HHE Health Hazard® Evaluation Program

Evaluation of Symptoms Among Above-Wing Uniformed Airline Employees

HHE Report No. 2022-0061-3393

November 2023

Centers for Disease Control and Prevention
National Institute for Occupational Safety and Health

Authors: **Karl D. Feldmann, MS, REHS/RS, CIH**

Sophia Chiu, MD, MPH

Kendra Broadwater, MPH, CIH, CSP

Dallas S. Shi, MD, PhD

Colleen O'Connor, MPH

Desktop Publisher: Shawna Watts

Editor: Cheryl Hamilton

Keywords: North American Industry Classification System (NAICS) 481111 (Scheduled Passenger Air Transportation), Bureau of Labor Statistics (BLS) Standard Occupational Classification (SOC) 53-2031 Flight Attendants, Gate Attendants, Flight Crew, Cabin Crew, Georgia, Dermatitis, Skin, Skin Rash, Patch Test, Allergy, Uniform, Airline, Federal Aviation Administration, FAA

Disclaimer

The Health Hazard Evaluation Program investigates possible health hazards in the workplace under the authority of the Occupational Safety and Health Act of 1970 [29 USC 669a(6)]. The Health Hazard Evaluation Program also provides, upon request, technical assistance to federal, state, and local agencies to investigate occupational health hazards and to prevent occupational disease or injury. Regulations guiding the Program can be found in Title 42, Code of Federal Regulations, Part 85; Requests for Health Hazard Evaluations [42 CFR Part 85].

Availability of Report

Copies of this report have been sent to the employer and employees. The state and local health departments, the Occupational Safety and Health Administration Regional Office, and the Federal Aviation Administration Southern Region office have also received a copy. This report is not copyrighted and may be freely reproduced.

Recommended Citation

NIOSH [2023]. Evaluation of symptoms among above-wing uniformed airline employees. By Feldmann KD, Chiu S, Broadwater K, Shi DS, O'Connor C. Cincinnati, OH: U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, Health Hazard Evaluation Report 2022-0061-3393, https://www.cdc.gov/niosh/hhe/reports/pdfs/2022-0061-3393.pdf.

Table of Contents

Main Report

Supporting Technical Information

This page left intentionally blank

Introduction

Request

From May through August 2022, the National Institute for Occupational Safety and Health (NIOSH) of the Centers for Disease Control and Prevention (CDC) received multiple confidential employee requests for a health hazard evaluation at a commercial airline. Employees were concerned about health effects they associated with their new, mandatory uniforms (COLOR B). Concerns included skin or allergic symptoms as well as cancer, diarrhea, dizziness, dry mouth, eye infection, fatigue, hair loss, irregular menstruation, joint pain, kidney and liver failure, memory issues, and urinary tract infection. The requestors also reported that many employees were hesitant to formally report health and safety problems related to the uniform to airline management for fear of being removed from their work assignments.

Background

In 2018, the employer rolled out COLOR A uniforms for flight attendants and customer service agents (referred to as above-wing employees). Shortly after the rollout, employees began to report skin-related health effects that they associated with the new uniform. To address this issue, management allowed some employees to use alternative uniform pieces (e.g., shirts, pants, jackets, etc.) on a temporary basis. Management began working with the uniform manufacturer to address employee concerns. Additionally, they conducted testing on the COLOR A uniforms for common textile chemicals.

In January 2020, the airline announced the development of a new uniform program (COLOR B), slated to be ready in 2021. Furthermore, management specified that COLOR B and all future uniforms will be certified using Standard 100 by OEKO-TEX®. OEKO-TEX is a registered trademark of the International Association for Research and Testing in the Field of Textile and Leather Ecology. The OEKO-TEX Standard 100 sets limits for individual chemicals or classes of chemicals in clothing and clothing pieces. This voluntary certification is meant to ensure chemicals used in the manufacturing, processing, and finishing of clothing and accessories are at or below the designated concentration limit. In May 2021, new COLOR B uniform pieces became available for order.

While COLOR B uniforms were being developed and adopted, management allowed employees with health concerns to wear generic black and white uniforms. Initially, medical documentation was required. Later, an email request without medical documentation was sufficient. In February 2022, the airline announced the transition period would end in May 2022. Unless granted explicit exception through the accommodation process, all employees were required to wear either COLOR A or COLOR B uniforms by May 2022.

To learn more about the workplace, go to Section A in the Supporting Technical Information

Our Approach

Our objectives were to understand employees' concerns about COLOR B uniforms, as well as review how the airline introduced the uniforms and their actions in response to reported symptoms. To accomplish this goal, we completed the following activities:

- Spoke with airline managers and employees.
- Reviewed documents provided by airline management. We also analyzed data on worker's compensation claims and accommodations requests.
- Reviewed scientific literature on health effects related to textiles, skin and allergy conditions, and health effects seen in flight attendants.

To learn more about our methods, go to **Section B in the Supporting Technical Information**

Our Key Findings

Employees reported a variety of symptoms they thought were related to the new uniforms. However, wearing COLOR B uniform pieces did not lead to a widespread outbreak of symptoms

- Less than 1% of above-wing employees filed claims or requests. Data provided by the airline showed 357 uniform-related workers' compensation claims filed from May 2021 (when COLOR B uniforms became available) through December 2022. From February 2022 through February 2023, employees made 106 uniform-related accommodation requests.
- Skin or allergy symptoms were the most common symptom types mentioned in workers' compensation data (78% of uniform-related claims).
- Other symptoms such as ear, nose, throat, or sinus symptoms; headache, dizziness, or balance symptoms; eye symptoms; respiratory symptoms; burning sensation; and hair loss were each mentioned in 15% or less of the uniform-related claims.

Of the records we reviewed, no uniform-related workers' compensation claims or accommodation requests were approved

- About 96% of uniform-related workers' compensations claims were denied. The rest were pending, or no further information was available to us. The most common reason for denial of a workers' compensation claim was the lack of treatment and diagnosis (80% of denied claims).
- The most common reason for a uniform-related accommodation request to be closed was that the employee did not submit any documents for review (60% of requests). Accommodation requests can also be closed while going through the workers' compensation process ("timed out").

- Airline representatives told us that employees are generally not scheduled to work during the accommodation request review process.
- Some employees told us that the accommodation process was cumbersome. Some reported feeling pressured to wear the uniform or risk unpaid leave or termination.

Airline representatives said a positive patch test for skin allergy was generally needed for a successful workers' compensation claim or uniform-related accommodation request

- Patch testing is a skin test used to find a specific cause of an allergic skin reaction (allergic contact dermatitis) when a physician suspects an allergic cause for contact dermatitis.
- People with skin symptoms who do not test positive might have other skin conditions.
- Patch testing was done in 9 (3%) of the 357 claims filed. An additional 8 (2%) patch tests were pending. No positive patch tests had been reported at the time of this evaluation.

Some symptoms employees reported could be associated with the uniforms, although we faced challenges linking symptoms to uniforms

- Research studies show that some textiles can have chemicals that can cause contact dermatitis. This is a skin condition where the skin becomes inflamed because of direct contact with something in the environment. However, we did not have information about the chemicals or their levels in the uniforms of employees who reported symptoms.
- COLOR B uniforms were certified to OEKO-TEX Standard 100. This is a voluntary standard that sets limits for the levels of chemicals in textiles that may be harmful to human health. However, OEKO-TEX Standard 100 may not take into account sensitization. People may become sensitized to a substance after their first exposure. This means that if they are exposed again to even a small amount of that chemical, it could cause an allergic reaction.
- Textile fiber composition, humidity, friction, and other environmental factors can also lead to clothing-related skin problems.
- Uniform-related workers' compensation claims were more commonly made by flight attendants (94%) than customer service agents (6%). This raised the possibility that symptoms might be related to other factors in the work environment or the interaction of those factors with uniforms.
- Few studies about textiles and health effects, other than skin conditions, exist. Not all chemicals in textiles or their potential health effects are well characterized.

To learn more about our results, go to **Section B in the Supporting Technical Information**

Our Recommendations

The Occupational Safety and Health Act requires employers to provide a safe workplace.

Potential Benefits of Improving Workplace Health and Safety:

- Improved worker health and well-being
- Better workplace morale
- Easier employee recruiting and retention
- Enhanced image and reputation
- Superior products, processes, and services
- Increased overall cost savings

The recommendations below are based on the findings of our evaluation. For each recommendation, we list a series of actions you can take to address the issue at your workplace. The actions at the beginning of each list are preferable to the ones listed later. The list order is based on a well-accepted approach called the "hierarchy of controls." The hierarchy of controls groups actions by their likely effectiveness in reducing or removing hazards. In most cases, the preferred approach is to eliminate hazardous materials or processes and install engineering controls to reduce exposure or shield employees. Until such controls are in place, or if they are not effective or practical, administrative measures and personal protective equipment might be needed. Read more about the hierarchy of controls at https://www.cdc.gov/niosh/topics/hierarchy/.

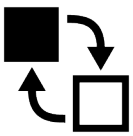
We encourage the company to use a health and safety committee to discuss our recommendations and develop an action plan. Both employee representatives and management representatives should be included on the committee. The Occupational Safety and Health Administration (OSHA) provides helpful guidance: *Recommended Practices for Safety and Health Programs* (https://www.osha.gov/shpguidelines/index.html).

Recommendation 1: Allow for more flexibility in the uniform wear policy

Why? There are many reasons an employer might require their employees to wear a uniform such as (1) the work requires special uniform component requirements (e.g., fire retardant or tear-away properties for safety), (2) uniforms indicate and assert authority when dealing with the public, and (3) uniforms are part of the company brand and identity.

The company uniform policy states that appropriate uniform wear by employees is essential to their service mission. However, some employees have reported health symptoms thought to be related to the uniforms that greatly impact their ability to work and lead healthful lives. Increased flexibility in the uniform wear policy should help those affected employees. This could lead to reduced workplace stress. Less stress may increase employee, team, and organizational productivity while continuing to offer a cohesive, consistent, and professional look.

How? At your workplace, we recommend these specific actions:



Allow employees who report symptoms to substitute uniform pieces.

- Continue to offer employees other choices in uniforms if they have developed symptoms or health effects related to wearing the current uniforms.
- Allow employees to continue wearing these alternative uniforms long term if their symptoms go away while wearing them.

Improve the approval process for uniform accommodation requests.

- Do not use a positive patch test result as the only basis for approving accommodation requests or workers' compensation claims.
- Evaluate how the accommodation request and workers' compensation processes interact and implement ways to avoid "time outs." Time outs happen when employees have their accommodation requests closed as they wait for the workers' compensation process to go forward.
- A small number of employees may need to be reassigned (with retention of pay, benefits, and employment status) to work environments where exposure is minimal or nonexistent if uniform-related health problems diagnosed by a physician do not go away with wearing alternative uniforms. For example, this might happen in some cases of allergic asthma and contact dermatitis.

Recommendation 2: Improve communication to address employee concerns

Why? We found that communication between management and employees could be improved. Good communication is a key component to a strong health and safety program. It is important that management clearly communicate about hazards in the workplace and address concerns about potential hazards reported by employees.

How? At your workplace, we recommend these specific actions:

Emphasize effective and consistent communication between all groups.

- Involve a supervisor or manager sensitive to employees' concerns to communicate directly with employees.
- Listen actively to employees' concerns in a nonjudgmental manner. Employees should feel that their concerns are taken seriously.
- Inform employees of what exact steps should be taken to report concerns. Tell them what steps are being taken to assess identified problems including what has been determined and what remains to be determined. Inform employees of management's responses to work-related health concerns, including the rationale behind those responses.

Encourage employees to report concerns about work-related symptoms or medical issues to their supervisor or another designee.

Review and act on data about potential work-related health conditions in a systematic and objective way.

- Follow up on the thorough review of surveillance data with more detailed investigations.
- Follow-up investigations and interventions may include these actions:
    - Focused survey or intervention among identified groups
    - Further chemical testing of particular garments or garment pieces
    - Removal from service of particular garments or garment pieces

Encourage employees to seek evaluation and care (if needed) from a healthcare provider knowledgeable in occupational medicine for work-related medical concerns.

- Resources to help locate healthcare providers with experience and expertise in occupational medicine include the Association of Occupational and Environmental Clinics (http://www.aoec.org/directory.htm) and the American College of Occupational and Environmental Medicine (https://acoem.org/Find-a-Provider).
- Persistent rash should be evaluated by a dermatologist with expertise in occupational health and skin patch testing. The dermatologist may then decide if skin patch testing with textile chemical allergens and with pieces of the uniform is warranted.

Supporting Technical Information

Evaluation of Symptoms Among Above-wing Uniformed Airline Employees

HHE Report No. 2022-0061-3393

November 2023

Section A: Workplace Information

The Federal Aviation Administration (FAA) issues and enforces regulations and minimum standards covering manufacturing, operating, and maintaining aircraft. They require commercial airlines to have flight attendants aboard aircraft for the safety and security of passengers. Military and civilian aviation operators use similar (but not always the same) terminology in their workplaces. Below are the FAA (14 CFR 1.1) definitions:

- Crewmember – a person assigned to perform duty in an aircraft during flight time.
- Flightdeck – the area from which a pilot controls the aircraft.
- Flightcrew member – a pilot, flight engineer, or flight navigator assigned to duty in an aircraft during flight time (the term flightdeck crewmember is sometimes used).
- Cabin – the section of an aircraft in which passengers travel.
- Cabin crew – a crewmember responsible for the safety of passengers.

Employees involved in this health hazard evaluation (HHE) worked as cabin crew for an airline that provided domestic and international flights. The airline classified both cabin crew and airport-based customer service agents as above-wing employees. Airline representatives reported about 25,000–30,000 employees were in each above-wing group. Both groups were required to wear a uniform comprised of airline-approved uniform pieces (e.g., shirts, pants, jackets, etc.) and accessories, with slight variations by job title. Cabin crew could occasionally serve as customer service agents.

Section B: Methods, Results, and Discussion

Our objectives were to (1) understand the introduction of COLOR B uniforms, (2) better understand employees' concerns about COLOR B uniforms, and (3) review actions taken by the airline in response to reported symptoms. To achieve these objectives, we reviewed information not only on the reported symptoms and concerns related to the COLOR B uniforms, but also on historical data pertaining to the previously worn COLOR A uniforms. To provide a well-rounded context, information from the transition phase between COLOR A and COLOR B uniforms was also taken into account. By combining information from both past and present uniform iterations, we sought to understand patterns or changes in employee experiences and perceptions.

Methods: Historical Context, Composition, and Rollout of COLOR B Uniforms

We reviewed the following documents provided by management:

- Standard 100 by OEKO-TEX dated 2021.
- Uniform roll out communications plan dated 2020–2022.
- Above-wing Uniform Care Instructions dated 2021.
- Above-wing Uniformed Employees Style Guide dated 2022.
- In-flight Service Programs and Policies Handbook excerpt titled "Uniform Policy," dated 2021.
- Safety Policies and Procedures Manual excerpt titled "Reporting and Recording Occupational Incidents," dated 2021.
- Chemical and Hazardous Materials Management plans dated 2018.
- Uniform Testing Comparison Report dated March 2019.

Results: Historical Context, Composition, and Rollout of COLOR B Uniforms

Standard 100 by OEKO-TEX

The Standard 100 by OEKO-TEX is a 51-page document detailing the parameters of this voluntary standard, which places limitations on the content of certain chemicals in textiles. Different standards exist for different garment product classes. The more intensive the skin contact and the more sensitive the skin, the stricter the requirements. There are four classes:

- Product Class I – Products for babies
    - Products for babies in the context of this standard are all articles, basic materials, and accessories that are provided for the production of articles for babies and children up to the age of 36 months.
- Product Class II – Products with direct contact to skin
    - Articles with direct contact to skin are those that are worn with a large part of their surface in direct contact with the skin (e.g., blouses, shirts, underwear, mattresses, etc.).

- Product Class III – Products without direct contact to skin
    - Articles without direct contact to skin are those that are worn with only a little part of their surface in direct contact with the skin (e.g., jackets, vests, belts, stuffings, etc.).
- Product Class IV – Decoration material(s)
    - Decoration material(s) are all articles (including initial products and accessories) that are used for decoration (e.g., tablecloths, wall coverings, furnishing fabrics and curtains, upholstery fabrics, and floor coverings, etc.).

The OEKO-TEX Standard 100 does not certify garments are free from chemicals. It requires the content of specified chemicals be at or below defined levels. It is also not a quality label, meaning the standard only covers the "as-produced" clothing item or accessory and does not account for "other properties such as fitness for use, reaction to cleaning processes, physiological behavior in respect of clothing, properties relating to use in buildings, burning behavior, etc." [OEKO-TEX 2023].

Uniform Concerns and Accommodations Prior to COLOR B Uniform

The uniform roll out communications plan was a 23-page document that included information on concerns and accommodations prior to use of the COLOR B uniform. The airline noted in a 2019 email addressed to above-wing employees about COLOR A uniforms that uniform-related symptoms were rare but present. Of approximately 64,000 employees, 1,900 had raised concerns pertaining to COLOR A uniforms. These concerns ranged from minor cases of chafing to more pronounced discomfort such as skin irritation or allergic reaction. Roughly 85% of the concerns came from flight attendants; 88% being female. The airline wrote that of 1,900 concerns, 1,400 (74%) were successfully resolved by offering alternatives such as these:

- Offering alternative uniform pieces from the collection (e.g., dress vs. pants)
- Ordering an alternate size to alleviate chafing
- Wearing the 100% cotton shirt/blouse without performance treatments
- Opting for nonwool alternatives
- Providing fully lined garments
- Creating a uniform dress without performance finishes

The airline was exploring further ways to accommodate employees including the possibility of prewashing all uniform items to lessen any chance of crocking, or dye transferring, from some garments to other clothing items.

Composition of COLOR B Uniforms

The Above-wing Uniform Care Instructions manual was a 22-page document that provided information on the content and care instructions for many COLOR B uniforms and pieces. COLOR B uniform pieces were made up of varying percentages of the following materials: cotton, polyester, spandex, nylon, rayon, viscose rayon, and wool. The document provided care instructions for 11 garment categories as employees are responsible for laundering their own uniforms. It also denoted which pieces

were OEKO-TEX Standard 100 certified and which pieces were available with or without finishes (such as performance treatments).

The In-flight Service Programs and Policies Handbook excerpt titled Uniform Policy referred the reader to the Above-wing Uniformed Employees Style Guide.

The Above-wing Uniformed Employees Style Guide was a 75-page document that provided employees with details about uniform wearing and appearance requirements. The guide included both COLOR A and COLOR B uniforms. The guide stated that a personal shirt of similar appearance could be worn instead of the uniform shirt. The guide also provided information about the OEKO-TEX Standard 100 and stated, "since 2021, all uniform pieces added to the collection are, and will continue to be, certified STANDARD 100 by OEKO-TEX®."

Only the uniform-related documents were specifically directed to above-wing employees. The remaining documents were generic and applied to a broad range of employees.

Rollout of COLOR B Uniforms

In January 2020, the airline announced the development of a new uniform program, slated to be ready in 2021. In May 2021, new uniform pieces that complied with the OEKO-TEX Standard 100 were available to order. During the development of and transition to the COLOR B uniforms, management supported the wearing of generic black and white uniforms for employees who had health concerns with COLOR A or COLOR B uniforms. Initially, medical documentation was required, but subsequently an email request, without the need for medical documentation, was sufficient. In February 2022, the airline announced that the transition period would end May 2022. Unless granted explicit exception via the accommodation process, all employees were required to wear either COLOR A or B uniforms by May 2022.

Communication About COLOR B Uniforms

Upon review of communication documents provided, we found that the predominant content consisted of messages disseminated from airline leadership to employees. These communications encompassed a range of topics, including the scheduled timeline for the transition to new uniforms, the ongoing development of the new COLOR B uniforms to align with OEKO-TEX standards, and the overarching objective of establishing a uniform solution that fostered comfort, safety, and a renewed sense of unity in appearance.

The uniform roll out communications plan included a table with 18 items dating from January 29, 2020, to October 21, 2021. Similar to the uniform report mentioned above, the plan included hyperlinks to additional documents. These links led to the airline's internal website or SharePoint, which were inaccessible to us. Additional communications from August 13, 2019, to February 23, 2022, were included. These included (1) product literature, (2) care instructions for uniforms, and (3) details about the OEKO-TEX Standard 100 and compliant uniforms.

A notable emphasis was placed on the OEKO-TEX Standard 100, highlighted by references to an OEKO-TEX townhall event and multiple links to OEKO-TEX testing. However, communication documents did not note that OEKO-TEX is not a quality label, as clarified in the Standard 100 document by OEKO-TEX dated 2021. Additionally, the uniform exception policy, which previously

permitted employees to wear their personal black and white garments, was officially terminated on March 31, 2022.

While multiple documents mentioned the airline's receptiveness to employee input and invited them to share their "thoughts, ideas, and feedback," the mechanisms through which this communication could take place, including availability of anonymous channels for expressing concerns, remain unknown. In a document providing responses to frequently asked questions dated October 21, 2022, the response to "How will I be able to share my feedback to enhance the uniform program?" was "We'll be offering numerous opportunities for you to share your thoughts, ideas and feedback as we evolve our program together. Details will be available soon." Employees were encouraged to check the company intranet site. It is possible that this information was provided to employees but was not available to us.

Methods: Workers' Compensation and Accommodation Policies and Procedures

The airline had parallel processes for employees to request accommodations and file workers' compensation claims related to uniform wear. To learn about these processes, we performed the following activities:

- Spoke with HHE requestors and management representatives about employee concerns, health effects related to uniforms, and airline policies and procedures
- Reviewed documents about the airline's uniform-related policies and procedures, including
    - Description of the accommodation program
    - Blank accommodation request form
    - Blank medical questionnaire form
- Performed descriptive statistical analysis on data provided by the airline about
    - Workers' compensation claims related to uniforms from May 2021 through December 2022
    - Accommodation requests related to uniforms that were not associated with workers' compensation claims from February 2022 through February 2023

Results: Workers' Compensation and Accommodation Policies and Procedures

Workers' Compensation

The workers' compensation claim process begins when an employee reports an injury or illness that they believe is related to work. The airline's third-party workers' compensation and disability administrator manages the claim, guided by medical professionals employed by the airline.

Accommodations

The airline offers reasonable accommodation to employees with "verified medical impairments" or religious beliefs. Not all requests can be accommodated. For example, the airline provided the following examples of reasons for not granting an accommodation: compromise of safety or operational standards, superseding of seniority, eliminating the essential functions of a job, or creating a new position.

To begin the accommodations process, an employee contacts the accommodations department. The department sends a 2-page request form for the employee to complete. A medical questionnaire completed by a healthcare provider is required for medical accommodation requests. Employees can also include additional medical documentation in support of the accommodation request. The accommodations department might follow up with the employee or the employee's healthcare provider for additional information. This information is used to certify the employee's medical condition, capabilities, and medical restrictions.

Once medical restrictions are identified by the healthcare provider, the airline tries to identify a reasonable accommodation. According to management representatives, a uniform-related accommodation might involve choosing temporary garments with the uniform department before custom-made uniform replacements for the accommodated employee are available.

During the accommodations process, employees are not scheduled to work. Management representatives reported that some employees with less severe uniform-related reactions who could be treated have been allowed to continue working. Employees can also be placed on paid short-term disability leave or unpaid medical leave. Some employees thought that they were being "forced" to wear the uniform or risk unpaid leave or termination; for example, employees reported being told that they cannot work if they do not wear the uniform.

If a reasonable accommodation is not feasible, the airline may offer a leave of absence and participation in a program to help the employee find a comparable alternative position at the airline where the accommodation can be granted.

The accommodations and workers' compensation claim processes can occur simultaneously. According to management representatives, very few employees submit a uniform-related accommodation request without also submitting a workers' compensation claim. Some employees have had accommodation requests closed while waiting for the workers' compensation process to proceed ("timed out"). Some employees told us that the accommodation process was cumbersome.

Patch Testing

Patch testing is a skin test used to find the cause of an allergic skin reaction (allergic contact dermatitis). According to management representatives, a positive patch test result is generally considered necessary for a uniform-related accommodation request or workers' compensation claim to be successful. While employees can pursue patch testing on their own, patch testing generally occurs as a part of the workers' compensation process. For patch testing that is done as part of the workers' compensation process, the airline chooses the healthcare provider performing patch testing in states where legal regulations allow the airline to select healthcare providers for workers' compensation care; otherwise, the employee chooses.

The airline works with a third-party company on patch testing. When a new uniform piece is released, the third-party company obtains several samples, with different fabric finishes, directly from the supplier. The third-party company compares one sample to the manufacturing specifications. If it passes this quality control check, then the third-party company sends the other samples to a laboratory. The laboratory cuts up the garment to create materials for patch tests.

The third-party company helps employees order patch test materials made from uniform pieces in states where the airline can select healthcare providers or when employees request these materials. However, employees may choose to undergo patch testing that is not based on uniform pieces prepared by the third-party company and laboratory.

Review of Workers' Compensation Claims and Accommodation Requests

The airline provided de-identified information about uniform-related workers' compensation claims and accommodation requests in two files. One file contained information about uniform-related workers' compensation claims that were associated with accommodation requests (workers' compensation file) from May 2021, when the COLOR B uniforms became available, through December 2022. The other file contained information about accommodation requests without accompanying workers' compensation claims filed from February 2022 through February 2023 (accommodation request file).

Workers' Compensation

The workers' compensation file contained 363 claims. We excluded 2 claims that were not from above-wing employees because they involved a different uniform. We also excluded 4 claims where manual review showed no claim was opened; this left 357 claims in the analysis. Flight attendants filed 94% (n = 337) of uniform-related claims while customer service agents filed 6% (n = 20). April 2022, the month before the policy requiring COLOR A or COLOR B uniforms came into effect, was the most common month when uniform-related health symptom concerns occurred.

Data on uniform type appeared in free-text form. Of the 357 claims, 138 (39%) mentioned the COLOR B uniform, 61 (17%) mentioned the COLOR A uniform, and 48 (13%) mentioned the uniform shirt. Various uniform pieces were mentioned, such as dress (6%, n = 20), sweater (4%, n = 14), and pants (3%, n = 11). These numbers do not sum to 100% because uniform type could be unspecified or multiple uniform types were mentioned in a single claim.

None of the 357 workers' compensation claims had been approved as of February 2023. The vast majority (96%, n = 342) were denied. There were 14 pending claims (4%) and 1 (<1%) claim with missing claim status data. Of 342 denied claims, "Did not treat – no diagnosis" or similar text was the most common reason (80%, n = 272).

Of the 357 uniform-related workers' compensation claims, a patch test had been performed for 9 (3%); this corresponds to 11% of claims without a "Did not treat – no diagnosis" denial. None of the patch tests were positive: 7 were negative and 2 had pending results. Of the 357 claims, 8 (2%) involved a patch test being scheduled, 7 (2%) had employees who did not follow through with patch testing, and 5 (1%) had employee refusal of patch testing. Patch testing was not performed for the remaining claims. According to notes about prior workers' compensation claims, one employee with a current claim had a positive patch test for multiple uniform pieces prior to the introduction of the COLOR B uniform.

Accommodation Requests

The accommodations request file contained 106 requests. By month, most requests were opened in February 2022 (26%, n = 28), March 2022 (41%, n = 43), or April 2022 (20%, n = 21). Most requests (84%, n = 89) were full uniform requests rather than partial uniform requests.

Of 106 requests, 99 (93%) were closed and 7 (7%) were pending as of February 2023. Among closed requests, the median request processing time was 22 days, with a range of 7–336 days.

No accommodations were granted. The most common reason for a request to be closed was that the employee did not submit any documents for review (60%, n = 59 of 99), followed by withdrawal of the request by the employee (18%, n = 18 of 99). The next most common reason was the employee having returned to work without notifying the accommodation department and stopped responding (13%, n = 13 of 99).

Methods: Health Symptoms

To characterize the types of health symptoms reported, two NIOSH physicians performed content analysis of the free-text descriptions in the workers' compensation claim file. During the initial review of the descriptions, one physician abstracted the symptoms mentioned from the text. Next, the two physicians refined symptom categories through discussion. The physicians re-read the descriptions and coded symptoms into those categories independently. Any discrepancies were then discussed to reach consensus.

The percentage of claims that mentioned each symptom category was calculated. Because each description could be coded as being in 0 or multiple symptom categories, the percentages do not sum to 100%. Claims with an alternative explanation for symptoms were excluded from this analysis.

Results: Health Symptoms

Of the 357 uniform-related workers' compensation claims filed by above-wing employees from May 2021 through December 2022, 9 (3%) were excluded from the health symptom analysis because an alternative explanation was reported. Alternative explanations included shingles (n = 3), insect bite (n = 2), laundry detergent (n = 2), dust mites (n = 1), and heat rash (n = 1). In addition, five claims were excluded because the condition was determined to be "not work related" by a healthcare provider, and four claims were excluded because there was "no issue."

Symptom categories for the 339 remaining uniform-related claims are shown in Figure 1. The most common category was skin or allergy (78%, n = 265). Apart from symptom categories, 10 (3%) claims mentioned symptoms that occurred while being near uniforms, for example, when uniforms were worn by coworkers. Six (2%) claims mentioned dye transfer from uniforms.

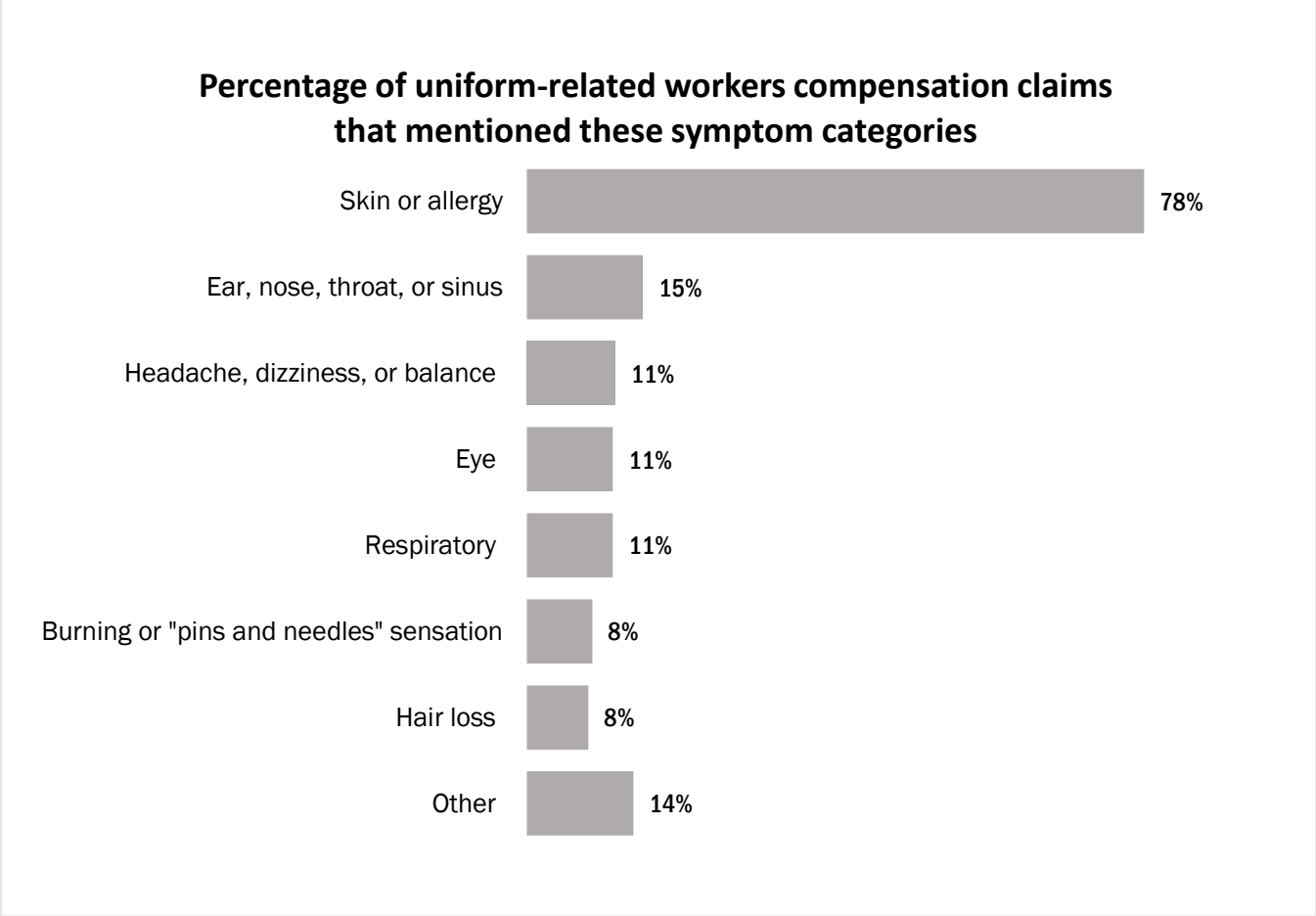


Figure 1. Percentage of uniform-related workers' compensation claims that mentioned various symptom categories. The percentages do not sum to 100% because each claim could be coded as being in 0 or multiple symptom categories.

Discussion

Textile Chemicals, Regulations, and Certifications

Chemicals are used to improve textile and garment performance or impart properties such as (1) reduced shrinking, (2) reduced wrinkling, (3) improved stain resistance, (4) improved fire resistance, (5) improved color fastness, or (6) improved quality, texture, durability, or color. Historically, exposure to formaldehyde from textile treatments had contributed to skin problems [Fowler et al. 1992]. However, in recent years, formaldehyde concentrations in textile resins have been greatly reduced in response to concerns and international regulations or guidelines that have been developed [DeGroot and Maibach 2010; GAO 2010]. A review article on textile formaldehyde-releasing finishes stated that the amounts of free formaldehyde in textiles have decreased drastically in recent years and are generally low [DeGroot and Maibach 2010; GAO 2010]. However, if cured incorrectly (not heated to a certain temperature for a specific length of time), the finishing chemicals may not bind to the fabric fibers as they should. Then, in certain conditions, such as sweating, high heat, and high humidity, the chemicals may leach out [DeGroot and Maibach 2010]. Although the use of textile resins with lower formaldehyde release has resulted in a decrease in the occurrences of formaldehyde-associated textile allergic contact

dermatitis, it is still commonly seen with highly finished garments such as uniforms [Mobolaji-Lawal and Nedorost 2015].

Studies evaluating textile chemicals represent the bulk of studies examining the relationship between textiles and dermatitis. We found no studies that examined the complexity of chemical mixtures in textiles that could create a combination of chemicals that could elicit a reaction.

Many chemicals used in textiles act as sensitizers, which are substances that can have the potential to cause allergic reactions. Certain metals (e.g., nickel), pharmaceutical ingredients (e.g., some antibiotics), and textile components, such as dyes and bleaches, are known to act as sensitizers in humans. One study noted that it is currently difficult to detect newer textile allergens because chemicals used in textiles are not always declared [Lisi et al. 2014]. The concentration at which each textile chemical causes sensitization has not been established for most chemicals, even for known dermal sensitizers. The process of establishing such values would have to consider (1) the environment in which individuals are exposed to the textiles containing the chemical, (2) the potency and exposure frequency of the chemical allergen, and (3) ranges of susceptibility to sensitization within the population [Kimber et al. 2012].

Sensitized individuals might react to even very small amounts of substances to which they are sensitized because the amount of exposure necessary to induce an adverse effect in a sensitized individual can be significantly less than the exposure necessary to induce a sensitization. Research has shown evidence that subthreshold concentrations of irritants can have an additive effect on the skin [Tur et al. 1995]. For example, if the skin is exposed to only one of these irritants, no visible changes are seen, but if exposed to several, the skin may develop an irritant response. Therefore, it is difficult to estimate the level of exposure that leads to no adverse effects for a sensitized individual.

The United States has not developed requirements for chemical or metal contents of adult apparel. National and international organizations have developed voluntary standards that are used by textile and garment manufacturers to standardize textile chemical contents. These standards are not explicitly in place to prevent allergic and irritation symptoms among wearers, but most consider dermal contact with the product. Some individual companies and industry organizations (such as bluesign® and AFIRM) have published limit values and set standards.

One of these standards is the OEKO-TEX Standard 100. COLOR B uniforms are certified to this voluntary standard placing limitations on certain chemical content in textiles and was developed by the International OEKO-TEX Association in 1992. The chemicals in the OEKO-TEX standard are partially based on the list of substances (e.g., chemicals, dyes, etc.) of very high concern established by the European Chemicals Agency (ECHA). As of July 2023, 235 substances were included on ECHA's candidate list of substances of very high concern for authorisation. Manufacturers wishing to use the OEKO-TEX Standard 100 trademark must meet established quality assurance and control standards and recertify their products annually.

The American Apparel and Footwear Association (AAFA) publishes a Restricted Substance List. The AAFA has similar standards to the OEKO-TEX Standard 100 and encourages its members to voluntarily follow these textile parameters [AAFA 2023; DeGroot and Maibach 2010; Reich and Warshaw 2010].

These standards do not certify garments are free from chemicals, rather the content of specified chemicals are at or below defined levels. These standards are detailed, but not exhaustive. Manufacturers using newly developed or unlisted chemicals could still comply with the published guidelines while using chemicals with unknown properties. Additionally, not all of these standards address other textile-related skin issues, such as irritation related to material composition or texture, or account for differences between individuals.

Workers' Compensation and Accommodation Policies and Procedures

According to the information available for review, none of the uniform-related workers' compensation claims or accommodation requests were approved. The most common documented reason for denial of workers' compensation claims was the lack of a diagnosis or treatment. The most common reason for an accommodation request to be closed was the lack of documentation. These findings might be related because many employees reportedly filed both a workers' compensation claim and an accommodations request. The underlying reasons for the lack of a diagnosis or treatment or supporting documentation remain unclear. One possibility is that symptoms were self-limited. However, another possibility is that employees discontinued pursuing the claim or request because they found the process opaque, or because it might not have been possible to work during the process.

Airline representatives reported that accommodations requests can "time out" during the workers' compensation process. However, it was not possible to determine the number of "time outs" based on the information available for review. Closer coordination of the workers' compensation and accommodations processes or timeline flexibilities might prevent "time outs." Further exploration of employees' experiences with the workers' compensation and accommodations processes by the airline can help it address employees' uniform-related concerns.

Symptoms

Our review of workers' compensation claims data showed that the most frequently mentioned symptom category was skin or allergy symptoms. We constructed this category because there was considerable overlap between skin and allergy symptoms in the workers' compensation claim descriptions. No specific diagnoses of skin or allergy symptoms were mentioned in the descriptions.

Contact dermatitis is a skin condition when the skin becomes inflamed due to direct contact with a substance in the environment. There are two types: allergic contact dermatitis and irritant contact dermatitis. Allergy refers to an exaggerated immune system reaction (hypersensitivity) to a specific substance (allergen) that does not bother most people. Allergic reactions occur when a person has prior exposure to a substance that leads to the body producing antibodies or specific immune cells to that substance (sensitization), and the person has symptoms when re-exposed to the substance. Irritant contact dermatitis is more common and occurs faster after exposure than allergic contact dermatitis, which usually happens 24–48 hours after exposure in a sensitized individual. It is not possible to distinguish between irritant and allergic contact dermatitis based solely on symptoms or the appearance of the skin. Not all skin symptoms are allergic reactions and allergic reactions are not necessarily confined to the skin, but it was not possible to distinguish between them with the data available.

The connection between textiles and skin or allergy symptoms has been investigated. When the Swedish Chemicals Agency [2014] conducted a review of the risks to human health from hazardous substances

in textiles, they found that azo dyes and fragrances have properties associated with an increased risk of allergy. Their report also stated that approximately 10% of 2,400 textile-related substances identified were considered to be of potential risk to human health [Swedish Chemicals Agency 2014]. Of note, the report only focused on chemicals that contributed to the design or properties of the fabric, which are expected to be present in high concentrations and are intended to remain in the fabric. Other chemicals, such as chemicals used in making the fabric but not intended to remain in the fabric, contaminants, and degradation products, were not evaluated. The European Commission's Directorate-General for Enterprise and Industry commissioned a study on the link between allergic reactions and substances used in textile production that remain on the textiles. The study identified the presence of substances with sensitizing or irritating properties in textiles such as dyes and finishes. However, there was not enough data to determine the prevalence of contact dermatitis due to textiles [RPS 2013].

Clothing dermatitis generally occurs in areas where clothing fits snugly. The skin lesions are sometimes symmetrical [Rietschel et al. 2008]. Friction, warmth, and moisture tend to increase the appearance of clothing dermatitis. The physical properties of fabrics can contribute to these factors. For example, some fibers such as wool can lead to mechanical irritation, and fabrics can trap moisture or perspiration on the skin [Nedorost 2023]. The clinical pattern is generally described as affecting the neck, major skin folds, and inner thighs. Prevention of skin contact with textile by use of underclothing or by a lining of a skirt or pants may be helpful in limiting clothing dermatitis [Le Coz 2011].

Skin or allergy symptoms were mentioned in 78% of uniform-related workers' compensation claims during the period after the COLOR B uniform was introduced. However, assuming that each uniform-related workers' compensation claim (n = 357) or accommodation request (n = 106) represented an employee experiencing symptoms, an estimated 0.8%–0.9% of the entire above-wing uniformed workforce reported uniform-related symptoms to the airline. This is based on the approximate figure of 50,000–60,000 above-wing uniformed employees reported by the airline.

Skin symptoms are relatively common in the working and working-age population. Data from the 2010 National Health Interview Survey showed that the overall prevalence of dermatitis reported among 17,524 current or recent workers in the previous 12 months was 9.8%. Overall, 5.6% of dermatitis cases among current or recent workers were attributed to work by health professionals [Luckhaupt et al. 2013]. Similarly, another study based on 2011 data from the Behavioral Risk Factor Surveillance System in three states found that 7.9%–15.6% of respondents reported working and having had dermatitis in the previous 12 months [St. Louis et al. 2014]. Even considering the possibility of underreporting due to hesitancy amid concerns about the ability to continue working, the proportion of employees with uniform-related symptoms might be low. This indicates that uniform-related health issues were not a widespread issue. Rather, these were problems that some workers might be experiencing due to individual factors related to uniform pieces, which can be addressed through personalized accommodations.

Little information is reported in the scientific literature about health effects other than contact dermatitis that may develop from skin exposure to textile chemicals. A retrospective sub-study of a larger study of flight attendants over time found a higher prevalence of eye, ears, nose, and throat; respiratory; skin; and multiple chemical sensitivity symptoms over the past week at a study timepoint

when a uniform was in use compared with the beginning of the study (6 years earlier) or when the uniform was recalled (2 years later). The authors of that exploratory analysis noted that they assessed exposure based on year and were limited to only evaluating symptoms with questions already included in the survey [McNeely et al. 2017]. Although they controlled for age, gender, and smoking, they did not assess other changes in the work or non-work environment that might possibly explain differences in the observed prevalence of symptoms. In another study of 18 flight attendants referred for patch testing due to concerns about uniforms, 8 (44%) reported "nondermatological complaints associated with the uniform," but the complaints were not specified [Schlarbaum et al. 2021].

A few workers' compensation claims we reviewed described symptoms after being in close proximity with uniforms without necessarily direct contact with the uniform. We were not able to find scientific literature that specifically addresses symptoms secondary to intermittent, close proximity to textiles worn by others. Contact dermatitis "by proxy," also referred to as consort dermatitis or connubial dermatitis, is dermatitis resulting from an agent that originates from another individual [McFadden 2014]. Exposure can occur via direct contact with the individual, the air, or contaminated clothing or bedding. A systematic review of consort allergic contact dermatitis found that the most common associated materials were medications, plant material, fragrances, products related to sexual activity, and hair dyes; textiles were not mentioned [Lee et al. 2022].

However, a study of cat allergen migration suggests that clothing can be the source of inhalational exposure to particles [Almqvist et al. 1999]. A forensic science study showed that textile fibers can be transferred between garments without contact via the air in small, semi-enclosed spaces [Sheridan et al. 2020]. These findings only suggest a possible mechanism of exposure without contact. They do not show that these scenarios occurred or led to the reported health effects described in a small number of uniform-related claims.

Uniform-related workers' compensation claims were more commonly made by flight attendants (94%) than customer service agents (6%). Not enough information was available to understand this finding. It is possible that there were differences in work environments, exposures, and schedules, or reporting behavior of these groups. For example, we learned that flight attendants might be wearing uniforms for prolonged periods on long flights, whereas customer service agents might have more regular working hours. Clothing-mediated exposures to various chemicals or particles might differ by environmental conditions and intensity and types of wearer activity, among many other factors [Licina et al. 2019].

Possible causes of symptoms reported by flight attendants include the cabin environment itself (e.g., cabin pressure and relative humidity), contaminants in the cabin air (e.g., ozone, pesticides, constituents of engine lubricating oils, and hydraulic fluids), and physiologic stressors (e.g., fatigue, cramped space, and disrupted circadian rhythms) [National Research Council 2002], or possible interactions between these factors and uniforms.

A study of 579 flight attendants found that sinonasal symptoms were associated with an increasing number of working days per month and the number of international trips per month [Shargorodsky et al. 2016]. Environmental stressors, including temperature, humidity, pressure, noise, vibration, and time-zone shifts, have been associated with the health and comfort complaints among flight attendants [Nagda and Koontz 2003]. Eye, ear, nose, throat, and respiratory symptoms are common among flight

attendants. Compared with office workers in one study, aircrew had a significantly higher prevalence of self-reported nose (15% vs. 6%), throat (8% vs. 1%), facial skin (12% vs. 7%), and hand skin symptoms (12% vs. 4%) [Lindgren et al. 2002]. In addition, the self-reported prevalence of ever-diagnosed asthma among female flight attendants was 8.2% [Whelan et al. 2003]. Several other studies have also reported eye and respiratory symptoms among crew members [de Ree et al. 2000; Lee et al. 2000; Lindgren et al. 2002].

In addition, symptoms could be due to the perception of hazardous exposures, which may or may not be related to an actual health hazard. There might have been heightened awareness of a suspected uniform problem due to communications about the COLOR A uniform. Such heightened awareness or perceived risk related to uniforms might lead some individuals to notice symptoms they might otherwise overlook and to attribute them to the work environment [Dalton et al. 1997; Gallacher et al. 2007]. Care must be taken when attributing common symptoms to particular exposures because the association can be coincidental rather than causal.

Patch Testing

Skin patch testing is useful in determining whether someone has allergic contact dermatitis, but there are limitations to such testing. Skin patch test kits include a limited number of allergens to be tested. While the airline had a procedure that allowed for employees to undergo patch testing with uniform pieces, not all patch tests submitted as part of workers' compensation claims or accommodation requests were necessarily performed with uniform pieces. For example, this might happen when employees arranged for patch testing independently or healthcare providers chose different panels of allergens to test. If an individual is not tested with the pertinent allergen, no reactions are noted, and the individual might be erroneously considered to not have skin allergy. As a result, there can be a lack of standardization in information used to evaluate accommodation requests or workers' compensation claims across employees.

Skin patch testing results might be falsely negative because the conditions that elicit leaching of dyes and resins from the fabric, such as sweating and friction, may not be the same when placing a piece of the textile on the skin of the back [Mobolaji-Lawal and Nedorost 2015]. Moisture, most commonly in the form of perspiration, is needed to leach dyes or resins from the textile to where it can be in close contact with the skin for allergic contact dermatitis to occur. Exposure to garments might not lead to dermatitis without perspiration [Nedorost 2023]. In addition, results might be falsely negative or less pronounced if the person being tested has a medical condition or is using medication that suppresses their immune system [Ophaug and Schwarzenberger 2020; Svedman and Bruze 2019]. Exposure to ultraviolet radiation from the sun can also make the skin area being tested less responsive [Koehler and Maibach 2000; Ophaug and Schwarzenberger 2020; Sasseville 2014]. Other technical issues associated with false-negative results include not knowing the optimal concentration of the allergen to use during the test or readings might not be optimally timed to identify delayed reactions [Ophaug and Schwarzenberger 2020].

Patch testing is intended to identify allergic contact dermatitis. The globally acknowledged International Contact Dermatitis Research Group (ICDRG) guidelines for reading patch tests include the categories of negative reaction, doubtful reaction, weak to extreme positive reactions, and irritant reactions

[Johansen et al. 2015]. While the patch test result might be negative, the individual with negative patch test results might have other conditions. For example, in one study of patients with suspected allergic contact dermatitis who had negative patch testing results for all substances evaluated, about one-third had a final diagnosis of irritant contact dermatitis [Starck et al. 2022].

In summary, patch testing is a technically complex procedure with many steps that can lead to inconsistent or imperfect results [Ophaug and Schwarzenberger 2020]. A positive test can establish the diagnosis of allergic contact dermatitis, but individuals with negative test results can have other conditions that can be related to uniforms. In addition, most claims did not involve patch testing. As a result, we do not recommend using a positive patch test result as the sole basis for granting accommodation requests or workers' compensation claims.

Limitations

Estimating the health impacts of COLOR B uniforms was complicated by the following limitations: (1) there is limited information available about reactions to textile chemicals in general; (2) it was not possible to completely characterize the exposure associated with uniforms as there are multiple uniform pieces and there might be differences between batches and in laundering practices; (3) there was limited data available on the uniform-related symptoms experienced by above-wing employees; further, the information from the records reviewed was incomplete, and no opportunity existed for us to follow up with employees on the data summarized in the workers' compensation and accommodations request files or review medical records; and (4) the experiences of employees with uniform-related health and safety problems who did not report them were not captured in this evaluation.

Conclusions

The possibility exists that textile chemicals in the uniforms or the physical irritant properties of the uniform fabrics have caused symptoms among some employees who wore the uniforms. The information we reviewed does not suggest that the COLOR B uniforms contributed to a widespread outbreak of symptoms; it is possible that some symptoms among some above-wing employees could be associated with uniform-related contact dermatitis. While patch testing is useful for establishing the diagnosis of allergic contact dermatitis, using a positive patch test result as the sole basis for granting accommodation requests or workers' compensation claims is not recommended.

We cannot determine whether some nonskin symptoms were related to uniform wear because of current limitations in assessing work-related exposures and the limited studies about textiles and health effects other than dermatitis. Similarly, we could not determine whether being in proximity to the COLOR B uniform caused some employees to experience symptoms. While some studies have suggested a possible route of exposure to textile materials other than via skin contact, we did not find any studies about symptoms from intermittent, close proximity to textiles worn by others.

Section C: HHE Legal Authority

Pursuant to the Federal Aviation Act of 1958, the FAA is charged with the promotion of safe flight of civil aircraft in air commerce by prescribing regulations and minimum standards for practices, methods, and procedures the Administrator finds necessary for safety in air commerce and national security (49 U.S.C. § 44701 et seq.).

NIOSH conducts HHEs and provides recommendations regarding hazards in places of employment under the Occupational Safety and Health Act of 1970 (OSH Act) and the agency's regulations at 42 CFR Part 85. The OSH Act limits its application where other federal agencies, such as the FAA, have exercised authority: *"Nothing in this chapter shall apply to working conditions of employees with respect to which other Federal agencies, and State agencies acting under section 2021 of title 42, exercise statutory authority to prescribe or enforce standards or regulations affecting occupational safety or health"* 29 USC § 653(b)(1). FAA has exercised authority over some airline worker activities, and NIOSH assesses its authority to conduct HHEs of such workplaces upon receipt of a request. Additional information about FAA and Occupational Safety and Health Administration (OSHA) enforcement authorities can be found here: https://www.osha.gov/airline-industry.

Section D: References

General

Almqvist C, Larsson PH, Egmar AC, Hedrén M, Malmberg P, Wickman M [1999]. School as a risk environment for children allergic to cats and a site for transfer of cat allergen to homes. J Allergy Clin Immunol *103*(6):1012–1017, https://doi.org/10.1016/S0091-6749(99)70172-7.

CFR [2023]. Code of Federal Regulations. Washington, DC: U.S. Government Printing Office, Office of the Federal Register, https://www.ecfr.gov/.

Dalton P, Wysocki CJ, Brody MJ, Lawley HJ [1997]. The influence of cognitive bias on the perceived odor, irritation and health symptoms from chemical exposure. Int Arch Occup Environ Health *69*(6):407–417, https://doi.org/10.1007/s004200050168.

Gallacher J, Bronstering K, Palmer S, Fone D, Lyons R [2007]. Symptomatology attributable to psychological exposure to a chemical incident: a natural experiment. J Epidemiol Community Health *61*(6):506–512, https://doi.org/10.1136/jech.2006.046987.

Sheridan KJ, Saltupyte E, Palmer R, Gallidabino MD [2020]. A study on contactless airborne transfer of textile fibres between different garments in small compact semi-enclosed spaces. Forensic Sci Int *315*:110432, https://doi.org/10.1016/j.forsciint.2020.110432.

Health Effects in Flight Attendants

de Ree H, Bagshaw M, Simons R, Brown A [2000]. Ozone and relative humidity in aircraft cabins on polar routes: measurements and physical symptoms. In: Nagda NL, ed. Air quality and comfort in airline cabins, ASTM STP 1393. West Conshohocken, PA: American Society for Testing Materials, https://www.astm.org/stp14497s.html.

Licina D, Morrison GC, Bekö G, Weschler CJ, Nazaroff WW [2019]. Clothing-mediated exposures to chemicals and particles. Environ Sci Technol *53*(10):5559–5575, https://doi.org/10.1021/acs.est.9b00272.

Lindgren T, Andersson K, Dammstrom BG, Norback D [2002]. Ocular, nasal, dermal and general symptoms among commercial airline crews. Int Arch Occup Environ Health *75*(7):475–483, https://doi.org/10.1007/s00420-002-0330-8.

McNeely E, Staffa SJ, Mordukhovich I, Coull B [2018]. Symptoms related to new flight attendant uniforms. BMC Public Health *17*(1):972, https://doi.org/10.1186/s12889-017-4982-4.

Nagda NL, Koontz MD [2003]. Review of studies on flight attendant health and comfort in airliner cabins. Aviat Space Environ Med *74*(2):101–109.

National Research Council [2002]. The airliner cabin environment and the health of passengers and crew. Washington, DC: National Academy Press, https://doi.org/10.17226/10238.

Shargorodsky J, Zheng L, Stillman F, Soong A, Navas-Acien A, Reh D [2016]. The association between airline flight and sinonasal symptoms. Int Forum Allergy Rhinol *6*(4):437–444, http://doi.org/10.1002/alr.21647.

Whelan EA, Lawson CC, Grajewski B, Petersen MR, Pinkerton LE, Ward EM, Schnorr TM [2003]. Prevalence of respiratory symptoms among female flight attendants and teachers. Occup Environ Med *62*(12):929–934, https://doi.org/10.1136/oem.60.12.929.

Skin and Allergy

Johansen JD, Aalto-Korte K, Agner T, Andersen KE, Bircher A, Bruze M, Cannavó A, Giménez-Arnau A, Gonçalo M, Goossens A, John SM, Lidén C, Lindberg M, Mahler V, Matura M, Rustemeyer T, Serup J, Spiewak R, Thyssen JP, Vigan M, White IR, Wilkinson M, Uter W [2015]. European Society of Contact Dermatitis guideline for diagnostic patch testing - recommendations on best practice. Contact Dermatitis *73*(4):195–221, https://doi.org/10.1111/cod.12432.

Kimber I, Travis MA, Martin SF, Dearman RJ [2012]. Immunoregulation of skin sensitization and regulatory T cells. Contact Dermatitis *67*(4):179–183, https://doi.org/10.1111/j.1600-0536.2012.02148.x.

Koehler AM, Maibach HI [2000]. Skin hyporeactivity in relation to patch testing. Contact Dermatitis *42*(1):1–4, https://doi.org/10.1034/j.1600-0536.2000.042001001.x.

Le Coz CJ [2011]. Clothing. In: Johansen JD, Frosch PJ, Lepoittevin JP, eds. Contact dermatitis. 5th ed. New York, NY: Springer, https://doi.org/10.1007/978-3-642-03827-3.

Lee J, Guo S, Dinalo J, DeLeo VA, Adler BL [2022]. Consort allergic contact dermatitis: a systematic review. Dermatitis *33*(3):181–186, https://doi.org/10.1097/der.0000000000000884.

Lee SC, Poon CS, Li XD, Luk F, Chang M. [2000]. Questionnaire survey to evaluate the health and comfort of cabin crew. In: Nagda NL, ed. Air quality and comfort in airliner cabins, ASTM STP 1393. West Conshohocken, PA: American Society for Testing and Materials, https://www.astm.org/stp14498s.html.

Luckhaupt SE, Dahlhamer JM, Ward BW, Sussell AL, Sweeney MH, Sestito JP, Calvert GM [2012]. Prevalence of dermatitis in the working population, United States, 2010 National Health Interview Survey. Am J Ind Med *56*(6):625–634, https://doi.org/10.1002/ajim.22080.

McFadden J [2014]. Proxy contact dermatitis, or contact dermatitis "by proxy" (consort or connubial dermatitis). In: Lachapelle J-M, Bruze M, Elsner PU, eds. Patch testing tips: recommendations from the ICDRG. Berlin, Germany: Springer, https://doi.org/10.1007/978-3-642-45395-3.

Nedorost S [2023]. Challenges in textile contact dermatitis. Curr Dermatol Rep *12*(1):1–7, https://doi.org/10.1007/s13671-023-00383-y.

Ophaug S, Schwarzenberger K [2020]. Pitfalls in patch testing: minimizing the risk of avoidable false-negative reactions. Dermatol Clin *38*(3):293–300, https://doi.org/https://doi.org/10.1016/j.det.2020.02.007.

Rietschel RL, Fowler JF, Fisher AA [2008]. Textile and shoes. In: Fisher's contact dermatitis. 6th ed. Philadelphia, PA: Lippincott Williams & Wilkins.

RPS [2013]. Study on the link between allergic reactions and chemicals in textile products. VRM11.8088. Final report (Draft no.7). Prepared by RPS Consultants/Engineering firm. Delft,

Netherlands: Directorate-General for Enterprise and Industry (European Commission), https://op.europa.eu/en/publication-detail/-/publication/6ac424b6-2a81-4ce2-84b2-20d64fb89f17.

Sasseville D [2014]. "Doctor, why are my patch tests negative?" In: Lachapelle J-M, Bruze M, Elsner PU, eds. Patch testing tips: recommendations from the ICDRG. Berlin, Germany: Springer, https://doi.org/10.1007/978-3-642-45395-3_5.

Schlarbaum JP, Dunnick CA, Scheman AJ, Powell DL, deShazo RA, Neeley AB, Warshaw EM, McKinney ZJ, Hylwa SA [2021]. A mini-epidemic of suspected contact dermatitis to Delta Airlines uniforms. Dermatitis *32*(4):e69-e71, https://doi.org/10.1097/der.0000000000000692.

St. Louis T, Ehrlich E, Bunn T, Kanotra S, Fussman C, Rosenman KD [2014]. Proportion of dermatitis attributed to work exposures in the working population, United States, 2011 Behavioral Risk Factor Surveillance System. Am J Ind Med *57*(6):653–659, https://doi.org/https://doi.org/10.1002/ajim.22311http://doi.org/10.1002/ajim.22311.

Starck M, Suzuki NM, Hafner MFS, Lazzarini R [2022]. Negative patch tests: what should we think about these results? An Bras Dermatol *97*(6):806–808, https://doi.org/10.1016/j.abd.2021.09.014.

Svedman C, Bruze M [2019]. Patch testing: technical details and interpretation. In: Johansen JD, Mahler V, Lepoittevin J-P, Frosch PJ, eds. Contact dermatitis. Cham, Switzerland: Springer, https://doi.org/10.1007/978-3-319-72451-5_62-1.

Tur E, Eshkol Z, Brenner S, Maibach HI [1995]. Cumulative effect of subthreshold concentrations of irritants in humans. Am J Contact Dermat *6*(4):216–220, https://doi.org/10.1016/1046-199X(95)90045-4.

Textiles and Health Effects

AAFA [2023]. Restricted substance list (RSL), v. 23. Washington, DC: American Apparel & Footwear Association, https://www.aafaglobal.org/AAFA/Solutions_Pages/Restricted_Substance_List.

DeGroot AC, Maibach HI [2010]. Does allergic contact dermatitis from formaldehyde in clothes treated with durable-press chemical finishes exist in the USA? Contact Dermatitis *62*(3):127–136, https://doi.org/10.1111/j.1600-0536.2009.01581.x.

Fowler JF Jr, Skinner SM, Belsito DV [1992]. Allergic contact dermatitis from formaldehyde resins in permanent press clothing: an underdiagnosed cause of generalized dermatitis. J Am Acad Dermatol *27*(6):962–968, https://doi.org/10.1016/0190-9622(92)70295-q.

GAO [2010]. Formaldehyde in textiles: while levels in clothing generally appear to be low, allergic contact dermatitis is a health issue for some people. Washington, DC: U.S. Government Accountability Office, http://www.gao.gov/products/GAO-10-875.

Lisi P, Stingeni L, Cristaudo A, Foti C, Pigatto P, Gola M, Schena D, Corazza M, Bianchi L [2014]. Clinical and epidemiological features of textile contact dermatitis: an Italian multicentre study. Contact Dermatitis *70*(6):344–350, https://doi.org/10.1111/cod.12179.

Mobolaji-Lawal M, Nedorost S [2015]. The role of textiles in dermatitis: an update. Curr Allergy Asthma Rep *15*(4):17, https://doi.org/10.1007/s11882-015-0518-0.

OEKO-TEX® [2023]. Certification according to OEKO-TEX® Standard 100. Zurich, Switzerland: OEKO-TEX®, https://www.oeko-tex.com/en/business/certifications_and_services/ots_100/ots_100_start.xhtml.

Reich HC, Warshaw EM [2010]. Allergic contact dermatitis from formaldehyde textile resins. Dermatitis *21*(2):65–76, https://doi.org/10.2310/6620.2010.09077.

Swedish Chemicals Agency [2014]. Chemicals in textiles. Risks to human health and the environment. Report of a government assignment. Article number: 361 130. Report 6/14, https://www.kemi.se/en/publications/reports/2014/report-6-14-chemicals-in-textiles.

National Institute for Occupational Safety and Health

NIOSH®

Promoting productive workplaces through safety and health research

HHE®

HHE Report No. 2022-0061-3393