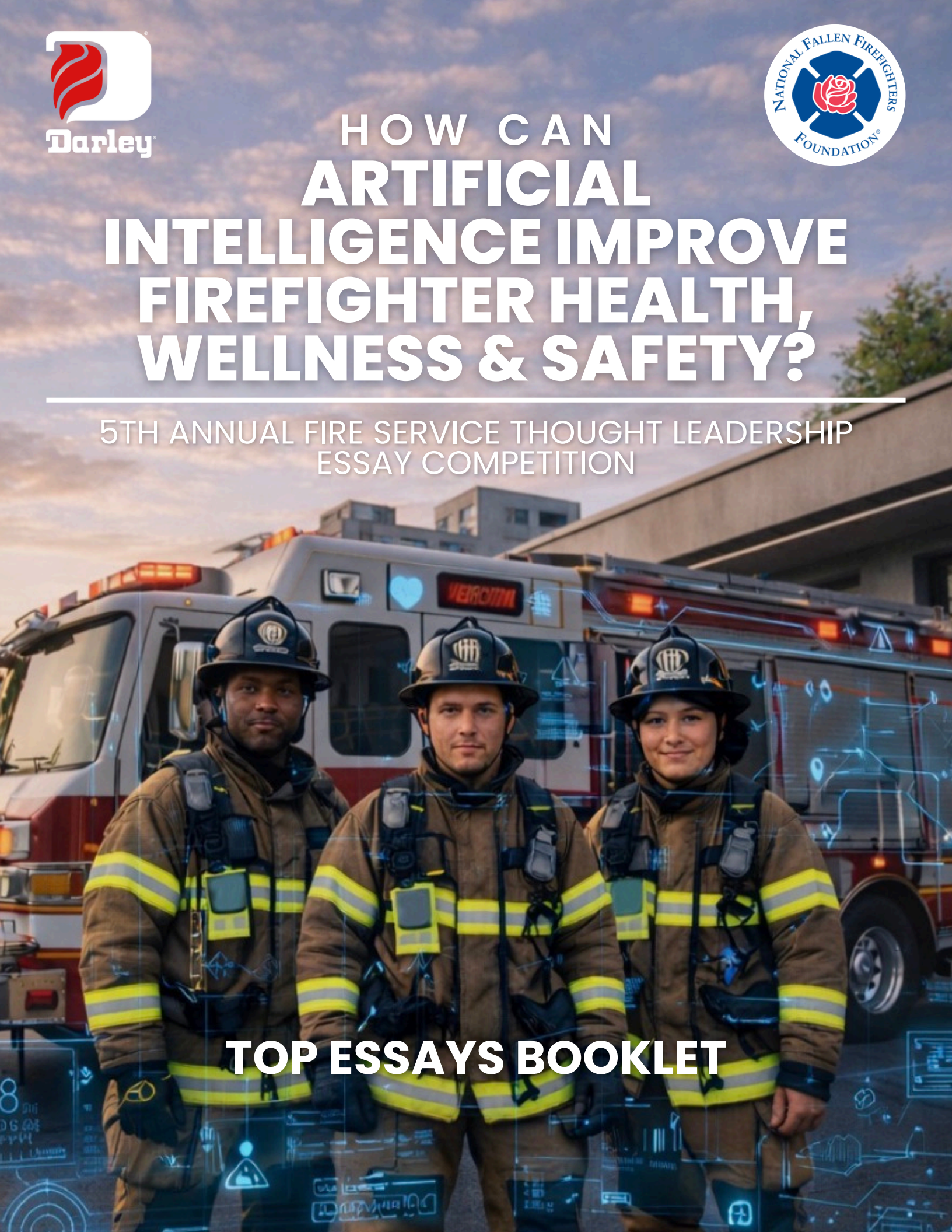


HOW CAN ARTIFICIAL INTELLIGENCE IMPROVE FIREFIGHTER HEALTH, WELLNESS & SAFETY?

5TH ANNUAL FIRE SERVICE THOUGHT LEADERSHIP ESSAY COMPETITION

TOP ESSAYS BOOKLET

THE 2026 FIRE SERVICE THOUGHT LEADERSHIP ESSAY COMPETITION

Top Three Essays & Honorable Mentions

How Can Artificial Intelligence Improve Firefighter Health, Wellness & Safety?

"Safety culture does not improve through compliance; it improves through trust."
- Alex Zielinski, 2026 Essay Winner

Sponsored by Darley in collaboration with the National Fallen Firefighters Foundation (NFFF)

*“We are inspired by the overwhelming enthusiasm and creativity showcased in our fifth Thought Leadership Essay Competition. With a commendable **42 entries** centered on how artificial intelligence can improve firefighter health, wellness & safety, it’s evident that our fire service heroes are eager to spotlight this important discussion.” - Paul Darley, CEO W.S. Darley & Company*

"Everyone Goes Home has always been about preventing the next line-of-duty death before it happens. These firefighters showed how new tools can serve that mission without taking judgment out of human hands."

- Danny Kistner, Director of Fire Programs, National Fallen Firefighters Foundation

WHY IS THOUGHT LEADERSHIP & WRITING SO IMPORTANT?

Informational influence has become one of the most important leadership traits. The only way to lead effectively is to be an example of how leaders share information and lead from a place of caring.

While future and current leaders may have different perspectives than more senior members of the fire service, their level of dedication and willingness to address and problem-solve reflects the best the fire service has to offer. It is both impressive and exciting when firefighters, company officers and chief officers thoughtfully and respectfully challenge how we think about the future of the fire service.

"These essays came from people who live with the problem every shift. That's exactly why we asked them. Several of these ideas could be tested in a firehouse next month, not five years from now."
- Paul Darley

"The Darley Essay Contest is an exceptional opportunity to encourage critical thinking, professional reflection, and intellectual leadership across the fire service. Having the honour to have served as a judge, I have been genuinely impressed by the quality of the submissions, the diversity of perspectives, and the willingness of participants to challenge conventional thinking. The contest creates space for important conversations about emerging issues, including artificial intelligence, firefighter health and wellness, and the evolving demands of our profession. Perhaps most importantly, it reinforces that the future of the fire service will be shaped not only by operational excellence, but also by our willingness to question, learn, innovate, and share ideas."

- Brian McAsey

HOW IT WORKS

Fire service members responded to the below prompt:

Artificial intelligence is rapidly moving from concept to everyday tool in the fire and rescue service, touching everything from incident reporting and staffing to immersive training, wildfire modeling, roadway operations, and fire-based EMS and technical rescue work. Taking inspiration from the NFL's "Digital Athlete" platform with AWS, which uses data, AI simulations, and predictive models to spot injury risks and design smarter training for players, this essay contest asks: how can artificial intelligence be used to improve firefighter health, wellness, and safety?

This year's Thought Leadership Essay Contest invites fire and rescue personnel to explore practical ways AI can improve firefighter health, wellness, and safety over roughly the next two years, not in a distant future. Authors might examine AI-enabled training such as virtual and augmented reality staff rides, predictive analytics for wildland and all-hazard incidents, roadway incident risk forecasting, or decision-support tools for complex fire, EMS, hazmat, and technical rescue operations. Other promising areas include AI-assisted fatigue and workload tracking for crews whose primary call volume is EMS, exposure and injury trend analysis, or mental health and resilience resources that support members before, during, and after critical events.

We encourage essays that connect these ideas to real operational needs across suppression, EMS, and rescue; address persistent risks such as roadway struck-by incidents and wildland deployments; draw from line-of-duty lessons; and align with the 12 NFFF Fire & Life Safety Initiatives so that technology clearly supports behavior change and reduces injuries, illnesses, and fatalities. Submissions should show how AI can help departments strengthen a culture of safety and wellness while recognizing the realities of staffing, budgets, and fire and rescue service culture.

GRADING CRITERIA

After the submission period closed, the 38 entries went through three rounds of peer reviewed judging process by our distinguished judges. Judges evaluated essays based on four key sets of criteria including:

1. Specific Solutions Offered
2. Potential Impact on the Fire Service
3. Quality of Writing
4. Intangibles

HOW ARE THE WINNERS RECOGNIZED

Winning this contest opens doors. It lets participants showcase their ideas, spark real conversations, and stand out for their commitment to a better fire service. Their voices reach peers, leaders, and industry platforms, helping drive meaningful, lasting change.

All winners received a monetary prize: 1st-$3,000, 2nd-$2,000, 3rd-$1,000

An additional recognition for the winning essay is the opportunity to present at the TEEX Leadership Development Symposium on Jan. 6-8, 2027, in The Woodlands, Texas, and at Fire-Rescue International (FRI).

Winners are highlighted on platforms such as the Inside Darley video series, the Darley Times Newsletter and other Darley media distribution, In Service Darley podcast, and partner publications such as Fire Engineering, Firehouse, FireRescue1 and CRACKYL.

2026 JUDGES

The competition served as a catalyst to those from all ranks and functions in the fire service to put forth their transformative ideas. This is a peer-reviewed process recognizing courage in innovative thinking. Our judging panel represents diverse backgrounds, genders, and ethnicities.

"Like past essay contests, the submissions this year were very impressive! The thoughts and suggestions highlighted in each write up demonstrate that technology will continue to play a very important role in advancing firefighter safety/well-being. More importantly, the individuals who participated this year demonstrate we have a great group of next generation fire service leaders who will take the profession to higher levels."

- Demond Simmons



Dr. Burton Clark
National Fire Academy (Retired)
Management Science Chair,
American Fire Culture



Vincent B Davis
Feeding America, Senior
Director of Disaster Services



Kerry Henderson
Battalion Chief, James City
County Fire,
2022 Essay Winner



Terri Reid
EMS Shift Commander,
Baltimore County



Anthony James
Deputy Chief/Fire Marshal,
Pasadena Fire Department



Dr. Lindsay Judah
NFFF Fellow
2023 Essay Winner



Bertral Washington
Fire Chief, San Bernardino
County Fire Deputy



Oren Bersagel-Briese
Deputy Chief, Operations
Division Castle Rock Fire and
Rescue



Jamie Howarth
Battalion Chief, Anne Arundel
County Fire Department,
2024 Essay Winner



LaRae Smiley-Sliger
Women in Fire, Emergency
Management Director
Hardin County Fire/EMA



Dr. Danny Kistner
Fire (Retired), Mckinney
NFFF Director of FIre Programs



Dr. Marc Wysocki
Captain, Sheffield Volunteer
Fire & EMS



Nick Russo
FEMA (Retired)
Assistant Director, Office of
Federal Disaster Coordination



Kory Pearn
Editor-in-Chief
CRACKYL Media



Demond Simmons
Oakland Fire, Deputy Chief



Drew Hoehn
Fire Chief, Breckenridge Fire
Department

JUDGES' INSIGHTS:

"The Darley Essay Contest provides a valuable opportunity for members of the fire service to share ideas, reflect on their experiences, and contribute to the profession's future. Its value goes beyond recognizing strong writing; it encourages thoughtful discussion about the challenges facing departments and the communities they serve. Making room for these perspectives helps turn individual lessons into shared learning. That exchange strengthens leadership, preparedness, and service to the public." *- Vince Davis*

"One of the things I appreciate about the Thought Leadership Essay Contest is that it gives people across the fire service an opportunity to share ideas and challenge some of the ways we've always done things. As a judge, it's been interesting to see the different perspectives and approaches people bring to the same topic. The real value of this contest isn't just recognizing good writing or innovative ideas, but encouraging conversations from anywhere in our profession that can move the fire service forward." *- Oren Bersagel-Briese*

"The 2026 Darley/NFFF Thought Leadership Essay Contest has a positive impact by encouraging participants to express their ideas, think critically, and strengthen their writing skills. It provides an opportunity to share meaningful perspectives and build confidence in their ability to address important issues. The contest inspires creativity, promotes learning, and encourages innovative thinking about the future of the fire service. By recognizing participants' efforts and ideas, it supports personal growth, leadership development, and a commitment to making a difference. Overall, the contest creates a valuable opportunity to share knowledge, inspire positive change, and contribute to a stronger and safer fire service community." *- Terri Reid*

We want to congratulate everyone who dared to submit an essay and especially spotlight the top 3 winners from this process! Enjoy reading these essays and please share your thoughts on the insights.

TOP 3 WINNERS: congrats!



1st place

Alex Zielinski
Fire Chief
Eli Lilly Fire Department, Houston, TX

Beyond the LODD Report: A Health Risk Intelligence System for Predicting and Preventing Firefighter Injuries and Deaths

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2nd place

Daniel Fernandez
Captain
Virginia Beach Fire Department, Virginia Beach, VA

The Tactical Athlete: Leveraging AI to Build a Safety Layer for Firefighter Wellness

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3rd place

Sara Kerr
Qualified Firefighter
Fire and Rescue NSW – New South Wales, Australia
Doctoral Candidate - University of Newcastle

The Cognitive Fireground – Rapid Access to Ground-Truth



BEYOND THE LODD REPORT:
A HEALTH RISK INTELLIGENCE SYSTEM FOR PREDICTING & PREVENTING FIREIGHTER INJURIES & DEATHS

Fire Chief Alex Zielinski

The Gap AI Was Made to Close

For the first time, AI makes it practical for any fire department to analyze its own operations against what the national records attempt to infer after the events happen.

A peer-reviewed analysis of 282 NIOSH investigations from 2006 to 2014, that created over 1,000 recommendations for fire service operations, identified four underlying root causes that are identified with the NIOSH 5: under-resourcing, inadequate preparation, incomplete incident command adoption, and sub-optimal personnel readiness.1 This knowledge is published and taught in academies and classrooms across the country. The departments doing the most effective safety work already apply it – reviewing precursors, tracking near-misses, conducting the root cause investigations. They represent the model. For many departments, sustaining that analysis requires staff, time, and administrative capacity that competes with operational demands. Artificial intelligence closes that gap.

One Behavior, Two Risk Timelines

This opportunity extends beyond the firefighter fatalities due to circumstances on the fireground. Sudden cardiac events – the result of years of cardiovascular strain – represent the single largest category among NIOSH-investigated deaths (1). Cancer and respiratory illness accumulate at the other end of the spectrum. The connection between these risk timelines is operational but they are tracked and mitigated as though they are independent.

A crew that repeatedly conducts overhaul without respiratory protection impacts both ends of that risk spectrum – near- and long-term risk – simultaneously: an SCBA compliance gap that appears in line-of-duty death (LODD) investigations, and carcinogen exposure that surfaces in a firefighters' diagnosis years later. Peer-reviewed research shows us that even when environments appear visually clear, unprotected overhaul exposure produces measurable changes in lunge gene expression linked to cancer and pulmonary disease (2). Every state has

enacted or debated occupational cancer presumption legislation for the fire service, illustrating the scale of the scale of burden in tracking and the inconsistency with which exposure data is collected (3, 4).

A system built to identify acute LODD risk by analyzing operational patterns is simultaneously building the chronic exposure record. This is not a secondary benefit of a Firefighter Health Risk Intelligence System (FHRIS), this is the primary purpose.

Working in Information Silos

Near misses, training deficiencies, PPE compliance gaps, and procedural deviations are precursor indicators. NIOSH investigations consistently show these factors were present before serious injuries or LODDs occurred (1). Many departments need a systematic way to read these reports, note precursors, and compare their own operations against the larger data pattern that can give them predictive insight and a path for corrective action.

Across nearly two decades in municipal, and industrial fire departments, I watched the same patterns accumulate without anyone asking what they were collectively showing us: communications cultures that equated minimal radio use with fireground professionalism; PPE falling out of compliance while equipment records captured requests and nothing more; training logs that showed attendance but never confirmed skills; and variability in statutory interpretation creating noticeable variations in department administration and operations across shifts, battalions, and companies and across multiple independent facilities within the same organization. This variability is created protection and performance gaps often invisible to any single perspective. Each data stream existed but none were generating a meaningful holistic plan of action.

Connecting that data to the NIOSH contributing factor records and doing so across months or years of operational history requires analytical capacity many departments cannot sustain alongside daily operations. FHRIS does not invent this capability, it makes it accessible.

How FHRIS Works

FHRIS applies natural language processing, machine learning, and automated pattern recognition to a department's existing operational data, producing a risk assessment across injury logs, exposure records, response data, and operational reports. It requires no new data collection; it merely analyzes what departments already have against what the fire service already knows.

The training dataset draws from the full NIOSH Fire Fighter Fatality Investigation and Prevention Program data library including the investigations and recommendations while incorporating occupational exposure research and the firefighter cancer presumption framework (1, 3, 4). Departments submit reports they already maintain: incident reports, training logs, near-miss documentation, PPE compliance records. Natural language processing manages any unstructured narratives regardless of records platform.

The fire service's own transition to the National Emergency Response Information System (NERIS) recognizes that data-informed decision-making is the profession's direction. NERIS improves data quality and provides incident analytics across all hazards.5 FHRIS builds on that foundation with what NERIS is not designed to provide: precursor-to-outcome pattern analysis trained on exposure, injury, and LODD contributing factor data.

What the system provides is not a score but a department-specific analysis in three parts:

- Track acute risk patterns with specific findings.
  - Not 'improve accountability' but 'your records show command transfer patterns consistent with accountability breakdowns documented in investigated fireground fatalities: here is what other departments with similar operations did to correct this.'
- Provide chronic health, operational, and administrative exposure indicators.
  - Mapped to the National Fallen Firefighters Foundation (NFFF) Life Safety Initiative they most directly implicate.
- Action steps ranked by the estimated impact

Regardless of department budget, staffing, and geographic complaints the agency gets a clear answer: start here.

The NFL's Digital Athlete applies video analysis, performance data, and AI modeling to identify player injury risk before it occurs. The system's results are clear as they produced a historic low in concussions during the 2024 season (6). FHRIS applies the same logic to fire departments where operational data becomes predictive intelligence that drives action before someone is hurt or killed. The data exists, the tools exist, FHRIS provides the analytical layer that connects them.

Built for the Operational Reality

FHRIS is built for departments that exist, not model departments with dedicated data analysts. It impacts the entire fire service regardless of department or

staffing type:

- High-volume departments face a volume problem – large dataset accumulate quickly.
- Volunteer and combination departments benefit from targeted findings rather than broad annual safety programs.
- Specialized teams and agencies, including industrial firefighters whose exposure profiles are limited in national health research (7), use the same framework while contributing underrepresented exposure research and receiving agency- or industry-specific analysis and recommendations.

This does not require a budget or an analyst. No new reports to generate. A department submits what it has and FHRIS returns what returns what the department needs – real, current intelligence about itself with a plan forward.

What it Requires to Work

Three challenges deserve acknowledgement. Data completeness for specialized populations is the first. Privately employed firefighters at large entertainment venues, warehouses, and manufacturing facilities are often excluded from national incident reporting or fire service population statistics in many states. This gap persists through the NERIS transition and is documented in peer-reviewed policy analysis (4). Building specialized training data for these populations coordinated research and intentional collection efforts.

The second challenge is cultural resistance. Reporting agency data to an external database can feel more like an audit; FHRIS must be department-controlled, advisory rather than regulatory. The NIOSH investigation data that trains FHRIS was produced from public tragedy and the resulting investigations, the system that enables it should be offered at no cost to every department through a USFA and NFFF partnership.

Safety culture does not improve through compliance; it improves through trust.

Where We Are, Where We Want to Be, How We Get There

In 2004, the NFFF's 16 Life Safety Initiatives gave the fire service a list of named behaviors for why firefighters are injured or die. Now, that list has evolved into the revised 12 Firefighter Life Safety Initiatives (8). These initiatives name the behaviors, but they do not tell any individual agency which behaviors to prioritize based on its own operational history. The analytical infrastructure to easily compare an individual department against the national and its own data did not exist.

It exists now, occupational health research is published, the NIOSH investigation data is available, and the AI tools are available. This means the fire service, and each individual department, can move forward with specific actions, not guidance based on a generalized national dataset. FHRIS requires no technological breathing, it requires a decision to implement.

The gap between knowing and acting is no longer a technology limitation. It is a priority limitation. The 16 Initiatives told us everyone goes home, FHRIS gives every department the intelligence to make that a standard.

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THE TACTICAL ATHLETE: LEVERAGING AI TO BUILD A SAFETY LAYER FOR FIREFIGHTER WELLNESS

Captain Daniel Fernandez

When the NFL partnered with Amazon Web Services to build the Digital Athlete program, they turned 500 million data points per week into a system that predicts player injuries before they happen. In 2023 alone, the program helped teams avoid roughly 700 missed player-games (1). The fire service doesn't need to copy the NFL's budget to copy the logic. Most fire departments already have mountains of data they are sitting on or collecting. The opportunity is to stop treating that information as paperwork and start treating it as a predictive safety system.

We've spent decades collecting the exact data that could protect our people: apparatus logs, call volume, staffing patterns, rehab vitals, but it gets written on a sheet of paper and dies in a filing cabinet. We have the data, but we have struggled to make meaningful sense of any of it. Artificial Intelligence removes that excuse by making the data understandable and actionable. The only thing standing between the fire service and a safer job is the willingness to use the tools.

Artificial Intelligence and its Relationship to the NFFF Initiatives

AI breaks down the barriers to business intelligence, allowing us to query our proprietary data using natural language and receive actionable, concrete answers. Over the next two years, the most practical use of AI in the fire service is not one giant platform, but rather a safety layer built around the things we already do, and have done for years. Integrating artificial intelligence into routine protocols allows fire departments to breathe life into the modernized NFFF Life Safety Initiatives. By utilizing AI to enhance training and make sense of data, leadership can move beyond passive reporting to fulfill Initiative 8 (Training and Innovation) and Initiative 5 (Evolving Health Practices); effectively converting raw data into active protection for our personnel.

Training Readiness

The best place to make firefighters safer is before the tones drop. I built one of these training tools myself with the assistance of AI: a voice driven command simulator that runs on a computer or tablet, no headset and no IT vendor. The officer keys up the mic, gives a size up and a 360, and then manages the incident

as units arrive every twenty seconds, each one needing an assignment. The user can inject a mayday, a flashover, or an early command turnover on demand. None of this requires virtual reality set ups. With the tools available today, if you can describe what you need in plain language, you can build the reps that build competence. The pump simulator module augments new driver training creating private practice reps where new drivers can practice countless hydraulic calculations, manage live water dynamics, and get the critical reps they need on a computer screen before doing it in the real world. Competence is what keeps crews alive. This is exactly what the modernized Initiative 8, Training and Innovation, calls for: leveraging new technology to expand access to high quality training and placing more reps between a firefighter and a fatal mistake.

Monitoring Risk

The way that next-generation stats are able to produce data for NFL athletes is by using wearables in their line of work. We in the fire service have that same opportunity through wearable technology that many firefighters are already wearing (2). The MSA G1 SCBA is capable of telemetry monitoring and bluetooth capabilities. Many firefighters already wear bluetooth enabled rings, watches, and other fitness apparel. In many departments, wearing a wrist watch is already part of the uniform. Many departments already contain the baseline tools to create a data trove of intelligence. The fire service is already closer to this reality than many think.

Data from wearable devices like Oura rings, Apple Watches, and WHOOP bracelets can be fed into custom programs to monitor firefighter vitals, exertion levels, and recovery needs in real-time while on and off duty (6). Data can be anonymized so that personal information remains, by nature, confidential. Departments are already piloting this technology. Duxbury Fire was among the first in the nation to deploy Oura rings to its members (3). West Metro Fire Rescue changed shift policy because wearable data showed crews were losing over an hour of sleep due to early start times. The data this project produced justified a shift change start time adjustment from 7:00 a.m. to 9:00 a.m. (4). To protect personally identifiable information (PII), West Metro swapped each firefighter's identity with a serial number that was owned by the union and siloed from municipal IT (5). Real department, real data, real policy change. When fire departments leverage metrics from wearable devices to adjust their duty schedules, they transition from merely gathering information to actively upholding the National Fallen Firefighters Foundation's mandates. The integration of sleep and physiology analytics directly supports Initiative 5 (Evolving Health Practices) and Initiative 6 (Comprehensive Wellness Programs. The long standing culture within the fire service has frequently celebrated the individual who pushes through absolute physical fatigue. However, the introduction of AI-powered

physiological data is beginning to dismantle this hazardous silence, transforming firefighter safety into a tangible, data driven metric that moves beyond the realm of personal opinion.

The same logic that protects a crew's recovery can protect them en route. During response, vehicle data obtained through Automatic Vehicle Location (AVL) and Department of Transportation (DOT) highway cameras combined with Application Program Interface (API) calls to navigation systems or weather services can provide real-time, live analytics for potential roadway hazards (7, 8). These systems can be trained to recognize dangerous conditions and warn drivers and apparatus officers about upcoming road hazards or probable collision risks. This approach confronts the lethal hazards of roadway strikes by identifying risks before the apparatus even reaches the scene.

Conclusion

The systems described in this paper aren't just hypothetical concepts. AI programs and models capable of building these tools are commercially available right now and firefighters are using them. No software engineering degree. No outside contractor. The learning curve is real, but it's climbable. If you can explain what you need in plain language, you can build something that works.

AI gives us the tools to protect who shows up. We just need the willingness to use the tools. The data exists. The technology exists. The only thing left is the decision to use it. The National Fallen Firefighters Foundation has called on the fire service for years to use available technology wherever it can produce higher levels of health and safety (9, 10). That's not a new idea, however what is new is that the technology is finally accessible enough for the people who understand the problem best; the fire departments and firefighters doing the job.

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THE COGNITIVE FIREGROUND:
RAPID ACCESS TO GROUND-TRUTH

Qualified Firefighter Sara Kerr

Introduction - Logic Before Reasoning

Modern firefighting has entered a new era of operational complexity. Construction materials burn faster with greater toxicity, climate change has intensified wildland/bush fire, and emerging hazards in the form of electric vehicles and renewable energy challenge traditional response procedures. Unlike conventional workplace safety, the risks and dangers of firefighting are inherent to the job description. Therefore, any solutions that genuinely seek to improve firefighter health, wellness, and safety must address this at its core.

The fire service has responded to modern complexity with increased intelligence. By seeking a greater understanding of our risks, we have adopted innovative tools and technologies and paired them with detailed research to build doctrine and procedures that draw from line-of-duty lessons. Contrary to belief, we have never been better prepared or better informed about our risks. But we have also never been more overwhelmed by this knowledge either.

This is perhaps where AI has the greatest opportunity to strengthen and support a firefighter's reasoning. Not by adding more information, the metaphorical fuel to the fire, but by clarifying the logic that informs it.

The Cognitive Advantage – Retain Expertise, not Replace it

Far too often, AI is positioned as a replacement for human limitations, promising speed and apparent certainty. However, our role is not defined by linear insights or operational tempo alone, but by human factors such as discernment, calculation, and conviction in the face of impending consequence. Although we recognise the benefits that AI offers, replacement or automation has no place in a profession built on human reasoning. If integrated naively, it raises complex questions and dynamics, eroding critical thinking and professional responsibility, endangering the very lives it was meant to help save (NFPA, 2024). Our problem is not that we are limited by a lack of knowledge, but by the inability to access it when it counts.

Cognitive overload threatens the modern firefighter, yet we are still expected to interpret, absorb, and synthesise dynamic intelligence. Then we are expected to act under intensifying uncertainty, whilst fragmented yet constant information,

paired with time constraints, compounds our stress (Misra et al. 2020). The heat of the moment offers no luxury for perfect reasoning, yet it demands our certainty anyway. It is here that the paradox emerges; AI appears to know everything, yet it thinks about nothing.

Yes, is true, AI can move to access information faster than we can.

But no, AI cannot replace the firefighter, nor can it replace our professional judgement.

But the right AI capability will enhance it. If AI can leverage the information that compounds our cognition faster than we can, yet our logic is what makes us strong, then AI should strengthen this, not undermine it. **Retrieval Augmented Generation (RAG)** (i) offers that bridge. Unlike conventional AI that relies primarily on open-source pre-trained knowledge, a RAG is a type of Large Language Model (LLM) that is bound to and can interrogate trusted, agency-proprietary databases and doctrine. It can be trained to understand domain-specific language and surface operationally relevant answers in real time. As a result, hallucination and bias risks are reduced (Nishisako et al., 2025), ensuring that outputs remain anchored in defensible, governed operational logic.

Our logic. Our strength.

RAGs undertake the mentally heavy lifting whilst retaining our expertise by rapidly retrieving, synthesising, and surfacing critical incident intelligence at machine speed. Imagine the bells sounding, and before the fire truck even arrives on scene, a RAG-enabled system is working alongside the crew. Hydrant access is identified, hazardous materials are flagged, and building-specific risks are surfaced before the first arrival message is passed. The immediate benefit is incident flow, which reduces the risk of line-of-duty **injury or death**. The longer-term benefit is reserving human cognition for tactical wisdom, avoiding burnout and protecting career endurance. Fundamentally, this solution strengthens a culture of health, wellness and safety by tackling the source of compounding risk from the moment we leave the station.

From Concept to Capability

The most powerful innovations are rarely replacements; they are force multipliers. As our emerging workforce are digital natives who already use, or inevitably will use AI, technology-enabled operations will be a natural evolution rather than a cultural leap, a great challenge our agencies once faced. Therefore, deploying the capability of a RAG is not a blue-sky dream. Modern firefighting is already a connected technological ecosystem, featuring an array of digital

systems ranging from sensors to mobile intelligence that continuously inform our response. While metro operations already benefit from advanced internet connectivity, satellite capability ensures regional and district services are not left behind.

However, mission-critical intelligence should not depend solely on open internet connectivity, as true system resilience requires that trusted insight survives failure. When connectivity breaks down, which would otherwise compound operational overload, RAGs can continue to provide cognitive support in remote or off-grid environments (Kang et al., 2026). This is an architectural measure known as **air-gapping** (ii), where the AI is isolated from open and unsecured networks. Our operating environment must not be a failure point, and by leveraging retrievals against agency databases ensure RAG capability remain agile. As internet connectivity is not an operational necessity, this emerges as a business continuity and security measure.

The proposed solution envisions integration as a **'digital crew member'**, riding alongside us. By leveraging existing devices, a bounded RAG capability could be embedded into MDTs, command tablets, or mobile incident devices, allowing firefighters and incident commanders to query agency-approved, incident-specific intelligence in real time. This includes our pre-incident plans and SOPs, HAZMAT references and local risk information, such as onsite lithium-ion batteries. When every second counts, leveraging that intelligence becomes not only a tactical advantage, but a health, wellness and safety strategy.

As this intelligence remains agency-specific, the business case is compelling. Scaling does not require standardising doctrine, only architecture; what works in one service can be adapted to another. A pilot could be rapidly and cost-effectively tested within one to two years, with an RAG installed into our existing hardware; thus, enabling operational deployment that considers the realities of budgets and staffing to be entirely achievable.

Values Before Velocity

Despite a clear opportunity to improve our operations, any AI solution must acknowledge that we are duty-bound to professional values. Therefore, the safest AI we can use is the one that knows these values. Functional RAG design achieves; bound to the agency by design, they are less susceptible to hallucinating and bias training, thus offering relatively low implementation risk. **Air-gapping** (iii) further offers security functionality and is commonly utilised in military and regulated industries.

Despite positioning RAGs as a cognitive aid, they are not a silver bullet (Penney et

al., 2024). The fireground has no tolerance for intelligence without judgment, and critical thinking must remain central to incident management. **As AI cannot be held accountable, it should never make critical decisions** (iv). RAGs enable retrieval pathways to audit traceability of decision-making logic, providing human oversight that maintains accountability and responsibility. This control, known as an **orchestration layer** (v), allows us to both interrogate and update the intelligence offered. What can be measured can be improved, and for the implementation and application of RAG, **governance becomes a functional pillar of system architecture, not a tokenised aspiration**.

To conclude, AI's place in our world is beside us, offering an extension of our expertise, never a replacement. Just as the axe enhances our physical capability, AI will enhance our cognitive capability, strengthening judgment, reducing exposure, and protecting health, wellness, and safety across a career.

Notes

(i) Retrieval augmented generation, or RAG, is an architecture for optimizing the performance of an artificial intelligence (AI) model by connecting it with external knowledge bases. RAG helps large language models (LLMs) deliver more relevant responses at a higher quality – IBM

(ii) Air gap backups are a data storage tactic that's typically used in disaster recovery (DR) to help organizations prevent data loss and business disruption during a catastrophic event – IBM

(iii) Air gaps are typically used by organizations to prevent malicious actors, such as hackers, viruses or natural disasters from causing irreparable harm to digital assets – IBM

(iv) "A computer can never be held accountable; therefore, a computer must never make a management decision." – IBM Training Manual, 1979

(v) The orchestration layer not only enhances the accuracy of the responses but also ensures that they are contextual and data-backed - IBM

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We also want to spotlight the top runner-ups! Enjoy reading these essays and please share your thoughts on the insights.

HONORABLE MENTIONS:

congrats!



Joe Hester

Assistant Chief of Operations, EMS & Training
Arizona Fire & Medical Authority

Proof to Prevention: Why the Two Deadliest Threats to Firefighters Are Exactly Where Responsible AI Belongs

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Thomas Hart

Firefighter, AI Software Consultant
Australia

From 'Die Tired' to Digital Athlete: Rethinking Firefighter Wellbeing Through AI



Jeremy Holmes

Fire Chief
Fernandina Beach Fire Department, Fernandina Beach, Florida

Reading the Human Smoke: Deploying AI Across the Mental, Physical, and Operational Layers of Firefighter Safety

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Peter Finkle

Ex-Chief
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AI & The Next Era of Firefighter Safety



PROOF TO PREVENTION: WHY THE TWO DEADLIEST THREATS TO FIREFIGHTERS ARE EXACTLY WHERE RESPONSIBLE AI BELONGS

Assistant Chief Joe Hester

A man once asked me why I took it so personally. We were standing outside a hearing room after a long day of testimony on occupational disease presumptions for firefighters. Around us were attorneys, researchers, physicians, legislators, and representatives from the insurance industry. Inside the room, the debate centered on evidence.

For the firefighters and families who had come to testify, it was never just about evidence. Some of those members were battling cancer. Some were facing financial ruin because they could not prove that decades of exposure on the job caused the disease that was now threatening their lives. Their spouses sat beside them while children waited at home. Their health battles were being reduced to questions of causation, statistical significance, and administrative burden.

Across the table sat an expert witness representing the insurance industry. He held a PhD and repeatedly dismissed the testimony of physicians and researchers who had spent years studying firefighter occupational disease. His argument was based on the premise that correlation is not causation.

When someone later asked why I cared so much, I remember thinking the better question would be how anyone in that room could not have cared more? People were dying. Not the deaths most people associate with firefighting. Not the mayday call or the collapsing roof. Not the dramatic line-of-duty death that makes the evening news. But dying with their boots on so to speak.

Many firefighters die slowly. They die years after the final shift. They die from cancers linked to occupational exposures accumulated over a career. They die from cardiac disease accelerated by chronic stress, disrupted sleep, environmental exposure, and the cumulative demands of the profession.

That reality is what led to the creation of presumptive occupational disease laws. A broken leg can often be traced to a specific incident. Cancer and heart disease rarely can. Their causes are cumulative. The injury may be the result of one exposure or a thousand exposures. The impossibility of identifying a single moment is precisely why presumption became necessary.

For much of my career, the fight was about proof. Today, I believe the fire service has an opportunity to pursue something even more important, prevention. Comparable to The National Football League's Digital Athlete platform which uses data, simulation, and predictive analytics to identify injury risks before an athlete gets hurt (1). The concept is simple: identify elevated risk early enough to intervene before the injury occurs.

Firefighters face a similar challenge, but with far greater consequences and much longer timelines. Our two deadliest threats are cancer and cardiac disease. Together, these account for a substantial share of firefighter deaths during active service and subsequent retirement. Unlike most athletic injuries, these threats often develop silently over years or decades before they become visible.

The scientific debate over firefighter cancer is no longer where it was twenty years ago. In 2022, the International Agency for Research on Cancer classified occupational exposure as a firefighter as carcinogenic to humans, its highest level of evidence (2).

The question before us is no longer whether the job carries risk but what we do with that knowledge. This is where I believe responsible artificial intelligence can make a meaningful contribution over the next several years. Not because AI is a replacement for physicians or that technology is inherently innovative. But because for the first time, we can connect exposure data, medical screening, and population-level research in ways that may help identify risk before disease becomes irreversible.

Cancer provides the clearest example. Departments increasingly document firefighter exposures at the incident level. At the same time, the National Firefighter Registry for Cancer is building the largest dataset ever assembled to study the relationship between firefighter exposures and cancer outcomes (3). Moreover, firefighters welcome exposure tracking but reject real-time biometric surveillance and machine issued commands. For decades, these records largely served as historical documentation. Today, they can become actionable information.

Artificial intelligence excels at identifying patterns across large datasets. Exposure histories, incident records, demographic information, and registry findings can be analyzed together to identify firefighters whose exposure profiles may justify earlier or more targeted screening. Importantly, this is not diagnosis. It is risk identification.

The purpose is not to tell a firefighter that he has cancer. The purpose is to help physicians determine whether additional screening may be warranted based on

occupational history and known risk factors. The final medical judgment remains where it belongs: with qualified healthcare professionals operating within established occupational health standards such as NFPA 1582 (4).

What excites me is not the technology itself. It is the possibility of changing the timeline. For years, firefighters and their advocates have fought after disease appeared. We gathered evidence. We challenged denials. We sought benefits and protections for members already facing life-changing diagnoses, and those efforts mattered, but they occurred after the damage had already been done. The possibility of identifying elevated risk years earlier represents a fundamentally different approach.

The same principle applies to cardiac disease. Sudden cardiac events remain the leading cause of firefighter line-of-duty deaths, accounting for approximately 45 percent of annual firefighter fatalities (5). Unlike many cancers, however, cardiac risk is often highly modifiable.

Modern medicine already provides tools capable of identifying risk long before symptoms emerge. Coronary artery calcium scoring, cardiovascular fitness testing, biomarkers, and occupational health screening can reveal warning signs years before a catastrophic event occurs. Viewed independently, each measure offers useful information. Viewed together, they provide a much more complete picture of a firefighter's cardiovascular health.

Artificial intelligence can help integrate those data points, identify trends, and flag elevated risk for physician review. The technology does not replace medical judgment. It helps ensure that important warning signs are not overlooked.

The same framework could also help departments address another growing threat: fatigue. In many communities, EMS calls now make up the majority of fire department responses. Sleep disruption, workload accumulation, mandatory overtime, and staffing shortages create measurable physiological strain. By analyzing scheduling patterns, call volume, workload indicators, and available health data, AI may help identify crews operating under elevated fatigue risk before that fatigue contributes to injury, illness, vehicle crashes, or poor decision-making.

The principle remains the same: identify risk early enough to intervene. That opportunity, however, comes with responsibility. Throughout my career, I have watched systems fail firefighters when evidence was ignored, misunderstood, or misapplied. Technology cannot become another version of that problem. Artificial intelligence should never be treated as an authority. It should be treated as a tool.

Any firefighter health system built around AI must begin with clear safeguards. Health information should never be used for promotion decisions, insurance underwriting, disciplinary action, or fitness-for-duty determinations outside established medical processes. Firefighters must trust that the information exists to protect them, not to penalize them. Without that trust, adoption will fail. And, without those safeguards, it should fail.

This approach aligns directly with the National Fallen Firefighters Foundation's Fire & Life Safety Initiatives, particularly those emphasizing medical and physical fitness, research and data collection, and the use of available technology to improve firefighter safety (6). AI should not replace those initiatives; it should strengthen our ability to achieve them.

The purpose of these systems must remain exactly what it was when we fought for occupational disease presumptions: protecting firefighters. I spent years helping build policies that recognized what was happening to firefighters after they became sick. That work mattered. Presumptive coverage gave families a measure of security and provided firefighters access to benefits they had earned through years of service. It acknowledged what many in the profession had known for decades: that cancer and cardiac disease were not simply personal misfortunes, but occupational risks associated with the job itself.

Truthfully, recognition was never the ultimate goal. The goal was always to keep more firefighters from reaching that point in the first place. When I think back to those hearings, I do not remember the statistics nearly as much as I remember the people. I remember members trying to explain what a diagnosis had done to their lives. I remember spouses sitting quietly beside them. I remember families carrying burdens they never expected to face. That experience is what shapes how I think about artificial intelligence today.

What interests me is not the technology itself. It is the possibility that we may finally have tools capable of acting earlier. For decades, the fire service has become increasingly effective at proving occupational disease after the damage was done. We are now approaching a point where data, medical science, and artificial intelligence may help us identify risk before disease becomes life changing.

That opportunity comes with responsibility. These systems must be evidence-based, physician-guided, and governed by policies that protect firefighters rather than punish them. The goal cannot be to replace professional judgment. The goal is to support better decisions with better information. If we do that well, the greatest contribution artificial intelligence makes to the fire service will not just be a faster report, a smarter dashboard, or a more sophisticated algorithm. It will be

measured in firefighters who receive earlier screenings, avoid preventable cardiac events, and spend more healthy years with their families after retirement.

For much of my career, the fight was about proof. Today, I believe the fire service has an opportunity to pursue something even more important: Prevention. Important questions like what are we missing? What are we overlooking? This is where AI may help detect factors that can be mitigated to prevent more firefighters from “dying with their boots on”. That is a future worth building.

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FROM ‘DIE TIRED’ TO DIGITAL ATHLETE: RETHINKING FIREFIGHTER WELLBEING THROUGH AI

Firefighter Thomas Hart

As both a professional firefighter and a software consultant working with artificial intelligence on a daily basis, I have observed two realities. First, firefighters routinely accept fatigue, injury, and psychological strain as unavoidable aspects of the profession - almost a badge of honour for a shift well worked. Second, industries facing similar high-performance demands are increasingly using artificial intelligence (AI) to predict and prevent these risks before harm occurs. Firefighters accept that responding to emergencies is inherently reactive. However, our approach to protecting firefighters themselves does not have to be. Perhaps the greatest opportunity with AI for the fire community worldwide may therefore not be the technology itself, but the cultural shift it enables.

Professional sports organisations increasingly use AI to identify injury risks before athletes step onto the field. The National Football League's 'Digital Athlete' platform uses predictive analytics to optimise training loads and reduce injury risk. Similar thinking is increasingly reflected within the fire community. In Australia, the New South Wales (NSW) Government's Tactical Athlete Resilience Program (TARP) provides firefighters from Fire and Rescue NSW - the state's urban fire and rescue agency - with access to resources, facilities, and programs that apply principles traditionally reserved for elite athletes. Explosive physical exertion, heavy personal protective equipment, heat stress, prolonged shifts, disrupted sleep, exposure to traumatic events, and cumulative fatigue all contribute to an elevated risk of injury, illness, and long-term disease. In the United States, sudden cardiac events also remain one of the leading causes of line-of-duty deaths among firefighters, highlighting that fatigue, cardiovascular strain, and long-term wellbeing are not simply quality-of-life issues, but fatality prevention issues.

Yet, unlike professional sports teams or military organisations, fire services have traditionally relied on reactive approaches to firefighter wellbeing. Support systems often intervene only after an injury has occurred, fatigue becomes debilitating, psychological distress reaches crisis point, or firefighters identify hazards through retrospective reporting mechanisms such as near miss reporting systems.

This is where AI presents the greatest opportunity - not merely as a technology innovation, but as a catalyst for cultural change.

Firefighters are trained to respond to emerging threats in environments characterised by uncertainty and urgency. While this reactive mindset saves lives on the fireground, it can unintentionally shape organisational approaches to firefighter wellbeing. Phrases such as 'You'll catch up on sleep later,' 'It's just part of the job,' or the popular mantra 'Die Tired' reflect a culture where fatigue and psychological strain are often accepted as inevitable consequences of service. Encouragingly, this future does not require futuristic technologies or significant organisational investment. Much of the data required already exists within fire services today.

Modern fire departments routinely collect information through computer-aided dispatch systems, staffing and rostering platforms, exposure reporting processes, training records, injury reports, and employee wellbeing programs. Independently, these systems provide useful operational and administrative insights. However, when analysed collectively using AI, they have the potential to identify emerging risks before they result in injury, burnout, or operational errors by recognising patterns and relationships across large volumes of data that would be difficult for individuals to detect through traditional approaches alone.

One practical application is fatigue management. Firefighters often experience periods of consecutive night calls, overtime, mandatory training commitments, and fluctuating workloads. AI-enabled systems could identify firefighters experiencing cumulative fatigue by analysing combinations of shift patterns, overnight responses, call volume, and recovery periods. Rather than waiting until fatigue manifests as injury, poor decision-making, or absenteeism, departments could proactively implement recovery strategies, check-ins, or adjustments to workload where operationally feasible. Fatigue management is also an operational safety issue. Reduced vigilance, impaired decision-making, and slower reaction times can increase risk during high-consequence activities such as roadway incidents or prolonged wildfire deployments, where situational awareness and sound judgement are critical to firefighter survival.

Critically, proactive prevention does not necessarily mean removing firefighters from operational duties altogether. Few firefighters want to miss work or be separated from their crews. Instead, AI-informed decision support could enable more nuanced approaches, such as temporarily assigning personnel to lower call volume apparatus, rotating firefighters through quieter stations within the same district or county, or modifying duties to support recovery while maintaining engagement with the team. The objective is not to reduce operational capability, but to sustain it by better managing cumulative fatigue before it compromises firefighter wellbeing or safety.

A practical first step may be a voluntary pilot program at one or two stations,

integrating existing staffing and wellbeing data to identify fatigue trends and evaluate targeted interventions. Success could be measured through reductions in injury rates, sick leave utilisation, overtime associated with workforce shortages, or improvements in self-reported wellbeing.

Similarly, AI has the potential to support psychological wellbeing through exposure trend analysis. Firefighters routinely attend traumatic incidents including fatalities, serious motor vehicle accidents, and medical emergencies involving children. While individual incidents may not trigger immediate concerns, repeated exposure over time can significantly increase psychological risk. By identifying patterns of cumulative exposure, AI-enabled systems could prompt confidential peer support outreach or early access to mental health resources before firefighters reach crisis point.

Perhaps most encouragingly, the cultural foundations for these approaches may already exist within the profession. The fitness-focused lifestyle that attracts many firefighters increasingly extends beyond the station, with wearable technologies such as Garmin watches and WHOOP bands commonly used to monitor sleep quality, recovery, heart rate variability, training load, and overall wellbeing. Following a busy night of calls, it has become almost ritualistic for crews to gather around the mess table comparing sleep scores, recovery metrics, or depleted "body batteries" over a strong coffee. Far from resisting data-informed wellbeing, many firefighters have already embraced it independently, presenting an opportunity for organisations to partner with firefighters rather than impose new technologies upon them.

Through voluntary and opt-in programs, firefighters could elect to securely share selected wellness metrics, such as sleep duration, recovery scores, or indicators of sustained physiological stress. AI could then provide firefighters with personalised insights into their own readiness and recovery while helping organisations identify broader workforce trends.

This concept mirrors the philosophy underpinning the NFL's Digital Athlete platform. Elite sporting organisations increasingly recognise that performance and safety are enhanced when interventions occur before injury rather than after it. Firefighters, often described as tactical athletes, deserve a similarly proactive approach to health and wellbeing.

However, the success of AI-enabled wellbeing initiatives will ultimately depend on trust. Firefighters may understandably question whether health data could be used for performance management, promotion decisions, or disciplinary purposes. Any implementation must therefore ensure participation remains voluntary, health information is used to support rather than punish firefighters,

and AI augments rather than replaces human judgement.

Organisations must also carefully consider governance challenges, including who has access to health data and how confidentiality is maintained. In small crews or individual stations, even aggregated wellbeing information may inadvertently identify individuals, potentially undermining trust if safeguards are not established from the outset. The objective is not to determine fitness for duty through automated systems, but to provide firefighters and leaders with better information to recognise emerging risks earlier and intervene sooner.

The benefits of proactive wellbeing initiatives extend beyond individual firefighters. Fire departments and governments also bear significant operational and financial consequences associated with occupational injuries and illnesses through increased overtime costs, workers' compensation claims, prolonged absences, and workforce shortages. In Australia, recent amendments to New South Wales presumptive cancer legislation recognising 22 occupational cancers among firefighters further reflect the growing responsibility agencies have in supporting long-term firefighter health. As fire services continue to expand their responsibilities while managing increasing operational demands, investing in approaches that help prevent injury and illness becomes not only a wellbeing imperative, but an operational and economic one.

This approach aligns strongly with several of the National Fallen Firefighters Foundation's 16 Firefighter Life Safety Initiatives, particularly Initiative 6 (medical and physical fitness), Initiative 8 (the use of technology to improve safety outcomes), and Initiative 13 (behavioral health and psychological wellbeing). AI-enabled wellness programs have the potential to support all three by identifying risks earlier and facilitating timely intervention.

The question facing the fire service is no longer whether artificial intelligence can improve firefighter health, wellness, and safety. Rather, it is whether we are prepared to embrace the cultural changes required to use these tools responsibly and effectively. By identifying risks earlier, supporting timely interventions, and fostering a culture of proactive wellbeing, AI provides fire services with an opportunity to move beyond simply responding to firefighter harm towards preventing it wherever possible - helping more firefighters not only return home safely after every shift, but also enjoy long, healthy, and fulfilling lives beyond their years of service.

READING THE HUMAN SMOKE: DEPLOYING AI ACROSS THE MENTAL, PHYSICAL & OPERATIONAL LAYERS OF FIREFIGHTER SAFETY

Fire Chief Jeremy Holmes

Every year, fire departments invest millions of dollars in utilizing artificial intelligence for predictive technology. Advanced algorithms are built to track fire behavior, from residential and commercial fires, to large-scale wildland incidents. The fire service uses AI to identify potential collapse zones, enhance apparatus response routes, and provide checklists to ensure ICS is properly followed. These are just a few of the ways AI is being used in public safety across the world. We are obsessed with predicting the failure points of everything surrounding fire departments, yet when it comes to the most important asset at the fire station—the human—the fire service remains stubbornly reactive. We check firefighter vital signs only after they appear to be suffering from heat exhaustion, and we offer mental health resources only after a member reaches a breaking point or following a single traumatic response. The fire service has always measured success by how well it responds to a crisis after the emergency. However, with the high volume of cardiac events, toxic exposures, and psychological burnout, we must ask a vital question: If we can use data to predict a flashover in a room, why are we not using data to predict the breakdown of our people?

Artificial intelligence can be the greatest advancement in occupational health and safety, offering an unprecedented opportunity to shift from reactive treatment to predictive safeguarding. This technology does not and cannot replace human judgment, nor can it override the intuition of fireground commanders. Instead, artificial intelligence can serve as a safety officer that never sleeps, always watching over the firefighters and the community they serve.

By integrating artificial intelligence systems into the mental and physical foundations of the fire service, predictive data can be used to intercept post-traumatic stress before it is realized, forecast life-threatening overexertion on scenes before injury occurs, and assist leadership with policies to reduce burnout while increasing daily wellness. Embracing artificial intelligence is not abandoning our honored traditions; it is modernizing our mission to ensure everyone goes home.

The Mental Foundation: Recognizing the Invisible Crisis

The reality of the problem is that firefighters are repeatedly exposed to acute trauma that builds over a long career. The common approach used by most fire departments relies on the individual self-reporting when they need help. This can be counter-productive in the fire service for many reasons, including the fear of being deemed unfit for duty or a culture that discourages members from speaking up. The truth is that a sleep-deprived, distracted, and traumatized firefighter is a liability to themselves and their crew, both on scenes and around the station.

The solution lies in using artificial intelligence in alliance with CAD and incident tracking. Algorithms could be built to monitor Computer-Aided Dispatch (CAD) or National Emergency Response Information Systems (NERIS) data in the background. Instead of monitoring the firefighter directly, the system monitors the inputs they face. By tracking the cumulative exposure of individual units, the system could automatically trigger a "trauma threshold alert." Further data points could be integrated, such as sleep monitoring, sick leave trends, or other indicators of a mental health crisis. Rather than sending these alerts to administrative personnel, notifications could be routed discreetly to peer support leaders or external clinicians.

While the hurdle will be ensuring privacy and trust, this can be addressed with transparent processes and data security. This shifts the burden away from the firefighter having to self-report and uses predictive analytics to prompt confidential peer check-ins, intercepting PTSD and substance abuse before they manifest into a life-threatening crisis.

The Physical Foundation: Preventing Fireground Overexertion

Firefighters often push themselves past the point of exhaustion due to adrenaline and necessity. Currently, most departments are reactive, checking vitals only after a crew exits a hot zone. By the time a firefighter feels dizzy, they may already be experiencing heat exhaustion or a cardiac crisis. Cardiac events and heat stroke remain leading causes of death in the fire service.

Artificial intelligence can be utilized to continuously monitor core temperatures and cardiac rhythms through biometric sensors integrated into uniforms or gear. This shifts fireground management from random bottle-change schedules to real-time data. For example, minutes before a medical emergency threshold is reached, AI could alert a Safety Officer that a specific firefighter has a high probability of heat stress failure. Just as a thermal imager sees through smoke, AI allows leaders to see through the "tough-it-out" mentality. Shifting to a data-

driven system can intercept cardiac events before they occur, actively reducing line-of-duty deaths.

The Operational Foundation - Combating Chronic Fatigue and Documentation Burnout

Sleep deprivation and chronic fatigue are major threats in firefighter safety. Studies are continuously being done showing extended hours of sleeplessness impairs cognitive and motor skills mirroring that of alcohol intoxication. When a fire service member is forced to sit at a computer desk for hours drafting narratives for reports on back-to-back calls in the middle of the night causes burnout and fatigue. This lack of recovery and restorative sleep leads to slower reaction times, compromised situational awareness, and long-term health issues.

Using artificial intelligence as a “voice-to-text” in a natural language processing (NLP) trained in fire service and medical terminology could combat this time dramatically. Instead of a medic or company officer typing out long narratives, they can simply dictate call details conversationally into a secure device on the return trip from the hospital or scene. Artificial intelligence would not just transcribe the text. Systems could be established that extracts key clinical or operational markers and automatically populate into the fields within the EPCR or NERIS incident report.

By cutting documentation time, departments will be able to reclaim hours of productivity time, reduce overtime costs associated with late-run reports, and ensure crews return to a state of operational readiness much quicker.

Utilizing AI in these foundations is deeply rooted in the National Fallen Firefighters Foundation’s "Everyone Goes Home" program. Initiative 8 mandates that available technology be utilized to produce higher levels of health and safety. Furthermore, Initiatives 4 and 6 are advanced by strengthening accountability and fitness through automated safety thresholds. Finally, AI empowers leadership to stop unsafe practices through undeniable data rather than relying on subjective human pride.

Artificial intelligence should never replace the tactical intuition of a firefighter or the presence of a commander. Instead, the fire service must embrace AI as an asset to enhance human decision-making. By intertwining our rich history of service with predictive power, we can modernize our commitment to safety. The data is available, the technology is viable, and our mandate is clear: we must use every tool at our disposal to ensure that everyone goes home.

AI AND THE
NEXT ERA OF FIREFIGHTER SAFETY

Ex-Chief Peter Finkle

On July 1, 1988, firefighters from the Hackensack New Jersey Fire Department were dispatched to a commercial structure fire at the Hackensack Ford dealership. It seemed to be a typical commercial structure fire, with heavy smoke pushing from the roof. Crews began by initiating an attack from the outside into the showroom with hand lines, with a truck company on the roof starting ventilation. Those firefighters in the showroom did not know how much danger was hidden above them.

The building had a lightweight bowstring truss and an added suspended ceiling that concealed that hazard. That ceiling allowed fire to spread rapidly through the attic space without any noticeable detection by the crews operating below. From the interior of the building, it appeared relatively stable. Communication at the scene was limited compared with what departments have available today, and there was no reliable way to relay how far and quickly the fire had extended overhead. The fire continued to burn, weakening the truss system, unbeknownst to any of the interior attack crews. Without warning, the roof gave way, and three members of the department lost their lives in the collapse. Two firefighters retreated from the collapse zone to a nearby isolated room, and despite heroic efforts to reach the trapped members, they perished as the remaining trusses and roof collapsed, destroying the building.

The Hackensack Ford fire became a defining tragedy in modern fire service history, leading to significant changes in awareness of collapse zones, truss and bowstring-roof construction, hidden fire conditions, and code enforcement. In my home state of New Jersey, the aftermath helped drive regulatory changes requiring exterior identification of structures with truss construction with roof-truss markers. Before this fire, Personal Alert Safety Systems (PASS) were not universally available because they were not mandatory. While this tragedy changed the fire service, it also makes us now question how this fire would unfold today...

Jump forward in time to today, and the outcome of this fire might be very diUerent with the help of artificial intelligence. Not because firefighters are less willing to take risks or any less committed to doing the job, but because departments, oUicers, and firefighters will have information at their fingertips that was not available in 1988. Artificial intelligence will be key to providing this life saving information and doing it instantaneously.

An AI system would be used to help identify the building as a bowstring truss structure on arrival by pulling from inspections, tax records, construction permits, and mapping data. Drones equipped with thermal imaging could scan the roof and detect changes in the roof line, as well as the rapid development of heat in void spaces, long before obvious signs of collapse appeared to command. All those warnings and essential information relayed in real time long before the roof system was being compromised.

Instead of relying only on our vision or what feels right in the moment, command could receive early warnings that conditions were worsening. Now with the knowledge that the building was becoming unstable, there is a good chance those crews will be pulled out sooner.

Now imagine the same incident unfolding today. Firefighters arrive on scene, stretch lines, search for victims, and work to save the building. What has changed is that AI gives us a new kind of vision—one that can detect danger through smoke, walls, and ceilings before it becomes visible. Command receives an alert that the bowstring truss roof has been seriously weakened, and interior crews are ordered out. They may not like backing out of a fire and may believe they can still fight it, but they listen and leave. Moments later, the roof collapses into the exact area where they had been working. The collapse still happens, but the firefighters are no longer beneath it.

Artificial intelligence will achieve its most profound impact on the fire service by safeguarding human life, rather than replacing personnel. The changes and information that it will bring will enhance and change how we work. Our health, safety, and training will change, and we will be better as a result. Wearable devices can monitor firefighters for heat stroke, dehydration, or heart problems before they become fatal by providing preemptive identification of fatigued firefighters. AI-driven simulations enable firefighters to master high-hazard fireground conditions without physical risk. By replicating complex, high-stress scenarios in a controlled environment, this new technology delivers critical tactical experience while eliminating frontline danger during training. On scene, predictive software assists in reading fire behavior or predicting building collapse for commanders—critical information in high-stress, high-speed scenarios. We can also use drones and robots for a first look at dangerous locations. Even during the post-incident review, AI can analyze incident data and reveal key lessons for tactical development and future training.

None of these advancements eliminate the human component of firefighting. Firefighters will always rely on their training, experience, discipline, gut instincts, camaraderie, and bravery. But today's fires burn hotter, building construction has become more complex, and there is often an even smaller time frame in which

the correct tactical decision needs to be made. AI can accelerate the analysis of incident information far beyond that of human capability and give commanders and firefighters the most eUective tactical tools at their disposal.

The fire at Hackensack Ford is a somber, significant reminder of the hazards of this profession and the importance of advancements in fire service operations. All fires and incidents teach lessons, and those lessons can aUect the way we train and operate on the fireground. AI is potentially the next stage in this development of the fire service, not to replace bravery but to protect those individuals who bring it to our communities.

In memory of the firefighters who gave their lives at the Hackensack Ford fire:

Captain Richard Williams, Engine Company 304

Lieutenant Richard Reinhagen, Engine Company 302

Firefighter Steven Ennis, Rescue Company 308

Firefighter William Krejsa, Engine Company 301

Firefighter Leonard Radumski, Engine Company 302

May our brothers' sacrifice never be forgotten, and may their legacy continue to push the fire service toward a safer future.

WHAT NEXT?

Thank you for helping us challenge the status quo and bring awareness to such an important topic. Change happens through thought leadership, and your contribution helps move us all forward. We invite you to apply for the 2027 contest and continue to question, disrupt, and inspire meaningful change.

STAY TUNED FOR THE 2027 ESSAY COMPETITION UPDATES AND FUTURE THOUGHT LEADERSHIP OPPORTUNITIES!

THE FIRE SERVICE THOUGHT LEADERSHIP COMPETITION WAS CONCEIVED BY GARRY BRIESE AND BROUGHT TO FRUITION BY DARLEY'S COMMITMENT TO THE FUTURE OF THE FIRE SERVICE.

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National Fallen Firefighters Foundation