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

KQ2 Body Handling- Initial Summary

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

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Question

Should bodies of patients deceased from Ebola or Marburg disease be disinfected versus not disinfected prior to handling/moving into a body bag?

- No studies specifically address this question. Therefore, additional searches were completed to address a revised question to provide information on the risk of EVD acquisition and transmission from handling dead bodies.
- **Revised Question:**
    - What is the risk of EVD acquisition/exposure from handling dead bodies compared to health workers providing care to patients (people who are alive)?

Methods Summary

This is one of a series of rapid reviews that will answer 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 will use 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 will be completed independently by two reviewers with any disagreements resolved by consensus, with arbitration by a third reviewer, if needed. Results from included studies will be synthesized narratively by theme and key question and pooled via random effects meta-analysis when appropriate.

Initial Findings Related to Body Handling

We present study characteristics in Table 1 and a summary of findings in Table 2 and Table 3.

Initially, 201 studies were screened in the CAL tool software and 38 studies were included for full-text screening. Of these 38 studies, none met the eligibility criteria for the primary question (Appendix 2). However, 3 studies were deemed to provide information on the risk of EVD acquisition/exposure from post-mortem contact and were included to address the revised question. To capture additional information related to vaccination status of healthcare workers, an additional 155 studies were reviewed in the CAL tool and 25 of these studies were included. Following full-text screening, an additional 5 studies were deemed relevant. A list of excluded studies with reasons for exclusion can be found in Appendix 1.

Table 1. Characteristics of Included Studies

Citation [Author, Year][citation #]	Funding Source	Country	Dates of Outbreak	Study Type	Virus Species	# Total Participants	Study Objectives [as reported by study authors]
Curran, 2016[1]	NR	Sierra Leone	2014	[Cross-sectional] Outbreak investigation	Ebola	78 cases	"The Sierra Leone Ministry of Health and Sanitation and CDC conducted a retrospective analysis of laboratory-confirmed Ebola cases in Moyamba during July 11–October 31, to investigate the increase in cases in September 2014, determine the source and risk factors, and recommend prevention and control measures"
Diallo, 2019[2]	Private, not-for-profit	Guinea	2016	[Cross-sectional] Retrospective cross-sectional	Ebola	1390	"The study aimed to identify risk factors for seropositivity and to estimate the prevalence of Ebola virus infection in unvaccinated contact persons"
Dietz, 2014[3]	Public	Sierra Leone	2014	[Cross-sectional] Surveillance; data linkage	Ebola	8056 cases	"Describe trends in laboratory-confirmed EVD, symptom presentation, and risk factors"
International Ebola Response Team, 2015[4]	Public/Private not-for-profit	Sierra Leone, Liberia and Guinea	2016	[Cross-sectional] Surveillance; data linkage	Ebola	19618 cases	"Analyses of data collected during the outbreak identifying drivers of transmission and highlighting areas where control could be improved"

Muoghalu, 2017[5]	None	Sierra Leone	2017	[Cross-sectional] Surveillance; data linkage	Ebola	142 cases	"Conduct an observational study to describe the transmission chain in the Koinadugo District and the impact of the control measures to contain the outbreak"
Senga, 2016[6]	Public/Private not-for-profit	Sierra Leone	2016	[Cross-sectional] Surveillance; data linkage	Ebola	706 cases	"Examined factors associated with Ebola virus exposure and mortality in HWs in Kenema District, Sierra Leone."
Tiffany, 2016[7]	Private, not-for-profit	Sierra Leone, Liberia and Guinea	2017	[Cross-sectional] Outbreak investigation	Ebola	45 unsafe burials and 310 contacts	"We performed epidemiological investigations in EVD affected communities to better understand disease transmission linked to unsafe burials of (suspect) EVD infected individuals, and risk factors for transmission linked to caring and burial practices"
Tiffany, 2017[8]	NR	Sierra Leone, Liberia and Guinea	2016	[Cross-sectional] Outbreak investigation	Ebola	45 unsafe burials and 310 contacts	"Quantify the impact of the Red Cross Safe and Dignified Burial Program on the EVD epidemic."

Table 2. Summary of Findings: Handling of deceased EVD/Marburg patients vs. Providing care to EVD/Marburg patients

Citation [Author, Year]	Handling of deceased patients (post-mortem contact) vs Providing care to patients	Outcome details	# Total Participants	# Exposed Cases (Post-Mortem contact) (n/N, %)	# Exposed Cases (Care provision) (n/N, %)	# Exposed Controls (Post-Mortem contact) (n/N, %)	# Exposed Controls (Care provision) (n/N, %)	Summary Effect Measure	Quality Assessment[a]	GRADE	Notes
	Incidence of EVD										
Curran, 2016, [Cross-sectional][1]	Contact with corpse vs. Contact with live patient	RT-PCR confirmed EVD	78 cases	23 exposed / 78 cases (29%)	26 exposed / 78 cases (33%)	N/A	N/A	N/A	High Risk of Bias	⊕◯◯◯ Very low	None
Diallo, 2019, [Cross-sectional][2]	Participation in Burial Rituals vs. No participation in burial rituals	Seropositivity for EVD[b]	1390 contacts (198 participated, 1192 didn't)	16 cases / 198 exposed (8%)	N/A	41 cases /1192 unexposed (3%)	N/A	OR = 2·47 (1·32–4·41; p=0·0031) Adjusted OR = 2·30 (1·21–4·17; p=0·0079)	Moderate Risk of Bias	⊕⊕◯◯ Low	Contacts were unvaccinated
	Provided care to individual with Ebola virus disease vs. Did not provide care to individual with Ebola virus disease	Seropositivity for EVD[b]	1390 contacts (820 provided care, 570 didn't)	N/A	41 cases /820 exposed (5%)	N/A	16 cases /570 unexposed (3%)	OR=1·82 (1·03–3·37; p=0·0454) Adjusted OR= 1·00 (0·51–2·02; p=0·99)		⊕◯◯◯ Very low	Contacts were unvaccinated
	Participation in Burial Rituals vs. No participation in burial rituals	Seropositivity for EVD[b]	1174 asymptomatic contacts (154 participated, 1020 didn't)	9 cases /154 exposed (6%)	N/A	30 cases /1020 unexposed (3%)	N/A	OR=2·05 (0·90–4·23; p=0·066) Adjusted OR=2·30 (1·01–		⊕⊕◯◯ Low	Contacts were unvaccinated

								4·80; p=0·0356)			
	Provided care to individual with Ebola virus disease vs. Did not provide care to individual with Ebola virus disease	Seropositivity for EVD[b]	1174 asymptomatic contacts (659 provided care, 515 didn't)	N/A	27 cases /659 exposed (4%)	N/A	12/515 unexposed (2%)	OR=1·79 (0·92–3·70; p=0·098) Adjusted OR=1·10 (0·52–2·42; p=0·82)		⊕◯◯◯ Very low	Contacts were unvaccinated
	Participation in Burial Rituals vs. No participation in burial rituals	Seropositivity for EVD[b]	216 paucisymptomatic contacts (44 participated, 172 did not)	7 cases/44 exposed (16%)	N/A	11 cases /172 unexposed (6%)	N/A	OR=2·77 (1·00–7·53; p=0·049) Adjusted OR=2·40 (0·81–6·74; p=0·099)		⊕⊕◯◯ Low	Contacts were unvaccinated
	Provided care to individual with Ebola virus disease vs. Did not provide care to individual with Ebola virus disease	Seropositivity for EVD[b]	216 paucisymptomatic contacts (161 provided care, 55 did not)	N/A	14 cases/161 exposed (9%)	N/A	4 cases/55 unexposed (7%)	[Unadjusted only] OR= 1·21 (0·41–4·43; p=0·74		⊕◯◯◯ Very low	Contacts were unvaccinated
Dietz, 2014, [Cross-sectional][3]	Touched Body at Funeral Vs. Contact With Suspected Case Patient or Any Sick Person	Seropositivity for EVD*	8056 cases	518 exposed/ 782 cases who attended funerals (66%)	2340 exposed / 4885 cases who provided exposure data (48%)	N/A	N/A	N/A	High Risk of Bias	⊕⊕◯◯ Low	None
International Ebola Response Team, 2015,	Touched corpse (Funeral) Vs. Direct physical contact (Non-funeral)	Confirmed and probable EVD cases	19618 cases	1071 exposed / 1657 cases with a type of exposure	2136 exposed / 2461 cases with a non funeral with	N/A	N/A	N/A	High Risk of Bias	⊕◯◯◯ Very low	None

[Cross-sectional][4]				reported at a funeral (65%)	exposure reported (87%)						
Muoghalu, 2017, [Cross-sectional][5]	Funeral Exposure Vs. Patient Care	Confirmed and probable EVD cases	142 cases	37 exposed / 142 cases (26%)	2 exposed / 142 cases (1%)	N/A	N/A	N/A	High Risk of Bias	⊕◯◯◯ Very low	The patient care cases were HCWs exposed in a public health unit who attended to patients at the onset of the EVD outbreak
Senga, 2016, [Cross-sectional][6]	Touched Body at Funeral Vs. Reported contact with case of Ebola virus disease	Confirmed EVD	92 HCW cases	1 exposed /3 cases who attended funeral (33%)	39 exposed / 92 cases (42%)	N/A	N/A	N/A	High Risk of Bias	⊕◯◯◯ Very low	
Tiffany, 2016, [Cross-sectional][7]	Contact after death only Vs. Contact before & after death	Laboratory-confirmed EVD	301 contacts with lab results (203 confirmed cases, 98 controls)	120 exposed cases /203 cases (59%)	83 exposed cases / 203 cases (41%)	76 exposed / 98 controls (78%)	22 exposed / 98 controls (22%)	OR=0.20 (95% CI, 0.12, 0.35)	Moderate Risk of Bias	⊕⊕◯◯ Low	
	Contact after death: Exposure to blood/body fluids Vs. Care during illness	Exposure to EVD from primary case	310 contacts	21 exposed / 310 contacts (7%)	142 exposed / 310 contacts (46%)	N/A	N/A	N/A		⊕⊕◯◯ Low	23% of contacts reported using protection
	Contact after death: Washed clothes/bedding Vs. Care during illness	Exposure to EVD from primary case	310 contacts	40 exposed / 310 contacts (13%)	142 exposed / 310 contacts (46%)	N/A	N/A	N/A		⊕⊕◯◯ Low	
	Contact after death: Washed body Vs. Care during illness	Exposure to EVD from primary case	310 contacts	112 exposed / 310	142 exposed / 310	N/A	N/A	N/A		⊕⊕◯◯ Low	

				contacts (36%)	contacts (46%)						
	Contact after death: Transported body Vs. Care during illness	Exposure to EVD from primary case	310 contacts	75 exposed / 310 contacts (24%)	142 exposed / 310 contacts (46%)	N/A	N/A	N/A		⊕⊕◯◯ Low	
	Contact after death: Burial/funeral rituals Vs. Care during illness	Exposure to EVD from primary case	310 contacts	86 exposed / 310 contacts (28%)	142 exposed / 310 contacts (46%)	N/A	N/A	N/A		⊕⊕◯◯ Low	
	Contact after death: Burial of body Vs. Care during illness	Exposure to EVD from primary case	310 contacts	110 exposed / 310 contacts (35%)	142 exposed / 310 contacts (46%)	N/A	N/A	N/A		⊕⊕◯◯ Low	
	Contact after death: Other Vs. Care during illness	Exposure to EVD from primary case	310 contacts	22 exposed / 310 contacts (7%)	142 exposed / 310 contacts (46%)	N/A	N/A	N/A		⊕◯◯◯ Very low	
Tiffany, 2017, [Cross-sectional][8]	Contact after death only Vs. Contact during acute illness	EVD cases	310 contacts	"Those having contact with the index case before death were 2.5 - 6 times more likely to be infected with EVD, compared to those with post mortem contact alone"					High Risk of Bias	⊕◯◯◯ Very low	Same study as Tiffany cohort et al. 2016, but additional analysis reported.

a. Quality assessment of studies was completed using the ROBINS-I scale for observational studies. Scores from 7-9 were considered to be high quality (low risk of bias), scores of 4-6 of moderate quality (moderate risk of bias) and scores of 0-3 of low quality (high risk of bias).
b. Antibody response against glycoprotein, nucleoprotein, and 40-kDa viral protein of Zaire Ebola virus

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

Full-text unavailable

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Senga M, Pringle K, Brett-Major D, et al. Largest documented cluster of ebola virus disease among health workers. Published online 2015.

Splino M, Chlibek R. Continual of the tens ebola outbreak - Democratic Republic Congo 2018/2019. *2019*. Vakcinologie.

Van Cutsem G. The medecins sans frontieres experience with the current ebola outbreaks. Published online 2015.

Study does not evaluate the risk of infection/exposure from handling patients deceased from EVD

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Appendix 2. Eligibility Criteria

Question (2): Should bodies of patients deceased from Ebola or Marburg disease be disinfected versus not disinfected prior to handling/moving *into a body bag?*

Setting	Health care facility, ETU, community
Population	Health workers and Burial teams handling bodies of Ebola and Marburg patients
Background interventions	Varies by organization. WHO says remains should not be sprayed, washed or embalmed.
Intervention	no disinfection of dead bodies prior to handling/moving
Comparator(s)	1) disinfection of dead bodies by wiping prior to handling/moving, 2) spraying dead bodies with disinfectant prior to handling/moving
Outcome	Symptoms of chemical exposure from spraying dead bodies, exposure during handling dead bodies, infection with Ebola or Marburg

Potential effect modifiers	*Ventilation in the area where bodies are sprayed may affect the outcome, vaccination*

Appendix 3. GRADE Table

Number of studies *Study Citations*	***Study Design***	***Risk of Bias*** [a]	***Inconsistency***	***Indirectness***	***Imprecision***	***Other Considerations***	***Quality***
Incidence of EVD							
Contact with corpse vs. Contact with live patient							
1[1]	[Cross-sectional]	Very Serious[b]	No serious[c]	Serious[d]	Serious[e]	None	⊕◯◯◯ Very low
Participation in Burial Rituals vs. No participation in burial rituals							
1[2]	[Cross-sectional	Serious[f]	No serious[c]	Serious[g]	Not Serious[h]	None	⊕⊕◯◯ Low
Provided care to individual with Ebola virus disease vs. Did not provide care to individual with Ebola virus disease							
1[2]	[Cross-sectional]	Serious[f]	No serious[c]	Serious[g]	Serious[i]	None	⊕◯◯◯ Very low
Touched Body at Funeral vs. Contact With Suspected Case Patient or Any Sick Person							
1[3]	[Cross-sectional]	Very Serious[j]	No serious[c]	Not Serious[k]	Not Serious[l]	None	⊕⊕◯◯ Low
Touched corpse (Funeral) Vs. Direct physical contact (Non-funeral)							
1[4]	[Cross-sectional]	Very Serious[m]	No serious[c]	Serious[n]	Not Serious[l]	None	⊕◯◯◯ Very low
Funeral Exposure Vs. Patient Care							
1[5]	[Cross-sectional]	Very Serious[o]	No serious[c]	Serious[p]	Serious[q]	None	⊕◯◯◯ Very low
Touched Body at Funeral Vs. Reported contact with case of Ebola virus disease							
1[6]	[Cross-sectional]	Serious[r]	No serious[c]	Serious[d]	Very Serious[s]	None	⊕◯◯◯ Very low
Contact after death only Vs. Contact before & after death							
1[7]	[Cross-sectional]	Serious[t]	No serious[c]	Serious[g]	Not Serious[u]	None	⊕⊕◯◯ Low
Contact after death: Exposure to blood/body fluids Vs. Care during illness							

Number of studies *Study Citations*	***Study Design***	***Risk of Bias***[a]	***Inconsistency***	***Indirectness***	***Imprecision***	***Other Considerations***	***Quality***
1[7]	[Cross-sectional]	Serious[t]	No serious[c]	Not Serious[k]	Serious[q]	None	⊕⊕◯◯ Low
Contact after death: Washed clothes/bedding Vs. Care during illness							
1[7]	[Cross-sectional]	Serious[t]	No serious[c]	Not Serious[k]	Serious[q]	None	⊕⊕◯◯ Low
Contact after death: Washed body Vs. Care during illness							
1[7]	[Cross-sectional]	Serious[t]	No serious[c]	Not Serious[k]	Serious[q]	None	⊕⊕◯◯ Low
Contact after death: Transported body Vs. Care during illness							
1[7]	[Cross-sectional]	Serious[t]	No serious[c]	Not Serious[k]	Serious[q]	None	⊕⊕◯◯ Low
Contact after death: Burial/funeral rituals Vs. Care during illness							
1[7]	[Cross-sectional]	Serious[t]	No serious[c]	Not Serious[k]	Serious[q]	None	⊕⊕◯◯ Low
Contact after death: Burial of body Vs. Care during illness							
1[7]	[Cross-sectional]	Serious[t]	No serious[c]	Not Serious[k]	Serious[q]	None	⊕⊕◯◯ Low
Contact after death: Other Vs. Care during illness							
1[7]	[Cross-sectional]	Serious[t]	No serious[c]	Serious[v]	Serious[q]	None	⊕◯◯◯ Very low
Contact after death only Vs. Contact during acute illness							
1[8]	[Cross-sectional]	Very Serious[w]	No serious[x]	Serious[d]	Very Serious[y]	None	⊕◯◯◯ Very low

a. Individual quality assessment of studies was completed using the ROBINS-I scale for observational studies. Scores from 7-9 were considered to be high quality (low risk of bias), scores of 4-6 of moderate quality (moderate risk of bias) and scores of 0-3 of low quality (high risk of bias).
b. NOS 3/9; Downrated for lack of controls, failure to adjust for confounders, and ascertainment of exposure not blinded to case/control status.
c. No inconsistency as only one study evaluated.
d. Downrated by 1 as study addresses any contact with live patient, rather than care provision.
e. Downrated by 1 due to small sample size; unable to evaluate relative effects.
f. NOS 6/9; Downrated for not addressing potential for selection bias, failure to report confounders adjusted in analysis and no reporting of non-response rate.

g. Downrated by 1 for not providing risk of EVD acquisition for post-mortem contact vs. for care provision.
h. Not downrated; most adjusted estimates do not cross null or show appreciable benefit or harm
i. Downrated by for most adjusted estimates crossing null and showing both appreciable benefit or harm
j. NOS 2/9; Downrated for lack of controls, lack of adjustment for confounders, ascertainment of exposure not blinded to case/control status, and no reporting of non-response rate.
k. Not downrated.
l. Not downrated; unable to evaluate relative effects.
m. NOS 2/9; Downrated due to no independent validation of cases, lack of controls, lack of adjustment for confounders, and ascertainment of exposure not blinded to case/control status.
n. Downrated by 1 as study addresses any direct contact with live patient, rather than care provision.
o. NOS 1/9; Downrated due to no independent validation of cases, lack of controls, lack of adjustment for confounders, ascertainment of exposure not blinded to case/control status and lack of reporting of non-response rate by EVD-status.
p. Downrated by 1 due to funeral exposure, not handling of deceased patients.
q. Downrated by 1 due to small sample size. Unable to evaluate relative effects.
r. NOS 2/10; Downrated for lack of controls, lack of adjustment for confounders, ascertainment of exposure not blinded to case/control status and lack of reporting of non-response rate.
s. Downrated by 2 due to small sample size and low number of events.
t. NOS 5/9; Downrated due to lack of adjustment for confounders, ascertainment of exposure not blinded to case/control status and lack of reporting of non-response rate by EVD-status.
u. Not downrated; estimates do not cross null or show appreciable benefit or harm
v. Downrated by 1 due to lack of clarity surround what "other" activities consisted of.
w. NOS 3/10; Downrated for failure to report case definition or sampling frame, details of ascertainment of exposure, and non-response rate.
x. Downrated by 1 for not providing details on type of contact after death.
y. Downrated by 2 for failure to provide measure of association or confidence intervals.