removed significantly less viruses than the other wipes ($p < 0.05$).

Removal from surfaces

- The Universal, sporicidal and detergent wipes showed marked differences in their ability to remove viruses from surfaces (Fig. 2).

	Mean removal	Range
Universal wipes	1.68 log ₁₀	1.37-1.87 log ₁₀
Sporicidal wipes	3.13 log ₁₀	2.61- 3.65 log ₁₀
Detergent wipes	2.11 log ₁₀	0.36- 3.85 log ₁₀

Transfer

- All of the universal and detergent wipes tested repeatedly transferred a large number of viruses onto another surface (Fig.2).
- Wipe E was the only wipe that showed no viral transfer.

DISCUSSION

- All universal wipes tested consistently removed low levels of viruses from surfaces.
- Detergent showed a wide variability in removal capability.
- All sporicidal wipes worked well at removing viruses from surfaces.
- All wipes tested, but one, repeatedly transferred a large amount of viruses to another surface following the re-use of the wipe.
- The level of removal and transfer of viruses when using commercially available disinfectant wipes is concerning as residual viral contamination has been linked to viral outbreaks [3]
- For some wipes, the amount of viruses removed from the surface was lower than the number of viruses transferred to surfaces. Viruses deposited in high number on surfaces likely form clumps. It is conceivable that the surfactant based formulation of the wipes breaks aggregates and release more microorganisms than inoculated as previously observed [4].

CONCLUSIONS

This study confirmed low levels of virucidal activity of antimicrobial wipes but raised a concern about the potential for transfer between surfaces during wiping. Universal wipes were not highly virucidal, however were consistent in their levels of activity. Although all sporicidal wipes did not necessarily kill viruses, they showed consistency in removing them from surfaces. Disinfectant wipes showed large variation in ability to control viruses on surfaces. This study confirmed that the 3-stage test is appropriate to study virucidal efficacy of disinfectant wipes.

References

1. Williams GJ, et al. J Hosp Infect 2007;67(4):329-35.
2. Maillard J-Y.(1996) Lett Appl Microbiol 1996; 23:273-274.
3. Rodriguez-Lazaro et al. FEMS Microbiol. Rev. 2012;36:786-814
4. Siani H, et al. Am J Infect Control 2011;39(3):212-8.