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1. Are Powered Air Purifying Respirators a Solution for Protecting Healthcare Workers from Emerging Aerosol-Transmissible Diseases?

Authors Brosseau, Lisa M
Source Annals of work exposures and health; Mar 2020
Publication Date Mar 2020
Publication Type(s) Journal Article
PubMedID 32154831
Database Medline
Available at Annals of work exposures and health from Unpaywall

2. Comparing mask fit and usability of traditional and nanofibre N95 filtering facepiece respirators before and after nursing procedures.

Authors Suen, L K P; Guo, Y P; Ho, S S K; Au-Yeung, C H; Lam, S C
Source The Journal of hospital infection; Mar 2020; vol. 104 (no. 3); p. 336-343
Publication Date Mar 2020
Publication Type(s) Journal Article
PubMedID 31545991
Database Medline
Available at The Journal of hospital infection from Unpaywall
Abstract BACKGROUNDThe reliability of N95 filtering facepiece respirators (FFRs) depends on correct fitting. The perceived usability of FFRs is equally important because discomfort during usage may affect compliance. Body movements during nursing procedures may also increase the risk of face seal leakage.AIMTo evaluate the mask fit and usability of the best-fitting 3M N95 FFR and the nanofibre N95 FFR before and after nursing procedures. The physical properties of these FFRs were also examined.METHODSThis experimental study had a one-group multiple comparison design. In total, 104 nursing students participated, and performed nursing procedures for 10 min when wearing the best-fitting 3M FFR and the nanofibre FFR. Mask fit and perceived usability of the FFRs were evaluated.FINDINGSMore participants failed to obtain a fit factor ≥100 when using the best-fitting 3M FFR than when wearing the nanofibre FFR (33.7% vs 21.2%) after the procedures (P=0.417). The nanofibre FFR also demonstrated higher usability than the 3M FFRs in terms of facial heat, breathability, facial pressure, speech intelligibility, itchiness, difficulty of maintaining the mask in place, and comfort level (P<0.001). The nanofibre FFR was also lighter, thinner and had slightly higher bacterial filtration efficiency than the 3M FFRs.CONCLUSIONThe nanofibre FFR demonstrated significantly better usability than the 3M FFRs. None of the respirators were able to provide consistent protection for the wearer, as detected by face seal leakage after performing nursing procedures. Further improvement in the prototype design is needed to increase compliance and ensure the respiratory protection of users.

3. Selection and Use of Respiratory Protection by Healthcare Workers to Protect from Infectious Diseases in Hospital Settings

Authors Chughtai A.A.; Seale H.; Rawlinson W.D.; Kunasekaran M.; Macintyre C.R.
Source Annals of work exposures and health; Mar 2020
Publication Date Mar 2020
Publication Type(s) Article
PubMedID 32144412
Database EMBASE
Available at Annals of work exposures and health from Unpaywall

Abstract OBJECTIVES: Infection control policies and guidelines recommend using facemasks and respirators to protect healthcare workers (HCWs) from respiratory infections. Common types of respirators used in healthcare settings are filtering facepiece respirators (FFRs) and powered air-purifying respirators (PAPRs). Aims of this study were to examine the current attitudes and practices of HCWs regarding the selection and use of respiratory protection and determine the acceptability of a novel PAPR.
METHOD(S): In-depth interviews were undertaken with 20 HCWs from a large tertiary hospital in Sydney, Australia. Participants were fit tested with a lightweight tight-fitting half-facepiece PAPR (CleanSpace2TM Power Unit, PAF-0034, by CleanSpace Technology) using the TSITM Portacount quantitative fit test method.
RESULT(S): Interview results showed that HCWs had a limited role in the selection and use of facemasks and respirators and had been using the devices provided by the hospital. The majority of subjects had no knowledge of hospital policy for the use of facemasks and respirators, had not been trained on the use of respirators, and had not been fit tested previously. Compliance with the use of facemasks and respirators was perceived as being low and facemasks and respirators were typically used only for short periods of time.All 20 participants were successfully fit tested to the CleanSpace2TM PAPR (overall geometric mean fit factor-6768). According to the exit surveys, CleanSpace2TM PAPRs were easy to don (14/20) and doff (15/20) and comfortable to wear (14/20). Most participants believed that PAPRs provide higher protection, comfort and reusability over N95 FFR and can be used during pandemics and other high-risk situations.
CONCLUSION(S): HCWs should be aware of infection control policies and training should be provided on the correct use of respiratory protective devices. PAPRs can be used in hospital settings to protect HCWs from certain highly infectious and emerging pathogens, however, HCWs require adequate training on storage, use, and cleaning of PAPRs.

4. Sterile field contamination from powered air-purifying respirators (PAPRs) versus contamination from surgical masks.

Authors Howard, Rex A; Lathrop, George W; Powell, Nathaniel
Source American journal of infection control; Feb 2020; vol. 48 (no. 2); p. 153-156
Publication Date Feb 2020
Publication Type(s) Journal Article
PubMedID 31519477
Database Medline
Abstract BACKGROUNDCurrently, powered air-purifying respirators (PAPRs) are not recommended for usage in close proximity to sterile fields owing to concerns that exhaled, unfiltered air potentially may cause contamination; however, this has not been confirmed by experimental study.METHODSAfter establishing background levels of airborne contamination, our team placed settling plates in a sterile field and collected contamination from participants who were performing particulate-generating actions. Participants performed the actions while wearing various forms of respiratory protection, including: (1) a full facepiece PAPR, (2) a full facepiece PAPR with a shoulder-length hood, (3) a surgical mask, and (4) no facial covering (as a positive control to determine contamination-reduction effectiveness). Specimens were collected at the end of a 10-minute sampling time frame. After incubation at 36.5˚C for 72 hours, we tabulated colony forming units as a marker of contamination.RESULTSSurgical masks and the 2 PAPR configurations all drastically reduced aerosolized droplet contamination. Surgical masks reduced contamination by 98.48%, and both PAPRs reduced contamination by 100% (compared with the usage of no facial covering). There was no statistical difference between their effectiveness (surgical mask vs both PAPRs, P value = .588 and no hood PAPR vs hood PAPR, P value >.999).DISCUSSION/CONCLUSIONSBased on these findings, the tested PAPR configurations are effective at reducing aerosolized droplet contamination into a sterile field, and further testing is warranted to assess other PAPR configurations as well as PAPR suitability in an operating room.

5. Technologies and requirements of protection and disinfection in key places during the novel coronavirus pneumonia (NCP) outbreak

Source Zhonghua yu fang yi xue za zhi [Chinese journal of preventive medicine]; Feb 2020; vol. 54
Publication Date Feb 2020
Publication Type(s) Article
PubMedID 32077664
Database EMBASE
Abstract Novel coronavirus pneumonia (NCP), a new respiratory infectious disease, has become an important public health problem. Inappropriate protection and disinfection measures are potential risk factors of transmission and outbreak of NCP in key places. This theme issue is concerned with the prevention and control of NCP. Comprehensive measures and suggestions for protection and disinfection are put forward from perspectives of functional areas in key places, such as hotels, mobile cabin hospitals, passenger transport stations and public transport facilities, environment and facilities, personal protection, operation management system, etc., so as to provide technical support for the prevention and control of new respiratory infectious diseases.

6. Limiting factors for wearing personal protective equipment (PPE) in a health care environment evaluated in a randomised study.

Authors Loibner, Martina; Hagauer, Sandra; Schwantzer, Gerold; Berghold, Andrea; Zatloukal, Kurt
Source PloS one; 2019; vol. 14 (no. 1); p. e0210775
Publication Date 2019
Publication Type(s) Research Support, Non-u.s. Gov't Comparative Study Evaluation Study Journal Article
PubMedID 30668567
Database Medline
Available at PloS one from Europe PubMed Central - Open Access
Available at PloS one from Public Library of Science (PLoS)
Available at PloS one from ProQuest (Health Research Premium) - NHS Version
Available at PloS one from Unpaywall
Abstract Pandemics and re-emerging diseases put pressure on the health care system to prepare for patient care and sample logistics requiring enhanced personnel protective equipment (PPE) for health care workers. We generated quantifiable data on ergonomics of PPE applicable in a health care setting by defining error rates and physically limiting factors due to PPE-induced restrictions. Nineteen study volunteers tested randomly allocated head- or full body-ventilated PPE suits equipped with powered-air-purifying-respirators and performed four different tasks (two laboratory tutorials, a timed test of selective attention and a test investigating reaction time, mobility, speed and physical exercise) during 6 working hours at 22°C on one day and 4 working hours at 28°C on another day. Error rates and physical parameters (fluid loss, body temperature, heart rate) were determined and ergonomic-related parameters were assessed hourly using assessment sheets. Depending on the PPE system the most restrictive factors, which however had no negative impact on performance (speed and error rate), were: reduced dexterity due to multiple glove layers, impaired visibility by flexible face shields and back pain related to the respirator of the fully ventilated suit. Heat stress and liquid loss were perceived as restrictive at a working temperature of 28°C but not 22°C.

7. Common Behaviors and Faults When Doffing Personal Protective Equipment for Patients With Serious Communicable Diseases.

Authors Mumma, Joel M; Durso, Francis T; Casanova, Lisa M; Erukunuakpor, Kimberly; Kraft, Colleen S; Ray, Susan M; Shane, Andi L; Walsh, Victoria L; Shah, Puja Y; Zimring, Craig; DuBose, Jennifer; Jacob, Jesse T
Source Clinical infectious diseases : an official publication of the Infectious Diseases Society of America; Sep 2019; vol. 69 ; p. S214
Publication Date Sep 2019
Publication Type(s) Journal Article
PubMedID 31517977
Database Medline
Available at Clinical infectious diseases : an official publication of the Infectious Diseases Society of America from Unpaywall
Abstract BACKGROUNDThe safe removal of personal protective equipment (PPE) can limit transmission of serious communicable diseases, but this process poses challenges to healthcare workers (HCWs).METHODSWe observed 41 HCWs across 4 Ebola treatment centers in Georgia doffing PPE for simulated patients with serious communicable diseases. Using human factors methodologies, we obtained the details, sequences, and durations of doffing steps; identified the ways each step can fail (failure modes [FMs]); quantified the riskiness of FMs; and characterized the workload of doffing steps.RESULTSEight doffing steps were common to all hospitals-removal of boot covers, gloves (outer and inner pairs), the outermost garment, the powered air purifying respirator (PAPR) hood, and the PAPR helmet assembly; repeated hand hygiene (eg, with hand sanitizer); and a final handwashing with soap and water. Across hospitals, we identified 256 FMs during the common doffing steps, 61 of which comprised 19 common FMs. Most of these common FMs were above average in their riskiness at each hospital. At all hospitals, hand hygiene, removal of the outermost garment, and removal of boot covers were above average in their overall riskiness. Measurements of workload revealed that doffing steps were often mentally demanding, and this facet of workload correlated most strongly with the effortfulness of a doffing step.CONCLUSIONSWe systematically identified common points of concern in protocols for doffing high-level PPE. Addressing FMs related to hand hygiene and the removal of the outermost garment, boot covers, and PAPR hood could improve HCW safety when doffing high-level PPE.We identified ways that doffing protocols for high-level personal protective equipment may fail to protect healthcare workers. Hand hygiene, removing the outermost garment, boot covers, and respirator hood harbored the greatest risk and failed in similar ways across different hospitals.

8. Personal protective equipment for preventing highly infectious diseases due to exposure to contaminated body fluids in healthcare staff.

Authors Verbeek, Jos H; Rajamaki, Blair; Ijaz, Sharea; Tikka, Christina; Ruotsalainen, Jani H; Edmond, Michael B; Sauni, Riitta; Kilinc Balci, F Selcen
Source The Cochrane database of systematic reviews; Jul 2019; vol. 7 ; p. CD011621

Publication Date Jul 2019
Publication Type(s) Research Support, Non-u.s. Gov't Journal Article Research Support, U.s. Gov't, P.h.s. Systematic Review
PubMedID 31259389
Database Medline
Available at The Cochrane database of systematic reviews from Cochrane Collaboration (Wiley)

Abstract BACKGROUNDIn epidemics of highly infectious diseases, such as Ebola Virus Disease (EVD) or Severe Acute Respiratory Syndrome (SARS), healthcare workers (HCW) are at much greater risk of infection than the general population, due to their contact with patients' contaminated body fluids. Contact precautions by means of personal protective equipment (PPE) can reduce the risk. It is unclear which type of PPE protects best, what is the best way to remove PPE, and how to make sure HCW use PPE as instructed.OBJECTIVESTo evaluate which type of full body PPE and which method of donning or doffing PPE have the least risk of self-contamination or infection for HCW, and which training methods increase compliance with PPE protocols.SEARCH METHODSWe searched MEDLINE (PubMed up to 15 July 2018), Cochrane Central Register of Trials (CENTRAL up to 18 June 2019), Scopus (Scopus 18 June 2019), CINAHL (EBSCOhost 31 July 2018), and OSH-Update (up to 31 December 2018). We also screened reference lists of included trials and relevant reviews, and contacted NGOs and manufacturers of PPE.SELECTION CRITERIAWe included all controlled studies that compared the effects of PPE used by HCW exposed to highly infectious diseases with serious consequences, such as Ebola or SARS, on the risk of infection, contamination, or noncompliance with protocols. This included studies that used simulated contamination with fluorescent markers or a non-pathogenic virus.We also included studies that compared the effect of various ways of donning or doffing PPE, and the effects of training in PPE use on the same outcomes.DATA COLLECTION AND ANALYSISTwo authors independently selected studies, extracted data and assessed risk of bias in included trials. We planned to perform meta-analyses but did not find sufficiently similar studies to combine their results.MAIN RESULTSWe included 17 studies with 1950 participants evaluating 21 interventions. Ten studies are Randomised Controlled Trials (RCTs), one is a quasi RCT and six have a non-randomised controlled design. Two studies are awaiting assessment.Ten studies compared types of PPE but only six of these reported sufficient data. Six studies compared different types of donning and doffing and three studies evaluated different types of training. Fifteen studies used simulated exposure with fluorescent markers or harmless viruses. In simulation studies, contamination rates varied from 10% to 100% of participants for all types of PPE. In one study HCW were exposed to Ebola and in another to SARS.Evidence for all outcomes is based on single studies and is very low quality.Different types of PPEPPE made of more breathable material may not lead to more contamination spots on the trunk (Mean Difference (MD) 1.60 (95% Confidence Interval (CI) -0.15 to 3.35) than more water repellent material but may have greater user satisfaction (MD -0.46; 95% CI -0.84 to -0.08, scale of 1 to 5).Gowns may protect better against contamination than aprons (MD large patches -1.36 95% CI -1.78 to -0.94).The use of a powered air-purifying respirator may protect better than a simple ensemble of PPE without such respirator (Relative Risk (RR) 0.27; 95% CI 0.17 to 0.43).Five different PPE ensembles (such as gown vs. coverall, boots with or without covers, hood vs. cap, length and number of gloves) were evaluated in one study, but there were no event data available for compared groups.Alterations to PPE design may lead to less contamination such as added tabs to grab masks (RR 0.33; 95% CI 0.14 to 0.80) or gloves (RR 0.22 95% CI 0.15 to 0.31), a sealed gown and glove combination (RR 0.27; 95% CI 0.09 to 0.78), or a better fitting gown around the neck, wrists and hands (RR 0.08; 95% CI 0.01 to 0.55) compared to standard PPE.Different methods of donning and doffing proceduresDouble gloving may lead to less contamination compared to single gloving (RR 0.36; 95% CI 0.16 to 0.78).Following CDC recommendations for doffing may lead to less contamination compared to no guidance (MD small patches -5.44; 95% CI -7.43 to -3.45).Alcohol-based hand rub used during the doffing process may not lead to less contamination than the use of a hypochlorite based solution (MD 4.00; 95% CI 0.47 to 34.24).Additional spoken instruction may lead to fewer errors in doffing (MD -0.9, 95% CI -1.4 to -0.4).Different types of trainingThe use of additional computer simulation may lead to fewer errors in doffing (MD -1.2, 95% CI -1.6 to -0.7).A video lecture on donning PPE may lead to better skills scores (MD 30.70; 95% CI 20.14,41.26) than a traditional lecture.Face to face instruction may reduce noncompliance with doffing guidance more (OR 0.45; 95% CI 0.21 to 0.98) than providing folders or videos only.There were no studies on effects of training in the long term or on resource use.The quality of the evidence is very low for all comparisons because of high risk of bias in all studies, indirectness of evidence, and small numbers of participants.AUTHORS' CONCLUSIONSWe found very low quality evidence that more breathable types of PPE may not lead to more contamination, but may have greater user satisfaction. Alterations to PPE, such as tabs to grab may decrease contamination. Double gloving, following CDC doffing guidance, and spoken instructions during doffing may reduce contamination and increase compliance. Face-to-face training in PPE use may reduce errors more than video or folder based training. Because data come from single small studies with high risk of bias, we are uncertain about the estimates of effects.We still need randomised controlled trials to find out which training works best in the long term. We need better simulation studies conducted with several dozen participants to find out which PPE protects best, and what is the safest way to remove PPE. Consensus on the best way to conduct simulation of exposure and assessment of outcome is urgently needed. HCW exposed to highly infectious diseases should have their use of PPE registered and should be prospectively followed for their risk of infection in the field.

9. A pilot study of minimum operational flow for loose-fitting powered air-purifying respirators used in healthcare cleaning services.

Authors Zhu, Jintuo; He, Xinjian; Bergman, Michael S; Guffey, Steven; Nimbarte, Ashish D; Zhuang, Ziqing
Source Journal of occupational and environmental hygiene; Jul 2019; vol. 16 (no. 7); p. 440-445
Publication Date Jul 2019
Publication Type(s) Journal Article Research Support, U.s. Gov't, P.h.s.
PubMedID 31081727
Database Medline
Available at Journal of occupational and environmental hygiene from Unpaywall
Abstract The objective of this pilot study was to determine the minimum operational flow for loose-fitting powered air-purifying respirators (PAPR) used in healthcare cleaning services. An innovative respiratory flow recording device was worn by nine healthcare workers to obtain the minute volume (MV, L/min), mean inhalation flow (MIF, L/min), and peak inhalation flow (PIF, L/min) while performing "isolation unit work" (cleaning and disinfecting) of a patient room within 30 min. The MV and PIF were compared with the theoretical values obtained from an empirical formula. The correlations of MV, MIF, and PIF with subjects' age, weight, height, body surface area (ADu), and body mass index (BMI) were analyzed. The average MV, MIF, and PIF were 33, 74, and 107 L/min, with maximal airflow rates of 41, 97, and 145 L/min, respectively, which are all below the current 170 L/min minimum operational flow for NIOSH certified loose-fitting PAPRs.

10. User acceptance of reusable respirators in health care

Authors Hines S.E.; Brown C.; Oliver M.; Gucer P.; Frisch M.; Hogan R.; Roth T.; Chang J.; McDiarmid M.
Source American Journal of Infection Control; Jun 2019; vol. 47 (no. 6); p. 648-655
Publication Date Jun 2019
Publication Type(s) Article
PubMedID 30638674
Database EMBASE
Available at American journal of infection control from Unpaywall
Abstract Background: Inclusion of reusable respirators, such as elastomeric half-face respirators (EHFRs) and powered air-purifying respirators (PAPRs), in hospital respiratory protection inventories may represent 1 solution to the problem of N95 respirator shortages experienced during pandemics. User acceptance of these devices is 1 potential barrier to implementing such a strategy in respiratory protection programs.
Method(s): To assess user attitudes toward various respirators, health care workers enrolled in respiratory protection programs in a medical system using EHFRs, N95s, and PAPRs and completed an online questionnaire that addressed attitudes, beliefs, and respirator preferences under different risk scenarios. Responses were compared between user groups.
Result(s): Of 1,152 participants, 53% currently used N95s, 24% used EHFRs, and 23% used PAPRs. N95 users rated their respirators more favorably compared with EHFR and PAPR users ($P < .001$) regarding comfort and communication, however, EHFR users rated their respirators much more highly regarding sense of protection ($P < .001$). For all user groups, reusable respirators were significantly more likely (odds ratios 2.3-7.7) to be preferred over N95 filtering facepiece respirators in higher risk scenarios compared to "usual circumstance" scenarios.
Conclusion(s): Despite somewhat less favorable ratings on comfort and communication, experienced EHFR and PAPR users still prefer reusable respirators over N95s in certain higher risk scenarios. This suggests that reusable respirators are an acceptable alternative to N95 respirators in health care and offer 1 viable solution to prevent pandemic-generated respirator shortages.

11. Flammability of Respirators and other Head and Facial Personal Protective Equipment.

Authors Rengasamy, Samy; Niezgoda, George; Shaffer, Ron
Source Journal of the International Society for Respiratory Protection; 2018; vol. 35 (no. 1); p. 1-13
Publication Date 2018
Publication Type(s) Journal Article
PubMedID 30364752
Database Medline
Available at Journal of the International Society for Respiratory Protection from PubMed
Available at Journal of the International Society for Respiratory Protection from PubMed Central

Abstract BackgroundPersonal protective equipment (PPE) is worn by workers in surgical settings to protect them and patients. Food and Drug Administration (FDA) clears some PPE (e.g., surgical masks (SM)) as class II medical devices, and regulates some (e.g. surgical head cover) as class I exempt devices. For respiratory protection, National Institute for Occupational Safety and Health (NIOSH)-approved N95 filtering facepiece respirators (FFRs), and powered air-purifying respirators (PAPRs) are used. One type of PPE, "surgical N95 respirators", is a NIOSH-approved FFR that is also cleared by the FDA for use in medical settings. The surgical environment poses unique risks such as the potential for surgical fires. As part of its substantial equivalence determination process, FDA requests testing of flammability and other parameters for SM and surgical N95 respirators. A lack of data regarding flammability of PPE used in healthcare exists. We hypothesize that commonly used PPE, regardless of whether regulated and/or cleared by FDA or not, will pass an industry standard such as the 16 CFR 1610 flammability test.MethodsEleven N95 FFR models, eight surgical N95 respirator models, seven SM models, five surgical head cover models, and five PAPR hood models were evaluated for flammability with a 45 degree flammability tester using the 16 CFR 1610 method. Three common fabrics were included for comparison.ResultsAll of the PPE samples regulated/and or cleared by FDA or not, passed the flammability test at class 1 (normal flammability), meaning they are less likely to burn. Only one of the three common fabrics, a cotton fabric at the lowest basis weight, was class 3 (high flammability).ConclusionsThe results obtained in the study suggest that NIOSH-approved N95 FFRs would likely pass the 16 CFR 1610 flammability standard. Moreover, results suggest that NIOSH is capable of undertaking flammability testing using the 16 CFR 1610 standard as the flammability results NIOSH obtained for N95 FFRs were comparable to the results obtained by a third party independent laboratory.

12. How well do N95 respirators protect healthcare providers against aerosolized influenza virus?

Authors Bischoff, Werner E; Turner, JoLyn; Russell, Gregory; Blevins, Maria; Missaiel, Engy; Stehle, John
Source Infection control and hospital epidemiology; Dec 2018 ; p. 1-3
Publication Date Dec 2018
Publication Type(s) Journal Article
PubMedID 30558691
Database Medline
Abstract N95 respirator masks are recommended for protection against respiratory viruses. Despite passing fit-testing 10% of N95 respirator users encountered breakthroughs with exposure to influenza virus compared to full protection provided by a powered air purifying respirator. The current recommendation of N95 respirators should be evaluated for endemic and emerging scenarios.

13. Risk of self-contamination during doffing of personal protective equipment.

Authors Chughtai, Abrar Ahmad; Chen, Xin; Macintyre, Chandini Raina
Source American journal of infection control; Dec 2018; vol. 46 (no. 12); p. 1329-1334
Publication Date Dec 2018
Publication Type(s) Research Support, Non-u.s. Gov't Journal Article
PubMedID 30029796
Database Medline
Abstract BACKGROUNDThe aim of this study was to describe the risk of self-contamination associated with doffing of personal protective equipment (PPE) and to compare self-contamination with various PPE protocols.METHODSWe tested 10 different PPE donning and doffing protocols, recommended by various health organizations for Ebola. Ten participants were recruited for this study and randomly assigned to use 3 different PPE protocols. After donning of PPE, fluorescent lotion and spray were applied on the external surface of the PPE to simulate contamination, and ultraviolet light was used to count fluorescent patches on the skin.RESULTSAfter testing 30 PPE sequences, large fluorescent patches were recorded after using "WHO coverall and 95" and "North Carolina coverall and N95" sequences, and small patches were recorded after using "CDC coverall and N95" and "Health Canada gown and N95" sequences. Commonly reported problems with PPE use were breathing difficulty, suffocation, heat stress, and fogging-up glasses. Most participants rated PPE high (18/30) or medium (11/30) for ease of donning/doffing and comfort. PPE sequences with powered air-purifying respirators (PAPRs) and assisted doffing were generally associated with fewer problems and were rated the highest.CONCLUSIONThis study confirmed the risk of self-contamination associated with the doffing of PPE. PAPR-containing protocols and assisted doffing should be preferred whenever possible during the outbreak of highly infectious pathogens.

14. Exploring respiratory protection practices for prominent hazards in healthcare settings

Authors Wizner K.; Nasarwanji M.; Fisher E.; Steege A.L.; Boiano J.M.
Source Journal of occupational and environmental hygiene; Aug 2018; vol. 15 (no. 8); p. 588-597
Publication Date Aug 2018
Publication Type(s) Article
PubMedID 29750600
Database EMBASE

Available at Journal of occupational and environmental hygiene from Unpaywall

Abstract The use of respiratory protection, an important component of personal protective equipment (PPE) in healthcare, is dependent on the hazard and environmental conditions in the workplace. This requires the employer and healthcare worker (HCW) to be knowledgeable about potential exposures and their respective protective measures. However, the use of respirators is inconsistent in healthcare settings, potentially putting HCWs at risk for illness or injury. To better understand respirator use, barriers, and influences, the National Institute for Occupational Safety and Health (NIOSH) Health and Safety Practices Survey of Healthcare Workers provided an opportunity to examine self-reported use of respirators and surgical masks for targeted hazards. The hazards of interest included aerosolized medications, antineoplastic drugs, chemical sterilants, high-level disinfectants, influenza-like illness (ILI), and surgical smoke. Of the 10,383 HCWs who reported respiratory protection behaviors, 1,904 (18%) reported wearing a respirator for at least one hazard. Hazard type, job duties, site characteristics, and organizational factors played a greater role in the likelihood of respirator use than individual factors. The proportion of respirator users was highest for aerosolized medications and lowest for chemical sterilants. Most respondents reported using a surgical mask for at least one of the hazards, with highest use for surgical smoke generated by electrosurgical techniques and ILI. The high proportion of respirator non-users who used surgical masks is concerning because HCWs may be using a surgical mask in situations that require a respirator, specifically for surgical smoke. Improved guidance on hazard recognition, risk evaluation, and appropriate respirator selection could potentially help HCWs better understand how to protect themselves at work.

15. Ultraviolet germicidal irradiation of influenza-contaminated N95 filtering facepiece respirators

Authors Mills D.; Harnish D.A.; Lawrence C.; Sandoval-Powers M.; Heimbuch B.K.
Source American Journal of Infection Control; Jul 2018; vol. 46 (no. 7)
Publication Date Jul 2018
Publication Type(s) Article
PubMedID 29678452
Database EMBASE

Available at American journal of infection control from Unpaywall

Abstract Background: Safe and effective decontamination and reuse of N95 filtering facepiece respirators (FFRs) has the potential to significantly extend FFR holdings, mitigating a potential shortage due to an influenza pandemic or other pandemic events. Ultraviolet germicidal irradiation (UVGI) has been shown to be effective for decontaminating influenza-contaminated FFRs. This study aims to build on past research by evaluating the UVGI decontamination efficiency of influenza-contaminated FFRs in the presence of soiling agents using an optimized UVGI dose.
Method(s): Twelve samples each of 15 N95 FFR models were contaminated with H1N1 influenza (facepiece and strap), then covered with a soiling agent-artificial saliva or artificial skin oil. For each soiling agent, 3 contaminated FFRs were treated with 1 J/cm^2 UVGI for approximately 1 minute, whereas 3 other contaminated FFRs remained untreated. All contaminated surfaces were cut out and virus extracted. Viable influenza was quantified using a median tissue culture infectious dose assay.
Result(s): Significant reductions (>=3 log) in influenza viability for both soiling conditions were observed on facepieces from 12 of 15 FFR models and straps from 7 of 15 FFR models.
Conclusion(s): These data suggest that FFR decontamination and reuse using UVGI can be effective. Implementation of a UVGI method will require careful consideration of FFR model, material type, and design.

16. Adherence to protocols by healthcare workers and self-contamination during doffing of personal protective equipment

Authors Lee M.-A.; Huh K.; Jeong J.; Choi E.; Choi J.R.; Cho S.Y.; Chung D.R.
Source American Journal of Infection Control; Jun 2018; vol. 46 (no. 6)
Publication Date Jun 2018
Publication Type(s) Conference Abstract
Database EMBASE

Abstract Background: Self-contamination during the doffing of personal protective equipment (PPE) has been considered a major risk during medical care for patients with high-consequence emerging infectious diseases (HCEID), such as Ebola virus disease. To prevent selfcontamination, strict adherence to the PPE doffing protocols is critical. We sought to evaluate the adherence of HCWs to doffing protocol and the rate of self-contamination.
Method(s): The study was conducted as a part of training of the dedicated response team for HCEID. HCWs donned PPE which consisted of a coverall, an apron, double gloves, a powered air purifying respirator (PAPR), and shoe covers. After donning, trainees conducted various simulated activities including intubation and insertion of central venous catheters. Before doffing the PPE, the surface of PPE was artificially contaminated with fluorescent fluid. Doffing of PPE was monitored by another trainee who verbally instructed each step using a checklist. Performance of each step was recorded by infection preventionists. Self-contamination was evaluated by the visualization of fluorescent fluid on HCWs using a handheld ultraviolet light.
Result(s): A total of 75 subjects were evaluated. At least one violation of protocol was observed in 22.7% of subjects. Most common violation occurred during decontamination of shoes (9.3%), followed by doffing coverall (8.0%), doffing shoe covers (6.7%), visual inspection for gross contamination (5.3%), doffing gloves (4.0%), doffing PAPR (2.7%), and hand hygiene (1.3%). Self-contamination was detected in 64.0% of subjects. The neck was most commonly contaminated (45.3%), followed by arms (28.0%), hands (26.7%), and the head (20.0%). No specific type of violation was shown to be significantly associated with self-contamination. However, all subjects who missed decontamination of gloves or those who failed to properly doff gloves or PAPR were contaminated.
Conclusion(s): Violation of doffing protocol was common during an intensive training session. Self-contamination was also common during PPE doffing.

17. Workplace Respiratory Protection Factors during Asbestos Removal Operations.

Authors Chazelet, Sandrine; Wild, Pascal; Silvente, Eric; Eypert-Blaison, Céline
Source Annals of work exposures and health; May 2018; vol. 62 (no. 5); p. 613-621
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Abstract Numerous changes have been made to the French labour regulations in recent years relating to the prevention of risks of exposure to asbestos fibres for operators removing asbestos-containing materials. These changes refer to the method used to count fibres, the collective and personal protective devices to be used on these worksites, and the occupational exposure limit value, which was reduced to 10 f.L-1 on 2 July 2015. In this context, this study assessed the level of respiratory protection afforded by supplied-air respirators and powered air-purifying respirators by monitoring exposure for several operators on nine worksites. The levels of dustiness measured in personal samples taken outside masks showed significant evidence of potential exposure during removal of asbestos-containing plaster or sprayed asbestos, and when using abrasive blasting to treat asbestos-containing materials. For these tasks outside concentration regularly exceeds 25000 f.L-1. Measurements inside masks were generally low, under 10 f.L-1, except in some situations involving the removal of asbestos-containing plaster. This partial penetration of fibres inside masks could be due to the high loading linked to this material. The distributions of Workplace Protection Factors obtained for the two types of respiratory protective devices studied were broad, and the fifth percentile values equal to 236 and 104, respectively, for supplied-air respirators and powered air-purifying respirators. This work highlights once again the need to prioritize collective protection when seeking to prevent asbestos-related risks.

18. Human Factors Risk Analyses of a Doffing Protocol for Ebola-Level Personal Protective Equipment: Mapping Errors to Contamination.

Authors Mumma, Joel M; Durso, Francis T; Ferguson, Ashley N; Gipson, Christina L; Casanova, Lisa; Erukunuakpor, Kimberly; Kraft, Colleen S; Walsh, Victoria L; Zimring, Craig; DuBose, Jennifer; Jacob, Jesse T; Centers for Disease Control and Prevention Epicenters Program, Division of Healthcare Quality Promotion
Source Clinical infectious diseases : an official publication of the Infectious Diseases Society of America; Mar 2018; vol. 66 (no. 6); p. 950-958
Publication Date Mar 2018
Publication Type(s) Research Support, N.i.h., Extramural Journal Article Research Support, U.s. Gov't, P.h.s.
PubMedID 29471368
Database Medline
Available at Clinical infectious diseases : an official publication of the Infectious Diseases Society of America from Unpaywall

Abstract BackgroundDoffing protocols for personal protective equipment (PPE) are critical for keeping healthcare workers (HCWs) safe during care of patients with Ebola virus disease. We assessed the relationship between errors and self-contamination during doffing.MethodsEleven HCWs experienced with doffing Ebola-level PPE participated in simulations in which HCWs donned PPE marked with surrogate viruses (ϕ6 and MS2), completed a clinical task, and were assessed for contamination after doffing. Simulations were video recorded, and a failure modes and effects analysis and fault tree analyses were performed to identify errors during doffing, quantify their risk (risk index), and predict contamination data.ResultsFifty-one types of errors were identified, many having the potential to spread contamination. Hand hygiene and removing the powered air purifying respirator (PAPR) hood had the highest total risk indexes (111 and 70, respectively) and number of types of errors (9 and 13, respectively). ϕ6 was detected on 10% of scrubs and the fault tree predicted a 10.4% contamination rate, likely occurring when the PAPR hood inadvertently contacted scrubs during removal. MS2 was detected on 10% of hands, 20% of scrubs, and 70% of inner gloves and the predicted rates were 7.3%, 19.4%, 73.4%, respectively. Fault trees for MS2 and ϕ6 contamination suggested similar pathways.ConclusionsEbola-level PPE can both protect and put HCWs at risk for self-contamination throughout the doffing process, even among experienced HCWs doffing with a trained observer. Human factors methodologies can identify error-prone steps, delineate the relationship between errors and self-contamination, and suggest remediation strategies.

19. Development of a Manikin-Based Performance Evaluation Method for Loose-Fitting Powered Air-Purifying Respirators.

Authors Bergman, Mike; Basu, Rohan; Lei, Zhipeng; Niezgoda, George; Zhuang, Ziqing
Source Journal of the International Society for Respiratory Protection; 2017; vol. 34 (no. 1); p. 40-57
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Available at Journal of the International Society for Respiratory Protection from PubMed
Available at Journal of the International Society for Respiratory Protection from PubMed Central

Abstract ObjectiveLoose-fitting powered air-purifying respirators (PAPRs) are increasingly being used in healthcare. NIOSH has previously used advanced manikin headforms to develop methods to evaluate filtering facepiece respirator fit; research has now begun to develop methods to evaluate PAPR performance using headforms. This preliminary study investigated the performance of PAPRs at different work rates to support development of a manikin-based test method.MethodsManikin penetration factors (mPF) of three models of loose-fitting PAPRs were measured at four different work rates (REST: 11 Lpm, LOW: 25 Lpm, MODERATE: 48 Lpm, and HIGH: 88 Lpm) using a medium-sized NIOSH static advanced headform mounted onto a torso. In-mask differential pressure was monitored throughout each test. Two condensation particle counters were used to measure the sodium chloride aerosol concentrations in the test chamber and also inside the PAPR facepiece over a 2-minute sample period. Two test system configurations were evaluated for returning air to the headform in the exhalation cycle (filtered and unfiltered). Geometric mean (GM) and 5th percentile mPFs for each model/work rate combination were computed. Analysis of variance tests were used to assess the variables affecting mPF.ResultsPAPR model, work rate, and test configuration significantly affected PAPR performance. PAPR airflow rates for the three models were approximately 185, 210, and 235 Lpm. All models achieved GM mPFs and 5th percentile mPFs greater than their designated Occupational Safety and Health Administration assigned protection factors despite negative minimum pressures observed for some work rate/model combinations.ConclusionsPAPR model, work rate, and test configuration affect PAPR performance. Advanced headforms have potential for assessing PAPR performance once test methods can be matured. A manikin-based inward leakage test method for PAPRs can be further developed using the knowledge gained from this study. Future studies should vary PAPR airflow rate to better understand the effects on performance. Additional future research is needed to evaluate the correlation of PAPR performance using advanced headforms to the performance measured with human subjects.

20. Filter quality of electret masks in filtering 14.6-594 nm aerosol particles: Effects of five decontamination methods.

Authors Lin, Tzu-Hsien; Chen, Chih-Chieh; Huang, Sheng-Hsiu; Kuo, Chung-Wen; Lai, Chane-Yu; Lin, Wen-Yinn
Source PloS one; 2017; vol. 12 (no. 10); p. e0186217
Publication Date 2017
Publication Type(s) Comparative Study Evaluation Study Journal Article
PubMedID 29023492
Database Medline
Available at PloS one from Europe PubMed Central - Open Access
Available at PloS one from Public Library of Science (PLoS)
Available at PloS one from ProQuest (Health Research Premium) - NHS Version
Available at PloS one from Unpaywall

Abstract This study investigates the effects of five decontamination methods on the filter quality (qf) of three commercially available electret masks-N95, Gauze and Spunlace nonwoven masks. Newly developed evaluation methods, the overall filter quality (qf,o) and the qf ratio were applied to evaluate the effectiveness of decontamination methods for respirators. A scanning mobility particle sizer is utilized to measure the concentration of polydispersed particles with diameter 14.6-594 nm. The penetration of particles and pressure drop (Δp) through the mask are used to determine qf and qf,o. Experimental results reveal that the most penetrating particle size (MPS) for the pre-decontaminated N95, Gauze and Spunlace masks were 118 nm, 461 nm and 279 nm, respectively, and the respective penetration rates were 2.6%, 23.2% and 70.0%. The Δp through the pretreated N95 masks was 9.2 mm H2O at the breathing flow rate of heavy-duty workers, exceeding the Δp values obtained through Gauze and Spunlace masks. Decontamination increased the sizes of the most penetrating particles, changing the qf values of all of the masks: qf fell as particle size increased because the penetration increased. Bleach increased the Δp of N95, but destroyed the Gauze mask. However, the use of an autoclave reduces the Δp values of both the N95 and the Gauze mask. Neither the rice cooker nor ethanol altered the Δp of the Gauze mask. Chemical decontamination methods reduced the qf,o values for the three electret masks. The value of qf,o for PM0.1 exceeded that for PM0.1-0.6, because particles smaller than 100 nm had lower penetration, resulting in a better qf for a given pressure drop. The values of qf,o, particularly for PM0.1, reveal that for the tested treatments and masks, physical decontamination methods are less destructive to the filter than chemical methods. Nevertheless, when purchasing new or reusing FFRs, penetration should be regarded as the priority.

21. Powered air-purifying respirator use in healthcare: Effects on thermal sensations and comfort.

Authors Powell, Jeffrey B; Kim, Jung-Hyun; Roberge, Raymond J
Source Journal of occupational and environmental hygiene; Dec 2017; vol. 14 (no. 12); p. 947-954
Publication Date Dec 2017
Publication Type(s) Comparative Study Journal Article
PubMedID 28763290
Database Medline
Available at Journal of occupational and environmental hygiene from Unpaywall

Abstract Twelve subjects wore an N95 filtering facepiece respirator (N95 FFR), one tight-fitting full facepiece powered air-purifying respirator (PAPR), two loose-fitting PAPRs, and one elastomeric/PAPR hybrid for 1 hr each during treadmill walking at 5.6 km/hr while undergoing physiological and subjective response monitoring. No significant interaction ($p \geq .05$) was noted between the five respirators in heart rate, respiratory rate, oxygen saturation, transcutaneous carbon dioxide, and perceptions of breathing effort or discomfort, exertion, facial heat, and overall body heat. Respirator deadspace heat/humidity were significantly greater for the N95 FFR, whereas tympanic forehead skin temperatures were significantly greater for the hybrid PAPR. Temperature of the facial skin covered by the respirator was equivalent for the N95 FFR and hybrid PAPR, and both were significantly higher than for the other three PAPRs. Perception of eye dryness was significantly greater for a tight-fitting full facepiece PAPR than the N95 FFR and hybrid PAPR. At a low-moderate work rate over 1 hr, effects on cardiopulmonary variables, breathing perceptions, and facial and overall body heat perceptions did not differ significantly between the four PAPRs and a N95 FFR, but the tight-fitting, full facepiece PAPR increased perceptions of eye dryness. The two loose-fitting PAPRs and the full facepiece tight-fitting PAPR ameliorated exercise-induced increases in facial temperature, but this did not translate to improved perception of facial heat and overall body heat.

22. Assessment of half-mask elastomeric respirator and powered air-purifying respirator reprocessing for an influenza pandemic

Authors Lawrence C.; Harnish D.A.; Sandoval-Powers M.; Mills D.; Heimbuch B.K.; Bergman M.
Source American Journal of Infection Control; Dec 2017; vol. 45 (no. 12); p. 1324-1330
Publication Date Dec 2017
Publication Type(s) Article
PubMedID 28844381
Database EMBASE
Available at American journal of infection control from Unpaywall

Abstract Background Health care facilities are considering the use of reusable respiratory protective devices (RPDs) to mitigate a potential N95 filtering facepiece respirator shortage caused by an influenza pandemic. US regulators are also considering stockpiling reusable RPDs for pandemic preparedness, but limited data exist on the effectiveness of cleaning and disinfection of these devices. This study defines reprocessing protocols and evaluates their effectiveness against a pandemic influenza strain in a laboratory setting. Methods Five half-mask elastomeric respirator models and 3 powered air-purifying respirator models were contaminated with influenza virus and artificial skin oil on multiple surfaces. RPDs were then manually treated with 1 of 2 methods: cleaned or cleaned and disinfected. Presence of viable influenza was determined via swab sampling and a median tissue culture infectious dose assay. Results Across 41 RPD surfaces, a mean log reduction in viable influenza of 4.54 +/- 0.97 $\log_{10}$ median tissue culture infectious dose was achieved for all treated surfaces, which included both cleaned and cleaned and disinfected surfaces. Conclusions The methods defined as part of this study are effective for eliminating viable influenza in the presence of artificial skin oil on most of the RPD surfaces tested. Material type and RPD design should be considered when implementing RPD reprocessing protocols.

23. Corrigendum.

Source Workplace health & safety; Aug 2017; vol. 65 (no. 8); p. 380
Publication Date Aug 2017
Publication Type(s) Published Erratum Journal Article
PubMedID 28182860
Database Medline
Available at Workplace health & safety from Unpaywall

Abstract Wizner, K., Stradtman, L., Novak, D., and Shaffer, R. (2016). Prevalence of respiratory protective devices in U.S. healthcare facilities: implications for emergency preparedness. Workplace Health & Safety, 64(8):359-368. (Original DOI: 10.1177/2165079916657108) Information from the Association of State and Territorial Health Officials (ASTHO; 2014) report was incorrectly paraphrased due to a misinterpretation. On p. 363, the original text states, "The ASTHO estimated that in 2014, on average, 21 PAPRs per hospital were available with PAPR purchasing in hospitals increasing from 131,387 purchased in 2011 to more than four million purchased the following year (ASTHO, 2014)." The correct text is as follows: "The ASTHO estimated that, on average, 21 PAPRs per hospital were available with PAPR purchasing in hospitals ranging from 0 to 131,387 between 2011 and 2012 (ASTHO, 2014)."

24. Universal and reusable virus deactivation system for respiratory protection

Authors Quan F.-S.; Rubino I.; Koch B.; Choi H.-J.; Lee S.-H.
Source Scientific reports; Jan 2017; vol. 7 ; p. 39956
Publication Date Jan 2017
Publication Type(s) Article
PubMedID 28051158
Database EMBASE
Available at Scientific reports from Europe PubMed Central - Open Access
Available at Scientific reports from Nature (Open Access)
Available at Scientific reports from ProQuest (Health Research Premium) - NHS Version
Available at Scientific reports from Unpaywall

Abstract Aerosolized pathogens are a leading cause of respiratory infection and transmission. Currently used protective measures pose potential risk of primary/secondary infection and transmission. Here, we report the development of a universal, reusable virus deactivation system by functionalization of the main fibrous filtration unit of surgical mask with sodium chloride salt. The salt coating on the fiber surface dissolves upon exposure to virus aerosols and recrystallizes during drying, destroying the pathogens. When tested with tightly sealed sides, salt-coated filters showed remarkably higher filtration efficiency than conventional mask filtration layer, and 100% survival rate was observed in mice infected with virus penetrated through salt-coated filters. Viruses captured on salt-coated filters exhibited rapid infectivity loss compared to gradual decrease on bare filters. Salt-coated filters proved highly effective in deactivating influenza viruses regardless of subtypes and following storage in harsh environmental conditions. Our results can be applied in obtaining a broad-spectrum, airborne pathogen prevention device in preparation for epidemic and pandemic of respiratory diseases.

25. Performance of an improperly sized and stretched-out loose-fitting powered air-purifying respirator: Manikin-based study.

Authors Gao, Shuang; McKay, Roy T; Yermakov, Michael; Kim, Jinyong; Reponen, Tiina; He, Xinjian; Kimura, Kazushi; Grinshpun, Sergey A
Source Journal of occupational and environmental hygiene; 2016; vol. 13 (no. 3); p. 169-176
Publication Date 2016
Publication Type(s) Research Support, Non-u.s. Gov't Evaluation Study Journal Article
PubMedID 26554716

Database Medline
Abstract The objective of this study was to investigate the protection level offered by a Powered Air-Purifying Respirator (PAPR) equipped with an improperly sized or stretched-out loose-fitting facepiece using constant and cyclic flow conditions. Improperly sized PAPR facepieces of two models as well as a stretched-out facepiece were tested. These facepieces were examined in two versions: with and without exhaust holes. Loose-fitting facepieces (size "large") were donned on a small manikin headform and challenged with sodium chloride (NaCl) aerosol particles in an exposure chamber. Four cyclic flows with mean inspiratory flows (MIFs) of 30, 55, 85, and 135 L/min were applied using an electromechanical Breathing Recording and Simulation System (BRSS). The manikin Fit Factor (mFF) was determined as the ratio of aerosol concentrations outside (Cout) to inside (Cin) of the facepiece, measured with a P-Trak condensation particle counter (CPC). Results showed that the mFF decreased exponentially with increasing MIF. The mFF values of the stretched-out facepiece were significantly lower than those obtained for the undamaged ones. Facepiece type and MIF were found to significantly affect the performance of the loose-fitting PAPR. The effect of the exhaust holes was less pronounced and depended on the facepiece type. It was concluded that an improperly sized facepiece might potentially offer relatively low protection (mFF < 250) at high to strenuous workloads. The testing was also performed at a constant inhalation flow to explore the mechanism of the particle-facepiece interaction. Results obtained with cyclic flow pattern were consistent with the data generated when testing the loose-fitting PAPR under constant flow conditions. The time-weighted average values of mFF calculated from the measurements conducted under the constant flow regime were capable of predicting the protection under cyclic flow regime. The findings suggest that program administrators need to equip employees with properly sized facepieces and remove stretched-out ones from workplace. Manufacturers should emphasize the importance of proper sizing with their user instructions.

26. Respiratory Protection Toolkit: Providing Guidance Without Changing Requirements-Can We Make an Impact?

Authors Bien, Elizabeth Ann; Gillespie, Gordon Lee; Betcher, Cynthia Ann; Thrasher, Terri L; Mingerink, Donna R
Source Workplace health & safety; Dec 2016; vol. 64 (no. 12); p. 596-602
Publication Date Dec 2016
Publication Type(s) Journal Article
PubMedID 27439880
Database Medline
Available at Workplace health & safety from Unpaywall
Abstract International travel and infectious respiratory illnesses worldwide place health care workers (HCWs) at increasing risk of respiratory exposures. To ensure the highest quality safety initiatives, one health care system used a quality improvement model of Plan-Do-Study-Act and guidance from Occupational Safety and Health Administration's (OSHA) May 2015 Hospital Respiratory Protection Program (RPP) Toolkit to assess a current program. The toolkit aided in identification of opportunities for improvement within their well-designed RPP. One opportunity was requiring respirator use during aerosol-generating procedures for specific infectious illnesses. Observation data demonstrated opportunities to mitigate controllable risks including strap placement, user seal check, and reuse of disposable N95 filtering facepiece respirators. Subsequent interdisciplinary collaboration resulted in other ideas to decrease risks and increase protection from potentially infectious respiratory illnesses. The toolkit's comprehensive document to evaluate the program showed that while the OSHA standards have not changed, the addition of the toolkit can better protect HCWs.

27. Harnessing the Powered Air Purifying Respirator.

Authors Varsamis, Paula
Source Occupational health & safety (Waco, Tex.); Nov 2016; vol. 85 (no. 11); p. 28-29
Publication Date Nov 2016
Publication Type(s) Journal Article
PubMedID 30281259
Database Medline
Abstract Differentiating between contaminants that are gaseous or dust can be crucial in ensuring your PAPR is the proper PAPR.

28. Prevalence of Respiratory Protective Devices in U.S. Health Care Facilities: Implications for Emergency Preparedness.

Authors Wizner, Kerri; Stradtman, Lindsay; Novak, Debra; Shaffer, Ronald
Source Workplace health & safety; Aug 2016; vol. 64 (no. 8); p. 359-368
Publication Date Aug 2016
Publication Type(s) Journal Article
PubMedID 27462029
Database Medline
Available at Workplace health & safety from Unpaywall

Abstract An online questionnaire was developed to explore respiratory protective device (RPD) prevalence in U.S. health care facilities. The survey was distributed to professional nursing society members in 2014 and again in 2015 receiving 322 and 232 participant responses, respectively. The purpose of this study was to explore if the emergency preparedness climate associated with Ebola virus disease changed the landscape of RPD use and awareness. Comparing response percentages from the two sampling time frames using bivariate analysis, no significant changes were found in types of RPDs used in health care settings. N95 filtering facepiece respirators continue to be the most prevalent RPD used in health care facilities, but powered air-purifying respirators are also popular, with regional use highest in the West and Midwest. Understanding RPD use prevalence could ensure that health care workers receive appropriate device trainings as well as improve supply matching for emergency RPD stockpiling.

29. Personal protective equipment for preventing highly infectious diseases due to exposure to contaminated body fluids in healthcare staff.

Authors Verbeek, Jos H; Ijaz, Sharea; Mischke, Christina; Ruotsalainen, Jani H; Mäkelä, Erja; Neuvonen, Kaisa; Edmond, Michael B; Sauni, Riitta; Kilinc Balci, F Selcen; Mihalache, Raluca C
Source The Cochrane database of systematic reviews; Apr 2016; vol. 4 ; p. CD011621
Publication Date Apr 2016
Publication Type(s) Research Support, Non-u.s. Gov't Journal Article Review Systematic Review
PubMedID 27093058
Database Medline
Available at The Cochrane database of systematic reviews from Cochrane Collaboration (Wiley)

Abstract BACKGROUNDIn epidemics of highly infectious diseases, such as Ebola Virus Disease (EVD) or SARS, healthcare workers (HCW) are at much greater risk of infection than the general population, due to their contact with patients' contaminated body fluids. Contact precautions by means of personal protective equipment (PPE) can reduce the risk. It is unclear which type of PPE protects best, what is the best way to remove PPE, and how to make sure HCWs use PPE as instructed.OBJECTIVESTo evaluate which type or component of full-body PPE and which method of donning or removing (doffing) PPE have the least risk of self-contamination or infection for HCWs, and which training methods most increase compliance with PPE protocols.SEARCH METHODSWe searched MEDLINE (PubMed up to 8 January 2016), Cochrane Central Register of Trials (CENTRAL up to 20 January 2016), EMBASE (embase.com up to 8 January 2016), CINAHL (EBSCOhost up to 20 January 2016), and OSH-Update up to 8 January 2016. We also screened reference lists of included trials and relevant reviews, and contacted NGOs and manufacturers of PPE.SELECTION CRITERIAWe included all eligible controlled studies that compared the effect of types or components of PPE in HCWs exposed to highly infectious diseases with serious consequences, such as EVD and SARS, on the risk of infection, contamination, or noncompliance with protocols. This included studies that simulated contamination with fluorescent markers or a non-pathogenic virus.We also included studies that compared the effect of various ways of donning or removing PPE, and the effects of various types of training in PPE use on the same outcomes.DATA COLLECTION AND ANALYSISTwo authors independently selected studies, extracted data and assessed risk of bias in included trials. We intended to perform meta-analyses but we did not find sufficiently similar studies to combine their results.MAIN RESULTSWe included nine studies with 1200 participants evaluating ten interventions. Of these, eight trials simulated the exposure with a fluorescent marker or virus or bacteria containing fluids. Five studies evaluated different types of PPE against each other but two did not report sufficient data. Another two studies compared different types of donning and doffing and three studies evaluated the effect of different types of training.None of the included studies reported a standardised classification of the protective properties against viral penetration of the PPE, and only one reported the brand of PPE used. None of the studies were conducted with HCWs exposed to EVD but in one study participants were exposed to SARS. Different types of PPE versus each otherIn simulation studies, contamination rates varied from 25% to 100% of participants for all types of PPE. In one study, PPE made of more breathable material did not lead to a statistically significantly different number of spots with contamination but did have greater user satisfaction (Mean Difference (MD) -0.46 (95% Confidence Interval (CI) -0.84 to -0.08, range 1 to 5, very low quality evidence). In another study, gowns protected better than aprons. In yet another study, the use of a powered air-purifying respirator protected better than a now outdated form of PPE. There were no studies on goggles versus face shields, on long- versus short-sleeved gloves, or on the use of taping PPE parts together. Different methods of donning and doffing procedures versus each otherTwo cross-over simulation studies (one RCT, one CCT) compared different methods for donning and doffing against each other. Double gloving led to less contamination compared to single gloving (Relative Risk (RR) 0.36; 95% CI 0.16 to 0.78, very low quality evidence) in one simulation study, but not to more noncompliance with guidance (RR 1.08; 95% CI 0.70 to 1.67, very low quality evidence). Following CDC recommendations for doffing led to less contamination in another study (very low quality evidence). There were no studies on the use of disinfectants while doffing. Different types of training versus each otherIn one study, the use of additional computer simulation led to less errors in doffing (MD -1.2, 95% CI -1.6 to -0.7) and in another study additional spoken instruction led to less errors (MD -0.9, 95% CI -1.4 to -0.4). One retrospective cohort study assessed the effect of active training - defined as face-to-face instruction - versus passive training - defined as folders or videos - on noncompliance with PPE use and on noncompliance with doffing guidance. Active training did not considerably reduce noncompliance in PPE use (Odds Ratio (OR) 0.63; 95% CI 0.31 to 1.30) but reduced noncompliance with doffing procedures (OR 0.45; 95% CI 0.21 to 0.98, very low quality evidence). There were no studies on how to retain the results of training in the long term or on resource use.The quality of the evidence was very low for all comparisons because of high risk of bias in studies, indirectness of evidence, and small numbers of participants. This means that it is likely that the true effect can be substantially different from the one reported here.AUTHORS' CONCLUSIONSWe found very low quality evidence that more breathable types of PPE may not lead to more contamination, but may have greater user satisfaction. We also found very low quality evidence that double gloving and CDC doffing guidance appear to decrease the risk of contamination and that more active training in PPE use may reduce PPE and doffing errors more than passive training. However, the data all come from single studies with high risk of bias and we are uncertain about the estimates of effects.We need simulation studies conducted with several dozens of participants, preferably using a non-pathogenic virus, to find out which type and combination of PPE protects best, and what is the best way to remove PPE. We also need randomised controlled studies of the effects of one type of training versus another to find out which training works best in the long term. HCWs exposed to highly infectious diseases should have their use of PPE registered and should be prospectively followed for their risk of infection.

30. Disinfection of reusable elastomeric respirators by health care workers: A feasibility study and development of standard operating procedure.

Authors Bessesen, Mary T; Adams, Jill C; Radonovich, Lewis; Anderson, Judith
Source American journal of infection control; Dec 2015; vol. 43 (no. 12); p. 1376
Publication Date Dec 2015

Publication Type(s) Letter
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31. Contamination during doffing of personal protective equipment by healthcare providers.

Authors Lim, Seong Mi; Cha, Won Chul; Chae, Minjung Kathy; Jo, Ik Joon
Source Clinical and experimental emergency medicine; Sep 2015; vol. 2 (no. 3); p. 162-167
Publication Date Sep 2015
Publication Type(s) Journal Article
PubMedID 27752591
Database Medline
Abstract OBJECTIVEIn this study, we aimed to describe the processes of both the donning and the doffing of personal protective equipment for Ebola and evaluate contamination during the doffing process.METHODSWe recruited study participants among physicians and nurses of the emergency department of Samsung Medical Center in Seoul, Korea. Participants were asked to carry out doffing and donning procedures with a helper after a 50-minute brief training and demonstration based on the 2014 Centers for Disease Control and Prevention protocol. Two separate cameras with high-density capability were set up, and the donning and doffing processes were video-taped. A trained examiner inspected all video recordings and coded for intervals, errors, and contaminations defined as the outside of the equipment touching the clinician's body surface.RESULTSOverall, 29 participants were enrolled. Twenty (68.9%) were female, and the mean age was 29.2 years. For the donning process, the average interval until the end was 234.2 seconds (standard deviation [SD], 65.7), and the most frequent errors occurred when putting on the outer gloves (27.5%), respirator (20.6%), and hood (20.6%). For the doffing process, the average interval until the end was 183.7 seconds (SD, 38.4), and the most frequent errors occurred during disinfecting the feet (37.9%), discarding the scrubs (17.2%), and putting on gloves (13.7%), respectively. During the doffing process, 65 incidences of contamination occurred (2.2 incidents/person). The most vulnerable processes were removing respirators (79.2%), removing the shoe covers (65.5%), and removal of the hood (41.3%).CONCLUSIONA significant number of contaminations occur during the doffing process of personal protective equipment.

32. Clinician Beliefs and Attitudes Regarding Use of Respiratory Protective Devices and Surgical Masks for Influenza

Authors Pillai S.K.; Beekmann S.E.; Babcock H.M.; Pavia A.T.; Koonin L.M.; Polgreen P.M.
Source Health security; Jul 2015; vol. 13 (no. 4); p. 274-280
Publication Date Jul 2015
Publication Type(s) Article
PubMedID 26173092
Database EMBASE
Available at Health security from Unpaywall
Abstract While influenza transmission is thought to occur primarily by droplet spread, the role of airborne spread remains uncertain. Understanding the beliefs and attitudes of infectious disease physicians regarding influenza transmission and respiratory and barrier protection preferences can provide insights into workplace decisions regarding respiratory protection planning. Physicians participating in the Infectious Diseases Society of America's Emerging Infections Network were queried in November 2013 to determine beliefs and attitudes on influenza transmission. A subset of physicians involved in their facility's respiratory protection decision making were queried about respirator and surgical mask choices under various pandemic scenarios; availability of, and challenges associated with, respirators in their facility; and protective strategies during disposable N95 shortages. The majority of 686 respondents (98%) believed influenza transmission occurs frequently or occasionally via droplets; 44% of respondents believed transmission occurs via small particles frequently (12%) or occasionally (32%). Among the subset of respondents involved in respiratory protection planning at their facility, over 90% preferred surgical masks during provision of non-aerosol-generating patient care for seasonal influenza. However, for the same type of care during an influenza pandemic, two-thirds of respondents opted for disposable N95 filtering facepiece respirators. In settings where filtering facepiece (disposable) N95 respirators were in short supply, preferred conservation strategies included extended use and reuse of disposable N95s. Use of reusable (elastomeric facepiece) respirator types was viewed less favorably. While respondents identified droplets as the primary mode of influenza transmission, during a high-severity pandemic scenario there was increased support for devices that reduced aerosol-based transmission. Use of potentially less familiar respirator types may partially relieve shortages of disposable N95s but also may require significant education efforts so that clinicians are aware of the characteristics of alternative personal protective equipment.

33. Disinfection of reusable elastomeric respirators by health care workers: A feasibility study and development of standard operating procedures

Authors Bessesen M.T.; Adams J.C.; Anderson J.; Radonovich L.

Source American Journal of Infection Control; Jun 2015; vol. 43 (no. 6); p. 629-634
Publication Date Jun 2015
Publication Type(s) Article
PubMedID 25816692
Database EMBASE
Available at American journal of infection control from Unpaywall

Abstract Background This was a feasibility study in a Department of Veterans Affairs Medical Center to develop a standard operating procedure (SOP) to be used by health care workers to disinfect reusable elastomeric respirators under pandemic conditions. Registered and licensed practical nurses, nurse practitioners, aides, clinical technicians, and physicians took part in the study. Methods Health care worker volunteers were provided with manufacturers' cleaning and disinfection instructions and all necessary supplies. They were observed and filmed. SOPs were developed, based on these observations, and tested on naive volunteer health care workers. Error rates using manufacturers' instructions and SOPs were compared. Results When using respirator manufacturers' cleaning and disinfection instructions, without specific training or supervision, all subjects made multiple errors. When using the SOPs developed in the study, without specific training or guidance, naive health care workers disinfected respirators with zero errors. Conclusion Reusable facial protective equipment may be disinfected by health care workers with minimal training using SOPs.

34. To PAPR or not to PAPR?

Authors Roberts, Vanessa
Source Canadian journal of respiratory therapy : CJRT = Revue canadienne de la therapie respiratoire : RCTR; 2014; vol. 50 (no. 3); p. 87-90
Publication Date 2014
Publication Type(s) Journal Article Review
PubMedID 26078617
Database Medline
Available at Canadian journal of respiratory therapy : CJRT = Revue canadienne de la therapie respiratoire : RCTR from PubMed
Available at Canadian journal of respiratory therapy : CJRT = Revue canadienne de la therapie respiratoire : RCTR from pulsus.com
Available at Canadian journal of respiratory therapy : CJRT = Revue canadienne de la therapie respiratoire : RCTR from PubMed Central

Abstract The present outbreak of Ebola has health care professionals seeking guidance on isolation precautions for routine care and aerosol-generating procedures (AGPs). The most recent guidelines state that during AGPs, health care professionals should wear respiratory protection at least as protective as a National Institute for Occupational Safety and Health-certified fit tested N95 filtering face piece respirator or higher; for example, a powered air-purifying respirator (PAPR). 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. Training programs on proper donning and doffing of personal protective equipment and quality control systems need to be in place. Respiratory therapists are frontline during AGPs and need to be active in the decision making of the type of equipment chosen to protect them.

35. Considerations for recommending extended use and limited reuse of filtering facepiece respirators in health care settings.

Authors Fisher, Edward M; Shaffer, Ronald E
Source Journal of occupational and environmental hygiene; 2014; vol. 11 (no. 8); p. D115
Publication Date 2014
Publication Type(s) Journal Article
PubMedID 24628658
Database Medline
Available at Journal of occupational and environmental hygiene from Unpaywall

Abstract Public health organizations, such as the Centers for Disease Control and Prevention (CDC), are increasingly recommending the use of N95 filtering facepiece respirators (FFRs) in health care settings. For infection control purposes, the usual practice is to discard FFRs after close contact with a patient ("single use"). However, in some situations, such as during contact with tuberculosis patients, limited FFR reuse (i.e., repeated donning and doffing of the same FFR by the same person) is practiced. A related practice, extended use, involves wearing the same FFR for multiple patient encounters without doffing. Extended use and limited FFR reuse have been recommended during infectious disease outbreaks and pandemics to conserve FFR supplies. This commentary examines CDC recommendations related to FFR extended use and limited reuse and analyzes available data from the literature to provide a relative estimate of the risks of these practices compared to single use. Analysis of the available data and the use of disease transmission models indicate that decisions regarding whether FFR extended use or reuse should be recommended should continue to be pathogen- and event-specific. Factors to be included in developing the recommendations are the potential for the pathogen to spread via contact transmission, the potential that the event could result in or is currently causing a FFR shortage, the protection provided by FFR use, human factors, potential for self-inoculation, the potential for secondary exposures, and government policies and regulations. While recent findings largely support the previous recommendations for extended use and limited reuse in certain situations, some new cautions and limitations should be considered before issuing recommendations in the future. In general, extended use of FFRs is preferred over limited FFR reuse. Limited FFR reuse would allow the user a brief respite from extended wear times, but increases the risk of self-inoculation and preliminary data from one study suggest that some FFR models may begin to lose effectiveness after multiple donnings.

36. Powered air purifying respirators: versatility beyond respiratory protection.

Authors Cuta, Karen
Source Occupational health & safety (Waco, Tex.); Nov 2014; vol. 83 (no. 11); p. 20-21
Publication Date Nov 2014
Publication Type(s) Journal Article
PubMedID 25980243
Database Medline

37. Effectiveness of common healthcare disinfectants against H1N1 influenza virus on reusable elastomeric respirators.

Authors Subhash, Shobha S; Cavaiuolo, Maria; Radonovich, Lewis J; Eagan, Aaron; Lee, Martin L; Campbell, Sheldon; Martinello, Richard A
Source Infection control and hospital epidemiology; Jul 2014; vol. 35 (no. 7); p. 894-897
Publication Date Jul 2014
Publication Type(s) Research Support, U.s. Gov't, Non-p.h.s. Evaluation Study Journal Article
PubMedID 24915224
Database Medline
Abstract This study evaluated the efficacy of 3 common hospital disinfectants to inactivate influenza virus on elastomeric respirators. Quaternary ammonium/isopropyl alcohol and bleach detergent wipes eliminated live virus, whereas 70% isopropyl alcohol alone was ineffective.

38. The effects of wearing respirators on human fine motor, visual, and cognitive performance.

Authors AlGhamri, Anas A; Murray, Susan L; Samaranayake, V A
Source Ergonomics; 2013; vol. 56 (no. 5); p. 791-802
Publication Date 2013
Publication Type(s) Journal Article
PubMedID 23514088
Database Medline
Abstract UNLABELLEDWhen selecting a respirator, it is important to understand how employees' motor, visual and cognitive abilities are impacted by the personal protective equipment. This study compares dust, powered-air-purifying and full-face, negative-pressure respirators. Thirty participants performed three varied tasks. Each participant performed each task without a respirator and while wearing the three respirator types. The tasks included a hand tool dexterity test, the Motor-Free Visual Perception Test and the Serial Sevens Test to evaluate fine motor, visual and cognitive performance, respectively. The time required for task completion and the errors made were measured. Analysis showed no significant effect due to respirator use on the task completion time. A significant increase was found in the error rate when participants performed the cognitive test wearing the full-face, negative-pressure respirator. Participants had varying respirator preferences. They indicated a potential for full-face, negative-pressure respirators to negatively affect jobs demanding high cognitive skills such as problem solving and decision-making.PRACTITIONER SUMMARYwhile respirators are life-saving personal protective equipment (PPE), they can unintentionally reduce human performance, especially if job characteristics are not considered during PPE selection. An experiment was conducted to compare three respirators (dust respirator, powered-air-purifying respirators and full-face respirator) for varying task types. The full-face respirator was found to affect human cognitive performance negatively.

39. Availability, consistency and evidence-base of policies and guidelines on the use of mask and respirator to protect hospital health care workers: a global analysis

Authors Chughtai A.A.; Seale H.; MacIntyre C.R.
Source BMC research notes; 2013; vol. 6 ; p. 216
Publication Date 2013
Publication Type(s) Article
PubMedID 23725338
Database EMBASE
Available at BMC research notes from BioMed Central
Available at BMC research notes from Europe PubMed Central - Open Access
Available at BMC research notes from Unpaywall
Abstract Currently there is an ongoing debate and limited evidence on the use of masks and respirators for the prevention of respiratory infections in health care workers (HCWs). This study aimed to examine available policies and guidelines around the use of masks and respirators in HCWs and to describe areas of consistency between guidelines, as well as gaps in the recommendations, with reference to the WHO and the CDC guidelines. Policies and guidelines related to mask and respirator use for the prevention of influenza, SARS and TB were examined. Guidelines from the World Health Organization (WHO), the Center for Disease Control and Prevention (CDC), three high-income countries and six low/middle-income countries were selected. Uniform recommendations are made by the WHO and the CDC in regards to protecting HCWs against seasonal influenza (a mask for low risk situations and a respirator for high risk situations) and TB (use of a respirator). However, for pandemic influenza and SARS, the WHO recommends mask use in low risk and respirators in high risk situations, whereas, the CDC recommends respirators in both low and high risk situations. Amongst the nine countries reviewed, there are variations in the recommendations for all three diseases. While, some countries align with the WHO recommendations, others align with those made by the CDC. The choice of respirator and the level of filtering ability vary amongst the guidelines and the different diseases. Lastly, none of the policies discuss reuse, extended use or the use of cloth masks. Currently, there are significant variations in the policies and recommendations around mask and respirator use for protection against influenza, SARS and TB. These differences may reflect the scarcity of level-one evidence available to inform policy development. The lack of any guidelines on the use of cloth masks, despite widespread use in many low and middle-income countries, remains a policy gap. Health organizations and countries should jointly evaluate the available evidence, prioritize research to inform evidence gaps, and develop consistent policy on masks and respirator use in the health care setting.

40. Impact of multiple consecutive donnings on filtering facepiece respirator fit.

Authors Bergman, Michael S; Viscusi, Dennis J; Zhuang, Ziqing; Palmiero, Andrew J; Powell, Jeffrey B; Shaffer, Ronald E
Source American journal of infection control; May 2012; vol. 40 (no. 4); p. 375-380
Publication Date May 2012
Publication Type(s) Journal Article
PubMedID 21864945
Database Medline
Abstract BACKGROUNDA concern with reuse of National Institute for Occupational Safety and Health-certified N95 filtering facepiece respirators (FFRs) is that multiple donnings could stress FFR components, impairing fit. This study investigated the impact of multiple donnings on the facepiece fit of 6 N95 FFR models using a group of 10 experienced test subjects per model.METHODSThe TSI PORTACOUNT Plus and N95 Companion accessory were used for all tests. After qualifying by passing a standard Occupational Safety and Health Administration fit test, subjects performed up to 20 consecutive tests on an individual FFR sample using a modified protocol. Regression analyses were performed for the percentage of donnings resulting in fit factors (FFs) ≥100 for all 6 FFR models combined.RESULTSRegression analyses showed statistical significance for donning groups 1-10, 1-15, and 1-20. The mean percentage of donnings with an FF ≥100 was 81%-93% for donning group 1-5, but dropped to 53%-75% for donning group 16-20.CONCLUSIONSOur results show that multiple donnings had a model-dependent impact on fit for the 6 N95 models evaluated. The data suggest that 5 consecutive donnings can be performed before FFs consistently drop below 100.

41. Effectiveness of three decontamination treatments against influenza virus applied to filtering facepiece respirators.

Authors Lore, Michael B; Heimbuch, Brian K; Brown, Teanne L; Wander, Joseph D; Hinrichs, Steven H
Source The Annals of occupational hygiene; Jan 2012; vol. 56 (no. 1); p. 92-101
Publication Date Jan 2012
Publication Type(s) Research Support, U.s. Gov't, Non-p.h.s. Journal Article
PubMedID 21859950
Database Medline
Available at The Annals of occupational hygiene from HighWire - Free Full Text
Available at The Annals of occupational hygiene from Unpaywall

Abstract Filtering facepiece respirators (FFRs) are recommended for use as precautions against airborne pathogenic microorganisms; however, during pandemics demand for FFRs may far exceed availability. Reuse of FFRs following decontamination has been proposed but few reported studies have addressed the feasibility. Concerns regarding biocidal efficacy, respirator performance post decontamination, decontamination cost, and user safety have impeded adoption of reuse measures. This study examined the effectiveness of three energetic decontamination methods [ultraviolet germicidal irradiation (UVGI), microwave-generated steam, and moist heat] on two National Institute for Occupational Safety and Health-certified N95 FFRs (3M models 1860s and 1870) contaminated with H5N1. An aerosol settling chamber was used to apply virus-laden droplets to FFRs in a method designed to simulate respiratory deposition of droplets onto surfaces. When FFRs were examined post decontamination by viral culture, all three decontamination methods were effective, reducing virus load by > 4 log median tissue culture infective dose. Analysis of treated FFRs using a quantitative molecular amplification assay (quantitative real-time polymerase chain reaction) indicated that UVGI decontamination resulted in lower levels of detectable viral RNA than the other two methods. Filter performance was evaluated before and after decontamination using a 1% NaCl aerosol. As all FFRs displayed <5% penetration by 300-nm particles, no profound reduction in filtration performance was caused in the FFRs tested by exposure to virus and subsequent decontamination by the methods used. These findings indicate that, when properly implemented, these methods effectively decontaminate H5N1 on the two FFR models tested and do not drastically affect their filtering function; however, other considerations may influence decisions to reuse FFRs.

42. Inward leakage in tight-fitting PAPRs.

Authors Koh, Frank C; Johnson, Arthur T; Rehak, Timothy E
Source Journal of environmental and public health; 2011; vol. 2011 ; p. 473143
Publication Date 2011
Publication Type(s) Comparative Study Evaluation Study Journal Article Research Support, U.s. Gov't, P.h.s.
PubMedID 21647352
Database Medline
Available at Journal of environmental and public health from Europe PubMed Central - Open Access
Available at Journal of environmental and public health from Hindawi Open Access Journals
Available at Journal of environmental and public health from Unpaywall
Abstract A combination of local flow measurement techniques and fog flow visualization was used to determine the inward leakage for two tight-fitting powered air-purifying respirators (PAPRs), the 3M Breathe-Easy PAPR and the SE 400 breathing demand PAPR. The PAPRs were mounted on a breathing machine head form, and flows were measured from the blower and into the breathing machine. Both respirators leaked a little at the beginning of inhalation, probably through their exhalation valves. In both cases, the leakage was not enough for fog to appear at the mouth of the head form.

43. Estimating reusability of organic air-purifying respirator cartridges.

Authors Wood, Gerry O; Snyder, Jay L
Source Journal of occupational and environmental hygiene; Oct 2011; vol. 8 (no. 10); p. 609-617
Publication Date Oct 2011
Publication Type(s) Journal Article
PubMedID 21936700
Database Medline
Abstract Reuse of organic vapor air-purifying respirator cartridges after a job or shift can provide economy and energy savings. However, standards and manufacturers' guidance discourage reuse, presumably due to a lack of quantitative objective exposure and use information. Storage and simulated reuse laboratory studies and modeling have been done to provide such information. Two important parameters of breakthrough curves, midpoint time (related to adsorption capacity) and midpoint slope (related to adsorption rate), have been shown to be unchanged during storage for reuse. Extrapolations to smaller breakthrough concentrations and times can be made from this reference breakthrough and time. Significant step increases in breakthrough concentration upon cartridge reuse have been observed in some cases. Values of immediate breakthrough concentrations upon reuse (IBURs) have been measured and correlated. The Dubinin/Radushkevich adsorption isotherm equation has been used to estimate maximum IBURs, which depend on many factors, including conditions and duration of first use. An empirical equation describing rate of approach to maximum IBUR as a function of storage time has been developed to provide intermediate IBUR estimates, which are also very dependent on the vapor identity and extent of first-use loading. Using these equations, IBUR estimates with appropriate safety factors can be compared with the allowable breakthrough concentration to help the Industrial Hygienist make reusability decisions.

44. Impact of three biological decontamination methods on filtering facepiece respirator fit, odor, comfort, and donning ease.

Authors Viscusi, Dennis J; Bergman, Michael S; Novak, Debra A; Faulkner, Kimberly A; Palmiero, Andrew; Powell, Jeffrey; Shaffer, Ronald E
Source Journal of occupational and environmental hygiene; Jul 2011; vol. 8 (no. 7); p. 426-436

Publication Date Jul 2011
Publication Type(s) Comparative Study Research Support, U.s. Gov't, Non-p.h.s. Evaluation Study Journal Article
PubMedID 21732856
Database Medline
Abstract The objective of this study was to determine if ultraviolet germicidal irradiation (UVGI), moist heat incubation (MHI), or microwave-generated steam (MGS) decontamination affects the fitting characteristics, odor, comfort, or donning ease of six N95 filtering facepiece respirator (FFR) models. For each model, 10 experienced test subjects qualified for the study by passing a standard OSHA quantitative fit test. Once qualified, each subject performed a series of fit tests to assess respirator fit and completed surveys to evaluate odor, comfort, and donning ease with FFRs that were not decontaminated (controls) and with FFRs of the same model that had been decontaminated. Respirator fit was quantitatively measured using a multidonning protocol with the TSI PORTACOUNT Plus and the N95 Companion accessory (designed to count only particles resulting from face to face-seal leakage). Participants' subjective appraisals of the respirator's odor, comfort, and donning ease were captured using a visual analog scale survey. Wilcoxon signed rank tests compared median values for fit, odor, comfort, and donning ease for each FFR and decontamination method against their respective controls for a given model. Two of the six FFRs demonstrated a statistically significant reduction ($p < 0.05$) in fit after MHI decontamination. However, for these two FFR models, post-decontamination mean fit factors were still ≥ 100. One of the other FFRs demonstrated a relatively small though statistically significant increase ($p < 0.05$) in median odor response after MHI decontamination. These data suggest that FFR users with characteristics similar to those in this study population would be unlikely to experience a clinically meaningful reduction in fit, increase in odor, increase in discomfort, or increased difficulty in donning with the six FFRs included in this study after UVGI, MHI, or MGS decontamination. Further research is needed before decontamination of N95 FFRs for purposes of reuse can be recommended.

45. A method to determine the available UV-C dose for the decontamination of filtering facepiece respirators.

Authors Fisher, E M; Shaffer, R E
Source Journal of applied microbiology; Jan 2011; vol. 110 (no. 1); p. 287-295
Publication Date Jan 2011
Publication Type(s) Journal Article
PubMedID 21054699
Database Medline
Available at Journal of applied microbiology from IngentaConnect - Open Access
Available at Journal of applied microbiology from Wiley Online Library Free Content - NHS
Abstract AIMSTo develop a method to assess model-specific parameters for ultraviolet-C (UV-C, 254 nm) decontamination of filtering facepiece respirators (FFRs).METHODS AND RESULTSUV-C transmittance was quantified for the distinct composite layers of six N95 FFR models and used to calculate model-specific α-values, the percentage of the surface UV-C irradiance available for the internal filtering medium (IFM). Circular coupons, excised from the FFRs, were exposed to aerosolized particles containing MS2 coliphage and treated with IFM-specific UV-C doses ranging from 38 to 4707 J m(-2). Models exposed to a minimum IFM dose of 1000 J m(-2) demonstrated at least a 3 log reduction (LR) in viable MS2. Model-specific exposure times to achieve this IFM dose ranged from 2 to 266 min.CONCLUSIONSUV-C transmits into and through FFR materials. LR of MS2 was a function of model-specific IFM UV-C doses.SIGNIFICANCE AND IMPACT OF THE STUDYFiltering facepiece respirators are in high demand during infectious disease outbreaks, potentially leading to supply shortages. Reuse of disposable FFRs after decontamination has been discussed as a possible remediation strategy, but to date lacks supporting scientific evidence. The methods described here can be used to assess the likelihood that UV-C decontamination will be successful for specific FFR models.

46. Special article: personal protective equipment for care of pandemic influenza patients: a training workshop for the powered air purifying respirator.

Authors Tompkins, Bonnie M; Kerchberger, John P
Source Anesthesia and analgesia; Oct 2010; vol. 111 (no. 4); p. 933-945
Publication Date Oct 2010
Publication Type(s) Journal Article
PubMedID 20810676
Database Medline
Available at Anesthesia and analgesia from Ovid (Journals @ Ovid) - Remote Access

Abstract Virulent respiratory infectious diseases may present a life-threatening risk for health care professionals during aerosol-generating procedures, including endotracheal intubation. The 2009 Pandemic Influenza A (H1N1) brings this concern to the immediate forefront. The Centers for Disease Control and Prevention have stated that, when performing or participating in aerosol-generating procedures on patients with virulent contagious respiratory diseases, health care professionals must wear a minimum of the N95 respirator, and they may wish to consider using the powered air purifying respirator (PAPR). For influenza and other diseases transmitted by both respiratory and contact modes, protective respirators must be combined with contact precautions. The PAPR provides 2.5 to 100 times greater protection than the N95, when used within the context of an Occupational Safety and Health Administration-compliant respiratory protection program. The relative protective capability of a respirator is quantified using the assigned protection factor. The level of protection designated by the APF can only be achieved with appropriate training and correct use of the respirator. Face seal leakage limits the protective capability of the N95 respirator, and fit testing does not assure the ability to maintain a tight face seal. The protective capability of the PAPR will be defeated by improper handling of contaminated equipment, incorrect assembly and maintenance, and improper don (put on) and doff (take off) procedures. Stress, discomfort, and physical encumbrance may impair performance. Acclimatization through training will mitigate these effects. Training in the use of PAPRs in advance of their need is strongly advised. "Just in time" training is unlikely to provide adequate preparation for groups of practitioners requiring specialized personal protective equipment during a pandemic. Employee health departments in hospitals may not presently have a PAPR training program in place. Anesthesia and critical care providers would be well advised to take the lead in working with their hospitals' employee health departments to establish a PAPR training program where none exists. User instructions state that the PAPR should not be used during surgery because it generates positive outward airflow, and may increase the risk of wound infection. Clarification of this prohibition and acceptable solutions are currently lacking and need to be addressed. The surgical hood system is not an acceptable alternative. We provide on line a PAPR training workshop. Supporting information is presented here. Anesthesia and critical care providers may use this workshop to supplement, but not substitute for, the manufacturers' detailed use and maintenance instructions.

47. Analysis of residual chemicals on filtering facepiece respirators after decontamination

Authors Salter W.B.; Kinney K.; Wallace W.H.; Lumley A.E.; Heimbuch B.K.; Wander J.D.
Source Journal of occupational and environmental hygiene; Aug 2010; vol. 7 (no. 8); p. 437-445
Publication Date Aug 2010
Publication Type(s) Article
PubMedID 20526947
Database EMBASE
Abstract The N95 filtering facepiece respirator (FFR) is commonly used to protect individuals from infectious aerosols. Health care experts predict a shortage of N95 FFRs if a severe pandemic occurs, and an option that has been suggested for mitigating such an FFR shortage is to decontaminate and reuse the devices. Before the effectiveness of this strategy can be established, many parameters affecting respiratory protection must be measured: biocidal efficacy of the decontamination treatment, filtration performance, pressure drop, fit, and toxicity to the end user post treatment. This research effort measured the amount of residual chemicals created or deposited on six models of FFRs following treatment by each of 7 simple decontamination technologies. Measured amounts of decontaminants retained by the FFRs treated with chemical disinfectants were small enough that exposure to wearers will be below the permissible exposure limit (PEL). Toxic by-products were also evaluated, and two suspected toxins were detected after ethylene oxide treatment of FFR rubber straps. The results provide encouragement to efforts promoting the evolution of effective strategies for decontamination and reuse of FFRs.

48. Reusable elastomeric air-purifying respirators: physiologic impact on health care workers.

Authors Roberge, Raymond J; Coca, Aitor; Williams, W Jon; Powell, Jeffrey B; Palmiero, Andrew J
Source American journal of infection control; Jun 2010; vol. 38 (no. 5); p. 381-386
Publication Date Jun 2010
Publication Type(s) Journal Article
PubMedID 20189685
Database Medline

Abstract BACKGROUNDElastomeric air-purifying respirators offer the benefit of reusability, but their physiological impact on health care workers is unknown.METHODSTen health care workers exercised at 2 health care-associated work rates wearing an elastomeric air-purifying respirator. Mixed inhalation/exhalation respirator dead space gases (oxygen, carbon dioxide) were sampled, and physiological parameters were monitored (heart rate, breathing rate, tidal volume, minute volume, oxygen saturation, transcutaneous carbon dioxide). Numerical rating scales were used to evaluate comfort and exertion.RESULTSCompared with controls (no respirator), significant decreases in the breathing rate at both work rates ($P < .05$) and increases in tidal volume at the lower work rate ($P < .01$) were noted with respirator use. Approximately half the subjects had transcutaneous carbon dioxide levels above the upper limit of normal after 1 hour of use. Although well tolerated, comfort was negatively impacted by elastomeric air-purifying respirators wear.CONCLUSIONReusable elastomeric air-purifying respirators impose little additional physiological burden over the course of 1 hour at usual health care work rates. However, the potential for carbon dioxide retention in a significant proportion of users exists and requires further investigation.

49. How clean is "clean"? Regulations and standards for workplace clothing and personal protective equipment.

Authors Sirianni, Greg; Borak, Jonathan
Source Journal of occupational and environmental medicine; Feb 2010; vol. 52 (no. 2); p. 190-196
Publication Date Feb 2010
Publication Type(s) Journal Article
PubMedID 20134338
Database Medline
Available at Journal of occupational and environmental medicine from Unpaywall
Abstract OBJECTIVETo compile current regulations and advisory recommendations on cleanliness of worker clothing and personal protective equipment and to evaluate the adequacy of criteria for determining whether cleanliness has been achieved.METHODSSystematic review of information provided by federal agencies (eg, OSHA, MSHA, and NIOSH), nongovernmental advisory bodies (eg, ACGIH, AIHA, and ANSI), and manufacturers of protective clothing and equipment.RESULTSWe identified an array of terms describing "cleanliness" and the processes for achieving "cleanliness" that were almost never defined in regulations and recommendations. We also found a general lack of criteria for determining whether cleanliness and/or sterility have been achieved.CONCLUSIONSThere is need to harmonize cleanliness-related terminology, establish best practices for equipment cleaning and sterilization, implement a signage systems to provide equipment-specific cleaning instructions, and adopt objective criteria for determining what is "clean."

50. Diminished speech intelligibility associated with certain types of respirators worn by healthcare workers.

Authors Radonovich, Lewis J; Yanke, Robert; Cheng, Jing; Bender, Bradley
Source Journal of occupational and environmental hygiene; Jan 2010; vol. 7 (no. 1); p. 63-70
Publication Date Jan 2010
Publication Type(s) Journal Article
PubMedID 19904661
Database Medline
Abstract This study sought to determine the level of communication interference associated with commonly used disposable and reusable respirators and surgical masks worn by healthcare workers. Speech intelligibility was assessed using the modified rhyme test in an intensive care unit environment. Respirators decreased speech intelligibility by a range of 1% to 17%, although not all were statistically significant. Differences in speech intelligibility associated with surgical masks and disposable filtering facepiece respirators (without exhalation valves) were not statistically significant compared with controls. Wearing half-face elastomeric respirators with voice augmentation equipment was associated with higher speech intelligibility than models without this equipment (OR = 2.81). Hearing clarity while wearing a powered air-purifying respirator (PAPR) was 79% compared with 90% with no PAPR (OR = 0.40). While some respirators appear to have little or no effect on speech intelligibility, interference with speech intelligibility associated with certain types of respirators commonly worn by U.S. healthcare workers may be substantial.

51. Evaluation of five decontamination methods for filtering facepiece respirators.

Authors Viscusi, Dennis J; Bergman, Michael S; Eimer, Benjamin C; Shaffer, Ronald E
Source The Annals of occupational hygiene; Nov 2009; vol. 53 (no. 8); p. 815-827
Publication Date Nov 2009
Publication Type(s) Research Support, N.i.h., Extramural Evaluation Study Journal Article
PubMedID 19805391
Database Medline
Available at The Annals of occupational hygiene from HighWire - Free Full Text
Available at The Annals of occupational hygiene from Unpaywall

Abstract Concerns have been raised regarding the availability of National Institute for Occupational Safety and Health (NIOSH)-certified N95 filtering facepiece respirators (FFRs) during an influenza pandemic. One possible strategy to mitigate a respirator shortage is to reuse FFRs following a biological decontamination process to render infectious material on the FFR inactive. However, little data exist on the effects of decontamination methods on respirator integrity and performance. This study evaluated five decontamination methods [ultraviolet germicidal irradiation (UVGI), ethylene oxide, vaporized hydrogen peroxide (VHP), microwave oven irradiation, and bleach] using nine models of NIOSH-certified respirators (three models each of N95 FFRs, surgical N95 respirators, and P100 FFRs) to determine which methods should be considered for future research studies. Following treatment by each decontamination method, the FFRs were evaluated for changes in physical appearance, odor, and laboratory performance (filter aerosol penetration and filter airflow resistance). Additional experiments (dry heat laboratory oven exposures, off-gassing, and FFR hydrophobicity) were subsequently conducted to better understand material properties and possible health risks to the respirator user following decontamination. However, this study did not assess the efficiency of the decontamination methods to inactivate viable microorganisms. Microwave oven irradiation melted samples from two FFR models. The remainder of the FFR samples that had been decontaminated had expected levels of filter aerosol penetration and filter airflow resistance. The scent of bleach remained noticeable following overnight drying and low levels of chlorine gas were found to off-gas from bleach-decontaminated FFRs when rehydrated with deionized water. UVGI, ethylene oxide (EtO), and VHP were found to be the most promising decontamination methods; however, concerns remain about the throughput capabilities for EtO and VHP. Further research is needed before any specific decontamination methods can be recommended.

52. Comparison of powered and conventional air-purifying respirators during simulated resuscitation of casualties contaminated with hazardous substances.

Authors Schumacher, J; Gray, S A; Weidelt, L; Brinker, A; Prior, K; Stratling, W M
Source Emergency medicine journal : EMJ; Jul 2009; vol. 26 (no. 7); p. 501-505
Publication Date Jul 2009
Publication Type(s) Research Support, Non-u.s. Gov't Comparative Study Randomized Controlled Trial Journal Article
PubMedID 19546271
Database Medline
Available at Emergency medicine journal : EMJ from BMJ Journals - NHS
Available at Emergency medicine journal : EMJ from ProQuest (Health Research Premium) - NHS Version

Abstract BACKGROUNDAdvanced life support of patients contaminated with chemical, biological, radiological or nuclear (CBRN) substances requires adequate respiratory protection for medical first responders. Conventional and powered air-purifying respirators may exert a different impact during resuscitation and therefore require evaluation. This will help to improve major incident planning and measures for protecting medical staff.METHODSA randomised crossover study was undertaken to investigate the influence of conventional negative pressure and powered air-purifying respirators on the simulated resuscitation of casualties contaminated with hazardous substances. Fourteen UK paramedics carried out a standardised resuscitation algorithm inside an ambulance vehicle, either unprotected or wearing a conventional or a powered respirator. Treatment times, wearer mobility, ease of communication and ease of breathing were determined and compared.RESULTSIn the questionnaire, volunteers stated that communication and mobility were similar in both respirator groups while breathing resistance was significantly lower in the powered respirator group. There was no difference in mean (SD) treatment times between the groups wearing respiratory protection and the controls (245 (19) s for controls, 247 (17) s for conventional respirators and 250 (12) s for powered respirators).CONCLUSIONSPowered air-purifying respirators improve the ease of breathing and do not appear to reduce mobility or delay treatment during a simulated resuscitation scenario inside an ambulance vehicle with a single CBRN casualty.

53. Use of personal protective equipment during infectious disease outbreak and nonoutbreak conditions: a survey of emergency medical technicians.

Authors Visentin, Laura M; Bondy, Susan J; Schwartz, Brian; Morrison, Laurie J
Source CJEM; Jan 2009; vol. 11 (no. 1); p. 44-56
Publication Date Jan 2009
Publication Type(s) Research Support, Non-u.s. Gov't Journal Article
PubMedID 19166639
Database Medline
Available at CJEM from ProQuest (Health Research Premium) - NHS Version
Available at CJEM from Unpaywall

Abstract OBJECTIVEWe sought to assess the knowledge of, use of and barriers to the use of personal protective equipment for airway management among emergency medical technicians (EMTs) during and since the 2003 Canadian outbreak of Severe Acute Respiratory Syndrome (SARS).METHODSUsing a cross-sectional survey, EMTs in Toronto, Ont., were surveyed 1 year after the SARS outbreak during mandatory training on the use of personal protective equipment in airway management during the outbreak and just before taking the survey. Practices that were addressed reflected government directives on the use of this equipment. Main outcome measures included the frequency of personal protective equipment use and, as applicable, why particular items were not always used.RESULTSThe response rate was 67.3% (n = 230). During the SARS outbreak, an N95-type particulate respirator was reported to be always used by 91.5% of respondents. Conversely, 72.9% of the respondents reported that they never used the open face hood. Equipment availability and vision impairment were often cited as impediments to personal protective equipment use. In nonoutbreak conditions, only the antimicrobial airway filter was most often reported to be always used (52.0%), while other items were used at an intermediate frequency. The most common reason for not always donning equipment was that paramedics deemed it unnecessary for the situation.CONCLUSIONPersonal protective equipment is not consistently employed as per medical directives. Reasons given for nonuse included nonavailability, judgment of nonnecessity or technical difficulties. There are important public health implications of noncompliance.

54. Wearing an N95 respirator concurrently with a powered air-purifying respirator: effect on protection factor.

Authors Roberge, Marc R; Vojtko, Mark R; Roberge, Raymond J; Vojtko, Richard J; Landsittel, Douglas P
Source Respiratory care; Dec 2008; vol. 53 (no. 12); p. 1685-1690
Publication Date Dec 2008
Publication Type(s) Journal Article
PubMedID 19025703
Database Medline
Abstract OBJECTIVETo determine if using an N95 filtering face-piece respirator concurrently with a loose-fitting powered air-purifying respirator (PAPR) offers additional protection to the wearer.METHODSWe used a breathing mannequin programmed to deliver minute volumes of 25 L/min and 40 L/min. We measured the baseline protection factor of the PAPR with its motor operational and then deactivated (to simulate mechanical or battery failure). We tested 3 replicates of 3 different N95 models. We glued each N95 to the breathing mannequin and obtained a minimum protection factor of 100 at 25 L/min. We then placed the PAPR on the mannequin and took protection factor measurements with the N95-plus-PAPR combination, at 25 L/min and 40 L/min, with the PAPR operational and then deactivated.RESULTSThe N95 significantly increased the PAPR's protection factor, even with the PAPR deactivated. The effect was multiplicative, not merely additive.CONCLUSIONSAn N95 decreases the concentration of airborne particles inspired by the wearer of a PAPR.

55. Enjoying the advantages of PAPRs.

Authors Weissman, Barry R
Source Occupational health & safety (Waco, Tex.); Nov 2008; vol. 77 (no. 11); p. 18-20
Publication Date Nov 2008
Publication Type(s) Journal Article
PubMedID 19025190
Database Medline
Abstract For those who are hard to fit with a respirator, for those with facial hair, and to improve your employees' comfort and increase productivity, a PAPR may be just the respirator for your program. Do your homework, start with a small test group, and you may find that PAPRs deliver.

56. Workplace performance of a hood-style supplied-air respirator.

Authors Janssen, Larry; Bidwell, Jeanne; Cuta, Karen; Nelson, Thomas
Source Journal of occupational and environmental hygiene; Jul 2008; vol. 5 (no. 7); p. 438-443
Publication Date Jul 2008
Publication Type(s) Journal Article
PubMedID 18464097
Database Medline

Abstract This study evaluated the workplace performance of a hood-style supplied-air respirator during aircraft sanding operations. Air samples were collected inside and outside the respirators worn by workers during normal work activities. The samples were analyzed for chromium, strontium, and magnesium. These contaminants were not detected on any inside sample from the valid sample sets. Program protection factors (PPFs) were estimated for the valid sample sets using the limit of detection as the inside sample mass. When it was possible, PPF estimates were made using each element individually and a combination of all three elements. The PPF estimates were in the range of >11000 to >65000 regardless of the elements used in the calculation. Examination of the PPF estimates for different elements reveals the differences are largely artificial. The results indicate the tested respirator performed well above its assigned protection factor of 1000. No worker was overexposed to chromium, strontium, or magnesium during the study. This study also illustrates the difficulty in locating workplaces with sufficient contaminant concentration and duration to measure the capabilities of high-performing respirators.

57. Human subject testing of leakage in a loose-fitting PAPR.

Authors Johnson, Arthur T; Koh, Frank C; Jamshidi, Shaya; Rehak, Timothy E
Source Journal of occupational and environmental hygiene; May 2008; vol. 5 (no. 5); p. 325-329
Publication Date May 2008
Publication Type(s) Research Support, Non-u.s. Gov't Research Support, N.i.h., Extramural Evaluation Study Journal Article
PubMedID 18348078
Database Medline
Abstract Leakage from loose-fitting PAPRs (powered air-purifying respirators) can compromise the safety of wearers. The Martindale Centurion MAX multifunction PAPR is a loose-fitting PAPR that also incorporates head, eye, and ear protection. This respirator is used in mines where coal dust usually is controlled by ventilation systems. Should the respirator be depended on for significant respiratory protection? Ten human volunteers were asked to wear the Centurion MAX inside a fog-filled chamber. Their inhalation flow rates were measured with small pitot-tube flowmeters held inside their mouths. They were video imaged while they breathed deeply, and the points at which the fog reached their mouths were determined. Results showed that an average of 1.1 L could be inhaled before contaminated air reached the mouth. As long as the blower purges contamination from inside the face piece during exhalation, the 1.1 L acts as a buffer against contaminants leaked due to overbreathing of blower flow rate.

58. Evaluation of the rationale for concurrent use of N95 filtering facepiece respirators with loose-fitting powered air-purifying respirators during aerosol-generating medical procedures.

Authors Roberge, Raymond J
Source American journal of infection control; Mar 2008; vol. 36 (no. 2); p. 135-141
Publication Date Mar 2008
Publication Type(s) Evaluation Study Journal Article Review
PubMedID 18313516
Database Medline
Abstract The concurrent use of N95 filtering facepiece respirators with powered air-purifying respirators during aerosol-generating medical procedures in patients with severe respiratory pathogens has been promoted as offering additional protection against infectious agents. The purpose of this article is to examine the impact of this additional respiratory equipment upon protection and personal performance. The presumed additive protective effect of an N95 filtering facepiece respirator used concurrently with a powered air-purifying respirator has not been subjected to rigorous scientific investigation. The burden imposed by additional respiratory protective equipment should not be discounted, and the potentially minor contribution to protection may be offset by the negative impact on personal performance. Novel uses of protective equipment occasionally are spawned during crisis situations, but their generalized applicability to healthcare workers should ultimately be evidence-based.

59. Health care worker protection in mass casualty respiratory failure: infection control, decontamination, and personal protective equipment.

Authors Daugherty, Elizabeth L
Source Respiratory care; Feb 2008; vol. 53 (no. 2); p. 201
Publication Date Feb 2008
Publication Type(s) Journal Article
PubMedID 18218151
Database Medline

Abstract Maintenance of a safe and stable health care infrastructure is critical to an effective mass casualty disaster response. Both secondary contamination during chemical disasters and hospital-associated infections during epidemic illness can pose substantial threats to achieving this goal. Understanding basic principles of decontamination and infection control during responses to chemical and biologic disasters can help minimize the risks to patients and health care workers. Effective decontamination following toxic chemical exposure should include both removal of contaminated clothing and decontamination of the victim's skin. Wet decontamination is the most feasible strategy in a mass casualty situation and should be performed promptly by trained personnel. In the event of an epidemic, infection prevention and control measures are based on essential principles of hand hygiene and standard precautions. Expanded precautions should be instituted as needed to target contact, droplet, and airborne routes of infectious disease transmission. Specific equipment and measures for critical care delivery may serve to decrease risk to health care workers in the event of an epidemic. Their use should be considered in developing comprehensive disaster response plans.

60. [Study on the performances of the positive pressure powered air-filter protective hood].

Authors Tian, Feng; Wang, Zheng; Yang, Jingquan; Yang, Jian; Liu, Shenjun; Zhang, Yanjun
Source Sheng wu yi xue gong cheng xue za zhi = Journal of biomedical engineering = Shengwu yixue gongchengxue zazhi; Aug 2006; vol. 23 (no. 4); p. 766-769
Publication Date Aug 2006
Publication Type(s) Research Support, Non-u.s. Gov't English Abstract Journal Article
PubMedID 17002103
Database Medline
Abstract The positive pressure powered air-filter protective hood can prevent physicians and nurses from being infected by serious respiratory infections. The contaminated air is filtered by the high efficiency specific air-filter (HESA) and then transported into the hood by a blower to form about 140 +/- 10 Pa positive pressure environment, which makes the air in hood overflow out from the lower part of the hood, by which carbon dioxide and vapor can be removed, and excreted. The HESA's filters of simulative virus up to 99.9999% with the structure of double layers filtering. With going at 4 km/h pace on a walking vehicle wearing the hood, the testees' heart rate is 90-105/min oxygen saturation of the blood(SPO2) is 97%-98%. When the air flow is from 75 L/min to 125 L/min, this can meet the testees' physiological demand under heavy workload. Clinical trial results show that the hood can effectively protect the physicians and nurses from infection.

61. Simulated workplace protection factor study of powered air-purifying and supplied air respirators.

Authors Cohen, H J; Hecker, L H; Mattheis, D K; Johnson, J S; Biermann, A H; Foote, K L
Source AIHAJ : a journal for the science of occupational and environmental health and safety; 2001; vol. 62 (no. 5); p. 595-604
Publication Date 2001
Publication Type(s) Research Support, Non-u.s. Gov't Comparative Study Journal Article
PubMedID 11669385
Database Medline
Abstract A study protocol was developed to obtain simulated workplace protection factor (SWPF) data for eleven models of powered air-purifying respirators (PAPRs) and supplied-air respirators (SAR) with hoods and helmets. Respirators were tested in a chamber that allowed the simulation of 12 exercises, including 2 exercises of interest to the pharmaceutical industry. Each respirator was tested by 12 volunteers, and a total of 144 sets of test results were obtained for each device. The testing protocol allowed SWPFs up to 250,000 to be measured (limit of quantification). Median SWPFs for all respirators, except one SAR, were at or above this reporting limit. Lower fifth percentiles were above 100,000, except for one SAR previously noted. An assigned protection factor (APF) was estimated for each respirator by dividing the lower fifth percentile by a safety factor of 25. APFs ranged from 6000-10,000 for PAPRs (including one loose-fitting PAPR) and 3400-10,000 for SARs, with one exception. This SAR had a lower fifth percentile of less than 20 and an estimated APF of 1. Results indicated that most respirators tested could provide a high degree of protection for workers, although one National Institute for Occupational Safety and Health-approved SAR provided minimal, if any, protection. Direct testing in a simulated workplace seems the only method that will assure employers of choosing an adequate SAR. This may be true for other classes of respirators. Furthermore, the historical approach of establishing APFs for classes of respirators, rather than individual models, may not provide adequate protection to the wearer. This is also a serious problem for regulatory agencies seeking to promulgate respirator standard provisions such as APFs for classes of respirators.

62. Workplace protection factors--supplied air hood.

Authors Nelson, T J; Wheeler, T H; Mustard, T S
Source AIHAJ : a journal for the science of occupational and environmental health and safety; 2001; vol. 62 (no. 1); p. 96-99
Publication Date 2001
Publication Type(s) Journal Article

PubMedID 11258874
Database Medline
Abstract Several organizations list assigned protection factors. For supplied air hoods, the value of the assigned protection factors varies from <10 to 2,000 depending on the organization. Workplace protection factors (WPFs) of a supplied air hood were measured during aircraft sanding and painting operations on several types of aircraft to evaluate whether the American National Standard Z88.2 (1992) assigned protection factor of 1,000 was realistic. The primary contaminant during these activities is strontium chromate. Samples collected inside the hood show that employees during sanding and painting operations were not exposed to strontium. The respirator performed adequately. This study is consistent with other simulated and WPF studies in that the ANSI Z88.2 WPF of 1,000 is supported.

Strategy 832173

#	Database	Search term	Results
1	Medline	("hooded respirator*").ti,ab	0
2	Medline	("hood*").ti,ab	5407
3	Medline	(respirator*).ti,ab	419819
4	Medline	(2 AND 3)	213
6	Medline	*"OCCUPATIONAL EXPOSURE -- PREVENTION & CONTROL"/	4183
7	Medline	*"PERSONAL PROTECTIVE EQUIPMENT"/	253
8	Medline	"PROTECTIVE CLOTHING"/	5825
9	Medline	"RESPIRATORY PROTECTIVE DEVICES"/	1992
10	Medline	(PAPR).ti,ab	156
11	Medline	("powered air purifying respirat*").ti,ab	74
12	Medline	(10 OR 11)	195
13	Medline	12 not 4	182
14	Medline	*"VENTILATORS, MECHANICAL"/	5549
15	Medline	("RESPIRATORY PROTECTIVE DEVICES").ti,ab	115
16	Medline	(9 OR 15)	2022
17	Medline	("supplied air respirat*").ti,ab	19
18	Medline	(16 OR 17)	2029
19	Medline	(reus*).ti,ab	22257
20	Medline	(reprocess*).ti,ab	3176
21	Medline	(decontaminat*).ti,ab	11601
22	Medline	(19 OR 20 OR 21)	36325
23	Medline	(18 AND 22)	52
24	Medline	*"DISINFECTION -- METHODS"/	5136

25	Medline	*"EQUIPMENT REUSE"/	917
26	Medline	(4 OR 18)	2216
27	Medline	(disinfect*).ti,ab	27632
28	Medline	STERILIZATION/	18322
29	Medline	DISINFECTION/	14353
30	Medline	(22 OR 25 OR 27 OR 28 OR 29)	81221
31	Medline	(26 AND 30)	73
32	EMBASE	("respiratory protective device*").ti,ab	135
33	EMBASE	"PROTECTIVE EQUIPMENT"/	12398
34	EMBASE	(respirator*).ti,ab	573280
35	EMBASE	(papr).ti,ab	198
36	EMBASE	("powered air purifying").ti,ab	89
37	EMBASE	(hood*).ti,ab	7109
38	EMBASE	("supplied air respirator*").ti,ab	22
39	EMBASE	(32 OR 33 OR 34 OR 35 OR 36 OR 37 OR 38)	591494
40	EMBASE	(reus*).ti,ab	32973
41	EMBASE	(reprocess*).ti,ab	4763
42	EMBASE	(decontaminat*).ti,ab	14817
43	EMBASE	(disinfect*).ti,ab	32782
44	EMBASE	DECONTAMINATION/	2190
45	EMBASE	DISINFECTION/	25230
46	EMBASE	(40 OR 41 OR 42 OR 43 OR 44 OR 45)	90278
47	EMBASE	(39 AND 46)	2440
48	EMBASE	(protect*).ti,ab	991906
49	EMBASE	(34 AND 48)	28194
50	EMBASE	(32 OR 33 OR 35 OR 36 OR 37 OR 38 OR 49)	46960

51	EMBASE	(46 AND 50)	825
52	EMBASE	51 [DT 2010-2020]	493
53	EMBASE	(32 OR 36 OR 37 OR 38 OR 49) [DT 2010-2020]	20147
54	EMBASE	(32 OR 35 OR 36 OR 37 OR 38 OR 49)	35415
55	EMBASE	(46 AND 54)	379
56	EMBASE	*VENTILATOR/	4657
57	EMBASE	"AIR FILTER"/	870
58	EMBASE	"DISINFECTANT AGENT"/	12176