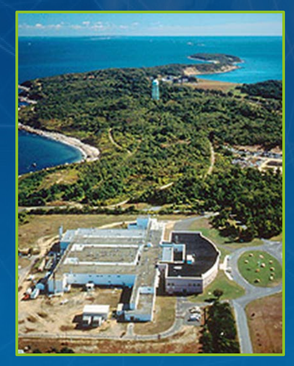
Decontamination of Select Agents on Smart Cards in a High Containment Laboratory



Lindsay Gabbert,[1] Justin Smith,[1, 2] John Neilan,[3] Geoffrey Ferman,[3] and Max Rasmussen[3]

[1] Leidos, Plum Island Animal Disease Center, Greenport, NY, USA; [2] Oak Ridge Institute for Science and Education, Plum Island Animal Disease Center Research Participation Program, Oak Ridge, Tennessee, USA; [3] United States Department of Homeland Security, Science and Technology Directorate, Plum Island Animal Disease Center, Greenport, NY, USA

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Abstract

Validated procedures for decontamination of laboratory surfaces and equipment are essential to biosafety and biorisk programs at high containment laboratories (HCLs). Each HCL contains a unique combination of surfaces, procedures and biological agents that require decontamination methods tailored to specific facility practices. The Plum Island Animal Disease Center (PIADC) is an HCL operating multiple biosafety level (BSL)-3, ABSL-3 and BSL-3 Ag spaces. The PIADC facility requires the use of federally issued smart cards, called Personal Identity Verification (PIV) cards, to access IT networks both outside of and within the HCL. Because PIV cards may require transit from the BSL-3 to office spaces, a validated procedure for disinfecting PIV card surfaces prior to removal from the HCL is critical to ensure biosafety and biosecurity. Two high risk select agents used in the PIADC HCL are Foot-and-Mouth-Disease Virus (FMDV) and Swine Vesicular Disease Virus (SVDV). We evaluated disinfection of PIV cards intentionally spotted with FMDV and SVDV using a modified quantitative carrier test and the liquid chemical disinfectant Virkon® S. Our experimental design modeled a "worst case scenario" of PIV card contamination and disinfection by combining high concentrations of virus dried with an organic soil load and the use of aged Virkon® S prepared in hard water. Results showed that FMDV and SVDV dried on PIV card surfaces were completely inactivated after immersion for 30 and 60 seconds, respectively, in a 5-day-old solution of 1% Virkon® S. Therefore, this study provided internal validation of PIADC biosafety protocols by demonstrating the efficacy of Virkon® S to inactivate viruses on contaminated smart cards at short contact times.

Study Goal

Evaluate the ability of 1% Virkon® S to disinfect PIV card surfaces intentionally spotted with high concentrations of both FMDV and SVDV under practical conditions and contact times.

Background

Homeland Security Presidential Directive 12 (HSPD-12): *Policy for a Common Identification Standard for Federal Employees and Contractors*

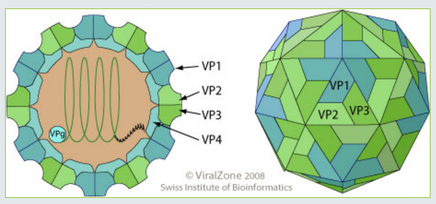
- PIV cards needed to access IT systems within biocontainment

Federal Select Agent Program Guidelines: require that inactivation procedures must be validated based on "in-house" testing protocols and supported by efficacy data produced by the specific

Biosafety Practices

"…eyeglasses must be totally immersed in an appropriate decontamination solution before their removal from the inside areas during exiting and personal decontamination procedures." –PIADC Biosafety Manual

Agents of Concern



Small non-enveloped +ssRNA picornaviruses are highly resistant to disinfection. Risk Assessment deemed these most critical to validate inactivation procedures for.

Experimental Design

Viruses tested:

- Foot and Mouth Disease Virus (FMDV) strain A24/Cruzeiro/BRA/55
- Swine Vesicular Disease Virus (SVDV) strain UKG 27/72

Test chemical: 1% Virkon ® S prepared in hard water and aged 5 days.

Treatment Groups:

- *Experimental*: 4 contact times tested: 1, 10, 30, 60 seconds (n=3 cards/group).
- *Controls:* Back Titration, Drying Control, Dipping Control (n=1 card/study).
- *Replicates:* Two independent rounds of testing with each virus.

Methods

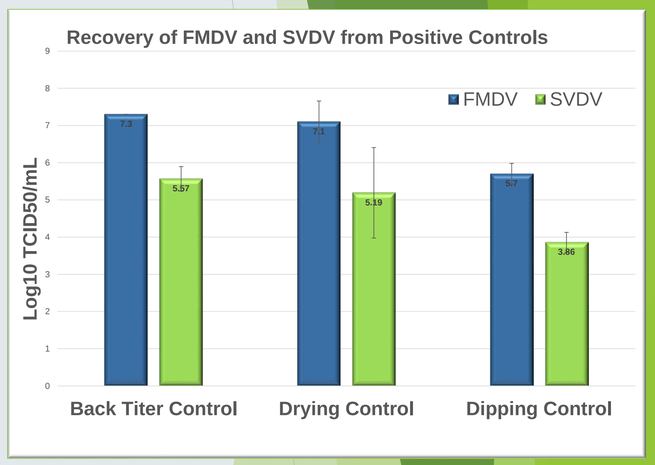
- Virus suspensions prepared with a soil load and inoculated onto PIV cards (50uL X 2 locations) and dried in the biosafety cabinet 1.5 hours
- Each card was exposed to 1% Virkon ® S for the required contact time and then rinsed in H_2O for ~1 sec
- Cards were placed in sterile plastic boxes with 10mL growth media (neutralizer) and shaken for 10 min on an orbital shaker
- Eluates were serially diluted and plated on either LFBK (FMDV) or MVPK (SVDV) cells
- Titrations of infectious virus were made by $TCID_{50}$ determination based on cell cytopathic effects
- Negative supernatants were blind passaged 2X (study 2)

Results

Recovery of Infectious Virus After Exposure to 1% Virkon ® S (Log_{10} $TCID_{50}$/mL)

	FMDV						SVDV					
	Study 1 Replicates			*Study 2 Replicates*			*Study 1 Replicates*			*Study 2 Replicates*		
Exposure Time	A	B	C	A	B	C	A	B	C	A	B	C
1 Second	6.2	6.7	6.7	6.6	6.6	7.0	Not Tested					
10 Seconds	<2.0	<2.0	<2.0	3.5	<2.0	<2.0	<1.0	2.6	1.1	1.66	<1.3	2.8
30 Seconds	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	2.7	<1.0	<1.0	<1.3	<1.3	<1.3
60 Seconds	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<1.0	<1.0	<1.0	<1.3	<1.3	<1.3
Drying Control	6.7			7.5			4.3			6.1		

Photos: PIV cards contaminated with FMDV (A), card replicates containing dried FMDV and individual Virkon ® S and water aliquots for exposure test (B), recovery of virus in elution media on orbital shaker (C), serial dilution/titration of recovered virus.



- The quantitative carrier test method gave good recovery of virus from positive controls; little virus was lost to drying.
- Infectious FMDV was not recovered after 30 second immersion in Virkon ® S.
- Infectious SVDV was not recovered after 60 second exposure to Virkon ® S.
- Additional blind passages (2) in cell culture remained negative.

Conclusions

- High concentrations of FMDV and SVDV select agent viruses dried on the surface of smart cards could be effectively decontaminated after being immersed in a 1% solution of aged Virkon ® S for at least 30 seconds.
- The data can be used to support in-house validation of biosafety practices and inform SOP development.
- This modified quantitative carrier assay method can be adapted to specific requirements of other laboratories and facilities to validate inactivation of biological agents with other disinfectants where smart cards are used.

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