

Note: This is Online Appendix 1 of Oringanje CM, Oparah SK, Oringanje C. Ultraviolet germicidal irradiation for surface cleaning of COVID-19 in healthcare settings: A review. J Public Health Africa. 2025;16(2), a572. <https://doi.org/10.4102/jphia.v16i2.572>

Appendix 1

Table 1. Characteristics of excluded studies

Study_ID	Reason for exclusion
ALvarenga 2022	Systematic review
Ambardar 2022	UVC irradiation on SARS-CoV-2 virus culture (laboratory - based research)
Barnewall 2021	UVC irradiation on SARS-CoV-2 virus culture (laboratory - based research)
Bartolomeu 2022	Mercury UV-C lamps ~254 nm on phage 6 bacteria host strain (laboratory-based research)
Beggs 2020	Feasibility study
Bradley 2020	A report
Buchan 2020	Simulation study (laboratory based)
Buchan 2021	Simulation study (laboratory based)
Camargo 2022	portable UVGI devices for common cold coronaviruses and SARS-CoV-2 (Laboratory based study)
Cheng 2020	Assessed bacterial contamination
Cimilluca 2021	Cross sectional survey
Choi 2022	Used UV-A (340 – 385 nm)
Correa 2021	Assessed bacterial contamination
Davidson 2021	Assessed the use of Low-cost bare-bulb germicidal ultraviolet-C fixtures in restaurants
De Souza 2022	Assessed bacterial contamination
Dexter 2020	A systematic review
Dexter 2022	Aimed at calculating UVC-disinfection treatment times (no actual test on virus was carried out-simulation)
Dokdok 2020	Letter to the editor
Galvan Contreras 2021	Cross sectional study
Gilbert 2020	Systematic review
Gordon 2021	A report
Guettari 2021	Descriptive study
Guo 2020	Cross sectional study
Gurnani 202	Letter to the editor
Hamzavi 2020	Letter to the editor
Harfoot 2022	UV-C irradiation to disinfect PPE for potential reuse infected with SARS-CoV-2 and bacteria (Laboratory-based research)
Heilingloh 2020	UVC (254 nm) irradiation on SARS-CoV-2 virus culture (laboratory - based research)
Ramos 2020	A systematic review
Zaman 2022	Cross sectional study/Evaluation of a cost effective UVC robot using bacterial samples

Table 2: Characteristics of Ongoing study

Brass 2021	
Study name	Prevention of SARS-CoV-2 (COVID-19) transmission in residential aged care using ultraviolet light (PETRA) study; Trial ID: ACTRN12621000567820
Methods	Parallel crossover randomised controlled trial
Participants	Residential aged care facilities
Intervention	Ultraviolet light vs Control (on UV light); 2 weeks "washout" period
Outcomes	reduction in symptomatic respiratory viral infection in residents of residential aged care facilities
Starting date	26 July 2021
Contact Information	Prof Geraint Rogers SAHMRI, North Terrace, Adelaide SA 5000 Australia PO Box 11060, Adelaide SA 5001 Australia +61 08 8204 7614 geraint.rogers@sahmri.com
Rockwood 2021	
Study name	Far-UVC Light Devices in Long-term Care Facilities to Reduce Infections ClinicalTrials.gov Identifier: NCT05084898
Methods	Cluster randomized control trial
Participants	Residents in long term care facilities
Intervention	Far-UVC as an additional method of disinfection versus Placebo fluorescent light
Outcomes	Reduction in the incidence of influenza-like illnesses, respiratory infections, and COVID-19 infections among residents
Starting date	1 October, 2021
Contact Information	Kenneth Rockwood, Nova Scotia Health Authority

Table 3. Risk of Bias Assessment (ROBINS-I Tool)

Study ID	Is confounding of the effect of intervention unlikely in this study?	Bias in selection of participants into the study	Bias in measurement of intervention	Bias due to departures from intended interventions	Bias due to missing data	Bias in measurement of outcomes	Bias in selection of the reported result	Overall bias
Su 2021	Low	Low	Low	Low	Low	Moderate	Moderate	Moderate
						It is probable that investigators who analysed the samples were aware of the source of the samples as there was no information was provided on efforts to ensure that staff were blinded to source of the samples	No information regarding the protocol to assess for reporting bias	
Lesho 2022	Low	Low	Low	Low	Low	Moderate	Moderate	Moderate
						It is probable that investigators who analysed the samples were aware of the source of the samples as there was no information was provided on efforts to ensure that staff were blinded to source of the samples	No information regarding the protocol to assess for reporting bias	
Su 2022	Low	Low	Low	Low	Low	Moderate	Moderate	Moderate
						It is probable that investigators who analysed the samples were aware of the source of the samples as there was no information was provided on efforts to ensure that staff were blinded to source of the samples	No information regarding the protocol to assess for reporting bias	

Note: Participants refers to surfaces sampled

LEGEND FOR RoB Assessment:






Low risk	
Moderate risk	
Serious risk	
Critical risk	
No Information	

Table 4a: Summary of Finding (GRADE): Ultraviolet C irradiation compared to Electrostatic cleaning for environmental (surface) cleaning measure in health care settings

Certainty assessment							Nº of patients		Effect		Certainty	Importance
Nº of studies	Study design	Risk of bias	Inconsistency	Indirectness	Imprecision	Other considerations	Ultraviolet C irradiation	Electrostatic cleaning	Relative (95% CI)	Absolute (95% CI)		
SARS-CoV-2 infection - not reported												
-	-	-	-	-	-	-	-	-	-	-	-	IMPORTANT
Clearance of SARS-CoV-2 viral RNA on surfaces												
1	observational studies	serious ^a	not serious	serious ^b	serious ^c	none	11/12 (91.7%)	6/12 (50.0%)	RR 1.83 (1.02 to 3.31)	415 fewer per 1,000 (from 10 more to 1,000 more)	⊕○○○ Very low	IMPORTANT
Optimal Irradiation dose/time - not reported												
-	-	-	-	-	-	-	-	-	-	-	-	IMPORTANT
Adverse effects associated with the use of UV-C irradiation - not reported												
-	-	-	-	-	-	-	-	-	-	-	-	IMPORTANT

CI: confidence interval; **RR:** risk ratio

Explanations

- a. Potential risk of bias in outcome measurement. Insufficient detail to assess reporting bias
- b. It was not clear what UV-C wavelength was used and the comparator is not a standard cleaning measure
- c. Wide confidence intervals; small sample size

References

1.Lesho E, Newhart D,Reno L,et al.. Effectiveness of various cleaning strategies in acute and long-term care facilities during novel corona virus 2019 disease pandemic related staff shortages. . PLoSONE; 2022.

Table 4b: Summary of Finding (GRADE)

Ultraviolet C Irradiation (UV-C) compared to Electrostatic spraying & UV-C for environmental (surface) cleaning measure in health care settings

Certainty assessment							Nº of patients		Effect		Certainty	Importance
Nº of studies	Study design	Risk of bias	Inconsistency	Indirectness	Imprecision	Other considerations	Ultraviolet C Irradiation (UV-C) only	Electrostatic spraying plus UV-C	Relative (95% CI)	Absolute (95% CI)		
SARS-CoV-2 infection - not reported - not reported												
-	-	-	-	-	-	-	-	-	-	-	-	IMPORTANT
Clearance of SARS-CoV-2 viral RNA on surfaces												
1	observational studies	serious ^a	not serious	serious ^b	serious ^c	none	11/12 (91.7%)	11/12 (91.7%)	RR 1.00 (0.79 to 1.27)	0 fewer per 1,000 (from 192 fewer to 248 more)	⊕○○○ Very low	IMPORTANT
Optimal Irradiation dose/time - not reported												
-	-	-	-	-	-	-	-	-	-	-	-	IMPORTANT
Adverse effects associated with the use of UV-C irradiation - not reported - not reported												
-	-	-	-	-	-	-	-	-	-	-	-	IMPORTANT

CI: confidence interval; **RR:** risk ratio

Explanations

- a. Potential risk of bias in outcome measurement. Insufficient detail to assess reporting bias
- b. It was not clear what UV-C wavelength was used and the comparator is not a standard cleaning measure
- c. Wide confidence intervals; small sample size

References

1. Lesho E, Newhart D, Reno L, et al.. Effectiveness of various cleaning strategies in acute and long-term care facilities during novel corona virus 2019 disease pandemic related staff shortages. . PLoSONE; 2022.

Table 4c: Summary of Finding (GRADE)

Ultraviolet C irradiation (far UVC-222nm) before and after as an environmental (surface) cleaning measure in health care settings

Certainty assessment							Nº of patients		Effect		Certainty	Importance
Nº of studies	Study design	Risk of bias	Inconsistency	Indirectness	Imprecision	Other considerations	Ultraviolet C irradiation	[comparison]	Relative (95% CI)	Absolute (95% CI)		
SARS-CoV-2 infection - not reported												
-	-	-	-	-	-	-	-	-	-	-	-	IMPORTANT
Clearance of SARS-CoV-2 viral RNA on surfaces at different exposure times												
1	observational studies	serious ^a	not serious	serious ^b	serious ^c	none	The study reported a before and after difference in the reduction of viral RNA on surfaces after UVC irradiation at 222 nm at different time points (N=36). The positivity rates were 13/36 (36.1%) at baseline (pre-UVC irradiation), 3/36 (8.3%), 2/36 (5.6%), 0/36 (0%), and 0/36 (0%) at 5, 10, 15, and 20 seconds post-UVC irradiation (p < 0.001).			⊕○○○ Very low	IMPORTANT	
Optimal Irradiation dose/time												
1	observational studies	serious ^a	not serious	serious ^b	serious ^c	none	Complete clearance of viral RNA was observed after 15 seconds of far UV-C (222nm) exposure with an estimated energy dose of 81 mJ/cm2.			⊕○○○ Very low ¹	IMPORTANT	
Adverse effects associated with the use of UV-C irradiation - not reported												
-	-	-	-	-	-	-	-	-	-	-	-	IMPORTANT

Explanations

- a. This is an open-single-arm before-and-after study; Possible risk of reporting bias.
- b. The study used UV-C irradiation outside the ultraviolet germicidal irradiation range.
- c. Few sampled surfaces

References

1.Su WL, Lin CP,Huang HC, et al.. Clinical application of 222 nm wavelength ultraviolet C irradiation on SARS CoV-2 contaminated environments. Journal of Microbiology, Immunology and Infection; 2022.

Table 4d: Summary of Finding (GRADE): Ultraviolet germicidal irradiation (UVGI) (254 nm) as an environmental (surface) cleaning measure in health care settings

Certainty assessment							Nº of patients		Effect		Certainty	Importance
Nº of studies	Study design	Risk of bias	Inconsistency	Indirectness	Imprecision	Other considerations	[intervention]	[comparison]	Relative (95% CI)	Absolute (95% CI)		
SARS-CoV-2 infection - not reported - not reported												
-	-	-	-	-	-	-	-	-	-	-	-	IMPORTANT
Clearance of SARS-CoV-2 viral RNA on surfaces at different exposure times												
1	observational studies	serious ^a	not serious	not serious	serious ^b	none	The study reported a before and after difference in the reduction of viral RNA on surfaces after UVC irradiation at 254 nm at different time points (N=12). The number of positive samples was 5/12 (42%) samples before UV exposure, and 3/12 (25%), 1/12 (8%), and 0/12 (0%) at 5, 10, and 15 minutes of UVGI irradiation.			⊕○○○ Very low	IMPORTANT	
Optimal Irradiation dose/time												
1	observational studies	serious ^a	not serious	not serious	serious ^b	none	The study found that at a wavelength of 254 nm (UVGI), complete clearance of viral RNA was observed after 15 minutes of exposure with an estimated energy dose of 125 mJ/cm ² .			⊕○○○ Very low	IMPORTANT	
Adverse effects associated with the use of UV-C irradiation - not reported												
-	-	-	-	-	-	-	-	-	-	-	-	IMPORTANT

Explanations

- a. This is an open-single-arm study. Insufficient details to assess risk in the several domains
- b. Few sampled surfaces

References

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