Impairment Detection Technology & Workplace Safety

National Safety Council

Disclaimer and Disclosure Statements

No intent exists from this research report or associated authors to endorse, promote, misrepresent or slander any represented companies or technologies. Data collection for this report concluded in the spring of 2022. As such, the features of currently included technology may have changed and newer technologies might now fit the research inclusion criteria. The results of this report are specific to the authors' definition of impairment in the workforce and should be viewed as such. The results of this report do not necessarily represent the views or policies of the National Safety Council or any affiliated partner or organization.

While concerted effort was made to limit potential bias and conflict in interpreting data collected for this research, the following disclosures are relevant. The National Safety Council invested in a third-party research study using one of the technologies (PVT Workfit) included in this report. Also, a contributing author was formerly employed by a company (Predictive Safety SRP, Inc.) included in this report and currently holds stock in the company.

The National Safety Council is America's leading nonprofit safety advocate – and has been for over 100 years. As a mission-based organization, we work to eliminate the leading causes of preventable death and injury, focusing our efforts on the workplace, roadway and impairment. We create a culture of safety to not only keep people safer at work, but also beyond the workplace so they can live their fullest lives.

Executive Summary

Impairment from chemical substances, fatigue, medical conditions, mental distress and other factors can present a fitness for duty concern as well as impact employee wellbeing. The broad range of signs and symptoms presented by all of these underlying causes of impairment makes impairment detection technology (IDT) an attractive safety solution for employers. NSC defines IDT as technology with the potential to screen for multiple forms of impairment to aid in fitness for work assessments.

IDT has many potential benefits, including the ability for real-time assessment and the potential to detect impairment from diverse causes. However, there are barriers to implementing this technology, including validation concerns, cost and employee buy-in. This report will assist employers with weighing these factors by examining the current state and evidence surrounding IDT.

A multi-step process was used to gather information on each technology, beginning with an environmental scan and review of existing academic and non-academic literature, online articles, and company websites. In a good-faith effort to collect accurate data, semi-structured interviews with company representatives were conducted. They were also given the opportunity to complete a survey to confirm the data collected and to suggest any corrections prior to analysis.

Ultimately, a total of 15 impairment technologies from 15 companies were eligible for inclusion in this analysis. Of these 15 IDTs:

- **Five of 15 companies (33.3%)** claimed their technology could detect for all seven impairment types that were discussed (alcohol, opioids, cannabis, other substances, fatigue, medical conditions and other forms of possible mental impairment such as mental distress)
- **Eight companies (53.3%)** reported the ability to detect at least five impairment types
- **Two companies (13.3%)** provided more specialized impairment detection
- **The most common type of technology** used to detect impairment was oculomotor-based testing (60%), followed by psychomotor vigilance testing (40%)
- **Small- to medium-sized companies** were most likely to be using IDTs
- **Safety-sensitive industries** were the most common adopters of this technology
- **A majority (80%) of the technology providers** recommended using IDT prior to the start of an employee's shift
- **Mobile applications and other handheld devices** were the most common IDT delivery method (53% combined)
- **All 15 companies** have either ongoing or past research concerning the scientific evaluation of their technology
- **11 of 15 companies (73.3%)** reported examining the use of their technology for more than one type of impairment, although most companies' studies focused on fatigue as the primary impairment type

The primary focus of IDT is to help workplaces keep employees safe and identify underlying illnesses or issues related to impairment. More research is needed to confirm and advance the science behind these technologies. Special attention should be paid to establishing how IDTs can quantify thresholds to determine fitness for duty and how each IDT has been evaluated across various forms of impairment and industries.

There are promising IDTs on the market for workplace safety, but there is no single technology that suits the needs of every employer. The landscape in this field is evolving, and employers should consider examining these technologies, ensuring each technology is fully evaluated, potential barriers are addressed, and effective change management principles are used to best prepare for piloting and/or implementation.

BACKGROUND

Drugs and alcohol are most often associated with the risk of impairment in the workplace. However, impairment can be caused by other, often interrelated factors. The National Safety Council (NSC) defines workplace impairment as the inability to function normally or safely because of any number of critical factors – from chemical factors such as legal and illicit drugs, physical factors such as fatigue or certain medical conditions, as well as social factors like stress or other mental distress. Each of these factors and more can present a fitness for duty concern and impact employee health, safety and wellbeing.

It is clear that impairment-related issues affect every workplace. An estimated 67% of people with a substance use disorder are in the workforce (SAMHSA, 2022). Evidence shows that nearly 20% of Americans live with a mental illness (NIMH, 2020) and more than 43% of employees are sleep-deprived (NSC, 2018). Additionally, in a study of 350 employers, NSC (2021) found that more than half of employers (52%) believed that impairment negatively impacts workforce safety. These issues are even more pertinent as many have been exacerbated by the COVID-19 pandemic (APA, 2021; Czeisler et al., 2020; Total Brain, 2022; Wong & O'Connor, 2021).

An array of signs and symptoms could indicate impairment, but many are difficult to identify. Certain changes in an employee's attendance, appearance, performance or behavior can be indicative of impairment (Dunn, 2005; CCOHS, 2018), such as:

- **Altered personality**
- **Erratic behavior**
- **Sleeping on the job**
- **Dilated or constricted pupils**
- **Isolation**
- **Bloodshot eyes**
- **Consistent tardiness**
- **Absenteeism**
- **Involvement in incidents**

Not everyone will show signs or symptoms. Some signs and symptoms may have a delayed onset. When these indicators of impairment are responded to it can provide an opportunity to address employee safety and wellbeing concerns. Identifying impairment protects employees by recognizing a safety risk so that workers can be removed from a potentially dangerous situation. After the immediate risk is addressed, conditions that can lead to impairment (e.g., substance use disorders, sleep disorders) can be identified through employer processes relating to cause investigation. Employers can take action to address these conditions by addressing the root cause of employee impairment. **Safety technologies may provide a more objective measure to help employers identify and address impairment in the workplace.**

Many organizations are turning to technology to address risks and hazards that could lead to serious injuries or fatalities (Washburn, 2020). Impairment detection technology (IDT) is becoming an attractive solution for employers. This type of technology can provide a promising alternative to drug testing, which lacks the ability to identify impairment in real-time and does not address the impairment risk presented by factors other than chemical substances. IDT is an emerging field, but relevant to ensure a safe and healthy work environment for all.

NSC defines IDT as technology with the potential to screen for multiple forms of impairment in order to aid in fitness for work assessments. Typically, they do not identify the cause of impairment, rather they detect indicators that are associated with impairment from various causes. While cause-specific technologies such as alcohol breathalyzers and fatigue wearables are valuable safety interventions, IDTs may provide a more holistic solution. These technologies can act as a singular detection solution for numerous impairment risks, possibly providing a more comprehensive solution for employers. The emergence of IDT can be especially beneficial for employers in safety-sensitive fields, allowing them to more completely address the risk of impairment in workers at higher risk of injury and fatality.

According to a 2021 NSC survey, 16% of employers reported using some form of IDT, while 32% reported having little or no knowledge of this type of technology. However, a majority of respondents indicated an interest in learning more.

The purpose of this paper is to examine the current state of IDT solutions for workplace safety, as well as scientific evidence around the use and value of the technologies. The intention is to assist employers exploring possible technology solutions and to inform their decisions about piloting or adopting technologies to detect impairment.

Impairment Detection Technology

Potential benefits

Real-time objectivity: One of the primary advantages of IDT is that it can provide an objective framework for fitness for work determinations at the time the employee is working. This real-time assessment can better identify impairment, and more effectively preserve workplace safety. Research conducted by the National Workrights Institute (Maltby. n.d.) found that 82% of employers using IDT reported improved workplace safety after technology adoption.

Privacy: Another benefit is that IDT better protects employee privacy. Its drug testing counterparts can disclose information about an employee's private life and are considered more invasive.

Comprehensive detection: IDTs aim to detect impairment from all causes (fatigue, substance use, mental distress, etc.), rather than for one cause alone (e.g., cannabis use). However, research is still needed to validate the technologies and their ability to detect for specific and multiple causes of impairment.

Cost savings: Employers may consider using IDT to reduce incident rates, reduce insurance and litigation costs, and increase production by proactively enhancing safety. IDT can also keep employers on the cutting edge of safety technology.

Prevention: Other suggested advantages of IDT include an improved ability to intervene before an incident occurs, the ability to detect impairment when signs are not readily visible, the ability to implement the technology at various intervals (e.g., pre-shift, reasonable suspicion, post-incident, random, etc.), and to help identify employees with medical conditions or other chronic impairment issues.

Impairment Detection Technology

Barriers and limitations

IDT is a promising safety solution, but is not without its obstacles. According to a survey conducted by NSC (2021), employers most commonly reported the following barriers to implementing IDTs: purchase cost, employee distrust and employee compliance. Other barriers included: leadership buy-in, lack of knowledge and/or time to properly investigate and implement the technology, and union objections. Additional details on these obstacles include:

Cost: While many technologies are priced per user, some carry large up-front costs. These costs may overly burden small employers and present hindrances for obtaining employee buy-in.

Time: On top of monetary cost, technology identification and implementation can take a significant time investment to review and introduce. This time investment can discourage employers from investigating these tools as potential safety interventions.

Acceptance: Acceptance of technology in the workplace can also pose a challenge because workers can be wary of behavior monitoring and potential privacy concerns. For example, they might interpret the adoption of IDT as evidence the employer views the employees as inherently untrustworthy.

Validation: Ambiguity surrounding formal product validation is a considerable limitation. More information is needed to better understand how the technology methodology (e.g., pupillary light reflex, psychomotor vigilance testing, Standardized Field Sobriety Test components, etc.) has been validated versus the product that applies the method(s). In many cases, the fundamental scientific base of the technology has been evaluated in some capacity, but the product itself has not been rigorously evaluated, especially in diverse workplace settings and populations (e.g., workers with cognitive disabilities, workers of various ages), or by a non-biased third party. For example, there are methods that have been rigorously evaluated in clinical or laboratory settings to be effective in determining impairment from certain causes, but there is less research available on the effectiveness of the workplace IDT products that incorporate these methods with the rest of their technology components.

Legal: Legal issues associated with the use of a new technology, such as limitations and liabilities, should be investigated and discussed among the appropriate personnel. Policies and procedures should be clear and consistently implemented to ensure equitable use of the technology. It is imperative employers ensure employees with underlying disabilities or cognitive impairments are protected through workplace policies when IDT is introduced.

RESEARCH APPROACH

Literature scans

An environmental scan was conducted including searches of academic literature and non-academic literature (e.g., grey literature and white papers) to collect information relating to the current state of knowledge and practice in the field of IDT. Five databases from two providers were used: EBSCO Information Services and the National Safety Council. Search strategies were limited to English-language articles published in peer-reviewed journals. The impairment detection technology search strategy used various iterations of the following terms: "impairment," "substance abuse," "technology," "workplace," "fit for duty," "cognitive," "retina" and "EEG." This search strategy was expanded to include "psychomotor vigilance testing," "evaluation" and "validity."

A grey literature search was also performed using Google Scholar to identify research published in trade magazines, white papers, government reports and other non-peer-reviewed sources. Hand searches were conducted using major journals, reference lists of relevant articles, relevant federal organizations (e.g., Substance Abuse and Mental Health Services Administration (SAMHSA), Federal Motor Carrier Safety Administration (FMSCA)) and conference proceedings to discover additional IDTs. The search strategy used various iterations of the following terms: "workplace," "impairment," "technology," "cognitive," "retina" and "EEG," informed partially by Maltby (n.d.). Finally, a snowball search technique was used to identify additional IDTs as necessary based on existing familiarity or references to other technologies in prior literature.

Inclusion/exclusion criteria

To identify IDTs for this analysis, a dual inclusion criterion was used. First, IDTs needed to have scientific evidence for use in the workplace – including the transportation industry. Technologies that did not meet the first criteria had to meet all of the following secondary inclusion criteria:

- **Ability to detect multi-substance factors (e.g., opioids, cannabis, alcohol) and/or multi-physical factors (e.g., fatigue) in addition to other causes of impairment**
- **Use of a non-invasive testing method (e.g., not urinalysis or blood analysis)**
- **Primarily designed to detect impairment in the workplace**
- **Technology descriptions and outputs available in English**

IDTs that focused on cognitive decline associated with chronic illness or physiological effects of aging (e.g., Alzheimer's disease, dementia), cognitive learning ("brain training") or exclusively fatigue monitoring were excluded.

Confirming data with technology companies

Once the literature review and environmental scan were completed, a data extraction table was constructed to organize descriptive and qualitative information collected on 15 technologies that met the inclusion criteria. Semi-structured interviews and surveys with company representatives were used to confirm accuracy of information to be included in this review. Approximately 10 of 15 companies were contacted by phone and 12 of 15 provided electronic feedback.

A second review of technology-specific characteristics, features and other relevant data to be reported in this paper was offered to companies, of which 11 of 15 offered acknowledgment or clarifications for final reporting.

FINDINGS

A total of 15 impairment technologies from 15 companies were eligible for inclusion (see Table 1). A multi-step process was used to gather information on each technology, beginning with an environmental scan and review of existing literature, online articles and company websites. In a good-faith effort to collect accurate data, semi-structured interviews with company representatives were conducted. They were also given the opportunity to complete a survey to confirm the data collected and to suggest any corrections prior to analysis.

Types of impairment detected

Several key factors were identified for comparison. The first was the types of impairment targeted for detection, which included:

- **Alcohol**
- **Opioids**
- **Cannabis**
- **Other substances (e.g., drugs, including over-the-counter medications)**
- **Fatigue**
- **Medical conditions, including COVID-19**
- **Other forms of possible mental impairment (e.g., stress, mental distress or distraction)**

Five of 15 companies (33.3%) claimed their technology could detect for all seven of the above impairment types identified for this study. Eight companies (53.3%) reported the ability to detect at least five impairment types and two companies (13.3%) provided more specialized impairment detection. The most commonly detected type of impairment was fatigue, with 100% of companies reporting that it could be detected with their technology. It is important to mention that during interviews with the vendors, several mentioned that their technologies are not limited by the type of impairment, but rather identify more general warning signs of impairment or distraction that could be the result of a number of factors.

Table 1. Vendor Information*

Tech	Headquarters	Year product launched	Pricing	Test duration	Recommended test deployment	Delivery application	Primary industries
AlertMeter	United States & Canada	2015	Monthly subscription	Approx. 60 seconds	Pre-shift; during shift; post-shift	Any touchscreen device	Ag, C, HC, M, Mn, U, MT, T/W
Druid	United States	2018	$30-99 per year per user (USD)	3 minutes	All intervals (except continuously)	Touchscreen tablet or smartphone	C, Ed, F/I, HC, M, Mn, PST, T/W, U, Ag, RT, PST, F/I, MC, WT
ExceleRATE/ Vitals	Canada	2012 - closed studies with law enforcement	Initial setup and training fee per assessment or annual license fee	20-25 minutes	Pre-hire; post-incident; random; return to work	Mobile tablet	T/W, other safety sensitive industries
Fit for Work	Canada	**	Setup fee plus monthly for 1, 2 or 3 year terms with unlimited scans	Up to 5 seconds	All intervals (except continuously)	Fixed "Safe Entry Stations"	Ag, C, HC, M
F2D2	Germany	2015 (F2D launched in 2006)	**	Up to 11 minutes	**	Head-based device	**
Guardian	Australia	**	**	**	Continuously	Fixed-location device	T/W
Optalert	Australia	Initial product built in 1994	Hardware/algorithm upfront cost + annual subscription	5 minutes	Pre-shift; during shift; post-shift; continuously;	In-cab hardware; wearables	A/F, A/W, Ag, Ed, F/I, HC, I, MC, Mn, PST, T/W, U
OSPAT	Australia	1993	Annual license on average $100 per user (USD)	1 minute	Pre-shift	Computer-based assessment	C, M, Mn, T/W, U
PMI FIT 2000	United States	**	Flat fee or annual service plan	23 seconds	Pre-shift	Mobile and fixed location device	Mn
PVT Workfit	United States	**	Annual subscription based on # of employees	3 minutes	Pre-shift; during shift; post-shift; monthly	Tablet, smartphone or computer	M, Mn, PST, T/W, U, WT
PVT-192	United States	**	$3,000 flat fee (USD)	1- 20 minutes	All intervals (except continuously)	Handheld device	**
SafetyScan	Canada	Expected 2022	SaaS business model with a price per user (various discounts available)	30 seconds	Pre-hire; pre-shift; during shift; post-shift; post-incident; randomly	Fixed-location device & portable system available	A/F, A/W, C, U, M, MT, T/W, Mn, Ag, RT, PST, HC, Ed, F/I, U, I, MC, WT
SOBEREYE	United States	On the market since 2018	Subscription-based service	1 minute	Pre-shift; during shift	Handheld device	C, M, Mn, T/W, U
WIT	Canada	Not yet on the market	WIT certification is $1,200 per tester; $50/month fee +a $1-3 fee per use of the test (USD)	15 minutes	Pre-hire; post-incident; random; pre-entry to external worksites; post- near miss; new medication check	Mobile app and trained evaluator	Ag, C, M, Mn, T/W
Zxerex Safe	United States	Beta product launched in 2021	Monthly fee based on total # of employees	2 minutes	Pre-hire; pre-shift; during shift; post-shift; post-incident; random	Fixed-location device	A/F, A/W, Ag, C, Ed, HC, M, Mn, RT, T/W, U

Key: A/F = accommodation and food services; Ag = agriculture, forestry, fishing, hunting; A/W = administration and support and waste management; C = construction; Ed = education; F/I = finance and insurance; HC = health care; I = information; M = manufacturing; MC = management of companies and enterprises; MT = maritime; Mn = mining; PST = professional, scientific, and technical services; RT= retail trade; T/W = transportation and warehousing; U = utilities; WT = wholesale trade

*All data are based on self-reported information collected from the respective technology vendors, as well as a scan of readily available public documents and scientific evidence (e.g., peer-reviewed, and unpublished scientific papers). Data presented in this report are intended for informational purposes only and are not intended to represent the views or policies of the National Safety Council.

** Unable to obtain sufficient evidence

Types of technology used

In total, eight different technology types were used to detect on-the-job impairment (see Table 2):

1. **Oculomotor-based testing**
2. **Psychomotor vigilance testing**
3. **Head movement/motion**
4. **Body movement/motion**
5. **Speech**
6. **Components of Standardized Field Sobriety Testing**
7. **Full-body scan**
8. **Other cognitive performance**

The most common type of technology used to detect impairment was oculomotor-based testing (60%). Nine of 15 companies reported using it as at least part of their overall IDT solution. Six of the 15 companies (40%) used psychomotor vigilance testing (PVT). Six vendors (40%) also used the ability to assess other cognitive performance measures, followed by tracking head movement (26.7%) and body movement (20%). The least commonly used technology types included speech monitoring, Standardized Field Sobriety Testing and full-body scans, which were characteristic of only one vendor each.

Table 2. IDT Category*

Tech	Oculomotor-based testing	Psychomotor vigilance testing	Head movement/motion	Body movement/motion	Speech	Components of Standardized Field Sobriety Testing	Full-body scan	Other cognitive performance
AlertMeter		X						X
Druid		X	X	X				X
ExceleRATE/ Vitals								X
Fit for Work	X		X	X	X		X	
F2D2**	X							
Guardian**	X		X					
Optalert	X		X					
OSPAT		X						X
PMI FIT 2000	X							
PVT Workfit		X						
PVT-192**		X						
SafetyScan	X							
SOBEREYE	X							
WIT	X	X		X		X		X
Zxerex Safe	X							X

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**Unable to obtain sufficient evidence

IDT usage

Size: Small- to medium-sized companies were most likely to be using IDTs for workplace safety. Six of the 15 IDT companies reported that their typical clients have 101-250 employees (40%), followed by companies with 501-1,000 employees (26.7%).

Industry: Safety-sensitive industries, such as transportation and warehousing, mining, construction, manufacturing, and utilities are the most common adopters of IDT technologies.

Timing: Regarding test deployment schedule, **a majority (80%) of the technologies recommended use of the IDT prior to the beginning of an employee's shift.** Additionally, 12 of 15 companies (80%) indicated that their technologies can be used at different times during the shift, up to and including ongoing and continuous impairment monitoring. It is notable to mention that the frequency and timing of impairment detection is ultimately up to the discretion of the employer based on feasibility, cost and necessity.

Delivery: Regarding IDT delivery method, **mobile applications and the use of other handheld devices were the most common** (53% combined) (see Table 1). The time it takes to detect impairment varied widely, from 5 seconds to 25 minutes depending on the type of technology used.

Baseline testing: Another characteristic of some IDTs includes baseline testing, the process of measuring individuals in a non-impaired state for comparison. **Baseline testing was associated with six of the 15 IDTs (40%).** Most commonly, the IDTs using baseline data were psychomotor vigilance testing or oculomotor-based technologies. The use of a baseline score for comparison was mentioned by some companies as designed to limit the chance of false negative test results. It is important to mention that the use of baseline testing does not validate or invalidate a technology's effectiveness, but can be useful to calibrate and confirm the effectiveness of a particular technology.

IDT effectiveness

Analysis revealed that all 15 companies have either ongoing or past research concerning the scientific evaluation of their technology solution (see Table 3). 11 of 15 companies (73.3%) reported examining the use of their technology for more than one type of impairment, although most companies' studies focused on fatigue as the primary impairment type.

In the Appendix, a sample of relevant studies are included to highlight proofs of concept for each IDT. The quality of research is dependent on a number of factors, including the primary source of funding, publication type, methodology, etc. Funding for these studies came from a variety of sources, with U.S. federal agencies and academic institutions being the most common (46.7%), followed by projects funded by the company themselves (40%). Notably, a vast majority of technologies (93%) reported being evaluated in peer-reviewed publications, meaning they have been reviewed by subject-matter experts before being published.

Table 3. IDT Evaluation Characteristics*

Tech	Has the technology been evaluated?	Have multiple forms of impairment been evaluated?	Type of research available	Primary source of funding for research	Do scientific publications exist concerning the use of the technology in the workplace?
AlertMeter	Yes	Yes (alcohol, cannabis and fatigue)	Peer-reviewed, case studies	Self-funded, academic institution(s), and a U.S. federal agency	Yes
Druid	Yes	Yes (alcohol, cannabis and fatigue)	3 peer-reviewed, published scientific papers	U.S. federal agency and academic institution(s)	Yes
ExceleRATE/ Vitals	Yes	Yes	Peer-reviewed; client-based case studies	Academic institution(s), U.S. federal agency, Canada federal agency, Nonprofit organization(s)	Yes, but primarily about driving risk among older adults
Fit for Work	Ongoing	Ongoing	Independent clinical studies, peer-reviewed	Self-funded	**
F2D2	Yes	Yes (mostly for fatigue)	Peer-reviewed	**	Yes
Guardian	Yes	No (mostly for fatigue)	Peer-reviewed, white papers	**	Yes
Optalert	Yes	Yes (alcohol & fatigue)	Peer-reviewed, case studies	Academic institution(s), U.S. federal agency, other federal agency, Australian federal agency, nonprofit organization(s	Yes
OSPAT	Yes	Yes	Peer-reviewed, case studies	Self-funded, academic institution(s)	Yes
PMI FIT 2000	Yes	Yes (alcohol, cannabis, cocaine and fatigue)	Peer-reviewed	Self-funded, academic institution(s), U.S. federal agency, other federal agency, and nonprofit organization(s)	Yes
PVT Workfit	Yes	Yes (mostly for fatigue)	Peer-reviewed, case studies	U.S. federal agency, nonprofit organization(s)	Yes
PVT-192	Yes	Yes (mostly for fatigue)	Peer-reviewed	**	**
SafetyScan	Yes	Yes	Peer-reviewed	Self-funded, U.S. federal agency, private investors	Yes
SOBEREYE	Yes	Yes (most studies focus on drugs and fatigue)	Peer reviewed	Self-funded, academic institution(s)	**
WIT	**	No (mostly for alcohol)	Peer reviewed***, case studies	N/A	No
Zxerex Safe	Yes	No (only evaluated for cannabis)	**	For-profit organization(s)	No

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**Unable to obtain sufficient evidence

***Vendor reported reliance on past research conducted to assess the efficacy of the science the technology is based on (e.g., oculomotor-based testing, psychomotor vigilance testing).

Barriers to implementing IDTs

Survey data collected from the technology companies revealed insights regarding employer reported barriers to implementing IDTs. **The most common barrier reported was employees being resistant to change (20.6%),** followed by lack of management buy-in (17.7%), lack of union support (11.8%) and employee comfort level with the technologies (11.8%).

While cost was not among the most noted barriers, other research has shown that it is a consideration in implementing safety technology in general (Washburn, 2020). Regarding pricing of the IDTs included in this analysis, the cost structure varied widely. Generally, the two most common pricing structures included an annual subscription model or a monthly fee based on the average number of users. See the Appendix for a more detailed overview of each technology's cost.

DISCUSSION

Overall, a variety of IDT solutions are available to detect multiple forms of impairment for workplace safety. Since the initial environmental scan began in 2020, five new technologies were identified. This suggests a possible demand for IDT solutions for workplace safety. The primary focus of these technologies is to ensure a safe workplace. They are not intended or recommended to be used for immediate disciplinary action or to be punitive in nature. Instead, the goal of IDT is to help companies in keeping employees safe and to assist them with underlying illnesses or issues related to impairment.

IDTs can facilitate an opportunity for employee assistance in order to improve impairment-related factors and conditions. It is up to the employer and their legal counsel to outline procedures for when cause investigation is warranted following impairment detection by use of the IDT. However, if the reason for employee impairment is identified (whether through employee disclosure, confirmatory drug testing, medical evaluation, etc.), it can provide an opportunity for employers to better support employees. This support can take shape as workplace accommodations, treatment for medical conditions, altered workplace policies that mitigate risks of impairment and more. By taking action, employers not only improve the health of the employee, they are better able to address the root cause of certain workplace injuries and fatalities since impairment is often a hidden risk.

While most IDTs are founded in fatigue management, many have expanded into chemical impairment and other causes of impairment.

Many technology providers reported their product is “cause agnostic” or that they focus on alertness, attention, vigilance and other cognitive performance indicators instead of aiming to detect impairment by specific causes. These factors can supposedly act as proxies to indicate impairment from substance use, fatigue, mental distress, etc. These proxy measures are used to indicate the probability of impairment in employees. Generally, these technologies do not precisely quantify how impaired an employee might be, rather they strive to indicate if an employee has passed a pre-determined threshold due to impairment that can lead to a fitness for duty concern. One IDT company clarified, “We are not identifying how much alcohol or cannabis a person has in their system, but rather we are identifying signs of impairments which is associated with consuming X amount of cannabis or alcohol.”

Considerations for implementing IDTs

It is important to prepare the workplace for adopting this new technology. It is beneficial for employers to have a rollout plan prior to implementation which is focused on open communication with employees. As employees may understandably be wary of new forms of assessment, it is important to have a thorough change management process throughout technology exploration and adoption to ensure employee concerns are able to be voiced and addressed. Many technology vendors provide support to aid in this process. In addition, the Work to Zero initiative from the National Safety Council recently released a suite of tools to help employers on their innovation journey, including a safety technology pilot and implementation roadmap (Guasta, Lin, & Whitcomb, 2022).

When selecting an IDT, one of the most important factors to consider is the validation of the product.

The ideal product should be well-researched with documented effectiveness in identifying multiple forms of impairment. The most reliable research is peer-reviewed studies conducted in workplace settings and funded by external sources.

Understanding the workplace landscape and needs will allow employers to choose an appropriate technology and implement it soundly. Employers should consider factors such as worksite location(s), industry, target population demographics, and the most common impairment risks experienced by workers (identified by both worksite and community-level data). Also, as IDT is often supported by accompanying software and reporting mechanisms to track and assess workplace risk, employers should determine if these options are preferred.

Once a technology is identified, pilot testing is recommended to further evaluate the technology, as every workplace will need to ensure the product is appropriate for their unique needs. With employee and legal input, policies should be developed well in advance of the technology rollout to define and set the expectations for the workplace, ensure necessary procedures are in place and protect the employer from potential legal repercussions. These policies should include when and how the cause of worker impairment is investigated after it is identified via use of the IDT. It is of the utmost importance that the technology is used consistently and not disproportionally applied to certain worker populations, especially in cases of reasonable suspicion.

Need for additional research

While impairment detection technology is a promising workplace safety solution, more research is needed to confirm and advance the evidence base behind these technologies. More data is needed to understand how each of the technologies have been evaluated across various forms of impairment, including the underlying methods of the technology and the actual IDT product that uses the methods. Furthermore, more rigorous studies are needed to examine the use of each IDT across various industries, their ability to detect for multiple forms of impairment and their use at different intervals of deployment (e.g., pre-hire, post-incident, reasonable suspicion, etc.).

Another topic that could benefit from additional research is how IDTs can possibly quantify and/or establish thresholds to determine sufficient alertness, attention and vigilance in order to be considered fit for duty. While the risks associated with employee impairment are clear, additional research is needed to better understand the relationship between specific sources of impairment on workplace safety, as well as the effects of various levels of impairment. Additionally, distraction was listed by a few IDT companies as a type of impairment, but debate exists as to whether distraction should be considered as a cause or a symptom of impairment. More investigation should be done to better understand this relationship.

Lastly, while IDT aims to remove human prejudice in fitness for work assessments, bias can inadvertently affect decisions to respond to impairment detected from IDT, which can potentially carry long-term consequences for employees. Additional research is needed to ensure that algorithms and risk profiles utilized by IDTs are specific, accurate and non-discriminatory.

CONCLUSION

As substance use, fatigue, mental distress and other causes of impairment remain largely under-reported and unaddressed among worker populations, it is key that IDTs and other assessment and mitigation strategies are included in the workplace to address threats to safety and worker wellbeing. While this report intended to provide an overview of information and scientific evidence regarding IDTs, it is important to note that the landscape in this field is evolving with new technologies and research available for review.

There are promising IDTs on the market for workplace safety, but there is no single technology that suits the needs of every employer. All workplaces have unique barriers and considerations. Additionally, this review is not without limitations and more research is needed to ensure each IDT is formally validated to detect for various forms of impairment. Even so, employers can and should consider examining these technologies for fitness for duty assessment. It is imperative that each technology is fully evaluated, potential barriers are addressed, and effective change management principles are used to best prepare for piloting and/or implementation.

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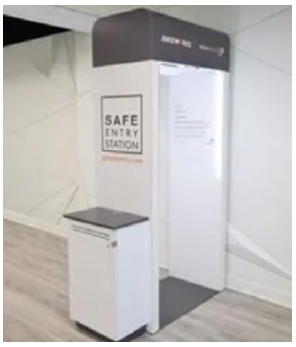
APPENDIX

Title	AlertMeter
Provider	Predictive Safety
Description	The AlertMeter® alertness test is a top-screen indicator of cognitive distress and lack of alertness due to a number of factors. It uses a graphical PVT-type test with interface displays of different shapes that the user must identify accurately and quickly.
Task, Testing Method	The AlertMeter® test interface displays a series of shapes presented in a static grid or a rotating circle. On some screens, all the shapes are identical; on other screens, one of the shapes will be different from the rest. The user's task is to determine whether all the shapes are the same, regardless of shape rotation. If they are all the same, the user taps or clicks a green button indicating, "They're all the same!" If one shape is different, the user taps or clicks on the different shape within the grid. Response times and accuracy are recorded, and a score is calculated at the end of the test. Feedback from the test includes: "Outside Your Normal Range," "Guarded, Significant, High Fatigue State" or "Choose from among these countermeasures". A typical test displays 30 items to measure performance.
Task Duration, Format	Fifty – 70 seconds on a tablet, smartphone or personal computer
Cost Structure	The cost is based on a subscription model per user per month/annual, unless an enterprise agreement has been arranged for a large organization. There are no setup costs or hardware provided.
Customer Support and Other Services	• 24/7 general support • Assistance with trial or pilot • Consulting • User error navigation • Maintenance and upkeep • Implementation support
Research Conducted	A non-exhaustive list of research publications include: • Research report: Measuring human fatigue with the BLT testing system, 2009. Link • Testing Alertness of emergency physicians: A novel quantitative measure of alertness and implications for worker and patient care, 2020. Link • Validation of AlertMeter® fatigue assessment device for transportation workers, 2021. Link Case studies are also available via the company website.
Website	https://predictivesafety.com/alertmeter/
Other Comments	• Aware4Duty is a white label available by Aware360 • Baselines are used • Also offers PRISM Fatigue Management System to use with this technology • Employee and supervisor training is recommended before application

Title	Druid
Provider	Impairment Science, Inc.
Description	The Druid app, in English or Spanish, measures cognitive abilities, motor abilities and performance in order to detect and measure impairment due to any cause.
Task, Testing Method	Druid detects impairment by taking several hundred key neurophysiological measurements in less than three minutes. The app measures reaction times, hand-eye coordination, decision making, time estimation and balance. Tasks include touching circles and squares as they appear on the phone screen in different order and tracking a circle by touch as it moves on the screen while counting the number of pop-up squares. Stability is measured by balancing on one leg at a time while holding the phone or tablet as steady as possible in one hand. After taking the test, the user is immediately provided with an impairment score. Employers can access and analyze test scores of individuals or groups over any period of time on Druid Enterprise, the company's online management portal and database.
Task Duration, Format	The duration of the test is less than three minutes using a touchscreen tablet or smartphone.
Cost Structure	For unlimited personal use, the subscription fee is $1.99 per month or $14.99 per year, downloaded from Apple or Google app stores. For organizational use of Druid app and Druid Enterprise (the management portal and database), subscription fees are available for unlimited use. These depend on volume, and range from $2.50 – $8.00 per month, per participating employee. Employers use their own devices, so there is no setup fee.
Customer Support and Other Services	• Assistance with trial or pilot • Consulting • System error navigation • User error navigation • Maintenance and upkeep • Implementation support • Policy development
Research Conducted	A non-exhaustive list of research publications include: • Effects of high-potency cannabis on psychomotor performance in frequent cannabis users, 2022. Link • Assessment of cognitive and psychomotor impairment, subjective drug effects, and blood THC concentrations following acute administration of oral and vaporized cannabis, 2021. Link • An investigation of the Druid® smartphone/tablet assessment for cognitive and psychomotor impairment associated with alcohol intoxication, 2019. Link
Website	https://impairmentscience.com/
Other Comments	• First-time users are required to practice the test twice before a third test establishes a baseline • This technology is white-labeled by other companies • Free personalized instruction is offered by this vendor



Title	Fit for Work
Provider	Predictmedix Inc.
Description	Predictmedix is a Canadian-based life sciences technology company and developer of AI-powered products designed to improve workplace health and safety. They utilize on-site “Safe Entry Stations” to screen employees for a variety of impairment factors. The contactless solution provides immediate results to detect potential alcohol and cannabis use. Further, multispectral thermal cameras and AI look at body temperature, eye redness, speech, flushness, breathing rate, heart rate and more.
Task, Testing Method	Predictmedix utilizes on-site “Safe Entry Stations”, containing multispectral devices and sensors designed to capture data from factors such as body temperature, eye redness, speech, facial flushness, breathing rate, heart rate and more. Testing takes approximately 20 seconds, and results are analyzed by a proprietary AI algorithm. If impairment is detected, employees are given a “red light”, indicating that they have been flagged for impairment.
Task Duration, Format	Twenty seconds; taken via “Safe Entry Stations” containing multiple devices and sensors designed to capture physiological data
Cost Structure	Setup plus monthly for 1, 2 or 3 year terms with unlimited scans. The approximate price: 1 year – $1,900 per month, 2 year – $1,200 per month, 3 year – $950 per month
Customer Support and Other Services	• Trial and pilot assistance • System error navigation • User error navigation • Maintenance and upkeep • Implementation support
Research Conducted	An ongoing clinical study is currently being validated by a third party.
Website	https://predictmedix.com/impairment-screening/
Other Comments	• Predictmedix also offers infectious disease screening and a Mobilewellbeing™ remote monitoring wearables and portable devices • Baselines are not used/needed • Basic training is recommended

Title	ExceleRATE/ Vitals
Provider	Impirica, Inc.
Description	ExceleRATE is a commercial driver risk-evaluation that is focused on the skills critical for safe driving. ExceleRATE is comprised of two assessments, VITALS and CORE. VITALS is a self-administered tablet-based assessment designed to evaluate impairment risk. CORE is a behind-the-wheel assessment that is used to assess a driver's functional ability to drive.
Task, Testing Method	ExceleRATE is the overall evaluation to establish driving risk but, within the evaluation protocol, it is the Vitals assessment that is used to measure impairment risk. With specific reference to the VITALS assessment– it is a mobile-based cognitive screen comprised of four tasks that engage the brain in the same way it would be during driving. The battery of four tasks evaluates 22 different cognitive weighted measures, including reaction time, attentional field, spatial judgment, attention shifting, executive decision making and identification of hazardous situations. The participant's cognitive performance is then processed to provide a predictive risk of real-world impairment relative to driving a vehicle. The CORE assessment is another service provided that is an on-road evaluation. These results can be combined with the Vitals assessment to provide a detailed risk evaluation.
Task Duration, Format	The VITALS mobile assessment takes approximately 20 minutes and the on-road CORE assessment takes approximately 45 minutes.
Cost Structure	A typical customer can budget as follows: site-setup fee: $2,950, Vitals assessment: $60, CORE assessment (where applicable): $60. Where there is predictability in the assessment volumes, a single, volume-based licensing fee that accommodates volume discounts is available.
Customer Support and Other Services	• Assistance with trial or pilot • System error navigation • User error navigation • Implementation support • Policy development • Maintenance and upkeep
Research Conducted	A non-exhaustive list of research publications include: • The DriveABLE Competence Screen as a predictor of on-road driving in a clinical sample, 2009. Link • Usefulness of the DriveABLE cognitive assessment in predicting the driving risk factor of stroke patients, 2015. Link A non-exhaustive list of research titles to be published in 2022 include: • Analysis of the effects of cannabis intoxication, driving impairment, and cognitive functioning. Colorado study. *Link unavailable~* • Analysis of employees operating in a safety sensitive environment. Comparison of cognitive screen data vs. toxicology report in addition collection of normative data. Ontario & Alberta (Canada). *Link unavailable~* Case study are also available via the company website.
Website	https://impirica.tech/solutions/excelerate/
Other Comments	• Tests results are compared to the individual results of healthy individuals in the same age range • Driving has been their initial focus, however they have identified application for other safety sensitive environments; it has been established that the cognitive skills required for safety-sensitive work tasks overlap with those required to operate a vehicle • This technology is resold by other companies

Title	F2D2*
Provider	Alertness Management Technologies
Description	The F2D2 Device analyzes for pupil dynamics and intends to assess the level of a person´s vigilance and impairment. This testing is based on the analysis of Pupillary Light Reflex. The F2D2 is designed as a portable system for roadside testing and measurements at the workplace.
Task, Testing Method	The PLR is triggered by an internal light stimulus and recorded by the integrated infrared camera. F2D2 records the diameter of the human pupil with an infrared camera integrated into a pair of glasses. The glasses also establish standardized light conditions for the test person and simplify fixation by a weak light. A dedicated software tool is continuously analyzing diameter changes of the pupil with a frequency of 25 measurements per second.
Task Duration, Format	The sleepiness test requires recording pupil behavior for up to 11 minutes via handheld glasses.
Cost Structure	Unknown
Customer Support and Other Services	Unknown
Research Conducted	A non-exhaustive list of research publications include: • Pupillary instability as an accurate, objective marker of alertness failure and performance impairment, 2019. Link • It's in the eyes - a novel, objective marker of alertness and performance impairment, 2017. Link • Sleepiness in professional truck drivers measured with an objective alertness test during routine traffic controls, 2014. Link A summary of available research can be found here.
Website	https://www.amtech.de/en/products/f2d2
Other Comments	• Glasses are accompanied by a computer with a software package to measure PLR and PUI

*Did not complete NSC survey

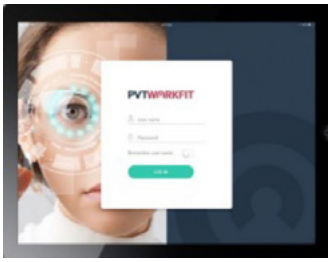
Title	Guardian*
Provider	Seeing Machines
Description	Seeing Machines is an Australian-based manufacturer of monitoring and intervention sensing technologies and services. Guardian utilizes artificial intelligence (AI) technology designed to observe drivers' visual attention to their environment, assess their degree of drowsiness and detect if the driver has passed a threshold of risk. Risk mitigation is then enacted via in-cab seat vibration, audible alarms and a call to relevant supervisor(s) if necessary.
Task, Testing Method	Continuous monitoring hardware devices, including an onboard computer, movement sensor and forward-facing camera, observe changes in eye aperture and head position. If decreased alertness is detected, an alert response is activated through a seat vibration, an audible in-cab notification and an event classification at the alert center. If coded as fatigue, a call to the driver's management is initiated. The chain of events takes less than 90 seconds.
Task Duration, Format	Less than 90 seconds for measurement and alerts; monitored via onboard computer, sensors and forward facing camera.
Cost Structure	Cost is dependent on the number of vehicles, including a hardware cost and servicing fee.
Customer Support and Other Services	• 24/7 customer service centers • 24/7 alert support centers
Research Conducted	While not necessarily exhaustive, one published study is available online: • The relative importance of real-time in-cab and external feedback in managing fatigue in real-world commercial transport operations, 2017. Link
Website	https://www.seeingmachines.com/guardian/
Other Comments	• False positives may occur after 30 – 50 hours of drive time • Field testing for detection of other forms of impairment

*Did not complete NSC survey

Title	Optalert
Provider	Optalert
Description	Optalert is an Australian-based medical technology company founded by sleep researcher Dr. Murray Johns. The technology utilizes "blepharometry", the measurement of blinks, to detect drowsiness and serve as an early alert system for drivers. Optalert quantifies the deterioration in cognitive brain function according to the Johns Drowsiness Score (JDS).
Task, Testing Method	Optalert's continuous *fatigue monitoring system* comprises a pair of glasses housing infrared light emitters and sensors that measure the duration and speed of eye and eyelid movements in real-time. This data is transmitted to an in-cab computer, which measures fatigue levels and can emit an audible warning if drowsiness is detected based on the Johns Drowsiness Scale (JDS).
Task Duration, Format	Continuous measurement; wearable spectacles measure eyelid movement and transmit data to the in-cab computer
Cost Structure	Pricing plans are flexible. Typically, hardware and/or algorithm costs are paid up front, followed by an annual subscription cost. Deep data is also offered for advanced industry 4.0 clients.
Customer Support and Other Services	• 24/7 general support • Assistance with trial or pilot • Consulting • System error navigation • User error navigation • Maintenance & upkeep • Implementation support • Policy development
Research Conducted	A non-exhaustive list of research publications include: • Assessment of drowsiness based on ocular parameters detected by infrared reflectance oculographym, 2013. Link • The relationship between driving performance and the Johns Drowsiness Scale as measured by the Optalert system, 2006. Link • The assessment of 'sleepiness' in human drug trials: a new perspective, 2019. Link
Website	https://www.optalert.com/
Other Comments	• Optalert is now exploring new pathways in the automotive industry, pharmaceutical drug trials and neurological research • Baselines are not used/needed • Their technology is white-labeled by other companies and resold • Training is recommended for employees, supervisors and medical professionals

Title	OSPAT: *Occupational Safety Performance Assessment Technologies*
Provider	Romtech Australia Pty Ltd.
Description	Romteck Australia is a manufacturing company specializing in safety critical telemetry solutions. The OSPAT (*Occupational Safety Performance Assessment Technologies*) system is a 60-second impairment assessment designed to be the first checkpoint for employees at the commencement of their shift. Historical data is stored for all employees, enabling the system to identify variations in performance that may indicate impairment. Results are relayed in real-time to the employee and relevant supervisor(s), and also stored into a comprehensive database.
Task, Testing Method	OSPAT is a non-invasive, on-site hand-eye coordination test to determine if an employee is fit for work, taking into account a wide range of potential impairment factors. OSPAT is designed to be the first checkpoint for employees at the start of a shift, with a dedicated terminal acting as an interface, which can also be integrated with existing security access systems.
Task Duration, Format	Sixty seconds; taken via a non-invasive hand-eye coordination assessment
Cost Structure	OSPAT is typically licensed on an annual basis. Cost is based on the number of distinct individuals who will perform the assessment (approx. one terminal per 40 employees). The cost per person decreases with an increasing count of people. On average, the cost per user is $100 (USD) annually. One terminal is included at no additional cost for each 40 users.
Customer Support and Other Services	•General support • Assistance with trial or pilot • Consulting • System error navigation • User error navigation • Maintenance & upkeep • Implementation support • Policy development • Data analysis
Research Conducted	A non-exhaustive list of research publications include: • Quantitative similarity between the cognitive psychomotor performance decrement associated with sustained wakefulness and alcohol intoxication, n.d. Link • The impact of sustained wakefulness and time-of-day on OSPAT performance, 2005. Link Case studies are also available via the company website.
Website	https://www.ospat.com/
Other Comments	• Baselines are used • Employee outcome reports and alerts are available to the employer • Training for employees, supervisors, medical professionals and other professionals is required to use this technology

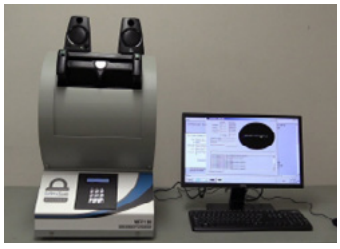
Title	PMI FIT 2000, Fitness for Duty Impairment Screener
Provider	Pulses Medical Instruments, Inc. (PMI, Inc.)
Description	The PMI FIT 2000 uses oculomotor-based science to measure a person's involuntary eye-reflex reactions to light and compares key eye measurements to the person's own baseline. These measurements are used to track changes in the person's alertness levels and levels of impairment.
Task, Testing Method	The hardware device performs eye tracking to measure changes in pupil diameters, latency and speed to determine an individual's level of risk. The system also measures Saccadic Velocity resulting from following a light side to side, which is the primary indication of fatigue. Individuals are required to take 10 initial tests to create a baseline; each test is compared to the baseline to determine one's level of risk. There is an immediate conclusion from the test which is displayed on a digital display and also a paper receipt showing: "proceed to work", "proceed with caution", or "see your supervisor" (High Risk conclusion). For all High Risk conclusions, automatic emails are sent to the supervisor.
Task Duration, Format	A 23-second test using the hardware device/retina scanner
Cost Structure	Some regions are on a flat fee basis and other regions are based on an annual service plan.
Customer Support and Other Services	• 24/7general support • Assistance with a trial or pilot • Consulting • System error navigation • Maintenance and upkeep • Implementation support • Policy development • User error navigation
Research Conducted	A non-exhaustive list of research publications include: • Oculomotor impairment during chronic partial sleep deprivation, 2003. Link • Neural basis of alertness and cognitive performance impairments during sleepiness: Effects of 24h of sleep deprivation on waking human regional brain activity, 2000. Link • Pupil dynamics and eye movements as indicators of fatigue and sleepiness, 1997. Link
Website	https://www.pmifit.com/
Other Comments	• Baselines are used • This technology is white-labeled by other companies and is resold



Title	PVT WorkFit
Provider	Pulsar Informatics
Description	PVT WorkFit provides a brief assay of alertness. The psychomotor vigilance test (PVT) was invented by Dr. David Dinges to measure changes in psychomotor speed, lapses of attention, wake state instability and impulsivity induced by fatigue and other performance-degrading factors commonly found in operational environments. Based on research supported by government agencies as well as the pharmaceutical industry, the PVT has been evaluated in laboratory studies, simulators and operational environments and shown to be sensitive to a variety of performance-degrading and fatigue-related factors.
Task, Testing Method	The PVT test requires a person to watch a screen for a light stimulus and press a response button as quickly as possible when the light is detected. The light comes on repeatedly at random intervals of a few seconds until enough responses are acquired to establish the consistency of the subject's visual reaction times. The test yields results for the stability of focused attention by measuring the number of errors of omission (performance lapses) and errors of commission (impulsive responses). By detecting these performance changes, the PVT records the degree of deficits in alertness and vigilant attention as well as response speed. The user receives feedback after interacting with the PVT that is customizable by the employer.
Task Duration, Format	The 10-, 5- or 3-minute models are performed on a tablet, smartphone or computer. Clinicians can access test results instantly along with analytics and normative data to aid interpretation.
Cost Structure	PVT Workfit is offered as a SaaS product. Annual subscriptions are based on the number of covered employees.
Customer Support and Other Services	• 24/7 general support • Assistance with a trial or pilot • Consulting • System error navigation • User error navigation • Maintenance and upkeep • Implementation support • Policy development
Research Conducted	A non-exhaustive list of research publications include: • Use of the psychomotor vigilance test in fitness for work assessments, 2017. Link • Sleep and alertness in a duty-hour flexibility trial in internal medicine, 2019. Link • Psychomotor vigilance performance: neurocognitive assay sensitive to sleep loss, n.d. Link • Validity and sensitivity of a brief psychomotor vigilance test (PVT-B) to a total and partial sleep deprivation, 2011. Link
Website	https://pulsarinformatics.com/products/pvtworkfit
Other Comments	• Available in English and French (other languages upon request) • The Pulsar software integrates with a company's policy, work schedules and punch-in/punch-out data • This technology is usually implemented in conjunction with a fatigue risk management program • Employee outcome reports and alerts are available to the employer • Training is required to use the technology • Baselines are not used/needed

Title	PVT-192*
Provider	Ambulatory Monitoring, Inc.
Description	The PVT-192 Psychomotor Vigilance Task Monitor provides a handheld, self-contained system to record and store reaction time measurements. The PVT (psychomotor vigilance test) is combined with a React software.
Task, Testing Method	The PVT measures degradation of vigilance in which stimuli are presented on the screen and users have to react as quickly as possible. Meanwhile, errors of omission and commission are recorded. Lapses, the primary outcome measures of PVT performance, are defined as reaction times exceeding 500 m/sec or failure to react. Lapses constitute sensitive measures of the effects of impairment on attention and vigilance. Impairment in executive functioning is defined as the count of false responses (responding when no stimulus is presented).
Task Duration, Format	Ten minutes on a handheld device (a small box with an LCD screen to provide instructions and another to display the stimuli)
Cost Structure	$3,000 for the handheld device including software, software updates, charging cables and one-year warranty
Customer Support and Other Services	No consulting or customer service provided outside of the product itself. When PVT-192 is purchased, the clients receive a demo, user manual and a series of phone calls if needed.
Research Conducted	A non-exhaustive list of research publications include: • The sensitivity of a palm-based psychomotor vigilance task to severe sleep loss, 2008. Link • PC-PVT 2.0: An updated platform for psychomotor vigilance task testing, analysis, prediction, and visualization, 2018. Link • Validation of touchscreen psychomotor vigilance task for android devices, 2017. Link Visit this page for a full listing of their references.
Website	http://www.ambulatory-monitoring.com/pvt192.html
Other Comments	• Employers have full access to the data • Ten minute-tests are the most published, but a three-minute test has recently been validated and is becoming popular in the transportation industry • Baselines are not used/needed

*Did not complete NSC survey



Title	SafetyScan
Provider	SafetyScan Technologies
Description	SafetyScan Technologies is a Canadian-based provider of workplace safety screening technologies worldwide. The test is a non-invasive eye-tracking screener designed to detect impairment from alcohol use, drug use or cognitive fatigue. An infrared camera tracks eye movement and results are analyzed through a proprietary algorithm. These results are compared to an established baseline. Baseline/onboarding begins with a health/sleep questionnaire, breathalyzer and fingerprint drug test. Baseline development is then an automated daily process completed over a 10-day period.
Task, Testing Method	Employees are instructed to look at visual stimuli within the machine, where an infrared camera tracks speed, movement, delay, accuracy and reaction of the eye to the stimuli. These results are analyzed through a proprietary algorithm and compared to an established baseline, where they either PASS (meaning no impairment is found) or REFER (meaning impairment has been found). Next steps following a REFER are dictated by each company's HR policies.
Task Duration, Format	Thirty seconds; taken by an infrared camera
Cost Structure	SaaS subscription cost structure - affordable for companies of all sizes. Discounts are based on number of employees, length of contract, prepaid or pay as you go, etc. There is no cost for hardware workstations.
Customer Support and Other Services	• Remote support • Baseline testing • Onboarding • Technical support • Training services
Research Conducted	A non-exhaustive list of research publications include: • Oculomotor impairment during chronic partial sleep deprivation, 2003. Link • Neural basis of alertness and cognitive performance impairments during sleepiness - effects of 24 h of sleep deprivation on waking human regional brain activity, 2000. Link Information about their research can be found here.
Website	https://safetyscan-technologies.com/pages/how-safetyscan-works
Other Comments	• Desktop version is in development that will include virtual reality goggles, increased portability, decreased weight and a cloud application • Baselines are used • The original product was known as the FIT 2000 and is the basis for SafetyScan 2.0 product development. • FIT 2000 is reflected in all the studies; vendor is also doing their own research

Title	SOBEREYE
Provider	SOBEREYE, INC.
Description	SOBEREYE measures alterations of the Pupillary Light Reflex (PLR), the pupil reaction to changing light intensity. The PLR is an involuntary reflex controlled by the autonomic nervous system. A PLR alteration from a normal response (baseline) is reported as an indication of brain function anomaly due to various forms of impairment.
Task, Testing Method	Users place the portable device over their eyes and receive spoken instruction before and during the test. The result of the test is immediately available on the testing device screen. The result is either "Low-Risk", meaning that no PLR alteration is detected and the employees can proceed, or "High-Risk", meaning that a significant PLR alteration is detected and the individual should not operate or perform a dangerous task, and should follow the company procedure for High-Risk results. When High-Risk result occurs, a notification is sent to the company's designated personnel assigned to handle the event.
Task Duration, Format	One minute; portable self-testing testing device comprising of an opaque enclosure containing a latest generation smartphone
Cost Structure	SOBEREYE is a subscription-based service that includes: testing devices, cloud-based enterprise software, training and support. The cost structure is price per user with unlimited testing. Only active daily users are counted against the plan.
Customer Support and Other Services	• Assistance with a trial or pilot • Consulting • Maintenance & upkeep • Implementation support • Policy development
Research Conducted	A non-exhaustive list of research publications include: • Estimation of operators' fatigue using optical methods for determination of pupil activity, 2015. Link • Opiate-induced pupillary effects in humans, 1989. Link • Testing human hair for drugs of abuse - individual dose and time profiles of morphine and codeine in plasma, saliva, urine, and beard compared to drug-induced effects on pupils and behavior, 1990. Link A listing of references can be found here.
Website	https://www.sober-eye.com/
Other Comments	• Employee outcome reports and alerts are available to the employer • Training is required for employees and supervisors before using the technology • The supplied testing devices include smartphones pre-configured and locked to work exclusively with SOBEREYE patented software • Baselines are used

Title	Workplace Impairment Test
Provider	Workplace Impairment Solutions
Description	The Workplace Impairment Test (WIT) is comprised of four divided-attention psychophysical tests and three tests assessing eye movement on a tablet-based app. It starts with general questions to determine if the subject is in need of medical attention. Next are the psychophysical and eye tests. The examiner will use checkboxes to score the performance on the tests, and a proprietary algorithm will determine if the subject shows "evidence of impairment," "no signs of impairment" or "inconclusive, please correlate with other tests."
Task, Testing Method	The WIT helps determine if someone is impaired using standardized divided attention and psychomotor tests. These tests are, as follows: walk and turn, one-leg stand, modified Romberg's test and the finger-to-nose test. The WIT observes eye functioning with the Horizontal Gaze Nystagmus Test, Lack of Convergence Testing and evidence of eyelid tremor.
Task Duration, Format	The test takes 15 minutes to complete and is executed on a smartphone or tablet.
Cost Structure	To become certified to use the WIT, the cost is $1,200 and requires the tester to complete an online learning component and one day of in-person training. There is a $50/month fee to continue to use the test, and a $1 – 3 fee per use of the test.
Customer Support and Other Services	• Assistance with a trial or pilot • Consulting • System error navigation • User error navigation • Maintenance and upkeep • Implementation support
Research Conducted	The WIT is based on the Drug Recognition Expert and the Standardized Field Sobriety Test models. A non-exhaustive list of research publications include: • Validation of the Standardized Field Sobriety Test battery at BACs below 0.10 percent, 1998. Link • A Florida validation study of the Standardized Field Sobriety Test (S.F.S.T.) battery, 1997. Link • A Colorado validation study of the Standardized Field Sobriety Test (SFST) battery, 1995. Link
Website	https://www.workplaceimpairment.com/
Other Comments	• Employee outcome reports and alerts are available to the employer • Training is needed for the person administering the WIT – either a company representative or an external representative at a collection site • Baselines are not used/needed

Title	ZXEREX Safe
Provider	ZXEREX Corporation
Description	The technology was developed at Arizona State University, the Barrow Neurological Institute (Dignity Health). A team invented a technology that analyzes saccadic and microsaccadic (fixational) eye movements to identify changes that occur as a result of drug use or fatigue. ZXEREX Corporation was formed and licensed the technology with the goal of improving the science and conducting human drug impairment studies. The software required to analyze and report upon impairment was developed by ZXEREX and a beta product launched in December 2021. The technology compares individuals to a baseline to identify changes consistent with impairment.
Task, Testing Method	The screening is self-administered; instructions appear on the screen. Coaching is provided during screening. The system will provide results to the supervisor or the employee as determined by the company.
Task Duration, Format	Two minutes; current technology utilizes a desktop system
Cost Structure	There is a monthly fee based upon an annual plan determined by the total number of employees at the facility.
Customer Support and Other Services	• 24/7general support • Assistance with a trial or pilot • User error navigation • Maintenance and upkeep • Implementation support
Research Conducted	An ongoing study on "the effect of opioids on the neurological systems" is in progress. Information on the scope of their research is described here.
Website	https://www.zxerex.com/
Other Comments	• Employee outcome reports and alerts are available to the employer • Brief training is needed for supervisors before technology implementation • The company expects to launch a mobile version in the future • ZXEREX has developed a oculomotor biomarker for marijuana and expects to have one for opioids shortly

National Safety Council