



TECHNICAL DOCUMENT

Safe use of personal protective equipment in the treatment of infectious diseases of high consequence

A tutorial for trainers in healthcare settings

Version 2: 2 December 2014

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Abbreviations

AGP	Aerosol Generating Procedure
CDC	US Centers for Disease Control and Prevention
CBRN	Chemical, biological, radiological and nuclear
ECDC	European Centre for Disease Prevention and Control
EVD	Ebola virus disease
FFP	Filtering face piece
HCW	Healthcare worker
IDHC	Infectious diseases of high consequence
MSF	Médecins sans Frontières
OSH	Occupational Safety and Health
PAPR	Powered air-purifying respirator
PPE	Personal protective equipment
VHF	Viral Haemorrhagic Fever
WHO	World Health Organization

1 Introduction

On 29 October 2014 ECDC launched the first version of the tutorial 'Critical aspects of the safe use of personal protective equipment'. It provides practical information on the proper use of personal protective equipment (PPE) at the point of care, including technical and procurement aspects. In light of the ongoing Ebola epidemic in West Africa there has been an enormous interest and response from professionals in clinical medicine and public health. The message that the risk of transmission to healthcare workers (HCWs) would potentially not be limited to the worst-affected West African countries has been noted.

Meanwhile, relevant international guidance on the use of PPE has been updated and additional insights on improved PPE components and processes gained.

This second version of the tutorial incorporates these updates, but also the valuable input provided from additional experts in- and outside ECDC.

Scope

The scope of the tutorial is to improve the protection of staff dealing with infectious diseases of high consequence (IDHC). Therefore it does not exclusively target current risks from viral haemorrhagic fevers but also strengthens hospital preparedness for future health threats posed by highly infectious pathogens.

The document focuses on an extended set of PPE components, which includes goggles, respirators, gloves, coveralls and footwear. Used properly, these PPE components can provide effective protection even from airborne transmission. The presented PPE components can be used in a variety of settings and also in different combinations. At the same time, the tutorial shall encourage trainers and users to understand the rationales behind the different approaches.

The issues covered start with procurement and technical requirements as mandated by EU regulation, followed by critical aspects and known pitfalls in the donning (putting on) and doffing (removing) of PPE. As effective staff protection never depends on the protective equipment alone, the tutorial also identifies operational basics of barrier management and nursing, including waste management, disinfection and incident management.

To increase the safety of HCWs, regular in-depth training in the use of PPE needs to be performed as an integral part of hospital preparedness. Additional challenges for hospital preparedness lie in the fact that one single case of an IDHC will heavily affect the overall routines of the hospital as a large number of the workforce will be drawn into this extended care setting.

Aim

This tutorial presents the fundamental concepts of PPE and barrier nursing. By this it aims to strengthen capabilities and capacities in hospital preparedness across Europe and in other countries with equivalent standards in healthcare.

The main learning objectives are:

- to know the technical requirements when procuring PPE for IDHC
- to become aware of critical aspects and known pitfalls when using PPE for IDHC
- to understand staff protection as a combined approach, which is not based on PPE alone
- to strengthen occupational safety and health (OSH) aspects in healthcare for patients with IDHC.

The main target audience are future PPE instructors with a background in infection control and hygiene in hospital settings. Additional target groups are professionals in communicable diseases, infection control and hospital hygiene experts, hospital managers in charge of administration, nursing, OSH and emergency planning. Also experts in preparedness at the regional and national levels should be considered.

How to use this tutorial

This tutorial is a 'living' document. This means that ECDC aims to expand, update, and revise the current version based on further scientific evidence and feedback from practitioners in the field. The main use is to support trainers with background information about the safe use of PPE. Adaptions in components and processes are required to be done in accordance with the actual disease pattern and the specific clinical setting. Preferences and alternative options for now are based on expert opinion due to the lack of scientific evidence in this field.

As the document follows a generic approach for PPE for IDHC, we amended on a case-by-case basis specifications for viral haemorrhagic fevers (VHF), which are primarily transmitted by contact or droplets, or for air-borne transmitted diseases.

Generally, the selection of PPE follows a risk-based approach, including factors such as type of planned interventions, the patient's infectivity and the work place environment. Occupational safety and health (OSH) experts with training in PPE matters should oversee the material selection and the training process. Manufacturer instructions on the use of PPE components need to be read and followed carefully. The tutorial will only support, but never replace, practical training and regular refresher courses held by experienced PPE instructors.

Methodology

In light of the current Ebola outbreak, recommendations need to carefully balance between a state-of-the-art scientific approach (evidence-based medicine) and the demands of an ongoing emergency.

A dedicated team of ECDC experts developed this document jointly, by combining their expertise on training, clinical medicine, infection control and preparedness.

Additional sources included documents on the use of PPE for the care of Ebola patients, released by international organisations and European public health institutes.

The team also analysed guidelines and training materials from the World Health Organization (WHO), US Centers for Disease Control and Prevention (US CDC), and Médecins sans Frontières (MSF).

Furthermore, the team was supported throughout the process by external experts on barrier nursing, hospital infection control, and biorisk management. A comprehensive video on the use of PPE produced by the Robert Koch Institute (Germany) and a textbook on biohazardsⁱ provided helpful examples of existing good practice.

Next updates of the tutorial will integrate further comments and corrections provided by experts on PPE in- and outside ECDC. These updates are planned at short intervals in order to keep the document as up to date as possible.

ECDC also provides an [e-tutorial](#) that can be used in training and for self-learners to support further training activities.

E-tutorial layout:



http://www.ecdc.europa.eu/en/healthtopics/ebola_marburg_fever/Pages/tutorial-ppe.aspx

Contact

ecdc.courses@ecdc.europa.eu

ⁱ Robert Koch Institut und Bundesamt für Bevölkerungsschutz und Katastrophenhilfe. Biologische Gefahren. Handbuch zum Bevölkerungsschutz. Third edition. Bonn 2007. Available from:

http://www.bbk.bund.de/SharedDocs/Downloads/BBK/DE/Publikationen/PublikationenForschung/BioGef-I_3Auflage.pdf

2 Staff safety

Basic considerations

Joint action from the employers and employees side is the basis for achieving safe and healthy workplaces. Employers have the overall responsibility for the protection of workers' safety and health, and are requested to provide leadership and commitment to OSH activities in the organisation.

Within the context of his responsibilities, the employer shall take the measures necessary for the safety and health protection of workers, including prevention of occupational risks and provision of information and training, as well as provision of the necessary organisation and meansⁱ.

Occupational safety and health measures shall not involve any expenditure for the workers.

In the process they are collaborating with representatives from the employees' side to establish sustainability in prevention and in the entire risk management process. A so-called 'OSH management system' provides the appropriate framework for planning and implementation, evaluation and action steps for further improvement of staff safety.

The OSH management system ensures thatⁱⁱ:

- compliance with safety and health requirements for the organisation is identified, evaluated and incorporated into purchasing and leasing specifications
- national laws and regulations and the organisation's own OSH requirements are identified prior to the procurement of goods and services
- arrangements are made to achieve conformance to the requirements prior to their use.

The selection of specific PPE components and their combination with each other needs to be based on a systematic risk assessment as a part of an OSH management system. This risk assessment needs to take into consideration the following entities:

- hazard posed by the characteristics of the causative pathogen of an IDHC
- specific vulnerabilities in staff exposed towards the hazard
- analysis of workplace setting in which exposure to the hazard occurs
- analysis and description of planned activities carried out by staff at a defined workplace.

Procurement decisions in most hospitals are mainly driven by budgetary considerations. Unsurprisingly, this applies in particular to measures which are commonly considered as preparedness for incidents of high impact but of low probability. Staff protection for infectious diseases of high consequence (IDHC) often falls into this category.

On the other hand, prudent procurement is crucial for the safety of HCWs in hazardous biological environments. This requires that hospital planners know the technical requirements and have a clear concept of which PPE components work best in a specific hospital setting. Even more important is an understanding that national and European ('EU Directive 2000/54/EC on Biological Agents'ⁱⁱⁱ) regulations oblige employers to provide appropriate protection for employees working in hazardous biological environments.

From the very beginning, staff – especially HCWs – need to be included in all relevant procurement considerations. Different types, sizes and shapes of PPE components need to be available in order to ensure a secure fit of PPE. These principles may become compromised if procurement for PPE is guided exclusively by economic considerations.

ⁱ Council Directive 89/391/EEC of 12 June 1989 on the introduction of measures to encourage improvements in the safety and health of workers at work see full text: <http://eur-lex.europa.eu/legal-content/EN/TXT/HTML/?uri=CELEX:01989L0391-20081211&from=EN>

ⁱⁱ International Labour Organization. Occupational Safety and Health Convention, 1981. Convention N. 155 concerning Occupational Safety and Health and the Working Environment [homepage on the Internet]. 1983 [cited 2014 Nov 24]. Available from: http://www.ilo.org/global/publications/ilo-bookstore/order-online/books/WCMS_PUBL_9221116344_EN/lang--en/index.htm

ⁱⁱⁱ Directive 2000/54/EC of the European Parliament and of the Council of 18 September 2000 on the protection of workers from risks related to exposure to biological agents at work (seventh individual directive within the meaning of Article 16(1) of Directive 89/391/EEC). Official Journal of the European Union. OJ L 262, 17.10.2000, p. 21–45. Available from: <http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:32000L0054>

Also, procurement of PPE for IDHC needs to be done in good time. Experiences from the H1N1 influenza in 2009 show, that purchasing substantial amounts of PPE can become difficult if not impossible during outbreaks of a global dimension.

Once purchased, PPE needs to be stored properly (proper environmental conditions, shelf life specified by the manufacturer). Equipment damaged due to improper storage can lead to an increase of the exposure risk.

Relevant EU occupational health and safety regulations

Council Directive 89/391/EEC of 12 June 1989ⁱ, usually referred to as the Occupational Safety and Health 'Framework Directive', introduces a set of general measures to encourage improvements in the safety and health of workers by imposing basic obligations on employers and workers, emphasising the responsibility of the employer. Particularly relevant is Directive 89/656/EECⁱⁱ, which lays down minimum requirements for personal protective equipment to be used by employees at work. Directive 2000/54/ECⁱⁱⁱ specifically refers to minimum requirements for the health and safety of workers exposed to biological hazards at work.

If EU Member States have carried out the transposition of the relevant Directives into national law, further details with regard to protective equipment may be contained in national legislation.

PPE needs to comply with EU legislation, and compliance is indicated either directly by the 'CE' symbol on the PPE, or by means of 'European Harmonised Standards' ('EN'), which confer a presumption of conformity to the essential health and safety requirements^{iv}.

Key messages

- Selection of PPE components needs to be based on a risk assessment
- Prudent procurement of PPE builds on users consultation
- Staff safety starts with proper procurement.

ⁱ Council Directive 89/391/EEC of 12 June 1989 on the introduction of measures to encourage improvements in the safety and health of workers at work. Full text of the consolidated version of the Directive (including later amendments) available from: <http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:01989L0391-20081211>

ⁱⁱ Council Directive 89/656/EEC of 30 November 1989 on the minimum health and safety requirements for the use by workers of personal protective equipment at the workplace (third individual directive within the meaning of Article 16 (1) of Directive 89/391/EEC). Full text of the consolidated version of the Directive (including later amendments) available from: <http://eur-lex.europa.eu/legal-content/EN/ALL/?uri=CELEX:01989L0656-20070627>

ⁱⁱⁱ Directive 2000/54/EC of the European Parliament and of the Council of 18 September 2000 on the protection of workers from risks related to exposure to biological agents at work (seventh individual directive within the meaning of Article 16(1) of Directive 89/391/EEC). Official Journal of the European Union. OJ L 262, 17.10.2000, p. 21–45. Available from: <http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:32000L0054>

^{iv} A list of harmonised standards is available from: http://ec.europa.eu/enterprise/policies/european-standards/harmonised-standards/personal-protective-equipment/index_en.htm

3 PPE components for infectious diseases of high consequence

Infectious diseases of high consequence (IDHC) are serious threats to human health. Patients develop severe symptoms, require a high level of care, and the case–fatality rates can be high. Often, there is no specific prophylaxis or treatment available. IDHC are transmissible from human to human (contagious) and therefore require transmission precautions in HCWs. Depending on the transmission mode (e.g. by droplets or airborne) and their infectivity, they 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).

For the conception of 'airborne transmission' additional differentiation is needed:

On one hand it describes a primary transmission mode of certain pathogens, such as from influenza or measles viruses. But also pathogens normally transmitted only by contact or by droplets, can become airborne under certain conditions. This occurs in cases of so-called 'secondary aerosolization': High velocity liquid flows create an aerosol of small droplets and environmental air in vicinity of the liquid flow. These accelerated flows can have natural origin, e.g. during vomiting or arterial haemorrhages, but can also be generated during invasive medical interventions, such as bronchoscopy or tracheal suction. The latter mechanism is summarised under the term 'aerosol generating procedures – AGPs'.

Staff protection with PPE and isolation of contagious patients are the two main principles to keep healthcare facilities functional and contain the risk for both HCWs and the community.

The setup of PPE required for IDHC goes beyond regular transmission-based hospital precautions. The rationale is to create an extended margin of safety for staff by anticipating unplanned high-exposure situations. For example, contact and droplet precautions are commonly seen as sufficient for HCWs involved in the treatment of Ebola virus disease (EVD) patients. However, enhanced treatment settings involve continuous close contact with EVD patients, adding also potential exposure to aerosols. PPE for IDHC always includes an option for protection against aerosols and/or airborne transmission.

The standard components for an IDHC treatment setting include eye protection, respiratory protection, hand protection, body protection, and foot protection.

Most of these materials – except for the boots, clogs and scrubs – are single-use, disposable materials, so they need to be disposed of following the established procedures for highly infectious waste. Cleaning, disinfecting, and re-conditioning of reusable PPE components is labour-intensive and often requires specific equipment not found in standard hospital settings.

Most PPE components come in different sizes. There is no one-size-fits-all principle, which does not come as a surprise because a good fit and a tight seal are essential for the protective functions of many PPE components.

In this section we describe the prerequisites for standard PPE components in the treatment of IDHC. A sample checklist for materials is provided in Annex 1.

Symbols used in the tutorial

To quickly signal what is good practice – and what is not – we use the following symbols:

- **[+/+]** Experts' choice. Recommended by experts with substantial experience of the process.
- **[+/-]** Consider the limitations before using this option. Further evidence needed.
- **[-/-]** According to experts, this practice should be avoided.

Picture framework colours used in the tutorial

To quickly signal the barrier nursing zone to which the pictures refer, we used the following picture frame colours:

- GREEN:** Green zone
- YELLOW:** Yellow zone
- RED:** Red zone

(For more information on zones and colour code see '8.2 Zones and space requirements')

Key messages

- The presented PPE components can be used in a variety of settings: they do not depend on electricity and they don't necessarily need dedicated staff decontamination facilities. Most components are designed as single-use items.
- Different combinations of PPE components allow adaption to different settings. This tutorial encourages trainers and users to understand the rationale behind the different approaches.

Table 1. PPE for IDHC in treatment settings and waste management material list

	Material	Specifiable aspects
	Hospital scrubs	Different sizes Re-usable or single use
	Cotton socks	Different sizes; Single use
	Coveralls	Different sizes; single-use (disposable); integrated hood; Fluid- and particle-proof; Zipper covered by adhesive flaps
	Separate hood	Splash-proof; Integrated surgical face mask
	Hair covers/surgical hoods	Different models
	Respirators	Different sizes and models; FFP3 and FFP2 (US occupational safety and health standards: N99 and N95); Valved and non-valved versions splash-proof and non splash-proof versions

	Material	Specifiable aspects
	Goggles	Different sizes and models; Anti-fog coating; No or covered ventilation openings preferred
	Heavy duty gloves	Different sizes and materials; Mainly for waste management or cleaning
	Gloves	Different sizes, materials and models; Latex and nitrile; Sterile (medical interventions) and non-sterile (nursing); Long cuffed and normal cuffed versions
	Boots or clogs	Different sizes, preferable with non-slip soles; Mark or colour-code clogs or boots if only for use in specific areas (e.g. in the patient treatment zone = 'red zone')
	Boot covers (optional)	Fluid-proof; Have to be mechanically resistant if used as outer cover; Non-slip soles
	Shoe covers (optional)	Non-slip soles
	Hand disinfectant	On alcohol, phenol or aldehyde basis; Placed at the point of care (red zone), in donning areas (green zone) and doffing areas (yellow zones)
	Waste management material	Big, mechanically resistant and leak-proof waste bag;

	Material	Specifiable aspects
		Leak-proof and autoclavable containers with clip on – non removable lids
		Container for sharp, pointed objects (e.g. needles, syringes, glass articles, tubing, etc.)
	Adhesive tape to use with PPE	Tape without textile layer preferred; quality parcel tape or chemical resistant tape works fine
	Apron (optional)	Single-use aprons preferred

Did you know?

Poor fit of PPE components is an often underestimated risk factor for PPE users. Coveralls, respirators, goggles, gloves and boots need to be provided in a variety of sizes.

3.1 Body protection

Technical specifications

The harmonised standard 'EN 14126:20035' adopted under Directive 89/686/EECⁱ describes the performance requirements and testing methods for protective clothing against infective agents. Most of the descriptions in the Directive refer to exposures in traditional occupational settings, for example in the chemical industry.

ⁱ Council Directive 89/686/EEC of 21 December 1989 on the approximation of the laws of the Member States relating to personal protective equipment. Official Journal of the European Union. OJ L 399, 30.12.1989, p. 18–38. Available from: <http://eur-lex.europa.eu/legal-content/en/ALL/?uri=CELEX:31989L0686>

Table 2. European quality norms for protective clothing referenced in EN14126:20035

Type	Description	Relevant standard
1a-B, 1b-B, 1c-B	Gas tight	EN 943-1:2002, EN 943-2:2002
2-B	Non gas tight	EN 943-1:2002, EN 943-2:2002
3-B*	Protection against pressurised liquid chemicals	EN 14605:2005 + A1:2009
4-B	Protection against liquid aerosols (spray tight)	EN 14605:2005 + A1:2009
5-B	Protection against airborne solid particulates	EN ISO 13982-1:2004+ A1:2010
6-B	Limited protection against liquid chemicals (light spray)	EN 13034:2005 + A1:2009

The appropriateness of protective clothing for hazardous biological environments is described in analogy to their resistance to chemical exposure. The 'B' following the type class number (classes 1 to 6) indicates that the material is also certified for various biological contaminants.

* Clothing material certified for Type 3-B ('Protection against pressurised liquid chemicals') is seen as an effective barrier for various types of biological exposure including aerosols and small particles such as viruses or spores. Furthermore, Type 3-B protection is resistant to chemicals used in enhanced decontamination procedures, as carried out, for example, in specialised treatment centres.

Functional details

However, the type class assigned to protective clothing in EN14126:20035 does not define functional details, such as taped seams, attached hoods, or covered zippers. Therefore, these specifications need to be checked and specified in the procurement process.

Essential features for single-use coveralls for IDHC include a splash-proof cover of the entry/exit zipper of the coveralls and an incorporated hood.

An integrated foot cover may be advantageous, especially in hospital settings because they can be easily combined with clogs, which are already widely used in surgical or intensive care units.

Integrated gloves are an additional option but potentially limit the choices for adapting the hand protection to certain activities such as patient procedures or waste management.

Dedicated, removable hoods covering head and shoulders are increasingly used as an alternative to the integrated hood of the coveralls. The potential benefits of this approach need to be investigated further.

Coveralls

The coveralls of the PPE ensemble have to be particle-tight and fluid-proof. The zipper of the coveralls needs to be covered by a particle-tight and splash-proof flap with an adhesive strip.

A coverall needs to fit the height and posture of the user. The PPE user must be able to move around freely without the coverall being displaced and giving room for fluids to enter the coveralls.

Practical hint

- PPE user needs to test the coverall's fit by kneeling down and lifting the arms when fully covered by the PPE ensemble. This needs to be done before entering a contaminated work zone.



Did you know?

Some PPE coveralls come with finger loops to hold the sleeves in position, thus preventing the sleeves from moving up and opening gaps between glove and coveralls while working.



Some coveralls have integrated foot parts, which potentially simplifies the donning and doffing process because the PPE user can easily remove boots or clogs when leaving the contaminated area. The clogs or boots can then stay behind, which facilitates waste management and the disinfection process for clogs/boots.



Hair covers

Hair covers (surgical hoods) should be worn under the hood of the coveralls to prevent hair from hanging out, where it can get easily contaminated with bodily fluids from the patient. This also prevents the hair from sticking to the flaps and the tape.



Ideally different types of hair covers are available, so PPE users can adapt them to their personal requirements.



Practical hint

- Ponytails or tying back hair with elastic straps under the hair cover can be uncomfortable while working in the PPE, as the goggles and the respirator’s strap can apply point pressure on it.

Separate hood

Using a separate splash-proof hood with an integrated surgical mask offers advantages in the splash protection for the face area. If a separate hood is used, the integrated hood of the coverall needs to be folded into the inside of the coverall first.

Figure 1. Different hood options

Coveralls with integrated hood



Separate hood[+/+]Fold in the integrated hood + use separated hood



Integrated hood



Separated hood without straps are also available, making the donning and doffing process easier.



3.2 Foot protection

There are mainly two options for foot protection: Boots or clogs.

[+ / +] Boots

Boots are made of robust, waterproof material. This also increases the protection from sharp objects like needles and syringes. Boots are the foot protection of choice, especially for heavy-duty tasks and any outside activity.

If boots will be reused they need to be cleaned, disinfected and reconditioned after use. Therefore boots must be made from a chemical-resistant material.

Boots can be used without boot covers and in combination with different boot covers.



[+ / +]

[+ / -] Rubber clogs

Clogs could be used in combination with complete boot covers or coveralls with integrated foot sections. Boot covers should be used inside the clogs, provided that they get taped to the coverall legs. This prevents fluids draining and contaminating the feet of HCWs.

Limitations:

- Clogs are less protective against liquids. There is a consistent risk that fluids accumulate inside the clogs, which leads to the PPE user standing directly in the fluids. In this situation liquid permeation through micro-leakages on the tissue could create an unnecessary exposure. Choose clogs that are waterproof and resistant to disinfectants.

Clogs need to be used in combination with boot covers to prevent the contamination of feet.



[+/-]

Practical hint

- Consider using different coloured clogs for the different zones (green, yellow and red) (see Section 8.2, Table 8). This way it is easy to recognise which clogs to wear when donning and doffing.

Benefits and limitations of boots covers

Using boot covers is optional when wearing boots. They also need to be made from liquid proof material. If boots are covered, they might get less contaminated. On the other hand, not using covers provides a better grip to the floor and may prevent falls.

Limitations:

- Boot covers can be slippery.
- The surface in contact with the floor is prone to be damaged. This can cause leakages of liquids.
- Any additional component used in PPE, also adds to the complexity in the donning and doffing process.

Practical hints

- Boot covers can be used as a sock when worn under the PPE coveralls. Tape the PPE coveralls to the boot cover. This makes removal easier.
- If a boot cover has a slippery sole, consider adding an extra outer shoe cover with an anti-slip treatment. (See blue shoe cover in the photo).



The choice of coveralls (i.e. without or with integrated foot section) determines how boots, clogs and shoe covers can be best combined. See Figure 2 below.

Figure 2. Choosing the right footwear for the type of coveralls selected

** In a clinical setting, only coveralls with an integrated foot section can be combined with clogs. If your coverall does not come with integrated foot sections, use separate boot covers instead and tape them to the coverall legs to create integrated foot sections.*

Practical hints

- Consider providing the PPE user with single-use cotton socks.
- Boots or clogs should be chosen at least two sizes bigger than normal due to the additional material layer from integrated foot sections. PPE users should easily slip in and out of their boots or clogs.

3.3 Hand protection

The choice of gloves always needs to balance tactility (e.g. for medical interventions) and the level of protection (defined by mechanical resistance).

PPE users should always use a minimum of two pairs of gloves.

- inner pair of gloves: covering the skin ('like a second skin')
- outer pair of gloves: gloves on top of gloves ('working gloves')

Gloves are available in different thickness, textures, materials, colours and qualities. PPE users should consider the use of different gloves depending on the exposure risk associated with the planned intervention. Glove combinations adapted to specific tasks improve safety and provide the desired tactility or the needed robustness.

Practical hints

- Check that the gloves have not expired as this will compromise their integrity. If possible, provide different colours to differentiate inner and outer gloves.



- Latex gloves should not be the only option provided, as allergies are a common issue in healthcare settings. Nitrile gloves, although less flexible, are a good alternative.
- Gloves with extended cuffs are useful to cover potential gaps between the coveralls sleeves and the hand.

Nitrile gloves protect against a wide variety of chemicals including caustics and alcohols which makes them more resistant to glove hygiene (hand sanitizer is an alcohol-based disinfectant). They eliminate the risk of an allergic reaction.

Natural (latex) rubber gloves are ideally used as outer gloves targeted to medical interventions. Good tactility, elasticity and resistance to temperature. Hypoallergenic gloves and un-powdered gloves help in preventing allergic reactions.

Glove selection guidance by national and international organisations can be followed to ensure meaningful glove procurement.

Different types of gloves



Light latex or nitrile gloves

Intermediate thickness

Heavy duty gloves

Practical hints

Inner gloves

- a glove of intermediate thickness works well as an inner layer
- consider gloves with extended cuffs as they cover a larger section of the coverall sleeves



- ideally, the inner pair of gloves should have a longer sleeve than the outer pair of gloves. This makes it easier to change gloves.



The outer pair of gloves should be adapted to the tasks that the PPE user has to perform. Consider the combinations shown below:

Different combinations of inner and outer gloves



Inner gloves + outer nursing gloves:
For patient care

Inner gloves + outer surgical gloves
(sterile if required):
For medical interventions

Inner gloves + rough outer working
gloves:
For waste management or cleaning

Did you know?

Gloves need to fit.

Gloves need to fit the PPE user, too big or too small gloves complicate patient care and increase the risk



NO!



NO!

3.4 Respiratory protection

Different kinds of masks and respirators offer different levels of protection.

Whether to use surgical masks or respirators depends on the level of exposure. A risk- and hazard-assessment for the different settings and activities is essential before any decisions are made on which level of protection is needed.

Surgical face masks mainly protect from exhaled droplets. If marked 'IIR' (surgical masks Type IIR), they are also splash-resistant and protect the wearer's mucosae and skin from fluid splashes. Surgical masks don't require fit testing.

A **respirator** instead protects from the inhalation of droplets and particles. However, most respirators are not certified 'splash-proof', especially if they are provided with an exhalation valve. They require a fit test.

A splash-proof respirator is needed in settings where there is not only the exposure risk to secondary aerosolisation but also to splashes from bodily fluids (e.g. during nursing and treatment of VHF patients). In these settings, it can be considered to complete a non splash-proof respirator by a splash-proof surgical face mask IIR, ideally integrated in a splash-proof hood. However, this combination might not conform to manufacturers' recommendations.

FFP 1, FFP2 and FFP3

The European standard EN 149 defines 'filtering half masks' (also called 'filtering face pieces' - FFP) in three classes, according to their capacity to filter particles.

Table 3. Classification of the different filter penetration limits of respirators

Respirator class EU (EU-OSHA)	Filter penetration limit (at 95 L/min air flow)	Inward leakage	Respirator class US (NIOSH)
FFP1	Filters at least 80% of airborne particles	< 22%	
FFP2	Filters at least 94% of airborne particles	< 8%	N95 (Filters at least 95% of airborne particles)
FFP3	Filters at least 99% of airborne particles	< 2%	N99

Disposable respirators require fit test.

EU-OSHA: European Agency for Safety and Health at Work. NIOSH: US National Institute for Occupational Safety and Health

FFP: Filtering face piece.

N: Not resistant to oil.

FFP3 provides best protection from aerosols and airborne transmission of IDHC.

- FFP2 or FFP3 protection should be decided depending on the pathogen and on the type of exposure.
- In an enhanced-care setting for VHF patients where secondary aerosolisation cannot be excluded, FFP3 is the respirator class of choice (e.g specialised treatment centres performing interventions with aerosolisation risk).
- FFP2 is considered sufficient for first-contact precautions, transport, visits, and supervision tasks. Do not consider FFP2 for invasive patient care, when there is risk of aerosolisation or in air-borne diseases.
- The seal fit is crucial to ensure the specified level of protection.
- Breathing resistance increases with the class of particle filtration. FFP2 are more comfortable as they offer less inhalation resistance. Valved FFP3 respirators offer less exhalation resistance than un-valved FFP3 respirators.
- An exhalation valve makes breathing more comfortable and helps to prevent goggles from fogging.
- Different models and sizes are needed to ensure seal fit in different face physiognomies.

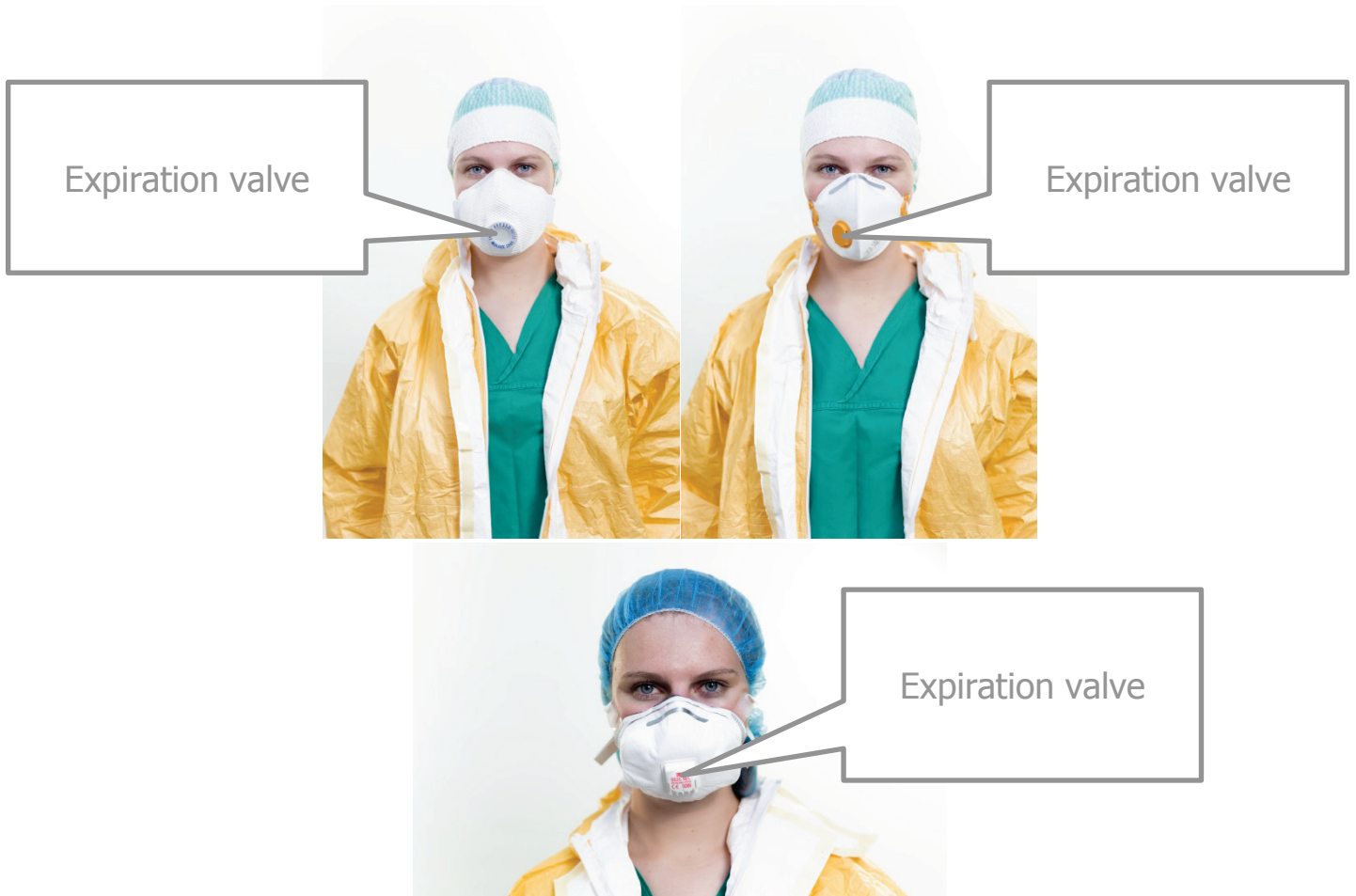
Examples of FFP3 respirators:



Did you know?

The textile surface lets in filtered air from the outside. Most valved FFP respirators are not certified as splash-proof.

Respirators fit differently between individuals. A qualitative respirator fit-test will prove optimal match between user and a certain type of respirator.



Some valved FFP3 respirators are even certified splash proof: In these respirators the filter fabric and an additional layer covering the valve are specified IIR.



[+ / +] Qualitative fit test

A qualitative respirator fit test needs to be performed before choosing a respirator for regular use as part of the PPE ensemble. A fit test verifies the seal between the respirator and the PPE user's face. The test is based on an indicator aerosol, sprayed on the user while wearing the respirator under a designated test hood. If the test person can detect the saccharin contained in the aerosol, the fit test is positive, which means that the respirator is leaking. Another model, style, or size which fits the user properly must be found. Employers have to provide users with a reasonable selection of sizes and models to choose from.



Once the respirator fit test is passed, users will continue in using this exact model, style and size. A retest should take place every 12 months to make sure the respirator still provides a perfect seal fit.

Full-face respirator ('gas mask'): benefits and limitations

Full-face respirators provide a high level of protection. They come with interchangeable filter cartridges which provide protection from biological particles, radiological particles, and vapours from chemical agents.

The respirator covers and seals the entire face. Thanks to the integrated nose and mouth mask, full-face respirators have good antifogging properties. The elastic straps which hold the respirator in place are made of rubber. They can be placed under the coverall (or an external) hood.

The cost of disposable filter cartridges for full-face respirators is significantly higher than for FFP respirators and goggles. On the other hand, full-face respirators can be reused (after decontamination) for years.



Full-face respirators, as part of the PPE ensemble, can only be used by staff members with proper medical certification and proof of adequate regular training.

Did you know?

FFP3 respirators in combination with goggles are as safe as full-face respirators when working in a treatment setting for patients with IDHC.

Powered air-purifying respirators (PAPRs)

Powered air-purifying respirators (PAPRs) are mostly used in specialised IDHC treatment centres. If used as part of the PPE, working hours can be extended, which is a clear advantage over other systems. PAPRs are multi-use items and have to be decontaminated and reconditioned (new filters cartridges) after use. Additionally, they require regular battery maintenance.

Benefits:

- Less training requirements.
- Can be used without limitations from beards or glasses worn by users.
- PPE can also be used by HCWs with stable respiratory disorders (e.g. asthma).
- Coveralls with integrated PAPR hoods enable a positive pressure flow all around the PPE user. This kind of body ventilation adds comfort and facilitates extended working hours (up to four hours). Furthermore the positive pressure provides an additional safety layer in case there is a rupture or puncture in the coverall's fabric.



Limitations:

- Expensive (procurement of reusable hoods, air tubes and power units; disposable sets of filter cartridges).
- Systematic and active battery management required.
- Decontamination and reconditioning require specific structures, normally only available in specialised settings.

The use of PAPRs is not synonymous with increased safety levels. If handled properly, the PPE for IDHC described in this tutorial provides the same safety level as PAPRs. All in all, PAPRs offer a higher level of comfort, combined with lower training needs.

Components:

- Power unit and tubes; independent from the coveralls and hoods.
- Reusable hoods combined with disposable coveralls.



- Disposable coveralls with integrated hood.



PAPRs combined with integrated hood coveralls provide the user with additional mobility inside the coverall.



3.5 Eye protection

It is important that goggles have a close fit to the face so no liquids can enter the goggles. Therefore goggles with soft-sealing edges are the preferred choice.

The goggles need to fit the face physiognomy of the PPE user and be compatible with neighbouring PPE components (respirator and hood). Providing a choice of different goggle designs increases the chances of finding the right pair for any user.



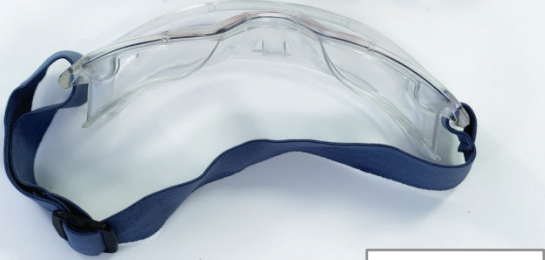
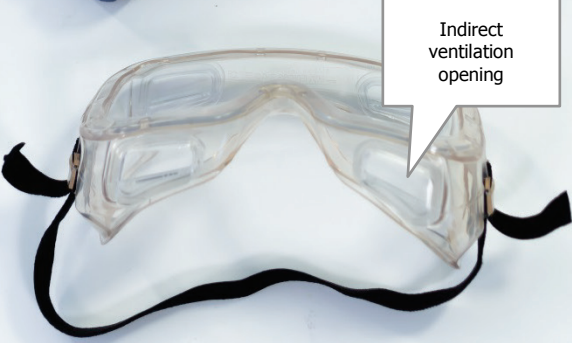
Ideally goggles won't fog up while being worn, because fogging seriously compromises patient care activities and staff safety. Modern goggles with anti-fog coating are highly effective and are seen as the best option to guarantee perfect vision in all situations. Additionally, external antifogging agents (e.g. spray) should be made available in the donning area.

Did you know?

Generally, goggles use either ventilation or anti-fog coating to prevent fogging. Both methods might be combined.

Ventilated goggles can have open or covered vents. Open vents potentially can make splashes enter inside the goggles. Covered vents still would let pass through aerosols. Only air- or gastight goggles protect against aerosols or airborne pathogens.

The recommended option is goggles with soft sealing edges, good anti-fog coating, but without ventilation.

Different types of goggles*	Characteristics
	<p>[+ / +] Experts' choice No ventilation (Gas tight), good anti-fog coating, soft silicon seal edge.</p>
	<p>Indirect ventilation, flexible seal edge</p>
	<p>No ventilation, flexible seal edge</p>
	<p>Indirect ventilation and standard seal edge</p>

*Providing anti-fog spray is essential in any case.

Practical hint

- Glasses can be worn under the goggles if the seal fit is fully preserved. However, they can also compromise the required tight seal and increase the risk of fogging. Additional application of anti-fogging spray helps in keeping fogging issues under control.



Different to a full face respirator, goggles should be worn **over** the hood of the PPE. Most goggles are secured with textile elastic straps. Wearing goggles over the hood prevents liquids from soaking through to the skin via the textile and also ensures a close fit of the hood, avoiding gaps between hood and goggles.

Key messages

- There is no such thing as 'one size fits all' when it comes to PPE components.
- Testing the fit of all PPE components before entering the red zone is mandatory.

3.6 Situational adaption of PPE components

Table 4. Situational adaption of PPE components for IDHC treatment (Contact and droplet versus air-borne transmitted diseases)

Transmission route	Contact and droplet (e.g plague, VHF ¹)		Air-borne (e.g HPAI ² , XDR-TB ³)
Transmission risk	Without risk of secondary aerosolisation (e.g. standard care)	With a risk of secondary aerosolisation (e.g. intensive care)	Pathogen is known to be also transmitted by air, independently from the care setting
Air way protection	Surgical mask specified IIR	Respirator FFP2 or FFP3 ⁴ certified "splash-proof"; alternatively combined with additional splash protection (surgical mask IIR or face shield)	Respirator FFP2 or FFP3 ⁴
Eye protection	Goggles or face shield	Goggles (Gas tight)	Goggles (Gas tight)
Face protection	Principle "no mucosae exposed"	[+/+] Separate hood with integrated splash protection. (Principle "no skin exposed") [+/-] Consider detail taping to cover gaps	Separate hood or sealing with detail taping. (Air tight)

1. VHF: Viral haemorrhagic fever
 2. HPAI: Highly pathogenic avian influenza.
 3. XDR-TB: Extensively drug-resistant tuberculosis.
 4. Depending on the pathogen

4 Considerations for the use of PPE

The presented PPE components can be used in a variety of settings: they do not depend on electricity and they do not necessarily need dedicated staff decontamination facilities. Most components are designed as single-use items and need to be disposed of immediately after usage.

Different combinations of PPE components are possible. This tutorial encourages trainers and users to understand the rationale behind the different combinations.

4.1 Precautions during first assessments

First contacts between HCWs and IDHC cases can occur in various settings, ranging from airports, public transport, waiting areas in doctor's offices or hospitals, ambulances, emergency rooms up to hospital wards if a patient shows IDHC symptoms while being treated for another kind of disease.

At the time of first contact, the staff should immediately assess the transmission risk and take appropriate precautions to avoid secondary infections.

A combination of awareness, distancing measures, and the use of appropriate PPE effectively reduces the infection risk.

- By using distancing measures (more than 1.5 metres) and common materials, the infection risk can be significantly reduced.
- PPE components: double gloves, hair cover, impermeable gown, surgical Type IIR face mask (or FFP2 respirator if available), face shield or goggles, and shoe covers.
- Limit the number of staff that comes into contact with the patient.

Practical hints

- Contact the relevant authorities or reference hospital. If necessary, transfer the patient.
- PPE used for first assessments is not sufficient to perform invasive diagnostic or treatment activities.
- Minimise additional moving of the patient to keep the potentially contaminated zone as small as possible.

Assessment of required PPE level

Assessing the necessary level of PPE protection is the key to allocating staff in the most effective and appropriate way for the identified risk level.

One approach for assigning the appropriate type of PPE lies in analysing the level of specialisation for IDHC in different healthcare settings:

Table 5. Staff protection approaches in different healthcare settings.

	Healthcare setting specialisation level	Staff protection approach	Clinical procedures
	1. Specialised treatment centres for IDHC	PAPRs and/or PPE for IDHC treatment Decontamination of HCWs before doffing Targeted vaccine or pharmaceutical prophylaxis if available	First assessment of patients with possible IDHC ('infection triage') Barrier nursing Invasive monitoring and treatment: e.g. mechanical ventilation, hemofiltration and other organ support interventions, pharmaceutical circulatory support,
	2. University hospitals and other advanced care hospitals qualified for IDHC.	PPE for IDHC treatment Wipe disinfection of HCWs before doffing Discharge of patient to specialized treatment centres for IDHC if necessary. Roster of multidisciplinary staff trained in PPE for IDHC use. (minimum of 20 HCWs) Regular refresher training	Non-invasive monitoring and treatment
	3. Primary healthcare settings and entry points.	First assessment PPE (>1.5 meters distance) Discharge to specialized treatment centres for IDHC (1 st choice) or hospitals qualified for IDHC (2 nd choice) Regular refresher training for all staff potentially involved in first assessment	First assessment of patients with possible IDHC ('infection triage') History taking Oral patient status updates Distance nursing (providing food and other necessities from a distance)

Another important criterion for choosing the right type of PPE is the level of transmission risk, which is defined by patients conditions and by the 'closeness' of the planned medical process. A generic approach stratifies between processes with low and high transmission risk. The levels need to be specified for any IDHC.

Table 6. PPE choices and transmission risks

First assessment PPE: Surgical mask (droplets) or respirators (air-borne), gown, hair cover, goggles or face shield, double gloving.	PPE for IDHC
	
Low transmission risk	High transmission risk

Non-specialised centres detecting IDHC possible or probable cases prioritise patient transfer ideally to a treatment centre specialised in IDHC or at least to a hospital qualified for IDHC (roster of HCWs trained in safe use of PPE for IDHC).

4.2 Preparing to work with PPE for infectious diseases of high consequence (IDHC)

Personal clothing should not be worn while working in the patient care areas. PPE users should wear scrubs under their coveralls.



Practical hints

- Consider sports underwear and single-use cotton socks for comfort.
- Wearing make-up impairs user comfort due to facial sweat and is not recommended when using respirators.
- Take off any jewellery or watches as they could damage PPE components (especially during the doffing process).
- Consider using the toilet before putting on the PPE.
- Drink 1–2 litres of water before putting on the PPE to prevent dehydration. Profuse sweating is an unavoidable side effect while working in PPE.
- Fasting is not recommended before working with PPE.
- Check the PPE items before starting the donning process, looking for damages like holes and cracks.

4.3 The additional use of tape: benefits and risks [+/-]

There is an ongoing controversial debate among PPE experts on the added value of additional taping of PPE components like gloves, respirators, boots and goggles. Prudent use of additional taping might contribute to an increase in safety for some highly specific aspects. However, it is crucial to understand that additional taping has both, benefits and risks.

The main improvements which can potentially be achieved by additional taping of PPE components are:

- Facilitation of the doffing process:
If gloves or boots/gloves are connected to the coveralls by adhesive tape, they can be taken off in 'one stroke', which limits the possibilities for secondary contamination. However, if done improperly the connection can break during doffing, increasing secondary contamination risks
- Closing gaps between adjoining PPE components:
Detail taping of small gaps between goggles, respirator and coveralls can prevent fluid from splashing inside. Done properly, this can even provide an aerosol-tight barrier. However, additional taping cannot compensate a primary lack in seal fit, e.g. of a respirator.
- Adapting the fit of the hood:
Tape can help to make the hood stay in position, preventing it from sliding over the eyes.

On the other side there are a couple of drawbacks PPE users need to be aware about:

- Taping is easily felt as providing 'additional safety'. But if done improperly, this perception is misleading and additional taping will create more harm than good.
- Inexperienced users are prone to tape over essential functional parts of PPE components. If for example the FFP respirator is covered by tape, this easily results in breathing difficulties.
- Careful taping significantly prolongs the donning process.
- Done incorrectly, taping jeopardises the doffing process. For example, if the tape connecting the glove to the sleeve is too tight around the forearm, it will be very difficult to take off the glove.
- Additional taping cannot resolve sizing issues in PPE components which do not fit, e.g. taping coveralls 'smaller' seriously compromises safety levels.

Generally, proper additional taping of PPE components requires high levels in training and experience. Most PPE manufacturers explicitly state in the product manuals, that taping compromises the integrity and functionality of PPE components.

Practical hints:

- The tape on the connections of gloves or boots is not to be removed during the doffing process.
- The tape on the connections of gloves and boots does NOT provide extra protection. Its objective is to enable a 'one stroke' removal of coverall arms/gloves resp. coverall legs/boots.

The tape

Different kinds of tape can be used. Tape with a textile-based layer ('duct tape') is not ideal, as it can soak up liquids (capillarity effect). Quality parcel tape or tape resistant to chemicals are good alternatives.



There are also tapes specifically certified as resistant to chemical agents.



5 Donning and doffing

Did you know?

Donning: putting **on** the PPE

Doffing: taking **off** the PPE

5.1 Basic principles in donning and doffing

There are many different ways of putting on ('donning') and removing the PPE ('doffing'). There is, however, no gold standard on how to do this. It is more important to understand the rationales behind the chosen approach for donning and doffing. The most critical aspects in the process are how to avoid secondary disease transmission to HCWs involved in patient care and avoid self-contamination while doffing.

Consequently, both processes, donning and doffing, strongly benefit from **active assistance** by a member of the team, who has been trained in this. The main advantage is that critical steps with basically no failure tolerance are carried out under direct visual control. Also, the risk of unaware self-contamination by a HCW doffing him- or herself is reduced to a minimum.

For building an integrated protection system to a high standard, PPE components have to be put on and off meticulously and in a systematic order. There may not be time pressure or other kind of distractions during the process. Checking the PPE-components for potential damage before donning, at the end of donning and before doffing adds another layer of safety.

In the yellow zone a checklist or a chart demonstrating the established procedures will help assistants in donning and doffing.

Active assistance and supervision

Donning and doffing PPE without assistance is complex and increases the risk for PPE dysfunction or even secondary contamination.

During the donning process, the assistant should wear scrubs and perform hand hygiene before starting. When the PPE user is donning to perform patient care activities, the donning assistant should wear nursing gloves and perform glove disinfection between each step in case sterile patient care conditions are needed.

By contrast, during doffing, the active assistant must wear a full-body PPE ensemble and perform glove disinfection and glove changes in accordance with the established procedure. If the doffing assistant is not taking over the next shift inside the red zone, the additional taping of PPE components is to be omitted.

The PPE user leaving the red zone only has minimum activities to perform. He or she will receive targeted instruction from the active assistant. It is important that the exiting PPE user stands still while remaining in a relaxed, yet stable, position.

In this setting the exiting PPE user is completely guided and handled by the assistant. This has the advantage that the PPE user does not need to manipulate the PPE on potentially contaminated body areas without having direct visual control.

Especially for the doffing, additional supervision from a qualified observer is required. The observer must not wear PPE. (See section 8.2 Zones and space requirements).



5.2 Donning (putting on the PPE)

It is critical to never don a PPE without proper active assistance and supervision by a barrier nursing guardian.

Suggested steps for donning

Steps	Action
1	Putting on scrubs and hair cover
2	Perform hand hygiene
3	Putting on the coverall
4	Putting on foot protection
5	Perform hand protection
6	Wear respiratory protection and perform orientation fit test
7	Putting on the hood
8	Close the zipper
9	Close adhesive flaps
10	Put on eye protection
11	Perform inner glove disinfection and put on outer gloves
12	Put on apron (optional)
13	Test the fit of the PPE components together
14	Ready to pass through the yellow zone and to enter the red zone.*

**Stop in yellow zone if you have to perform assisted doffing for a buddy first. (See Section 8.2.)*

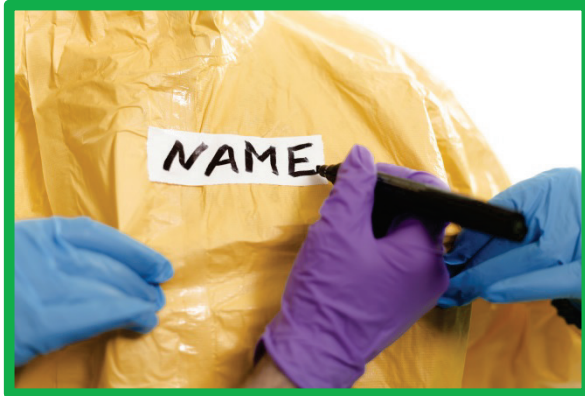
Steps 1 and 2: Putting on scrubs and hair cover; hand hygiene



To ensure comfortable and safe working conditions for the PPE user, the PPE user should wear hospital scrubs and a hair cover under the coveralls. The scrubs will absorb sweat, and the hair cover prevents fluids from seeping in through individual strands of hair sticking out from the hood. Before putting on the PPE components, perform hand hygiene.

Step 3: Putting on the coveralls

Put on the finger loops under the first pair of gloves. Placing the finger loops above the first pair of gloves has limitations as the loops are usually made of textile. Once in contact with fluids, the capillary effect can drain the fluid inside of the sleeve and where it potentially comes in contact with unprotected skin. There is no good rationale for accepting this additional risk for secondary contamination.



Easy identification of PPE users facilitates interaction and communication among HCWs and with the patient as well. This is helped by attaching a name tag (a simple piece of tape labelled with a marker) to a highly visible part of the coverall.

Did you know?

Writing directly on the coveralls may disrupt the integrity of the coverall fabric.

Step 4: Foot protection

In this section we explain the different options available depending on the material available: coveralls with or without integrated foot sections, boots, clogs, or boot covers.

Rubber boots are the preferred option for foot protection in IDHC. They can be used in combination with coveralls with or without integrated foot sections.

Clogs are less protective against liquids. There is a consistent risk that fluids accumulate inside the clogs, which leads to the PPE user standing directly in the fluids. In this situation liquid permeation through micro-leakages on the tissue could lead to an unnecessary exposure. Clogs are commonly in use in functional areas of most hospitals. They can be taken into consideration as an alternative to boots in foot protection even though they present a couple of limitations:

- The material is usually less resistant to sharp objects and more slippery than boots.
- Due to their construction clogs are prone to accumulate fluids inside.

Boot covers are not the preferred option as any extra components added to the PPE complicates the donning and doffing process. Nevertheless when boots are not available and coveralls do not have integrated foot sections, boot covers are necessary. Take into consideration that any kind of shoe worn inside a boot cover will potentially break it. Using a shoe or boot cover reduces contact with fluids but makes waste management more difficult and the soles more slippery. Also, retrieving clogs or boots from the waste bag after doffing can be difficult if they remain trapped inside the covers. If a boot cover has a slippery sole, consider adding an extra outer shoe cover with an anti-slip treatment.



Benefits and limitations of taping in foot protection

There are two benefits of taping the boots to the PPE:

- easier doffing
- preventing leakage of fluids to the inside of the boot.

Pull up the coverall legs before taping them to the boots, otherwise they will be uncomfortably short when moving around. Actively assisted doffing is preferred when additional taping is used in foot protection. Taping directly to the boots may complicate the boots disinfection process.

Table 7. Different options for foot protection presented in this section

	Coveralls without integrated foot section	Coveralls with integrated foot section
Boots	<p>[+/-+] Option A: Coverall legs placed outside the boots Excess length of coverall legs above the upper endings of the boots are folded downwards to form a 'drip-off-edge'</p> <p>[+/-+] Option A1: Coverall legs edgings are connected with the upper endings of the boots by taping Folding 'drip-off-edge': See option A</p> <p>Reflections: Coverall legs and boots can be removed in one stroke while doffing; additional barrier to liquids entering into the boots</p> <p>[+/-] Option A2: Boots are additionally covered by boot covers Reflections: Potentially less contamination on boots surface; additional step during doffing process – no one stroke doffing; boot covers prone to mechanical damage; questionable sole grip</p>	<p>[+/-+] Option B: Coverall legs placed inside the boots Folding 'drip-off-edge': See option A Reflection: Boots can easily be retrieved after doffing for cleaning and disinfection</p> <p>[+/-+] Option B1: Boots upper edgings are connected to the coverall legs by taping Folding 'drip-off-edge': See option A Reflections: Coverall legs and boots can be removed in one stroke while doffing; additional barrier to liquids entering into the boots</p> <p>[+/-] Option B2: Boots are additionally covered by boot covers Reflections: No practical experience on potential benefits or trade-offs</p>
Clogs	<p>[+/-] Option C: Coverall legs are connected with boot covers by taping the edging of the boot covers on the lower end of the coverall legs; attached foot section steps into the clogs Reflections: 'Functional zone clogs' are widely available in most hospital settings; clogs are prone to accumulate liquids inside – foot sections of PPE might be in direct contact with the liquids over extended time and under the pressure of the PPE user's weight (permeation); crushed excess material from foot section creates discomfort to PPE user's feet inside the clogs</p>	<p>[+/-] Option D: Coverall foot sections step into the clogs Reflections: 'Functional zone clogs' are widely available in most hospital settings; coverall integrated foot sections save time in the donning process; clogs are prone to accumulate liquids inside – foot sections of PPE might be in direct contact with the liquids over extended time and under the pressure of the PPE user's weight (permeation!); crushed excess material from foot section creates discomfort to PPE user's feet inside the clogs</p>
Boot covers	<p>[--] Option E: Boot covers are placed outside the coverall legs; no shoes under boot covers Reflections: No mechanical foot protection; slip protection questionable</p> <p>[--] Option E1: Boot covers are placed outside of PPE user's shoes and the coverall legs Reflections: Boot covers are prone to break due to mechanical strain from shoes underneath; slip protection questionable</p>	<p>[--] Option D: Boot covers are placed outside the coverall legs; no shoes under boot covers Reflections: No mechanical foot protection; slip protection questionable</p>

* In this option boot covers are not covering the boots or clogs, but covering the feet in order to create integrated coveralls sections.

[+/+]Option A: Coverall legs placed outside the boots. Coveralls without integrated foot sections over the boots

The legs of the coveralls without integrated foot sections are always placed outside of the boots. This prevents contaminated fluids potentially entering inside the boots.



Do not place the coverall legs inside the boots to avoid liquids leaking to the inside.



Fold the excess length of the coverall leg downwards to cover the upper part of the boot to keep fluids away from the inside of the boot (‘drip-off-edge’).



[+ / +] Option A1: Coverall legs placed outside the boots

Boots can also be taped directly to the coverall legs to avoid liquids leaking in. Also, the connection between boot and coverall enables one stroke doffing. Tape the coverall leg by following the edging perimeter of the boot's upper opening. In that way that the PPE user will easily step out of them while doffing.



Fold the excess length of the coverall leg downwards to cover the upper part of the boot to keep fluids away from the inside of the boot (‘drip-off-edge’).

[+ / -] Option A2: Boots are additionally covered by boot covers

In some settings it might be considered an advantage if boots are covered by boot covers.

Tape the shoe cover directly to the trousers and fold the slack to cover the taped area. In this option the coveralls always stay over the boot.



Pull up the trousers before attaching them to the widest part of the calves.

Do not put the coveralls inside the boot.

Tape the boot covers directly to the trousers and not to the boot because the boots will eventually have to be recovered from the waste pile. This way, the boots do not come into contact with the tape and can easily be retrieved.



Boot covers are secured with at least two layers of tape wrapped all around. Fold down the remaining slack of the trousers. A shoe cover with non-slip soles worn over the boot/clog cover can help to avoid accidents.

[+ / +] Option B: Coverall legs placed inside the boots

Coveralls with integrated foot sections are to be placed directly inside the boots. This will facilitate the donning and doffing process.



Fold the slack of the coverall leg to cover the upper part of the boot to keep fluids away from the inside of the boot.

[+ / +] Option B1: Boots upper edgings are connected to the coverall legs by taping

Taping the boots to the coverall with integrated foot section avoids liquids leaking to the inside and facilitates the actively assisted doffing process.

Tape the top of the boot to the coverall legs and fold the excess length of the coverall leg downwards to cover the upper part of the boot ('drip-off-edge').

[+/-] Option B2: Boots are additionally covered by boot covers

No practical experience on potential benefits or trade-offs

[+/-]Option C: Creating coveralls with integrated foot sections (Clogs over the boot covers).

Coverall legs are connected with boot covers by taping the edging of the boot covers on the lower end of the coverall legs; attached foot section steps into the clogs. If your coverall does not come with integrated foot sections, use separate boot covers instead and tape them to the coverall legs to create integrated foot sections.

As it is impossible to create a fluid tight connection between clogs and the legs of a standard coverall, a foot section needs to be added to the coverall: First a boot covers are put on above the coverall legs. As a next step the upper edging of the boot cover is fixed to the coverall leg by circular taping.

Place boot covers over clogs/boots and tape them to the coveralls legs at the widest part of the calves so the feet can easily slip out of the coveralls when removing the PPE. Tape the boot cover to the coverall legs at (and not under) the juncture.



Fold the slack of the coverall leg to cover the upper part of the boot to keep fluids away from the inside of the boot.

Never tape the boot cover tightly around the ankles.



[+/-]Option D: Clogs combined with coveralls with integrated foot sections

Coverall foot sections step into the clogs



[-/-] Option E: Boot covers are placed outside the coverall legs; no shoes under boot covers

No mechanical foot protection; slip protection questionable

[-/-]Option E1: Clogs. Boot covers covering the clogs. Boot covers are placed outside of PPE user's shoes and the coverall legs; Clogs under boot covers.

When using clogs in combination with coveralls without integrated foot sections, the clogs need to be covered by boot covers.

This option does not allow to have dedicated clogs for the red area because the clog is covered. The disinfection process of the clogs needs to be assessed depending on the risk of penetration of bodily fluid across the boots covers. Boot covers can be ripped off with the use and compromise the protection.



Fold the slack of the coverall leg to cover the upper part of the boot cover to keep fluids away from the inside of the boot cover.

[+/-]Extended option E2: Clogs. Taping the boot covers to the coveralls covering the clogs. Boot covers are taped outside the coverall legs; Clogs under boot covers.

When boots covers are used to cover clogs, additional taping of the connection of boot cover and coverall leg is useful for three reasons:

- To prevent liquids getting inside the covers
- To enable a safe 'one stroke' doffing process.
- To facilitate doffing and prevent displacement of the boot cover.



Fold the slack of the coverall leg to cover the part of the taping.



[–/–] Option F: Boot covers are placed outside the coverall legs; no shoes under boot covers

No mechanical foot protection; slip protection questionable

Practical hints

- Any additional component used in PPE, like boot covers, potentially also adds to the complexity of the donning and doffing process
- Keeping fluids away from the inside of the boot is very important.
 - Pull the coverall legs over the boots.
 - Fold the slack of the coverall leg to cover the upper part of the boot.
- Do not use tape without having a clear objective.



Step 5: Hand protection

Double gloving can be seen as a well-balanced approach between the needs for flexibility, tactility and safety.

In this approach the external 'working layer' can easily be adapted to different tasks or simply changed, in case there would be any doubt regarding it's physical integrity.

The cuffs of 'base layer' or inner gloves always need to be placed above of the coverall sleeves of the coveralls to prevent fluids from entering inside the sleeves.

Benefits and limitations of taping the inner gloves

Creating a fixed connection between the inner gloves and the coverall by taping, mainly offers three advantages:

- Gloves and the coverall's sleeves will stay in place during work activities.
- Removing the PPE gets easier because the gloves can be pulled off together with the coverall sleeves in one stroke.
- Liquids dripping off downwards from the coverall arm will not enter inside the glove.

Limitations:

- Any kind of taping increases the donning time.
- Improper tape connections increase the risk for secondary contamination.

A notorious pitfall consists in wrapping the tape tightly around the wrist:

- When removing the PPE it will be impossible to pull the hand out of the glove.
- Tight circular taping around the wrist inevitably leads to impaired blood supply to the hands.



Table 8. Different options for hand protection presented in this section

[++] Taping*	Option A: Taping the gloves to the coveralls with a distance ring (spacer)	Alternative option A1: Vertical taping with two or more strips of tape	Alternative option A2: Taping the gloves without a spacer; only applicable for gloves with cuffs reaching to the middle of the forearm
[+/-] Without taping	Option B: no taping		

**To ensure personal comfort and easy glove removal, one of these methods can be used.*

[+ / +] Option A: Taping the gloves to the coveralls with a distance ring (spacer)

To ensure a loose connection between the glove and the sleeve, use a roll of tape or a cardboard roll as a spacer.



Slide the roll of tape/ cardboard roll (spacer) over the hand. Pull the sleeve over the spacer. Pull the glove over the spacer.



Tape the glove to the sleeve, using the spacer as support.



Remove the spacer from inside the coverall arm. The fixed connection between glove and coverall arm is now wide enough to enable a one stroke doffing of glove and arm at the same time.

Practical hints

- **Never** tape directly 'from the roll' because this applies too much pressure on the tape connection, which will severely impair the blood supply to the hands.



- Cut a sufficient number of small strips of tape before starting the donning process.

[+ / +] Alternative option A1: vertical taping with two or more strips of tape

Pull the glove as high as possible over the sleeve of the PPE coveralls. Tape the glove to the sleeve using a minimum of two strips of tape alongside the forearm.



This option also ensures the easy removal of the PPE.

[+ / +] Alternative option A2: basic taping (without spacer)

Pull the glove up over the sleeve of the PPE coveralls until reaching the widest part of the forearm. Tape the glove to the sleeve so it fully covers the opening of the glove. However, this method only works with long cuffed gloves.

Practical hint

- The diameter of the section of tape around the forearm/wrist should be wider than the thickest part of the hand. If not, it will be impossible to pull the hand from the glove during the doffing process.



[+ / -] Option 2: no taping

Even if no tape is used, assistance is still needed when putting on (and removing) the inner gloves. Slip into the finger loops before putting on the first pair of gloves. They prevent displacement of the coveralls sleeves and avoid skin exposition. At least one pair of gloves should have long cuffs in this option.



The PPE assistant needs to hold the glove while the PPE user pushes his or her hand into the glove until a substantial section of the sleeve is inside the glove.

Step 6: FFP respirator and orientation fit test

For the fitting of a FFP respirator it is best to follow the manufacturer's instructions: The nose metal clip needs to be adapted and the straps tightened to have a firm yet comfortable fit.



Practical hints

- It is crucial that the PPE user proofs the seal fit of a respirator before relying on it on a routine basis. Otherwise effective protection against aerosols cannot be granted. There are different methods to fit-test a respirator.
- In case of difficulties in achieving the right fit, positioning the straps across each other can be an alternative. However, already this minor modification can mean a deviation from the recommendations in the manufacturer's product manual.



This alternative way of fitting the respirator is an observed practice in some settings however it is not recommended by manufacturers.¹

¹ The pictures showing the respirator straps crossed in this tutorial follow this clinical practice; it should not be seen as endorsement of ECDC on this alternative.

Respirator fitting: orientation fit tests (Fit check)

Before using a specific PPE ensemble, a qualitative fit test is a mandatory step to select a properly sealing respirator (see chapter 3.4 Respiratory Protection, section qualitative fit test above). This procedure is not part of the regular donning process.

Instead, an orientation fit test is done every time a respirator is put on, to ensure that the respirator is fitted properly. Even a respirator model that passed the qualitative fit test needs to be tested in an orientation test during the donning process.

Exhalation and inhalation test

The fit check of a respirator is done by an inspiration and an expiration manoeuvre.

For the inhalation test the assistant covers the respirator surface with both hands and asks the user to inhale deeply. If airflow is entering around the nose, the nose metal clip has to be adapted. If air is entering from the respirators edges, the straps need to be re-adjusted.

In the exhalation testing the assistant again covers the respirator surface (unvalved respirator) or the exhalation valve (valved respirator). When sharply exhaling in the respirator, the PPE user should feel no air blowing into the eyes or cheeks. If air is escaping the respirator needs to be adapted according to the inhalation test.

Double-check if there is any air leakage by repeating the procedure. If you cannot achieve a proper fit, **do not** enter the high risk zone and consult your supervisor.



The respirator straps must always be placed under the coverall hood or under an external hood, if used instead.

Practical hints

- Most FFP respirators have textile elastic straps to position the respirator on the upper airways. Ensure that no parts of the straps are exposed to the outside of the hood in order to prevent liquids getting drained towards the face (capillary effect).
- Tuck dangling strap ends under the main section of the straps or cut them before putting on the hood.



- Any kind of beards will compromise the seal fit of any half- or full-face respirator.

Did you know?

Sneezing inside of a FFP respirator is possible. Just make sure you do not touch the respirator with your hands.

[+ / +] Step 7: Separated hood

A separated splash-proof hood with integrated surgical mask effectively prevents remaining gaps between mask, goggles and coverall. As most of the valved FFP respirators are not splash-proof, the additional splash protection in the hood is essential in the nursing and treatment of VHF patients.

Donning

If the coverall has an integrated hood, roll the integrated hood inside the coveralls.



Close the coveralls and wear the hood over the respirator. Tie the straps.



Place the goggle strap in between the hoods straps to prevent pressure points under the knots.



The lower strap should be tight underneath the armpits around the body.

Integrated hood (alternative)



Adjusting the size of the coverall hood is the only exception in which taping can be considered to fix PPE sizing issues.



Steps 8 and 9: Zipper and flaps

Make sure that the flaps are properly closed and form a flat surface without wrinkles.

The PPE user can help the assistant with the closing of the flaps by straightening the zipper by pulling the suit downwards.



The PPE user can stretch loose parts of the coverall to avoid pressure on sensitive body areas and to facilitate a smooth sealing of the flaps.

Step 10: Eye protection

Place the goggles over the hood and ensure that the textile elastic strap fits firmly but not too tightly. Ideally, your entire face should be covered by both respirator and goggles.

Once the goggles are in place, search for eventual gaps between the different PPE components.

Goggles should be worn on the outside of the hood in order to keep the hood in place and to avoid gaps between the goggles and the hood. Furthermore, as the goggle's elastic straps are mostly made on a textile basis it is crucial to keep them outside in order to prevent liquid from soaking under the hood.

Practical hints

- If the PPE user needs to wear glasses, ensure that they do not affect the seal fit.
- Experienced users of contact lenses will prefer them in a barrier nursing setting. However, displacement of a contact lens can create significant disturbance if manual interventions are not possible.



[+/-] *Alternative option #1: face shields*

Face shields for eye protection can be used for first-assessment precautions. But consider the potential limitations of non-sealing eye-protection in patient care settings.

Benefits:

- Face shields provide good protection from fluid splashes.
- Face shields are more difficult to fog up.
- Face shields are easier to wear for PPE users with glasses.

Limitations:

- Face shields do not protect from aerosols.
- In theory, face shields can still permit entry of splashes from unexpected angles.
- Face shields are prone to displacement after brusque movements.
- Limited experience regarding their effectiveness in staff protection for IDHC.



[+/+] Alternative option #2: full-face respirator (gas mask)

Full face respirators normally have non-textile straps so they can be used under the coverall hood. Check that a new set of filter cartridges is correctly installed before using them.

**Step 11: Inner glove disinfection and outer gloves**

The outer pair of gloves can be easily changed. The choice of outer gloves depends on the work activities.

Step 12: Apron (optional)



Using a plastic apron can be useful when carrying large plastic bags, cleaning up, or handling a dead body. Rubber boots are also the preferred choice when performing these activities.

Step 13: Testing the PPE components

Once the PPE user wears the full PPE ensemble, a member of the team should verify that there are no irregularities in the material and no open gaps.

Practical hints

- A PPE user can test if the coveralls fit by kneeling down and lifting the arms when fully covered by the PPE ensemble.
- If PPE components get displaced during this test, they need to be re-arranged and fixed before entering the patient-care area.



Step 14: Ready to pass through the yellow zone and into the red zone

Final result

This is an example of a PPE user prepared to go into the red zone.



5.3 Doffing (removing the PPE)

Active assistance

Active assistance in doffing of the HCW leaving the red zone is essential for preventing him or her from manipulating contaminated PPE without having direct sight. This is even more crucial when it comes to the delicate parts of the doffing process, such as removing eventual detail taping in the face area or opening the zipper flaps and then the zipper itself.

Therefore active assistance is the preferred option for the doffing compared to guided assistance by a qualified observer or to mirror-assisted self-doffing.

The doffing process takes place in the so called 'dark yellow zone' designated for this purpose.

Supervision (barrier nursing guardian)

Any assisted doffing process is additionally monitored by a qualified observer, who is normally the supervisor ('barrier nursing guardian', see also section 8.2 Zones and space requirements).

Suggested steps for doffing

Steps	Actions Contaminated staff (PPE user)	Actions Assistant (clean)* (Dark yellow zone)
1	Removing the optional apron. (Red zone)	
2	Step out of the red zone.	PPE inspection of the HCW ready for doffing to identify cuts or contamination; disinfect the PPE (wipe with disinfectant)
3	Removing the outer gloves.	Use new pair of outer gloves.
4	Stay relaxed and stand still so the assistant can easily access the components.	Removing tape from face area if present.
5		Removing the goggles.
6		Open the flaps.
7		Use new pair of outer gloves.
8		Open the zipper.
9		Removing the hood.
10		Roll down the coveralls.
11		Roll down the sleeves with the integrated gloves (taped).
12	Step out of the coveralls (with integrated foot section) and put on the light yellow-zone clogs.	Hold the coveralls and stay in the dark yellow zone.
13		Use new pair of outer gloves
14	Stand still in the light yellow zone while the assistant removes your mask from the dark yellow zone.	Removing the PPE user's respirator.
15	Hand hygiene and step into the green zone	
16	Take off the hair cover, re-hydrate and take a shower.	

* Consider glove disinfection with hand sanitizer every time an item is removed.

Practical hint:

- All these steps are adapted to an ASSISTED PPE removal. The PPE user doffed will be assisted by a buddy wearing full body PPE. In case there is no assistance these steps need to be adapted.

During the doffing process: the PPE user should only move on command to avoid secondary contamination. The PPE user should not use their hands while PPE is being removed by the assistant.

Disinfection of the gloves worn by the assistant: Use of alcohol-based hand disinfectant or a disinfectant for non-enveloped viruses is also needed at various steps of the doffing process. The assistant should consider glove disinfection of the outer gloves after each item is removed.

The exiting HCW should perform hand disinfection using a dedicated, 'clean' dispenser immediately on entering the yellow zone.

Changing the gloves of the assistant: During the doffing process, the assistant will need to change gloves a minimum of three times. This process can be made easier if the assistant initially wears four pairs of gloves on top of each other and then takes off each pair one at a time. The first three pairs of gloves are meant to be taken off during the doffing process.

Gloves need to be changed when the assistant has finished touching the 'contaminated areas' and starts touching the 'clean areas'. Gloves also have to be changed before removing the respirator. (See "Suggested steps for doffing" In the doffing section 5.3)

Change gloves:

- before removing the goggles
- after opening the coverall flaps and before opening the zipper
- before removing the respirator
- any time there is the slightest suspicion that secondary contamination could have occurred in a glove that needs to be 'clean'.

Practical hint

- During the doffing process, the assistant can wear up to four pairs of gloves on top of each other, which saves time on changing the gloves. Instead of having to put on a new pair of gloves every time, the assistant will simply remove the outer pair. The use of this approach needs to be balanced with its limitations, as wearing four layers might compromise tactility and motility.

Step 1: Doffing the apron – PPE user, alone

The PPE user removes the optional apron himself, ideally by breaking the apron straps, making sure the apron is not removed over the head. When removing the optional apron, the goggles or the respirator should not be touched by the contaminated apron.

Disposable apron: Remove the disposable apron in the red zone, at a prudent distance from the patient point of care. Roll the apron from the inside to the outside to avoid unnecessary contamination of the outer pair of gloves. Dispose of the apron.

Reusable apron: In case the apron is reusable, remove it in the dark yellow area to start the disinfection process.



Step 2: PPE inspection and disinfection – assistant

Before starting the doffing process, the active assistant looks carefully for visible contamination or damage of the PPE. Additional disinfection with a disinfecting wipe and heavy-duty gloves should be considered.

When using coveralls with integrated or taped foot sections in combination with clogs, stepping out of the foot protection is easy. Dedicated red-zone clogs can stay to be reused by the next HCW in the red zone. The PPE user steps into the dark yellow zone dedicated for doffing.

Practical hint

- Leave your clogs in the red zone before stepping into the waste plastic bag in the dark yellow zone. Dedicated red-zone clogs will not be discarded, they can be reused.
- Stand with legs spread and hold arms at a distance from the body.

In case boots are taped to the coverall or boots/clogs are used inside of boot covers: they will be removed inside the waste bag in the dark yellow area. Boots disposed in the waste bag will be disinfected by an assistant for reuse (see Step 12 in this section).

Practical hint

- Disinfectants potentially make the floor slippery. Stepping into the plastic waste bag before disinfecting the PPE will circumvent this risk.



Wipe disinfection of PPE on the HCW before taking of the PPE significantly reduces the risk of secondary contamination. If there is visible contamination in the face area, consider decontaminating the face area as well. Apply the disinfectant used in your clinical setting. The disinfectant quickly reduces the risk of potential contamination with bodily fluids during the doffing process. However, this does not imply that you may be less strict in following the established doffing protocols.

Step into a waste bag for PPE component disposal in the dark yellow area. The PPE user should stand in a rolled-down, leak-proof infectious waste bag. All removed PPE components and the used wipes should be placed in the bag.

The assistant should always use heavy duty gloves when cleaning and disinfecting PPE components.



Step 3: Removing the outer gloves – PPE user alone

- Inspect and disinfect the outer pair of gloves and take them off.
- Inspect the inner pair of gloves and disinfect them.
- Inspect the PPE user's outer pair of gloves in order to identify cuts, visible contaminations, or tears. Proceed with disinfecting the PPE user's gloves and take them off. (See also Annex 2 'Removing the gloves'.)

Step 4: Removing detail taping from the face area (if applicable)

This step only applies following to those situations in which there were no other options to achieve an effective splash or aerosol barrier to the skin. (See point 7.3 on the chapter 'tactical considerations')

Step 5: Removing the goggles – assistant



Most goggles are designed and certified for single use. The disinfection of non-disposable goggles requires strict adherence to the certified procedure.



[+ / +] Removing the separated hood
Remove the goggles



Open the laces



Place the back laces on the front in order to avoid uncontrolled movements and contact with the face during doffing.



Practical hint

- In order to remove the separated hood safely, the PPE user should bend forward.
- Make sure the straps do not touch revealed areas of the face.



Steps 6 and 7: Open the flaps; put on new pair of outer gloves – assistant

After opening the flaps, attach their adhesive sides to the suit to secure them.



Change gloves before opening the zipper.

Step 8: Open the zipper

Where can the assistant touch during the doffing process?

Always change gloves before opening the zipper. When opening the zipper, only touch the clean area, i.e. only the area that was previously covered by the flaps.



Use fresh gloves

Do not touch: Do not touch contaminated areas when opening the zipper.



Don't touch contaminated area with fresh gloves

If you accidentally touch a contaminated area, change gloves before opening the zipper any further.



Touch: Once you have changed your gloves to open the zipper, you can also touch the clean area previously covered by the flaps.

Steps 9 to 10: Doffing the coveralls – assistant

Make sure you perform glove disinfection before rolling the hood down from the inside.



Alternative option: Cutting the coverall from the back – assistant

Making a vertical cut from the top of the hood down to the waist area with blunt scissors can be a time-efficient alternative for opening the coverall before doffing. Perform wipe disinfection before making the cut.

Main advantage: The steps to open the front zipper as described above can be skipped. Also, the back of an HCW's coverall returning from the red zone can always be considered as less contaminated.

Obviously, for this approach active assistance is mandatory.

Step 11: Rolling down the coverall sleeves – assistant

If the inner pair of gloves is taped to the coverall sleeves, the removal process is relatively easy because both gloves and coveralls can be removed together in one movement (‘one stroke’).

The inner pair of gloves should not be removed before the coveralls. If the inner pair of gloves was not taped to the coveralls, the doffing process needs to be done even more carefully.



Using the finger loops is recommended in order to avoid gaps between sleeves and gloves. Gloves can get stuck to the hand during doffing if the inner pair of gloves was not taped to the coveralls.



NO!

The assistant can help remove the gloves from the inside, touching only the clean area with a new pair of gloves. But there is an unnecessary risk of contamination of the clean area with the assistant's arms.



NO!

Don't touch the PPE user's chest with the respirator during the doffing process. Remain stationary and do not move during the entire doffing process unless it cannot be avoided.



NO!

NO!

Step 12: Stepping out of the footwear – PPE user, assisted

Assistance for this process is critical. If assistance is not available, remove the boots but avoid touching them (a dedicated 'boot jack' might be an option). Always use double-glove protection to hold the boots in this process.

Remove the protective overshoes by pulling out your feet and slip into a clean pair of clogs (provided by a second assistant or previously placed on the floor). The boots or clogs would remain in the waste bag for removal and disinfection in the dark yellow area by an assistant wearing full PPE protection.



Consider the help of an assistant in the yellow zone in terms of buddy awareness. Always use nursing gloves and perform hand hygiene after this step.



Disposal of boots (waste bag)

Normally, boots are the only component of the PPE that can be reused. Their decontamination needs to be carried out under strict infection control measures. Boots first are retrieved from the waste bag, then cleaned, disinfected and dried. Placing the boots in a container with liquid disinfectant (in the dark yellow zone) is an efficient first step for the re-conditioning. Once dried, boots can be placed in the green zone for the next donning process.

Process-wise reusing the boots has some drawbacks:

- retrieving them from the waste bag is awkward
- it is difficult to avoid splashes when cleaning the boots
- additional time and workforce is needed.

Step 14: Change gloves and remove the respirator – assistant

- Change gloves before removing the respirator.
- Avoid touching the face when removing the respirator. Pull the respirator off the face and carefully move it up. Pull straps over the head and remove the respirator completely.
- The respirator is removed by the assistant still standing in the dark yellow zone, while the HCW being doffed has already moved towards the light yellow area.
- The active assistant can use both hands to avoid a snap back by the respirator accidentally slipping down.



Hint: This way of removing the respirator is only applicable when a buddy is assisting during the doffing process

Removal of FFP from the front to the back by a PPE user doffing alone results in an increased risk for secondary contamination.

Alternative removal of the respirator: Removal of FFP from the back to the front by an assistant in the light yellow zone.



The last part of the removal should be done only from one side to avoid accidental contact of the mask with the PPE user face. Proceed with the disposal of the mask in the waste bag avoiding contact with the filtering face piece.

Step 15: Perform hand hygiene and step into the green zone

Step 16: Remove the hair cover, re-hydrate and take a shower

Key messages

- Donning and doffing need to be actively assisted.
- Be consistent in following all of the steps in the protocol defined for your specific healthcare setting.
- Understanding the rationales behind the different hints and tips provided in this tutorial helps in developing custom tailored training for specific healthcare settings.
- Not rushing and being fully focused on the current task is crucial in preventing mistakes.

The last one doffing

The last PPE user to remove the PPE ensemble will have to perform all tasks without external assistance. Receiving guidance from a qualified observer (like the barrier nursing guardian) without being touched is the essential principle during this process.

The 'last one doffing' can be the last active assistant withdrawing from the red zone but also a person who had performed the last tasks in patient management or cleaning. However, doffing alone after obvious exposure to bodily fluids or waste should be avoided at all costs, even when a qualified supervisor (barrier nursing guardian) is available.

The spoken instructions from the qualified supervisor to the 'last one doffing' should be clear and unequivocal. A mirror, placed close to the doffing zone enables self-monitoring during the process, providing additional control.

Practical hints

- HCWs removing their PPE alone should use a mirror, especially when opening flaps and zippers and removing goggles and respirators.
- The HCW with most experience in the use of PPE should be the last one doffing.

6 Operational considerations

6.1 Working under PPE

Wearing PPE heavily affects your work routines.

Starting with the first step, the donning process already requires full attention, long before starting to care for the patient.

The biggest challenge for many HCWs dealing with IDHC is a change of mindset: The focus needs to expand from patient care activities to self-protection, the protection of other staff members, and the prevention of spread to the community.

Beside the physical constraints (heat, dehydration, and intensive duty rosters), there are several psychological aspects to prepare for:

- Full clinical pictures of IDHC like EVD may be traumatic, even for experienced HCWs.
- The normal patient-HCW model of interaction/communication is disrupted. One reason lies in the 'depersonalisation' of the HCW who is now completely masked, which may be perceived as threatening. Communication is hampered by respirators and coverall hoods.
- The fear of undetected contamination or secondary transmission to relatives and friends results in increased stress levels for HCWs.

The main principle for working in the contaminated treatment zone (red zone) is: Never go there alone, always work in a team. A minimum of two HCWs wearing PPE at the same time is needed in order to provide the necessary amount of help and assistance.

Active assistance is mandatory during the donning and the doffing process. The PPE user must be able to fully trust the person providing assistance. Training to get used to these procedures is very important. The 'buddy system', established as an essential safety mechanism in scuba diving, is a perfect model for staff working with PPE and IDHC.

Practical hints

- Never adjust any of the PPE components during patient care or waste management. If adjustment is needed, leave the patient care zone with your 'buddy' and return after the adjustment has been made.
- Consider learning some breathing and relaxation exercises when preparing for working under PPE.
- Take into account that the working time under PPE for IDHC is limited to two hours maximum, even in an air-conditioned environment.

Targeted operations

HCWs need to adapt the PPE also according to specific procedures, such as taking an x-ray or an invasive intervention carried out under sterile conditions.

When sterile conditions are required, perform glove disinfection for the inner pair of gloves before putting on the sterile outer pair.

In cleaning activities instead wearing an apron on top of the coverall, heavy-duty gloves and boots adds to the mechanical robustness of the PPE and reduces contamination.

Practical hint

- Wearing PPE does not per se avoid the spread of nosocomial infections. Therefore standard hygiene precautions still need to be performed regularly. With regard to disinfection needs, the inner gloves should be considered just like uncovered hands.



6.2 Hand and glove hygiene

Hand disinfection dispensers are needed at the point of care and diagnosis, in the doffing area, and in the donning area.

Practical hint

- Always consider sanitiser dispensers in the red zone and in the dark yellow zone as contaminated. Never touch the pump with your clean gloves. Instead, use your elbows.

Hand/glove hygiene

Performing hand hygiene according to international recommendations (WHO) is a critical aspect in this setting.

Hand hygiene, on bare skin, has to be performed before the donning and after the doffing.

Inner gloves disinfection has to be performed after each change of outer gloves (if necessary).

The performance of clinical or waste management duties must be done according to the 'WHO five moments for hand hygiene': 1) before touching a patient; 2) before clean/aseptic procedures; 3) after bodily fluid exposure/risk; 4) after touching a patient; and 5) after touching patient surroundings.

When working with PPE, 'hand hygiene' becomes 'glove hygiene'. Hand/glove hygiene should be performed:

- before putting on gloves/wearing PPE (i.e. before entering the isolation room/area) (*hand hygiene*);
- before performing clean/aseptic procedures (*glove hygiene*);
- after any exposure/risk to/from the patient's bodily fluids (*glove hygiene*);
- after touching (actually or potentially) contaminated surfaces/items/equipment in the patient's surroundings (*glove hygiene*);
- after removing the PPE and entering the yellow zone (*hand hygiene*).

Hand hygiene in isolation rooms/areas should be performed every time the above criteria indicate it, along with a change of gloves. When caring for several patients in the same room, it is essential to complete all tasks before moving to the next patient.

Performing hand hygiene, including after the doffing of PPE, is part of routine infection control.

HCWs should perform hand (and glove) hygiene frequently, especially before and after patient contact, contact with potentially infectious material, and before putting on/removing PPE.

Glove disinfection

Performing glove disinfection is a critical aspect in this setting. After putting on the inner gloves, they always stay on. Use them as if it they were the skin of your hands.

Gloves need to be disinfected regularly and after these critical moments:

- During the doffing process (both assistant and PPE user)
- Whenever there is a possibility of potential contamination.

Allow the gloves to dry after disinfection.

Always disinfect your hands right after you have removed your inner gloves.

[+ / +] Practical hint:

Hand sanitizer and alcohol based disinfectants: disinfectants with a label claim for use against a non-enveloped virus are effective and suitable for most IDHC. Alcohol-based disinfectants dry faster facilitating the glove disinfection process.

Disinfectants based on bleach don't show any advantages in healthcare settings in Europe. In closed environments they pose a risk for generating toxic vapours.

Consider that some glove manufacturers do not recommend using alcohol-based disinfection due to risk of compromising integrity.

Practical hints

- Think of the inner gloves as if they were your skin.
- Change gloves between patients and tasks, especially after contact with bodily fluids.
- Replace the outer gloves if they become damaged or torn.

6.3 Mitigation of transmission risks by disinfection or decontamination

Risk mitigation by disinfection should be considered after high-risk procedures, especially when bodily fluids are present on PPE components.

For surfaces or objects contaminated by blood or other bodily fluids or secretions, prompt cleaning followed by disinfection using standard hospital detergents and disinfectants is recommended.

Linen and any equipment contaminated with bodily fluids should be placed in impermeable, clearly labelled bags and processed according to procedures for highly infectious waste.

Procedures and routines for waste management must be in place before starting up IDHC treatment activities.

Staff disinfection

Disinfecting staff members exiting the red zone should always be considered, as this adds an additional safety layer, before starting the actual doffing procedure.

Practical hint

- After splashes with bodily fluids, the PPE user first takes off the apron (if worn) after which he or she can be wiped clean with any disinfectant used in the hospital. The assistant in charge of the clean-up must use an outer pair of heavy duty gloves.



- Use the disinfectants already available in the hospital.



Disinfection by spraying is not applicable in closed hospital settings. In small environments, spraying disinfectants can rapidly lead to toxic concentrations in the air. There is also a considerable risk of generating an inflammable aerosol.

6.4 Targeted operations for patient care

Although working with PPE prevents infection, one should always try to avoid splashing when performing high-risk tasks.

If possible, place yourself at a 45-degree angle to the patient so that acute splashing of bodily fluids does not reach your front and face.

Limit the number of staff in direct contact with the patient. Prevent unnecessary exposure by assigning specific tasks to a limited number of HCWs, making sure that not all the PPE users in the red zone are exposed to bodily fluids.

Key messages

- Think of the inner gloves as if they were your skin.
- Common sense based professional attitudes may effectively support in minimising contamination risks.

7 Practical considerations

7.1 Staff planning

Working with PPE requires a considerable amount of human and economic resources. Coordination and preparation of the donning and doffing processes help to make the most efficient use of those resources.

The nursing and treatment procedures need to be adapted to the patient's condition and carefully balanced with the availability of trained workforce in the shift work roster. Explore all the options for transferring the patient to a specialised treatment centre at an early stage.

Some consideration for the staff:

- The assistant for doffing should be the same HCW that afterwards takes the next shift in red zone. In this way additional donning and doffing processes are avoided.
- Consider two working hours in PPE as the absolute maximum in a fully air-conditioned hospital.
- Prepare to reduce shift length if staff in the red zone shows signs of exhaustion.

A conservative approach based on two HCWs caring for a stable patient, says that 24 PPE ensembles are needed per patient and day (24-hour basis, maximum work time two hours). This number will significantly increase if the patient becomes instable and requires round the clock treatment.

Work has to be done in shifts. Each shift should have a sufficient number of experienced staff members.

- Plan your shifts in a way that there are always HCWs available who can assist with the doffing of the PPE in the dark yellow zone.
- Proper coordination with the hospital structures outside of the isolation setting is crucial.
- Identify dedicated staff for providing consistent information to the patients' relatives and close contacts.

7.2 Incident management and reporting

Be prepared that incidents such as needlestick and sharp injuries could happen at any time.

Practical hint

- When an incident occurs, do not act on impulse, but reflect on what happened and assess before acting.
- Inform your buddy/assistant immediately and ask for help in managing the situation (e.g. leaving the red zone in a correct manner).

Reporting incidents

All incidents have to be reported in order to meet OSH protocols including liability issues and to prevent future events. Analyse all reported incidents to identify lessons learned. Establish a culture of open reporting of incidents and nearby incidents as this will substantially contribute to an improvement in staff safety in the long run.

Needlestick and sharp injuries

Staff need to prepare for needlestick and sharp injuries even in high precaution areas such as the red zone.

Hospitals normally have established safe injection practices as part of their standard procedures. However, for incidents in an IDHC setting emergency plans need to be adapted to the barrier nursing environment.

If an accident occurs, act calmly and inform your buddy and your supervisor. Only HCWs wearing full body PPE can provide direct assistance in the dark yellow zone or in the red zone.

Practical hints

- Prepare a container with alcohol disinfectant that can be used after a needle incident to clean the hand. The hand should be put into this container with the glove/s still on. In the meantime, the assistant can start the doffing process.
- Make sure that there is a system in place that looks after staff after a high risk exposure, considering medical as well as psychological support

PPE components displaced

Some PPE components such as the respirator or the goggles can be displaced during work, which compromises the safety of the HCW. In this case ask for assistance in readjusting the PPE components by a colleague also wearing PPE. This should not be done in direct vicinity of the patient.

Consider a proper doffing and re-donning process if the problem cannot be fixed easily (e.g. respirator dislocates partially under the hood).

Coverall rips, cuts and tears

If a coverall is damaged, remain calm and proceed to the doffing process. Do not continue working with the compromised coveralls, not even after provisional fixing.

Steps:

- Disinfect the affected area.
- Fix the torn area with tape to avoid unnecessary contamination of skin or scrubs during doffing.
- Proceed calmly to the doffing process.



Damaged gloves

If a glove is damaged, determine whether only the outer glove is damaged or also the inner one/s. If only the outer glove is damaged, replace the torn glove. Be sure to apply proper glove hygiene. When the inner glove is also damaged, act as described below. Always report this as a high-risk incident.

If a damaged inner glove is discovered during the doffing process, disinfect the inner glove by putting the hand in the container with disinfectant. Put on a new inner glove on top of the broken one, so that bare skin doesn't come into contact with the coverall sleeve during doffing. Proceed calmly with the doffing process and do not forget to report this incident.



Fainting

If your buddy faints or is indisposed, provide care without displacing any PPE components. Never assist any member of the team in the dark yellow or red zone without wearing full PPE.

Key messages

- Never work alone.
- If an incident occurs, think first, ask the team to help and act calmly.

7.3 Detail taping of respirator and goggles

Detail taping of PPE components in the face area is seen as highly controversial. Currently there is no evidence supporting or contradicting this procedure.

Potential benefits:

- Detail taping covers remaining gaps between respirator, goggles and hood. This strengthens the 'no skin exposed' principle, when no other options are available (see 'separate hood')
- By detail taping, skin exposure to splashes but also to aerosols can be effectively prevented.

Limitations and drawbacks:

- Effective detail taping is a time-consuming process, requiring manual skills and experience.
- Even covering only minimal sections of the respirator's surface will considerably reduce the air intake of the PPE user.
- Creating fixed connections between respirator and goggles is likely to cause loss of seal fit in both items.
- Generally, taping of PPE components does not conform to manufacturer instructions.

Donning/putting on detail taping of respirator and goggles:

If ever considering detail taping, prepare smaller pieces/strips of tape before starting. Then use the tape to cover gaps and/or to seal the respirator and the goggles to the hood.



Tape the sides of the goggles to the hood. Do not cover the elastic straps as they are made of fabric, which could get wet due to capillarity.



Use smaller pieces of tape to seal the goggles to the respirator in order to avoid covering more of the surface of the respirator than necessary.



Cover all possible gaps between goggles, respirator and the hood with tape and make sure that the tape is properly stuck to the hood. Ensure that the area around the nose is covered with tape.



Do only tape the minimum indispensable of the surface of the respirator since this seriously limits the air intake.

Doffing/removing detail taping of respirator and goggles:

Removing detail taping likely will result in delamination of respirator construction and the coveralls. However this will only occur in the low risk 'yellow zone' where direct contamination is no longer an issue.

Do not touch any area previously covered by the tape (clean area) with the gloves as they are considered contaminated. Hold the goggles while removing the tape in order to avoid them being pulled off the coveralls.

Press the coveralls to the face. Only touch the areas not previously covered by tape in order to avoid dislodging the respirator or the goggles.



The assistant should never touch a 'clean area' with contaminated gloves.



Don't touch!

Do not touch: Never touch areas which were covered with tape with the first pair of gloves.



Okay to touch

Touch: You can touch all areas not previously covered by tape to facilitate the removal of the tape.

8 Considerations on barrier management

8.1 Waste management

Infected materials should be put in impermeable bags or hard plastic containers. These bags and containers need to be clearly labelled as highly infectious waste.

Considerations on waste management:

- Solid non-sharp waste should be placed in impermeable, clearly labelled bags to be discarded following applicable environmental regulations for the disposal and inactivation of infectious medical waste. Temporary disposal sites should be located as close as possible to the patient care area.
- Sharp, pointed objects (e.g. open vials, needles) should be placed in hard plastic containers and labelled clearly.
- Liquid waste (e.g. vomit, urine and diarrheal fluids) may only be disposed in the sanitary sewer if the pathogen in question would allow such procedure. Alternatively all bodily fluids need to be collected in tissues/diapers and then been disposed with other waste.

Practical hint

- The area designated for the final treatment and disposal of waste should have controlled access to prevent entry by non-authorized staff.

Extra protection for waste management

Consider using an extra pair of heavy-duty gloves when handling linen and waste as these items are highly infectious.

Using an impermeable apron and rubber boots is useful when handling large waste bags, cleaning up, or handling dead bodies.

Key messages

- Waste needs to be actively managed while caring for patients with IDHC.
- Waste bags and containers need to be clearly labelled to identify them as highly infectious waste.

8.2 Zones and space requirements

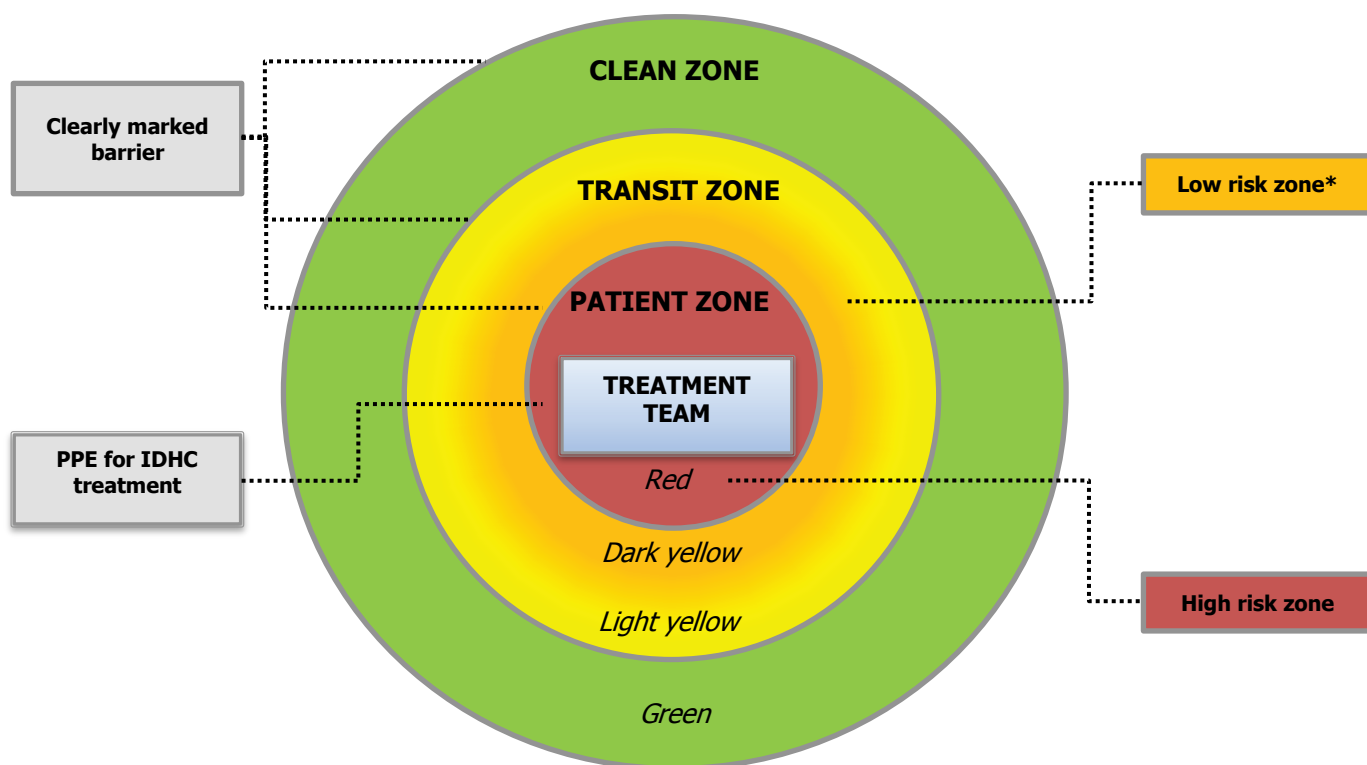
Did you know?

Barrier nursing means working around the patient in clearly defined zones with different levels of transmission risk.

The aim of barrier nursing is to protect the HCW but also the community from transmission of IDHC.

Proper barrier management is the cornerstone in containing the spread of IDHC in healthcare settings.

Figure 3. Zones and colour code.



**Yellow zone needs to be conceived as with a gradient from dark yellow to light yellow according to the decrease in risk of secondary contamination.*

Table 9. Barrier management: zones and areas

Different zones	Activities	Specifications
Red zone	<ul style="list-style-type: none"> • Patient treatment area • Point of care; diagnostics • After visible contamination, cleaning and disinfection of HCW 	<ul style="list-style-type: none"> • Monitored by direct or video assisted observation
Dark yellow zone	<ul style="list-style-type: none"> • First re-entry step for staff exiting the red zone • Assisted disinfection and doffing for exit HCW • Potentially contaminating processes, such as cleaning and disinfection of boots and waste bags • Preparing waste for further processing, such as packaging waste bags in containers with non-removable clip-on lids • Storage of waste • Hand disinfection for HCW before stepping into the green zone 	<ul style="list-style-type: none"> • Critical zone for prevention and control of secondary contamination. • Abundant space required for unrestricted assisted doffing process of two HCW in PPE • Additional dedicated cleaning and disinfection areas • Additional generously dimensioned waste storage areas. • Supervisor (barrier nursing guardian)
Light yellow zone		
Green zone	<ul style="list-style-type: none"> • Second step re-entry of staff from light yellow zone • Complete assisted donning for entry HCW • Briefing and de-briefing of staff • Staff coordination and supervision of activities • Inbound and outbound communications 	<ul style="list-style-type: none"> • Strict access control • Space for clean supplies • Zones for staff recreation
Outside isolation area (access control)	Hospital routines	Hospital structures

Functionally, the yellow zone needs to be understood as the decisive area, in which secondary contamination is prevented and controlled: Here a contaminated HCW exiting from the red zone is brought in to clean conditions, which enable him or her to safely re-enter the green zone. Also, any material coming from the red zone, such as waste bags, re-usable PPE items, patient samples needed to be processed outside of the isolation unit are first cleaned and disinfected in the yellow zone. A particular function lies in the temporary storage of considerable amounts of waste produced every day in the nursing of a patient with an IDHC.

However, in all these processes there are some with a higher potential for secondary contamination than others, e.g. assisted doffing of an HCW compared with waste storage. Therefore the yellow zone needs to be conceived of with a gradient from dark yellow to light yellow according to the decrease in risk of secondary contamination. The 'dark yellow zone' starts immediately at the border with the 'red zone' while the 'light yellow zone' borders with the green zone. It is crucial that processes in the yellow zone are always allocated to the right gradient. E.g. assisted doffing of an HCW must be carried out in the dark yellow zone.

The transition from dark yellow to light yellow does not necessarily follow any spatial or structural elements, such as doors or rooms. It is a virtual gradient following different kinds of functions.

Practical hints

- Different zones need to be clearly marked.
- Prevention and control of secondary contamination happens in the yellow zone.
- The yellow zone has a virtual gradient from 'high potential for contamination' (dark yellow) to 'low potential of contamination' (light yellow).
- Instructions for staff should be displayed at the entry of the isolation area.
- If there is a cross-contamination incident outside the red zone (e.g. patient leaving the red zone), the contaminated area has also to be considered as a red zone. New yellow and green zones need to be established around the new red zone. The zones can be put back into normal function by room disinfection, once the patient has been dismissed.
- Donning and doffing areas must be separated and visually marked. The donning area is in the green zone.
- The doffing area must be in the dark yellow zone, but has to be clearly separated from the light yellow zone.

Supervision (barrier nursing guardian)

An experienced and specifically trained supervisor is essential for safe barrier nursing.

The main tasks of the supervisor are safeguarding occupational safety, coordinating logistics, managing waste, planning staff, and leading on documentation and incident management.

Supervisors should not primarily be bound in patient care but stay flexible by acting at distance from the red zone (e.g. by audio/video communication). However, they always need to be prepared for providing ad hoc support. In case of staff-related emergencies they might be required to enter the red zone in PPE at short notice.

The supervisor can also support an inexperienced doffing assistant, or guide the HCW who is the last exiting the red zone when there is no active assistance. The presence of a supervisor alone is not sufficient to guarantee the safety of HCWs in donning and doffing. Every HCW who puts on or removes PPE also needs an active assistant ('buddy system').

Key messages

- The yellow zone needs to be planned big enough.
- The doffing area is in the dark yellow zone and is separated from the patient point of care in the red zone and from the waste storage in the light yellow zone.
- The processes among the different zones are coordinated by a designated supervisor, who also guards the integrity of each zone.

9 Staff safety requires proper training

There are few specialised treatment centres for infectious diseases in Europe. They are characterised by a high technical standard, e.g. rooms with negative air pressure, airlock anterooms, or dedicated decontamination showers for staff leaving the red zone, which simplifies the doffing of PPE. Even more important than the technical details is the fact that staffs in these centres are continuously trained on the use of PPE and barrier nursing.

However, a large majority of hospitals are not specialised for IDHC and will face some serious challenges when attempting to build emergency capacity for highly contagious diseases:

- Prioritising self-, staff- and community protection while caring for patients with IDHC normally requires a major change of mindset in most HCWs.
- It only takes a single IDHC patient to disrupt all daily routine processes and upset staff allocation.
- Recruiting staff for being part of a roster of experts ready to deal with IDHC patients only works on a voluntary basis. HCWs need the best possible training to be prepared for such work.
- In order to work with confidence in an IDHC scenario, HCWs need to continuously assess the 'invisible' risk of secondary contamination.
- 'Experienced' instructors on PPE and barrier nursing are difficult to find. Look for additional resources which can support the process of improving personal protection and safety.

Ideally single patients with an IDHC can be transferred at short notice to a specialised treatment centre, which means that non-specialised hospitals only need limited IDHC capacity.

Nonetheless, unplanned emergencies can happen, and non-specialised hospitals need to 'build safety through training'. There are several practical steps to achieve this goal:

- Staff protection, including provision of PPE and training is an employer's legal responsibility^{i,ii}. It can be easily prioritised from a hospital's management perspective in periods of increased risk for importation of an IDHC, such as EVD from West Africa in 2014.
- Hospitals need to identify and mobilise relevant partners, e.g. officers for OSH, occupational physicians, specialised HCWs for hygiene and infection prevention and control, emergency planning managers, etc.
- Intersectoral cooperation is essential in this context. Emergency planning can then be supported by, for example, fire departments and their specialised units for the management of chemical, biological, radiological and nuclear (CBRN) threats. The principles of staff protection in this area are identical to the ones in a clinical setting. There are also CBRN-trained units in the area of civil protection which could easily share their know-how with HCWs. Military medicine is an additional potential resource because it covers the treatment of casualties from CBRN attacks.
- Specialised treatment centres for IDHC are ideal partners for conducting training activities. This type of partnership can be established at the regional, national and international level. Ideally these partnerships start in 'peacetime', so cooperation in a real life emergency has to overcome only a low threshold. Joint training initiatives in pre-outbreak times offer an enormous added value when it comes to the smooth coordination of patient transfers in outbreak emergencies.

Key messages

- HCWs need to be thoroughly trained on the use of PPE and in barrier nursing before cases of an IDHC appear.
- Occupational safety and health needs to be seen as top priority by the management of any institution dealing with IDHC.

ⁱ International Labour Organization (ILO). Occupational Safety and Health Convention, 1981. Convention N. 155 concerning Occupational Safety and Health and the Working Environment [homepage on the Internet]. 1983 [cited 2014 Nov 24]. Available from: http://www.ilo.org/global/publications/ilo-bookstore/order-online/books/WCMS_PUBL_9221116344_EN/lang--en/index.htm

ⁱⁱ Council Directive 89/391/EEC of 12 June 1989 on the introduction of measures to encourage improvements in the safety and health of workers at work see full text: <http://eur-lex.europa.eu/legal-content/EN/TXT/HTML/?uri=CELEX:01989L0391-20081211&from=EN>

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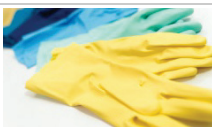

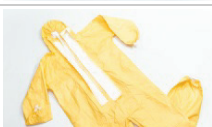
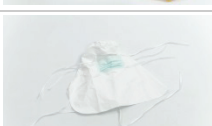


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Annex 1 Checklist for PPE and waste management items

Table A1. Checklist: PPE and waste management items

	Item	Specifiable aspects	Due for review	In progress	Completed
	Respirators	Different sizes and models; FFP3 and FFP2	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
	Goggles	Different sizes and models; anti-fog coating; no or covered ventilation openings preferred	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
	Hair covers	Different models	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
	Heavy duty gloves	Different sizes and materials	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
	Gloves	Different sizes, materials and models; latex and nitrile; sterile and non-sterile	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
	Coveralls	Different sizes; single-use (disposable); integrated hood; fluid- and particle-proof; zipper covered by adhesive flaps	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
	Separate hood	Fluid- and particle-proof	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
	Hospital scrubs	Different sizes	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
	Cotton socks	Different sizes	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

	Item	Specifiable aspects	Due for review	In progress	Completed
	Clogs or boots	Different sizes, preferable with non-slip soles; mark or colour-code clogs or boots if only for use in specific areas (e.g. in the patient treatment zone = 'red zone')	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	Boot covers	Fluid-proof; have to be mechanically resistant if used as outer cover; non-slip soles are preferable	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	Shoe covers	Non-slip soles are preferable.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	Hand disinfectant	Placed at the point of care, in donning and in the doffing areas	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	Waste management material	Big, leak-proof waste bag for solid infectious waste and clearly-labelled leak-proof bags or containers for linen	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
		Leak-proof container for solid infectious waste	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
		Container for sharp, pointed objects (e.g. needles, syringes, glass articles, tubing, etc.)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

	Item	Specifiable aspects	Due for review	In progress	Completed
	<p>Adhesive tape to use with PPE</p>	<p>Tape without textile layer is preferred; quality parcel tape or chemical resistant tape works fine</p>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Annex 2 Removing the gloves

Properly removing gloves, while keeping the under-layer clean, should be practised frequently.

