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Using AI to Enhance OEHS

Guidance Document

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AIHA®
3120 Fairview Park Drive, Suite 360
Falls Church, VA 22042
Tel: (703) 849-8888
Fax: (703) 207-3561
Email: infonet@aiha.org
https://www.aiha.org

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Glossary

Algorithms: Mathematical processes that are expressed as computer programming code (Ooi et al., 2023).

Application Programming Interface (API): A set of rules or protocols that enable software applications to communicate with each other to exchange data, features, and functionality (IBM, 2024).

Artificial Intelligence (AI): Computing technology designed to assist with or address tasks such as pattern detection, prediction, decision-making, or process optimization traditionally requiring human intelligence (Jetha et al., 2023).

Agentic AI – Agentic AI uses sophisticated reasoning and iterative planning to autonomously solve complex, multi-step problems (Nvidia, 2024).

Augmented Reality (AR): Real-time integration of digital information into a user's environment. AR technology overlays content onto the real world, enriching a user's perception of reality rather than replacing it (IBM, 2024f).

Black Box: An AI system whose internal workings are a mystery to its users (IBM 2024g).

Data Quality: A broad category of criteria that organizations use to evaluate their data for accuracy, completeness, validity, consistency, uniqueness, timeliness, and fitness for purpose (IBM, 2024a).

Data Security: The implementation of safeguards to prevent data corruption by malicious actors (IBM, 2024a).

Generative AI: Using artificial intelligence techniques to create new data, like images, text, or music. These models learn the underlying patterns and structure of existing data and use that knowledge to generate novel content that resembles the training data (IBM 2024c).

Hallucinations: A phenomenon wherein a large language model, often a generative AI chatbot or computer vision tool, perceives patterns or objects that are nonexistent or imperceptible to human observers, creating outputs that are nonsensical or altogether inaccurate (IBM 2024d).

Large Language Models (LLMs): Tools trained on extensive quantities of data and designed to understand and generate text and other forms of content like a human; examples include OpenAI's ChatGPT, Meta's LLAMA, and Google's PaLM models (IBM 2024c).

Machine Learning: A branch of artificial intelligence that focuses on the use of data and algorithms to enable AI to imitate the way that humans learn (Jetha et al., 2023).

Model Collapse: A degenerative phenomenon in generative AI where models trained on AI-generated content (synthetic data) experience a decline in performance, accuracy, and diversity over successive generations (Shumailov et al., 2023).

Multi-Modal AI: A branch of AI that can consume, evaluate, and create various data types, including images, videos, audio, and motion in addition to text (Ooi et al., 2023).

Glossary

Mixed Reality (MR): Similar to Augmented Reality, this is also real-time integration of digital information overlaid onto the real world; however, in MR, the physical and digital elements can be perceived as interacting (Microsoft, 2023).

Natural Language Processing: A branch of artificial intelligence that "enables computers and digital devices to recognize, understand and generate text and speech by combining computational linguistics... with statistical modeling, machine learning, and deep learning." (IBM 2024b).

Predictive Analytics: A branch of advanced analytics that makes predictions about future outcomes using historical data combined with statistical modeling, data mining techniques, and machine learning (IBM, 2024e).

Virtual Reality (VR): Immerses users in a digital environment, typically by using a VR headset, head-mounted display, or VR goggles. Unlike Augmented Reality (AR), VR completely replaces the physical world, surrounding users with a 360-degree view of computer-generated environments (IBM 2024f).

Executive Summary

This report examines the rise of Artificial Intelligence (AI) technology and its potential use by practicing occupational and environmental health and safety (OEHS) professionals. AI, computing technology designed to assist with or address tasks traditionally requiring human intelligence, has rapidly advanced.

With this advancement comes the need for OEHS professionals to:

- recognize different categories of AI technology currently available and applicable to OEHS work tasks;
- understand case studies of how these tools have begun to be implemented for OEHS purposes;
- begin planning how AI can and will be integrated into their OEHS practice; and
- understand the potential impacts on the OEHS profession from widespread adoption of AI.

Benefits and Risks

Different types of AI offer OEHS professionals a variety of impactful benefits above and beyond what was previously available to the profession. These AI types include:

- machine learning that uses data and algorithms to imitate human learning processes;
- predictive analytics to process and analyze complex datasets, identify trends related to occupational exposure hazards, and offer rapid decision-making assistance;
- computer vision and processing that utilizes still or video images to identify, track, and provide recommendations on health and safety modifications;
- complex language models and natural language processing trained to perform tasks such as writing occupational health programs or drafting risk communication products;
- interactive systems that communicate with workers or other interested parties to answer questions or provide guidance based on curated data sets; and
- agentic AI and other automations with the capacity to reduce or eliminate routine tasks.

This report presents and links to case studies that demonstrate and describe the application of these AI types in the occupational health context.

Despite the potential benefits of incorporating AI into OEHS practice, several factors may impede successful utilization. Information technology (IT) concerns about data security and privacy are amplified as AI adoption increases. OEHS professionals must understand these security threats and actively assist in planning mitigation measures. For AI output to be accurate, actionable, and reliable, OEHS professionals must take appropriate steps to ensure high-quality data input. Furthermore, as AI models and algorithms become more complex, the risks increase of generating output without a clear understanding of how the output was derived (i.e., the "black box" issue), as does the potential for biased results. Practitioners will always be responsible for any information they communicate. "The AI did it" will never be an acceptable excuse for workers, clients, or the public.

Call to Action

Despite these risks, AI has already become ubiquitous in many aspects of our personal and professional lives. OEHS professionals must become comfortable working with this technology to incorporate it thoughtfully and strategically into their practice. They will need to ensure that data quality and integrity

are prioritized when using predictive analysis or machine learning. Collaboration with employees at all levels of their organization will be vital, especially with workers concerned about how these technologies will impact them. OEHS professionals must understand and explore the ethical implications of AI use in their specific contexts and act ethically upon these considerations. AIHA members should familiarize themselves with the AIHA Members and Volunteers Artificial Intelligence Responsible Usage Policy; the AIHA Board of Directors will revisit and revise this policy as AI technology continues to evolve. Furthermore, AIHA will advocate for increased understanding of this technology among members and develop learning content to address the needs of OEHS professionals.

Overview

As OEHS professionals, we are committed to protecting workers' health and safety while ensuring safe and healthy work environments. While traditional tools like sampling pumps, calibrators, and dosimeters remain essential, the evolution of artificial intelligence (AI) technologies offers opportunities to enhance our practice in innovative ways. AI continues to evolve with enormous potential benefits across industries; recent data shows that AI adoption is accelerating, with 76.1% of Fortune 1000 organizations in experimentation and testing phases. Implementation at scale has increased from 4.9% to 23.9% between 2023 and 2024 (Bean, 2025). While these advances may prove advantageous in many ways, AI will likely disrupt existing jobs and tasks, potentially leading to workplace adjustments as jobs are redesigned or require new skills (European Commission, 2022).

What is AI?

Artificial Intelligence refers to computing technologies that address problems traditionally requiring human intelligence, including pattern detection, prediction, decision-making, and process optimization (Jetha et al., 2023). Major categories of AI technologies relevant to OEHS include predictive analytics via machine learning, computer vision, large language models (LLMs), and agentic AI.

A review by Jetha et al. (2023) identified three areas in which AI adoption affects workplace health and safety:

- AI-catalyzed changes in the design of work environments, how job tasks are performed, and increased demands for workers in certain occupations;
- AI as tools to identify and address hazards to which workers are exposed and to promote their health and safety; and
- AI produces biased and/or discriminatory outcomes for workers if the diversity of worker experiences and backgrounds are not accounted for.

For OEHS professionals, AI tools offer potential benefits for addressing worker exposure hazards, with documented applications across core industrial hygiene functions:

- **Anticipation** - AI-driven systems can monitor workplace conditions and predict equipment failures before they occur. Predictive maintenance capabilities help anticipate potential safety issues.
- **Recognition** - AI contributes to safer workplaces by providing real-time insights, risk assessment, and behavior monitoring. Computer vision systems can identify safety violations and hazardous conditions.

- **Evaluation -** AI has potential in augmenting human expertise in occupational exposure assessment. Machine learning can analyze complex exposure data patterns.
- **Control -** AI enhances safety and productivity through automated monitoring and control systems. However, human oversight remains essential for verification and decision-making.

These applications represent emerging capabilities rather than fully mature solutions, and implementation requires careful consideration of data quality, validation, and human oversight to ensure effectiveness. Literature reviews have documented successful applications of AI adoption and/or integration across diverse industry sectors. Pishgar et al. (2021) highlighted implementations in transportation, mining, oil and gas, agriculture, and construction, where AI has enhanced OEHS interventions. However, the authors also identified gaps in educational resources and funding for AI research in OEHS, advocating for longer-term strategies to explore benefits and challenges systematically (Pishgar et al., 2021).

The Evolution of AI Standards and Best Practices

As of the date of publication, the U.S. lacks comprehensive federal legislation regarding the responsible development and use of AI (Tantleff & Howell, 2025). While the Biden administration issued an executive order on the safe development of AI (Manning, 2024), executive orders are subject to modification by subsequent administrations. In January 2025, President Trump rescinded the previous administration's executive order, requiring several agencies to develop an action plan to help sustain and enhance America's global AI dominance. (Tantleff & Howell, 2025). In July 2025, the White House released America's AI Action Plan, a comprehensive strategy built on three pillars: accelerating AI innovation, building American AI infrastructure, and leading in international AI diplomacy and security.

The U.S. Supreme Court's decision in *Loper Bright Enterprises v. Raimondo, Secretary of Commerce et al.* overturned the longstanding Chevron deference doctrine, which previously required courts to defer to federal agencies' interpretations of ambiguous statutes. This landmark ruling weakens agencies' power to implement regulatory laws and transfers interpretive authority from expert agencies to individual judges, even for highly technical matters (New Lines Institute, 2024).

For AI regulation, this means agencies can no longer expect judicial deference when applying existing statutes to emerging AI technologies. Agencies must now craft interpretations that can withstand independent judicial review rather than relying on deference (Manning, 2024). The decision shifts interpretive authority from administrative agencies to federal courts, potentially requiring more explicit congressional action for comprehensive AI regulation.

At the time of writing, AI regulations exist in 17 U.S. states (see Appendix A for a complete listing) that have enacted 29 AI-focused bills since 2019. These bills primarily address data privacy, algorithmic transparency, and accountability. (Wright, 2023). International AI governance frameworks are also emerging in the European Union and other jurisdictions (Sheehan, 2023; EU, 2024). However, until the U.S. Congress passes regulation, and likely thereafter, it will be up to the private sector and non-governmental groups to work together to develop consensus standards on the responsible use of AI. The International Organization for Standardization (ISO) has published several standards pertaining to AI (ISO, n.d.). In addition, the National Institute of Standards and Technology (NIST) has provided general guidance for the responsible use of AI (NIST, 2024). Standards from these organizations can be adapted to an OEHS context by aligning with the following framework:

1. Use AI with human expertise, not as a replacement.

2. Disclose any use of AI to all stakeholders.
    a. **Example:** The use of AI to perform a literature review
    b. **Example:** The use of AI-generated figures for presentations
    c. **Example:** The use of AI to translate documents

3. Develop and use AI in accordance with existing laws and regulations (AI-related or other).
    a. **OEHS Example:** A company wishing to use AI to help identify patterns in employee health surveillance data must ensure that all data provided to the AI is protected in accordance with federal, state, and local privacy laws. In addition, the company must adhere to its policies regarding the handling of personally identifiable information (PII). This includes the transmission of data to third-party AI services.

4. The corpus of knowledge used to train and fine-tune the AI should be transparent and fit for use.
    a. **OEHS Example:** A company wishing to utilize AI to analyze safety data sheets (SDSs) to provide a chatbot that employees can consult regarding safe handling and personal protective equipment (PPE) selection should only fine-tune the chatbot on the latest version of the safety data sheets so that it presents the most up-to-date information.

5. Evaluate risk for every AI tool to determine the probability and severity of negative outcomes (i.e., those that are harmful or incorrect).
    a. **OEHS Example:** A company wishing to use continuous sensor data and a machine learning (ML) algorithm to predict airborne concentrations of a certain chemical based on product volume should understand the inherent error rate in the sensors generating the data, natural variability in workplace exposures, and the uncertainty around model estimates over a range of plausible values. Based on worst-case assumptions, determine if the probability and severity of an adverse outcome are sufficiently low to be tolerable.

6. Evaluate AI continuously to ensure appropriate and relevant outputs for the given task.
    a. **OEHS Example:** A company that develops an AI to predict noise exposure in certain occupations should ensure that the AI is still operating within acceptable parameters as processes and job responsibilities change.

While the above guidelines provide a baseline for the responsible use of AI, as detailed below, several unique challenges associated with AI will indirectly and directly impact the OEHS profession. As the underlying technology advances and new tools are released, these challenges are certain to change.

Advancements in AI that will Indirectly Impact the OEHS Profession

On a societal level, the propagation of AI coupled with targeted content delivery through social media will lead to the siloing of incorrect information to different subgroups of society, potentially leading to a widening gap in the public's understanding and agreement with basic facts, making it more difficult to productively engage employees in a company's safety culture (Saheb et al., 2024). This could occur due to bad actors (Freedom House, 2023) or incidentally because platforms compete for users' limited attention spans, often prioritizing engaging content over accurate content to maximize advertising revenue, which can drive users towards incorrect information (UN, 2023).

The adoption of AI will also serve to democratize specific skills at the expense of expertise. For example, a large part of computer programming involves understanding the syntax of the programming language to instruct a computer to complete a specific task. LLMs are already competent at writing a basic functional program in dozens of languages based on the description provided by the user. However, this allows a user to bypass the typical troubleshooting process programmers use to solve a problem. While the code written by LLMs can be technically correct, it often lacks information on the larger purpose of the code, which can lead to errors, causing the code not to run, or worse, having the code run but producing less than optimal outcomes, leading to the risk of injury or loss. This experience is critical to a new programmer's understanding of the language they are working in, the data structure of their project, and other nuances critical for ensuring a comprehensive understanding of computer programming (Ooi et al., 2023). While the long-term effects of relying on AI to code have yet to materialize, preliminary analysis suggests that programmers working with AI assistants produce less secure code than those without (Perry, Srivastava, Kumar, & Boneh, 2023).

Similar concerns could be expressed for more creative pursuits such as story writing, lyric composition, or writing a fan letter to your favorite Olympic athlete (Holmes, 2024). Going forward, it will be more difficult for companies to distinguish between candidates who truly possess specific skills and those who can utilize AI, giving the illusion that they have those skills. OEHS educators and professionals will need to adapt to this new reality to ensure that those new to the field actually possess the necessary knowledge and skills and are not simply relying on AI.

Advancements in AI that Will Directly Impact the OEHS Profession

As artificial intelligence tools continue to evolve and become more accessible, many tasks currently performed by OEHS professionals are poised to be partially or fully automated. Activities once streamlined by mobile computing, such as communication, note-taking during walkthrough surveys, and referencing documentation, may soon be handled largely by AI (Khogali & Mekid, 2023). This shift will require OEHS professionals to become proficient in using AI tools appropriately and to critically assess the outputs they generate.

While these technologies promise to improve efficiency, they will also broaden the scope of OEHS roles. Professionals may be asked to take on new responsibilities that demand a foundational understanding of data science and artificial intelligence. As a result, OEHS education, whether through academic programs or continuing professional development, must adapt to include these competencies.

It's important to recognize, however, that increased reliance on AI can come with unintended consequences. For students and early-career professionals in particular, there is a risk that cognitive offloading, relying on AI for thinking and decision-making, could hinder the development of critical thinking skills (Gerlich, 2025). Ironically, overdependence on AI could reduce the analytical capabilities needed to evaluate AI-generated outputs.

In addition to direct health and safety applications, OEHS professionals will increasingly be involved in designing and overseeing related automated systems. These include optimizing sensor placement or determining which employees and areas to monitor. Applying professional judgment will remain essential, especially when interpreting the results of AI or machine learning models. Practitioners must also understand the limitations of these tools, including potential risks like sampling bias or "model collapse" caused by recursively feeding model-generated data back into the system (Shumailov et al., 2023). Ultimately, OEHS professionals must remain actively engaged in all AI-enabled processes. They are the final safeguard, ensuring that AI-driven decisions align with the core mission: protecting the health and safety of workers.

As agentic AI systems mature, they will have a significant impact on OEHS as they are autonomous, goal-driven agents that couple perception with reasoning and action. They can ingest live data (from sensors, documents, or human prompts), break high-level objectives into discrete steps, and iteratively execute them while monitoring results. Unlike basic generative tools that stop after each discrete step, these agents close the loop (e.g., detecting an airborne contaminant spike, notifying the employee, sending a text message to the OEHS team, and providing a draft exposure notice to the occupational health clinic). This autonomy makes them uniquely powerful for OEHS tasks that demand real-time, multi-step hazard control. The autonomous nature of agentic systems stands to benefit seasoned OEHS professionals greatly by reducing or eliminating the routine and mundane tasks involved in the profession while increasing the responsibility to ensure quality outputs and actions of the agentic AI system. However, agentic systems may have a significant impact on entry-level OEHS professionals who historically have "cut their teeth" on repetitive and mundane tasks to better understand the intricacies of the profession.

Understanding AI's Role in AIHA Content Priorities

AI will become an essential aspect of content development through all of AIHA's content priorities. A 2024 AIHA environmental scan of future trends and themes identified AI-related technologies as being highly influential across all aspects of OEHS practice. The scan found AI to be one of the most impactful trends, affecting everything from how information is gathered and analyzed to how workplace health and safety decisions are made. By understanding and embracing these changes, while carefully managing their implementation, OEHS professionals can enhance their effectiveness in protecting workers' health and safety. The scan led to AI being explicitly added to the Big Data and Sensor Technology priority. However, as the following sections show, AI will play a role across all AIHA priority areas.

Big Data, A.I., & Sensor Technologies

Big Data, AI, & Sensor Technologies focus on helping OEHS professionals leverage cutting-edge technologies to collect and integrate data to inform risk assessment and management decisions and stay relevant in the face of transformative change. The field of industrial hygiene is rapidly incorporating emerging exposure assessment tools, including those that use direct-reading real-time sensors to measure and record exposure concentrations, analyze video, and generate streams of complex datasets (i.e., big data) for analysis. The 2024 AIHA environmental scan identified several key trends related to AI and data analysis, including the emergence of machine-readable workplaces and domain-specific AI models. As such, industrial hygienists will need to have a basic understanding of AI technology and how such technology can be used for improved collection and analysis of this data.

Changing Work Dynamics

Changing Work Dynamics focuses on educating OEHS professionals about evolving workplace trends and transformations, including shifts in employment relationships, physical and virtual work environments, technological innovations, and emerging work processes. This priority equips the OEHS community with strategies to effectively respond to these developments while maintaining its mission to protect human health in both workplace and community settings. The environmental scan highlighted workforce shifts and automation as key areas of change. Non-traditional work arrangements and the changing workforce allow for non-traditional exposure profiles and new ways to address them. OEHS professionals need to have a functional awareness of emerging AI technology tools that can address these changing workforce issues. Some of these changing workforce issues may have emerging AI technologies as a causative factor of those changes.

Enhancing OEHS Communication Skills

Enhancing OEHS Communication Skills focuses on developing the interpersonal skills of OEHS professionals to listen, relate, communicate, educate, and collaborate effectively with a diverse range of stakeholders to enhance the influence and value of the OEHS profession in a dynamic social-technological landscape. The 2024 scan identified significant trends around changing information flows and the growing role of AI in communication. As part of OEHS practice, OEHS professionals need to communicate and collaborate effectively with various stakeholders and may increasingly rely on AI tools to do so. AI tools may also offer opportunities to create new and unique training or educational products, communicating important OEHS concepts. Examples include:

- Creating short instructional videos on PPE usage without filming (text-to-video);
- Converting safety training into multiple languages instantly;
- Developing scenario-based training for hazard recognition;
- Transforming complex exposure data into comprehensible graphics; and
- Adapting training content based on individual knowledge gaps.

Furthermore, AI is increasingly becoming a key interpreter of OEHS information for various stakeholders, helping to analyze trends, predict risks, and communicate findings in accessible formats.

Total Worker Health®

Total Worker Health® focuses on protecting and promoting worker well-being. The environmental scan identified several emerging health threats and challenges that AI could help address, including the integration of workplace, environmental, and personal health factors. AI technologies will be able to help analyze complex interactions between workplace exposures, environmental factors, and individual health indicators, addressing health and safety prevention in a manner consistent with Total Worker Health® principles. As AI tools advance, they can provide OEHS professionals with the ability to better understand disparate and extensive data sources, including occupational and environmental exposures, individual personal behaviors and characteristics, and other stressors, allowing for more comprehensive approaches to worker health protection.

OEHS and AI Technologies

The growing utilization of AI has significantly influenced environmental health and safety. AI will continue to aid EHS professionals in anticipating, recognizing, evaluating, and controlling health hazards. The effective use of AI can be seen across multiple disciplines under the OEHS umbrella. As AI continues to evolve, EHS professionals can use this technology to assist in OEHS assessments and decision-making related to feasible implementations of traditional methodologies and OEHS concepts.

While examples of successful implementation of the use of advanced AI specific to industrial hygiene have historically been limited, examples are increasing, and there are tremendous opportunities for improving the quality of programs, harnessing complex sets of exposure, hazard, and work process information, training and modifying the behavior of workers, and increasing access and output of information. All of these efforts can be used to enhance safety and health in the workplace and minimize the risk of accidents, injuries, and adverse health effects. These opportunities require multidisciplinary coordination, especially with IT, operations, management, and the worker. The following sections offer a brief description of the types of AI that OEHS professionals can leverage. This is not intended to cover all types of AI as the field continues to evolve rapidly. Resources that have useful, regularly updated content include MIT's Technology Review, The Berkeley AI (BAIR) Blog, IBM's AI Page and Resources, and Google's Research blog.

AI-enabled Sensors

Wearable devices equipped to work with AI are becoming an essential part of industrial hygiene, providing personalized data about each worker's health and exposure to hazards. These wearables, such as smart helmets, wristbands, and glasses, monitor vital signs, fatigue levels, and environmental exposures in real-time, and AI can analyze this data to offer personalized safety recommendations. These detection tools can be all-in-one devices, such as AI-powered safety glasses currently being field tested by OSHA, discrete sensors that link with existing IT infrastructure, or even employees' smart devices (El-Helaly, 2024). For example, if a worker is exposed to high temperatures or hazardous chemicals for an extended period, the wearable can alert them to take a break or seek assistance. This type of passive data collection and early warning capability has been demonstrated with the Apple Noise app on its smartwatches (Roberts et al., 2022). AI can also monitor fatigue levels to prevent accidents caused by overexertion, such as falls or mishandling of equipment. As stated in a recent publication, "The data collected by wearable devices and the Internet of Things (IoT) can be manipulated by AI to inform the implementation of targeted wellness programs, including personalized fitness plans and stress management workshops, to support overall employee well-being." (El-Helaly, 2024) By continuously adapting to individual workers' needs, these AI-powered wearables help ensure both safety and productivity.

Machine Learning and Predictive Analytics

ML is a subset of AI that focuses on the use of data and algorithms to enable AI to imitate the way that humans learn. This includes the ability of a network to classify data, make predictions, "learn" via supervised and/or unsupervised techniques, and make further predictions based on its learning – also known as predictive analytics.

Until recently, linking data in different datasets and databases was a very manual, time-consuming process. In addition, in many cases, data clean-up is necessary to maximize the value of the data and the accuracy of the ML predictions and classifications. Both efforts can be very time-consuming. Machine learning offers a way to more efficiently process and classify data, automate data linkages to enable data connections across databases, and then use the data to make predictions. Data connections can be made between OEHS, process, quality, maintenance, and/or training data, which can then be used to better understand the relationships between process activities, performance, exposures, and, ultimately, health outcomes. This can increase the value of existing OEHS data and has the potential to improve exposure and risk assessment processes, as well as risk management and risk communication efforts, and create a business case for investments in tools, equipment, and training.

AI's capacity to process complex datasets enables OEHS professionals with the ability to more accurately and comprehensively assess health risk in the workplace. AI can integrate and analyze data from multiple sources, including historical health records, environmental conditions, and worker behavior, to assess the likelihood of various health risks. AI can use this data to identify workers at higher risk of injury or illness and recommend personalized safety measures. In emergency situations, AI can provide critical support by utilizing the vast amount of sensor data gathered and analyzing the data in real time to offer rapid decision-making assistance. During events such as chemical spills, fires, or machinery failures, AI systems can assess the situation, predict the spread of hazards, and recommend the best course of action for evacuating workers or containing the incident (Japeto, 2024). It is, however, important to recognize that, like any modeling, predictions will never precisely match real-world results, and in some cases, major deviations can occur. AI systems, for example, can monitor data from machinery to predict when maintenance is required, preventing breakdowns that could result in dangerous conditions. In chemical plants, AI can analyze environmental conditions and provide early warnings when exposures are trending toward harmful levels, allowing workers to evacuate or take corrective actions before harm occurs. This predictive ability drastically reduces the risk of accidents, injuries, and exposure to harmful substances (Japeto, 2024). AI is also transforming project planning by optimizing processes to reduce the risk of hazards. In many industries, such as manufacturing and construction, AI can analyze workflows and identify inefficiencies that may contribute to unsafe working conditions. By optimizing task assignments, AI can balance workloads between human workers and machines, reducing strain and minimizing the likelihood of errors that could result in accidents (Japeto, 2024). For instance, in a production environment, a multi-modal AI can assess how machinery and employees interact to recommend changes that improve efficiency and reduce safety risks. It can analyze the movement of workers, the speed of machines, and the flow of materials to identify bottlenecks, areas of congestion, or dangerous intersections where accidents could occur. These insights allow managers to make data-driven decisions that enhance both safety and productivity.

Case Study: OEHS professionals have been collecting exposure data to characterize worker exposures for decades. This data is often stored and managed in an occupational exposure database with other workplace information, but it is typically not linked to other data, such as clinical data/medical records and human resources (HR) data. Creating these linkages can enable OEHS professionals to understand exposures better and improve workplace health and safety. In a case study described in more detail in the SynergistNOW blog post, ML was used to enable the connection of an OEHS exposure database with HR data to enable improved exposure estimates for worker exposure reconstruction, which will then be used for occupational epidemiology studies (Shin, 2022).

Case study: Another case study focused on work-related musculoskeletal disorders demonstrates how the integration of ML algorithms with wearable sensor data can automatically classify work activities into different physical exposure risk categories (Donisi et al., 2021). In this study, seven healthy volunteers performed various lifting tasks, during which time-domain features were extracted using a wearable inertial system. The data collected by the sensor system was used to train several ML algorithms and classify biomechanical risk according to the revised NIOSH Lifting Equation (Donisi et al., 2021). Results from the study show that wearable sensor data combined with ML can be used to accurately predict physical exposure risk, enabling faster and more systematic biomechanical risk assessment (Donisi et al., 2021).

Large Language Models and Natural Language Processing

LLMs, such as OpenAI's ChatGPT and Meta's LLAMA models, are tools for general-purpose language generation and other natural language processing tasks. These models can be used directly to respond in natural language to user queries based solely on the corpus of content the models were initially trained upon. But they can be further tuned and customized to unique datasets directly within the model's hosted application or through an application programming interface (API) to be trained to address a specific task with more accuracy, precision, and a reduction in incidents of hallucinations. While the list of OEHS tasks that general LLMs can perform is almost infinite and depends upon the user, some examples that may be useful include the basic development of written occupational health programs (e.g., respiratory protection program), crafting draft risk communication products, conducting chemical risk assessments, or even developing draft presentations.

Case study: In the OEHS field, one potential use of LLMs is to assist with the development of occupational exposure limits (OEL). OELs are used to ensure that workers are protected in the workplace from potential hazards. There are different approaches for setting OELs, but most include the following steps: problem formulation, literature screening and review, the weight of evidence assessment, selection of a point of departure, application of adjustment factors, a final OEL recommendation, and documentation of all supporting evidence used for deriving the OEL (Maurer et al., 2022). Both the literature screening and final documentation steps are time-consuming yet require less scientific expertise, making them suitable for automation through the use of LLMs. For example, in the literature screening process, typically, a toxicologist and epidemiologist will screen titles and abstracts using specified inclusion or exclusion criteria to identify relevant studies for full-text review. LLMs can be used to do this instead if the criteria can be clearly defined. Similarly, with well-written prompts and control over the studies to be summarized, LLMs can be used to generate the final documentation that accompanies the OEL recommendation. Note that if the titles and abstracts are not available in digital form, they will not be available for use by the AI model.

AI-enabled Computer Vision

From still images or video footage, multi-modal AI computer vision systems can be trained to identify and track objects, such as humans, powered industrial trucks, equipment, etc. These systems can be programmed to provide alerts to discourage unsafe behaviors or to track activities for future investigation. For example, some systems can be trained to identify if workers are wearing the appropriate personal protective equipment and to disengage equipment or systems if not properly outfitted with appropriate safety controls. Drivers can be warned about potential collisions with other objects, and chemical spills can be identified and reported without required action from a worker. These systems can also be combined with sensors to provide even more detailed feedback. For example, biomechanical sensors, combined with computer vision, can be used to more effectively develop workload estimates than with just computer vision alone (Egeonu, 2024).

The utility of these models is largely based on the quality and representativeness of the training data. While multi-modal AI analytics can be programmed to look for certain safety risks and perform ergonomic and work analyses, several confounding factors must be considered, including the quality of source video, camera placement, infrastructure costs, and implementation logistics.

Case study: Chemical handling and product use patterns provide crucial contextual and behavioral information for workplace exposure assessments. However, it is often impractical for health and safety professionals to document every task performed by workers, making comprehensive data collection difficult. Recent advances in mobile imaging technologies, such as those embedded in smartphones and tablets, combined with the widespread use of social media for sharing photos and videos, present new opportunities. By applying deep learning techniques to these images and videos, many of which illustrate how products or chemicals are used, researchers can more effectively collect exposure data and enhance the robustness of safety assessments. In a proof-of-concept study completed by a team of exposure scientists and data scientists, a hybrid computer vision model was developed to improve dermal exposure assessment by automating and quantifying the detection of exposure skin surfaces from images (Qian et al., 2024).

AI-Enabled Virtual Reality, Augmented Reality, and Mixed Reality in Worker Training

AI has revolutionized worker training through Virtual Reality (VR), Augmented Reality (AR), and Mixed Reality (MR) by providing immersive, hands-on experiences in hazardous scenarios without real-world risks. AI-powered simulations enable workers to practice emergency responses, operate machinery safely, and handle hazardous materials in a controlled environment (Wang et al., 2022). By immersing trainees in realistic scenarios, AI enhances their understanding of safety protocols and improves preparedness, reducing human error in critical situations (Sacks et al., 2023).

Augmented Reality (AR) overlays procedural guidance onto a worker's field of vision, offering real-time instructions. However, since AR can obscure parts of the visual field, careful design is required to ensure critical safety information remains visible (Azuma et al., 2021).

Mixed Reality (MR) bridges the gap between VR and AR by integrating interactive virtual elements into the real world. Unlike AR, which merely overlays digital content, MR allows workers to manipulate virtual objects while maintaining spatial awareness, ideal for complex training scenarios like equipment maintenance or hazardous material handling (Microsoft, 2023). For example, an MR headset could simulate a malfunctioning valve in a real pipeline, allowing trainees to interact with it while receiving AI-generated feedback on corrective actions.

The combination of AI, VR, AR, and MR not only improves safety training but also boosts worker confidence, ensuring better compliance with protocols and reducing workplace accidents (Deloitte, 2022).

Agentic AI Systems

In a modern OEHS program, agentic AI can function as an invisible operations coordinator, continuously absorbing streams of sampling data, purchase orders, maintenance logs, and regulatory alerts. Rather than forcing professionals to manually move or manipulate information from one form to the next, the agent translates these inputs into self-executing decisions: sampling results roll straight into incident-ready summaries; procurement records instantaneously update chemical inventories; and rule changes trigger fully drafted permitrenewal packets, with no manual tracking required.

When linked to low-code automation platforms, the entire knowledge cycle (e.g., record, analyze, document, notify) may run autonomously in the background. OEHS professionals may reclaim their time for more advanced and important tasks such as building relationships, pattern recognition, mentorship, and novel problemsolving, while the agent sustains the daily cadence of compliance documentation and stakeholder communication.

Importantly, adopting agentic AI is not a tactical software swap but a strategic redesign of information flow. This requires collaboration and coordination from many different groups outside of OEHS (e.g., human resources, occupational medicine, process engineering, information technology, and management). Humans define the guardrails, performance objectives, and ethical constraints, while the agent then carries the routine cognitive load, ensuring that every repetitive task is completed with machine-level consistency and that human expertise is reserved for prevention, innovation, and high-consequence decisions.

Challenges and Considerations

When adopting AI, OEHS professionals should carefully consider several of the following key factors.

AI Risk Management and Data Security: Current Practices and Critical Gaps

The implementation of AI risk management practices, including technical guardrails (e.g., output filters) and organizational safeguards (e.g., governance policies), has become standard across industries as organizations recognize escalating risks. A recent survey found that 77.6% of Fortune 1000 companies have adopted responsible AI safeguards, up from 62.9% the previous year (Bean, 2025). However, the FLI AI Safety Index 2024 reveals severe disparities in these efforts, grading six leading AI companies (Anthropic, Google DeepMind, Meta, OpenAI, x.AI, and Zhipu AI) on safety frameworks, with Meta receiving an “F” for inadequate governance and transparency, while even the highest-scoring firm, Anthropic, earned only a “C” (FLI, 2024).

Data Security and Privacy: Systemic Failures

Internally, data security must be prioritized throughout an AI project's lifecycle, especially in occupational and environmental health and safety (OEHS) applications where risks are amplified. IBM defines data security as protecting digital information from unauthorized access across hardware, software, and administrative controls (IBM, 2024a). Yet the FLI report highlights critical vulnerabilities:

- All flagship AI models evaluated were susceptible to adversarial attacks, exposing confidential data.
- Companies like OpenAI and Meta resisted independent validation of safety protocols, raising concerns about unchecked data handling.
- The report criticizes "black box" AI systems, where training data and decision-making processes lack transparency, complicating accountability for misuse.

The challenge that will arise for OEHS professionals wishing to utilize AI is that it requires the organization to either invest heavily in internal IT infrastructure or trust third-party providers, a risky proposition given incidents like Deepseek-R1's data leakage to China (Burgess & Newman, 2025) and Meta's failure to secure model weights. Given the history of data breaches at sophisticated organizations (AT&T, 2024) and recent concerns about the ambiguity of terms of service (Reuters, 2024), organizations should not take these risks lightly.

On an individual level, organizations must be cautious in allowing their employees to utilize AI tools when working with company data. For example, ChatGPT allows users to upload documents and chat with the software about those documents. An OEHS professional who is stretched thin may rely on such a tool to help identify weaknesses in a corporate health and safety policy while inadvertently providing this confidential information to a third-party LLM, which may further train itself on the proprietary content and expose the content publicly. Care should also be taken to ensure that organizations do not prioritize the latest and greatest tool without a careful audit of the security features of the tool. For example, in January 2025, a research group in China released a model called Deepseek-R1, which rapidly surpassed the popularity of ChatGPT in the Apple App Store (Field, 2025). However, several days later, it was discovered that the online chat interface was sending user information to China (Burgess & Newman, 2025). While this revelation caused concern in the media, it is important to consider that US-based AI companies are also collecting user data, and the U.S. Government has given approval to Microsoft and OpenAI to use ChatGPT with non-public governmental information in domains such as healthcare, law enforcement, finance, and emergency response (Bracken, 2024). This approval will likely have a significant but largely unrecognized impact on government functions.

The "Garbage In, Garbage Out" Problem

Raw data often requires preparation before being used. Missing entries, stray marks, incorrect grammar, misspelled columns, incorrect formatting, and other issues can prohibit analysis. While these issues would often be detected during manual data analysis, the flexibility of AI allows the model to ingest and process this data without providing an opportunity for error correction.

This challenge is widespread across industries. According to Bean (2025), only 37% of companies reported success in their data quality improvement efforts. This has led to a renewed focus on data quality initiatives, with companies doubling down on finally getting data right because great AI relies on great data. This issue is magnified when models are trained on open data. Public data sources are rife with intentional and unintentional biases. Those biases would then be incorporated into any analysis provided by the AI systems.

To avoid this issue, organizations must take care to ensure that their data is maintained clearly and consistently. Data cleaning is the practice of fixing errors in data and organizing data into a format that is more readable by a computer or a human. Data cleaning is often the most time-consuming portion of many projects because it requires users to thoroughly understand their data structure(s) prior to deployment. OEHS professionals must prioritize data quality before implementing AI solutions.

Separately, care must be taken to ensure the model is not trained on content produced by another model, which can lead to model collapse (Alemohammad et al., 2024). For the OEHS professional, this can lead to a model underpredicting the probability of a rare but adverse outcome that could lead to harm or loss.

IT Infrastructure

As noted above, utilizing AI typically requires access to hardware beyond the capabilities of standard laptops and desktop computers. Organizations deploying OEHS data for use with AI systems and methodologies require well-architected data pipelines. Amazon Web Services (AWS) describes a data pipeline as "*a series of processing steps to prepare enterprise data for analysis. Organizations have a large volume of data from various sources like applications, Internet of Things devices, and other digital channels. A data pipeline includes various technologies to verify, summarize, and find patterns in data to inform business decisions.*" Adhering to data engineering and data pipeline best practices ensure OEHS users are provided AI-produced business intelligence in a streamlined manner.

Algorithms and the Black Box Issue

An algorithm is a systematic procedure designed to transform inputs into a desired output or solution. In practice, algorithms are used to automate tasks, analyze data, and solve problems. For example, an algorithm can be used to scan a set of SDS and select those with the least toxic ingredients. Regarding AI, algorithms often refer to mathematical processes through which a model interprets and makes decisions directly from the data. This contrasts with traditional programming that involves giving fixed instructions to a computer. There is considerable overlap between the methods and terminology used in statistical analysis and AI models, which has led to some confusion. Generally, statistical models are deterministic; that is, if one fits a model with the same data multiple times, it is expected that they would get the same results. There are exceptions to this rule, as some probabilistic methods, such as Bayesian modeling, require random draws from a distribution, but consistent results can be generated by setting a seed value before the analysis. In either case, it is possible to directly observe the data used in the model and understand statistical relationships between dependent variables and their impact on the outcomes. Machine learning is a branch of AI that applies algorithms and allows machines to execute those algorithms and update their outputs or "learn." Three types of machine learning are relevant to this paper: supervised learning, unsupervised learning, and deep learning. When developing supervised learning, the user monitors the performance of the algorithm and tunes it according to predetermined success parameters. For example, a machine can be taught how to distinguish between palm trees and oak trees.

The user supervises the output and is the ultimate decider of what a correct answer is to reinforce the algorithm's accuracy. Google Cloud describes unsupervised learning as "*a type of machine learning that learns from data without human supervision. Unlike supervised learning, unsupervised machine learning models are given unlabeled data and allowed to discover patterns and insights without any explicit guidance or instruction.*" (Google Cloud, n.d.)

While AI models may use statistical tools such as linear regression, it is not always clear what data is included, how each data point is weighted, and the relationship between the various dependent variables. This gives rise to the "black box" problem. IBM describes black box AI as "*an AI system whose internal workings are a mystery to its users. Users can see the system's inputs and outputs, but they can't see what happens within the AI tool to produce those outputs*" (IBM, n.d.). The implications of black box models should clearly be communicated to stakeholders in cases where the OEHS professional is unable to interpret the work and outcomes of such models. For example, algorithms such as neural networks are not as easily understandable as simpler approaches. Therefore, users of black box models may not be able to explain how these models arrive at their decisions and may be blind to the potential bias inherent in the model. Caution is recommended when applying complex AI models to OEHS.

Agentic AI Risks

Agentic AI introduces several risk domains that require thoughtful consideration, both organizationally and nationally. Primarily, prolonged reliance upon autonomous agents can quietly erode human expertise. When software or automation systems take the lead on routine hazard recognition and control decisions, situational awareness, manual sampling skills, and emergency reflexes may dull. Second, accountability and explainability grow more complex as more agents and tools are involved. The multistep reasoning chains an agent travels - drawing on models, rules, and real-time data - can be opaque, making it difficult to reconstruct why a decision was made (e.g., a ventilation fan was triggered or a permit was withheld). Third, security exposure widens because agents often need elevated privileges, from facility control APIs to personnel databases. A compromised agent could disable safety interlocks or spam false alarms. Lastly, poorly specified objectives can misalign an agent's behavior with OEHS priorities. A mandate to "reduce complaints," for instance, might induce a bot to suppress alarms rather than address root causes.

Bias

An AI model may produce biased results. This can result from using training sets that are not representative of the broader population of interest. As a simple example, an algorithm used to predict the adult height of children based on their sex at birth and the state they were born in would likely be biased if all the data used in the algorithm were derived from a database of professional basketball players. Additionally, underlying biases in the data can then be amplified as humans interact with the model, leading to a snowball effect where biases are amplified by both the AI and the human (Glickman & Sharot, 2024).
Data breaches and other data security vulnerabilities can also lead to biased output. For example, if PII is leaked to an algorithm that isn't designed to work with PII, the algorithm may use characteristics such as sex or race to make decisions.

Conclusion

The integration of AI in OEHS marks the beginning of a new era – one where organizations dedicated to its implementation will face several challenges but potentially better identify and mitigate risk to its employees. As automation of manual tasks becomes more mainstream, this provides an unprecedented opportunity for proactive risk management and operational efficiency. However, AI integration must be approached strategically and meticulously, with careful attention to data quality, privacy concerns, and ethical implications. Addressing these challenges through transparency is essential to ensure AI serves as a force for good in the workplace.

Despite the challenges described in the sections above, it will be important for the OEHS professional to become comfortable with working with AI. OEHS professionals should collaborate with employees at all levels of their organization to ensure that AI is used safely. The OEHS professionals should also identify trusted internal and external resources that can assist with using AI in an OEHS context.

By maximizing the value of their data, OEHS professionals can strengthen risk assessment processes and enhance management and communication strategies. This creates a compelling business case for investing in advanced tools, equipment, and training. The OEHS profession will be significantly shaped by evolving standards, emerging best practices, and AI advancements. While specific developments remain uncertain, by 2030, AI will fundamentally transform workplace operations. OEHS professionals must embrace continuous learning and adapt their skill sets to remain effective in this rapidly evolving technological landscape.

The future of OEHS lies in the responsible adoption of such technologies, driving innovation, enhancing safety, and promoting a healthier, more secure workplace for all.

Recommendations

As seen throughout this document, there are many facets of AI and even more use cases. We expect this to continually change and change quickly. AI will likely permeate every part of business and private lives, making it important to know how to navigate these new technologies safely and efficiently. As OEHS professionals, it is our responsibility to ensure the health and safety of our workers and to promote safe working environments. Based on the information we reviewed, we recommend the following practices as you begin to implement AI in your organization.

Ensure Ethical Use of AI:

Ethical use of AI is paramount. As succinctly described in the 2023 Synergist article *AI in OEHS: Ethics of the Future*, "*addressing these ethical concerns requires a multidisciplinary approach involving OEHS professionals, data scientists, ethicists, policymakers, and stakeholders. It is important to foster open dialogue, establish guidelines and standards, and promote ethical frameworks to guide the development, deployment, and use of AI in OEHS practices.*" (Lebowitz, 2023) AIHA members should familiarize themselves with expectations of responsible AI usage in their professional and AIHA-related activities as outlined in the AIHA Members & Volunteers Artificial Intelligence (AI) Responsible Usage Policy.

Incorporate AI Thoughtfully and Strategically:

Organizations should adopt AI with a well-planned strategy by identifying gaps within their workflow to ensure implementation will fulfill specific needs.

Organizations are increasingly recognizing this need for strategic implementation through dedicated leadership structures. A 2025 survey found that 33.1% of Fortune 1000 companies have appointed chief AI officers, with 70.8% viewing AI and data leadership roles as permanent C-suite positions (Bean, 2025). This trend reflects the importance of high-level oversight in AI adoption.

Using AI to close these gaps should be done responsibly and methodically. This work should be done with other stakeholders, such as those in IT, operations, involved employees, and management groups to ensure systems are aligned with organizational goals and privacy rules are being followed. When using third-party AI software, be aware of what information is being transmitted to the third party.

Agentic AI deployment demands three critical safeguards: rigorous testing of reward functions, multi-objective constraints that prioritize safety and compliance over efficiency, and carefully monitored pilot phases that verify the agent's optimization targets. Furthermore, hardening network endpoints, validating sensor data at multiple tiers, and enforcing leastprivilege permission schemes close many of the gaps identified in agentic AI risks. A comprehensive promptandaction logging, adoption of explainableAI toolkits, and assignment of a clear human owner for each deployed agent restore a defensible audit trail. Lastly, to counter the de-skilling potential, organizations should insist on deliberate human-in-the-loop checkpoints, schedule periodic manual drills, rotate responsibilities so that practitioners stay sharp, and realize their role as a safety assurance lead with a "trust but verify" mentality. Ultimately, companies must adopt a culture that promotes that humans and professionals are responsible for the decisions.

Focus on Data Quality and Integrity:

Do not fall into the trap of using AI without knowing the source of information. Instead of using "off-the-shelf" models, consider using machines that can run LLMs locally and fine-tune these existing models with relevant and correct information. OEHS professionals must ensure data sets are clean, comprehensive, up-to-date, and properly categorized, especially when using predictive analysis or machine learning. Make sure to engage partners and stakeholders in this process.

Address Worker Concerns on Data and Privacy:

AI use may raise significant "Big Brother" concerns from workers regarding certain technologies, such as wearables or surveillance. To mitigate these concerns, try to adopt systems that prevent the recording of private personal information and include other privacy controls such as face-blurring technology, or even something as simple as avoiding taking pictures of people's faces. With wearables, follow manufacturer recommendations and give clear communication about what they will be measuring and how the information will be used. When dealing with injuries, ensure HIPAA laws, PII laws, and ethical considerations are being followed, especially with data input or logging with LLMs. Assume that any data that leaves your control is no longer private and may lead to data exposure if not handled properly.

Weigh the Benefits of AI Along with the Risks:

It is easy to get caught up in the potential risks that AI systems pose, such as privacy concerns, bias, and ethical considerations. However, do not let it restrict the exploration and adoption of the powerful tools that AI offers. Embracing AI the right way can prevent injuries, increase efficiency, make informed decisions, and achieve an overall higher standard of safety. Remember that while AI tools can assist in analysis, they are not a replacement for professional judgment. Practitioners are always accountable for the guidance they communicate.

Develop Professional Skills and Training:

For OEHS professionals to effectively use and interact with AI, it is imperative to develop fundamental AI literacy to better understand key concepts of machine learning, natural language processing, and data analytics. By enhancing their technical proficiency and gaining a solid grasp of data privacy and compliance concerns, OEHS professionals can identify and mitigate potential pitfalls, such as bias or inaccurate assumptions, early in the process. This foundational knowledge also facilitates clearer communication and collaboration with stakeholders, including IT, legal, and operations teams. Ultimately, a deeper understanding of AI enables professionals to integrate AI-driven solutions more confidently across all safety areas, ensuring accurate risk assessments, proactive hazard identification, and a more robust, data-informed approach to workplace health and safety.

AIHA Resources

AIHA has begun developing resources to support the profession's AI adoption, including the AIHA Members and Volunteers Artificial Intelligence Responsible Usage Policy (May 2024). The organization provides ongoing education through several key publications available to members:

- "AI in Academia: How Will It Change OEHS Practice?" (Synergist, June/July 2024)
- "AI in OEHS: Ethics of the Future" (Synergist, September 2023)
- "Communication Strategies for AI Projects" (Synergist Blog, March 2023)
- "Keeping Pace with the AI Revolution: Considerations for OHS Professionals" (Synergist, June/July 2022)
- "How Machine Learning Can Improve Worker Health Research: An FAQ" (Synergist Blog, April 2022)
- "A Picture Says Thousands of Words: Harnessing Dermal Exposure Data from Images" (Synergist, October 2024)

These and future resources demonstrate AIHA's commitment to providing continuing information as AI technologies evolve.

Project Team Members & Reviewers

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Project Team Members

Alex Watts, MPH, CIH
Benjamin Roberts, MPH, PhD, CIH
Bradley S. King, PhD, MPH, CIH
Jay A. Vietas, PhD, CIH, CSP
Jennifer (Mi K.) Shin, MHS, CIH
John R. Moore III, CIH, CSP
Kevin J. Slates, PhD, COHC
Michael T. Groh, CIH, CSP
Mwangi Ndonga, CIH, CSP, CHMM
Phil Clark, MS, CIH, CSP

Reviewers

The authors acknowledge the technical review and valuable input provided by:

Alan Leibowitz, CIH, CSP, FAIHA
Cheri Marcham, PhD, CIH, CSP, CHMM, FAIHA
Emanuele Cauda, PhD
Mark Rollins, CIH, CSP, FAIHA

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