Infection prevention and control measures for Ebola and Marburg Virus disease: A series of rapid reviews

KQ9 Spraying vs. wiping for disinfection of surfaces/materials - Initial Summary

(Version 1, 2 September 2022)

Nicole Shaver, nicole.shaver@uottawa.ca, Knowledge Synthesis and Application Unit, School of Epidemiology and Public Health, Faculty of Medicine, University of Ottawa, Ottawa, Ontario, Canada. ORCID 0000-0003-3210-8895

Ba' Pham, ba.pham@theta.utoronto.ca, Li Ka Shing Knowledge Institute, St. Michael's Hospital, Unity Health Toronto, Toronto, Ontario, Canada

Alexandria Bennett, d.bennett@uottawa.ca, Knowledge Synthesis and Application Unit, School of Epidemiology and Public Health, Faculty of Medicine, University of Ottawa, Ottawa, Ontario, Canada. ORCID 0000-0002-5977-2094

Andrew Beck, andrew.beck@uottawa.ca, Knowledge Synthesis and Application Unit, School of Epidemiology and Public Health, Faculty of Medicine, University of Ottawa, Ottawa, Ontario, Canada. ORCID 0000-0002-8308-2202

Becky Skidmore, bskidmore@rogers.com, Independent Information Specialist, Ottawa, Ontario, Canada.

Maura R. Grossman, maura.grossman@uwaterloo.ca, University of Waterloo, Waterloo, Ontario, Canada.

Gordon V. Cormack, gvcormac@uwaterloo.ca, University of Waterloo, Waterloo, Ontario, Canada.

Sharmistha Mishra, Sharmistha.Mishra@toronto.ca, Department of Medicine, St. Michael's Hospital, University of Toronto, Toronto, Ontario, Canada;
MAP Centre for Urban Health Solutions, Li Ka Shing Knowledge Institute, Unity Health Toronto, Toronto, Ontario, Canada;
Epidemiology Division and Institute of Health Policy, Management, and Evaluation, Dalla Lana School of Public Health, University of Toronto, Toronto, Ontario, Canada;
Institute of Medical Science, University of Toronto, Toronto, Ontario, Canada. ORCID: 0000-0001-8492-5470

Adrienne Chan, adrienne.chan@sunnybrook.ca, Sunnybrook Health Sciences Centre, Toronto;
Dalla Lana School of Public Health, University of Toronto, Toronto, Ontario, Canada.

Lan Xu, lan.xu@sjtu.edu.cn, School of Medicine, Shanghai Jiao Tong University, China.

David Moher, dmoher@ohri.ca, Knowledge Synthesis and Application Unit, School of Epidemiology and Public Health, Faculty of Medicine, University of Ottawa, Ottawa, Ontario, Canada.

Melissa Brouwers, Melissa.Brouwers@uottawa.ca, Knowledge Synthesis and Application Unit, School of Epidemiology and Public Health, Faculty of Medicine, University of Ottawa, Ottawa, Ontario, Canada.

Andrea C. Tricco, Andrea.Tricco@unityhealth.to, Li Ka Shing Knowledge Institute, St. Michael's Hospital, Unity Health Toronto, Toronto, Ontario, Canada;
Epidemiology Division and Institute of Health Policy, Management, and Evaluation, Dalla Lana School of Public Health, University of Toronto, Toronto, Ontario, Canada;
Queen's Collaboration for Health Care Quality Joanna Briggs Institute Centre of Excellence, Queen's University, Kingston, Ontario, Canada.

Julian Little, jlittle@uottawa.ca, Knowledge Synthesis and Application Unit, School of Epidemiology and Public Health, Faculty of Medicine, University of Ottawa, Ottawa, Ontario, Canada.

Funding: Funding for this protocol and the subsequent reviews was provided by the World Health Organization (Funding # 202818287). The working group (WG) from the WHO/HQ Country Readiness Strengthening Health Care Readiness Unit will be consulted to develop and refine the scope, and review and approve the protocol. The WG will not be involved in the conduct of the review including selection of studies and data analysis but will advise as needed on priority population(s), interventions, and outcomes in an iterative process during the review process based on the available evidence. The WG will also comment on the draft report and provide input on interpretations of findings. AT is funded by a Tier 2 Canada Research Chair in Knowledge Synthesis. SM is funded by a Tier 2 Canada Research Chair in Mathematical Modeling and Program Science.

Competing interests: DM was involved in the 2015 rapid review by Hersi et al. [1] There are no other competing interests to acknowledge.

Acknowledgements: We thank Kaitryn Campbell, MLIS, MSc (St. Joseph's Healthcare Hamilton/McMaster University) for peer review of the Embase search strategy.

Key Question

KQ9: Should surfaces and materials in healthcare facilities, ETUs and community settings providing care to patients with Ebola or Marburg disease be disinfected using a wiping method versus a spraying method?

Methods Summary

This is one of a series of rapid reviews answering 12 key questions related to three themes on infection prevention and control measures for filoviruses: (i) transmission/exposure (n=3 questions), (ii) personal protective equipment (PPE) (n=5), and (iii) decontamination and disinfection (n=4). Data sources include Medline, Embase, bio/medRxiv pre-print servers, Global Medicus Index, Epistemonikos, China National Knowledge Infrastructure (CNKI) and Wangfang database. We used an automation tool (CAL® tool) for titles/abstracts screening for relevant systematic reviews and primary comparative studies. Full-text screening, data extraction, risk of bias assessment, and GRADE (Grading of Recommendations Assessment, Development and Evaluation) for the certainty of evidence were completed independently by two reviewers with any disagreements resolved by consensus, with arbitration by a third reviewer, when needed.

Findings

A total of 80 studies were screened in the CAL tool software and 17 studies were included for full-text screening. One of the 17 studies was a recent systematic review published in 2021 that reviewed the efficacy of chlorine-based surface disinfection against seven pathogens (including Ebola virus).[1] For completeness, we reviewed the titles and abstracts of 89 laboratory studies included in the systematic review, as well 25 more recent studies that had cited the review. Four additional articles were deemed relevant and screened at the full-text screening stage.[2–5]

No studies met the eligibility criteria. Most articles excluded at the full-text stage examined the efficacy of different types of disinfection solutions for Ebola (e.g., chlorine, ethanol) in a controlled laboratory setting. We found no studies that provided data on the efficacy of wiping compared to spraying for any disinfection agent. A complete list of excluded studies with reasons for exclusion can be found in Appendix 1.

References:

1. Gallandat K, Kolus RC, Julian TR, Lantagne DS. A systematic review of chlorine-based surface disinfection efficacy to inform recommendations for low-resource outbreak settings. *Am J Infect Control*. 2021;49(1):90-103. doi:10.1016/j.ajic.2020.05.014

2. Amadin, Jacob. *Comparison of the Effectiveness of Disinfectant-Impregnated Wipes Versus Detergent Wipes for Surface Decontamination*. University of South Florida; 2021.

3. String GM, Kamal Y, Gute DM, Lantagne DS. Chlorine efficacy against bacteriophage Phi6, a surrogate for enveloped human viruses, on porous and non-porous surfaces at varying temperatures and humidity. *J Environ Sci Health Part A*. 2022;57(8):685-693. doi:10.1080/10934529.2022.2101845

4. Park GW, Sobsey MD. Simultaneous Comparison of Murine Norovirus, Feline Calicivirus, Coliphage MS2, and GII.4 Norovirus to Evaluate the Efficacy of Sodium Hypochlorite Against Human Norovirus on a Fecally Soiled Stainless Steel Surface. *Foodborne Pathog Dis*. 2011;8(9):1005-1010. doi:10.1089/fpd.2010.0782

5. Julian TR, Trumble JM, Schwab KJ. Evaluating Efficacy of Field-Generated Electrochemical Oxidants on Disinfection of Fomites Using Bacteriophage MS2 and Mouse Norovirus MNV-1 as Pathogenic Virus Surrogates. *Food Environ Virol*. 2014;6(2):145-155. doi:10.1007/s12560-014-9136-6

Appendix 1. Excluded Studies List – By Reason for Exclusion:

Does not examine Ebola or Marburg (or surrogate viruses)

Amadin, Jacob. Comparison of the Effectiveness of Disinfectant-Impregnated Wipes Versus Detergent Wipes for Surface Decontamination. University of South Florida; 2021.

Intervention not of interest

Calfee MW, Ryan SP, Abdel-Hady A, et al. Virucidal efficacy of antimicrobial surface coatings against the enveloped bacteriophage Φ6. *J of Applied Microbiology*. 2022;132(3):1813-1824. doi:10.1111/jam.15339

Cutts TA, Robertson C, Theriault SS, et al. Assessing the Contributions of Inactivation, Removal, and Transfer of Ebola Virus and Vesicular Stomatitis Virus by Disinfectant Pre-soaked Wipes. *Front Public Health*. 2020;8:183. doi:10.3389/fpubh.2020.00183

Tomas ME, Cadnum JL, Jencson A, Donskey CJ. The Ebola Disinfection Booth: Evaluation of an Enclosed Ultraviolet Light Booth for Disinfection of Contaminated Personal Protective Equipment Prior to Removal. *Infect Control Hosp Epidemiol*. 2015;36(10):1226-1228. doi:10.1017/ice.2015.166

No relevant comparisons

Casey ML, Nguyen DT, Idriss B, Bennett S, Dunn A, Martin S. Potential Exposure to Ebola Virus from Body Fluids due to Ambulance Compartment Permeability in Sierra Leone. *Prehosp Disaster med*. 2015;30(6):625-627. doi:10.1017/S1049023X15005294

Cook B, Cutts T, Nikiforuk A, et al. Evaluating Environmental Persistence and Disinfection of the Ebola Virus Makona Variant. *Viruses*. 2015;7(4):1975-1986. doi:10.3390/v7041975

Cook BWM, Cutts TA, Nikiforuk AM, Leung A, Kobasa D, Theriault SS. The Disinfection Characteristics of Ebola Virus Outbreak Variants. *Sci Rep*. 2016;6(1):38293. doi:10.1038/srep38293

Cutts TA, Robertson C, Theriault SS, et al. Efficacy of microbicides for inactivation of Ebola–Makona virus on a non-porous surface: a targeted hygiene intervention for reducing virus spread. *Sci Rep*. 2020;10(1):15247. doi:10.1038/s41598-020-71736-x

Gallandat K, Lantagne D. Selection of a Biosafety Level 1 (BSL-1) surrogate to evaluate surface disinfection efficacy in Ebola outbreaks: Comparison of four bacteriophages. Galdiero M, ed. *PLoS ONE*. 2017;12(5):e0177943. doi:10.1371/journal.pone.0177943

Gallandat K, Wolfe MK, Lantagne D. Surface Cleaning and Disinfection: Efficacy Assessment of Four Chlorine Types Using Escherichia coli and the Ebola Surrogate Phi6. *Environ Sci Technol*. Published online 2017:8.

Ijaz MK. Comparison of the Efficacy of Disinfectant Pre-impregnated Wipes for Decontaminating Stainless Steel Carriers Experimentally Inoculated With Ebola Virus and Vesicular Stomatitis Virus. *Frontiers in Public Health*. 2021;9:9.

Julian TR, Trumble JM, Schwab KJ. Evaluating Efficacy of Field-Generated Electrochemical Oxidants on Disinfection of Fomites Using Bacteriophage MS2 and Mouse Norovirus MNV-1 as Pathogenic Virus Surrogates. *Food Environ Virol*. 2014;6(2):145-155. doi:10.1007/s12560-014-9136-6

Park GW, Sobsey MD. Simultaneous Comparison of Murine Norovirus, Feline Calicivirus, Coliphage MS2, and GII.4 Norovirus to Evaluate the Efficacy of Sodium Hypochlorite Against Human Norovirus on a Fecally Soiled Stainless Steel Surface. *Foodborne Pathogens and Disease*. 2011;8(9):1005-1010. doi:10.1089/fpd.2010.0782

Poliquin PG, Vogt F, Kasztura M, et al. Environmental Contamination and Persistence of Ebola Virus RNA in an Ebola Treatment Center. *J Infect Dis*. 2016;214(suppl 3):S145-S152. doi:10.1093/infdis/jiw198

String GM, Kamal Y, Gute DM, Lantagne DS. Chlorine efficacy against bacteriophage Phi6, a surrogate for enveloped human viruses, on porous and non-porous surfaces at varying temperatures and humidity. *Journal of Environmental Science and Health, Part A*. 2022;57(8):685-693. doi:10.1080/10934529.2022.2101845

Smither S, Phelps A, Eastaugh L, et al. Effectiveness of Four Disinfectants against Ebola Virus on Different Materials. *Viruses*. 2016;8(7):185. doi:10.3390/v8070185

Smither SJ, Eastaugh L, Filone CM, et al. Two-Center Evaluation of Disinfectant Efficacy against Ebola Virus in Clinical and Laboratory Matrices. *Emerg Infect Dis*. 2018;24(1). doi:10.3201/eid2401.170504

Wood JP, Richter W, Sunderman M, Calfee MW, Serre S, Mickelsen L. Evaluating the Environmental Persistence and Inactivation of MS2 Bacteriophage and the Presumed Ebola Virus Surrogate Phi6 Using Low Concentration Hydrogen Peroxide Vapor. *Environ Sci Technol*. 2020;54(6):3581-3590. doi:10.1021/acs.est.9b06034

Narrative review (Study design not of interest)

Lantagne D, Wolfe M, Gallandat K, Opryszko M. Determining the Efficacy, Safety and Suitability of Disinfectants to Prevent Emerging Infectious Disease Transmission. *Water*. 2018;10(10):1397. doi:10.3390/w10101397

Boyce JM. Alcohols as Surface Disinfectants in Healthcare Settings. *Infect Control Hosp Epidemiol*. 2018;39(3):323-328. doi:10.1017/ice.2017.301

Appendix 2. Eligibility Criteria

Question (9): Should surfaces and materials in healthcare facilities, Ebola treatment units (ETU) and community settings providing care to patients with Ebola or Marburg disease be disinfected using a wiping method versus a spraying method

Setting	Health care facility, ETU, community
Population	Staff and or patients in healthcare facilities (HCF), ETU and community
Background interventions (Standard of care)	Disinfection of surfaces daily and when visibly soiled
Intervention	spray surfaces with disinfectant
Comparator(s)	wipe surfaces with disinfectant
Outcome	Adverse effects associated with chemical exposure, coverage of surfaces with disinfectant, log reduction of virus or surrogate on surface, infection with Ebola, *psychological effects (stigma) associated with spraying of homes with disinfectants, patient experience (e.g. extensive chlorine smell in the environment/skin exposure, etc.,*
Potential effect modifiers	Disinfectant chemical used Design/spraying technology Adequacy of spraying (surface coverage) Surface cleaning first *Time of exposure to disinfectant* *Surface composition*

	Concentration of solution *Disinfectant product*