

**Literature Review**  
**Personal Protective Equipment (PPE) for Infectious Diseases  
of High Consequence (IDHC)**

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2.0	May 2017	New recommendation 'Respirator hoods must be fluid-resistant and must offer barrier protection that is equivalent to the gown or coverall component of the PPE ensemble.'	
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## 1. Objectives

The aim of this review is to examine the extant professional literature regarding Personal Protective Equipment (PPE) for Infectious Diseases of High Consequence (IDHC). The specific objectives of the review are to determine:

- What is the definition of an IDHC?
- How should employers determine what level of PPE is required for IDHC?
- What is the required PPE for IDHC requiring aerosol generating procedures (AGPs) e.g. pandemic influenza, MERS-CoV?
- What is the required PPE for IDHC with uncontrolled bleeding, vomiting or diarrhoea e.g. Viral Haemorrhagic Fever (VHF)?
- What standards (EN) must PPE adhere to and what design features are desirable?
- How should different elements of PPE for IDHC be integrated/interfaced i.e. use of tape?
- How should PPE for IDHC be donned and doffed?
- How is 'competence'/'competency' defined regarding PPE for IDHC?
- What training is required for staff to be considered 'competent' in the use of PPE for IDHC and how frequently should staff be trained to remain competent?
- How should staff competency be assessed?

N.B. Recommendations on the use of personal protective equipment for Standard Infection Control Procedures (SICPs) and Transmission Based Precautions (TBPs) (not including IDHC) e.g. FFP3 respirators, surgical masks, gowns and aprons, gloves etc., are discussed within the corresponding SICPs and TBPs literature reviews and within the [National Infection Prevention and Control Manual](#).

## 2. Methodology

This targeted literature review was produced using a defined methodology as described in the [National Infection Prevention and Control Manual: Development Process](#).

## 3. Recommendations

This review makes the following recommendations based on an assessment of the extant professional literature on PPE for IDHC.

### What is the definition of an IDHC?

An IDHC:

- Typically causes severe symptoms requiring a high level of care
- Typically has a high case-fatality rate
- Is transmissible from human to human (contagious)
- May not have effective prophylaxis or treatment
- Is capable of causing large-scale epidemics or pandemics
- Is often considered to be 'novel' or 'emerging'

**(Good Practice Point (GPP))**

### How should employers determine what level of PPE is required for IDHC?

A risk assessment must be performed to determine the required PPE for IDHC. Risk assessments must include the:

- cross infection risk (transmissibility);
- route of transmission;
- risk of exposure to blood and body fluids;
- task(s) to be undertaken; and
- environment PPE will be used in.

**(Good Practice Point (GPP))**

**(Mandatory)**

### What is the required PPE for IDHC requiring AGPs e.g. pandemic influenza, MERS-CoV?

Pathogen specific guidance should be consulted if available; a clinical risk assessment will inform the required PPE which at a minimum should include:

- long-sleeved, fluid-resistant disposable surgical gown;
- non-sterile, non-latex, disposable gloves;
- an FFP3 respirator conforming to (EN149:2001): Fit testing must be undertaken prior to using this equipment and fit checking must be performed each time an FFP3 respirator is worn. Alternatively, a powered respirator with hood/helmet conforming to BS EN 12941:1998 may be worn;
- eye/face protection (face shield or goggles) compatible with the FFP3 respirator (prescription glasses do not provide adequate protection against droplets, sprays and splashes).

#### **Grade D Recommendation**

#### **(Good Practice Point (GPP))**

### **What is the required PPE for IDHC with uncontrolled bleeding, vomiting or diarrhoea e.g. VHF?**

Pathogen specific guidance should be consulted if available; a clinical risk assessment will inform the required PPE which at a minimum should include:

- non-sterile, non-latex disposable gloves with extended cuffs (2 pairs);
- a disposable, fluid-resistant apron;
- a disposable, fluid-resistant coverall (with integrated hood if using an FFP3 respirator);
- an FFP3 respirator conforming to (EN149:2001): Fit testing must be undertaken prior to using this equipment and fit checking must be performed each time an FFP3 respirator is worn. Alternatively, a powered respirator with hood/helmet conforming to BS EN 1294:1998 may be worn;
- eye/face protection (face shield or goggles) compatible with respiratory protection;
- impermeable boots or closed shoes;
- disposable boot covers.

#### **Grade D Recommendation**

#### **(Good Practice Point (GPP))**

### **What standards (EN) must PPE adhere to and what design features are desirable?**

All PPE must bear a CE mark that signifies compliance with the Personal Protective Equipment Regulations 2002.

FFP3 respirators must comply with BS EN149:2001.

Powered respirators with a hood/helmet used as an alternative to FFP3 respirators must comply with British Standard BS EN 12941:1998.

Fluid-resistant, disposable gowns must comply with the requirements for a 'standard performance' surgical gown according to EN 13975:2011, at a minimum.

Coveralls must achieve the highest classification for protection against biological agents in accordance with EN 14126:2003 (type 3-B, 4/5/6).

#### **(Mandatory)**

Gowns should be back fastening with a high neckline and be of a sufficient length to reach below the knees.

Coveralls should ideally have integrated thumb/finger loops.

Gown and coverall cuffs, zips, storm flaps etc. should be constructed of the same material as the rest of the garment or have an equivalent resistance to penetration by fluid/biological materials. All seams/closures should provide a similar barrier protection to the fabric itself e.g. welded or double-taped seams.

Powered respirator hoods must be fluid-resistant and must offer barrier protection that is equivalent to the gown or coverall component of the PPE ensemble.

**(Good Practice Point (GPP))**

#### **How should different elements of PPE be integrated/interfaced i.e. use of tape?**

When worn together PPE items must be compatible with each other and should interface sufficiently well to form a barrier e.g. sleeves must be long enough to be adequately overlapped by glove cuffs.

**(Mandatory)**

Adhesive tape should not be used in place of correctly fitted, compatible and adequately interfaced PPE.

**(Good Practice Point (GPP))**



## How should PPE be donned and doffed?

A detailed and pre-defined sequence for donning and doffing should be developed, implemented and monitored.

### **(Mandatory)**

A trained observer or 'buddy' should be present at all times during donning and doffing of PPE for IDHC with uncontrolled bleeding, vomiting or diarrhoea e.g. VHF. The 'buddy' will ensure and record adherence to the defined protocol providing instruction and assistance as required by the protocol.

### **Donning:**

Before commencing the donning protocol healthcare workers (HCWs) should:

- put on scrubs;
- if applicable, ensure hair is tied back securely and off of the neck and collar;
- remove jewellery/pens;
- ensure they are hydrated;
- perform hand hygiene.

During donning each item must be adjusted as required to ensure it fits correctly and interfaces well with other PPE items

### **Doffing:**

When doffing potentially contaminated PPE HCWs must (with the assistance of buddy as required):

- inspect the PPE for damage and/or contamination;
- remove any visible contamination on the surface of PPE with a chlorine-based disinfectant wipe;
- perform hand hygiene using alcohol based hand rub (ABHR) after each item of PPE is removed;
- carefully remove aprons, gowns or coveralls by peeling, folding or rolling away from the body taking care not to touch the outside of the item;
- handle eye/face/respiratory PPE by the ties/elastic or handles only.

Sharp instruments such as scissors should not be used to assist in the removal of PPE.

### **(Good Practice Point (GPP))**

### How should PPE be disposed of after doffing?

If pathogen specific guidance is unavailable waste should be treated as category A waste (yellow stream) until a risk assessment is completed and/or further evidence assesses the waste as category B (orange stream).

#### **(Good Practice Point (GPP))**

PPE must be disposed of as healthcare waste and disposed of into the same stream as other healthcare waste from management of a patient with an IDHC in accordance with local waste management policy.

Category A waste must be packaged in a rigid container compliant with UN2814 before transport to a specialist waste management facility.

#### **(Mandatory)**

### How should reusable PPE be managed after doffing?

As far as possible PPE should be single-use disposable; any reusable items must have a defined disinfection protocol in place, be correctly stored and have regular recorded maintenance checks.

#### **(Good Practice Point (GPP))**

Disinfectant products must be suitable for use against the identified pathogen and compatible with the PPE item, and used in accordance with the manufacturer's instructions.

#### **(Mandatory)**

### How is 'competence'/'competency' defined regarding PPE?

Persons can be considered 'competent' when they have acquired a combination of training, skills, experience and knowledge regarding PPE for IDHC and can demonstrate they can apply them to perform a task to a recognised standard.

#### **(Mandatory)**

## What training is required for staff to be considered 'competent' and how frequently should staff be trained to remain competent?

Training must be formed of both theory and practice.

### Grade D Recommendation

Training must include:

- How to correctly fit and wear all required PPE
- The purpose and limitations of the required PPE
- How to don, doff and dispose of all required PPE safely
- Procedures to follow if there is a breach in PPE

### (Good Practice Point (GPP))

#### (Mandatory)

Regular refresher training should be provided to ensure HCWs remain competent in the PPE required for IDHC. The frequency of this training should be determined locally.

### (Good Practice Point (GPP))

## How should staff competency be assessed?

Staff must be able to correctly perform **all** tasks related to wearing PPE for IDHC, for example:

- Donning PPE in the correct sequence
- Doffing PPE in the correct sequence and using the correct technique(s)
- Safely disposing of PPE

Assessments should check and record correct completion of each step of PPE donning and doffing, and ensure the trainee understands the theory underpinning the process.

### (Good Practice Point (GPP))

## Discussion

### 3.1 Implications for practice

#### What is the definition of an IDHC?

There is no single accepted definition for IDHC, indeed these infectious agents are variably referred to as 'potential pandemic pathogens', 'highly infectious diseases', 'high consequence infectious diseases' etc. <sup>1-5</sup>

The European Centre for Disease Prevention and Control (ECDC) defines an IDHC as follows: *'Infectious diseases of high consequence (IDHC) are serious threats to human health. Patients develop severe symptoms; require a high level of care and case–fatality rates can be high. Often, there is no specific prophylaxis or treatment available. IDHC are transmissible from human to human (contagious); depending on their transmission mode (e.g. by droplets or airborne) and infectivity IDHC can generate large-scale epidemics (e.g. Ebola in West Africa 2014 or SARS in 2003) or even pandemics (e.g. the Spanish influenza pandemic in 1918).*<sup>5</sup>

The following agents or diseases have been described as IDHC:

- VHF caused by Marburg virus, Ebola virus, Crimean Congo haemorrhagic fever virus, Lassa virus, Lujo virus, Junin virus, Machupo virus, Sabia virus and Guanarito virus;
- Novel coronavirus SARS and MERS-CoV;
- MDR and XDR Mycobacterium tuberculosis;
- Newly emerging highly pathogenic strains of influenza virus;
- Smallpox and other orthopox infections e.g. monkeypox, but excluding vaccinia virus infection;
- Other emerging highly pathogenic agents, including agents of deliberate release (e.g. pneumonic plague), some of which could also be extensively antibiotic resistant.<sup>1;2;4</sup>

#### **(Good Practice Point (GPP))**

Infectious agents or diseases that have been identified as IDHC by National or International public health organisations typically fall into hazard group 3 or 4 of The Approved List of Biological Agents (Table 1) and are capable of human to human transmission.<sup>6</sup> Hazard group 3 agents can cause severe human disease and may be a serious hazard to employees; they may

spread to the community, but there is usually effective prophylaxis or treatment available. Hazard group 4 agents cause severe human disease and are a serious hazard to employees; they are likely to spread to the community and there is usually no effective prophylaxis or treatment available.<sup>6</sup>

**Table 1** Examples of Hazard group 3 and 4 infectious agents from The Approved List of Biological Agents.

<b>Hazard group 3</b>	<b>Hazard group 4</b>
<i>Bacillus anthracis</i>	Filoviruses e.g. Ebola virus
Influenza*	Lujovirus
MERS-CoV	Crimean Congo haemorrhagic fever virus
SARS-CoV	Variola virus (minor and major)

\*Influenza types A, B and C have been classified as hazard group 2, however, the Advisory Committee on Dangerous Pathogens (ACDP) states that a local risk assessment should be carried out for pandemic strains likely to cause (or already causing) severe human disease. Typically, strains that have been lethal in birds or have pandemic potential should be classified (by risk assessment) as at least hazard group 3.<sup>6</sup>

### **(Mandatory)**

IDHC are often described as 'novel' and/or 'emerging', the WHO defines an emerging infectious disease as '*one that has appeared in the population for the first time, or that may have existed previously but is rapidly increasing incidence or geographical range*'<sup>1,2</sup> the CDC defines emerging infectious diseases as:

- *New infections resulting from changes in or evolution of existing organisms.*
- *Known infections spreading to new geographical areas or populations.*
- *Previously unrecognised infections appearing in areas undergoing ecological transformation.*
- *Old infections re-emerging as a result of antibiotic resistance in known agents or breakdown in public health measures.*<sup>2</sup>

### **(Good Practice point (GPP))**

## How should employers determine what level of PPE is required for IDHC?

The Advisory Committee on Dangerous Pathogens (ACDP) guidance on management of VHF and IDHC states that *'when selecting PPE, the infection risk, the tasks to be undertaken, the environment in which the PPE is being used and the person using the PPE must be considered.'*<sup>4</sup>

### (Mandatory)

Similarly, the CDC recommend that employers should conduct a risk assessment to identify potential exposure to blood and body fluids; the selection of PPE will be determined by the route of transmission and risk may vary depending on stage of disease and/or severity of symptoms.<sup>7</sup>

### (Good Practice point (GPP))

## What is the required PPE for IDHC requiring AGPs e.g. pandemic influenza, MERS-CoV?

It is consistently recommended that staff wear:

- gloves (latex, nitrile or neoprene);
- disposable, fluid-resistant long-sleeved gown ( surgical gown);
- a face shield or goggles<sup>2;8-11</sup>

Guidance has differed on whether respiratory protective equipment (FFP3) is required for these pathogens<sup>2;11</sup> or if a surgical mask is sufficient (except during AGPs).<sup>9</sup> It has been shown that both surgical masks and N95 respirators were protective during the SARS epidemic but it is unclear whether one offered superior protection over the other.<sup>8;10</sup> Current NHSScotland guidance for severe respiratory illness caused by novel or emerging pathogens recommends that a fit-tested, fit-checked FFP3 respirator is worn for all patient care activities.<sup>12</sup> A recent (2016) survey of RPE in NHSScotland showed that powered respirators with hood/helmets are increasingly used as an alternative to FFP3 respirators, particularly where staff have been unable to pass a fit test with an FFP3 respirator or are unshaven (unpublished).

### (Good Practice point (GPP))

## **What is the required PPE for IDHC with uncontrolled bleeding, vomiting or diarrhoea e.g. Viral Haemorrhagic Fever?**

The ACDP states that the PPE/RPE combination has to establish a barrier against contact with contaminated surfaces, splash, spray, bulk fluids and aerosol particles as follows:

- Should provide adequate coverage of all exposed skin, with sufficient integrity to prevent ingress or seepage of bulk liquids or airborne particles, under foreseeable conditions of usage;
- The materials from which the PPE is made should resist penetration of relevant liquids/suspensions and aerosols.<sup>4</sup>

### **(Mandatory)**

A Cochrane review did not find sufficient evidence to make recommendations on the required PPE for IDHC;<sup>3</sup> however, the following items have consistently been recommended for HCW caring for symptomatic patients with suspected or confirmed VHF:

- A double layer of long or extended cuff gloves (latex, nitrile or neoprene)
- A disposable, fluid-resistant apron
- A disposable, fluid-resistant long-sleeved gown (surgical gown) or coverall
- A disposable, fluid resistant hood (if wearing a gown or a coverall without an attached hood)
- Respiratory protection (FFP3 or powered respirator with hood/helmet)
- Face shield or goggles
- Impermeable boots or closed shoes
- Disposable boot covers<sup>2;5;13-16</sup>

There is evidence that double gloves provide greater protection than single gloves.<sup>3;17</sup> One guideline has recommended the use of a third layer of disposable gloves,<sup>16</sup> however, it has been suggested that more than two pairs of gloves make it difficult to perform patient care.<sup>15</sup>

### **(Good Practice point (GPP))**

The ACDP state that although there is no evidence of airborne transmission of VHF, as a precautionary measure it is considered appropriate to wear RPE when managing a confirmed case.<sup>4</sup>

### **(Mandatory)**

An experimental study using simulated vomit, cough secretions, sweat and diarrhoea has been used to test five different PPE ensembles from UK centres.<sup>18</sup> The study identified key features which may be important for an effective PPE ensemble for IDHC;

- head and neck protection in the form of a fluid-resistant hood was more effective than ensembles using a cap;
- aprons should be worn to provide additional protection to critical areas,
- aprons should cover the tops of boots;
- boot covers should not be worn alone and their removal when worn over boots has been associated with contamination events.<sup>19</sup>

### **(Good Practice Point (GPP))**

#### **What standards (EN) must PPE adhere to and what design features are desirable?**

All PPE must bear a 'CE' mark that signifies compliance with the Personal Protective Equipment Regulations 2002.<sup>4;20;21</sup> This demonstrates conformance with the relevant European (EN) or International (ISO) standards.<sup>4;20</sup> Some EN standards have different performance levels, employers and HCWs must ensure that each PPE item worn conforms to the performance level appropriate for the identified risk.

Surgical masks for use in infection control should be classed as Type IIR in accordance with BS EN 14683; this series of tests measures the performance of a surgical mask in bacterial filtration efficiency, breathing resistance and splash resistance. Type II and Type IIR surgical masks are both tested against this standard; however only Type IIR masks must pass the splash resistance test with a resistance of at least 120mmHg.

FFP3 respirators are specified for use in UK healthcare settings by the Health and Safety Executive (HSE) to protect healthcare workers from infectious aerosols.<sup>22</sup> The HSE stipulate that FFP3 respirators must comply with British Standard BS EN149:2001 and that powered respirators must comply with British Standard BS EN 12941:1998.<sup>22</sup> The hood component of



powered respirators must be fluid-resistant and must offer barrier protection that is equivalent to the gown or coverall component of the PPE ensemble.

The ACDP state that the materials from which PPE for VHF is made should resist penetration of relevant liquids/suspensions and aerosols.<sup>4</sup> Disposable, fluid-resistant gowns should be resistant to liquid penetration and should have achieved a hydrostatic pressure test result of  $\geq 20\text{cm}$ ; this is equivalent to a “standard performance” surgical gown that is compliant with EN 13975. Coveralls suitable for protection against IDHC typically achieve the highest classification for protection against biological agents in accordance with EN 14126:2003; this is usually described in the manufacturer’s technical notes as type 3-B, 4/5/6.

### **(Mandatory)**

In addition to providing sufficient barrier protection, gowns for managing cases of IDHC should be back-fastening with a high neckline and be of sufficient length to reach below the knees. Gown and coverall cuffs, zips, storm flaps etc. should be constructed of the same material as the rest of the garment or have an equivalent resistance to penetration by fluid/biological materials. Coveralls with integrated thumb hooks/finger loops should be considered, these prevent sleeves from riding up and exposing the bare forearm during patient care.<sup>15</sup> Consideration must also be given to garment properties such as seams, it is essential that all seams/closures provide similar barrier protection to the fabric itself e.g. welded or double taped seams.<sup>7</sup> Whether the blower unit of a powered respirator is self-contained or externally belt-mounted will determine both the order of donning and doffing and the required decontamination, this should be considered when purchasing.

### **(Good Practice point (GPP))**

#### **How should different elements of PPE be integrated/interfaced i.e. use of tape?**

The Personal Protective Equipment (PPE) at Work Regulations 1992 state that when more than one item of PPE is worn they must be compatible with each other and when used together, should adequately control the risk.<sup>21</sup> The ACDP adds that the various components (body clothing, footwear, gloves, respiratory/face/eye protection) should be designed to interface sufficiently well to maintain a barrier, e.g. sleeves long enough to be adequately overlapped by glove cuffs.<sup>4</sup> Employers and HCWs should consider how the garment will interface with other elements of PPE such as gloves with the sleeves of the gown, or respiratory protection with the

hood. The interfaces will determine the users overall protection. The characteristics of the work environment and tasks to be undertaken should also be considered.<sup>7</sup>

### **(Mandatory)**

The WHO state that adhesive tape should not be used to attach gloves to the sleeves of coveralls, if the inner gloves or coverall sleeve are too short they recommend making a thumb hole (or utilise thumb/finger loops if available) to ensure forearms are not exposed when making wide movements.<sup>13</sup> The ECDC recommends the extensive use of parcel tape to secure inner gloves to coveralls, adjust coverall size (hoods) and to seal small gaps and interfaces around the face, gloves and boots.<sup>5</sup> However, the ECDC acknowledge that there are potential safety issues with the use of tape; ‘over-taping’ near the respirator can make breathing difficult or cause the respirator to lose its seal, taping too tightly or using too much tape can complicate the doffing process and removing tape can delaminate the surface of protective clothing potentially reducing its barrier function.<sup>5</sup> Following admission of the first imported case of EVD to the U.S. and subsequent transmission to two HCWs the hospital involved reviewed its PPE protocols, it was found that the tapes being used were either too adhesive and would tear gloves on removal, or the tape itself would tear creating doffing issues, PPE protocols were altered to utilise thumb holes rather than tape.<sup>23</sup> In a simulation exercise to test different ensembles from UK IDHC ‘surge’ centres users (HCWs) felt that taped gloves were more secure and led to easier doffing but the study also reported tearing of gloves and that circumferential taping could risk making sleeve removal difficult if done too tightly.<sup>19</sup>

### **(Good Practice point (GPP))**

#### **How should PPE be donned and doffed?**

The ACDP state that a detailed and pre-defined sequence for donning and doffing should be developed, implemented and monitored.<sup>4</sup>

### **(Mandatory)**

A recent Cochrane systematic review found some evidence to suggest that using the CDC doffing protocol was associated with a reduced risk of contamination compared to doffing without following a protocol.<sup>3</sup>

### **(Good Practice point (GPP))**

It is consistently recommended that a trained observer or 'buddy' should be present for donning and doffing of PPE for IDHC; the buddy may actively assist in the donning and doffing process and/or may serve to instruct the HCW and record adherence to the protocol.<sup>5;13-16</sup>

Before donning PPE HCWs should put on clean scrubs, remove any jewellery/pens and perform hand hygiene, they should also ensure they are well hydrated.<sup>5;13-15</sup> There was limited consistency in the order for donning and doffing PPE in the identified protocols, this is largely due to the variation in the PPE/PPE combinations used. However, it was consistently recommended that when doffing:

- PPE should be inspected for damage and/or contamination before removal, any visible contamination should be removed with disinfectant wipes before proceeding.<sup>5;13-15</sup>
- Hand hygiene using ABHR must be performed after each contact with PPE,<sup>13-15</sup> alternatively, some protocols recommend changing outer gloves rather than hand hygiene.<sup>5;16</sup>
- Care must be taken to avoid touching potentially contaminated areas such as the outside of the coveralls/gowns or front-facing areas of respirators/masks and eye protection.
- The removal of gowns or coveralls must be done carefully by peeling or rolling away from the body taking care to only touch the inside of the garment; similarly, items of PPE such as eye/face and respiratory protection should only be handled by the ties or elastics.<sup>5;13-16</sup>

These findings were reflected in a survey of European isolation facilities which found that donning and doffing sequences varied considerably but that there was general consensus that contact between contaminated gloves or hands with facial and respiratory protection should be avoided and that hand hygiene should be performed after each contact with potentially contaminated PPE; in addition it was recommended goggles or face shields should be removed early in the sequence as they are cumbersome and can impair vision and therefore PPE removal.<sup>1</sup>

There is differing guidance on the use of sharps such as scissors as doffing aids, the ECDC suggest the use of scissors to cut away coveralls from the back while doffing,<sup>5</sup> however, the CDC state that scissors must never be used to remove tape or any item of PPE.<sup>15</sup>

### **(Good Practice point (GPP))**

## **How should PPE be disposed of after doffing?**

PPE must be disposed of into the same waste stream as other healthcare waste from the management of a patient with an IDHC, in accordance with local waste management policy. Pathogen specific guidance for MERS-CoV states that waste (including PPE) should be disposed of as category B healthcare waste (orange stream),<sup>11</sup> however, waste from the management of patients with VHF should be disposed of as category A healthcare waste (yellow stream).<sup>4</sup> Requirements for the categorisation of healthcare waste are detailed in HTM 07-01, in the absence of pathogen specific guidance waste must be assessed for risk and categorised as either category A waste (yellow stream) or category B waste (orange stream). According to HTM 07-0,1 category A waste is “An infectious substance which is carried in a form that, when exposure to it occurs, is capable of causing permanent disability, life threatening or fatal disease to humans or animals.”<sup>24</sup> Category A waste must be packaged in a rigid container compliant with UN2814 before transport to a specialist waste management facility.<sup>24</sup>

### **(Mandatory)**

## **How should reusable PPE be managed after doffing?**

Some items of PPE used for IDHC may be considered reusable e.g. goggles, wellington boots etc., however, it is recommended that wherever possible PPE should be single-use disposable. If reusable items of PPE are used these must be decontaminated after each use, following the manufacturer’s instructions; a protocol for decontamination must be in place and responsibility assigned.<sup>11;12</sup>

### **(Good Practice Point (GPP))**

Disinfectant products must be suitable for use against the identified pathogen and compatible with the PPE item, according to the manufacturer’s instructions.<sup>4</sup>

### **(Mandatory)**

## **How is ‘competence’/‘competency’ defined regarding PPE?**

The HSE states that ‘competence can be described as the combination of training, skills, experience and knowledge that a person has and their ability to apply them to perform a task safely’, as well as ‘the ability to undertake responsibilities and perform activities to a recognised standard on a regular basis.’<sup>25;26</sup>

### **(Mandatory)**

## **What training is required for staff to be considered ‘competent’ and how frequently should staff be trained to remain competent?**

The PPE at Work Regulations 1992 state that employers must provide suitable information, instruction and training for their employees to make effective use of the PPE provided to them.<sup>21</sup> Training must include how to correctly fit and wear PPE as well as the purpose and limitations of the PPE.<sup>21</sup> Training should include elements of both theory and practice and should be carried out in accordance with any recommendations or instruction supplied by the manufacturer.<sup>21</sup>

### **(Mandatory)**

In their guidance for managing patients with suspected or confirmed EVD the CDC recommends that HCWs are trained in all recommended PPE and protocols; they recommend that training involve simulated care activities while wearing PPE and should include donning, doffing and disposing of PPE correctly as well as procedures to follow if there is a breach in PPE.<sup>15</sup> Similar methods have been recommended for other IDHC such as MERS-CoV, SARS and pandemic influenza.<sup>2</sup>

### **(Good Practice point (GPP))**

It is consistently recommended that training should include practical elements (‘active training’),<sup>2;15;27-29</sup> a recent Cochrane review also found some evidence to support this.<sup>3</sup> It has also been shown that correcting errors made during training and immediately reinforcing correct technique with further education can improve competency and lead to better rates of knowledge retention.<sup>27;28</sup>

### **(Grade D recommendation)**

The CDC state that refresher training is essential to maintain competency but do not recommend a frequency for refresher training.<sup>29</sup> A recent Cochrane review did not identify any studies that addressed retention of knowledge or frequency of training; however, one study demonstrated that six months following HAZMAT PPE training only 8.6% of students remained competent.<sup>30</sup>

### **(Good Practice point (GPP))**

#### **How should staff competency be assessed?**

The CDC has stated that hospitals should ensure that employees can demonstrate how to properly don, use and doff the same type/model of PPE and respirators they will use when caring for a patient.<sup>15</sup> A number of organisations have produced checklist style tools for assessment and recording of competence; some are simple checklists while others also include scoring systems.<sup>31</sup>

### 3.2 Implications for research

There have been limited high quality studies to determine appropriate selection and use of PPE for IDHC. No evidence-based guidelines were identified for this review; although many guidelines on PPE for IDHC exist the vast majority of these are focussed on EVD and were developed rapidly in response to the Ebola crisis in West Africa from 2014-2016. Lack of an evidence base at that time led to substantial variation in recommendations for PPE. There are inconsistencies in both the PPE recommended and the order for donning and doffing. In the event of a pandemic which requires an international response, disparity between protocols puts HCWs at risk; given the increased likelihood of infection for staff, HCWs must have access to PPE and protocols that are consistent with their training. This also applies where variation exists between institutes within the same country or between developed countries within a union such as the UK. The simulation exercise supported by the Health and Safety Executive and published by Hall et al. has identified a potential national PPE ensemble for IDHC, following further testing using the methods described by Poller et al. the intention is to publish this along with training tools to ensure a coordinated, evidence-based UK approach.<sup>18;19</sup>

This literature review has identified extremely limited evidence for defining and therefore for assessing HCW competency in the PPE required for IDHC. The competency assessments that were identified did not provide a minimum score or pass mark for competency; since HCWs must be able to select, don and doff all items correctly it must be assumed that a score of 100% is required to demonstrate competency.



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