KQ12 Contextual data

KQ 12 – "Should heavily soiled linen resulting from care to patients with Ebola or Marburg in health care, ETUs or community settings be incinerated versus disinfected?

- Risks related to staff/person handling the linens (washing manually or by machine wash).

Previous Guideline recommendations

Table 1. summarizes recommendations regarding cleaning and disinfection of surfaces and materials potentially contaminated with Ebola or Marburg viruses by the WHO, US CDC and European CDC.[1] [2] [3] A guidance document from the European CDC cites the US CDC guidance on Ebola waste management. [2] [3] Texts that are deemed to be relevant to Key Question 12 are highlighted in yellow below.

The WHO 2014 Interim infection prevention and control guidance makes the following recommendations: [1]

Personal protective equipment

• Wear heavy duty/rubber gloves, impermeable gown, closed shoes (e.g. boots) and facial protection (mask and goggle or face shield), when handling infectious waste (e.g. solid waste or any secretion or excretion with visible blood). Goggles provide greater protection than visors from splashes that may come from below when pouring liquid waste from a bucket. Avoid splashing when disposing of liquid infectious waste.

Waste management procedures

• Waste should be segregated at point of generation to enable appropriate and safe handling.

• Collect all solid, non-sharp, infectious waste using leak-proof waste bags and covered bins. Bins should never be carried against the body (e.g. on the shoulder).

• Waste should be placed in a designated pit of appropriate depth (e.g. 2 meters or about 7 feet) and filled to a depth of 1–1.5 m (or about 3–5 feet). After each waste load, the waste should be covered with a layer of 10 –15 cm deep soil.

• An incinerator may be used for short periods during an outbreak to destroy solid waste. However, it is essential to ensure that total incineration has taken place. Caution is also required when handling flammable material and when wearing gloves due to the risk of burn injuries if gloves get ignited.

According to the US CDC Procedures for Safe Handling and Management of Ebola-Associated Waste,[2] the safe handling and in-hospital management of waste generated through the care of patients with Ebola is based on three main principles.

1. Safe containment and packaging of waste should be performed as close as possible to the point of generation. Staff should avoid opening containers to manipulate the waste after primary containment.

2. Limit the number of personnel entering the Ebola patient care area and those handling generated waste before and after primary containment.

3. Always use appropriate personal protective equipment (PPE) and procedures for handling waste until the onsite inactivation or transport away from the hospital for offsite inactivation.

In the section titled “Preparing a Waste Management Plan as Part of Ebola Patient Care”, the CDC guides specify

1. Comply with your State and local regulation for handling, storage, treatment, and disposal of Ebola-associated waste.

2. Determine whether Ebola-associated waste will be inactivated onsite at the hospital or transported offsite for inactivation.

3. Identify a dedicated waste management team with specific training on standardized procedures for waste handling, including wearing appropriate PPE, and protocols for safely bagging and packaging waste, storing waste, and transporting packaged waste.

- Onsite inactivation: Ebola-associated waste may be inactivated through incineration or by autoclaving using properly maintained equipment with appropriate biological indicators.
- Offsite inactivation: Comply with regulations for packaging, transport and disposal of Ebola-associated waste.

US CDC 2019 Ebola-Associated Waste Management [3]

- Ebola-associated waste that has been appropriately incinerated, autoclaved, or otherwise inactivated is not infectious, does not pose a health risk, and is not considered to be regulated medical waste or a hazardous material under federal law.

Inactivation or incineration of Ebola-associated waste within a hospital system may be subject to state, local, and OSHA regulations.

- On-site inactivation
  - Ebola-associated waste may be inactivated through the use of appropriate autoclaves. Other methods of inactivation (e.g., chemical inactivation) have not been standardized and would need to consider worker safety issues, as well as the potential for triggering other federal safety regulations.
- On-site incineration
  - Ebola-associated waste may be incinerated. The products of incineration (i.e., the ash) can be transported and disposed of in accordance with state and local regulations and standard protocols for hospital waste disposal.

Contextual data

Table 2. summarizes the contextual data from six studies that were identified during study selection. Texts in the excerpts below are highlighted green if they are deemed to be relevant to KQ 12.

In Edmunds et al. 2016, a team with expertise in the Hazard Analysis of Critical Control Points framework identified waste products from the care of individuals with Ebola virus disease and constructed, tested and confirmed flow diagrams showing the creation of such products. [4] After listing potential hazards associated with each step in each flow diagram, the team conducted a hazard analysis, determined critical control points and made recommendations to mitigate the transmission risks at each control point. They identified 13 critical control points – i.e. 13 points at which there is an opportunity to adopt measures to reduce the risks of transmission (Figure 1).

Critical control point 2 - Washing and cleaning - The level of concern about washing and cleaning fomite contaminated with blood is high (Figure 1). [4] The level of concern about washing and cleaning fomite contaminated with contaminated bodily fluids other than blood is medium. The concern is with contamination of cleaners (Figure 1). Use water and detergent for cleaning, followed by 0.5% chlorinated water for disinfecting. The concern for wastewater contamination is low. Wastewater is to be managed with Critical Control Point 12 in Figure 1.

Critical control point 3 - Reuse or shared use of fomites - The level of concern about contaminated fomites with blood is high (Figure 1). [4] The level of concern about contaminated fomites with bodily fluids other than blood is medium. The concern with reuse or shared use of fomite is inadequate cleaning. Avoid reuse where possible and dispose as per Critical Control Point 8 in Figure 1. If reuse is essential, wear full PPE when washing reusable materials or products. Check fomite for damage and suitability for reuse. If reuse is possible, clean fomite using a moist single-use cloth, which should then be incinerated. Following cleaning, if possible, with a wash with water at >60 °C. If not possible, soak in 0.5% chlorine solution for a minimum of 30 min, after removing most organic material, and then let air-dry before transporting for reuse.

Critical control point 8 - Burning of waste - The concern with burning of waste contaminated with blood or bodily fluids other than blood is low (Figure 1). [4] The concern is with incomplete combustion. If waste is to be burned, use an incinerator – that reaches sufficient complete burning temperatures and meets environmental emission standards – according to manufacturer's operating manual. If an incinerator is not available, burn in a barrel or pit with sufficient additional combustible material to ensure complete combustion. If large volumes of waste need to be burned, divide into smaller volumes before burning. PPE should be worn but extreme caution needs to be taken to avoid the handler's PPE catching alight.

Garibaldi et al 2016 describe a biocontainment and treatment unit at Johns Hopkins Medicine to care for patients with EVD. [5] They examined published literature and guidelines, visited two existing U.S. biocontainment units, and contacted national and international experts to inform the design of the physical structure and patient care activities of the unit. The Johns Hopkins Biocontainment Unit (BCU) has an onsite waste-handling room with two pass-through autoclaves (Primus Sterilizer, Omaha, NE). Infectious material is loaded into the autoclaves on the contaminated side and, once sterilized, is removed on the clean side for processing as regular medical waste. Biological and chemical indicators are used with every autoclave cycle to ensure sterilization before transport off the unit. Autoclave protocols were derived from guidelines for Biological Safety Level BSL-3 and BSL-4 laboratories.

According to Garibaldi et al., there are few data on the use of autoclaves for decontamination of clinical and patient-related waste. [5] The BCU autoclave protocols were developed and validated through a

rigorous process that used biological indicators embedded within mock patient trash loads. This ensures that effective kill of organisms is achieved in solid trash, liquid waste, and soiled linens.

Items that are reused on the BCU are transported to a room off the waste-handling area, where they undergo disinfection with a hydrogen peroxide vapor system (Bioquell, Horsham, PA). [5] This system also decontaminates patient care areas after discharge (20–23). The elevator is cleaned with hospital disinfectant and can undergo decontamination with vaporized hydrogen peroxide if a spill occurs during transport. The plumbing is resistant to hospital disinfectants and has a dedicated wastewater conduit to the hospital's main sanitary system. This allows dilution of waste materials with disinfectants and protects the floors below in the case of a plumbing disruption.

Garibaldi et al. 2017 conducted a validation study of autoclave protocols for successful decontamination of category A medical waste generated from care of patients with serious communicable diseases. [6] The most difficult loads to sterilize were those containing saturated linens (soaked with 1 liter of water) comprising a cotton blanket, sheets, and pillow cases, which required a vacuum cycle of a minimum of 60 min to achieve adequate sterilization using the settings as described for other dry waste. Nine of nine runs (100%) containing multiple saturated linens and using a shorter sterilizing time (3 runs each of 15, 30, and 45 min) failed.

While autoclave sterilization may be an effective and safe way to process infectious waste for transport and disposal, this study shows that factory default settings and laboratory waste guidelines are likely insufficient to adequately sterilize pathogens in the center of medical waste autoclave loads.[6] Autoclave parameters may need to be adjusted, with particular attention paid to the way that waste loads are packaged prior to treatment.

Haverkort et al. 2016 report how the Major Incident Hospital of the University Medical Centre of Utrecht prepared for admitting Ebola patients. [7] An assessment of the hospital's preparations for an outbreak of viral hemorrhagic fever and its experience during admission of a patient with Ebola virus disease showed that the use of the buddy system, frequent training, and information sessions for staff and their relatives greatly increased the sense of safety and motivation among staff. Differing procedures among ambulance services limited the number of services used for transporting patients. Waste management was the greatest concern, and destruction of waste had to be outsourced.

Preparations for waste management were a major concern given the expected amount of waste and the time consuming procedures involved (replacing a single waste container in the isolation unit can take as long as 20 minutes). [7] Designated, sealable, 60-L waste containers would be used for waste storage, and waste management procedures were strictly protocolled and repeatedly conveyed through training. In-hospital autoclave capacity appeared insufficient; therefore, waste destruction would be outsourced to an external facility. In accordance with transportation laws, one specific 20-L container had been approved for transport by public road (5). However, these containers were too small, and opening and closing them presented a safety risk. Therefore, category A medical waste (UN2814) containers were chosen; these were to be packed in a large plastic drum and the waste stored in a guarded and certified cooled sea container outside the hospital before transport.

Otter et al. 2010 report the use of a hydrogen peroxide vapor decontamination of a critical care unit room used to treat a patient with Lassa fever. [8] They based their decontamination strategy on a UK 1996 Health Protection Agency guidance document for the management and control of viral hemorrhagic fevers which states that 'In some circumstances VHF [viral hemorrhagic fever] viruses can survive for two weeks or even longer on contaminated fabrics and equipment.' They therefore decided to decontaminate the critical care unit room, which was contaminated with blood and body fluids, with hydrogen peroxide vapour, a sporicidal and virucidal vapour-phase method that is being used increasingly in healthcare settings.

References

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Table 1: Summary of guideline recommendations regarding disinfection of Ebola-exposed surfaces by the WHO, US and European CDC

Source	Should heavily soiled linen resulting from care to patients with Ebola or Marburg in health care, ETUs or community settings be incinerated versus disinfected? Risks related to staff/person handling the linens (washing manually or by machine wash).
WHO [1]	2014
Recommendations	Interim infection prevention and control guidance for care of patients with suspected or confirmed filovirus haemorrhagic fever in health-care settings, with focus on Ebola 4. WASTE MANAGEMENT Personal protective equipment Wear heavy duty/rubber gloves, impermeable gown, closed shoes (e.g. boots) and facial protection (mask and goggle or face shield), when handling infectious waste (e.g. solid waste or any secretion or excretion with visible blood). Goggles provide greater protection than visors from splashes that may come from below when pouring liquid waste from a bucket. Avoid splashing when disposing of liquid infectious waste. Waste management procedures Waste should be segregated at point of generation to enable appropriate and safe handling. Sharp objects (e.g. needles, syringes, glass articles) and tubing that has been in contact with blood or body fluids should be placed inside puncture resistant waste containers (as described above). These should be located as close as practical to the patient care area where the items are used, similarly in laboratories. Collect all solid, non-sharp, infectious waste using leak-proof waste bags and covered bins. Bins should never be carried against the body (e.g. on the shoulder). Waste should be placed in a designated pit of appropriate depth (e.g. 2 meters or about 7 feet) and filled to a depth of 1–1.5 m (or about 3–5 feet). After each waste load, the waste should be covered with a layer of soil 10 –15 cm deep. An incinerator may be used for short periods during an outbreak to destroy solid waste. However, it is essential to ensure that total incineration has taken place. Caution is also required when handling flammable material and when wearing gloves due to the risk of burn injuries if gloves are ignited. Placenta and anatomical samples should be buried in a separate pit. The area designated for the final treatment and disposal of waste should have controlled access to prevent entry by animals, untrained personnel or children. Waste, such as faeces, urine and vomit, and liquid waste from washing, can be disposed of in the sanitary sewer or pit latrine. No further treatment is necessary.
US CDC [2]	Procedures for Safe Handling and Management of Ebola-Associated Waste The safe handling and in-hospital management of waste generated through the care of patients with Ebola is based on three main principles. 1. Safe containment and packaging of waste should be performed as close as possible to the point of generation. Staff should avoid opening containers to manipulate the waste after primary containment. 2. Limit the number of personnel entering the Ebola patient care area and those handling generated waste before and after primary containment.

	3. Always use appropriate personal protective equipment (PPE) and procedures for handling waste until onsite inactivation or transport away from the hospital for offsite inactivation. **Preparing a Waste Management Plan as Part of Ebola Patient Care** 1. Comply with your State and local regulation for handling, storage, treatment, and disposal of Ebola-associated waste. 2. Determine whether Ebola-associated waste will be inactivated onsite at the hospital or transported offsite for inactivation. 3. Identify a dedicated waste management team with specific training on standardized procedures for waste handling, including wearing appropriate PPE, and protocols for safely bagging and packaging waste, storing waste, and transporting packaged waste. o Onsite inactivation: Ebola-associated waste may be inactivated through incineration or by autoclaving using properly maintained equipment with appropriate biological indicators. o Offsite inactivation: Comply with regulations for packaging, transport and disposal of Ebola-associated waste.
US CDC	2019 Ebola-Associated Waste Management [3] • Ebola-associated waste that has been appropriately incinerated, autoclaved, or otherwise inactivated is not infectious, does not pose a health risk, and is not considered to be regulated medical waste or a hazardous material under federal law. Inactivation or incineration of Ebola-associated waste within a hospital system may be subject to state, local, and OSHA regulations. • On-site inactivation o Ebola-associated waste may be inactivated through the use of appropriate autoclaves. Other methods of inactivation (e.g., chemical inactivation) have not been standardized and would need to consider worker safety issues, as well as the potential for triggering other federal safety regulations. • On-site incineration o Ebola-associated waste may be incinerated. The products of incineration (i.e., the ash) can be transported and disposed of in accordance with state and local regulations and standard protocols for hospital waste disposal.
European CDC	2019 Health emergency preparedness for imported cases of high-consequence infectious diseases [9] No specific recommendations. This document cites the US CDC guides regarding Ebola-Associated Waste Management

Table 2. Summary of contextual data

Author, year	Study methods	Method details, measures or findings relevant to the extraction of contextual data	Data type	Contextual data
Cummings, 2016 [10]	Practice reflection	After admission of the first patient with EVD, a multidisciplinary team from the Centers for Disease Control and Prevention (CDC) joined the hospital's infection prevention to implement a system of occupational safety and health controls for direct patient care, handling of clinical specimens, and managing regulated medical waste. Existing engineering and administrative controls were strengthened.	Implementation	**Engineering Controls -** A designated waste anteroom was constructed by adding a second zippered wall separating the hot zone from adjacent nursing stations. Throughout their shifts, nurses in the hot zone brought double-bagged medical waste directly to the waste anteroom and placed it in 55-gallon Department of Transportation– approved category A lined cardboard drums (category A — contaminated with EVD and other highly infectious pathogens—). Environmental services staff removed the full drums from the waste anteroom and replaced them with empty drums daily. The waste anteroom allowed EVS staff to avoid an earlier practice of entering the hot zone to collect the drums. **Administrative Controls and PPE -** The addition of solidifier to liquid waste (urine, vomitus, and feces) before bagging minimized the potential for the biohazard bags to leak. Nurses were asked to fill biohazard bags until they were only onehalf to three-quarters full to help ensure that they would safely fit in the drums without excessive manipulation. When a biohazard bag was ready to be disposed, 100 mL of a 0.5% chlorine solution was added, the bag was hand-tied, and the outside was disinfected using hospital-grade disinfecting chlorine wipes. The bag was placed in a second biohazard bag, which was hand-tied, externally disinfected using chlorine wipes, and placed in a drum in the waste anteroom. When the drum was full, the liner was secured with a zip tie and the lid was secured with a metal band clamp. Drums were transported off-site by a contractor for incineration. Once environmental services staff no longer entered the hot zone, their recommended PPE ensemble was limited to skin protection. However, having previously worn respiratory protection in the hot zone, they chose to wear disposable N95 respirators when transporting waste.
Edmunds, 2016 [4]	Hazard analysis	A team with expertise in the Hazard Analysis of Critical Control Points framework identified waste products from the care of individuals with Ebola virus disease and constructed, tested and confirmed flow diagrams showing the creation of such products. After listing potential hazards associated with each step in each flow diagram, the team conducted a hazard analysis, determined critical control points and made recommendations to mitigate the transmission risks at each control point.	Implementation	Findings The collection, transportation, cleaning and shared use of **blood-soiled** fomites and the shared use of latrines contaminated with blood or bloodied feces appeared to be associated with particularly **high levels of risk** of Ebola virus transmission. More moderate levels of risk were associated with the collection and transportation of material contaminated with **bodily fluids other than blood**, shared use of latrines soiled with such fluids, the cleaning and shared use of fomites soiled with such fluids, and the contamination of the environment during the collection and transportation of blood-contaminated waste. Conclusion The risk of the waste-related transmission of Ebola virus could be reduced by the use of full PPE, appropriate hand hygiene and an appropriate disinfectant after careful cleaning.

Author, year	Study methods	Method details, measures or findings relevant to the extraction of contextual data	Data type	Contextual data
Garibaldi, 2016 [5]	Description of a biocontainment and treatment unit	Johns Hopkins Medicine (JHM) created a new biocontainment and treatment unit (BCU) to safely care for patients with EVD. The unit team examined published literature and guidelines, visited two existing U.S. biocontainment units, and contacted national and international experts to inform the design of the physical structure and patient care activities of the unit.		An onsite laboratory and an autoclave waste management system minimize the transport of infectious materials out of the unit. The Johns Hopkins Biocontainment Unit (BCU) has an onsite waste-handling room with two pass-through autoclaves (Primus Sterilizer, Omaha, NE). Infectious material is loaded into the autoclaves on the contaminated side and, once sterilized, is removed on the clean side for processing as regular medical waste (Figure 5). Biological and chemical indicators are used with every autoclave cycle to ensure sterilization before transport off the unit. Autoclave protocols were derived from guidelines for BSL-3 and BSL-4 laboratories (19). There are few data on the use of autoclaves for decontamination of clinical and patient-related waste. The BCU autoclave protocols were developed and validated through a rigorous process that used biological indicators embedded within mock patient trash loads. This ensures that effective kill of organisms is achieved in solid trash, liquid waste, and soiled linens. Items that are reused on the unit are transported to a room off the waste-handling area, where they undergo disinfection with a hydrogen peroxide vapor system (Bioquell, Horsham, PA). This system also decontaminates patient care areas after discharge (20–23). The elevator is cleaned with hospital disinfectant and can undergo decontamination with vaporized hydrogen peroxide if a spill occurs during transport. The plumbing is resistant to hospital disinfectants and has a dedicated wastewater conduit to the hospital's main sanitary system. This allows dilution of waste materials with disinfectants and protects the floors below in the case of a plumbing disruption.
Garibaldi, 2017 [6]	Validation study	Validation of autoclave protocols for successful decontamination of category A medical waste generated from care of patients with serious communicable diseases	Implementation	The most difficult loads to sterilize were those containing saturated linens (soaked with 1 liter of water) comprising a cotton blanket, sheets, and pillow cases, which required a vacuum cycle of a minimum of 60 min to achieve adequate sterilization using the settings as described for other dry waste. Nine of nine runs (100%) containing multiple saturated linens and using a shorter sterilizing time (3 runs each of 15, 30, and 45 min) failed. While autoclave sterilization may be an effective and safe way to process infectious waste for transport and disposal, this study shows that factory default settings and laboratory waste guidelines are likely insufficient to adequately sterilize pathogens in the center of medical waste autoclave loads. Autoclave parameters may need to be adjusted, with particular attention paid to the way that waste loads are packaged prior to treatment.
Haverkort, 2016 [7]	Report of a hospital preparations for Ebola patients	An assessment of the hospital's preparations for an outbreak of viral hemorrhagic fever and its experience during admission of a patient with Ebola virus disease showed that the use of the buddy system, frequent training, and information sessions for staff and their relatives greatly increased the sense of safety and motivation among staff. Differing procedures among ambulance services limited the number of services used for transporting patients. Waste management was the greatest concern, and destruction of waste had to be outsourced. The admission of an Ebola patient proceeded without incident but led to considerable demands on staff. The maximum time allowed for wearing personal protective equipment was 45 minutes to ensure safety, and an additional 20 minutes was needed for recovery.	Implementation	Preparations for waste management were a major concern given the expected amount of waste and the time-consuming procedures involved (replacing a single waste container in the isolation unit can take as long as 20 minutes). Designated, sealable, 60-L waste containers would be used for waste storage, and waste management procedures were strictly protocolled and repeatedly conveyed through training. In-hospital autoclave capacity appeared insufficient; therefore, waste destruction would be outsourced to an external facility. In accordance with transportation laws, one specific 20-L container had been approved for transport by public road (5). However, these containers were too small, and opening and closing them presented a safety risk. Therefore, category A medical waste (UN2814) containers were chosen; these were to be packed in a large plastic drum and the waste stored in a guarded and certified cooled sea container outside the hospital before transport.

Author, year	Study methods	Method details, measures or findings relevant to the extraction of contextual data	Data type	Contextual data
Otter, 2010 [8]	Report of a decontamination method	Hydrogen peroxide vapour decontamination of a critical care unit room used to treat a patient with Lassa fever		We based our decontamination strategy (Figure 1) on a 1996 Health Protection Agency guidance document for the management and control of viral hemorrhagic fevers which states that 'In some circumstances VHF [viral hemorrhagic fever] viruses can survive for two weeks or even longer on contaminated fabrics and equipment.' 5 We therefore decided to decontaminate the CCU room, which was contaminated with blood and body fluids, with hydrogen peroxide vapor (HPV), a sporicidal and virucidal vapor-phase method that is being used increasingly in healthcare settings.6e8

Figure 1. Summary of potential hazard by critical control point (Source Edmunds et al. 2016) [4]

Table 1. **Summary of the Hazard Analysis of Critical Control Point (HACCP) assessment for the disposal of waste potentially contaminated with Ebola virus**

Potential hazard by critical control point	Level of concern about contaminated materials		Recommendations[b]
	with blood	with bodily fluids other than blood[a]	
1. Latrine use			
Contamination of environment	High	Medium	– Suspected and confirmed cases use isolated and segregated latrines and keep pit secure for 7 days[10,24] after last use by suspected case. – Avoid surface water inflow by using external channels or concrete surroundings, and ensure adequate quality of construction to limit risk of collapse and contamination of groundwater sources.[17] – Using a single-use cloth – which should subsequently be incinerated – clean surfaces with water and detergent. Then wipe 0.5% chlorine solution[16,18–21] over all surfaces, including door handles, toilet seat, floor and walls.[7] Wash hands with soap and water after using latrine.
2. Washing and cleaning			
Contamination of cleaner	High	Medium	– Provide proper training of cleaners and ensure experienced supervision. – Use water and detergent for cleaning, followed by 0.5% chlorinated water for disinfecting.[10,18,19] – Treat wastewater as per CCP12.
3. Reuse or shared use of fomite			
Inadequate cleaning	High	Medium	– Avoid reuse where possible and dispose as per CCP8. If reuse is essential, wear full PPE when washing reusable materials or products.[c] – Check fomite for damage and suitability for reuse. If reuse is possible, clean fomite using a moist single-use cloth, which should then be incinerated. Following cleaning, if possible, with a wash with water at > 60 °C.[16,22] If not possible, soak in 0.5% chlorine solution[18,19] for a minimum of 30 min, after removing most organic material,[10,16,21,22] and then let air-dry before transporting for reuse.
4. Transport			
Splashing on handler	High	Medium	– Avoid handling fresh waste. If unavoidable, wear full PPE and employ appropriate hand hygiene measures.[c]
Contamination of vehicles and/or containers	High	Medium	– At end of each transportation or shift, using a moist single-use cloth that should subsequently be incinerated, clean vehicles and containers with water and detergent. Following cleaning, disinfect using 0.5% chlorine solution.[16,18,19,21] If cloth must be reused, wash with warm water and detergent while wearing appropriate PPE to remove organic matter. Then soak in 0.5% chlorine solution for a minimum of 30 min and rinse with cold water.[23] – Always wear full PPE when cleaning vehicles and containers and disinfect or burn PPE after use.
Contamination of environment	Medium	Low	– Use leak-proof containers – e.g. plastic barrels with secure lids – for contaminated items.[17] – Using a single-use cloth that should subsequently be incinerated, clean outer surfaces of vehicles and containers before and after use with water and detergent. If cloth must be reused, wash with warm water and detergent, while wearing appropriate PPE, to remove organic matter. Then soak in 0.5% chlorine solution for a minimum of 30 min and rinse with cold water.[23] Following cleaning, disinfect using 0.5% chlorine solution.[10,18,19,21] – Enclose and/or isolate site. – Spills should be covered first with a cloth, to avoid splashing or dispersion of fluids. Then wipe up spill with rags and dispose of rags through incineration. Clean the area with a detergent and water and then disinfect by wiping with 0.5% chlorine solution.[18,19]
5. Disposal of sharps			
Contamination of handler	High	Low	– Sharps should be segregated from other waste at point of generation,[17,21,23] placed in puncture-resistant, sealed biohazard-labelled containers and disposed of appropriately, as local facilities allow.[17,23]

Figure 1. Summary of potential hazard by critical control point (Continued)

Potential hazard by critical control point	Level of concern about contaminated materials		Recommendations[b]
	with blood	with bodily fluids other than blood[b]	
6. Emptying of latrine when more than two thirds full			
Contamination of handler	Variable, depending on age of waste, construction of latrine etc.	Variable, depending on age of waste, construction of latrine etc.	– Wait a minimum of 7 days after last use by a known case before desludging.[19,24] – If not possible to wait 7 days, wear full PPE.[25–27,b]
7. Storage			
Exposure to contaminated waste	Variable, depending on age of waste	Variable, depending on age of waste	– Segregate waste into a secure nonporous container and destroy within 24 h.[19]
8. Burning of waste			
Incomplete combustion	Low	Low	– If waste is to be burned, use an incinerator – that reaches sufficient complete burning temperatures and meets environmental emission standards – according to manufacturer's operating manual. If an incinerator is not available, burn in a barrel or pit with sufficient additional combustible material to ensure complete combustion.[19] – If large volumes of waste need to be burned, divide into smaller volumes before burning.[19] – PPE should be worn but extreme caution needs to be taken to avoid the handler's PPE catching alight.
9. Cleaning and disinfecting of non-human waste			
Theft and reuse	Low	Low	– For fabric waste – e.g. bed linen and clothing – discard if possible. If reuse necessary, wash with warm water and detergent, while wearing appropriate PPE, to remove organic matter. Then soak in 0.5% chlorine solution for a minimum of 30 min and rinse with cold water. – For hard waste – e.g. crockery and buckets – wash with a detergent, while wearing appropriate PPE, to remove organic matter. Then soak in 0.5% chlorine solution for a minimum of 10 min and rinse with cold water. – Items can be reused if not damaged. For items not suitable for reuse, dump in a secure area and limit animal access to the secure area.[10,16,18,19,21]
10. Burial of waste			
Digging up or theft of health-care waste	Low	Low	– Bury in reliably secure areas, with limited access to animals, and keep secure for 14 days after last disposal. Acidify or soak in 0.5% chlorine solution for 30 min[10,16,18,19,21] before dumping.
11. Disposal on ground			
Contamination of food crops	Low	Low[13]	– Prevent disposal onto ground used for food crops and ensure that all crops are handled and prepared according to appropriate food safety guidelines.[28]

Figure 1. Summary of potential hazard by critical control point (Continued)

Potential hazard by critical control point	Level of concern about contaminated materials		Recommendations[b]
	with blood	with bodily fluids other than blood[a]	
Contamination of water supply	Low	Low	– Ensure water supply point is designed to prevent contamination following principles of sanitary assessments included in water safety plans.[12] – Encourage safe water handling and storage practices and encourage proven household water treatment methods – e.g. filtration, chlorination or boiling.[12,19]
12. Discharge and treatment of wastewater through sewer			
Contact of general public with virus via open sewers	Low	Low	– Give public health education to community representatives and construct physical barriers.[12] Ensure appropriate conditions of carriage – in many places effluent streams are used by neighbours[17] – by following sanitation safety planning guidelines.[17,29]
Contact of sewage workers with virus	Low	Low	– Ensure standard PPE and hygiene practices are followed.[30]
13. Open defecation			
Human and animal contact with virus via human excrement	Low	Low	– Discourage open defecation and encourage pit latrine use. Remove excrement to a pit latrine or bury at a minimum depth of 0.5 m. If unavoidable, dump excrement in secure area.

CCP: critical control point; PPE: personal protective equipment.

[a] Including urine, faeces and wash water.

[b] During the execution of this recommendation, appropriate hand hygiene must be employed and full PPE worn, with the correct protocols observed. After each use, PPE should be treated as an infected fomite and either disinfected or burned.

[c] Due to the nature of Ebola viruses, there must be 100% compliance with this recommendation.