WORKtoZERO
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Using Lone Worker Monitoring Technology to Protect Workers

National Safety Council

Executive Summary

This white paper explores the use of lone worker monitoring in environment, health and safety (EHS) and how these technologies can reduce the risk of serious injuries, illnesses and fatalities (SIIFs). We discuss the benefits of lone worker monitoring, including its ability to provide real-time safety alerts, decrease emergency response times and improve the overall safety culture. The potential challenges and risks of implementation, including privacy concerns and technology limitations, are also discussed. Finally, we share two successful use cases of lone worker monitoring technologies, which highlight how employers are leveraging technology to enhance the safety of their lone workers.

Key Findings:

1. Although lone workers encounter many of the same hazards as those who work alongside others, working alone can increase both the likelihood of incidents and the severity of adverse outcomes.

2. Lone worker monitoring technologies offer multiple options for deployment, including wearable devices, stand-alone or complimentary mobile applications, or integrated software platforms. Additional add-on safety functionalities include digital gas monitors, biometric sensors, GPS-locating or proximity sensors.

3. Three key benefits of utilizing lone worker technologies include enabling two-way communication, enhancing safety capabilities and increasing cost savings.

4. Potential barriers to lone worker monitoring include data privacy concerns, employee resistance to implementation and potential implementation costs.

Introduction

NSC Work to Zero

Despite concerted efforts to reduce serious injuries, illnesses and fatalities (SIIFs), workplace fatalities have not seen a drastic reduction in the United States. Between 1992 and 2021, the OSHA recordable injury rate dropped from 8.9 injuries per 100 workers to 2.7 injuries per 100 workers, a nearly 70% decrease (Bureau of Labor Statistics, 2022a). In the same period, fatal work injuries only fell by about 15%, from 6,217 fatalities in 1992 to 5,190 in 2021 (BLS, 2022b). Thus, the expansive efforts by companies to reduce workplace injuries do not seem to translate into impactful reductions in workplace fatalities.

Recognizing this trend, in 2019 the National Safety Council (NSC) launched its Work to Zero initiative, supported by a grant from the McElhattan Foundation, to focus on combatting the lagging decline in workplace fatalities and serious injury events. The end goal of the Work to Zero initiative at NSC is to eliminate workplace fatality risk through the use of technology. Using decades of insight and data, and leveraging the expertise of its membership and network, Work to Zero identifies promising technology innovations geared towards eliminating workplace fatality risks within our lifetime.

Digital Technology as an Approach to Reducing Workplace SIIF Events

In 2020, the Work to Zero initiative released its first white paper (NSC, 2020) detailing the top eighteen hazardous workplace situations (e.g., work at height, machinery operation, confined space entry) and associated situational risks (e.g., falls, struck-by, hazardous gas exposure). The report went further and identified the systemic contributing factors (e.g., lack of training, fatigue and work design) that can exacerbate risk within these hazardous situations. Next, NSC worked with Verdantix researchers to identify over 100 relevant EHS technologies helpful in mitigating both situational and systemic risks and mapped these risks in ways surveyed EHS professionals perceived to be most effective.

The initial Work to Zero report identified several key technologies garnering the most interest and value among the surveyed professionals. In addition, safety leaders have demonstrated interest in assessing and evaluating certain technologies – such as virtual reality, wearables, sensors and unmanned aerial vehicles (drones). This is one in a series of reports taking a more focused look at specific risks and an associated promising technology.

This white paper will explore the use of lone worker monitoring solutions, highlighting their ability to mitigate risks faced by workers in remote or isolated environments. It will assess the current applications of these technologies in EHS, including an overview of the estimated user base and market value. The benefits of adopting lone worker solutions will be reviewed, including potential risks, limitations and barriers to implementation as well as additional guidance to navigate these challenges.

The Role of Lone Worker Monitoring in Workplace Safety

Generally considered to be an accepted workplace practice, an estimated 53 million people work as lone workers across the United States, Canada and Europe (Verdantix, 2019). A "lone worker" is defined by the Health and Safety Executive (HSE) as any employee working by themselves without close or direct supervision (HSE, 2020). This includes mobile and field workers, but it can apply to any worker outside of the view of another colleague, including:

- Working separately from others at a fixed worksite (e.g., retail workers, factory workers, warehousing, office personnel)
- Working away from the main worksite (e.g., lone construction workers, land surveyors, oil and gas drilling fields, mine sites, agricultural or forestry workers, remote or hybrid work)
- Mobile work (e.g., transportation and logistics, oil and gas technicians, real estate management, emergency responders, home health care workers)
- Irregular or late shift work (e.g., security guards, custodians, gas station attendants, service technicians, housekeepers)

Risks to Lone Workers

With increases in automation and leaner staffing models in modern industrial settings, lone worker practices are becoming increasingly more common (Agnew, Hyten, & Sevin, 2017), with an estimated 15% of the overall workforce considered lone workers (Verdantix, 2021b). The use of these practices can be beneficial for both organizations and their employees, allowing for more flexibility, greater utilization of resources and increased worker autonomy (Vazquez, 2017). However, lone workers are also confronted with unique challenges that must be carefully considered and controlled for.

In general, lone workers face many of the same hazards as those in comparable industries, although working alone may increase both the likelihood of incidents and the severity of adverse outcomes (Thayn, Eggum, Dartt & Toon, 2021). In 2021 alone, 5,190 fatal workplace injuries occurred in the United States (BLS, 2022b).

The total cost of workplace injuries was $167 billion in 2021, or about $42,000 per medically consulted injury (Injury Facts, 2022). This figure accounts for wage and productivity losses ($47.4 billion), medical expenses ($36.6 billion) and administrative expenses ($57.5 billion).

While injury rates for lone workers are largely unknown, survey and self-reported data may provide some insight into the true risk. According to a survey of 478 companies, 68% reported experiencing an incident involving a lone worker in the past three years, with 20% being described as "quite severe" or "very severe" (StaySafe, 2021).

When operating alone, although the employer still holds the burden of care, workers often become more responsible for their health and safety (Pedley, 2019), relying on their individual decision-making instead of outside support from colleagues or supervisors (Huang et al., 2013). According to Straub (2018), some of the SIIF risks faced by lone workers include:

- Chemical exposure
- Electrocution
- Falls from height
- Machinery entrapment
- Slips or falls
- Struck-by heavy equipment or motor vehicles
- Sudden illness

According to one survey of 224 lone workers and their supervisors, 19% of respondents reported having had difficulty getting help after a workplace incident, and nearly half (44%) have felt unsafe on the job as a result of working alone (TracPlus & Ground Control, 2022). Because lone workers often work nontraditional hours or in environments where emergency personnel are not immediately accessible, the outcomes could be more severe if an incident occurs (O'Connor, 2023). Furthermore, in the event of an incident or medical emergency, workers may be unable to get the vital help they need in a timely manner.

Lone workers may also be vulnerable to violence or aggression from clients, customers or members of the public. Studies have shown lone workers in public-facing industries, such as health care, retail and transportation, are particularly susceptible to violence in the workplace (OSHA, 2016). Other risk factors of workplace violence[1] commonly associated with lone work include:

- Prolonged or irregular shiftwork
- Working alone
- Working in isolated locations or in patient/customer homes
- Handling cash or valuables
- Delivery of passengers, goods or services (OSHA, 2016)

[1] For more information about workplace violence, see the National Safety Council Workplace Violence: Using Technology to Reduce Risk report (NSC, 2021a).

Lone Worker Regulations and Recommendations for Best Practices

Currently, the Occupational Safety and Health Administration (OSHA) does not have specific industry-wide standards for lone workers. However, the General Duty Clause (Section 5(a)) outlined in the OSHA Act of 1970 (H.R. 1195) requires employers to provide a workplace free from recognized hazards that are causing, or likely to cause, death or serious harm. Employers should conduct regular hazard risk assessments of the work site, including determining how lone work may exacerbate hazard risk and/or severity. OSHA's Standards for Shipyard Employment, while industry-specific, also provides additional mandates for lone workers. More specifically, employers are required to account for lone workers via sight or verbal communication at regular intervals during a shift, at the end of the job assignment and/or at the end of a shift (OSHA, 2011).

The American Society of Safety Professionals (2021) identifies several best practices for managing lone workers, including:

- Identify the hazards lone workers may encounter while performing their duties
- Conduct a lone worker risk assessment by talking with or surveying workers and conducting formal job site or job hazard analyses
- Engineer out lone work hazards that pose a high risk for SIIFs (e.g., using aerial drones for inspections at height or autonomous mobile robots for confined space entry)
- Schedule high-risk tasks to be done during normal business hours, or when another worker can provide assistance
- Provide appropriate training and education for lone workers, including how to conduct their own task hazard analyses
- Establish communication procedures with lone workers, such as the use of two-way radios, in-person check-ins, wearable technologies or cell phone check-ins

Research Approach

The methodology of this paper consisted of two parts:

1. A comprehensive literature review of industry and academic articles
2. Identification of case studies and use cases for lone worker monitoring

Data for this paper came from literature reviews of academic articles, industry reports and gray literature on lone worker monitoring technologies. A flexible research strategy was employed, utilizing multiple databases, including EBSCO, JSTOR, PsycINFO and Verdantix's research portal. The search strategy was limited to literature published between January 2013 and April 2023. A gray literature search for the same period was conducted using Google Scholar. The search strategy was based on the following iterations of the terms: (Lone OR Alone) AND (Worker OR Work) AND (Technologies OR Solutions OR Monitoring OR Systems). Interviews were also conducted with members of the Work to Zero Advisory Council who are currently using or trialing lone worker technology to gather relevant use cases and best practices.

Introduction to Lone Worker Monitoring

Lone worker monitoring refers to technologies that help monitor, protect and manage workers who perform activities in isolation or without close supervision. These technologies offer multiple options for deployment, including wearable devices, stand-alone or complimentary mobile applications, or integrated software platforms (Verdantix, 2019). Common functionalities associated with lone worker devices include:

- App-based deployment
- Check-in and check-out procedures
- Live GPS
- Motion or fall detection
- SOS panic alarm
- Two-way communication (Verdantix, 2019)

According to Verdantix (2021b), these technologies may also come equipped with other EHS capabilities, such as digital gas monitors, proximity sensors or other physiological monitoring capabilities (e.g., fatigue monitoring, ECG, respiration rate, temperature).

For employers interested in adopting lone worker technology, Verdantix (2021b) recommends exploring technologies that align with the following:

1. Type of industry and associated risk of the workflow

The risks associated with different industries and occupations will require different deployment strategies and capabilities. For example, public-facing roles such as health care workers may benefit from simple and discreet personal duress alarms to avoid escalating a potential workplace violence incident (Farrell, Shafiei, & Chan, 2014). For those working outdoors, audible alarm systems may be more suitable compared to confined, indoor settings where alarms could potentially escalate the situation (Perkins et al., 2017).

In other cases, those working long or irregular shifts, such as logistics drivers or manufacturing workers, may benefit from wearables enabled with fatigue monitoring (NSC, 2021b). Alternatively, in industries such as construction, mining or agriculture, workers may require devices equipped with additional capabilities like proximity sensors, physiological monitoring or gas detection.

2. Size of the organization and ease of scalability

Next, organizations should consider the number of potential users, the scalability of the technology and how new devices will integrate with pre-existing technologies. According to Verdantix (2021b), mobile applications tend to be the most simple and cost-effective way to incorporate lone worker monitoring on a larger scale. For smaller companies, the focus should be on the co-benefits and cost-effectiveness of adopting new technologies, where additional capabilities may only be added on an as-needed basis. Additionally, most lone worker technology providers offer "off-the-shelf" solutions, which tend to be more easily integrated into an organization (Aware360, n.d.).

3. Ability to leverage multiple technologies to provide a comprehensive system

Finally, it is recommended that employers consider the use of technology holistically and utilize more than one approach where needed (Verdantix, 2021b). Again, companies should carefully assess how lone worker devices will integrate with technologies already in use and assess whether they need to leverage more than one safety technology to address a particular hazard or risk. Employers interested in deploying lone worker technology can also choose between different approaches toward configurability.

For providers who integrate third-party software or hardware into their devices, closed solutions such as "off-the-shelf" technologies often limit the ability to customize the functionalities to the needs of the employer but can be more quickly implemented into the organization. Alternatively, open solutions can be integrated into an organization's existing devices and technology, enhancing their adaptability compared to closed solutions (Aware360, n.d.). Providers who build their solutions in-house may also provide additional flexibility during the implementation process.

Market Overview

Data from Berg Insights (2022) shows the market for lone worker protection solutions is growing significantly across both Europe and North America. In 2021, the market value for these solutions in Europe was an estimated $100 million, and it is anticipated to grow to $135 million by 2026. Similarly, the market value in North America was an estimated $65 million in 2021, and it is expected to reach $95 million by 2026; a compound annual growth rate (CAGR) of 6.2% and 7.9% respectively.

The user base for lone worker technologies also continues to grow. In 2021, there were an estimated 890,000 European users of lone worker technologies, and this number is expected to grow to 1.4 million by 2026. At the same time, there were an estimated 429,000 users across North America, with that number expected to grow to 780,000 by 2026 (Berg Insights, 2022).

Additionally, according to the 2021 Verdantix Global Corporate Survey, representing 256 corporate decision-makers, lone worker technology was ranked the second highest among use cases driving adoption of connected worker solutions (Verdantix, 2021a). Overall, these data suggest the market for lone worker protection solutions is expanding across both Europe and North America, with an increasing number of users adopting these technologies. This trend is expected to continue over the next few years, with significant growth opportunities for companies operating in this space (Berg Insights, 2022).

Benefits of Leveraging Lone Worker Monitoring Technology

Three central benefits of utilizing lone worker monitoring technologies in the workplace include:

1. Enabling Two-Way Communication
2. Enhancing Safety Capabilities
3. Increasing Cost Savings

According to a survey of 224 lone workers and supervisors, 93% reported "sometimes" or "often" working outside of cell phone coverage, and 63% have been unable to contact someone due to a lack of connection (TracPlus & Ground Control, 2022). One of the primary advantages associated with lone worker technologies is they enable employers to stay connected to their workers, often with two-way communication capabilities. In the event of a workplace incident, emergency or if working conditions change suddenly, teams can take immediate action, effectively reducing the risk of serious injuries or fatalities (Pedley, 2019).

Furthermore, because these devices are also often equipped with GPS-tracking capabilities, they provide an extra layer of protection for mobile workers or those outside of cell phone range. Other lone worker devices may also come equipped with motion and fall detection. If no movement is recorded for several minutes, employers will be sent an automatic alert so they can respond more quickly to the situation (Pedley, 2019).

Many lone worker devices on the market today also offer a range of other EHS functionalities that enable situational awareness and provide early warnings of potential workplace incidents. These devices can be used to monitor environmental conditions and workers' physiological conditions in real-time, and preemptively intervene when a hazard is detected.

For example, some wearable technologies can detect and alert workers to hazards such as gas emissions, machinery proximity warnings or thermal exposure (Verdantix, 2022). Others may also be configured to monitor workers' physiological wellbeing, such as the ability to monitor body temperature exposure, fatigue, heart rate, breathing rate or body position (Verdantix, 2019).

Furthermore, many companies rely on manual check-ins for their workers, which not only takes valuable time but does not address the issue of what happens if a worker does not check in (Aware360, n.d.). Lone worker devices may help streamline the otherwise cumbersome task of monitoring lone workers via calendars, emails, check-ins or phone calls, ultimately increasing overall efficiency (Verdantix, 2019). For example, according to the British Security Industry Association (BSIA), an increase in organizations using lone worker devices reduced unnecessary police calls to false alarms following missed check-ins, resulting in an estimated £60m of savings in just one year (IFSEC Global, 2019).

It is also notable to mention that although OSHA does not have specific industry-wide standards for lone workers, the General Duty Clause (H.R. 1195) requires employers to provide a workplace free from recognized hazards that are causing, or likely to cause, death or serious harm. Consequently, an employer can be cited if it is determined they failed to provide a safe work environment for lone workers, which may include implementation of emergency response procedures, communication systems or engineering out hazards that provide a high risk of SIIFs.

By leveraging lone worker monitoring technology, employers can actively take steps to fulfill their regulatory obligations and ensure the safety and wellbeing of their employees. These devices can also provide employers with records of their safety program, including logs or reports following incidents or investigations. Therefore, the ability to prove compliance with regulations or other jurisdictional laws is another key value add.

Challenges of Leveraging Lone Worker Monitoring Technology

Risks and Limitations

As with all technologies, there are unintended risks and limitations associated with lone worker monitoring technologies. Perhaps the largest shortcoming of these devices is they can only mitigate hazards; they do not eliminate the exposure to hazards or the necessity of lone work. In the case of an incident or an emergency, it still takes vital time for employers to recognize the issue and dispatch help.

If these devices rely on workers checking in or out, the gaps between these check-in times might contribute to emergencies going unnoticed for a long time. Therefore, we recommend employers interested in deploying these technologies conduct thorough risk assessments for all lone work duties to better understand if the task can be eliminated or if additional workers are needed to provide support. If risk elimination is not possible, employers should consider if additional functionalities, such as vital signs monitoring, are necessary add-ons.

Furthermore, depending on the technology being used for lone worker monitoring, there can be limitations affecting the overall functionality. For example, scenarios, like missed check-ins, technical malfunctions or connectivity issues can potentially contribute to false alarms. If escalated, these procedures can cost additional time and resources to the organization. Employers should conduct regular emergency response drills to ensure those tasked with monitoring lone workers are adequately trained to respond in these scenarios and dispatch aid in an emergency.

Regularly maintain all safety technologies, including lone worker monitoring devices. Depending on the functionality and deployment types, this may include regular testing of monitors or sensors, software updates, and/or replacing or updating equipment.

Barriers to Adoption

As with any new or emerging technology, lone worker monitoring technology encounters barriers hindering its widespread adoption. A key challenge affecting the growth of lone worker monitoring devices surrounds the issue of worker and data privacy (Interdisciplinary Center for Healthy Workplaces, 2015). These technologies may be enabled with sensors and monitors that collect personal information about workers, such as their location, biometric data or activity levels. Consequently, workers may feel like their privacy is being invaded, their data is at risk or that they are being surveilled while on the worksite.

In a survey of 102 EHS decision-makers, 65% of respondents said data privacy concerns were a significant barrier to their adoption of industrial wearable technology (Verdantix, 2019). Workers may be concerned their employer is potentially tracking their movements, listening to their conversations or gaining access to sensitive data, such as health or performance metrics. These concerns might also arise from uncertainties about the intended use of such data, whether it's for punitive actions or influencing decisions related to termination.

Regulations such as the EU's General Data Protection Regulation (GDPR) and the California Consumer Privacy Act (CCPA) have introduced new considerations for employers when managing worker data from all sources. Therefore, it is recommended employers draft strong data privacy policies and remain transparent about what data is being collected, how it's being used, where it is stored and how it is encrypted.

Additionally, employers should educate workers on the purpose of the technology and involve them in the pilot and implementation process. While employee buy-in can be a potentially long and slow process, involving workers ultimately allows them to trial the technology, ask questions, share feedback and express their concerns.

Lone worker technologies can also be cost-prohibitive, although pricing depends widely on the deployment, functionality and number of devices needed (Verdantix, 2021b). For new and emerging technologies, a lack of evidence for return on investment (ROI) and potential effectiveness may also be potential barriers to adoption (Interdisciplinary Center for Healthy Workplaces, 2015). Furthermore, implementing any new technology often requires employees to be trained to use it, an additional investment in time and resources.

To enhance acceptance and use of safety technology, experts recommend involving employees early in the adoption process and communicating throughout the pilot and adoption process. Employees should be educated on the benefits of the technology, its functionalities and limitations, and how their data will be used, stored and encrypted (Ferguson, 2022).

The National Safety Council Work to Zero initiative partnered with Verdantix to develop employer investment calculators for eight different safety technologies, including lone worker mobile applications (National Safety Council, 2021c).

Case Studies

The following case studies are based on interviews conducted with members of the Work to Zero Advisory Council. The inclusion of case studies featuring specific vendors or technologies in this paper is purely for educational purposes and does not constitute an endorsement of any particular technology or vendor, rather, the intention is to provide practical insights into the implementation and applications of lone worker monitoring technologies.

1. NiSource's Use of Lone Worker Monitoring (NSC, 2022)

NiSource, a natural gas and electric utility company, took an iterative process toward adopting Blackline Safety's G7 Safety Devices. This initiative aimed to ensure the safety of their utility workers who often encounter a variety of on-the-job hazards, such as gas exposure or work alone in remote areas. Blackline Safety's devices are designed to be intrinsically safe and include fall and no motion detection, two-way voice and text messaging, push-to-talk capabilities, gas detection and GPS monitoring.

Although the use of the technology is relatively new for the company, they have cited several success stories since deployment. In one instance, the device detected high CO levels while an employee was eating lunch at a restaurant. The employee was able to resolve the issue with restaurant management before any employees or patrons were harmed. In another example, a leakage inspector was able to discover a boiler that was improperly exhausting after getting elevated readings from the device. Finally, an employee who went to a friend's house after work received a notification that high CO levels were detected, and they were able to pinpoint it to the furnace and promptly resolve the issue.

2. Avenue Living's Use of Wearable Panic Buttons (NSC, 2023)

In response to concerns raised by at-risk employees regarding their safety, Avenue Living, a leading Canadian alternative asset manager, took steps to enhance employee protection by implementing SolusGuard's wearable panic button and safety monitoring system. The system offers various features, including two-way communication between employees and a pre-selected network of contacts. The technology also ensures emergency services are notified, even if the phone is locked or the application is unavailable.

Since the implementation of the SolusGuard technology, Avenue Living employees have reported increased feelings of security and confidence while carrying out their job responsibilities. They also expressed the system's simple interface and easily understandable training proved particularly beneficial, especially for employees whose first language is not English. Consequently, employees expressed increased trust in technology and an openness to explore other technologies in the workplace.

Conclusion and Future Direction

Lone workers face unique challenges and hazards in their work, and although they may benefit from increased flexibility and autonomy, they are at an increased risk of serious injuries and fatalities (Thayn, Eggum, Dartt & Toon, 2021). Consequently, the market for lone worker technologies continues to grow, both in market value and number of users (Berg Insights, 2022).

Lone worker monitoring technologies offer multiple options for deployment and functionality, such as app-based deployment, GPS, fall detection, panic alarms and physiological monitoring capabilities (Verdantix, 2019). These technologies can help organizations monitor, protect and manage lone workers and address the risks associated with working alone.

Since the use of lone worker monitoring is anticipated to expand, there is a growing need for further research, development and evaluation in this area. For example, more research is needed to better understand and address the barriers associated with implementing safety technology in the workplace.

Furthermore, more robust studies are needed to better understand the effectiveness of these technologies and their impact on worker safety, including the potential ethical implications of using these solutions. Finally, more research is needed to better understand the impact of lone worker monitoring on employee satisfaction, both before and after implementation. In addition to research, sharing use cases of successful implementation may help demonstrate the benefits of these technologies and increase adoption overall.

In summary, by addressing these areas of concern, building upon the current body of research and sharing use cases, the future of lone worker monitoring technologies holds promise for enhancing the safety and wellbeing of lone workers.

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