

OSHA FactSheet

Avian Flu

Avian influenza (AI) viruses infect wild birds and poultry (e.g., chickens). They are divided into two groups based upon the severity of the disease they produce in poultry: low pathogenicity AI (LPAI) viruses and highly pathogenic AI (HPAI) viruses. LPAI viruses occur naturally in wild birds but can spread to poultry where they generally cause minor illness. However, HPAI viruses are highly contagious and cause high mortality in poultry. While LPAI viruses pose little threat to human health, certain HPAI viruses have caused serious illness and even death. Of particular concern to public health are the HPAI H5N1 viruses that are spreading rapidly in some parts of the world. HPAI H5N1 viruses have caused the deaths of millions of birds and of over 140 people worldwide. These deaths have thus far been restricted to Asia, the Middle East, and Africa. As of October 2006, the HPAI H5N1 virus has not been found in the United States.

Although HPAI H5N1 viruses have the potential to develop into pandemic viruses if they acquire the ability to pass readily from human-to-human, thus far, there has been only very limited transmission between humans. This document provides interim guidance for protecting employees who may be exposed if there is an outbreak of HPAI H5N1 in the United States. For the most up-to-date information on the occurrence of HPAI H5N1 outbreaks throughout the world, as well as other HPAI virus outbreaks that may also pose a hazard to human health, consult the Department of Health and Human Services (HHS) web site at: www.avianflu.gov.

Symptoms of Avian Influenza (AI) in Humans

Range from: fever, cough, sore throat and muscle aches; to diarrhea, eye infections, pneumonia and severe respiratory diseases; and other severe and life-threatening complications.

The symptoms of avian influenza may depend on which virus caused the infection but often are similar to those associated with human seasonal influenza.

Individuals with these symptoms may be experiencing an illness other than influenza. Therefore, laboratory tests can be used to confirm avian influenza infection in humans.

How People Become Infected

So far, most cases of avian influenza infection in humans have resulted from direct contact with infected poultry (e.g., domesticated chickens, ducks, and turkeys) or contact with surfaces soiled with discharges from their mouths, beaks, or with feces. Other possible means of infection include consuming raw or undercooked poultry or poultry products and inhaling contaminated poultry particles (e.g., this could occur during butchering).

Eating properly handled and cooked poultry and eggs is safe. Cooking poultry to an internal temperature of 165°F and eggs until they are firm throughout kills the AI virus.

Employees at Potential Risk of Exposure

- Poultry employees involved in eradication activities (for example, depopulating poultry);
- Animal handlers (other than poultry employees);
- Laboratory employees;
- Health care workers treating patients with known or suspected avian influenza viruses;
- Food handlers;
- Airport personnel with close exposure to passengers suspected of being avian influenza-infected; and
- Travelers on temporary work assignments abroad in areas affected by HPAI H5N1 outbreaks.

Treatment

Prescription antiviral drugs approved for influenza (based on seasonal outbreak data) may be of some benefit in treating avian flu infection in humans. However, influenza viruses can become resistant to these drugs, so these medications may not always work. For some of these drugs to be most effective, they must be taken within 48 hours after the first sign of symptoms. Additional drugs may be developed for influenza, and it is not yet known whether they will be more effective.

General Precautions for People Who May Be Exposed to Avian Flu Viruses

- Use proper hand hygiene practices. Clean your hands often and thoroughly, preferably using soap and water for 15-20 seconds (or a waterless, alcohol-based hand rub when soap is not available), especially if you are handling poultry or poultry products.
- If possible, avoid contact with poultry and other birds suspected or known to be infected.
- Avoid eating uncooked or undercooked poultry or poultry products.
- If you are sick, stay at home except to get medical attention.
- Cover your mouth and nose when you cough or sneeze.

Specific control measures should be selected as appropriate to the particular exposure situation.

- If eradication (depopulating) of poultry is necessary, use the following personal protective equipment (PPE):
 - ◆ Disposable gloves or gloves that can be disinfected;
 - ◆ Protective clothing (e.g., long-sleeved coveralls with waterproof aprons that can be disinfected or disposed of);

- ◆ Disposable protective shoe covers or boots that can be cleaned and disinfected;
- ◆ Safety goggles;
- ◆ Wear at least the minimum level of respiratory protection, N95 or higher respirator; and
- ◆ Employees should follow proper containment and decontamination procedures when wearing PPE.

- Employees should check with their health care providers about seasonal flu vaccine or antiviral drugs.
- If you believe that you may have been exposed to avian influenza:
 - ◆ Monitor your health for 10 days;
 - ◆ If you become ill with fever and develop a cough or difficulty breathing, consult a health care provider about what steps to take; and
 - ◆ Do not travel while sick, and limit contact with others as much as possible to help prevent the spread of any infectious disease.

Training

Employees with potential for exposure should receive training on hazards associated with exposure to HPAI H5N1 and on the procedures in place in their facility to isolate and report cases and reduce exposures.

Additional Information

More information on avian influenza can be found on OSHA's website, www.osha.gov and search on "avian flu." For up-to-date information about outbreaks of HPAI viruses and treatments see: www.avianflu.gov.

This is one in a series of informational fact sheets highlighting OSHA programs, policies or standards. It does not impose any new compliance requirements. For a comprehensive list of compliance requirements of OSHA standards or regulations, refer to Title 29 of the Code of Federal Regulations. This information will be made available to sensory impaired individuals upon request. The voice phone is (202) 693-1999; teletypewriter (TTY) number: (877) 889-5627.

For more complete information:



U.S. Department of Labor

www.osha.gov

(800) 321-OSHA



U. S. Department of Labor
Occupational Safety and Health Administration
Directorate of Science, Technology & Medicine
Office of Occupational Medicine

Avian Influenza

Protecting Poultry Workers at Risk

Safety and Health Information Bulletin

SHIB 12-13-2004

Introduction

Avian influenza is a viral disease that can cause sickness and death among poultry. On rare occasions, avian influenza virus can be transmitted to poultry workers or others who come in contact with infected poultry or contact contaminated surfaces. Examples of such workers who could be at risk include poultry growers and their employees; service technicians of poultry processing companies; caretakers, layer barn workers, and chick movers at egg production facilities; and workers involved in disease control and eradication activities, including state, federal, contract, and company employees.

This Safety and Health Information Bulletin describes measures for protecting poultry workers when an avian influenza outbreak occurs. It presents basic information about avian influenza and describes measures for minimizing exposure to the virus. Links to Internet sites are provided for those wanting more detailed information on avian influenza, biosecurity measures, and personal protective equipment. This document complements avian population disease control and eradication strategies of state governments, industry, and the U.S. Department of Agriculture (USDA).

Avian Influenza

Avian influenza is a disease caused by infection of poultry with type A influenza viruses. The disease occurs worldwide, and all species of birds are thought to be susceptible to it. Strains of avian influenza are classified as being of either low pathogenicity (most strains) or high pathogenicity.

This Safety and Health Information Bulletin is **not** a standard or regulation, and it creates no new legal obligations. The Bulletin is advisory in nature, informational in content, and is intended to assist employers in providing a safe and healthful workplace. Pursuant to the *Occupational Safety and Health Act*, employers must comply with hazard-specific safety and health standards promulgated by OSHA or by a state with an OSHA-approved state plan. In addition, pursuant to Section 5(a)(1), the General Duty Clause of the Act, employers must provide their employees with a workplace free from recognized hazards likely to cause death or serious physical harm. Employers can be cited for violating the General Duty Clause if there is a recognized hazard and they do not take reasonable steps to prevent or abate the hazard. However, failure to implement any recommendations in this Safety and Health Information Bulletin is not, in itself, a violation of the General Duty Clause. Citations can only be based on standards, regulations, and the General Duty Clause.

Low-pathogenic strains typically cause few or no signs in infected birds. When signs are seen, they may include respiratory problems, diarrhea, a decline in egg production, or an increase in mortality. However, under field conditions, some low-pathogenic strains (H5 and H7 subtypes) can mutate and become highly pathogenic, leading to the deaths of entire flocks. Highly pathogenic avian influenza is extremely contagious and a fatal form of the disease for poultry.

Although avian influenza A viruses rarely infect humans, since 1997, instances of human infection have occurred; some (outside the United States) have resulted in death. The virus is excreted in the droppings of infected birds and in their respiratory secretions. Transmission to humans is thought to have resulted from contact with infected sick or dead poultry or their droppings, or contact with contaminated litter or surfaces (e.g., egg flats). The suspected routes of entry of the virus to humans are the mouth, nose, eyes, and lungs. Although the human health risk of low-pathogenic avian influenza viruses is not well established, protective measures should be taken by persons likely to have prolonged direct or indirect exposure to any avian influenza virus in an enclosed setting.

Measures for Protecting Poultry Workers

Follow biosecurity practices

Poultry workers should know and follow biosecurity practices to prevent the introduction of avian influenza and other diseases into a poultry flock. An understanding of how infection can be spread is important for both effective biosecurity and worker safety and health practices. Poultry processing companies should provide a written copy of biosecurity practices to each of their contract growers.

A 2004 USDA fact sheet lists eight general biosecurity practices for poultry farms (http://www.aphis.usda.gov/lpa/pubs/fsheet_faq_notice/faq_ahhpai.pdf). Guidance is also available in the free biosecurity CD, *Infectious Disease Risk Management: Practical Biosecurity Resources for Commercial Poultry Producers*, which is available from the U.S. Poultry and Egg Association (<http://www.poultryegg.org/>).

Depending on temperature and moisture conditions, avian influenza A viruses can survive in the environment for weeks. However, they are generally sensitive to most detergents and disinfectants and are

inactivated by heating and drying. Contact with organic material such as dust, dirt, litter, and manure can decrease the effectiveness of some disinfectants, and thus the possibility persists that viruses will survive. U.S. Environmental Protection Agency (EPA)-registered products that have a claim of being effective against influenza viruses should provide some measure of activity against avian influenza A viruses.

The label of an EPA-registered disinfectant describes how to use the product safely and effectively and includes measures that applicators should take to protect themselves. The personal protective equipment listed on a disinfectant label is based on the chemical's toxicity and may not be appropriate for all exposure conditions and handling activities. Thus, an exposure assessment should also be done when selecting personal protective equipment for applicators.

Know the signs indicating birds are infected with avian influenza viruses

The signs of illness seen in domestic poultry infected with avian influenza viruses are variable and affected by the virus strain, age and species of infected birds, concurrent bacterial disease, and the environment. Such signs may include –

- Sudden death without any signs
- Lack of coordination
- Purple discoloration of the wattles, combs, and legs
- Soft-shelled or misshapen eggs
- Lack of energy and appetite
- Diarrhea
- Swelling of the head, eyelids, comb, wattles, and hocks
- Nasal discharge
- Decreased egg production
- Coughing, sneezing

Some birds might be otherwise healthy-looking but still infected with avian influenza virus. The severity of disease in poultry can also vary during an outbreak. Poultry workers should be aware of signs of disease in poultry so when necessary they can take immediate steps to protect themselves and other workers,

quarantine the farm to prevent spread of disease, and report the disease to the responsible animal health authorities.

Take antiviral medication and get the current season's influenza vaccine if appropriate

In the event of an avian influenza outbreak, workers who will be involved in disease control and eradication activities should consult their healthcare provider about the advisability of taking antiviral medications for influenza. The Centers for Disease Control and Prevention (CDC) has recommended that workers receive an influenza antiviral drug daily for the entire time they are in direct contact with infected poultry or contaminated surfaces. In the absence of sensitivity testing, oseltamavir is the antiviral drug currently of choice because the likelihood that the virus will be resistant to it is less than with amantadine or rimantadine.

The CDC recommends that workers involved in avian influenza disease control and eradication activities should get the current season's human influenza vaccine. Human influenza vaccine will not prevent infection with low pathogenic or highly pathogenic avian influenza A viruses, but this precautionary measure could reduce the possibility of dual infection with avian and human influenza viruses. Although dual infection is unlikely, it is plausible that such a situation might cause new and different viral strains to be created; such new strains might be transmissible among people and lead to more widespread infections. Although this CDC recommendation is only for workers involved in disease control and eradication activities, other poultry workers should consider getting the current season's influenza vaccine for the same reason.

Current information suggests that limited human-to-human transmission of avian influenza A viruses has occurred but is very uncommon. Public health authorities are monitoring outbreaks of human illness associated with avian influenza, and to date, human infections with avian influenza viruses identified since 1997 have not resulted in sustained human-to-human transmission.

Additional CDC information on concerns about dual infection, the use of antiviral medications, and vaccination of poultry workers is available at <http://www.cdc.gov/flu/avian/protectionguid.htm>.

Know the signs and symptoms of human infection with avian influenza viruses

All poultry workers should know the signs and symptoms of avian influenza virus infection in humans so that measures can be taken for immediate treatment. The signs and symptoms may include fever, cough, sore throat, conjunctivitis (eye infections), and muscle aches. Infection with avian influenza viruses can also lead to pneumonia, acute respiratory distress, and other severe and life-threatening complications. A worker who experiences any of these symptoms or illnesses, or who might have been exposed to avian influenza virus should seek medical care and tell the healthcare provider before arrival that exposure to avian influenza virus may have occurred.

More information concerning human infection with avian influenza viruses is available at <http://www.cdc.gov/flu/avian/professional/han081304.htm> and http://www.who.int/csr/don/2004_01_15/en/.

Wear personal protective equipment

People, including children, working daily in poultry confinement units are at risk of exposure to a variety of contaminants including organic dusts, gases such as ammonia, and microorganisms (viruses, bacteria, and fungi) that can cause illness. Thus, for many poultry workers, wearing personal protective equipment is a routine practice. For example, wearing a respirator can reduce exposures to airborne organic dusts that might pose a risk of respiratory disease and decreased breathing capacity. These exposures in the poultry industry can lead to chronic lung disease and premature death. The National Institute for Occupational Safety and Health (NIOSH) recommends that children should not do any work that requires wearing a respirator. Respirators are

designed to fit adults and the likelihood that they will fit and protect children is doubtful. (See *NIOSH Recommendations to the U.S. Department of Labor for Changes to Hazardous Orders*. This document and others concerning young workers can be found at <http://www.cdc.gov/niosh/topics/youth>.)

Most cases of avian influenza virus infection in humans are thought to have resulted from contact with infected poultry or contacting contaminated surfaces followed by self-inoculation of the virus into the eyes, nose or mouth. Other means of transmission are possible, such as airborne material containing the virus entering a person's mouth, nose, or eyes, or being inhaled into the lungs.

The CDC and the Occupational Safety and Health Administration (OSHA) have made recommendations for protecting workers involved in avian influenza outbreak disease control and eradication activities concerning the respiratory protection, eye protection, and protective clothing that should be worn and the hand-hygiene practices that should be followed. (See <http://www.cdc.gov/flu/avian/protectionguid.htm> and <http://www.osha.gov/dsg/guidance/avian-flu.html>.)

The following information describes why respiratory protection, eye protection, protective clothing, and hand-hygiene practices are recommended for disease control and eradication activities and gives guidance on selecting personal protective equipment for workers responding to outbreaks of avian influenza. This information was prepared as an aid to the development of biosecurity guidelines and standard operating procedures for the various sectors of the poultry industry.

The process of selecting an appropriate ensemble of personal protective equipment requires an understanding of the work activities associated with possible exposures; the health effects that may result from exposure; properties of the virus (such as whether it is low pathogenicity or high pathogenicity); host factors (e.g., a worker's susceptibility and

immunization status); and the advantages, disadvantages, and protective capabilities of the different types of personal protective equipment. Because changes to the initial ensemble may occur during the course of a response to an outbreak, the persons with responsibility for making revisions should be identified in the biosecurity guidelines.

Respiratory Protection

Because infectious diseases such as avian influenza may be transmitted by breathing contaminated dust, poultry workers should wear respirators. Respirators that have filters or cartridges are called air-purifying respirators. These types are the most practical and appropriate choices for poultry workers to wear when they might be exposed to infected birds or during day-to-day activities in poultry barns. The table below lists the advantages, disadvantages, and costs of the five types of air-purifying respirators in order of increasing levels of protection. More information on the advantages and disadvantages of different respirators and guidance on selecting respirators for infectious agents can be found in the respirator selection section of the CDC/NIOSH histoplasmosis guidelines at <http://www.cdc.gov/niosh/docs/2005-109>. Also, for guidance on the protective capabilities of respirators, see 2004 *NIOSH Respirator Selection Logic* (<http://www.cdc.gov/niosh/docs/2005-100/default.html>).

While all of the listed respirators can protect poultry workers, they will not be protective unless all of the elements of a written respiratory protection program are followed. Examples include providing respirator training to workers and fit testing tight-fitting facepieces to ensure a secure and comfortable face seal. Also, every respiratory protection program must have an administrator who is responsible for overseeing the program's functioning and who can answer questions workers might have about respirator use; workers need to be informed about who the program administrator is.

The need for respiratory protection presents a challenge to many poultry workers, such as

contract poultry growers and their employees. Workers at risk of prolonged direct or indirect exposure to any avian influenza virus in an enclosed setting should always be included in a respiratory protection program.

Information describing all of the elements of a complete respiratory protection program and the use of respirators can be found at <http://www.osha.gov/SLTC/respiratoryprotection/index.html>.

Eye Protection

Eye protection will reduce direct exposure of the eyes to contaminated dust and aerosols and help keep workers from touching their eyes with contaminated fingers. To prevent the mucous membranes of the eyes from being exposed to the avian influenza virus, poultry workers should wear safety goggles or a respirator that has a full facepiece, hood, helmet, or loose-fitting facepiece. If safety goggles are worn, they should be nonvented (eyecup goggles, for example) or, at a minimum, indirectly vented.

Properly fitted, indirectly vented safety goggles with a good antifog coating may be a good choice for poultry workers who have lower risks of exposure. However, such goggles are not airtight, and consequently, they will not completely prevent exposures to airborne material. Directly vented goggles and safety glasses will provide limited protection, but are not recommended for protection against fine particles, splashes, or aerosols such as required in situations when workers will be exposed to infected birds.

Workers who wear prescription lenses should wear eye protection that has the correction built into the safety lenses of the protective eyewear, has lens inserts, or can be fitted over regular street-wear prescription glasses without compromising eye or respiratory protection. Although regular prescription glasses cannot be worn with full facepiece respirators, they can be worn with some types of powered air-purifying respirators (those

with hoods and some with helmets) and some styles of goggles. However, for goggles to be effective they must fit snugly, especially from the corners of the eyes across the brow. Additionally, protective eyewear should be selected that does not interfere with the worker's vision by disturbing the proper position of the prescription lenses. Contact lenses may be worn with goggles, safety glasses, or any respirator and thus provide excellent corrective vision while maximizing the protective eyewear selected.

Eye protection should be fitted together with a respirator because some goggles can alter the fit of a half-facepiece respirator. To ensure that the eye protection does not interfere with a facepiece seal, it should be worn when half-facepiece respirators are fit tested and when workers conduct seal checks each time they put on the respirator.

Caution should also be used when removing eye protection to ensure that contaminated equipment does not come in contact with the eyes or other mucous membranes. Eye protection that is properly selected and used will help prevent conjunctivitis (redness, swelling and pain in the eyes and eyelids). Poultry workers exposed to birds infected with avian influenza should see a physician at the first signs of conjunctivitis.

More information on eye protection for infection control and other documents concerning eye safety are available at <http://www.cdc.gov/niosh/topics/eye/>.

Protective Clothing and Hand-hygiene Practices

Protective clothing (which includes gloves, aprons, outer garments or coveralls, and boots or boot covers) should be used to prevent direct skin contact with contaminated materials and surfaces and reduce the likelihood of transferring contaminated material outside a poultry barn or work site. Disposable protective clothing is preferred.

Because protective clothing can be more insulating than regular work clothing, precautions should be

taken to protect workers from the effects of heat stress. For example, wearing a lightweight cotton coverall might create less of a heat stress risk for a worker than a chemical resistant suit. Additionally, workers should know the symptoms of heat-stress-related illnesses and be able to take appropriate measures to ensure that such illnesses do not occur. Information concerning heat stress and possible solutions can be found at <http://www.osha.gov/SLTC/heatstress/>.

When selecting gloves, whether disposable ones made of nitrile or vinyl that are lightweight (a thickness of 8 to 12 mil) or ones that are heavy duty (a thickness of 18 mil or greater) that can be reused after being disinfected, factors to consider include a worker's activities, the importance of dexterity, and whether the gloves need to be durable and resistant to tearing and abrasion. Regardless of the type of glove selected, care is needed to ensure that wearing protective gloves does not aggravate existing dermatitis or damage healthy skin because of prolonged exposure to water or sweating hands. For example, a thin cotton glove can be worn beneath a glove to protect against dermatitis, which can occur from prolonged skin exposure to moisture in gloves caused by perspiration.

Workers should always remove protective clothing (except for gloves) first and discard or secure the clothing for disinfection before removing their respirators and goggles. It is important that workers understand the importance of strict adherence to hand washing after contacting infected birds or surfaces that might be contaminated. Having suitable hand-washing facilities and a good supply of soap and disposable towels is essential. Before removing their gloves, workers should wash their gloved hands thoroughly with soap and water, and after removing the gloves, they should wash their hands again. If hand-washing facilities are unavailable at the site of an outbreak response, alternative hand-disinfection procedures will be specified. If waterless soaps or alcohol-based sanitizers are provided, care should be

taken because they are very harsh on the skin, which might lead to dermatitis if used too frequently.

It is important to take measures for preventing the avian influenza virus from being spread to other areas. To do this, disposable items of personal protective equipment should be discarded properly, and non-disposable items should be cleaned and disinfected according to outbreak-response guidelines.

Where to get more Information

Links to Internet sites are provided in this Safety and Health Information Bulletin for those wanting more detailed information on the topics presented. In addition, for those wanting sources of personal protective equipment, manufacturers of protective clothing, respirators, eye protection, and other items of personal protective equipment are listed in the *Buyer's Guide* of the International Safety Equipment Association at <http://www.safetyequipment.org>.

For answers to workplace safety and health questions, check the Web sites of NIOSH (<http://www.cdc.gov/niosh/homepage.html>) or OSHA (<http://www.osha.gov>), or telephone NIOSH at (800) 356-4674 or OSHA at (800) 321-6742.

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Disclaimer

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Advantages, Disadvantages, and Costs of Air-purifying Respirators for Protecting Poultry Workers

Respirator type	Advantages	Disadvantages	Cost (2004 dollars)
Filtering facepiece (disposable; dust mask)	<ul style="list-style-type: none"> - Lightweight. - No maintenance or cleaning needed. - No effect on mobility. 	<ul style="list-style-type: none"> - Provides no eye protection. - Provides no protection against irritant gases such as ammonia. - Can add to heat burden. - Inward leakage at gaps in face seal. - Many models do not have adjustable head straps. Difficult for a user to do a seal check. - Level of protection varies greatly among models. - Communication may be difficult. - Fit testing required to select proper facepiece size. - Some eyewear may interfere with facepiece fit. 	\$0.70 to \$10
Elastomeric half-facepiece	<ul style="list-style-type: none"> - Low maintenance. - Reusable facepiece and replaceable filters and cartridges. - Dual cartridges can be used to protect workers from exposures to particles, gases, and vapors. - No effect on mobility. 	<ul style="list-style-type: none"> - Provides no eye protection. - Can add to heat burden. - Inward leakage at gaps in face seal. - Facepiece must be cleaned and disinfected before reuse, this can be a contact-exposure risk. - Communication may be difficult. - Fit testing required to select proper facepiece size. - Some eyewear may interfere with facepiece fit. 	facepiece: \$12 to \$35 filters: \$4 to \$8 each
Powered with hood, helmet, or loose-fitting facepiece	<ul style="list-style-type: none"> - Provides eye protection. - Protection for people with beards, missing dentures, or facial scars. - Low breathing resistance. - Combination cartridges can be used for exposures to particles, gases, and vapors. - Flowing air creates cooling effect. - Face seal leakage is generally outward. - Fit testing is not required. - Prescription glasses can be worn. - Communication less difficult than with rubber half-facepiece or full-facepiece respirators. - Reusable components and replaceable filters. 	<ul style="list-style-type: none"> - Added weight of battery and blower. - Awkward to wear for some tasks. - Components must be cleaned and disinfected before reuse; this can be a contact-exposure risk. - Battery requires charging. - Air flow must be tested with flow device before use. 	unit: \$400 to \$1000 filters: \$10 to \$30
Elastomeric full-facepiece with N-100, R-100, or P-100 filters	<ul style="list-style-type: none"> - Provides eye protection. - Low maintenance. - Reusable facepiece and replaceable filters and cartridges. - Combination cartridges can be used for exposures to particles, gases, and vapors. - No effect on mobility. - More effective face seal than that of filtering facepiece or rubber half-facepiece respirators. 	<ul style="list-style-type: none"> - Can add to heat burden. - Reduced field-of-vision compared to half-facepiece. - Inward leakage at gaps in face seal. - Facepiece must be cleaned and disinfected before reuse; this can be a contact-exposure risk. - Fit testing required to select proper facepiece size. - Facepiece lens can fog without nose cup or lens treatment. - Spectacle kit needed for people who wear corrective glasses. 	facepiece: \$90 to \$240 filters: \$4 to \$8 each nose cup: \$30
Powered with tight-fitting half-facepiece or full-facepiece	<ul style="list-style-type: none"> - Provides eye protection with full-facepiece. - Low breathing resistance. - Face seal leakage is generally outward. - Flowing air creates cooling effect. - Reusable components and replaceable filters. - Combination cartridges can be used for exposures to particles, gases, and vapors. 	<ul style="list-style-type: none"> - Added weight of battery and blower. - Awkward to wear for some tasks. - No eye protection with half-facepiece. - Components must be cleaned and disinfected before reuse; this can be a contact-exposure risk. - Fit testing required to select proper facepiece size. - Battery requires charging. - Communication may be difficult. - Spectacle kit needed for people who wear corrective glasses with full-facepiece respirators. - Air flow must be tested with flow device before use. 	unit: \$500 to \$1000 filters: \$10 to \$30