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Expanded Recommendations for Use of Pneumococcal Conjugate Vaccines Among Adults Aged ≥50 Years: Recommendations of the Advisory Committee on Immunization Practices — United States, 2024

Miwako Kobayashi, MD[1]; Andrew J. Leidner, PhD[2]; Ryan Gierke, MPH[1]; Wei Xing, MSTAT[1]; Emma Accorsi, PhD[1]; Pedro Moro, MD[3]; Mini Kamboj, MD[4]; George A. Kuchel, MD[5]; Robert Schechter, MD[6]; Jamie Loehr, MD[7]; Adam L. Cohen, MD[1]

Abstract

Before October 2024, the Advisory Committee on Immunization Practices (ACIP) recommended use of a pneumococcal conjugate vaccine (PCV) for all adults aged ≥65 years, as well as for those aged 19–64 years with risk conditions for pneumococcal disease who have not received a PCV or whose vaccination history is unknown. Options included either 20-valent PCV (PCV20; Prevnar20; Wyeth Pharmaceuticals) or 21-valent PCV (PCV21; CAPVAXIVE; Merck Sharp & Dohme) alone or 15-valent PCV (PCV15; VAXNEUVANCE; Merck Sharp & Dohme) in series with 23-valent pneumococcal polysaccharide vaccine (PPSV23; Pneumovax23; Merck Sharp & Dohme). There are additional recommendations for use of PCV20 or PCV21 for adults who started their pneumococcal vaccination series with 13-valent PCV (PCV13; Prevnar13; Wyeth Pharmaceuticals). The ACIP Pneumococcal Vaccines Work Group employed the Evidence to Recommendations framework to guide its deliberations on expanding the age-based PCV recommendation to include adults aged 50–64 years. On October 23, 2024, ACIP recommended a single dose of PCV for all PCV-naïve adults aged ≥50 years. Recommendations for PCVs among adults aged 19–49 years with risk conditions and PCV13-vaccinated adults have not changed from previous recommendations. This report summarizes evidence considered for these recommendations and provides updated clinical guidance for use of PCV.

Introduction

Streptococcus pneumoniae (pneumococcus) is a common bacterial cause of respiratory tract infections, bacteremia, and meningitis. Widespread use of pneumococcal conjugate vaccine (PCV) in children reduced the incidence of pneumococcal disease, both among children through direct effects and among older children and adults who have not received PCV through indirect effects (i.e., reduction in disease incidence in the population because of decreased transmission of pneumococcus from children) (*1*,*2*). However, persons with underlying conditions or factors that increase their risk for pneumococcal disease (risk conditions)* and older adults experience higher pneumococcal disease rates. In addition, racial disparities in pneumococcal disease incidence persist, including higher rates among non-Hispanic Black or African American (Black) and non-Hispanic American Indian or Alaska Native (AI/AN) adults (*3*).

* Alcoholism; cerebrospinal fluid leak; chronic heart, liver, or lung disease; chronic renal failure; cigarette smoking; cochlear implant; congenital or acquired asplenia; diabetes mellitus; generalized malignancy; HIV; Hodgkin disease; immunodeficiency; iatrogenic immunosuppression; leukemia, lymphoma, or multiple myeloma; nephrotic syndrome; solid organ transplant; or sickle cell disease or other hemoglobinopathies.

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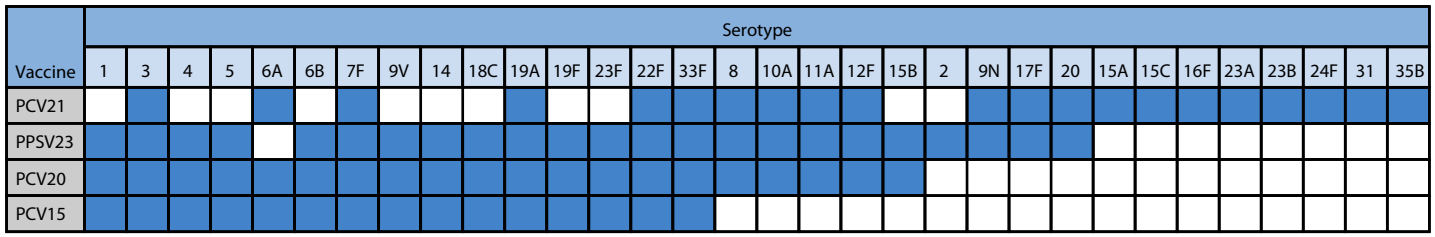
Before its October meeting, the Advisory Committee on Immunization Practices (ACIP) recommended receipt of a single dose of PCV for all adults aged ≥65 years and those aged 19–64 years with a risk condition who have not received PCV or whose vaccination history is unknown. Options included either 20-valent PCV (PCV20; Prevnar20; Wyeth Pharmaceuticals) (*4*) or 21-valent PCV (PCV21; CAPVAXIVE; Merck Sharp & Dohme) (*5*) alone, or 15-valent PCV (PCV15; VAXNEUVANCE; Merck Sharp & Dohme) (*6*) followed by 23-valent pneumococcal polysaccharide vaccine (PPSV23; Pneumovax23, Merck Sharp & Dohme) (*7*). Additional recommendations are applicable for use of PCV20 or PCV21 for adults who commenced their pneumococcal vaccination series with 13-valent PCV (PCV13; Prevnar13, Wyeth Pharmaceuticals) (*8,9*).

In June 2024, ACIP recommended PCV21 as an option for adults who are recommended to receive PCV and proposed a review of available evidence to determine whether data supported lowering the age-based recommendation to ≥50 years for all recommended PCVs (*8*). The approval of PCV21, which was specifically developed to target pneumococcal serotypes that commonly cause disease in adults (Figure), was seen as a unique opportunity to reduce pneumococcal disease incidence and health disparities among U.S. adults. This report summarizes the evidence considered by ACIP regarding the expansion of the age-based recommendation to include adults

FIGURE. Serotypes*,† included in pneumococcal vaccines currently recommended for adults — United States, 2024



Abbreviations: PCV = pneumococcal conjugate vaccine; PCV15 = 15-valent PCV; PCV20 = 20-valent PCV; PCV21 = 21-valent PCV; PPSV23 = 23-valent pneumococcal polysaccharide vaccine.

* PCV21 is approved for the prevention of invasive pneumococcal disease caused by serotype 15B based upon prespecified criteria for the proportion of participants with fourfold or more rise in opsonophagocytic activity responses. https://www.fda.gov/media/179426/download?attachment

† PCV21 contains serotype 20A.

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aged 50–64 years, highlighting considerations of pneumococcal disease incidence and mortality, health disparities, and resource use.

Methods

During July–October 2024, the ACIP Pneumococcal Vaccines Work Group considered PCV use among PCV-naïve adults aged 50–64 years within the Evidence to Recommendations (EtR) framework.† Published and unpublished data on pneumococcal disease incidence and mortality, pneumococcal vaccination coverage, and economic models of age-based PCV use at age ≥50 years were reviewed; and findings were summarized by race and ethnicity whenever available (*3,10*). Previous Grading of Recommendations, Assessment, Development and Evaluation (GRADE) reviews for PCV15, PCV20, and PCV21 (*8,11,12*) were supplemented by an updated search of MEDLINE, (using PubMed) and ClinicalTrials.gov to identify additional literature on safety and immunogenicity. Postlicensure safety data on PCV20 from the Vaccine Adverse Event Reporting System (VAERS) and an analysis using Centers for Medicare & Medicaid Services (CMS) data were reviewed.

Rationale and Evidence

Pneumococcal Disease Incidence in Adults Aged ≥19 Years

Pneumococcal pneumonia, accounting for 12%–13% of all hospitalized pneumonia cases, has been estimated to result in approximately 225,000 U.S. adult hospitalizations annually (*13–15*). Among adults aged 50–64 years with invasive pneumococcal disease (IPD) and those hospitalized with pneumococcal pneumonia, approximately 90% had one or more risk condition (*3,14*). Before the COVID-19 pandemic, approximately 30,000 IPD§ cases occurred annually among U.S. adults (*16*). In 2022, adults aged 50–64 years experienced IPD incidence and mortality rates of 13.2 and 1.8 per 100,000 population, respectively. These rates were higher than those in all other age groups except adults aged ≥65 years, whose incidence and mortality rates were 17.2 and 2.7 per 100,000 population, respectively (*1*). According to CDC's Active Bacterial Core surveillance (ABCs) data, during 2018–2022 (before PCV20 was widely used and before PCV21 approval among adults), 56% and 83%¶ of IPD cases were due to pneumococcal serotypes contained in PCV20 and PCV21 in adults aged 50–64 years, respectively (*17*).

Racial Disparities in Pneumococcal Disease Incidence and Vaccination Coverage

An estimated 32%–54% of adults aged 50–64 years had at least one risk condition that qualifies for risk-based pneumococcal vaccination.** However, 2022 Behavioral Risk Factor Surveillance System data showed that only 37% of adults aged 50–64 years with a risk-based vaccination recommendation received a pneumococcal vaccine, compared with 70% of adults aged ≥65 years with an age-based recommendation; racial disparities in vaccination rates were apparent†† (*3*). ABCs data showed that IPD rates among Black adults peaked at a younger age (55–59 years) compared with rates among non-Black adults whose IPD rates increased with increasing age (*3*). Although PCV13 use among U.S. children has reduced disparities in PCV13-type IPD incidence in adults, likely because of indirect effects; remaining racial disparities are driven by non-PCV13 serotypes, with non-PCV13 serotype IPD rates among AI/AN and Black adults (25 and 10 per 100,000 population, respectively) exceeding the population average of six per 100,000 (*3*).

PCV Immunogenicity and Safety from Clinical Trials

An updated literature search identified six PCV15 trials (*18–23*), three PCV20 trials (*24–26*), and seven PCV21 trials (*27–32*) that included immunogenicity and safety data for adults aged ≥50 years. Summary of evidence from the updated literature search remained essentially unchanged from previous summaries (*3,8,11,12*). Compared with PCV13, PCV15 met noninferiority criteria for all shared PCV13 serotypes, and immune responses for non-PCV13 serotypes 22F and 33F were statistically significantly higher. PCV20 met noninferiority criteria for all PCV13 serotypes compared with PCV13 and for six of seven non-PCV13 serotypes (not met for serotype 8) compared with PPSV23 (*24–26*). Compared with PCV20, PCV21 met noninferiority criteria for 10 of 10

† https://www.cdc.gov/acip/evidence-to-recommendations/adults-50-64-without-pneumococcal-vaccine-etr.html

§ Defined as a pneumococcal infection in a normally sterile site (e.g., blood, cerebrospinal fluid, bone, or joint space).

¶ PCV21 received indication for protection against IPD serotype 15B based on immunogenicity data. The percentage increases to 85% if serotype 15B is included as part of PCV21 serotype.

** At least one of the following conditions, according to the 2020 National Health Interview Survey: chronic heart disease, chronic lung disease, chronic liver disease, diabetes, smoking, alcoholism, weakened immune system due to prescriptions, weakened immune system due to health condition, solid cancer (not including nonmelanoma skin cancer or unknown type of skin cancer), and blood cancer. The percentages were 32% for non-Hispanic Asian (Asian) adults; 43% for Hispanic or Latino (Hispanic) adults; 50% for non-Hispanic White (White) adults; and 54% for Black adults.

†† According to 2022 Behavioral Risk Factor Surveillance System data, coverage with any pneumococcal vaccine among adults aged 50–64 years with risk-based recommendation by race and ethnicity was 27.9% (Hispanic), 39.3% (White), 38.2% (Black), 36.5% (Asian), and 35.1% (AI/AN); coverage among adults aged ≥65 years by race and ethnicity was 55.1% (Hispanic), 72.7% (White), 63.1% (Black), 64.1% (Asian), and 62.1% (AI/AN).

shared serotypes, and immune responses for 10 of 11 unique serotypes were statistically significantly higher (not met for serotype 15C). No vaccine-related serious adverse events (SAEs) were reported after PCV15 or PCV20 administration; two vaccine-related SAEs had been previously reported after PCV21 administration (*8*).

PCV20 Postlicensure Safety Data

Analysis of reports to VAERS after PCV20 administration in adults aged ≥19 years during October 2021–August 2024 showed a signal for Guillain-Barré syndrome (GBS); however, the overall reporting rate remained low (0.7 cases per million doses distributed) (*3*). Primary analysis of CMS data through May 2024 showed a statistically significant signal for GBS[§§] after PCV20 administration in Medicare beneficiaries aged ≥65 years. However, the signal was not statistically significant when applying an alternative GBS definition in sensitivity analysis or adjusted for the positive predictive value of diagnostic codes compared with confirmation by chart review (*3*).

Economic Analysis

Two economic models (Tulane-CDC and Merck) assessed the cost-effectiveness of PCV20 and PCV21 use among PCV-naïve adults aged 50–64 years (*10*). A third model (Pfizer) assessed the cost-effectiveness of PCV20 use only (*10*). All three models used quality-adjusted life-year (QALY) as the primary health outcome. The Tulane-CDC model estimated costs of $131,023–$214,430 per QALY gained for PCV21 and $251,037–$546,811 for PCV20. The Merck model estimated $251,048–$425,455 per QALY gained for PCV21 and $548,114–$879,117 for PCV20. The Pfizer model estimated $56,376–$133,524 per QALY gained for PCV20. Cost-effectiveness estimates were most sensitive to assumptions about indirect effects from pediatric vaccination and duration of protection from vaccination. Limitations of the models included uncertainties about duration of protection from vaccination, magnitude of indirect effects from pediatric vaccination, and impact of future supplementary pneumococcal vaccine doses for adults.

Recommendations for Use of PCV

ACIP recommended PCV for all PCV-naïve adults aged ≥50 years. Recommendations for PCVs for adults aged 19–49 years with a risk condition and for adults who have previously received PCV13 remain unchanged (Table) (*8*). The recommendation was supported by several factors, including the potential to improve vaccination coverage and reduce pneumococcal disease incidence and mortality in adults aged 50–64 years, particularly among demographic groups experiencing higher disease rates. Ease of implementing consistent age-based recommendations for all PCVs was also considered. Uncertainties regarding key assumptions guiding the economic models and higher cost per QALY estimates for PCV20 compared with PCV21 were acknowledged.

Summary

What is already known about this topic?

Before October 2024, a single dose of 15-valent, 20-valent, or 21-valent pneumococcal conjugate vaccine (PCV), was recommended for adults aged 19–64 years with risk conditions for pneumococcal disease and for all adults aged ≥65 years.

What is added by this report?

On October 23, 2024, the Advisory Committee on Immunization Practices recommended a single dose of PCV for all adults aged ≥50 years who are PCV-naïve or who have unknown vaccination history. The risk-based recommendation for adults aged 19–49 years is unchanged.

What are the implications for public health practice?

The updated, expanded age-based recommendation is expected to improve pneumococcal disease prevention in adults aged 50–64 years, particularly among demographic groups experiencing higher disease rates.

Selection of PCV in Populations with High Proportions of Serotype 4 Pneumococcal Disease

In many U.S. settings, PCV21 is expected to cover more circulating pneumococcal strains than do other recommended PCVs. In certain populations in which ≥30% of pneumococcal disease[¶¶] is due to serotype 4, pneumococcal vaccines that include serotype 4 (PCV20 alone or PCV15 and PPSV23 in series) (Figure) are expected to provide broader serotype coverage against locally circulating strains than does PCV21 (Box).

PPSV23 Use in PCV13-Experienced Adults Who Have Not Completed the Recommended Vaccination Series

Among adults aged ≥19 years who have started their pneumococcal vaccination series with PCV13 but have not received all recommended doses, PPSV23 is no longer recommended as an option to complete the series. Either PCV20 or

[§§] These cases were based on claims without chart confirmation. Therefore, in addition to the GBS definition used for the primary analysis (*International Classification of Diseases, Tenth Revision, Clinical Modification* [ICD-10-CM] code: G61.0), an alternative definition based on literature search (ICD-10-CM codes: G61.0, G61.81, G61.1, G61.8, and G61.9) was used for sensitivity analysis.

[¶¶] The 30% threshold was guided by economic models that showed that once the percentage of cases of pneumococcal disease caused by serotype 4 exceeds 30%, PCV21 use might result in higher cost and, in some cases, worse health outcomes compared with PCV20 use. https://www.cdc.gov/acip/downloads/slides-2024-06-26-28/02-Pneumococcal-Stoecker-508.pdf

TABLE. Clinical guidance for implementing pneumococcal vaccine recommendations for adults aged ≥19 years — United States, October 2024

Risk or age group	Vaccine received previously	Options for vaccination
Adults aged ≥50 years	None or PCV7 only at any age	A single dose of PCV21, PCV20, or PCV15. If PCV15 is administered, a single dose of PPSV23* should be administered ≥1 year after the PCV15 dose. A minimum interval of 8 weeks can be considered if PCV15 is used in adults with an immunocompromising condition,† cochlear implant, or CSF leak.
	PPSV23 only	A single dose of PCV21, PCV20, or PCV15 ≥1 year after the last PPSV23 dose.
	PCV13 only	A single dose of PCV21 or PCV20 ≥1 year after the PCV13 dose.
	PCV13 at any age and PPSV23 at age <65 years	A single dose of PCV21 or PCV20 ≥5 years after the last pneumococcal vaccine dose.
	PCV13 at any age and PPSV23 at age ≥65 years	Shared clinical decision-making is recommended regarding administration of either a single dose of PCV21 or PCV20 for any adult aged ≥65 years who has completed the recommended vaccination series with both PCV13 and PPSV23 (i.e., PPSV23 administered at age ≥65 years) but PCV21, PCV20, or PCV15 not yet received. If a decision to administer PCV21 or PCV20 is made, a single dose is recommended ≥5 years after the last pneumococcal vaccine dose.
Adults aged 19–49 years with an immunocompromising condition,† a CSF leak, or a cochlear implant	None or PCV7 only at any age	A single dose of PCV21, PCV20, or PCV15. If PCV15 is used, administer a single dose of PPSV23* ≥8 weeks after the PCV15 dose.
	PPSV23 only	A single dose of PCV21, PCV20, or PCV15 ≥1 year after the last PPSV23 dose.
	PCV13 only	A single dose of PCV21 or PCV20 administered ≥1 year after the PCV13 dose.
	PCV13 and 1 dose of PPSV23	A single dose of PCV21 or PCV20 ≥5 years after the last pneumococcal vaccine dose. The pneumococcal vaccination series is complete, and it need not be followed by additional pneumococcal vaccine doses.
	PCV13 and 2 doses of PPSV23	The pneumococcal vaccination recommendations should be reviewed again when the person turns age 50 years. Alternatively, a single dose of either PCV21 or PCV20 should be administered ≥5 years after the last pneumococcal vaccine dose. If PCV21 or PCV20 is used, the series is complete, and it need not be followed by additional pneumococcal vaccine doses.
Adults aged 19–49 years with chronic medical conditions§	None or PCV7 only at any age	A single dose of PCV21, PCV20, or PCV15. If PCV15 is administered, a single dose of PPSV23* should be administered ≥1 year after the PCV15 dose.
	PPSV23 only	A single dose of PCV21, PCV20, or PCV15 ≥1 year after the last PPSV23 dose.
	PCV13 only	A single dose of PCV21 or PCV20 ≥1 year after the PCV13 dose.
	PCV13 and 1 dose of PPSV23	The pneumococcal vaccination recommendations should be reviewed again when the person reaches age 50 years.

Abbreviations: CSF = cerebrospinal fluid; PCV = pneumococcal conjugate vaccine; PCV7 = 7-valent PCV; PCV13 = 13-valent PCV; PCV15 = 15-valent PCV; PCV20 = 20-valent PCV; PCV21 = 21-valent PCV; PPSV23 = 23-valent pneumococcal polysaccharide vaccine.

* For adults who have received PCV15 but have not completed their recommended pneumococcal vaccine series with PPSV23, 1 dose of PCV21 or PCV20 may be used if PPSV23 is not available.

† Chronic renal failure, nephrotic syndrome, immunodeficiency, iatrogenic immunosuppression, generalized malignancy, HIV infection, Hodgkin disease, leukemia, lymphoma, multiple myeloma, solid organ transplant, congenital or acquired asplenia, or sickle cell disease or other hemoglobinopathies.

§ Alcoholism; chronic heart disease, including congestive heart failure and cardiomyopathies; chronic liver disease; chronic lung disease, including chronic obstructive pulmonary disease, emphysema, and asthma; cigarette smoking; or diabetes mellitus.

PCV21 is recommended to complete the series as previously recommended. (Table).

Coadministration with Other Vaccines

In accordance with CDC's General Best Practice Guidelines for Immunization, routine administration of a pneumococcal vaccine with other age-appropriate doses of vaccines at the same visit is recommended for adults who have no specific contraindications to vaccination at the time of the health care visit (*33*).

Contraindications and Precautions

Vaccination providers should consult the vaccine package insert for precautions, warnings, and contraindications (*4–7*). Vaccination with PCV or PPSV23 is contraindicated in persons known to have had a severe allergic reaction (e.g., anaphylaxis) to any component of the vaccine. Because PCVs are conjugated to CRM197, a nontoxic genetically altered diphtheria toxin, these vaccines are also contraindicated in persons known to have had a severe allergic reaction to any diphtheria toxoid–containing vaccine (*4–7*).

Reporting of Vaccine Adverse Events

Adverse events occurring after administration of any vaccine should be reported to VAERS. Instructions for reporting to VAERS are available at https://vaers.hhs.gov/reportevent.html or by calling 800-822-7967.

BOX. Clinical guidance on selection of pneumococcal conjugate vaccine in communities with high percentages of serotype 4 pneumococcal disease — United States, 2024

- PCV21 contains eight pneumococcal serotypes that are not included in previously recommended pneumococcal vaccines (i.e., PCV15, PCV20, and PPSV23). However, PCV21 does not contain certain pneumococcal serotypes that are contained in previously recommended pneumococcal vaccines, one of which is pneumococcal serotype 4.
- In certain adult populations in the western United States, high percentages (i.e., ≥30%) of IPD caused by serotype 4 have occurred. The available IPD serotype data from CDC's Active Bacterial Core surveillance, as well as similar surveillance from Alaska and Navajo Nation, indicate that this serotype is particularly prevalent in Alaska, Colorado, Navajo Nation, New Mexico, and Oregon. Serotype 4 IPD occurs across age groups; however, cases are frequently observed among adults aged <65 years who have underlying conditions such as alcoholism, chronic lung disease, cigarette smoking, homelessness, and injection drug use. In such populations in these geographic areas, other recommended pneumococcal vaccines (e.g., PCV20 alone or both PCV15 and PPSV23) are expected to provide broader serotype coverage against locally circulating strains compared with PCV21.
- The percentages of serotype 4 IPD cases in other areas of the western United States without IPD surveillance are currently unknown. IPD surveillance from other geographic areas in the United States (e.g., midwestern, eastern, and southern regions) has not detected significant percentages of serotype 4.
- This clinical guidance will be reviewed and updated as pneumococcal disease epidemiology evolves.

Abbreviations: IPD = invasive pneumococcal disease; PCV = pneumococcal conjugate vaccine; PCV13 = 13-valent PCV; PCV15 = 15-valent PCV; PCV20 = 20-valent PCV; PCV21 = 21-valent PCV; PPSV23 = 23-valent pneumococcal polysaccharide vaccine.

Future Research and Monitoring Priorities

CDC and ACIP will continue to assess safety and public health impact of pneumococcal vaccines among adults. This includes monitoring the duration of vaccine-conferred immunity from PCV to determine the need for a booster to ensure that older adults continue to be protected under the updated vaccine recommendation and to measure any indirect effects on incidence in adults from routine childhood vaccination.

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ACIP Pneumococcal Vaccines Work Group

Jamie Loehr, Cayuga Family Medicine; Mini Kamboj, Memorial Sloan Kettering Cancer Center, Joan and Sanford Weill Medical College of Cornell University; George Kuchel, UConn Health; Robert Schechter, California Department of Public Health; Lucia Lee, Tina Mongeau, Food and Drug Administration; Risa Claytor, Health Resources and Services Administration; Uzo Chukwuma, Indian Health Service; Mamodikoe Makhene, Meenu Upadyay, National Institutes of Health; Lynn Fisher, American Academy of Family Physicians; Monica Ardura, American Academy of Pediatrics, Committee on Infectious Diseases; Jason Goldman, Saba Hasan, American College of Physicians; David A. Nace, American Geriatrics Society, Post-Acute and Long-Term Care Medical Association; Cora Hoover, Association of Immunization Managers; Mary Hayney, American Pharmacists Association; Eva Wong, Canadian National Advisory Committee on Immunization; James McAuley, Infectious Diseases Society of America; Robert Hopkins, William Schaffner, National Foundation for Infectious Diseases; Virginia Caine, National Medical Association; Monica M. Farley, Emory University; Keith Klugman, Gates Foundation; Sarah S. Long, Drexel University College of Medicine; Katherine A. Poehling, Wake Forest University School of Medicine; Arthur Reingold, University of California, Berkeley; Lorry Rubin, Cohen Children's Medical Center of New York; Richard K. Zimmerman, University of Pittsburgh.

Corresponding author: Miwako Kobayashi, mkobayashi@cdc.gov.

[1]Division of Bacterial Diseases, National Center for Immunization and Respiratory Diseases, CDC; [2]Immunization Services Division, National Center for Immunization and Respiratory Diseases, CDC; [3]Immunization Safety Office, CDC; [4]Memorial Sloan Kettering Cancer Center, Joan and Sanford Weill Medical College of Cornell University, New York, New York; [5]UConn Health, Farmington, Connecticut; [6]California Department of Public Health; [7]Cayuga Family Medicine, Ithaca, New York.

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Occupational Exposure to Mercury at an Electronics Waste and Lamp Recycling Facility — Ohio, 2023

Dallas S. Shi, MD, PhD[1,2]; Melissa Charles, MS[1]; Catherine Beaucham, PhD[1]; Sheldon Walker[1]; Walter Alarcon, MD[1]; Scott E. Brueck, MS[1]; Sophia K. Chiu, MD[1]; Nicholas Somerville, MD[1]

Abstract

Workers in electronics waste and lamp recycling facilities are at risk of exposure to elemental mercury through inhalation of mercury vapor and mercury-containing dust. Employers at an electronics waste and lamp recycling facility in Ohio that crushes mercury-containing lamps expressed concerns about mercury exposure from work processes and requested a health hazard evaluation by CDC's National Institute for Occupational Safety and Health (NIOSH). In April 2023, NIOSH conducted a multidisciplinary investigation to assess elemental and inorganic mercury exposures, including epidemiologic, environmental, and ventilation assessments. Results indicated that mercury vapor was detected throughout the facility, with six of 14 workers having elevated urine mercury levels. These workers had a median job tenure of 8 months; four did not speak English, and five reported symptoms consistent with mercury toxicity, such as metallic or bitter taste, difficulty thinking, and changes in personality. Recommendations included improving the ventilation system, changing work practices to reduce mercury exposure, and providing training and communication tailored to the worker. As the electronic waste recycling industry continues to grow, it is important for employers to evaluate mercury exposure and safeguard employees using a hierarchy of controls. Health departments should consider monitoring occupational mercury exposure in recycling facilities, and clinicians should be aware of the potential for mercury toxicity among workers in these settings.

Investigation and Results

Mercury exposure is an occupational hazard with serious health consequences, including neurological symptoms such as tremors, memory loss, and difficulty concentrating, as well as kidney damage and other systemic effects (*1*). Elemental mercury exposure occurs primarily through inhalation of mercury vapor, which can be rapidly absorbed into the bloodstream. Chronic exposure, even at low levels, can lead to cumulative health effects over time (*1*,*2*).

Occupational limits have been established to safeguard workers against mercury exposure. These limits include the American Conference of Governmental Industrial Hygienists (ACGIH) threshold limit value (TLV) of 25 $\mu g/m^3$, the National Institute for Occupational Safety and Health's (NIOSH) recommended exposure limit (REL) of 50 $\mu g/m^3$, and the Occupational Safety and Health Administration's (OSHA's) permissible exposure limit (PEL) of 100 $\mu g/m^3$. ACGIH TLV and NIOSH REL are recommended exposure limits to prevent adverse health effects among workers; OSHA PEL is a legally enforceable limit.

Workers in electronics waste and lamp recycling facilities face unique risks for mercury exposure due to the crushing and processing of mercury-containing lamps (*3*). Mercury vapor and dust can become airborne, creating significant inhalation risks. In response to concerns raised by employers at an electronics waste and lamp recycling facility in Ohio about mercury exposure from work processes, NIOSH conducted a health hazard evaluation (HHE).* The evaluation, carried out in April 2023, involved a multidisciplinary team of industrial hygienists, epidemiologists, and medical officers. During a 2-day site visit, CDC investigators conducted a cross-sectional epidemiologic study by interviewing 15 workers, performed environmental sampling for mercury vapor, assessed the facility's ventilation system to identify potential sources and levels of mercury exposure, and offered spot urine testing (*4*). This activity was reviewed by CDC, deemed not research, and conducted consistent with applicable federal law and CDC policy.†

Facility and Work Process Description

The facility was a two-story warehouse divided into four sections: 1) administrative areas; 2) common spaces (entrance, hallways, bathrooms, breakroom, conference room, locker room, and personal protective equipment [PPE] storage); 3) lamp recycling areas (lamp room, glass roll-off, shaker, and retort furnace); and 4) additional workspaces (material storage, battery and ballast sorting, and bulb storage). During an 8-hour work day, lamp room workers load mercury-containing bulbs onto a conveyor for crushing. A sorting machine divides the bulbs into glass (deposited in the glass roll-off area), metal, and mercury dust (further sieved into ultrafine dust by the shaker). The retort furnace, which extracts mercury from ultrafine dust using heat, was not in use at the time of HHE. Workers in the battery and ballast areas prepare electrode components, such

* https://www.cdc.gov/niosh/hhe/default.html
† 45 C.F.R. part 46.102(l)(2), 21 C.F.R. part 56; 42 U.S.C. Sect. 241(d); 5 U.S.C. Sect. 552a; 44 U.S.C. Sect. 3501 et seq.

as metal or graphite parts, for shipment to facilities where they are reused or recycled into new batteries or other products. Employees in the lamp room and retort furnace area wear half-mask elastomeric respirators (reusable respirators made from a flexible material that provides a tight seal and are equipped with replaceable cartridges for filtering mercury vapor), steel-toed boots, safety glasses, and a company-issued long-sleeved shirt.

Worker Interviews and Spot Urine Testing

All 15 workers at the facility participated in a semistructured interview about employment history, work characteristics, signs and symptoms consistent with mercury toxicity, and medical and social histories. Workers were given the option to undergo spot urine testing for inorganic and elemental mercury at the time of the interview. Spot urine testing was chosen because of its convenience, instead of 24-hour urine or end-of-shift collection at the end of the workweek. Urine specimens were analyzed by Associated Regional and University Pathologists, Inc. (https://www.aruplab.com/) laboratories using inductively coupled plasma mass spectrometry, an analytic technique that can detect the concentration of elements and their isotopes in a sample. Creatinine levels, a marker of kidney function, were measured, and urine mercury-to-creatinine ratios were calculated for comparison with the ACGIH Biologic Exposure Index (BEI) of 20.0 μg/g creatinine. BEI is a guideline value indicating the level of a substance in biologic samples below which most workers are unlikely to experience adverse health effects.

Environmental and Personal Air Sampling Methodology

Direct area air sampling for elemental mercury vapor was conducted during 2 work days using a Jerome J405 atomic fluorescence mercury vapor analyzer (https://www.pine-environmental.com/products/jerome_j405). A total of 171 direct area air samples were measured at breathing height (approximately 5 ft [1.5 m] above floor level) to assess mercury vapor levels across the facility. Comparisons to occupational exposure limits were used to identify potential areas of concern within the facility. In addition, all workers were offered the opportunity to participate in personal air sampling, which involved collection of full-shift personal breathing zone samples for mercury vapor analysis during 2 days to directly compare against occupational exposure limits.

PPE Use

Inconsistent use of recommended PPE was observed throughout the facility. Observations during the site visit revealed that, particularly in the lamp room where respirators are mandatory, workers frequently did not adhere to proper PPE use. Instances included employees removing their respirators or wearing them incorrectly, such as one employee using an N95 respirator with one of the straps cut off, severely compromising the respirator's seal. Other observations included sporadic use of gloves and protective clothing. These observations were further corroborated by worker interviews. Some workers reported challenges with the fit and comfort of their PPE, while others cited a lack of understanding regarding the proper use and maintenance of equipment. Language barriers among workers appeared to exacerbate these issues, as training and communication were not always provided in workers' preferred languages.

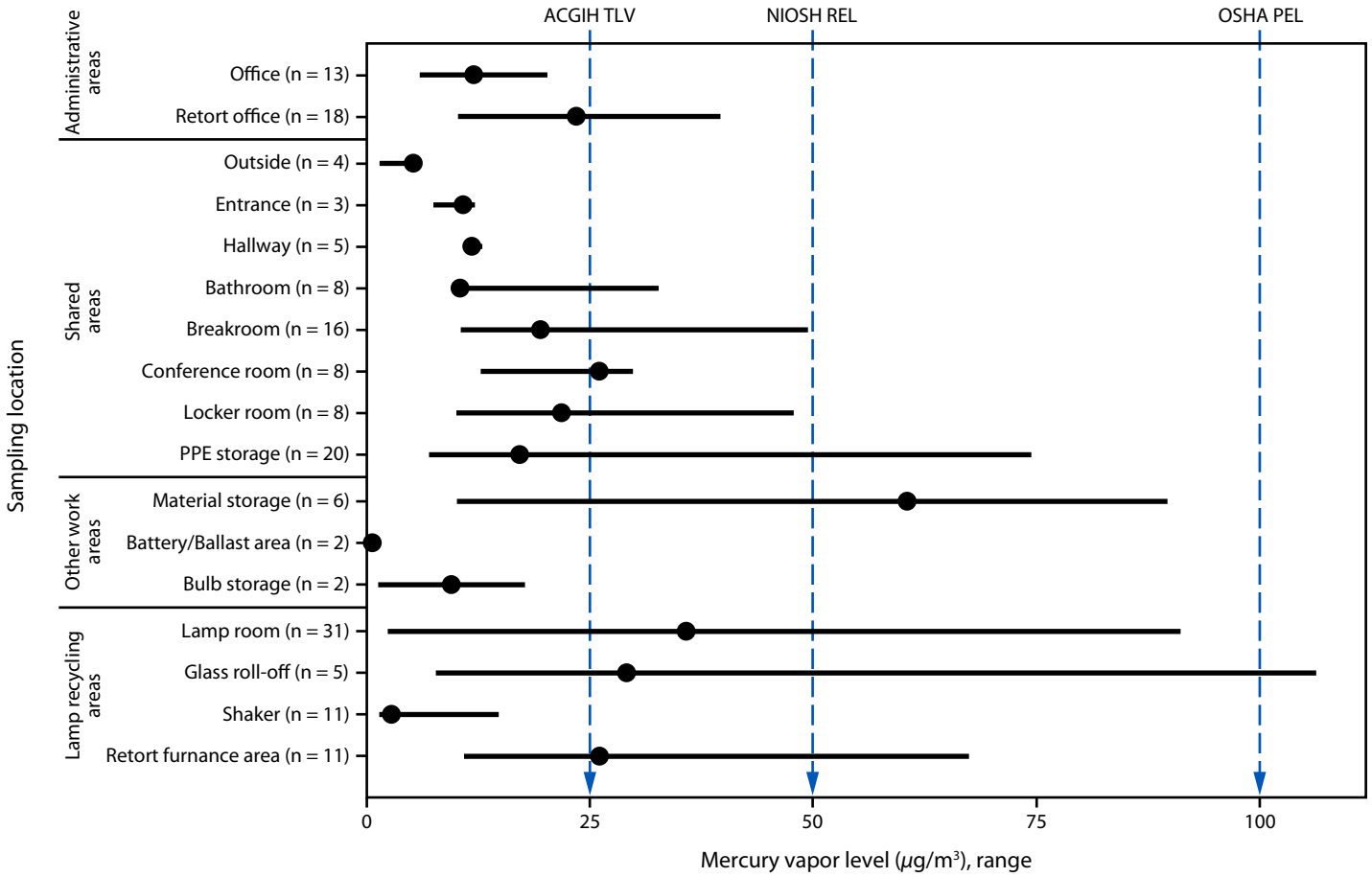
Environmental Air Sampling Findings

Mercury was detected in all 171 direct area air samples (Figure). In areas outside of the lamp recycling areas (lamp room, glass roll-off, shaker, and retort areas), referred to as nonproduction areas, the median mercury vapor concentrations in the conference room (26.0 $\mu g/m^3$; range = 12.8–29.8 $\mu g/m^3$) and material storage area (60.5 $\mu g/m^3$; range = 10.1–89.7 $\mu g/m^3$) exceeded the ACGIH TLV of 25 $\mu g/m^3$. The median mercury vapor concentration in the material storage area also exceeded the NIOSH REL of 50 $\mu g/m^3$. In production areas, the median mercury vapor concentrations in the lamp room (35.8 $\mu g/m^3$; range = 2.5–91.1 $\mu g/m^3$), glass roll-off area (29.1 $\mu g/m^3$; range = 7.8–106.3 $\mu g/m^3$), and retort furnace area (26.1 $\mu g/m^3$; range = 10.9–67.5 $\mu g/m^3$) were also above ACGIH TLV. One sample from the glass roll-off area (106.3 $\mu g/m^3$) exceeded both NIOSH REL and OSHA PEL.

Results of Urine Testing and Personal Air Sampling

All 15 employees participated in urine collection. One urine sample was too diluted to interpret. Among six workers in the lamp recycling area, the median mercury-to-creatinine ratio was 41.3 μg/g, and the levels of five of these workers exceeded ACGIH BEI (Table 1). Among three workers in administrative areas and five in other work areas, the median urine mercury-to-creatinine ratios were 8.6 μg/g and 5.8 μg/g, respectively. Overall, six of 14 workers had spot urine mercury levels above ACGIH BEI, including five of six workers in the lamp recycling areas and one of five workers in other work areas. All six workers in the lamp recycling areas and three of those in other work areas participated in personal air sampling. Five of six workers in the lamp recycling areas had personal air exposures to mercury vapor above the ACGIH TLV of 25 $\mu g/m^3$ (median = 64.8 $\mu g/m^3$).

FIGURE. Median mercury vapor levels, by work location at an electronic waste and lamp recycling facility — Ohio, 2023



Abbreviations: ACGIH = American Conference of Governmental Industrial Hygienists; NIOSH = National Institute for Occupational Safety and Health; OSHA = Occupational Safety and Health Administration; PEL = permissible exposure limit; PPE = personal protective equipment; REL = recommended exposure limit; TLV = threshold limit value.

TABLE 1. Median spot urine mercury levels and personal mercury vapor exposure levels among workers at an electronic waste and lamp recycling facility, by primary work location (N = 15) — Ohio, 2023

Primary job location	No. of workers	Median (range) urine mercury to creatinine ratio (μg/g)	No. (%) of samples >ACGIH BEI*	No. of personal air samples	Median (range) personal mercury vapor exposure (μg/m³)†	No. (%) of samples >ACGIH TLV§
Lamp recycling areas	6	41.3 (16.1–64.0)	5 (83)	12	64.8 (10.7–81.8)	10 (83)
Administrative areas	3	8.6 (4.2–13.0)	0 (—)	0	—	—
Other work areas	5¶	5.8 (1.3–45.2)	1 (20)	6	6.6 (2.9–11.5)	0 (—)
Total	**14****	**51.0 (1.3–64.0)**	**6 (43)**	**18**	**33.6 (2.9–81.8)**	**10 (56)**

Abbreviations: ACGIH = American Conference of Governmental Industrial Hygienists; BEI = biologic exposure index; TLV = threshold limit value.
* ACGIH BEI for inorganic mercury in urine is 20 μg/g creatinine.
† Personal air sampling was collected over the course of two shifts per worker. In total, nine workers participated with a total of 18 samples collected. Workers in the administrative areas did not participate in personal air sampling.
§ ACGIH TLV for elemental mercury is 25 μg/m³.
¶ All five workers participated in urine testing; three participated in personal air sampling.
** Urine specimen from one employee was too diluted to interpret.

Characteristics of Workers with Elevated Spot Urine Mercury Levels

Of the 14 workers whose spot urine samples were sufficiently concentrated for interpretation of mercury levels, six had levels exceeding ACGIH BEI (Table 2). Among these, all were male and four were Spanish-speaking. All eight workers with mercury levels below BEI primarily spoke English and worked in production areas. Median job tenure of workers with mercury levels above BEI was 8 months compared with 23 months among workers with mercury levels below BEI. Five of the six workers with levels above BEI reported signs and symptoms consistent with mercury exposure, including a metallic or bitter taste, difficulty thinking, or personality changes (three each); difficulty writing or loss of balance, light headedness, or dizziness (two each); and skin rash, headache, numbness or tingling in hands or feet, weight loss, or diarrhea (one each). (Participants could identify any signs or symptoms that began after their employment began at the recycling facility, and multiple signs and symptoms could be reported by each participant.) Four of the eight workers with levels below BEI reported no symptoms.

TABLE 2. Demographic characteristics and symptoms of electronic waste and lamp recycling facility workers with spot urine mercury levels above and below the American Conference of Governmental Industrial Hygienists biologic exposure index* (N = 14) — Ohio, 2023

Characteristic	No. (%), by urine mercury level	
	≤20 μg/g creatinine	>20 μg/g creatinine
No. of workers	8	6
Median age, yrs (range)	**40 (25–53)**	**41 (35–54)**
Sex		
Female	2 (25)	0 (—)
Male	6 (75)	6 (100)
Primary language		
English	8 (100)	2 (33)
Spanish	0 (—)	4 (67)
Job tenure, mos, median (range)	23 (14–144)	8 (3–32)
Self-reported signs and symptoms†		
Any sign or symptom	4 (50)	5 (83)
Metallic or bitter taste	1 (13)	3 (50)
Difficulty thinking	0 (—)	3 (50)
Changes in personality	0 (—)	3 (50)
Difficulty writing	0 (—)	2 (33)
Loss of balance, lightheadedness, or dizziness	0 (—)	2 (33)
Skin rash or sore	1 (13)	1 (17)
Headaches	3 (38)	1 (17)
Numbness or tingling in hands or feet	1 (13)	1 (17)
Unplanned weight loss	1 (13)	1 (17)
Diarrhea	1 (13)	1 (17)
No reported sign or symptom	4 (50)	1 (17)

* 20 μg/g creatinine.
† Reported signs and symptoms are not mutually exclusive. Participants could identify any symptoms that began after their employment began at the recycling facility, and multiple symptoms could be reported by each participant.

Public Health Response

Recommendations to protect workers based on a hierarchy of controls[§] approach were provided to the facility (*4*). Recommended engineering controls included installing local exhaust ventilation over the conveyer in the lamp room and maintenance of the facility's heating, ventilation, and air conditioning systems. Other recommendations included implementing a workflow progressing from clean to dirty zones to prevent the spread of mercury to clean areas, improving housekeeping, tailoring training in workers' preferred languages, and standardizing use of recommended PPE.

Discussion

The expansion of the recycling industry offers opportunities to promote sustainable waste management practices but also raises challenges related to workers' health (*5*). This investigation highlights occupational health concerns at an electronics waste and lamp recycling facility, where identification of environmental mercury vapor and individual worker urine mercury concentrations surpassing ACGIH safety thresholds indicate a need for enhanced protective measures and monitoring. Previous studies have consistently demonstrated the occupational hazards posed by mercury exposure in recycling and manufacturing settings, and underscore the importance of comprehensive safety protocols that help worksites adhere to recommended exposure limits (*3*,*6*). Observed inconsistent proper PPE use likely contributed to high urine mercury measurements despite the use of respiratory protection, indicating a need for enforcement of safety protocols and targeted training to support proper PPE use.

Elevated mercury vapor levels were also identified in areas of the facility not directly involved in lamp recycling. Although personal exposure measurements for mercury in these areas did not surpass ACGIH TLV, one worker with no direct involvement in lamp recycling had elevated urine mercury levels. This finding suggests that contamination of nonproduction areas can affect nonproduction workers. Mercury exposure below established occupational limits can have harmful health effects over time, including neurologic symptoms such as tremors, memory problems, and difficulty concentrating, as well as kidney damage (*1*,*2*). To mitigate these risks, comprehensive controls are essential. The diverse nature of recycling operations means that workers, regardless of their direct involvement with recycling processes, might be exposed to hazardous substances such as mercury.

[§] The hierarchy of controls is a framework that groups corrective actions by their likely effectiveness in reducing or removing hazards from the workplace. Levels in the hierarchy include elimination, substitution, engineering controls, administrative or work-practice controls, and PPE. https://www.cdc.gov/niosh/hierarchy-of-controls/about/index.html

Summary

What is already known about this topic?

Workers in electronics waste and lamp recycling facilities face health risks from inhaling mercury vapor and mercury-containing dust.

What is added by this report?

At an Ohio electronics waste and lamp recycling facility, mercury vapor was found throughout, and six of 14 workers had elevated urine mercury levels. Among those with elevated urine mercury, the median job tenure was 8 months; four workers did not speak English, and five reported signs and symptoms consistent with mercury toxicity.

What are the implications for public health practice?

Employers at electronics waste and lamp recycling facilities are encouraged to evaluate mercury exposure and implement controls such as enhancing ventilation systems and providing training tailored to the worker.

This investigation identified a disparity in exposure levels among workers with different primary languages and job tenure, suggesting potential barriers to effective communication and training (*2*,*7*). These findings align with broader occupational health literature, which identifies language barriers and job tenure as factors influencing health and safety (*7*–*9*). The higher prevalence of self-reported symptoms among workers with elevated mercury levels reinforces the need for ongoing health monitoring to mitigate the adverse health effects of mercury.

Employers at recycling facilities can implement comprehensive exposure mitigation strategies that align with the hierarchy of controls. These strategies include enclosing spaces with the highest potential for mercury exposure to prevent contamination of nonproduction areas, improved ventilation, use of appropriate PPE, regular exposure surveillance, and training programs tailored to worker needs. Health departments with recycling facilities in their jurisdiction should be aware of the potential for mercury exposure, while clinicians should remain vigilant for signs and sympoms of mercury toxicity among workers in these environments. Regular monitoring is essential to ensure that controls are effective and to detect any changes in exposure levels (*10*).

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Brian Christensen, Vidisha Parasram, National Institute for Occupational Safety and Health, CDC.

Corresponding author: Dallas S. Shi; Dshi@cdc.gov.

[1]Division of Field Studies and Engineering, National Institute for Occupational Safety and Health, CDC; [2]Epidemic Intelligence Service, CDC.

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Notes from the Field

Severe Health Outcomes Linked to Consumption of Mushroom-Based Psychoactive Microdosing Products — Arizona, June–October 2024

Heather L. Walker, DVM[1,2,3]; Maureen Roland[4]; Steven Dudley, PharmD[5]; Kenneth Komatsu, MPH[1]; Joli Weiss, PhD[1]; Jamaica Dillard, MPH[1]; Hsin-I Lin, ScD[1]; Laura Rust, MPH[1]; Traci Plummer, MPH[1]; Rachel Berg[1]; Stephen Everett, MPH[6]; Arthur Chang, MD[7]; Michael Yeh, MD[7]; Johnni Daniel, DHSc[7]; Shane Brady, MPH[1]

In June 2024, Arizona Department of Health Services (ADHS) was notified by Arizona's poison control centers (PCCs)* of adverse health outcomes occurring after ingestion of a Diamond Shruumz–brand product containing proprietary blends of mushroom extracts and adaptogens.† These products were sold as chocolate bars, gummies, and cones and could be purchased online or at local retailers nationwide.§ Availability of similar products containing psychoactive compounds is increasing, with some known to contain unlabeled psychoactive substances (*1*,*2*). This report describes findings from a national outbreak of illness associated with ingestion of Diamond Shruumz–brand products. This activity was reviewed by CDC, deemed not research, and was conducted consistent with applicable federal law and CDC policy.¶

Investigation and Outcomes

On June 1, 2024, a woman (patient A) and a man (patient B), both aged 20–29 years from Yavapai County, Arizona, reported sharing a Diamond Shruumz–brand chocolate bar** (Table). Patient A experienced loss of consciousness and bladder and bowel incontinence and was transported to a local emergency department (ED) by patient B. After arrival at the ED, both patients experienced generalized seizures. Both received benzodiazepines for seizure control and supportive care. Patient A stabilized 10 hours later and was discharged, whereas patient B remained unresponsive, requiring endotracheal intubation and admission to an intensive care unit. Patient B regained consciousness after 8 hours and was discharged after 2 days.

On June 2, 2024, two adolescent girls (patients C and D) from Yavapai County reported ingesting a Diamond Shruumz–brand chocolate bar. Within 2 hours, both experienced decreased level of consciousness, respiratory depression, and vomiting. Patient C also had a generalized seizure. Emergency medical services were called, and both patients were transported to a local ED. En route, patient D had a generalized seizure, and both patients were administered benzodiazepines during transport. In the ED, both patients had tachycardia, hypertension, and intermittent muscle rigidity lasting for 12 hours after ingestion. Both received endotracheal intubation for airway protection, additional benzodiazepine doses for seizure control and muscle rigidity, and supportive care. Both stabilized 24 hours after ingestion and were discharged the next morning.

Preliminary Conclusions and Actions

On June 3, 2024, PCCs notified ADHS of these patients, issued a press release warning consumers about Diamond Shruumz–brand products, and encouraged health care professionals to report related cases to PCCs (*3*). On June 19, ADHS released a consumer alert including similar messaging (*4*). Two additional patients who sought medical care after consumption of a Diamond Shruumz–brand product were reported to PCCs, one of whom consumed the product and received medical treatment 2 months before this investigation began. ADHS collaborated with PCCs to interview patients, family members, and attending clinicians to collect information on demographic characteristics, medical history, product consumption, patient signs and symptoms, and substance use history. ADHS used syndromic surveillance to identify additional cases not reported to PCCs.

The successful partnership between ADHS and Arizona's PCCs (*5*) led to prompt notification of this outbreak, highlighting the benefits of collaboration and cooperation with PCCs for investigating poisonings, toxic substance exposures, or ingestions. In addition, PCCs provided lifesaving medical management recommendations to the treating physicians. ADHS alerted CDC and the Food and Drug Administration (FDA) of the ill patients and product consumption, which resulted in a federally led outbreak response that included CDC, FDA, state and local health departments, and regional poison centers. CDC's National Center for Environmental

* Arizona Poison and Drug Information Center and Banner Poison and Drug Information Center are the two poison centers in Arizona.

† https://my.clevelandclinic.org/health/drugs/22361-adaptogens

§ Local retailers include those that sell hemp-derived products (cannabidiol or delta-8 tetrahydrocannabinol) and smoke and vape products. Additional information about Diamond Shruumz–brand products is not available because the company's website is not active at the time of this report.

¶ 45 C.F.R. part 46, 21 C.F.R. part 56; 42 U.S.C. Sect. 241(d); 5 U.S.C. Sect. 552a; 44 U.S.C. Sect. 3501 et seq.

** An entire chocolate bar consists of 15 presectioned pieces with a total weight of 1.6 oz (43.4 g), although some other Diamond Shruumz chocolate bars were divided into 12 presectioned pieces. The company's website mentioned two squares as the starting dose for "microdosing" and to consume more as needed to achieve the desired effect, with no maximum dose listed.

TABLE. Characteristics, symptomology, and product consumption results among four patients who consumed Diamond Shruumz–brand products — Arizona, June 2024

Characteristic	Patient A	Patient B	Patient C	Patient D
Age group	Young adult	Young adult	Adolescent	Adolescent
Sex	Female	Male	Female	Female
County of residence	Yavapai	Yavapai	Yavapai	Yavapai
Diamond Shruumz–brand product consumed/Flavor	Chocolate bar/ Cookies and cream	Chocolate bar/ Cookies and cream	Chocolate bar/ Dark chocolate	Chocolate bar/ Dark chocolate
Amount consumed	Eight pieces	Seven pieces	15 pieces	15 pieces
Symptom onset date	Jun 1, 2024	Jun 1, 2024	Jun 2, 2024	Jun 2, 2024
Signs and symptoms associated with product consumption	Bladder and bowel incontinence, LOC, seizure, and hypersalivation	LOC, seizure, hypersalivation, bradycardia, myoclonus, and diaphoresis	Hallucinations, nausea, vomiting, seizure, muscle rigidity, tachycardia, HTN, agitation, and myoclonus	Hallucinations, nausea, vomiting, seizure, muscle rigidity, tachycardia, HTN, agitation, and myoclonus
Hospitalized	Yes	Yes	Yes	Yes
No. of days hospitalized	1	2	2	2
Endotracheal intubation	No	Yes	Yes	Yes
Reported substance use history	Other edible microdosing products	Other edible microdosing products and marijuana	Unknown	Marijuana

Abbreviations: HTN = hypertension; LOC = loss of consciousness.

Health supported the response nationally through creation of a case definition and use of the National Poison Data System for case ascertainment and reporting.[††] On June 7, 2024, FDA reported on the investigation of illnesses and recommended that consumers not eat, sell, or serve the implicated products.[§§,¶¶] On June 12, CDC informed clinicians and public health professionals about this investigation associated with Diamond Shruumz–brand products via the Health Alert Network.[***] On June 27, Prophet Premium Blends issued a national recall and ceased production and distribution of all Diamond Shruumz–brand products.[†††] As of October 31, CDC had identified 180 cases and three potentially associated deaths in 34 states related to the consumption of Diamond Shruumz–brand products.[§§§] It is important that persons stop consuming Diamond Shruumz–brand products and exercise caution when consuming other products marketed with mushroom-based psychoactive substances.

Summary

What is already known about this topic?

Availability of products containing labeled and sometimes unlabeled psychoactive compounds is increasing.

What is added by this report?

In June 2024, Arizona identified a cluster of cases of severe adverse health effects, including neurologic and cardiac signs and symptoms, after ingestion of Diamond Shruumz–brand chocolate bars. These products are labeled to include psychoactive mushroom extracts. The investigation prompted a nationwide product recall and public health response with detection of 180 cases in 34 states.

What are the implications for public health practice?

Edible products marketed as containing mushroom-based psychoactive substances could provoke life-threatening illness. Persons should stop consuming Diamond Shruumz–brand products and exercise caution when consuming other products reported to contain mushroom-based psychoactive substances.

[††] https://www.cdc.gov/chemical-radiological-surveillance/php/about/index.html
[§§] https://www.fda.gov/food/outbreaks-foodborne-illness/investigation-illnesses-diamond-shruumz-brand-chocolate-bars-cones-gummies-june-2024
[¶¶] https://www.fda.gov/food/hfp-constituent-updates/fda-alerts-industry-and-consumers-about-use-amanita-muscaria-or-its-constituents-food
[***] https://emergency.cdc.gov/han/2024/han00509.asp
[†††] https://www.fda.gov/safety/recalls-market-withdrawals-safety-alerts/prophet-premium-blends-recalls-diamond-shruumz-products-because-possible-health-risk
[§§§] https://www.cdc.gov/environmental-health-studies/outbreak-investigation-diamond-shruumz-products/index.html

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Corresponding author: Heather L. Walker, HWalker6@cdc.gov.

[1]Arizona Department of Health Services; [2]Epidemic Intelligence Service, CDC; [3]Maricopa County Department of Public Health, Phoenix, Arizona; [4]Banner Poison and Drug Information Center, Phoenix, Arizona; [5]Arizona Poison and Drug Information Center, Tucson, Arizona; [6]Yavapai County Community Health Services, Prescott, Arizona; [7]Division of Environmental Health Science and Practice, National Center for Environmental Health, CDC.

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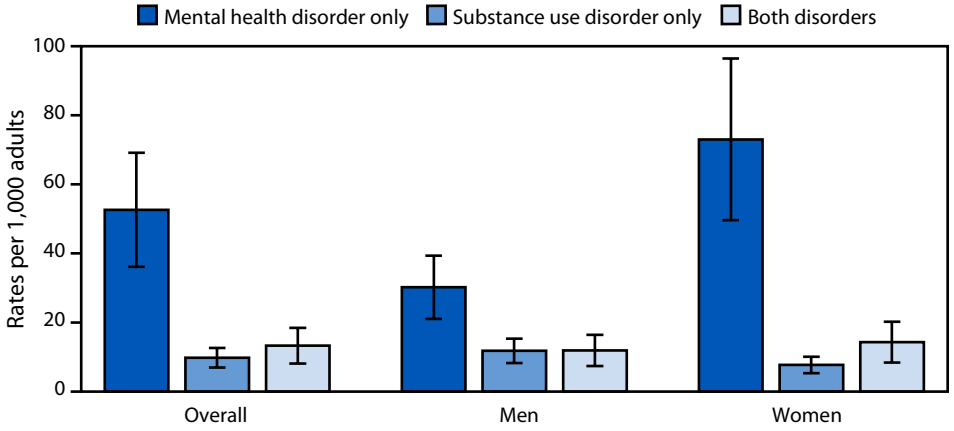
QuickStats

FROM THE NATIONAL CENTER FOR HEALTH STATISTICS

Health Center* Visit Rates,† by Adults Aged ≥18 Years with Mental Health Disorder,§ Substance Use Disorder, or Both, by Sex — United States, 2023



* Health centers are community-based clinics that offer access to primary care to underserved communities.
† Visit rates, with 95% CIs indicated by error bars, are based on July 1, 2023, estimates of the U.S. civilian, noninstitutionalized population developed by the U.S. Census Bureau.
§ Based on a sample of approximately 100.4 million visits made by adults. Mental health disorders are defined as visits with an *International Classification of Diseases, Tenth Revision, Clinical Modification* (ICD-10-CM) code F01–F09 or F20–F99. Substance use disorders are defined as visits with an ICD-10-CM code F10–F19. Mental health disorder only and substance use disorder only are mutually exclusive categories.

In 2023, the health center visit rate for adults with a mental health disorder was 52.6 visits per 1,000 adults. This rate was higher than the rate of visits for a substance use disorder (9.8) or both disorders (13.3). This pattern was similar for men and women. The visit rate for women with a mental health disorder (73.0) was higher than the rate for men (30.2), but the rates for visits with a substance use disorder or both disorders were similar among both men and women.

Supplementary Table: https://stacks.cdc.gov/view/cdc/174550

Source: National Center for Health Statistics, National Ambulatory Medical Care Survey Health Center Component, 2023.

Reported by: Loredana Santo, MD, lsanto@cdc.gov; Lello Guluma, MPH; Jill J. Ashman, PhD.

For more information on this topic, CDC recommends the following link: https://www.cdc.gov/mental-health/caring/index.html

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