Contextual data

KQ5. Should health workers in direct contact and/or indirect contact to patients with Ebola or Marburg virus disease *cover head and neck skin* and mucous membranes or just cover mucous membranes?

We conducted a rapid review for KQ 5, especially updating the Hersi et al. 2015 rapid review and the Verbeek et al. 2020 systematic review with respect to cover head and neck skin. [1] [2] There is very limited data to support the choice of "*covering head and neck skin"*. The data gap related to this key question identified in the WHO recommendations in 2014 remains an issue today. [3]

Table 1 summarizes PPE recommendations related to cover head and neck skin by the WHO, US CDC and European CDC. The WHO recommends a head cover that covers the head and neck skin for HWs providing clinical care for patients with filovirus disease; the head cover is suggested to be separate from the gown or coverall, so that these may be removed separately. [3]

The US CDC recommends that either a Powered Air Purifying Respirator (PAPR) or disposable, NIOSH-certified N95 respirator should be worn in case a potentially aerosol-generating procedure needs to be performed emergently. If N95 respirators are used instead of PAPRs, use it in combination with a single-use (disposable) surgical hood extending to shoulders and a single-use (disposable) full-face shield. [4]

The European CDC recommends that a separate splash-proof hood with an integrated surgical mask offer 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. Separated hood without straps are also available, making the donning and doffing process easier. [5]

The Occupational Safety and Health Administration (OSHA) in the US recommends head/neck cover for individuals providing medical and supportive care, conducting research and clinical laboratory work, maintenance work, cleaning and disinfecting environments and handling of death bodies in area suspected or known to have Ebola contamination (Table 2). [6] The recommended PPE is an impermeable head/neck cover (eg, surgical hood). PAPR powered air-purifying respirator is recommended in these working conditions when high(er)-risk exposure(s) is present.

With respect to the extraction of contextual data, the key findings are as follows (Table 2).

- Zamora et al. 2006 conducted a prospective, randomized, controlled crossover study to compare two PPE ensembles.[7] The PPE ensemble E-RCP (enhance respiratory and contact precautions) included a head covering (without covering the neck skin), goggles and a face shield (Figure 1). The PAPR system in use had outer and inner protective layers (Figure 1). According to the results, participants wearing E-RCP were more likely to experience skin and base-clothing contamination; their contamination episodes measuring ≥1 cm2 were more frequent, and they had larger total areas of contamination (all $p < 0.0001$; Figure 2). The anterior neck, forearms, wrists and hands were the likeliest zones for contamination (Figure 2). Participants donning powered air-purifying respirator (PAPR) committed more donning procedure violations ($p = 0.0034$). Donning and removing the PAPR system took longer than donning and removing E-RCP garments ($p < 0.0001$).
- Suen et al. 2018 conducted an experimental study using a group of 59 participants who randomly performed PPE donning and doffing.[8] The study consisted of PPE donning, applying fluorescent solution on the PPE surface, PPE doffing of participants, and estimation of the degree of contamination as indicated by the number of fluorescent stains on the working clothes and environment. They monitored protocol deviations during PPE donning and doffing. They tested three PPE ensembles: PPE1 consists of a neck-to-ankle outfit, N95 respirator, **hood,** disposable face shield,

surgical gown, boots and double gloves. PPE2 consists of a *head-to-ankle* coverall, N95 respirator, hood, disposable face shield, boots and double gloves. PPE3 consists of neck-to-ankle outfit, N95 respirator, **no hood**, disposable face shield, isolation gown, shoes and single latex gloves. Everything else being equal, PPE1 differed from PPE3 with respect to hood (PPE1) vs no hood (PPE3), double gloves (PPE1) vs single gloves (PPE3), and boots (PPE1) vs shoes (PPE3). During doffing of the PPE, PPE1 was less contaminated in regions purportedly protected by the hood, including hair, head and neck than PPE3 (Figure 1). The results seemed to support covering the head and neck skin.

- Coca et al. 2015 conducted a simulation study using a thermal manikin to assess the time to achievement of a critical core temperature of 39°C while wearing 4 different PPE ensembles similar to those recommended by the World Health Organization and Médecins Sans Frontières at 2 different ambient conditions: temperature/humidity of 32°C/92% relative to 26°C/80%).[9] The results suggest that encapsulation of the head and neck region resulted in higher model-predicted subjective impressions of heat sensation.
- Coca et al. 2017 conducted a simulation study with six healthy individuals in an environmental chamber (32°C, 92% relative humidity) while walking (3 Metabolic equivalent of tasks, 2.5 mph, 0% incline) on a treadmill for 60 minutes.[10] All subjects wore medical scrubs and PPE items. Ensemble E1 had a face shield, **no hood**, and fluid-resistant surgical gown; E2 additionally included goggles, coverall, and separate **hood**; and E3 also contained a highly impermeable coverall, separate **hood**, and surgical mask cover over the N95 respirator. They showed that heart rate and core temperature at the end of the exercise were significantly higher for E2 and E3 than for E1. Subjective perceptions of heat and exertion were significantly higher for E2 and E3 than for E1.
- Boon et al. 2014 conducted a survey of frontline physicians' and nurses' perspectives about PPE use during the 2014-2016 EVD outbreak in West Africa.[11] The aim was to incorporate these findings into the development process of a WHO rapid advice guideline. They surveyed 44 frontline physicians and nurses deployed to West Africa between March and September of 2014. They report that heat and dehydration were a major issue for 64% of the surveyees using a hood. In terms of preferences, a hood was perceived as pausing extremely low risk or low risk in term of safety by 93% (38/41) of surveyees, none or minor impairment in term of communication by 58% (18/42), no reduction or minor reduction in term of the ability to provide patient care by 60% (18/30), no issues or minor issues in term of personal wellbeing (heat or dehydration) by 13% (4/30), and comfortable or fairly comfortable by 53% (16/30).
- Grélot et al. 2016 assessed thermal strain of 25 HWs in the 2014 Ebola virus disease outbreak. [12] The PPE was used in accordance with the World Health Organization regulations. Its ensemble was comprised of waterproof garments from head to toe (DuPont Tychem), European standard EN 143–approved class 2 respirators (3M Company), 2-layered gloves, **surgical hoods** covering the head and neck, leg-covering waterproof boot covers, and waterproof aprons covering the torso to the level of the mid-calf. They report a mean (standard deviation) working ambient temperature of 29.6°C (2.0°C) and a mean relative humidity of 65.4% (10.3%), a mean time wearing PPE of 65.7 (13.5) minutes, and a mean core body temperature increase of 0.46°C (0.20°C). Four HCWs (16%, 4/25) reached or exceeded a mean core body temperature of ≥38.5°C. The results suggest that HWs wearing PPE for approximately 1 hour exhibited moderate but safe thermal strain.
- Sprecher et al. 2015 report on a meeting convened by Médecins Sans Frontières in 2014 to address concerns with PPE. [13] Meeting participants included representatives from the CDC Viral Special Pathogens Branch, the World Health Organization, the National Institutes of Health's Integrated Research Facilities at Frederick, Maryland and Rocky Mountain Laboratories at Hamilton, Montana the Galveston National Laboratory, the Public Health Agency of Canada's Special Pathogens Unit, the PPE divisions of DuPont, 3M, and Microgard, and the CDC National Institute for Occupational

Safety and Health. According to the meeting deliberation, *polyethylene fabric hoods* that fully covered the head and neck became favored over surgical head covering. The meeting attendants called for better evidence in the selection of PPE's.

Figure 1. Equipment list and pictures for the 2 protective-clothing systems compared in Zamora et al. 2006 (use without permission) [14]

System			
E-RCP	PAPR	Item	Manufacturer (location)
	√	Tyvek hood	3M (St. Paul, Minn.)
√	√	Bouffant hair cover	Prime Line Medical Products (Edmonton, Alta.)
√	√	Economy impact goggle	Spartan (Taiwan)
	√	Air-mate breathing tube	3M (Berkshire, United Kingdom)
√		Face shield	Splash Shield (Uniontown, Penn.)
	√	HEPA filter unit	3M (St. Paul, Minn.)
√	√	N95 mask — any of several models:	
		8210	3M (St. Paul)
		1860s	3M (St. Paul)
		PFR95	Kimberly-Clark (Roswell, Geo.)
		7210	Northern Safety (Frankfort, NY)
		695	Alpha Protech (North Salt Lake, Utah)
		Gloves	
√	√	Nonlatex	SensiCare (Caledonia, Mich.)
	√	Latex surgical	MicroTouch (Dothan, Ala.)
√	√	Latex	AMD (Lachine, Que.)
	√	Tyvek coveralls with hood	Lakeland Industries (Decatur, Ala.)
	√	Tyvek boot covers	Lakeland Industries (Decatur)
√	√	Astound impervious surgical gown	Cardinal Health (McGraw Park, Ill.)

Note: E-RCP = enhanced respiratory and contact precautions, PAPR = powered air-purifying respirator, HEPA = high-efficiency particulate air.

Fig. 1: Enhanced respiratory and contact precautions (E-RCP), familiar to most health care workers. The towel used for neck protection was omitted for illustrative purposes.

Fig. 2: The other system studied, named for its powered air-purifying respirator (PAPR), has 2 protective layers, shown above. The outer layer (left panel) consists of a hood, fluid-resistant surgical gown, shoe covers and 2 pairs of fitted surgical gloves. The inner (right) includes a hooded coverall and shoe covers, PAPR power unit, N95 mask, goggles, bouffant hair cover, and 1 pair of fitted surgical gloves. Contamination assessment for this layer was performed with the PAPR power unit and fitted surgical gloves removed. The towel worn to protect the neck has been omitted for illustrative purposes.

Figure 2. Contamination data for skin and the base layer of clothing worn under the PAPR and E-RCP personal protective systems (use without permission from Zamora et al. 2006) [14]

Location	Contamination, PAPR system			Contamination, E-RCP			*p*, Mainland-Gart test*		*p* value, WMW test‡
	Any *n* (%)	≥ 1 cm^2 *n* (%)	Area, cm^2 mean *n* (SD)	Any *n* (%)	≥ 1 cm^2 *n* (%)	Area, cm^2 mean *n* (SD)	Actual areas	Areas ≥ 1 cm^2†	
Face	0	0	NA	2 (4)	1 (2)	1.1 (0.6)	1	1*	Und.
Back of head	0	0	NA	0	0	NA	Und.	Und.	Und.
Anterior neck	3 (6)	2 (4)	1.5 (0.9)	48 (96)	48 (96)	76.5 (54.4)	< 0.001	< 0.001	< 0.001
Posterior neck	1 (2)	1 (2)	1.0	9 (18)	4 (8)	1.7 (1.9)	0.012	0.25	1
Forearms, hands or wrists	9 (18)	7 (14)	1.8 (1.8)	38 (76)	35 (70)	6.5 (7.6)	< 0.001	< 0.001	0.015
Anterior torso, anterior upper arms	0	0	NA	5 (10)	4 (8)	6.3 (6.2)	0.06*	0.13*	Und.
Back and posterior upper arms	0	0	NA	1 (2)	1 (2)	7.0	1*	1*	Und.
Anywhere below beltline	0	0	NA	1 (2)	0	0.5	1*	Und.	Und.
Total	13 (26)	10 (20)	1.7 (1.5)	48 (96)	48 (96)	82.8 (54.0)	< 0.001	< 0.001	< 0.001
Total excluding the neck	9 (18)	7 (14)	1.8 (1.8)	39 (78)	36 (72)	7.4 (8.2)	< 0.001	< 0.001	0.013

Note: E-RCP = enhanced respiratory and contact precautions, PAPR = powered air-purifying respirator, WMW = Wilcoxon-Mann-Whitney test, NA = not applicable, Und. = undefined.
*Except where McNemar's test was used, as indicated with asterisks. The Mainland-Gart test was used when contamination occurred during both periods. McNemar's test was substituted when only 1 period had any contamination. Neither test was applied when there was no contamination in either period.
†Repeat analysis, in which areas smaller than 1 cm^2 in area were counted as 0 cm.
‡The Wilcoxon-Mann-Whitney test was used to compare the area of contamination for subjects with some contamination. Since these contaminated subjects were different for each system, a test for paired data was not used.

Figure 3. Contamination during doffing of PPE (copy from Suen et al. 2018 without permission)[8]

	Small sized contaminated patches (< 1 cm ^{2}), median				Extra large sized contaminated patches (≥ 5 cm^2), median			
Location	PPE1	PPE2	PPE3	*p*-value	PPE1	PPE2	PPE3	*p*-value
Hair and head	1.00	2.00	2.50	0.68	0.00	17.00	0.00	N/A
Face	1.00	4.00	2.00	0.602	0.00	0.00	8.00	N/A
Neck (anterior)	2.50	5.00	11.00	0.095	0.00	0.00	24.00	N/A
Neck (posterior)	2.00	1.00	18.50	0.824	0.00	0.00	0.00	N/A
Arms (right)	3.50	1.00	4.00	0.414	0.00	0.00	28.00	N/A
Arms (left)	2.00	2.00	1.00	0.909	0.00	0.00	49.00	N/A
Hands or wrists	1.00	1.00	6.00	0.414	8.00	61.00	0.00	N/A
Working clothes (upper)	8.50	9.00	7.00	0.997	21.00	48.50	42.00	0.690
Working clothes (lower)	2.00	2.50	6.00	0.111	12.00	46.00	17.50	0.276
Clogs	3.00	5.00	13.50	< 0.001*	121.00	55.00	133.00	0.397
Environment (rubbish bin cover)	2.00	7.00	2.50	0.254	20.00	14.00	23.00	0.737
Environment (chair)	3.00	6.50	2.00	0.053	0.00	36.00	0.00	N/A
Faucet	2.00	2.00	1.50	0.659	0.00	16.00	14.00	N/A
Sink	12.50	14.00	10.00	0.072	75.50	66.50	44.00	0.649
Overall	5.00	7.00	7.00	0.05*	39.00	43.00	47.00	< 0.001*

*significant *p* values
N/A: There are fewer than two groups for the dependent variables, so no inferential statistics are computed using ANOVA
PPE1: Hospital Authority Standard Ebola PPE set
PPE2: DuPont™ Tyvek®, Model 1422A
PPE3: Hospital Authority isolation gown for routine patient care and performing aerosol-generating procedures

Table 1: Summary of PPE recommendations regarding head cover by WHO, US and European CDC

Source	Head cover
WHO [3]	
Recommendation 11	All health workers should wear a head cover that covers the head and neck while providing clinical care for patients with filovirus disease in order to prevent virus exposure. *Conditional recommendation. Low quality evidence for effectiveness of head cover in preventing transmission*
Recommendation 12	The head cover is suggested to be separate from the gown or coverall, so that these may be removed separately. *Conditional recommendation. Low quality evidence comparing different types of head covers*. **Rationale and remarks:** The purpose of head covers is to protect the head and neck skin and hair from virus contamination and the possibility of subsequent unrecognized transmission to the mucosae of the eyes, nose or mouth. Hair and hair extensions need to fit inside the head cover. Recommendation 11 is conditional since there is no evidence to support use of a head cover over a hood (covering the shoulders) or hair cap for preventing transmission of infection. The need for covering all skin surfaces including the back of the neck was discussed in detail during the GDG meeting. There was no consensus among the GDG: nine experts were of the opinion that all skin surfaces should be covered, three disagreed and one was absent during voting. Recommendation 12 is conditional since there was no comparative evidence of effectiveness in preventing transmission between a separate head cover and a head cover that is integrated in the coverall. When a separate head cover is not available, a coverall with hood can be worn if the hood is put on after eye, nose and mouth protection so that mucosal protection is maintained after taking off the hooded coverall.
Other recommendation	PAPR powered air-purifying respirator is recommended for aerosol generating procedures
US CDC [4]	**Respiratory Protection**: Either a Powered Air Purifying Respirator (PAPR) or disposable, NIOSH-certified N95 respirator should be worn in case a potentially aerosol-generating procedure needs to performed emergently. PAPRs with *a full-face covering and head-shroud* make accidental self-contamination during care more difficult (e.g., while adjusting eyeglasses); disposable N95 face piece respirators are less cumbersome and can be easier to doff safely. … PAPR: A hooded respirator with a full-face shield, helmet, or headpiece. Any reusable helmet or headpiece must be covered *with a single-use (disposable) hood that extends to the shoulders and fully covers the neck* and is compatible with the selected PAPR. If a hood is used over the PAPR, it must not interfere with the function of the PAPR. … N95 Respirator: Single-use (disposable) N95 respirator or higher in combination with *single-use (disposable) surgical hood extending to shoulders* and single-use (disposable) full-face shield. If N95 respirators are used instead of PAPRs, healthcare workers should be carefully observed to ensure that they do not inadvertently touch their faces under the face shield during patient care.

European CDC [5]	**Hair covers** Hair covers (surgical hoods) should be worn under the hood of the coveralls to prevent hair from hanging out, where it can be 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. **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. Separated hood without straps are also available, making the donning and doffing process easier.

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Table 2. Summary of contextual data

Author	Year	Study methods	Method details, measures or findings relevant to the extraction of contextual data	Data type	Contextual data
Zamora [7]	2006	Prospective, randomized, controlled crossover study	The study compared two PPE ensembles. The PPE ensemble E-RCP (enhance respiratory and contact precautions) included a head covering (without covering the neck skin), goggles and a face shield (Figure 1). The PAPR system in use had outer and inner protective layers (Figure 1).	Usability	Participants wearing E-RCP were more likely to experience skin and base-clothing contamination; their contamination episodes measuring ≥1 cm2 were more frequent, and they had larger total areas of contamination (all $p < 0.0001$). The anterior neck, forearms, wrists and hands were the likeliest zones for contamination. Participants donning PAPR committed more donning procedure violations ($p = 0.0034$). Donning and removing the PAPR system took longer than donning and removing E-RCP garments ($p < 0.0001$).
Abela [15]	2015	Use WHO and ECDC guides to select PPE	During the preparedness for the admission of a potential EVD case, the infection control unit in the tertiary care hospital in Malta guided the selection process of different types of PPE supplies according the WHO and ECDC guidelines.	Acceptability	The best preferred option to be the use of PAPR rather than goggles and particulate respirator (N95), the former providing comfort and a sense of protection.
Coca [9]	2015	Simulation study using a thermal manikin	A sweating thermal manikin was used to ascertain the time to achievement of a critical core temperature of 39°C while wearing 4 different PPE ensembles similar to those recommended by the World Health Organization and Médecins Sans Frontières (Doctors Without Borders) at 2 different ambient conditions (32°C/92% relative humidity and 26°C/80% relative humidity) compared with a control ensemble.	Usability	Encapsulation of the head and neck region resulted in higher model-predicted subjective impressions of heat sensation. To maximize work capacity and to protect health care workers in the challenging ambient conditions of West Africa, consideration should be given to adjustment of work and rest schedules, improvement of PPE (e.g., using less impermeable and more breathable fabrics that provide the same protection), and the possible use of cooling devices worn simultaneously with PPE.
Coca	2015	Simulation study using a thermal manikin		Usability	PPE ensemble similar to the E4 PPE studied here are currently in use by Medicine Sans Frontiers health care personnel in Ebola-affected countries of West Africa. The results of the present study indicate that use of this ensemble results in significant heat stress after 1 hour of use (80 minutes) in a "near worst case" ambient environment scenario (32°C, 92% relative humidity) at a typical HW work rate. The results also suggests that the encapsulation of the head and neck by the cape/hood and goggles has a greater impact on subjective perceptions of heat, but this supposition would require human trials to verify.
Coca[10]	2017	Simulation study with healthy individuals	Six healthy individuals were tested in an environmental chamber (32°C, 92% relative humidity) while walking (3 Metabolic equivalent of tasks, 2.5 mph, 0% incline) on a treadmill for 60 minutes. All subjects wore medical scrubs and PPE items. E1 also had a face shield and fluid-resistant surgical gown; E2 additionally included goggles, coverall, and separate hood; and E3 also contained a highly impermeable coverall, separate hood, and surgical mask cover over the N95 respirator.	Usability	Results: Heart rate and core temperature at the end of the exercise were significantly higher for E2 and E3 than for E1. Subjective perceptions of heat and exertion were significantly higher for E2 and E3 than for E1. Conclusions: Heat stress and PPE training, as well as the implementation of a work-to-rest ratio that avoids dehydration and possible heat stress issues, are recommended.
Suen [8]	2018	An experimental study of one group using multiple comparisons	A total of 59 participants randomly performed PPE donning and doffing. The trial consisted of PPE donning, applying fluorescent solution on the PPE surface, PPE doffing of participants, and estimation of the degree of contamination as indicated by the number of fluorescent stains on the working clothes and environment. Protocol deviations during PPE donning and doffing were monitored. PPE1 consists of a neck-to-ankle outfit, N95 respirator, hood, disposable face shield, surgical gown, boots and double gloves. PPE2 consists of a head-to-ankle coverall, N95 respirator, hood, disposable face shield, boots and double gloves. PPE3 consists of neck-to-ankle outfit, N95 respirator, no hood, disposable face shield, isolation gown, shoes and single latex gloves.	Usability	Results: PPE2 and PPE3 presented higher contamination risks than PPE1. Environmental contaminations such as those originating from rubbish bin covers, chairs, faucets, and sinks were detected. Procedure deviations were observed during PPE donning and doffing, with PPE1 presenting the lowest overall deviation rate (%) among the three PPE ensembles ($p < 0.05$). **Everything else being equal, PPE1 differed from PPE3 with respect to hood (PPE1) vs no hood (PPE3), double gloves (PPE1) vs single gloves (PPE3), and boots (PPE1) vs shoes (PPE3). PPE1 was less contaminated in the hair, head and neck than PPE1 (Figure 1). The results seemed to support covering the head and neck skin.**
Brown [6]	2019	Guidelines development	Development of an Occupational Safety and Health Administration (OSHA) EBV PPE selection matrix during the response to the West Africa epidemic and resulting US cases	Implementation	OSHA recommends head/neck cover for individuals providing medical and supportive care, conducting research and clinical laboratory work, maintenance work, cleaning and disinfecting environments and handling of death bodies in area suspected or known to have Ebola contamination.

					The recommended PPE is an impermeable head/neck cover (eg, surgical hood). PAPR powered air-purifying respirator is recommended in these working conditions, especially when high(er)-risk exposure(s) is present.
Boon [11]	2014	Survey	To understand frontline physicians' and nurses' perspectives about personal protective equipment (PPE) use during the 2014-2016 EVD outbreak in West Africa and to incorporate these findings into the development process of a WHO rapid advice guideline. Survey 44 frontline physicians and nurses deployed to West Africa between March and September of 2014.	Implementation	Heat and dehydration were a major issue for 64% using a hood and for 76% of the participants using goggles. Both gowns and coveralls were associated with significant heat stress and dehydration. In terms of HW preferences, a hood was perceived as pausing extremely low risk or low risk in terms of safety by 93% (38/41 of surveyees), none or minor impairment in communication by 58% (18/42), no reduction or minor reduction in ability to provide patient care by 60% (18/30), no issues or minor issues in term of personal wellbeing (heat or dehydration) by 13% (4/30), and comfortable or fairly comfortable by 53% (16/30).
Grélot [12]	2016	Thermal strain monitor of 25 HWs in 2014 Ebola Virus Disease Outbreak	The PPE was used in accordance with the World Health Organization regulations [4]. It comprised waterproof garments from head to toe (DuPont Tychem), European standard EN 143–approved class 2 respirators (3M Company), 2-layered gloves, surgical hoods covering the head and neck, leg-covering waterproof boot covers, and waterproof aprons covering the torso to the level of the midcalf.	Implementation	The mean (standard deviation) working ambient temperature and relative humidity were 29.6°C (2.0°C) and 65.4% (10.3%), respectively; the mean time wearing PPE was 65.7 (13.5) minutes; and themean core body temperature increased by 0.46°C (0.20°C). Four HCWs (16%, 4/25) reached or exceeded a mean core body temperature of ≥38.5°C. HCWs wearing PPE for approximately 1 hour exhibited moderate but safe thermal strain.
Sprecher [13]	2015	Meeting report	The article is titled "Personal Protective Equipment for Filovirus Epidemics: A Call for Better Evidence". To try to address concerns with PPE, Médecins Sans Frontières convened a meeting on 3 April 2014, at the Galveston National Laboratory in Galveston, Texas. Representatives were present from the CDC Viral Special Pathogens Branch, the World Health Organization, the National Institutes of Health's Integrated Research Facilities at Frederick, Maryland and Rocky Mountain Laboratories at Hamilton, Montana the Galveston National Laboratory, the Public Health Agency of Canada's Special Pathogens Unit, the PPE divisions ofDuPont, 3M, and Microgard, and the CDC National Institute for Occupational Safety and Health. This meeting brought together, for the first time, experts in the virology of filoviruses, worker protection and protective equipment, epidemiologists, and outbreak response agencies. Their deliberations are summarized.	Implementation	In subsequent outbreaks coveralls were added, as wearers sought more complete coverage. The garments became more resistant, changing from the material used in surgical gowns to uncoated polyethylene fabric and then to coated polyethylene. Polyethylene fabric hoods that fully covered the head and neck became favored over surgical head covering. Surgical masks were abandoned in favor of masks that did not lie flat against the face.Most of these changes were made because of the presumption of increased security, but there was no empiric basis for the changes other than that granted by the EN 14126 certification [2] of the coated polyethylene material.
Roberts [16]	2014	Review by a single expert	The present review discusses the advantages and disadvantages of using a PAPR versus an N95 mask, and relates the experience of the Jewish General Hospital (Montreal, Quebec) of PAPR policy implementation.	Usability	The use of HEPA filters in PAPRs implies that they have a greater level of respiratory protection than N95 masks. They also have the advantage of providing head and neck protection, do not require fit testing because of a full hood, are approved for use with facial hair and allow for continuous bedside care of a patient. Their disadvantages include difficulties in communicating due to their bulk and noise, the inability to use a stethoscope and a requirement for electricity (batteries) to ensure proper airflow rates into the hood.