Arthritis Foundation®

Ease of Use Rigid Packaging Guide | COMPONENTS

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INTRODUCTION

In the United States, arthritis is the #1 cause of disability, affecting nearly 60 million adults and hundreds of thousands of children. This complex disease can cause chronic, debilitating pain — and make daily activities difficult to do — while also impacting physical and social wellness and mental health. People of all ages, races and sexes live with arthritis.

Arthritis symptoms include pain, stiffness, swelling and diminished range of motion in joints. Symptoms vary, from mild to severe, and may come and go, getting progressively worse over time. Arthritis can also cause permanent joint damage, often leading to immobility. In addition, arthritis can affect the heart, lungs, kidneys, eyes, skin and other organs.

For almost eight decades, the Arthritis Foundation has led the way in supporting people with arthritis and their caregivers. As the largest nonprofit organization focused on arthritis and related conditions, we've played a key role in the development of groundbreaking arthritis treatments — and have successfully advocated for policies and laws that make health care more accessible and affordable for arthritis patients.

We also create life-changing resources that help patients take control of their disease. And we nurture a vibrant, caring community where they can connect with others and know they're not alone.

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EASE OF USE PRODUCTS AND PACKAGING

The Arthritis Foundation's Ease of Use Certification program recognizes products and packaging that have been tested, approved and certified as easy to use for people who live with arthritis and chronic pain.

Consumer products and packaging are often not designed to meet the needs of those challenged by arthritis and chronic pain. When easy-to-use designs are implemented, products and packages are made easier to use for the arthritis community, which means they are easier to use by everyone.

Each product and package considered for Ease of Use is first independently tested by the Intuitive Design Applied Research Institute (IDARI). Upon receiving a favorable review, they are then eligible to license the Ease of Use Certified seal, which may be incorporated in all marketing initiatives as a shelf differentiator, in both retail and e-commerce, as well as become part of the Arthritis Foundation's Ease of Use annual marketing strategy.

Did You Know?

72% of consumers said they would switch brands if a product/package was certified as Ease of Use Certified. - *Nielsen Ease of Use Survey 2016*

Both the consumer and corporate sectors are gaining great value in updated designs of products and packages that are easy to use. Carrying the seal, brands like Pilot® Pen, Nexium, Advil®, Duracell®, IMAK®, SafeStep and others are seeing sales that outpace their competition. Many brands use the seal in presentations and buyer meetings, along with marketing in print, digital and television.

People living with arthritis and chronic pain also make shopping decisions when they see the item has been certified as easy to use. Easier to use designs are easier for everyone, whether living with chronic pain or not, and often become a shelf differentiator.

"I trust all products that are labeled Ease of Use. My absolute favorite that I use the most is the Advil® Easy Open Arthritis Cap. I've had arthritis for almost 20 years, and I've always struggled to open a medicine bottle cap. Advil made it so much easier. My second favorite is the Ezy Dose® Pill Organizer. This helps me organize my meds and have easier access to them, despite any pain I may have in my hands. I'm grateful for the partnerships the Arthritis Foundation has made to create products that make life easier with arthritis."

–Ashley Nicole, autoimmune health coach and master trainer, diagnosed with rheumatoid arthritis at age 27

Intuitive Design Applied Research Institute

The Intuitive Design Applied Research Institute, LLC (IDARI), assists in identifying user needs and scientifically evaluating consumer product and packaging solutions. IDARI offers many research and evaluation services, specializing in objectively measuring human performance that delivers key insights. This, in turn, drives innovation — especially for the needs, aspirations and latent demands of consumers dealing with arthritis, chronic pain and other functional limitations.

IDARI serves as the official consumer product Ease of Use test lab for the Arthritis Foundation. A favorable evaluation by IDARI qualifies the manufacturer for inclusion in the Arthritis Foundation's Ease of Use Certification program.

Dr. Brad Fain, IDARI founder and Georgia Tech Regents' Researcher, has more than three decades of experience researching human factors engineering and design. From Ease of Use evaluation and universal design studies, to ethnographic research and consumer product design, Dr. Fain founded IDARI to conduct usability and accessibility testing for the Arthritis Foundation and other entities across the globe. At Georgia Tech, his research has spanned projects for the U.S. Department of Defense to manufacturers of critical health systems. He established the Accessibility Evaluation Facility at Georgia Tech, which performs objective accessibility evaluations of workplace information technology for both industry and government customers. Learn more about Dr. Fain and his research at idarinstitute.com.

Dr. Brad Fain

Arthritis Foundation®

EASE OF USE CERTIFIED Arthritis Foundation

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PARTNERSHIP

The Arthritis Foundation is the largest nonprofit organization dedicated to the prevention, control and cure of America's No. 1 cause of disability. The Arthritis Foundation champions the fight to conquer arthritis through life-changing science, resources, advocacy and community connections. Taking diversity, equity and inclusion very seriously, the Arthritis Foundation strives to empower all people with arthritis to live a better lifestyle and remove barriers that limit quality of life. As the leading expert in Ease of Use design certification, the Arthritis Foundation helps generate more than $100 million in annual sales of products and packages carrying the Ease of Use seal.

Target is one of America's leading retailers and an iconic brand with a single purpose: to help all families discover the joy of everyday life. Diversity, equity and inclusion are part of Target's core values, shaping culture and driving business. At the heart of this endeavor is the Owned Brand Product Design & Packaging organization. This team designs and engineers products and packaging for an industry-leading portfolio of over 45 Target owned brands. Inclusive design and accessibility improvements have been long-term goals of this team. Target collaborates with external partners to advance their owned brands portfolio with exclusive designs only found at Target.

This collaborative partnership is driving innovation on product and package designs. The mutual goal is to provide products and packages that are easier to use for people living with arthritis and chronic pain, plus other consumers who are also looking for easy-to-use items. Together, we want to help all families discover the joy of everyday life, driving innovation that leads to life-changing satisfaction.

This Ease of Use Design Guide provides the first guidelines developed in the United States, offering resources for engineers and designers in the requirements definition and design development stage. Our collaboration is leading the way in design accessibility.

This innovative partnership of the Arthritis Foundation, Target and IDARI has been a collaborative effort of industry experts in the Ease of Use design space — with Target funding the research and contributing to the illustrations, photographs and graphic design of these guidelines.

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Arthritis Foundation

INTUITIVE DESIGN
APPLIED RESEARCH INSTITUTE

HIGH-LEVEL CONSIDERATIONS: ISSUES AND RECOMMENDATIONS

Packaged items are too heavy. People with arthritis can have difficulty holding and transporting heavy items. Items over 5.0 pounds can be difficult to carry with one hand. If items exceed 5.0 pounds, consider adding design elements to facilitate a two-handed hold. Items over 10.0 pounds can be difficult to carry regardless of handle placement.

The linear force required is too high. People with arthritis can experience pain when asked to apply a linear force to a design element. Consider requiring less than 3.0 pounds of linear force for design elements meant to be operated with a single finger or designed to be pinched between two fingers. Consider requiring less than 5.0 pounds of force for design elements that are to be operated by multiple fingers or a palm press.

The rotational force requirement is too high. People with arthritis may have difficulty rotating design elements, such as twist off closures. The amount of force a user can apply to a rotating design element will depend on multiple factors, such as the diameter, height, coefficient of friction and the knurling pattern of the element. Small-diameter and large-diameter rotating design elements can be particularly difficult to operate. Avoid design element shapes or knurling patterns that directly apply pressure to finger joints during rotation.

Users become fatigued after prolonged usage. Users with arthritis may become fatigued when using products that must be held or actuated repeatedly over a prolonged period. When designing the product for extended use, reduce the number of individual actions required and minimize the amount of effort required for each action.

Use of the product causes joints to be placed in an uncomfortable position or posture. Some products require users to articulate their joints in an uncomfortable position. Whenever possible, design the product to maintain a neutral position of the wrist joint. Do not require users to extend their arms above shoulder height.

Use of the product causes painful pressure across finger joints. Ridges, bumps and other small-radius protrusions along the graspable area of the product can increase pressure along painful finger joints. Ensure that all graspable areas are designed to distribute the load across the entire grasp point so that pressure is not concentrated on individual finger joints.

Use of the product requires an excessive grip span. Some users with arthritis have increasingly diminishing grip strength once the grip span exceeds 2.5 to 3.0 inches. Design graspable items that require user strength to not require excessive grip span.

The product requires the use of a tool. Users with arthritis are more likely to injure themselves if interacting with the product requires a sharp instrument like scissors or a knife. Consider not requiring the use of a tool to open or interact with the product.

Avoid requiring simultaneous actions. Some users with arthritis have difficultly performing two actions at the same time, such as rotating and pinching a closure. If the use of the product requires multiple actions, design the product in a way that those actions can be performed sequentially.

Avoid sharp edges. Sharp edges can create a hazard or may be uncomfortable if users are required to apply force to the edge. Consider rolling metal edges or finishing plastic edges with a dull surface.

Components

Components are the mechanisms used to dispense the product. They range from simple, single-material components, such as a twist off plastic cap, to complex components with dozens of parts, such as trigger sprayers. While there are many different components of rigid packaging, this section focuses on common components, such as flip top closures, disc top closures, twist off closures, aerosol spray cap closures, pumps and trigger sprayers.

COMPONENTS OVERVIEW

Rigid packaging is a category of packaging that does not flex or bend. It includes bottles, boxes, cans and jars made of materials such as paperboard, plastic, glass and metals. Often, rigid packaging is used to protect and contain fragile materials and liquids. Many of these packages are part of a packaging assembly with a cap, closure, dispenser or other mechanism to dispense the product.

This guide focuses on high-volume rigid packaging components used in the United States in the early 2020s. Rigid packaging used for medication and health care is not included in this guide due to the complexity of the topic. This topic is under consideration for a future guide. This is part of a series of guides covering rigid bottles and bases, rigid components, films and pouches, sealed trays and cards, and boxes and bags. This guide starts with a review of the high-level issues and recommendations across all packaging. Following this section, the guide discusses optimum design guidelines, common issues and recommendations for rigid packaging components.

FLIP TOP CLOSURES

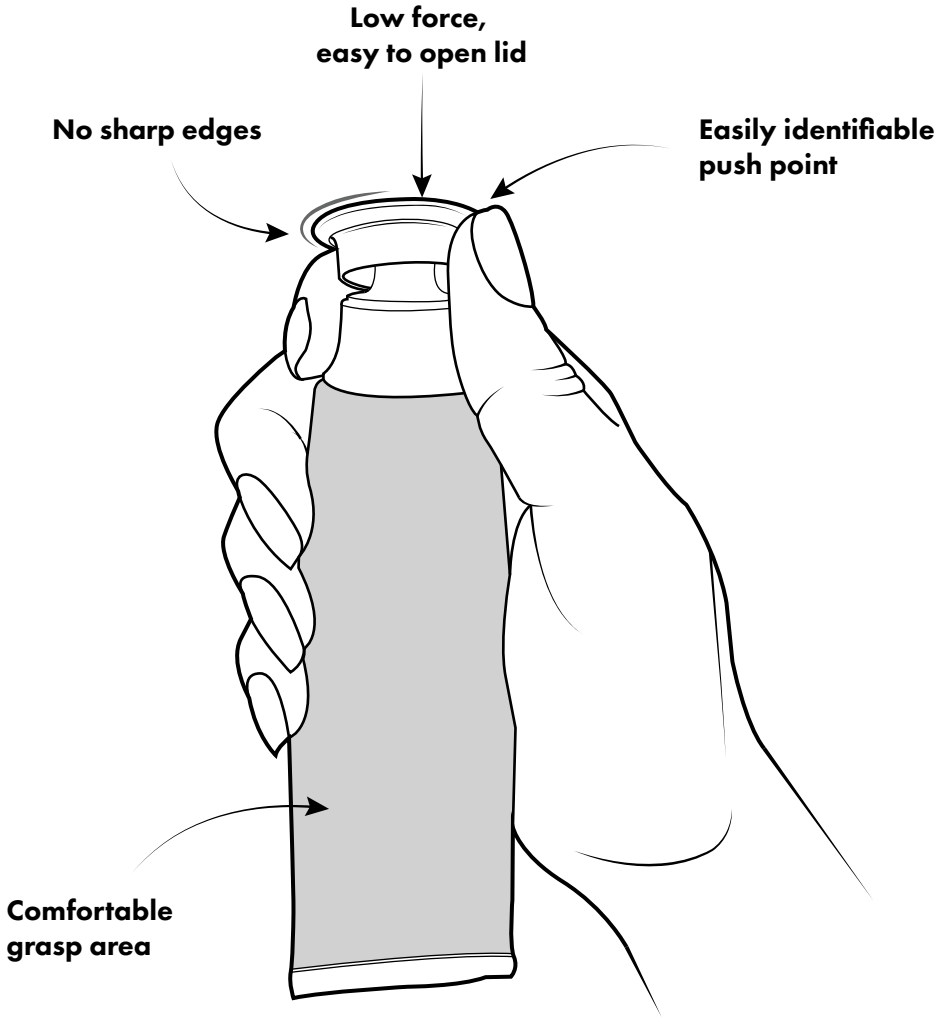
Flip top closures are packaging components used to contain and dispense products, typically creams, pastes and other liquids with medium levels of viscosity. Most are one-piece components with a lid and base connected by a molded hinge. Occasionally, the component will use a separate hinge or pin to connect the base and lid. The closures are opened by placing a finger underneath the lid and flipping the lid 180 degrees. Most flip top closures have a depression in the base to accommodate a finger below the lid. Once the lid has been flipped over, the product is dispensed by rotating the packaging and squeezing the base of the package.

Examples of Flip Top Closures

Optimum Flip Top Closure Design Guidelines

Recommendation Highlights

- **Comfortable grasp area**
- **Easy open lid**
    - Low force
    - No sharp edges
    - Easy to grasp
    - Easily identifiable push point
- **No-mess dispensing**
- **Easy to remove seal**



FLIP TOP CLOSURES ISSUES

Most issues are derived from three tasks: closure operation, dispensing and grip. Below is a summary of the common issues with each task. Many issues for people with arthritis stem from the shape of the closure and the amount of force required to open the closure. The following pages have detailed descriptions, population impact considerations and potential solutions for each issue.

1. Flip Top Closure Operation Issues

1.1. The force required to operate the flip top may be too high.

1.2. The user may have difficulty locating the flip top push point.

1.3. The torque required to remove the flip top may be too high.

1.4. The inner seal is difficult to remove.

2. Flip Top Dispense Issues

2.1. The product is difficult to dispense precisely.

2.2. The product requires too much force to dispense.

2.3. The nozzle is difficult to keep clean.

3. Grip & Weight Issues

3.1. The flip top bottle is too heavy.

3.2. The flip top bottle is uncomfortable to hold.

Operation Issues

1.1 The force required to operate the flip top may be too high.

Detailed Description: The force required to press against the flip top lip to open it may exceed the functional capacity of some users with arthritis. A user's ability to apply sufficient force may be influenced by the lip shape and the friction between the flip top stopper and the flip top nozzle. Sharp edges may be uncomfortable and may limit the amount of force a user is willing to apply.

Populations Impacted: Limited strength

Potential Solutions: *Reduce the force required to articulate the flip top to below 3.0 pounds of force.* The amount of force required for the flip top should be below 3.0 pounds.

Design the flip top lip to have a clear push point. Flip top lips that have a sharp edge at the front of the lip may be painful for some users with arthritis. Users may not be able to apply sufficient force to open the flip top prior to reaching their pain threshold. Consider providing a flat, finger-sized surface for users to apply pressure to the flip top to facilitate opening.

1.2 The user may have difficulty locating the flip top push point.

Detailed Description: Users may have difficulty locating the flip top push point if the push point is not clearly indicated. Consider visually highlighting the flip top push point with a textured or contoured surface, a distinct color or with instructions indicating appropriate finger placement.

Populations Impacted: Limited fine motor control

Potential Solutions: *Provide a visual indication of appropriate finger placement.* Consider visually indicating the appropriate finger placement for applying pressure to operate the flip top closure. Use a contrasting color, a textured push point or a contoured push point to highlight the finger placement location.

Provide instructions for finger placement. Consider adding an arrow or written instructions such as the word "PUSH" to indicate the location of the push point for the flip top.

1.3 The torque required to remove the flip top may be too high.

Detailed Description: Some flip top closures must be removed to access an inner seal. Flip top closures with excessive torque requirements may be difficult to remove. The specialized shape of some flip top closures may make the closure difficult to grip without causing painful pressure points.

Populations Impacted: Limited strength, limited grip

Potential Solutions: *Limit the circumference of the closure.* Users with arthritis may experience limited strength with excessive grip spans. Some users experience reductions in strength when grip spans exceed 2.5 to 3.0 inches.

Limit the torque required to remove the closure. Excessive torque may make it difficult or impossible for users with arthritis to remove the closure.

Provide a high coefficient of friction closure grip. Consider using a high coefficient of friction material at the grasp point of the closure or using a knurling pattern that maximizes grip.

Provide a knurling pattern or high coefficient of friction grip surface. Consider providing a visible grip surface for removal of the closure. A high coefficient of friction coating or knurling pattern on the grip surface can make it less likely to slip in the user's hands when removing the closure.

1.4 The inner seal is difficult to remove.

Detailed Description: Some flip top containers feature an inner seal located at the top of the container under the closure. Users with arthritis may have difficulty removing the inner seal due to the absence of a grasp point and the amount of force required to separate the seal from the container.

Populations Impacted: Limited strength, limited grip

Potential Solutions: *Limit the amount of force required to remove the seal to 3.0 pounds or less.* Minimize the amount of force required to remove the seal. Require no more than 3.0 pounds of force to remove the seal when an adequate grasp point is provided, and the user can utilize a key pinch grip to securely grasp the grasp point.

Provide an adequate grasp point for the removal of the inner seal. Consider providing a grasp point that can be easily grasped between the thumb and knuckle using a key pinch grip. The grasp point should extend beyond the seal and be visually apparent to the user.

Do not require the use of a tool. Inner seals that require puncturing with a tool can pose a potential hazard for users with arthritis. Do not require a knife or scissors to remove the inner seal. If appropriate, reduce the amount of force required to puncture the seal to allow users to puncture it with a fingernail.

Ensure the grasp point has a sufficient coefficient of friction. Inner seal grasp points can be difficult to pinch securely without slipping. Consider the use of a texture or high coefficient of friction coating to facilitate a secure grip on the grasp point.

Dispense Issues

2.1 The product is difficult to dispense precisely.

Detailed Description: Some use cases may require that a particular amount of product be dispensed, or the product must be dispensed in a precise location. Users with arthritis may have difficulty accurately dispensing the product. The amount of force required to dispense the product, the weight of the bottle, the size of the bottle and the shape of the nozzle may impact precise dispensing.

Populations Impacted: Limited strength, limited grip, fatigue

Potential Solutions: *Limit the amount of force required to dispense the product.* Design the nozzle so that users are not required to use excessive force to dispense the product. If a user must use excessive force to dispense the product, they may not have enough fine motor control to dispense the product precisely. The amount of force required to dispense the product should not exceed 3.0 pounds.

Design the nozzle to prevent inadvertent dispensing. Design the nozzle aperture to precisely dispense the product with a slight squeeze. Products that dispense without force being applied can be difficult to control.

Limit the required grip span. Users should not be required to use a grip span exceeding 2.5 to 3.0 inches to grasp the bottle while dispensing.

2.2 The product requires too much force to dispense.

Detailed Description: Users grasping a bottle while holding it inverted may have difficulty applying sufficient pressure to dispense the product.

Populations Impacted: Limited strength, limited grip, fatigue

Potential Solutions: *Limit the amount of force required to dispense the product.* Design the nozzle so that users are not required to use excessive force to dispense the product.

Develop a no-drip nozzle. Design the nozzle so that excess product returns to the bottle at the end of the dispense task instead of being deposited on the surface of the flip top or inside the aperture of the nozzle so that the nozzle does not become clogged with product.

Design the nozzle stopper to ensure the nozzle is cleared when closed. Design the nozzle stopper built into the flip top closure to clear the nozzle when the flip top is closed.

2.3 The nozzle is difficult to keep clean.

Detailed Description: Nozzles may be difficult to keep clean. Nozzles clogged with product can be difficult to dispense. If the area around the nozzle becomes contaminated with product, the flip top closure can be difficult to open and close.

Populations Impacted: Limited strength, limited grip, fatigue

Potential Solutions: *Develop a no-drip nozzle.* Design the nozzle so that excess product returns to the bottle at the end of the dispense task instead of being deposited on the surface of the flip top or inside the aperture of the nozzle.

Design the area around the nozzle to be easy to clean. Avoid textures around the nozzle where product can be deposited. Design the surface of the nozzle flange so that it can be easily cleaned without contaminating the product.

Grip and Weight Issues

3.1 The flip top bottle is too heavy.

Detailed Description: Bottles over 3.0 pounds may be difficult to hold or invert. Heavy bottles can be impossible to use if the product needs to be dispensed precisely.

Populations Impacted: Limited strength, limited range of motion, limited grip, fatigue

Potential Solutions: *Reduce the weight of the bottle.* A heavy bottle may be difficult to hold in position while the bottle is in use. Consider reducing the bottle's weight, particularly when it is expected to be used for a longer-duration task.

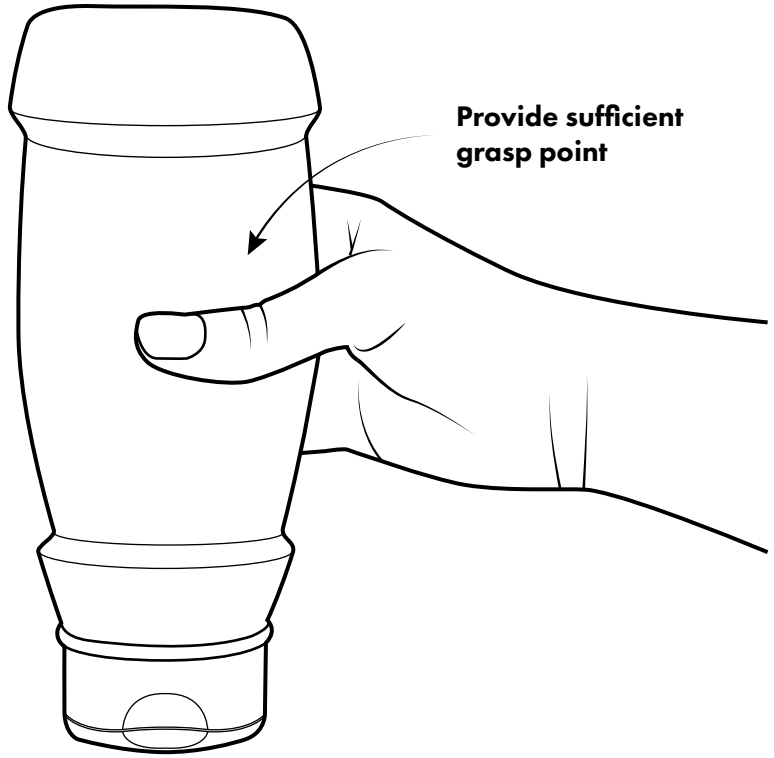
3.2 The flip top bottle is uncomfortable to hold.

Detailed Description: The ability to hold the bottle in a comfortable position while transporting or using the product is critical to overall ease of use. Typically, flip top containers must be inverted to dispense the product. The user may have difficulty comfortably holding an inverted bottle and applying a precise amount of pressure to the bottle to accurately dispense the contents.

Populations Impacted: Limited strength, limited grip, limited range of motion, fatigue

Potential Solutions: *Reduce the weight of the bottle.* A heavy bottle may be difficult to hold in position while the bottle is in use. Consider reducing the bottle's weight, particularly when the contents of the bottle must be dispensed precisely.

Provide a sufficient grasp point for hand placement. The bottle should provide an adequate grasp point to prevent bottle slippage while the bottle is being carried or held inverted during the dispensing process. Consider providing an indented area of the bottle with a grasp point requiring no greater than 2.5 to 3.0 inches in grip span when the bottle is a large diameter.



DISC TOP CLOSURES

Disc top closures are packaging components used to contain and dispense products, typically lotions and other liquids with medium levels of viscosity. Most are multipiece components with a base and a disc that rotates on a horizontal axis to reveal an opening in the base to dispense the product. The closures are opened by placing a finger on the top of the disc on the opposite side of the opening and pressing down. Most disc top closures have a slight depression in the disc to indicate where to press down. Once the closure has been opened, the product is dispensed by rotating the packaging and squeezing the base of the package.

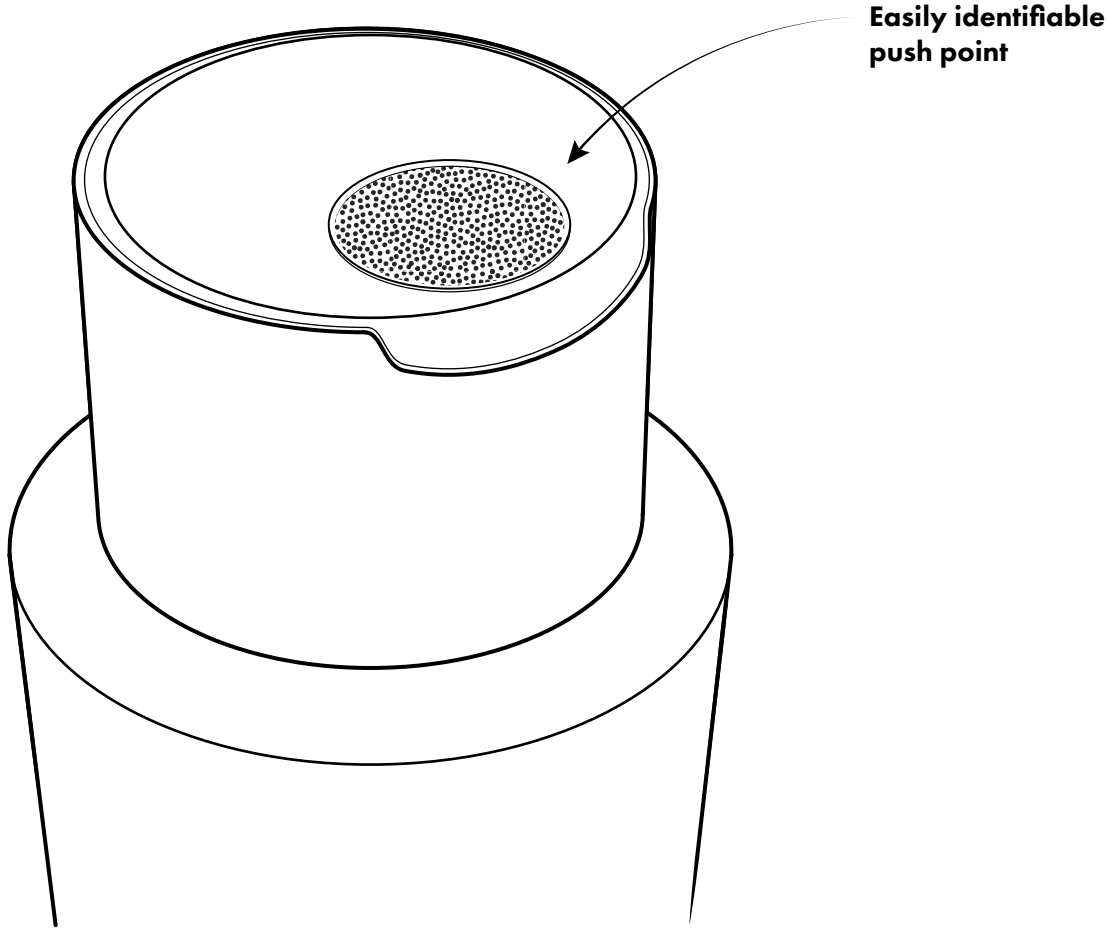
Examples of Disc Top Closures

Optimum Disc Top Closure Design Guidelines

Recommendation Highlights

- **Comfortable grasp area**
- **Easy open lid**
    - Low force
    - No sharp edges
    - Clear indication of where to push

- **Low dispense force**
- **Easy to dispense precisely**



DISC TOP CLOSURE ISSUES

Most issues are derived from three tasks: closure operation, dispensing and grip. Below is a summary of the common issues with each task. Many issues for people with arthritis stem from the shape of the closure and the amount of force required to operate the disc top. The following pages have detailed descriptions, population impact considerations and potential solutions for each issue.

1. Disc Top Closure Operation Issues

1.1. The force required to operate the disc top is too high.

1.2. The disc top press point is too small.

2. Disc Top Closure Dispense Issues

2.1. The product is difficult to dispense precisely.

2.2. The product requires too much force to dispense.

3. Grip and Weight Issues

3.1. The disc top container is too heavy.

3.2. The disc top container is uncomfortable to hold.

Operation Issues

1.1 The force required to operate the disc top may be too high.

Detailed Description: The force required to press against the disc top lip to open it may exceed the functional capacity of some users with arthritis. A user's ability to apply sufficient force may be influenced by the lip shape and the friction between the disc and the rest of the closure. Sharp edges may be uncomfortable and may limit the amount of force a user is willing to apply.

Populations Impacted: Limited strength

Potential Solutions: *Reduce the force required to articulate the disc top to below 3.0 pounds of force.* The amount of force required to flip the top should be below 3.0 pounds.

Design the disc top lip to have a clear push point. Disc top press points that have a sharp edge at the corner of the top may be painful for some users with arthritis. Users may not be able to apply sufficient force to open the disc top prior to reaching their pain threshold. Consider providing a flat, finger-sized surface for users to apply pressure to the disc top to facilitate opening.

1.2 The user may have difficulty locating the disc top push point.

Detailed Description: Users may have difficulty locating the disc top push point if the push point is not clearly indicated. Consider visually highlighting the disc top push point with a textured or contoured surface, a distinct color or with instructions indicating appropriate finger placement.

Populations Impacted: Limited fine motor control

Potential Solutions: *Provide a visual indication of appropriate finger placement.* Consider visually indicating the appropriate finger placement for applying pressure to operate the disc top closure. Use a contrasting color, a textured push point or a contoured push point to highlight the finger placement location.

Provide instructions for finger placement. Consider adding an arrow or written instructions such as the word "PUSH" to indicate the location of the push point for the disc top.

Dispense Issues

2.1 The product is difficult to dispense precisely.

Detailed Description: Some use cases may require that a particular amount of product be dispensed, or the product must be dispensed in a precise location. Users with arthritis may have difficulty accurately dispensing the product. The amount of force required to dispense the product, the weight of the container, the size of the container and the shape of the nozzle may impact precise dispensing.

Populations Impacted: Limited strength, limited grip, fatigue

Potential Solutions: *Limit the amount of force required to dispense the product.* Design the nozzle so that users are not required to use excessive force to dispense the product. If a user must use excessive force to dispense the product, they may not have enough fine motor control to dispense the product precisely. The amount of force required to dispense the product should not exceed 3.0 pounds.

Design the nozzle to prevent inadvertent dispensing. Design the nozzle aperture to precisely dispense the product with a slight squeeze. Products that dispense without force being applied can be difficult to control.

Limit the required grip span. Users should not be required to use a grip span exceeding 2.5 to 3.0 inches to grasp the container while dispensing.

2.2 The product requires too much force to dispense.

Detailed Description: Users grasping a container while holding it inverted may have difficulty applying sufficient pressure to dispense the product.

Populations Impacted: Limited strength, limited grip, fatigue

Potential Solutions: *Limit the amount of force required to dispense the product.* Design the nozzle so that users are not required to use excessive force to dispense the product.

Develop a no-drip nozzle. Design the nozzle so that excess product returns to the container at the end of the dispense task, instead of being deposited on the surface of the disc top or inside the aperture of the nozzle, so that the nozzle does not become clogged with product.

Grip and Weight Issues

3.1 The disc top container is too heavy.

Detailed Description: Containers over 3.0 pounds may be difficult to hold or invert. Heavy containers can be impossible to use if the product needs to be dispensed precisely.

Populations Impacted: Limited strength, limited range of motion, limited grip, fatigue

Potential Solutions: *Reduce the weight of the container.* A heavy container may be difficult to hold in position while the container is in use. Consider reducing the container's weight, particularly when it is expected to be used for a longer-duration task.

3.2 The disc top container is uncomfortable to hold.

Detailed Description: The ability to hold the container in a comfortable position while transporting or using the product is critical to overall ease of use. Typically, disc top containers must be inverted to dispense the product. The user may have difficulty comfortably holding an inverted container and applying a precise amount of pressure to the container to accurately dispense the contents.

Populations Impacted: Limited strength, limited grip, limited range of motion, fatigue

Potential Solutions: *Reduce the weight of the container.* A heavy container may be difficult to hold in position while the container is in use. Consider reducing the container's weight, particularly when the contents of the container must be dispensed precisely.

Provide a sufficient grasp point for hand placement. The container should provide an adequate grasp point to prevent container slippage while the container is being carried or held inverted during the dispensing process. Consider providing an indented area of the container with a grasp point requiring no greater than 2.5 to 3.0 inches in grip span when the container is of a larger diameter.

TWIST OFF CLOSURES

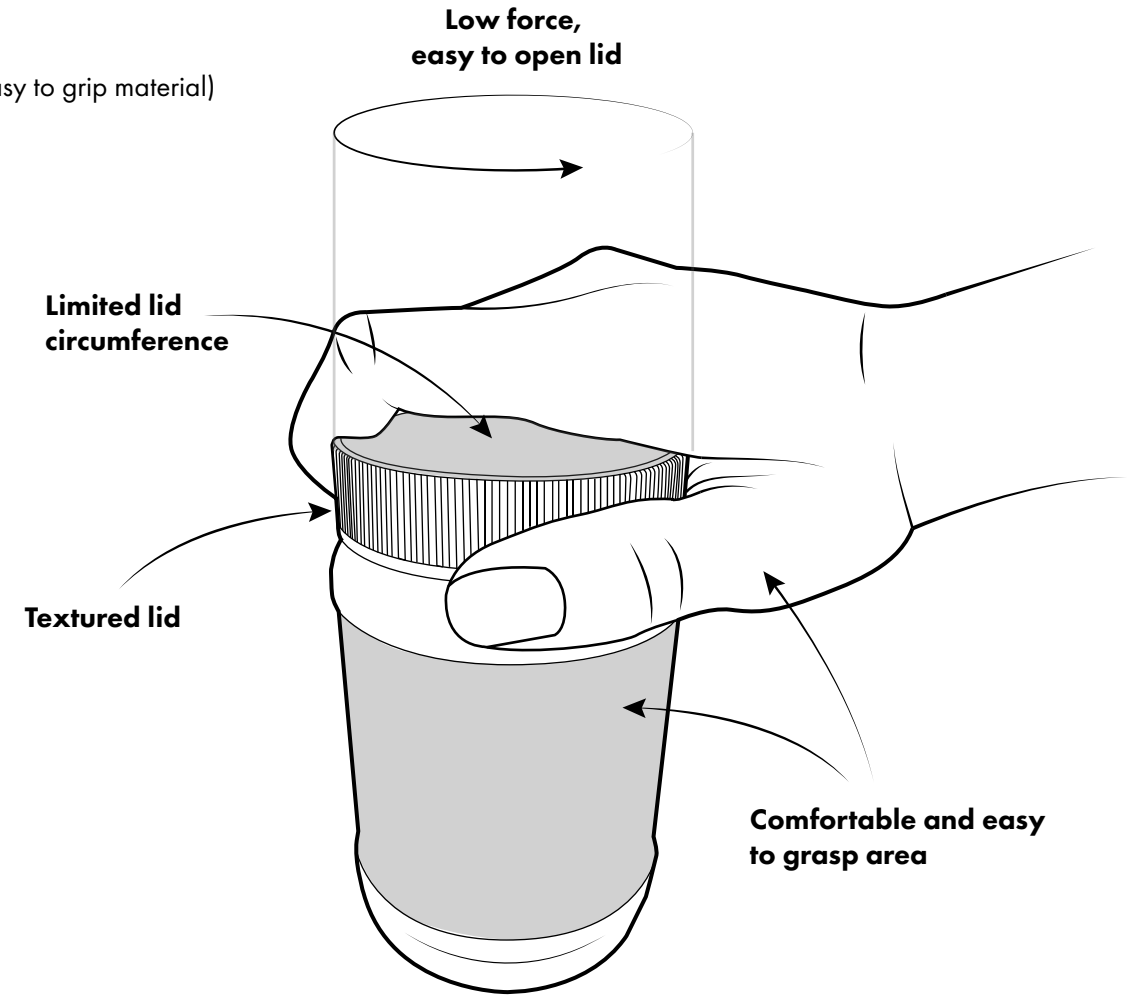
Twist off closures are a broad category of packaging components that include lids with an internal thread and lug lids. Threaded lids have a recessed or protruded thread feature that screws onto a thread feature on the neck of a bottle, jar or pouch. Lug lids have small tabs instead of internal screws. These tabs travel down thread features on the neck of a bottle, jar or pouch. These closures are opened by grasping the lid and twisting to open. Once the lid has been twisted off the base, it is typically set upside down on a counter or surface, and the product is dispensed by pouring or using a utensil to access the contents.

Examples of Twist Off Closures

Optimum Twist Off Closures Design Guidelines

Recommendation Highlights

- **Comfortable grasp area**
- **Easy open lid**
  - Low force
  - Limit lid circumference
  - Easy to grasp
  - High coefficient of friction lid (e.g., knurled texture, easy to grip material)
- **Easy to remove seal**
  - Large pull tab
  - Textured pull tab
  - Low removal force pull tab
  - Pull tab removes in one piece



TWIST OFF CLOSURES ISSUES

Most issues are derived from two tasks: transport and opening. Below is a summary of the common issues with each task. Many issues for people with arthritis stem from the ability of the user to securely grasp the product and the ability of the user to apply sufficient grip and rotational force to open the product. Small diameter closures, large diameter closures or closures requiring excessive force may be particularly problematic for people with arthritis. The following pages have detailed descriptions, population impact considerations and potential solutions for each issue.

1. Twist Off Closure Operation Issues

1.1. The torque required to remove the twist off closure may be too high

1.2. The user may have difficulty gripping the bottle while removing the closure

1.3. The inner seal is difficult to remove

2. Grip & Weight Issues

2.1. The bottle or container is too heavy

Operation Issues

1.1 The torque required to remove the twist off closure may be too high.

Detailed Description: Twist off closures with excessive torque requirements may be difficult to remove. The shape of some twist off closures may make the closure difficult to grip without causing painful pressure points.

Populations Impacted: Limited strength, limited grip

Potential Solutions: *Limit the circumference of the closure.* Users with arthritis may experience limited strength with excessive grip spans. Some users experience reductions in strength when grip spans exceed 2.5 to 3.0 inches.

Limit the torque required to remove the closure. Excessive torque may make it difficult or impossible for users with arthritis to remove the closure.

Provide a high coefficient of friction closure grip. Consider using a high coefficient of friction material at the grasp point of the closure or using a knurling pattern that maximizes grip.

Provide a knurling pattern or high coefficient of friction grip surface. Consider providing a visible grip surface for removal of the closure. A high coefficient of friction coating or knurling pattern on the grip surface can make it less likely to slip in the user's hands when removing the closure.

1.2 The user may have difficulty gripping the bottle or container while removing the closure.

Detailed Description: Twist off closures with excessive torque requirements may be difficult to remove. Removing the twist off closure requires a firm grip on the bottle or container in addition to the grip required for the closure. The shape of some bottles or containers may make the bottle or container difficult to grip without causing painful pressure points.

Populations Impacted: Limited strength, limited grip

Potential Solutions: *Limit the circumference of the bottle or container grasp point.* Users with arthritis may experience limited strength with excessive grip spans. Some users experience reductions in strength when grip spans exceed 2.5 to 3.0 inches. Limit the diameter of the bottle or container or build a grasp point into the bottle or container that does not require an excessive grip span.

Provide a high coefficient of friction bottle or container surface. Consider using a high coefficient of friction material at the grasp point of the bottle or container.

Use a non-cylindrical bottle or container design. Cylindrical bottles or containers are more likely to slip in the hand as compared to non-cylindrical bottles or containers. Consider using an oval-shaped bottle or container that is less likely to rotate in the hand while the user is removing the closure.

1.3 The inner seal is difficult to remove.

Detailed Description: Some containers feature an inner seal located at the top of the container under the closure. Users with arthritis may have difficulty removing the inner seal due to the absence of a grasp point and the amount of force required to separate the seal from the container.

Populations Impacted: Limited strength, limited grip

Potential Solutions: *Limit the amount of force required to remove the seal to 3.0 pounds or less.* Minimize the amount of force required to remove the seal. Require no more than 3.0 pounds of force to remove the seal when an adequate grasp point is provided, and the user can utilize a key pinch grip to securely grasp the grasp point.

Provide an adequate grasp point for the removal of the inner seal. Consider providing a grasp point that can be easily grasped between the thumb and knuckle using a key pinch grip. The grasp point should extend beyond the seal and be visually apparent to the user.

Do not require the use of a tool. Inner seals that require puncturing with a tool can pose a potential hazard for users with arthritis. Do not require a knife or scissors to remove the inner seal. If appropriate, reduce the amount of force required to puncture the seal to allow users to puncture it with a fingernail.

Ensure the grasp point has a sufficient coefficient of friction. Inner seal grasp points can be difficult to pinch securely without slipping. Consider the use of a texture or high coefficient of friction coating to facilitate a secure grip on the grasp point.

Inner seal removes in one piece. The inner seal can be extremely difficult to remove if it separates into multiple pieces. The remaining pieces not connected to the pull tab may require a tool or fine motor control to remove. The inner seal should be removable in one piece with one continuous motion.

Grip and Weight Issues

2.1 The bottle or container is too heavy.

Detailed Description: People with arthritis who experience limited strength or painful finger joints may have difficulty transporting bottles or containers that exceed 5.0 pounds for long distances. Heavier items that exceed 10.0 pounds may require a two-handed carry.

Populations Impacted: Limited strength

Potential Solutions: *Reduce weight of the container for a single-handle design to below 5.0 pounds.* Users may need to use two hands to carry and transport containers exceeding 5.0 pounds.

Design a second grasp point to facilitate a two-handed carry for containers that weigh more than 5.0 pounds. Heavy containers over 5.0 pounds should be designed to be carried using two hands. A grasp point built into the container, in addition to the handle, can be useful when the container needs to be transported as part of the use case.

SPRAY CAP CLOSURES

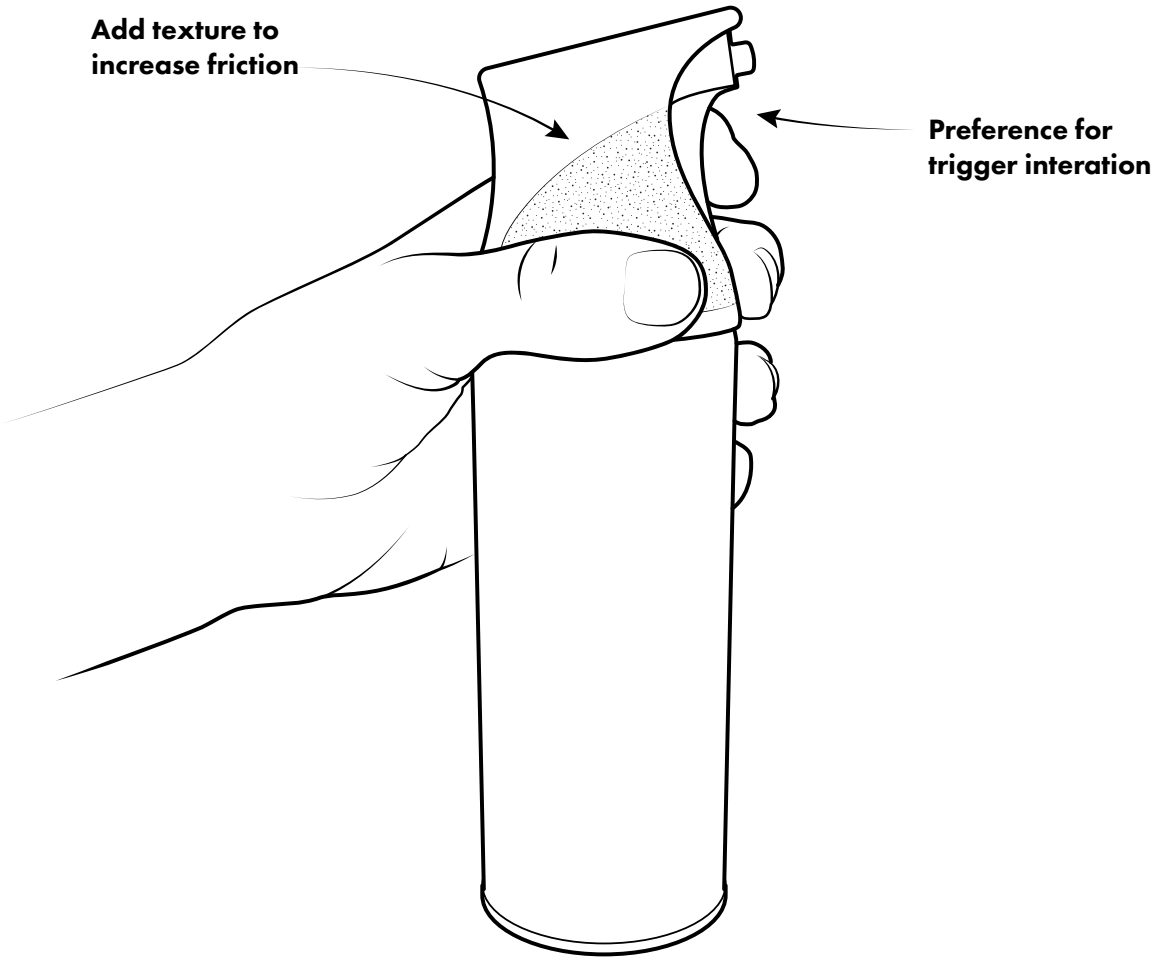
Spray cap closures are packaging components used to contain and dispense liquids or small-size solid particles in a mist or spray. Typical applications are cleaning chemicals, beauty products, paints and insecticides. The closures are operated by placing a finger on the top of closure on the opposite side of the opening and pressing down. Most closures have a slight depression on top to indicate where to press down.

Examples of Spray Cap Closure Tops

Optimum Spray Cap Design Guidelines

Recommendation Highlights

- **Comfortable grasp area**
- **Low force spray**
- **Comfortable depression point**
- **Low force to activate spray**
- **Easy to remove cap**



SPRAY CAP ISSUES

Most issues are derived from two tasks: spray nozzle operation and grip. Below is a summary of the common issues with each task. Many issues for people with arthritis stem from the shape of the spray nozzle, operation of the nozzle lock and the amount of force required to dispense the product. A powered sprayer or a triggered sprayer may be viable alternatives for difficult-to-use spray cap designs. The following pages have detailed descriptions, population impact considerations and potential solutions for each issue.

1. Spray Cap Operation Issues

1.1. The force required to depress the spray nozzle is too high.

1.2. The spray head is uncomfortable to press.

1.3. The spray lock is difficult to rotate.

1.4. The spray lock label is difficult to read.

1.5. The cap is difficult to remove.

1.6. Users become fatigued after prolonged operation.

1.7. The spray pressure is inappropriate for the use case.

2. Grip and Weight Issues

2.1. The container is too heavy.

2.2. The container is uncomfortable to hold while spraying.

Operation Issues

1.1 The force required to fully depress the spray nozzle may be too high.

Detailed Description: The force required to properly depress the spray nozzle may exceed the functional capacity of some users with arthritis. A user's ability to apply sufficient force may be influenced by the shape of the top of the nozzle, the size of the spray nozzle and the distance between the outer diameter of the spray nozzle and the nozzle itself.

Populations Impacted: Limited strength, limited grip span

Potential Solutions: *Reduce the force required to articulate the nozzle to below 3.0 pounds of force.* The amount of force required to squeeze the nozzle should be below 3.0 pounds throughout the nozzle's range of motion.

Design the nozzle touch point to accommodate the entire width of the index finger. Spreading the force load across the surface area of the fingertip may reduce discomfort due to pressure points created by small diameter nozzles.

Design the nozzle touch point to have a slightly concave surface. A wide, slightly curved surface will allow users to apply a directed force to the nozzle efficiently.

1.2 The spray head is uncomfortable to press.

Detailed Description: Depressing the spray nozzle may be uncomfortable for some users with arthritis, particularly if the use case requires depressing the nozzle repeatedly or for long durations. Nozzle activation comfort may be influenced by the shape of the top of the nozzle, the size of the spray nozzle and the distance between the outer diameter of the spray nozzle and the nozzle itself.

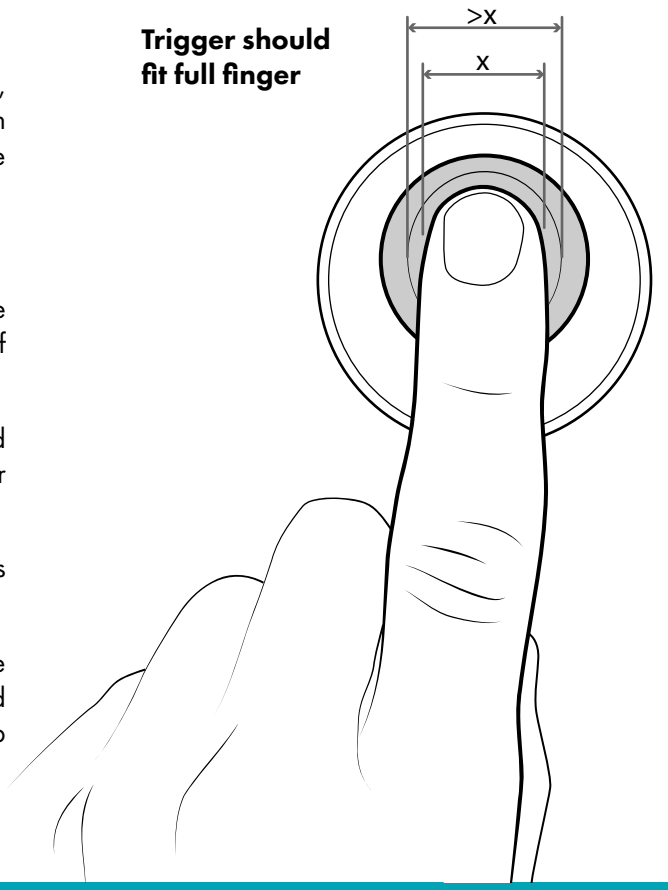
Populations Impacted: Limited strength, limited grip span

Potential Solutions: *Reduce the force required to articulate the nozzle to below 3.0 pounds of force.* The amount of force required to squeeze the nozzle should be below 3.0 pounds throughout the nozzle's range of motion.

Design the nozzle touch point to accommodate the entire width of the index finger. Spreading the force load across the surface area of the fingertip may reduce discomfort due to pressure points created by small diameter nozzles.

Design the nozzle touch point to have a slightly concave surface. A wide, slightly curved surface will allow users to apply a directed force to the nozzle efficiently.

Ensure the nozzle touch point is easily reached. If the distance between the edge of the container and the nozzle touch point is too great, users may be required to hold the container in an awkward position or hyperextend their index finger to reach the touch point. Position the nozzle touch point to be in reach without requiring grip adjustment or hyperextension of the index finger.



1.3 The spray lock is difficult to rotate.

Detailed Description: Some aerosol containers feature a locking mechanism that prevents inadvertent activation of the nozzle. Typically, users must rotate a design element located below the nozzle to a locked or unlocked position. Users may have difficulty identifying the current state of the locking mechanism and applying sufficient force to transition the mechanism from one state to another.

Populations Impacted: Limited strength, limited grip span

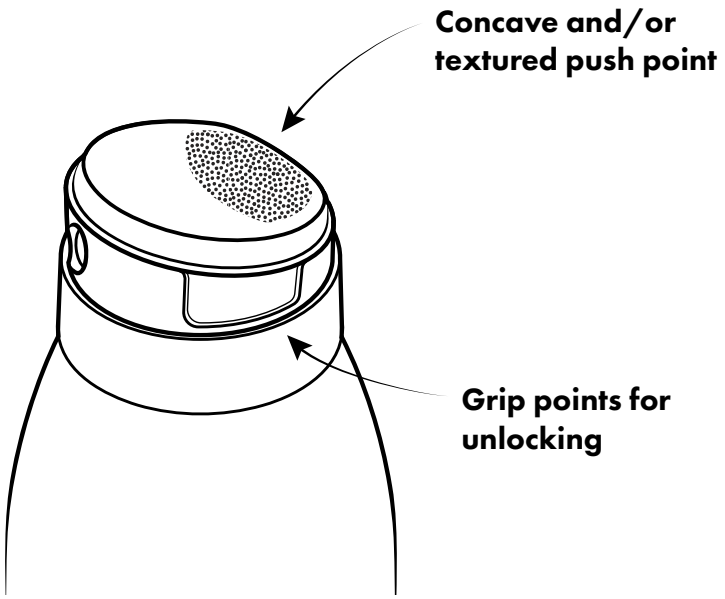
Potential Solutions: *Limit the circumference of the nozzle lock.* Users with arthritis may experience limited strength with excessive grip spans. Some users experience reductions in strength when grip spans exceed 2.5 to 3.0 inches. Limit the circumference of the nozzle lock to avoid excessive grip spans.

Limit the torque required to adjust the nozzle lock. Excessive torque may make it difficult or impossible for users with arthritis to rotate the nozzle lock.

Provide a high coefficient of friction nozzle lock grip. Consider using a high coefficient of friction material at the grasp point of the nozzle lock or using a knurling pattern that maximizes grip.

Provide a clear indication of nozzle lock state transition. Tactile and visual cues should indicate the status of the nozzle lock. The user should be given a clear indication of when the desired nozzle lock position has been achieved. Provide a high coefficient of friction grasp surface.

Ensure the nozzle lock grasp point is easily reached. Ensure there is sufficient space surrounding the nozzle lock to allow the user to grasp the nozzle lock with a key pinch. Design elements directly above or below the nozzle lock can unnecessarily limit how a user might grasp the nozzle lock.



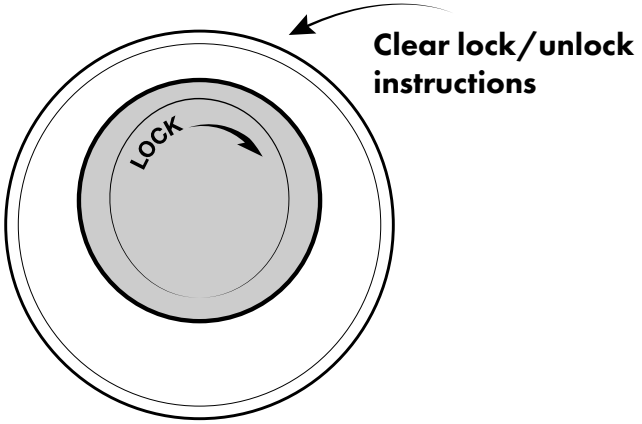
1.4 The spray lock label is difficult to read.

Detailed Description: Graphical or textual labels indicating the presence, current state and direction of travel of the nozzle lock can be difficult to read. Graphical elements or textual labels may be too small or have poor contrast, creating readability issues. Lighting conditions can exacerbate readability issues.

Populations Impacted: Limited vision

Potential Solutions: *Increase the size of critical labels or graphical elements.* Critical information should be sized in a 10-point font or equivalent to accommodate individuals with poor visual acuity.

Increase the visual contrast between the label and the nozzle background. A contrast ratio of at least 10 to 1 would increase the readability of the nozzle label under all lighting conditions.



1.5 The cap is difficult to remove.

Detailed Description: Some aerosol containers feature a cap that covers the top of the container. The cap may be difficult for people with arthritis to grasp and remove.

Populations Impacted: Limited strength, limited grip span

Potential Solutions: *Limit the circumference of the cap.* Users with arthritis may experience limited strength with excessive grip spans. Some users experience reductions in strength when grip spans exceed 2.5 to 3.0 inches. Limit the circumference of the cap to avoid excessive grip spans.

Limit the force required to remove the cap. Excessive force requirements may make it difficult or impossible for a user with arthritis to remove the cap. Limit the amount of force required to remove the cap to 5.0 pounds or less. If the cap requires using a single finger to apply pressure to remove the cap, limit the removal force requirement for the cap to no more than 3.0 pounds.

Provide a high coefficient of friction cap grasp surface. Consider using a high coefficient of friction material at the grasp point of the cap or using a knurling pattern that maximizes grip, without requiring grip adjustment or hyperextension of the index finger.

1.6 Users become fatigued after prolonged operation.

Detailed Description: Some use cases require users to repeatedly activate the spray nozzle within a short amount of time or hold the spray nozzle in the activated position for long durations. Users with arthritis may become fatigued and no longer able to operate the mechanism. If the use case includes repeated activation or long-duration activations, take steps to minimize user fatigue.

Populations Impacted: Limited strength, limited grip span

Potential Solutions: *Reduce the force required to articulate the nozzle to below 3.0 pounds of force.* The amount of force required to squeeze the nozzle should be below 3.0 pounds throughout the nozzle's range of motion.

Design the nozzle touch point to accommodate the entire width of the index finger. Spreading the force load across the surface area of the fingertip may reduce discomfort due to pressure points created by small diameter nozzles.

Design the nozzle touch point to have a slightly concave surface. A wide, slightly curved surface will allow users to apply a directed force to the nozzle efficiently.

Design a nozzle activation lock-assist design element. If the use case includes prolonged nozzle activation, consider adding a design element that allows the user to enter the activated state with a single user action, followed by a separate action to deactivate the nozzle.

1.7 The spray pressure is inappropriate for the use case.

Detailed Description: Some products, such as products designed to mitigate wasps or stinging insect nests, are designed to be applied from a distance. If the spray stream is insufficient, users may need to extend their arm above their shoulders to apply the product. Users with arthritis often are unable to do so or experience significant pain if they are required to extend their reach above shoulder height.

Populations Impacted: *Limited range of motion*

Potential Solutions: *Design the device to be operated without requiring an arm extension above the shoulder.* Users with arthritis may not have the range of motion required to extend their arm above the shoulder. Consider providing an adequate stream pressure that does not require arm extension.

Grip and Weight Issues

2.1 The container is too heavy.

Detailed Description: People with arthritis who experience limited strength or painful finger joints may have difficulty transporting containers that exceed 5.0 pounds for long distances.

Populations Impacted: Limited strength

Potential Solutions: *Reduce weight of the container to below 5.0 pounds.* Users may need to use two hands to utilize and transport containers exceeding 5.0 pounds. If the use case requires the container to be used above shoulder height, limit the weight of the container to below 3.0 pounds.

Design a second grasp point to facilitate a two-handed carry for containers that weigh more than 5.0 pounds. Heavy containers over 5.0 pounds should be designed to be carried using two hands. A grasp point built into the container, in addition to the handle, can be useful when the container needs to be transported as part of the use case.

2.2 The container is uncomfortable to hold while spraying.

Detailed Description: The ability to hold the container in a comfortable position while using the product is critical to overall ease of use. The user may have difficulty comfortably holding a container and applying sufficient pressure to the nozzle to accurately dispense the contents.

Populations Impacted: Limited strength, limited grip, limited range of motion, fatigue

Potential Solutions: *Reduce the weight of the container.* A heavy container may be difficult to hold in position while the container is in use. Consider reducing the container's weight, particularly when the container must be dispensed precisely.

Provide a sufficient grasp point for hand placement. The container should provide an adequate grasp point to prevent container slippage while the container is being carried or held during the dispensing process. Consider providing a high coefficient of friction grasp point requiring no greater than 2.5 to 3.0 inches in grip span when the container is of a larger diameter.

PUMPS

Pumps are a rigid packaging component used to disperse a small, measured amount of the product. They are assembled from dozens of parts. This guide focuses on the components in contact with the user during operation.

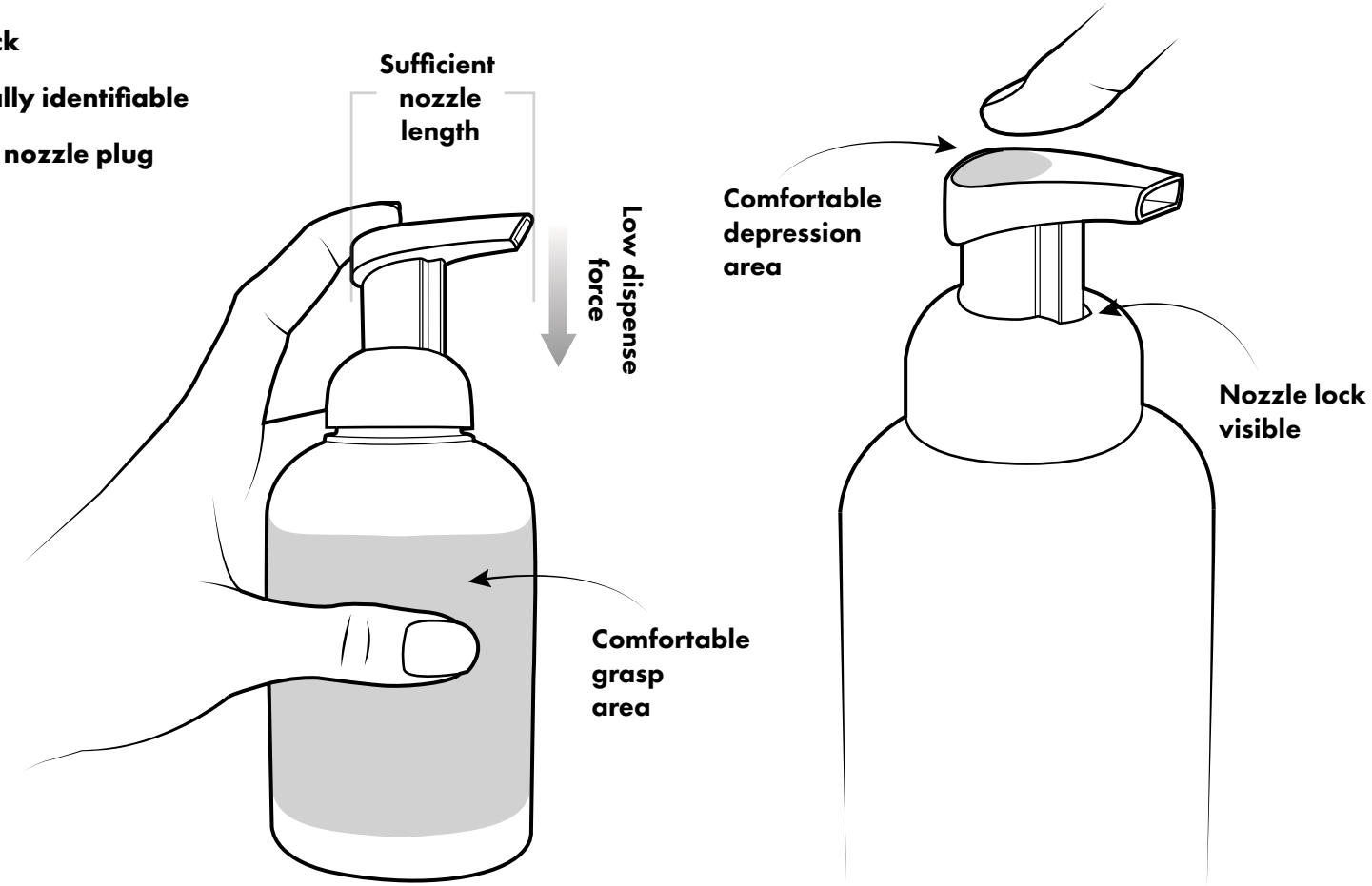
Users press down on the part at the top of the pump, commonly called the "head," using one hand while another hand is used to catch the product. As the head travels down, the pump is activated, dispensing the liquid into the user's open hand.

Examples of Pumps

Optimum Pumps Design Guidelines

Recommendation Highlights

- **Comfortable grasp area**
- **Clear indication of dispense area**
- **Low dispense force**
- **Comfortable pump depression area**
- **Nozzle sufficiently long**
- **Easy to operate nozzle lock**
- **Nozzle lock position visually identifiable**
- **Absent or easy to remove nozzle plug**



PUMP CLOSURE ISSUES

Most pump closures designed to be operated by one hand will be accessible to users with arthritis. Pumps that have excessive activation force requirements, or pumps that utilize nozzle plugs or seals, may be difficult for users with arthritis. Pump nozzles that are too short may be difficult to operate with one hand. Pump nozzles that are small or shaped with sharp edges may be uncomfortable to operate.

1. Pump Operation Issues

1.1. The force required to actuate the pump is too high.

1.2. The nozzle length is too short.

1.3. The pump top surface area is too small.

1.4. The pump bottle is not stable during dispensing.

1.5. Nozzle locks may be difficult to operate.

1.6. Pump nozzle plugs can be difficult to remove (some products may feature pump nozzle plugs that must be removed before usage.)

1.7. The direction of product flow may be difficult to determine.

2. Grip and Weight Issues

2.1. The bottle is too heavy.

Operation Issues

1.1 The force required to fully depress the pump closure may be too high.

Detailed Description: The force required to properly depress the pump closure may exceed the functional capacity of some users with arthritis. A user's ability to apply sufficient force may be influenced by the shape of the pump closure, the surface area of the pump closure and the pump travel distance.

Populations Impacted: Limited strength, limited grip span

Potential Solutions: *Reduce the force required to articulate the pump closure to below 3.0 pounds of force.* The amount of force required to depress the pump closure should be below 3.0 pounds throughout the pump closure's range of motion.

Design with a sufficient surface area to be easily depressed by the palm of the hand. The pump closure should be designed to allow users to operate the pump closure with the palm of the hand. Users with arthritis may find applying a downward force using the palm of their hands easier than using individual fingers.

Design the pump shaft to allow smooth operation, even if some force is applied at an angle that is not directly aligned with the shaft. Poorly designed pump shafts may bind with the shaft wall if the application force is not directly in line with the direction of the shaft. Bound pump shafts may be exceedingly difficult to operate and cause pain for users with arthritis.

1.2 The nozzle length is too short.

Detailed Description: Users with arthritis will find it easier to rest the pump container on a stable surface while actuating the pump with the palm or fingers. The design of the nozzle should accommodate either a two-handed operation, where one hand is used to actuate the pump and the other hand is used to capture the dispense, or a single-handed operation, where the figures are curled under the pump nozzle during the dispense operation.

Populations Impacted: Limited strength, limited grip span

Potential Solutions: *Provide a nozzle length that facilitates the accurate dispensing of the product.* The length of the nozzle should allow for either a single-handed or two-handed operation. The nozzle should be long enough to dispense the product without spillage.

Adjust the velocity of the liquid being dispensed. Users with arthritis may have difficulty regulating the amount of force applied to the top surface of the pump. Regulate the dispensed velocity to minimize spillage.

1.3 The pump top surface area is too small.

Detailed Description: Pump nozzles with small top surface areas may be uncomfortable to depress. Larger surface areas spread the amount of force across a larger surface area of the hand or fingertips.

Populations Impacted: Limited strength, limited grip span

Potential Solutions: *Provide a large surface area for depressing the nozzle.* The nozzle surface area should accommodate at least a two-finger press. Larger surface areas enable a stable press using the palm as well.

Reduce the force required to articulate the pump closure to below 3.0 pounds of force. The amount of force required to depress the pump closure should be below 3.0 pounds throughout the pump closure's range of motion.

1.4 The pump bottle is not stable during dispensing.

Detailed Description: Users with arthritis will find it easier to rest the pump container on a stable surface while actuating the pump with the palm or fingers. The base of the container should be designed to be stable during a dispense operation.

Populations Impacted: Limited strength, limited grip span

Potential Solutions: *Provide a large base surface area.* The base on the container should be large enough to remain stable during the dispense operation when placed on a flat surface.

Provide a base with a high coefficient of friction. A base with a rubberized coating can increase bottle stability during dispensing.

Reduce the force required to articulate the pump closure to below 3.0 pounds of force. The amount of force required to depress the pump closure should be below 3.0 pounds throughout the pump closure's range of motion. Higher forces increase the likelihood of the container becoming unstable.

Lower the center of gravity. A container with a lower center of gravity will be more stable as compared to a top-heavy container.

1.5 Nozzle locks may be difficult to operate.

Detailed Description: Users with arthritis will find it easier to rest the pump container on a stable surface while actuating the pump with the palm or fingers. The base of the container should be designed to be stable during a dispense operation.

Populations Impacted: Limited strength, limited grip span, limited vision

Potential Solutions: *Minimize the amount of force required to operate the nozzle lock.* The amount of force required to operate the nozzle lock should be below 3.0 pounds for both opening and closing the nozzle lock.

Provide high-contrast labels and instructions. Embossed labels and instructions are difficult to read. Consider providing high-contrast labels and instructions for operating the nozzle lock.

Provide large labels and instructions. Small labels and instructions are difficult to read. Consider providing large font labels and large graphical instructions for operating the nozzle lock.

Provide a clear indication of nozzle lock status. Users should be able to discern the state of the nozzle lock visually. Consider providing an indication of the state of the nozzle on or around the nozzle.

1.6 Pump nozzle plugs can be difficult to remove.

Detailed Description: Some pump nozzles feature a plug that must be removed prior to use. The plug is used to prevent leakage during shipment. Users may have difficulty locating and removing the nozzle plug.

Populations Impacted: Limited strength, limited grip span, limited vision

Potential Solutions: *Provide directions on how to remove the nozzle plug directly on the device.* If the packaging requires a nozzle plug, consider adding instructions for removing the plug directly on the device.

Visually highlight the nozzle plug. Some plugs are small and made of translucent plastic, making them difficult to locate. Consider visually highlighting the nozzle plug so that it is easily located.

Provide a sufficient grip surface for removal of the nozzle plug. Consider attaching a pull tab or extending the plug away from the nozzle so that it can easily be grasped using a key pinch.

Minimize the amount of force required to remove the nozzle plug. Reduce the amount of force required to remove the nozzle plug to below 3.0 pounds of force.

1.7 The direction of product flow may be difficult to determine.

Detailed Description: Some pump nozzles feature a symmetrical design, making it difficult to determine the direction of product flow upon actuation. Pump nozzles should be shaped so that the direction of product flow is clearly indicated to avoid dispensing errors.

Populations Impacted: Limited vision

Potential Solutions: *Clearly indicate the direction of product flow.* Consider shaping the pump nozzle to clearly indicate the direction of product flow. A narrow extension in the direction of product flow, terminating in a visible opening, can be a good indication of product flow. Arrows or other visual indicators can be used to reduce ambiguity.

Grip and Weight Issues

2.1 The pump container is too heavy.

Detailed Description: Containers over 3.0 pounds may be difficult to transport or hold in a use position over extended periods.

Populations Impacted: Limited strength, limited range of motion, limited grip, fatigue

Potential Solutions: *Reduce the weight of the container.* A heavy container may be difficult to transport or hold in position while the bottle is in use. Consider reducing the bottle's weight, particularly when it is expected to be used for a longer-duration task.

TRIGGER SPRAYERS

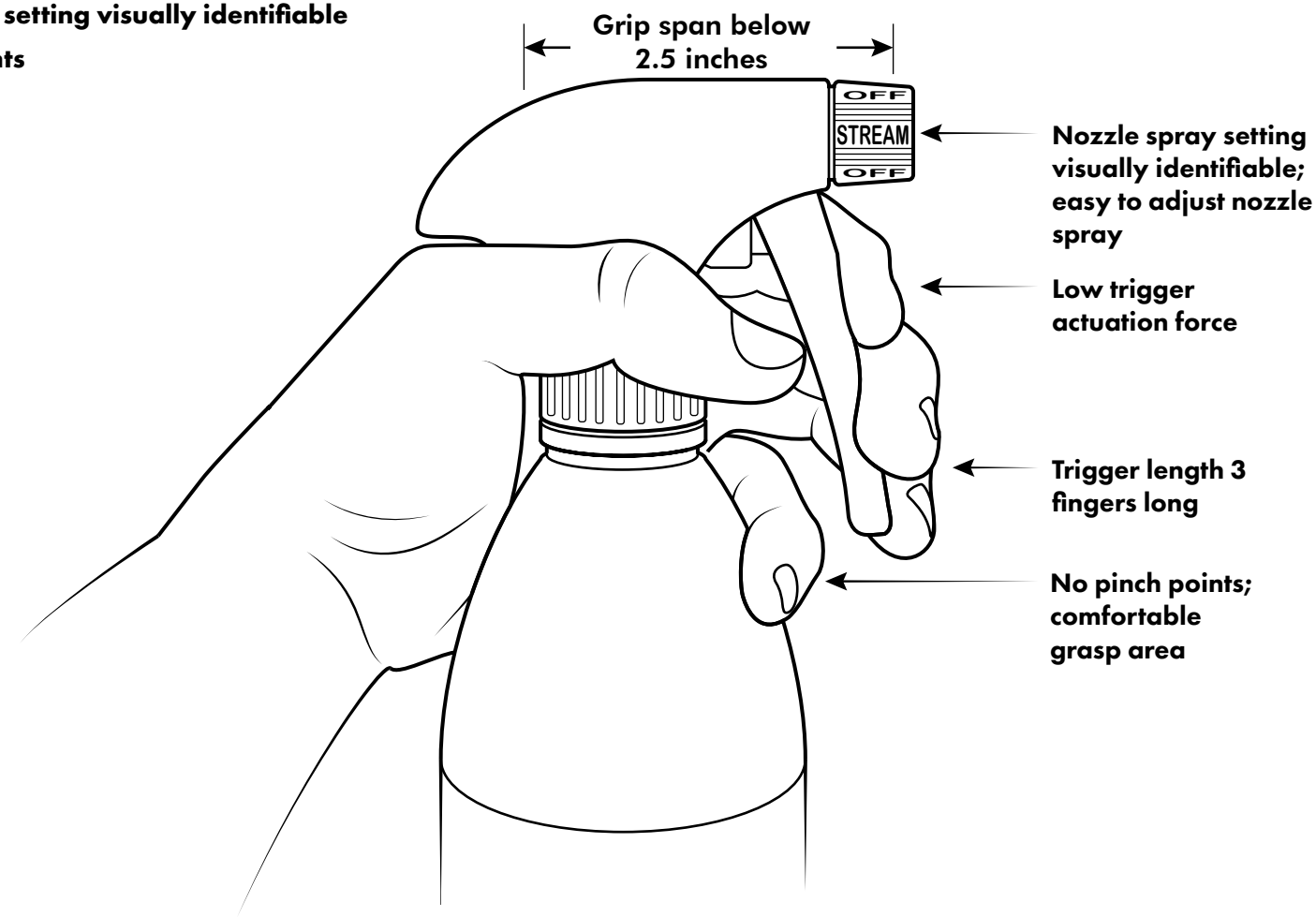
Trigger sprayers are a component of rigid packaging, used to dispense a liquid product. They are made from an assembly of approximately a dozen parts. This guide focuses on the components in contact with the user while operating a trigger sprayer.

Examples of Trigger Sprayers

Optimum Trigger Sprayer Design Guidelines

Recommendation Highlights

- **Comfortable grasp area**
- **Grip span below 2.5 inches**
- **Trigger length 3 fingers long**
- **Low trigger actuation force**
- **Easy to adjust nozzle spray**
- **Easy to operate nozzle lock**
- **Nozzle spray setting visually identifiable**
- **No pinch points**



TRIGGER SPRAYER ISSUES

Most issues are derived from three tasks: the trigger operation, the nozzle operation and grip and weight factors. Below is a summary of the common issues with each task. The following pages have detailed descriptions, population impact considerations and potential solutions for each issue.

1. Trigger Sprayer Operation Issues

1.1. The force required to actuate the spray trigger is too high.

1.2. The shape of the spray trigger is uncomfortable.

1.3. The length of the spray trigger is too short.

1.4. The spray trigger requires excessive grip span.

1.5. Trigger creates a pinch point.

1.6. Users may become fatigued or experience pain after extended operation of the spray trigger.

1.7 The stream pressure is inappropriate for the use case.

2. Nozzle Operation Issues

2.1. The adjustable nozzle is difficult to turn.

2.2. The labels on the nozzle are difficult to read.

3. Grip and Weight Issues

3.1. The spray bottle is not comfortable to hold.

3.2. Operation places the wrist in an uncomfortable position.

3.3. The spray bottle is too heavy.

3.4.Spray bottle is not operable from either hand.

Operation Issues

1.1 The force required to fully actuate the spray trigger may be too high.

Detailed Description: The force required to properly squeeze the spray trigger may exceed the functional capacity of some users with arthritis. A user's ability to apply sufficient force may be influenced by the shape of the trigger, the length of the trigger, the distance between the neck and the trigger and the profile of the force required as a function of trigger position. For example, some devices may require additional force at the beginning of the trigger squeeze, as opposed to the force required to squeeze the trigger at the midpoint position. Users with limited grip span will have much less strength at the beginning of the trigger squeeze.

Populations Impacted: Limited strength, limited grip span

Potential Solutions: *Reduce the force required to articulate the trigger to below 3.0 pounds of force.* The amount of force required to squeeze the trigger should be below 3.0 pounds throughout the trigger's range of motion.

Design the trigger to accommodate at least three fingers. Longer triggers allow the users to apply additional muscle groups to the actuation of the trigger. Some forms of degenerative arthritis may impact the commonly used joints in the middle and index fingers disproportionately. Spreading the load across three fingers can reduce the pressure on impacted joints.

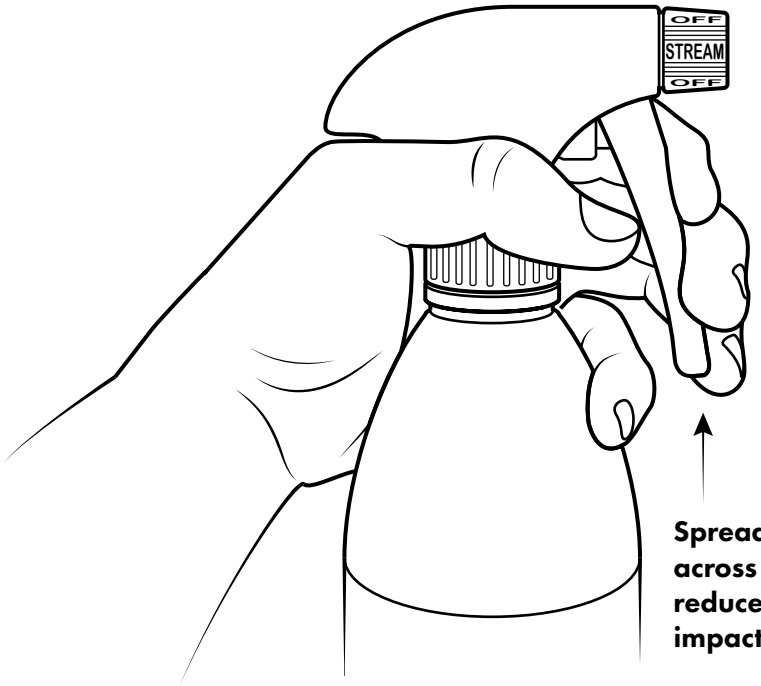
Limit distance between the back of the neck and the initial placement of the trigger. Users with arthritis may experience limited strength with excessive grip spans. Some users experience reductions in strength when grip spans exceed 2.5 to 3.0 inches.

1.2 The shape of the spray trigger is uncomfortable.

Detailed Description: The shape of the trigger can cause excessive pressure across painful finger joints. Users may experience significant pain before sufficient force is applied to acuate the trigger. Rounded triggers, or triggers with sharp edges, are particularly problematic.

Populations Impacted: Limited strength

Potential Solutions: *Design the trigger to reduce pressure points.* Rounded triggers, or triggers with sharp edges, may cause increased pressure across painful finger joints. Design the trigger to spread the load to the fingers across a wide area. Use flat surfaces or surfaces that conform to a slightly curved finger grasp in the neutral grip posture.



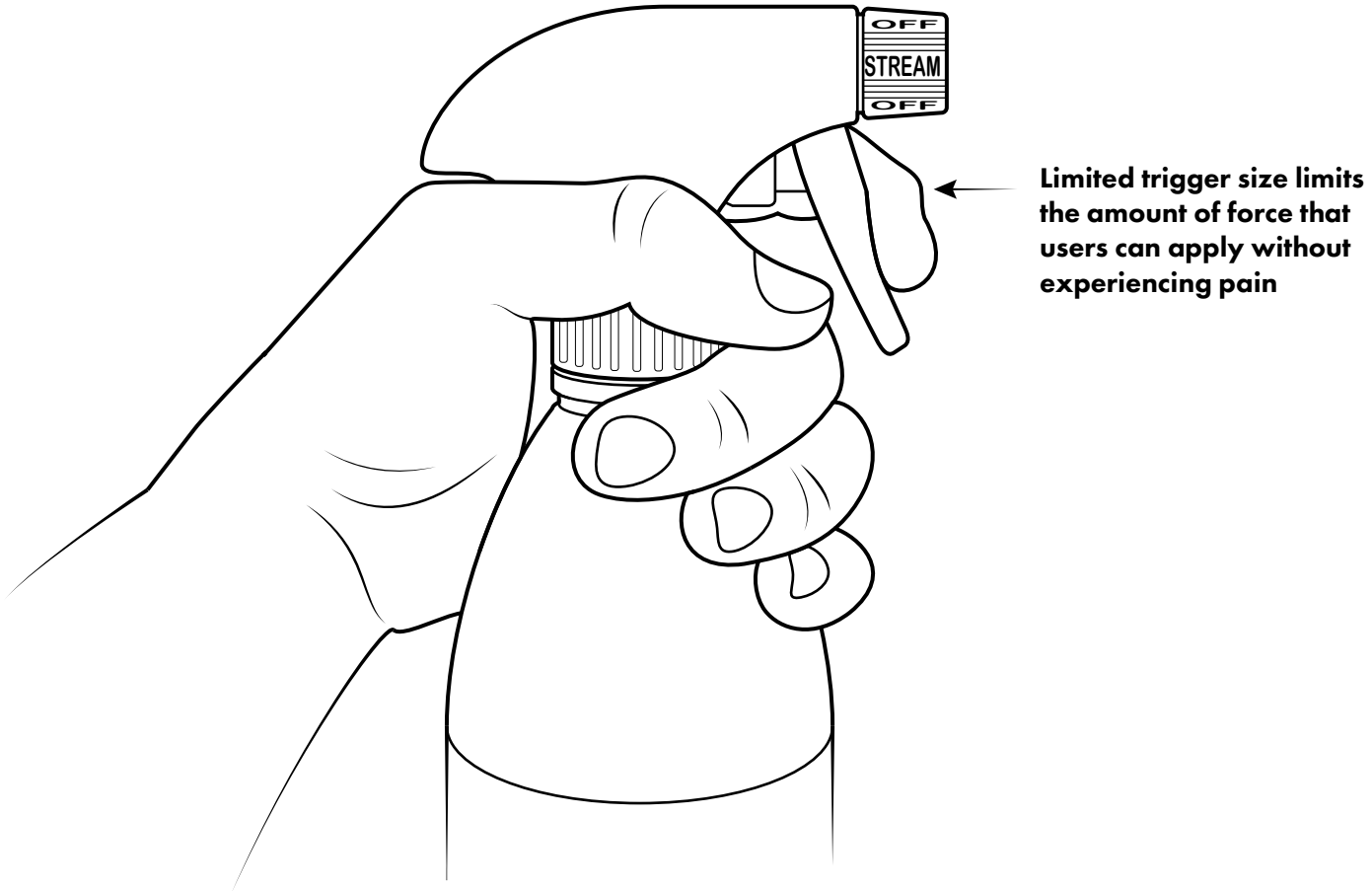
Spreading the load across three fingers can reduce the pressure on impacted joints

1.3 The length of the spray trigger is too short.

Detailed Description: Users with arthritis are more likely to experience symptoms of arthritis in the index and middle fingers. Some triggers are sized such that only one or two fingers can comfortably be applied to the trigger. Limited trigger size may severely limit the amount of force that users can apply to the trigger without experiencing pain.

Populations Impacted: Limited strength, limited grip span, fatigue

Potential Solutions: *Design the trigger to accommodate at least three fingers.* Longer triggers allow the users to apply additional muscle groups to the actuation of the trigger. Some forms of degenerative arthritis may impact the commonly used joints in the middle and index fingers disproportionately. Spreading the load across three fingers can reduce the pressure on impacted joints.



1.4 The spray trigger requires excessive grip span.

Detailed Description: The grip strength of someone with moderate to severe arthritis in their hands is increasingly diminished after the grip span exceeds 2.5 to 3.0 inches. If the distance between the back of the neck and the front of the trigger exceeds the recommended grip span, the user may not be able to apply sufficient force to the trigger. In severe cases, some users may not be able to extend their fingers adequately to grasp the trigger.

Populations Impacted: Limited reach, limited strength

Potential Solutions: *Reduce the force required to articulate the trigger to below 3.0 pounds of force.* The amount of force required to squeeze the trigger should be below 3.0 pounds throughout the trigger's range of motion.

Limit the required trigger grip span. Users should not be required to use a grip span exceeding 2.5 to 3.0 inches to grasp the spray trigger. Adjust the trigger range of motion or the neck indentation to reduce the grip span accordingly.

1.5 Trigger creates a pinch point.

Detailed Description: Users may accidentally trap a finger beneath the trigger. Squeezing the trigger with a finger underneath the trigger may cause pain or damage to finger joints with arthritis.

Populations Impacted: Limited fine motor control

Potential Solutions: *Design the trigger to accommodate at least three fingers.* Longer triggers allow the users to apply additional muscle groups to the actuation of the trigger. Some forms of degenerative arthritis may impact the commonly used joints in the middle and index fingers disproportionately. Spreading the load across three fingers can reduce the pressure on impacted joints. Longer triggers reduce the possibility of trapping a finger under the trigger when the trigger is squeezed.

Design the nozzle to prevent inadvertent dispensing. Design the nozzle aperture to precisely dispense the product with a slight squeeze. Products that dispense without force being applied can be difficult to control.

Limit the required grip span. Users should not be required to use a grip span exceeding 2.5 to 3.0 inches to grasp the container while dispensing.

1.6 Users may become fatigued or experience pain after extended operation of the spray trigger.

Detailed Description: Extended use of a spray trigger can cause pain or fatigue. The pain may be experienced immediately or result in increased sensitivity or reduced range of motion the next day.

Populations Impacted: Limited strength, limited range of motion, fatigue

Potential Solutions: *Reduce the force required to articulate the trigger to below 3.0 pounds of force.* The amount of force required to squeeze the trigger should be below 3.0 pounds throughout the trigger's range of motion.

Design the trigger to accommodate at least three fingers. Longer triggers allow the users to apply additional muscle groups to the actuation of the trigger. Some forms of degenerative arthritis may impact the commonly used joints in the middle and index fingers disproportionately. Spreading the load across three fingers can reduce the pressure on impacted joints.

Automate the spray trigger. Adding a battery-operated mechanism to control the spray would reduce repetitive motions that might be problematic for people with arthritis.

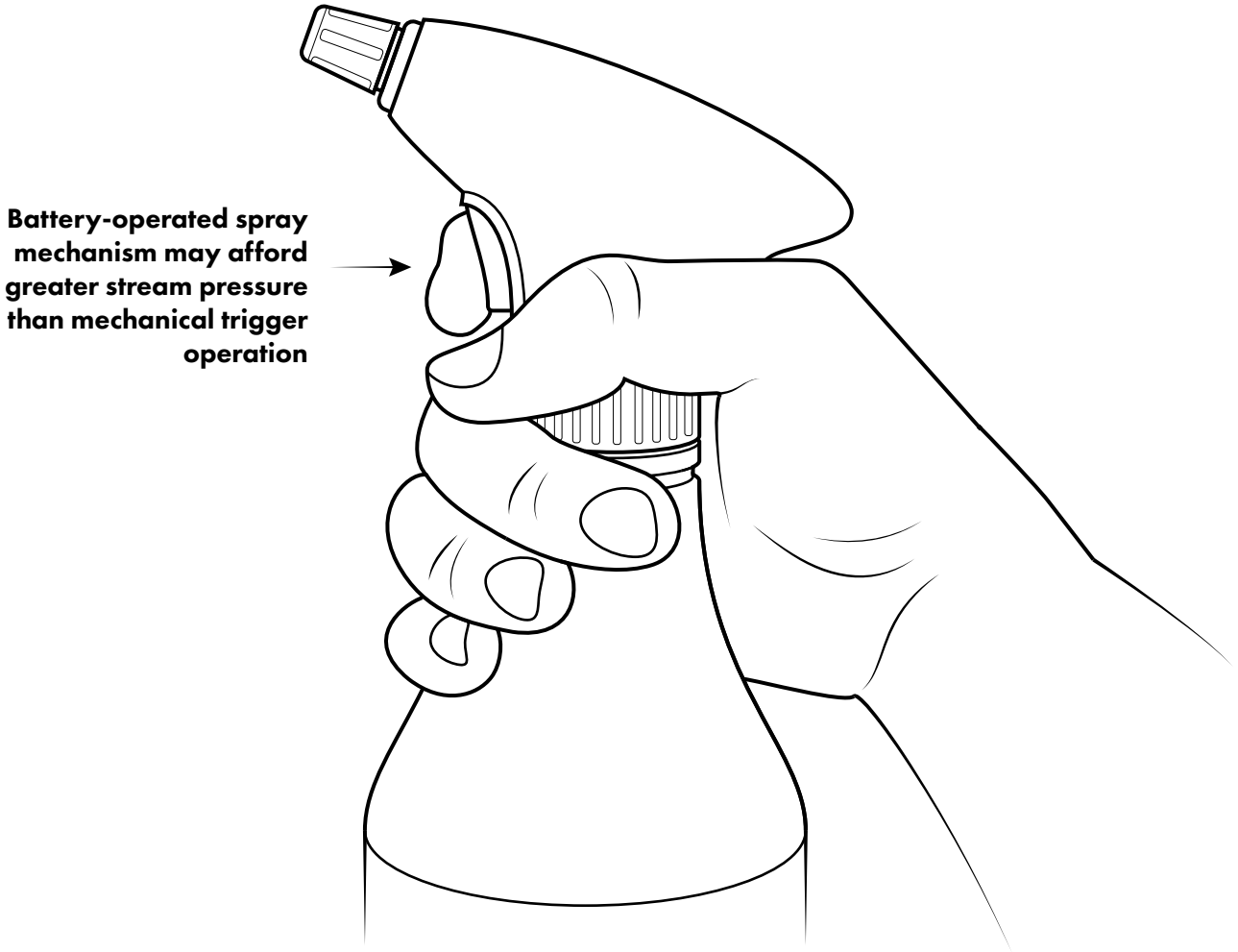
1.7 The stream pressure is inappropriate for the use case.

Detailed Description: Some products, such as products designed to mitigate wasps or stinging insect nests, are designed to be applied from a distance. If the spray stream is insufficient, users may need to extend their arm above their shoulders to apply the product. Users with arthritis often are unable to do so, or experience significant pain, if they are required to extend their reach above shoulder height.

Populations Impacted: Limited range of motion

Potential Solutions: *Design the device to be operated without requiring an arm extension above the shoulder.* Users with arthritis may not have the range of motion required to extend their arm above the shoulder. Consider providing an adequate stream pressure that does not require arm extension.

Automate the spray trigger. Adding a battery-operated mechanism to control the spray would reduce repetitive motions that might be problematic for people with arthritis. Use of a battery-operated spray mechanism may afford greater stream pressure than could be afforded by mechanical trigger operation.



Grip and Weight Issues

2.1 The adjustable nozzle is difficult to turn.

Detailed Description: The adjustable nozzle can be difficult to turn because of the small grasp point and the amount of torque required to rotate the nozzle into the desired position.

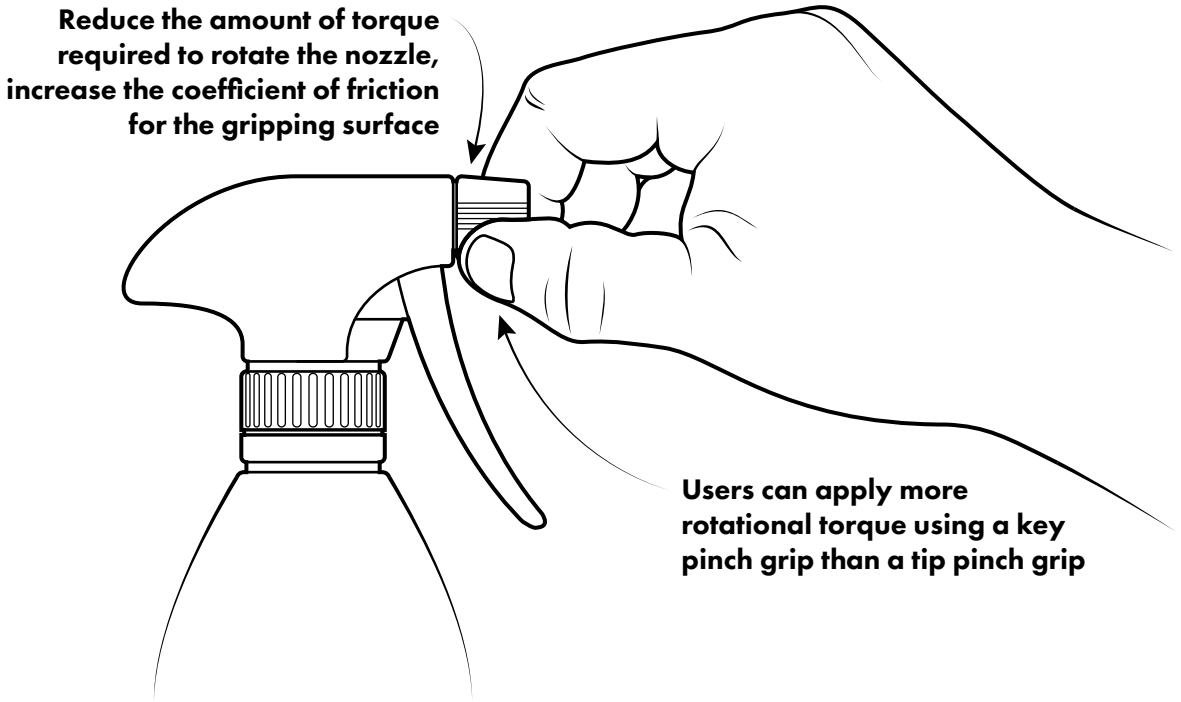
Populations Impacted: Limited strength, limited fine motor control, limited grip

Potential Solutions: *Reduce the amount of torque required to rotate the nozzle.* The amount of torque required to rotate the nozzle may exceed the functional capabilities of some users with arthritis. The problem is exacerbated when the nozzle has a small diameter and low coefficient of friction.

Increase the coefficient of friction of the nozzle. Users with limited pinch strength may have difficulty applying sufficient pressure against the nozzle to facilitate nozzle rotation. Nozzles that tend to slip in the user's grip are particularly problematic. Consider using a non-slip material or a non-slip knurling pattern to enhance the user's ability to grip the nozzle during rotation.

Avoid rounded nozzles. Rounded nozzles are more likely to slip while the user is rotating the nozzle. Consider using a squared nozzle or a nozzle with an asymmetric shape to facilitate grasping.

Increase the size of the nozzle. Larger nozzles are easier to grip. In general, users can apply more rotational torque using a key pinch grip than a tip pinch grip. Larger nozzles that can be grasped between the thumb and side of the index finger during rotation will be easier to rotate than nozzles that require the user to use the pads of the thumb and index fingers.



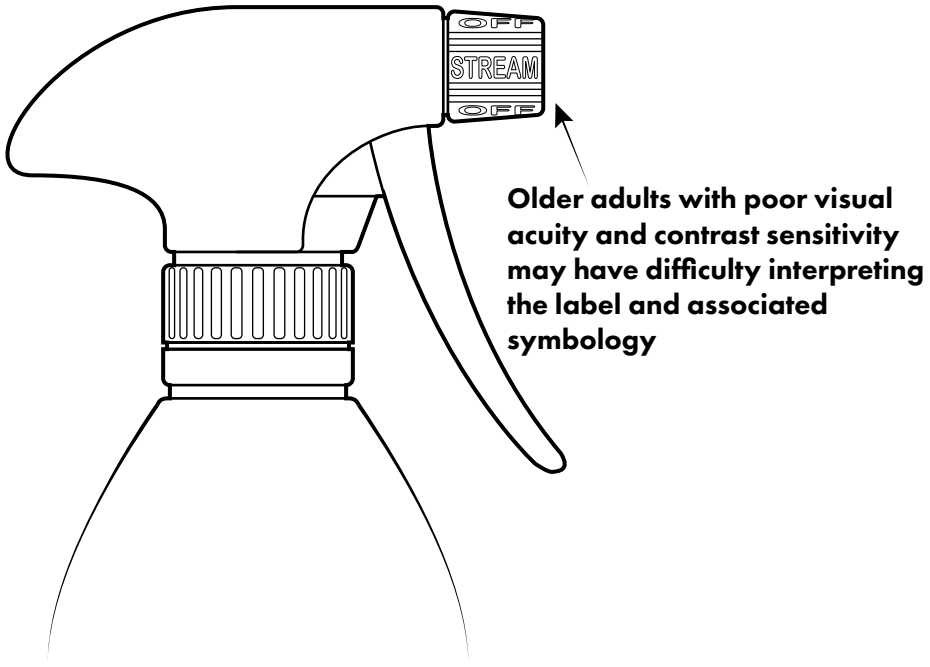
2.2 The labels on the nozzle are difficult to read.

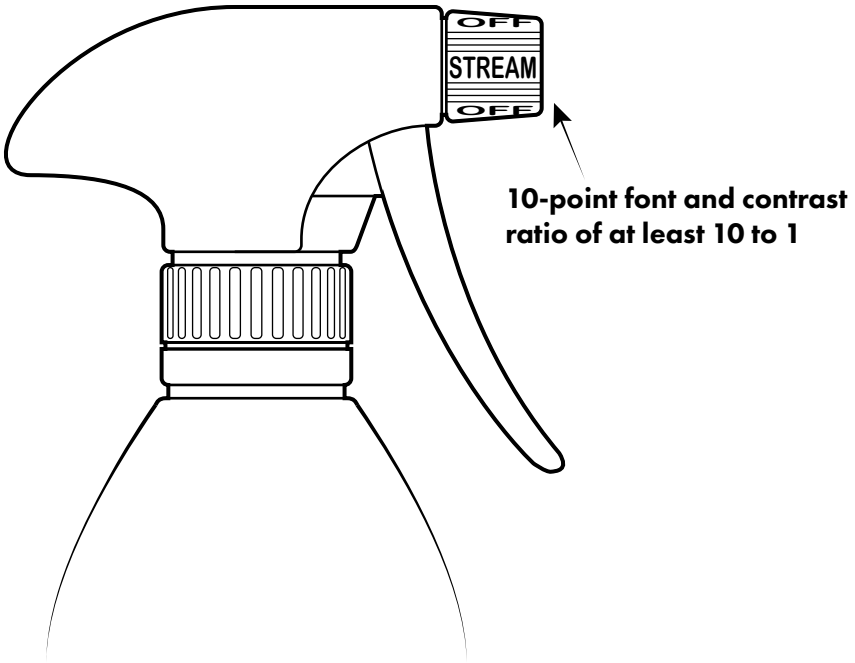
Detailed Description: Often, labels found on nozzles indicating the nozzle position are embossed and have poor contrast. Some labels may be too small. Older adults with poor visual acuity and contrast sensitivity may have difficulty interpreting the label and associated symbology. The problem may be made worse under poor lighting conditions.

Populations Impacted: Limited vision

Potential Solutions: *Increase the size of critical labels or graphical elements.* Critical information should be sized in a 10-point font or equivalent to accommodate individuals with poor visual acuity.

Increase the size of the contrast between the label and the nozzle background. A contrast ratio of at least 10 to 1 would increase the readability of the nozzle label under all lighting conditions.





Grip and Weight Issues

3.1 The spray bottle is not comfortable to hold.

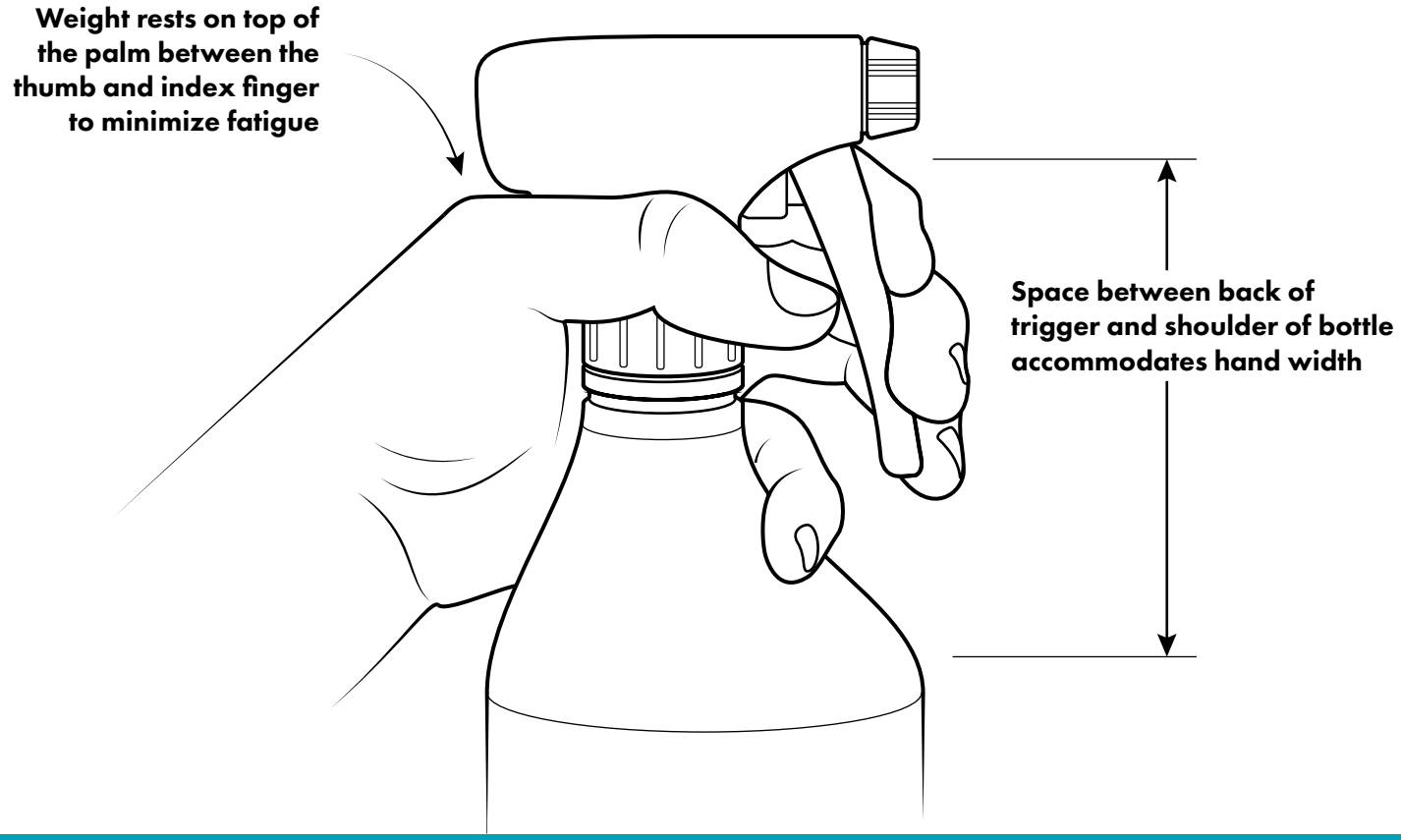
Detailed Description: The ability to hold the bottle in a comfortable position while transporting or using the product is critical to overall ease of use. Some bottles force the wrist into an uncomfortable position due to the geometry of the intended grasp point. Heavy bottles may be too heavy for extended use and can become more uncomfortable over time.

Populations Impacted: Limited strength, limited grip, limited range of motion, fatigue

Potential Solutions: *Reduce the weight of the bottle.* A heavy bottle may be difficult to hold in position while the bottle is in use. Consider reducing the bottle's weight, particularly when it is expected to be used for a longer-duration task.

Provide sufficient neck space for hand placement. The space between the bottom of the back of the trigger and the top of the bottle should be wide enough to accommodate a hand width. Ideally, the design of the bottle should accommodate a neutral wrist posture while holding the product.

Provide a space above the neck for resting the head of the trigger on the hand. The back of the trigger should overlap the hand when the bottle is grasped for usage. A significant component of the bottle's weight should rest on the top of the palm between the thumb and index finger to minimize fatigue.

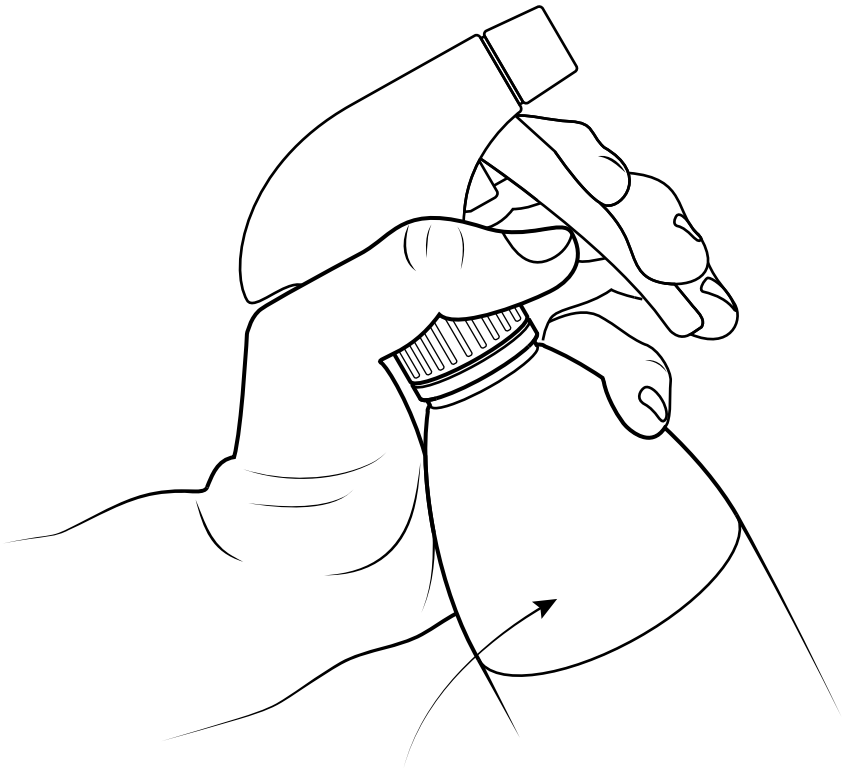


3.2 Operation places the wrist in an uncomfortable position.

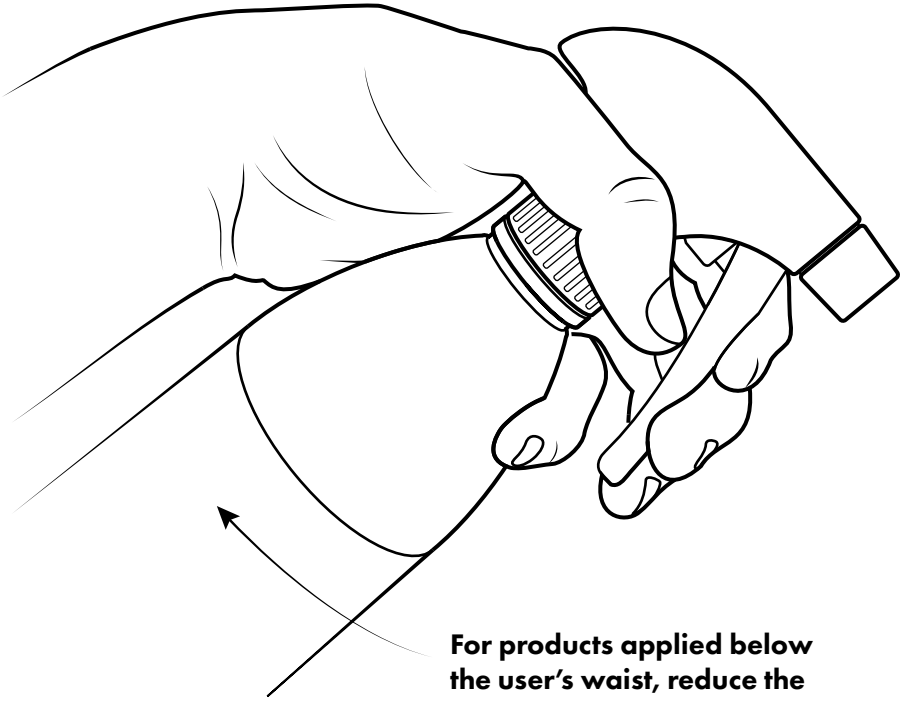
Detailed Description: Products designed to be applied to a surface above the user's shoulders or below the user's waist can cause the user to hold the device in an uncomfortable position. The weight of the bottle can put stress on the wrist joint when the wrist is moved out of the neutral position.

Populations Impacted: Limited range of motion

Potential Solutions: *Reduce the weight of the bottle.* A heavy bottle may be difficult to hold in position while the bottle is in use. Consider reducing the bottle's weight, particularly when it is expected to be used for a longer-duration task.



For products applied above the user's shoulders, reduce the bottle's weight



For products applied below the user's waist, reduce the bottle's weight

3.3 The spray bottle is too heavy.

Detailed Description: Bottles over 3.0 pounds may be difficult to hold in a use position over extended periods. Heavy bottles can be impossible to use if the use case requires the user to hold the bottle above shoulder height.

Populations Impacted: Limited strength, limited range of motion, limited grip, fatigue

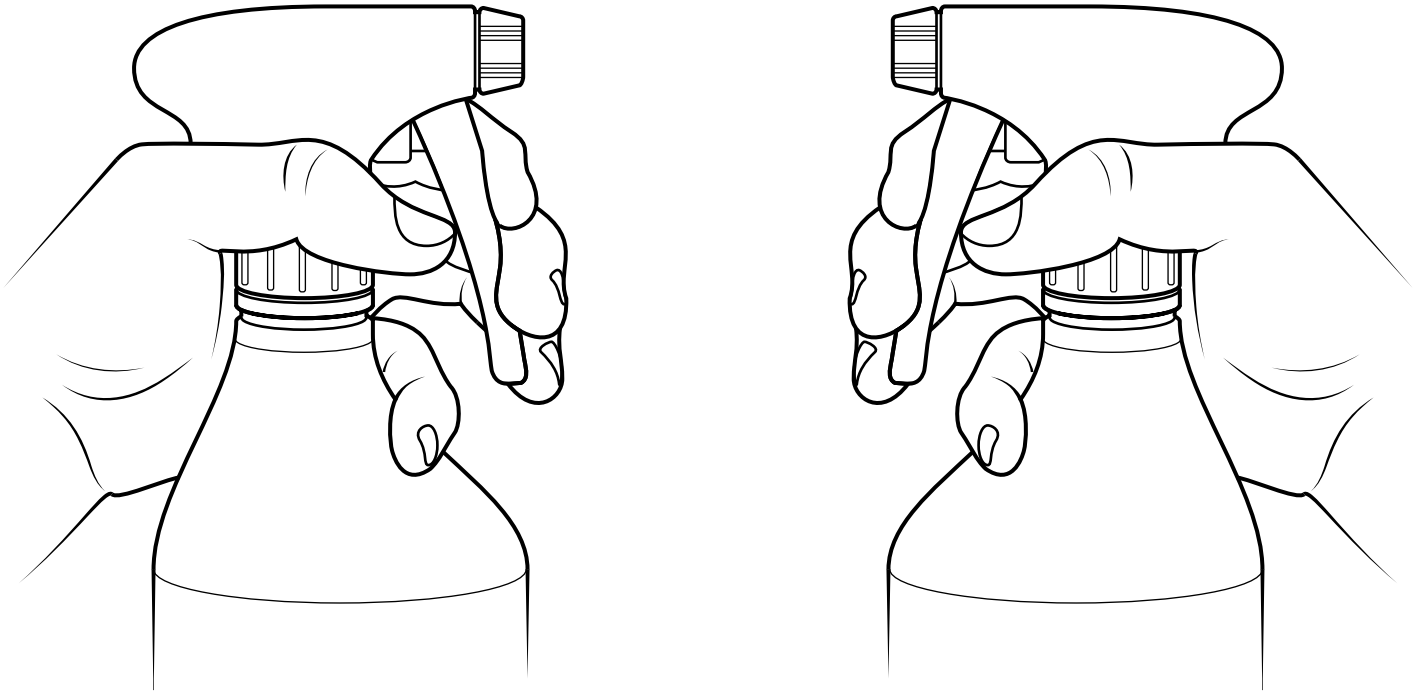
Potential Solutions: *Reduce the weight of the bottle.* A heavy bottle may be difficult to hold in position while the bottle is in use. Consider reducing the bottle's weight, particularly when it is expected to be used for a longer-duration task.

3.4 Spray bottle is not operable from either hand.

Detailed Description: In many cases, arthritis may present asymmetrically. Users with an arthritis flare-up (a period of time with a sudden increase in their joint pain) may need to use their non-dominant hand to operate the squeeze trigger. Fatigue may cause users to switch hands as needed for comfort. Transient symptoms may cause users to switch hands if a flare-up causes temporary pain. The spray trigger's design should accommodate the use of either the right or left hand equally.

Populations Impacted: Limited strength, fatigue

Potential Solutions: *Design the spray trigger to be operated by either hand.* The device should be operable from either hand without requiring adjustments or reconfigurations. Users should be able to freely switch between hands during usage.



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Contributors

Intuitive Design Applied Research Institute

Dr. Brad Fain, Intuitive Design Applied Research Institute founder and Georgia Tech Regents' Researcher

Target Corporation

Michael Habig, Senior Designer

Jasmine Kent, Designer

Mark Kuhn, Senior Business Partner

Ryan McCoy, Director Packaging Design & Innovation

Nicholas Resop, Senior Packaging Specialist

Arthritis Foundation

Deborah Gokie, Vice President Consumer Health & Ease of Use

Kelley Graham, Senior Director of Content, Creative & Brand

Anthony Williams, Senior Writer & Editor

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