



DISTRIBUTION CENTERS USING EXOSKELETONS CUT TOTAL STRAIN AND SPRAIN INJURY RATE BY 62%

New industry-first, longitudinal study found **total strain and sprain injuries were reduced** when case-picking workers across five sites wore back exosuits.


HEROWEAR

Exoskeletons have evolved from experimental prototypes to routine frontline safety tools in warehouses and distribution centers. As the adoption of wearable safety technology accelerates, longitudinal data continues to grow, and logistics leaders are ranking exoskeletons among the top priority technologies in 2025, the conversation has shifted.¹

The question around the technology is no longer whether exoskeletons help, but rather where companies should deploy them, and how specifically they impact long-term worker health and well-being.

FIRST LONGITUDINAL STUDY SHOWING MEANINGFUL REDUCTION IN TOTAL INJURY RATE AND NO EVIDENCE OF RISK TRANSFERRED TO OTHER BODY PARTS.

Converging evidence from academic studies and industry trials has proven that exos—*including rigid exoskeletons and soft exosuits*—reduce back strain and injury risk during repetitive bending and lifting work. However, one pressing concern has lingered: ***Does protecting a worker's back with an exo shift the injury risk to other joints or muscle groups?***

This uncertainty about potential unintended consequences has been a barrier to exo adoption for some organizations and safety professionals, underscoring the need for rigorous, real-world evidence. For the first time, a large-scale, real-world study on an elastic back exosuit provides compelling evidence that injury risk was not transferred to other body parts and instead showed meaningful reductions in back injuries alongside no corresponding rise in injuries elsewhere.

¹ dhl-freight-connections.com/en/trends/dhl-logistics-trend-radar-echo/



WHAT MAJOR PAIN POINTS ARE DRIVING DISTRIBUTION CENTERS TO LOOK FOR NEW WAYS TO SUPPORT WORKERS?

Across warehouses and distribution centers, workers lift and carry tens of thousands of pounds of goods each day. These are labor-intensive, difficult jobs. **Injuries and fatigue are often a resulting, painful problem that hurts workers and the bottom line.** Back and other overexertion injuries are one of industry's most costly and persistent problems—costing U.S. businesses over \$13.7 billion a year.²

Worker turnover due to physical job demands is also a common and significant problem. **The average worker turnover rate in warehousing is roughly 50%, with some facilities experiencing 150% per year,** with recruitment and training of each new worker costing thousands of dollars.³ Lost productivity and overtime costs further exacerbate this problem, as does the worsening labor

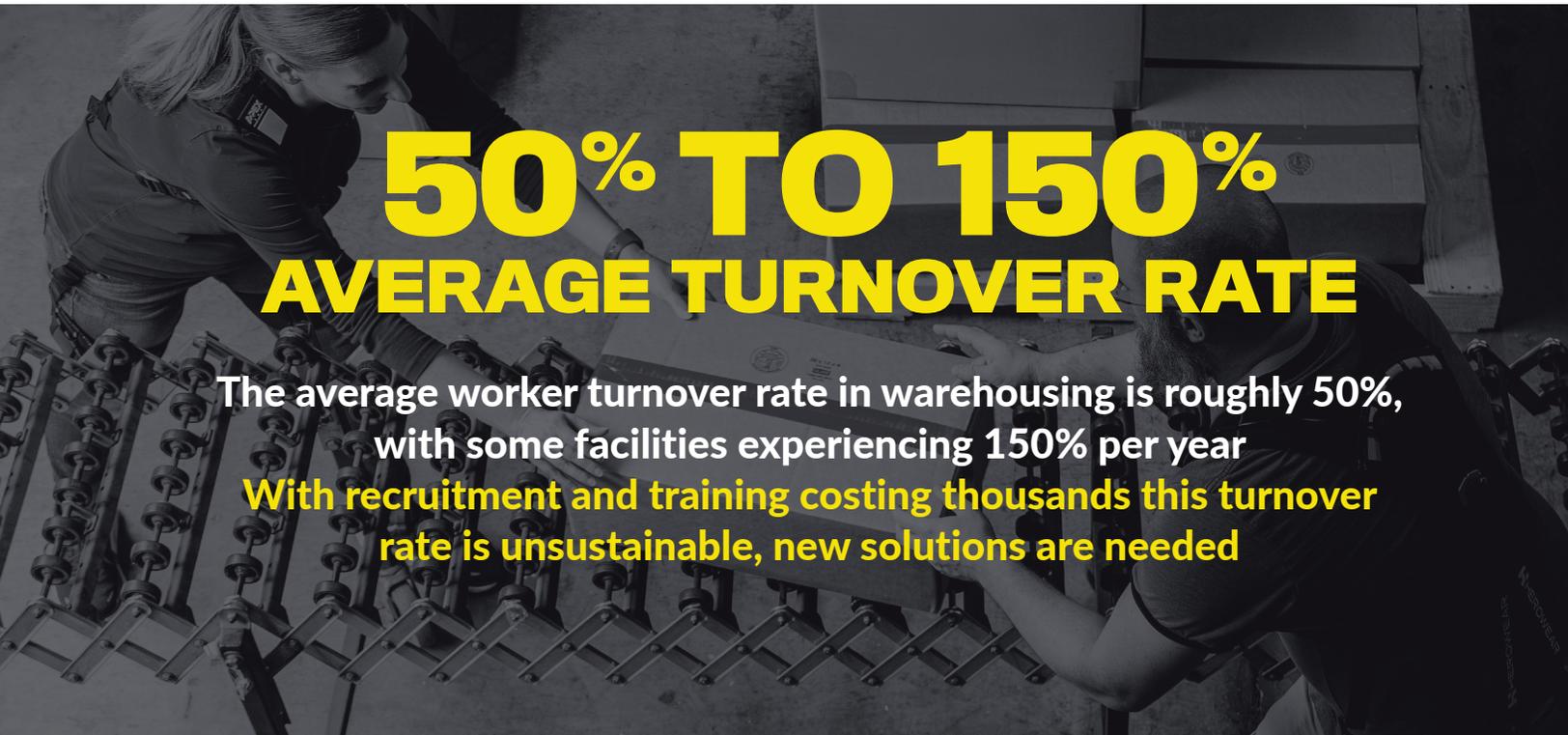
shortage.⁴ **This highlights why many logistics operations are actively searching for new solutions to support the health and well-being of their workers who perform manual material handling.**

Many of these companies already have robust safety programs, are using ergonomic best practices, training their warehouse workers, and following the hierarchy of controls. These warehousing teams have typically implemented a variety of traditional ergonomic controls—from redesigning workstations to installing mechanical lifts and administrative controls to automating portions of their operations. However, despite these advances, these organizations recognize that some manual and labor-intensive tasks with ergonomic risks are here to stay for the foreseeable future.

² business.libertymutual.com/workplace-safety-index/

³ kpisolutions.com/warehouse-turnover-hurts-more-than-you-think/

⁴ ohsonline.com/articles/2025/10/03/how-wearable--technology-is-helping-mitigate-the-skilled-labor-shortage.aspx



50% TO 150%
AVERAGE TURNOVER RATE

The average worker turnover rate in warehousing is roughly 50%, with some facilities experiencing 150% per year
With recruitment and training costing thousands this turnover rate is unsustainable, new solutions are needed

WHAT MOTIVATED THE DISTRIBUTION CENTERS IN THIS CASE STUDY TO EXPLORE EXOS?

Five distribution centers in the U.S. are included in this case study. They each have a track-record of workplace safety improvements and chose to expand their ergonomics programs by deploying back exosuits to further reduce worker injury risks and improve their quality of life. These logistics facilities spanned multiple sectors, including food and beverage, retail, manufacturing, and general warehousing.

Despite a healthy safety culture and proactive ergonomics programs, they still had workers in their logistics facilities who were **sore and exhausted at the end of each shift** and still experiencing painful musculoskeletal disorders. This was particularly true for workers in case-picking and order-selecting roles, which involve **repetitive lifting of moderate**

to heavy weights (e.g., 20-50 lbs), often hundreds or thousands of times per day.

This is what prompted these companies—and many other logistics facilities—to explore emerging solutions to support their workforce. However, exos aren't always the obvious choice. These distribution centers broadly explored other options first, taking into account the capital expenditure and ongoing operational costs of solutions, practicality, likelihood of worker acceptance, evidence of efficacy, and anticipated impacts.

It was sometimes only after exhausting other ergonomics interventions that the companies began to seriously consider exos for their workers.

**AFTER EXHAUSTING OTHER
ERGONOMICS INTERVENTIONS,
COMPANIES BEGAN TO
SERIOUSLY CONSIDER EXOS
FOR THEIR WORKERS.**



HOW DID THESE DISTRIBUTION CENTERS PILOT, SELECT, DEPLOY, AND SCALE EXOSUITS IN THEIR FACILITIES?

At the start of this process, **each company spent time learning about exos—including overcoming myths and preconceptions**—and then piloting multiple different exo products. Success was not immediate. They found that some devices were too bulky or heavy, others were too uncomfortable, some did not fit their full workforce, or others were too complex and costly to justify the purchase or provide a positive return on investment. The companies also had to ensure **they assigned exos to the workers and jobs that could benefit the most**, which sometimes required updated ergonomics assessments or pilot iterations.

Most importantly, by including their workers in the decision process, these distribution centers gained buy-in while learning what was important and acceptable to their workers, what was compatible with their operations, and what fit into the workers' daily workflow.

During this process, the five companies independently piloted and identified the HeroWear Apex 2 exosuit as a solution that provided back and fatigue relief to workers, was sufficiently comfortable, achieved high user acceptance, and was practical to implement, sustain, and scale in their facilities. These distribution centers committed to the implementation process by **involving frontline workers, getting leadership buy-in, and instituting policies** to support the exosuit integration. To help accomplish this, they worked closely with HeroWear's training and implementation specialists to provide the support needed to empower both the management team and workers during onboarding, ensuring the exosuits were effectively integrated into everyday workflows—**an often underemphasized but critical factor in sustained acceptance**.

Each company started with an initial pilot, tracked success criteria, then expanded exosuit deployment to more workers and additional facilities in their distribution network. Some facilities implemented exosuits as optional tools, while **others decided to mandate the exosuits for new workers or entire shifts after completing multi-month field trials that involved collecting subjective worker feedback and measuring operational impacts**.

These five distribution centers are not unique in their physical and operational demands, or in their challenges to finding and integrating quality safety tools and programs. Thousands of logistics facilities around the globe face similar dilemmas, and a growing number are exploring the use of exos in their operations. However, relatively few of these organizations have sustained large-scale exo deployments **AND** shared their data on the long-term injury impacts. As such, **this aggregated case study represents a significant milestone in the emerging exoskeleton field**, as it is amongst the first to provide this kind of objective longitudinal evidence.

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WHAT WERE THE LONG-TERM IMPACTS OF EXOSUIT USAGE?

Workers wearing exosuits were monitored for **8 to 23 months** at each distribution center, encompassing over **311,000 hours of work**—the equivalent of 155 full-time workers wearing an exosuit regularly on the job for one year.

The long-term data provided 2 major new insights:

1. There was a 62% reduction in the total strain and sprain injury rate, from 10.2% historically to 3.8% after exosuits were deployed. This means injuries decreased from previously having one every 20,000 work hours, to less than one every 50,000 work hours.

2. Workers had fewer back injuries without unintended consequences. The number of back injuries amongst case-picking workers in distribution centers decreased to zero in this cohort without a corresponding increase in strains or sprains to other parts of the body. This finding would not be expected if exosuits simply shifted risks to other joints or muscles.

In addition to benefiting individual workers, the injury reduction also has significant operational and financial impacts. According to the U.S. Occupational Safety and Health Administration, **the average workplace strain or sprain injury costs \$67,248**—with about \$32K from direct costs associated with medical treatment and workers' compensation, and about \$35K from indirect costs due to lost productivity, overtime, and training replacement workers.⁵

Plymouth Inc., a leading West Coast protein distributor, was one of the companies to share injury rate data from before and after exosuit deployment. Their Director of Operations, Travis Erickson, summarized the daily challenges faced by their warehouse workers, why they invested in exosuits, and the impacts that Plymouth has experienced.⁶

“A night shift employee will pick up an average of 60,000 pounds a night,” said Erickson. “Our main goal at Plymouth is to make sure we are supporting every worker to have a happy healthy life outside of work. **Some of our workers who have had back issues started wearing the Apex 2 exosuit and don't have back issues any longer.**”

⁵ [osha.gov/safetypays/estimator](https://www.osha.gov/safetypays/estimator)

⁶ [ishn.com/videos/6384294068112?bctid=6384294068112](https://www.ishn.com/videos/6384294068112?bctid=6384294068112)

BY THE NUMBERS

FINDINGS: Reduction in the total strain and sprain injury rate, went from 10.2% historically to 3.8%. Meaning injuries decreased from previously having one every 20,000 work hours, to less than one every 50,000 work hours.



Five distribution centers participated in the case study

311K+ HOURS

Over 311k+ hours were analyzed—the equivalent of 155 full-time workers wearing exosuits regularly for one year

62%
DECREASE
in total strain and sprain injury rate

A Plymouth warehouse worker shared his personal experience wearing an exosuit, saying, “I love it. **It makes the work easier for me.**” He added, “I don’t feel the weight as much as before when I’m not wearing it. It reduces the weight by probably like 50%, which is good because we are lifting constantly. Before I had this, it was a pain for me working because I had back problems.”

The warehouse worker also described the impacts outside of work, adding, “Working here within the second month, I wouldn’t be able to sleep because of my back, all the pain. I told my bosses, and they gave me this exosuit, and ever since that it was working perfectly fine.”

HeroWear exosuits take **up to 40% of the load off a worker’s back muscles during lifting and bending**, resulting in less fatigue, discomfort, and wear-and-tear on a worker’s low back muscles and spine.⁷ This new case study further suggests that exosuits protect the low back without shifting injury risks to other parts of the body, allowing more

⁷ herowarexo.com/apex-reduces-the-strain-on-back-muscles

⁸ rustoleum.com/newsroom/2025/safety-trailblazers-honored-with-inaugural-impact-awards

workers to go home to their families with less fatigue and pain.

Another company that shared injury impact data was Rust-Oleum, a leading global manufacturer of protective paints and coatings. Rust-Oleum’s Director of Distribution, Cory Mitchnick, was awarded a Safety Impact Achievement Award in 2025 for outstanding leadership in improving the lives of workers by equipping hundreds of employees across multiple distribution centers with HeroWear Apex 2 exosuits.⁸

Rust-Oleum Vice President of Distribution and Freight, Barry Horner shared, “We have always prioritized the safety and well-being of our teams. Cory’s leadership in the **deployment of these exosuits has been monumental for us in reaching even higher safety standards and dramatically reducing injuries in our warehouses.**”



**EXOSUITS PROTECT
THE LOW BACK
WITHOUT SHIFTING
INJURY RISKS TO
OTHER PARTS
OF THE BODY.**

HOW DOES THIS NEW STUDY ADD TO THE EXISTING EVIDENCE BASE ON EXOSUITS?

This long-term field study builds upon over a dozen existing longitudinal case studies on occupational exos—all of which indicate positive impacts on workers.⁹ However, **this is one of the first to examine total strain and sprain injury rates—not just back injuries.**

The growth in exo adoption and real-world evidence has caught the attention of major logistics and professional services companies. DHL is the largest operator of warehouses globally. In their 2025 Logistics Trend Radar Echo report, DHL identified exoskeletons as one of the priority focus areas based on surveys from over 2,500 supply chain experts.¹⁰ Moreover, they concluded that the exoskeleton is not a future concept, but a current reality.¹¹

EY (one of the “Big Four” global professional services firms) also spotlighted exoskeletons in their 2026 Megatrend insight article, outlining evidence of significant injury reductions, as well as meaningful productivity gains due to less fatigued workers and a strong return on investment (ROI).^{12, 13, 14}

In 2024, HeroWear released a pioneering industry study showing back injuries dropped to zero through more than 281,000 hours of work after Apex 2 exosuits were adopted.¹⁵ In 2025, this complementary new dataset was aggregated over 311,000 hours to explore further exosuit impacts, not just on the back, but across the entire body by examining total strain and sprain injury rates.

This longitudinal data also builds upon over 50 academic and scientific studies on soft elastic exosuits like the Apex 2, which provide insight on the underlying biomechanical effects.¹⁶ Short-term studies using leading indicators of

injury risk show that back exosuits can simultaneously reduce loading on the back and other parts of the body. Notably, two recent scientific studies by the Fraunhofer Institute in Germany and Georgia Institute of Technology each found that elastic back exosuits reduced joint contact forces in both the spine and the knees.^{17, 18} These findings align with standardized surveys from 531 HeroWear exosuit users, which revealed that, on average, workers reported a 32% reduction in low back discomfort and a 23% reduction in knee discomfort after wearing exosuits for 1–2 months. Collectively, this converging evidence indicates that back exosuits not only reduce loading on the back and spine but also on other body parts like the knees.

“Emerging technologies demand continuous learning, and **the only way we advance is through converging, real-world evidence,**” said HeroWear Co-Founder and Chief Scientific Officer, Dr. Karl Zelik. “I’m deeply grateful to the companies willing to share longitudinal data. They’re accelerating progress for all of us and helping make every workplace safer. We’re excited to keep partnering with clients, aggregating large-scale data, and sharing new insights on worker impacts.”

IN 2025, DHL IDENTIFIED EXOSKELETONS AS ONE OF THE PRIORITY FOCUS AREAS BASED ON SURVEYS FROM OVER 2,500 SUPPLY CHAIN EXPERTS.

⁹ [youtube.com/watch?v=MDoksEYHGbA](https://www.youtube.com/watch?v=MDoksEYHGbA)

¹⁰ [dhl-freight-connections.com/en/trends/dhl-logistics-trend-radar-echo/](https://www.dhl-freight-connections.com/en/trends/dhl-logistics-trend-radar-echo/)

¹¹ [dhl-freight-connections.com/en/trends/how-exoskeletons-can-improve-logistics/](https://www.dhl-freight-connections.com/en/trends/how-exoskeletons-can-improve-logistics/)

¹² [ey.com/en_eg/megatrends/how-emerging-technologies-are-enabling-the-human-machine-hybrid-economy](https://www.ey.com/en_eg/megatrends/how-emerging-technologies-are-enabling-the-human-machine-hybrid-economy)

¹³ [forbes.com/sites/borislavmarinov/2024/12/12/can-exoskeletons-boost-productivity-without-sacrificing-safety/](https://www.forbes.com/sites/borislavmarinov/2024/12/12/can-exoskeletons-boost-productivity-without-sacrificing-safety/)

¹⁴ [herowarexo.com/roi-calculator/](https://www.herowarexo.com/roi-calculator/)

¹⁵ [mmh.com/article/new_study_finds_exosuits_reduce_back_injuries_fatigue_in_dcs/safety](https://www.mmh.com/article/new_study_finds_exosuits_reduce_back_injuries_fatigue_in_dcs/safety)

¹⁶ [herowarexo.com/the-science-studies-behind-the-apex-back-exosuit](https://www.herowarexo.com/the-science-studies-behind-the-apex-back-exosuit)

¹⁷ [sciencedirect.com/science/article/pii/S0003687025002078](https://www.sciencedirect.com/science/article/pii/S0003687025002078)

¹⁸ power.me.gatech.edu/wp-content/uploads/2025/08/DAVENPORT-DISSERTATION-2024.pdf

HOW WAS LONG-TERM INJURY RATE DATA COLLECTED?

Five distribution centers opted to share total strain and sprain data with HeroWear after adopting Apex 2 back-assist exosuits for case-picking workers to address ergonomic challenges and improve worker well-being. To avoid biasing the results, HeroWear did not pay any companies to participate. Companies purchased the Apex 2 exosuits and workers were not compensated for using the exosuits or for providing feedback or testimonials.

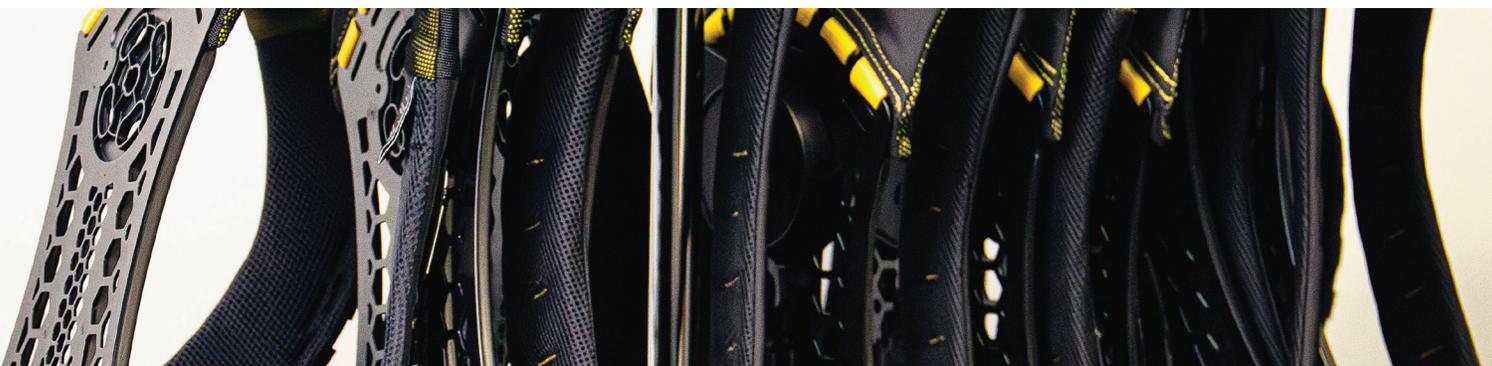
Distribution centers tracked and provided their own historical injury data before and after exosuit deployment based on their recordable musculoskeletal incident rates. Each company provided summary metrics for total strains and sprains, and back injuries. For total strains and sprains, historical injury rate data were obtained from the same jobs and sites during a 9-24 month period preceding exosuit use.

HeroWear collected, de-identified, and aggregated the client data. Injury data were converted into incidence rate (*total strains and sprains per 100 full-time workers per year*) prior to aggregating. Historical incidence rate was then used to compute the expected number of injuries over the total hours worked, to enable comparison against the actual number of strains and sprains recorded amongst exosuit users. Historically, these distribution centers **would have expected 15.9 total strains and sprain injuries** amongst

case pickers over the 311,000 work hours monitored, **but only six such injuries occurred after workers began using exosuits**—a 62% reduction, none of which were back injuries.

There are some limitations to acknowledge with this case study. First, confidential data on individual worker demographics and work history were not provided, nor were comprehensive safety metrics available across all categories. However, some feedback from individual workers and companies suggested that, in addition to an overall reduction in injury rates, exosuit use may also result in less recurring back pain and fewer workers re-injuring their backs. Additional worker information could be gathered in future studies to assess this quantitatively.

Second, this was not a controlled experiment, and it used a natural experiment design to compare injury rates before vs. after exosuit deployment. Natural experiments do not explicitly control for risk exposure, exo usage time, self-selection bias, or organizational changes. This can lead to challenges in establishing clear cause-and-effect relationships due to these potential confounding variables and the inherent limitations of relying on naturally occurring events to test a hypothesis. Nonetheless, consistent long-term findings across multiple distribution centers add to the growing knowledge base and provide some of the **most direct and compelling evidence to date** on exosuit impacts.





ABOUT HEROWEAR

Spun off from Vanderbilt University in 2019, HeroWear has established itself as a pioneer in the occupational exoskeleton field, providing one of the most scientifically validated and widely used exoskeletons in the world. HeroWear's Apex 2 is a back-assist exosuit worn by thousands of workers in physically demanding jobs, and is particularly well-suited for material handling and repetitive lifting jobs in warehouses and distribution centers. The Apex 2 contains no motors or batteries, rather the exosuit's elastic bands function like an artificial set of back muscles that reduce strain and make lifting easier. This patented exosuit has a modular design, adjustable assistance levels, and multiple sizes to ensure comfortable fit and proper performance for women and men of varying size and shape. Beyond just the product, one of HeroWear's keys to growing usage, high user acceptance, and sustained long-term adoption—which is what enables longitudinal case studies like this—is its world-class client services team that provides fitting, training, guidance, and implementation support to companies of all sizes. HeroWear exosuits are being used in over 30 countries, including within multinational corporations and companies that are implementing or mandating exosuits as standard equipment. [Learn more at HeroWearExo.com](https://www.herowear.com)

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To learn more about HeroWear's exosuit solutions, the science behind the suit, ROI impacts, and more customer stories, visit [HeroWearExo.com/contact](https://www.herowear.com/contact)

