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REVIEW

Clinical Guidance for Monitoring and Accountability in Safety-Sensitive Workers with a History of Substance-related Disorders

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Abstract

Background With rare exception, Canadian jurisprudence rejects the use of random, unannounced workplace alcohol and drug testing for *all* employees, as an implied right of management, even in safety-sensitive settings. Instead, reasonable cause for individualized testing must first be established. That is, testing may be justifiable in the presence of an acknowledged problem, e.g. a worker with a substance use disorder, within the context of a rehabilitation plan, or post-incident. Currently, there exists no Canadian standards for monitoring and accountability in safety-sensitive workers with a history of substance use disorders returning to safety-sensitive work following substance use disorder (addiction) treatment.

Methods This review provides recommendations for such monitoring and accountability in safety-sensitive workers.

Results Key considerations are offered for safe and effective monitoring in an occupational setting, including roles and responsibilities, duration of monitoring, detection techniques, monitoring of other substances, testing matrices, management of non-adherence and relapse/return to use, and ethical concerns.

Conclusions This paper discusses essentials of monitoring and their rationale in a context intended to inform a range of stakeholders tasked with formulating and/or implementing monitoring and accountability in the Canadian occupational context to ensure safe and durable work.

Keywords Substance use disorder · Safety-sensitive work · Monitoring agreement · Recovery · Accountability

Introduction

Substance Use Impacts Occupational Capacity and Risk

The bona fide occupational requirements (BFOR) of an occupation are the specific qualifications, skills, and characteristics needed to successfully and safely perform the tasks and duties of a particular job or profession. These work tasks and duties can be inherently dangerous, e.g. in safety-sensitive positions [1, 2], where errors in judgement or performance can result in a direct and serious risk of injury to workers and the public, or damage to property or the environment. In decision-critical occupations [3], errors in judgment or performance can lead to negative consequences, either in the short or long term, for operations, finances, the employer's reputation, and the environment.

Many factors can impact and even preclude a worker from meeting BFORs. A typical cause or contributor of workplace incidents is human error resulting from the

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worker's inability to accurately recognize and monitor their own impairment and risk. Deficits in cognition, psychomotor and executive functioning are associated with a range of mental and behavioural disorders, including substance-related disorders. These can foreseeably increase the risk of workplace incidents, near-misses, and accidents. Potentially impairing substances used by workers (usually not including nicotine and caffeine) are collectively referred to for the purposes of this paper as occupationally relevant substances. Consumption, recreationally or in the context of a substance use disorder (addiction), can affect occupational capacity, risk, and tolerance. The use of occupationally relevant substances can foreseeably result in deficits in human cognition (e.g. attention, concentration, alertness, memory, judgment, cognitive flexibility, reasoning, and others) as well as deficits in psychomotor function (e.g. reaction time, multi-tasking, and others). Such performance deficits are associated with increased risk of workplace incidents and fatalities [4–7].

Impairment related to substance use does not have to be sustained to pose material risk [8]. Even very brief episodes, or impairment that may not be obvious to others in the workplace, may result in the potential for serious harm. Impairment can manifest particularly during situations where cognitive demand ("load") is high, e.g. when a worker has to multi-task, or where the worker is faced with a sudden, non-routine, unexpected, or emergency situation where a rapid, appropriate, and effective response is required to maintain control or to avoid an incident. Additional factors, such as stress, fatigue, other medical conditions, side-effects of medications, psychosocial crises and conflict, either alone or in combination, contribute further to risk [9]. These risk factors are addressed through other domains of monitoring and accountability, such as practice monitoring, in addition to biological monitoring, when impairment is partially related to, or unrelated to substance use. Aside from the impact on occupational risk, workers with substance use disorders also have higher rates of absenteeism, increased turnover, and increased healthcare costs compared to workers in recovery [10, 11]. The impact of substance use on occupational variables can occur at any stage during the history of substance use, i.e. during intoxication, post-intoxication, i.e. persistent "carry-over" effects, and during withdrawal. In addition, there can be persisting and even permanent psychiatric or neurocognitive deficits following chronic and heavy consumption of certain substances such as alcohol [12] and stimulants [13].

In order to best ensure optimal occupational safety and performance, the impacts of the use of occupationally relevant substances on the workplace must be appropriately acknowledged and addressed. Workplaces with clear, established workplace substance policies and evidence-based practices can positively impact health and safety while reducing related costs and productivity [14–20]. Once a substance-related condition has been identified in a worker, and the necessary and appropriate care and treatment have been incorporated, ongoing health monitoring and accountability is required to ensure mitigation of occupational risk and to ensure the achievement of the maximum medical improvement and the highest attainable level of health.

An indispensable mechanism in mitigating safety risk and promoting remission of a diagnosed substance use disorder in a worker in a safety-sensitive workplace is through random, unannounced drug and alcohol testing [21, 22]. In such circumstances, drug and alcohol testing is justifiable under prevailing Canada Labour Code and Human Rights Code [2], to be coordinated and administered by an independent third party monitoring provider and not the employer. The Supreme Court of Canada has allowed alcohol and/or drug testing where the employee is returning to work after receiving treatment for a substance use disorder [23, 24]. In safety-sensitive sectors, particularly within industrial construction and the natural resource sectors, workplace alcohol and drug testing policies have been developed, and endorsed by, both employers and unions [25, 26]. Any agency or employer that conducts random testing of alcohol and/or drugs should stay informed of relevant and current legal parameters within their own jurisdiction. It is especially important to ensure compliance with human rights and privacy considerations.

Occupational Monitoring

Monitoring and Accountability

Monitoring programs for individuals in early recovery from substance use disorders contribute to recovery through deterrence and early detection of relapse; particularly in workplaces where relapse to substance consumption could reasonably and foreseeably result in harm [5, 27]. Aside from the safety imperative, individual and societal savings can also result from fewer interpersonal conflicts, greater workplace employment and productivity [28, 29], improved workplace morale [30], and fewer drug-related incidents, including overdoses and deaths [17].

Independent from medical and/or psychosocial treatment programs, monitoring and accountability protocols have the potential to significantly improve return-to-work and long-term outcomes for workers in early remission. This has been most robustly demonstrated in health care professionals – through physician health monitoring programs [31–33]. Healthcare is broadly considered a safety-sensitive sector, although some health professional roles represent a hybrid

of safety-sensitive and decision-critical ones, while others are likely best conceptualized as decision-critical only. Research indicates that workers with untreated substance use disorders have higher rates of absenteeism, increased turnover, and greater healthcare costs compared to workers in recovery [10, 11, 30]. Workplace monitoring programs that promote recovery have been shown to improve outcomes among healthcare workers [34, 35] which has applicability to other sectors [36]. The literature also supports the importance of integrating workers within a recovery community to enhance the likelihood of long-term remission [37, 38].

Formulation of Clinical Guidance for Monitoring of safety-sensitive Workers with a substance-related History

The primary objective of monitoring and accountability is to ensure occupational safety. It forms part of a broader approach to a worker with a substance use history, and includes three broad domains, i.e. biological monitoring (random drug and alcohol testing), workplace monitoring, and individual health monitoring. Failure to provide clearly defined monitoring recommendations can result in inadequate oversight, increasing the risk of undetected substance use or relapse to a substance use disorder. Conversely, some workplace monitoring recommendations may be excessively cautious, leading to unrealistic and overly intrusive protocols. The nature of the workplace, as well as the specific and essential job duties of the worker, must be taken into consideration in order to strike the right balance.

Although there is a paucity of research data related to standardized drug testing paradigms, there is a wealth of clinical experience that guides the development of customized monitoring protocols for each individual based upon the severity and chronicity of their disease. In practice, customized and standardized testing paradigms are commonly based on factors such as drug(s) of choice, program adherence and years in the monitoring program. However, too much standardization risks a monitoring system becoming too rigid and inflexible to accommodate individual circumstances, while too little standardization risks making a monitoring system arbitrary.

Key Elements of Biological Monitoring

In biological monitoring, a variety of practices can be found. There is often limited standardization across worksites and vast inter-individual differences between occupational medicine practitioners. Inadequate recommendations for components of monitoring, such as testing parameters or the scope of aftercare activities, may limit the effectiveness of monitoring or return-to-work agreements. Based on the authors' experience and a narrative review of relevant literature, we outline the key elements of effective monitoring agreements.

The Monitoring Agreement: Roles and Responsibilities

There are a number of professionals involved in the monitoring of workers' abstinence in recovery. Their roles differ from those of therapeutic care providers, e.g. the treating primary care physician, psychiatrist, clinical social worker, or psychologist. Unlike the traditional health professional-patient relationship, in the delivery of safe, justifiable and effective forensic-standard monitoring, the medical monitor in an occupational setting cannot have a concurrent therapeutic duty of care or a duty to advocate for the monitored individual. Establishing both a therapeutic or treatment role and a forensic monitoring role results in a dual agency bias, representing financial and social conflict of interest, which compromises the quality of treatment and is ultimately incompatible with prevailing ethical standards. It further deprives administrative and legal systems of the objectivity they require [39].

The executed monitoring agreement is mutually binding and outlines the requirements of the individual's monitoring program. Components of a comprehensive monitoring agreement should include:

1. The Monitor
   The monitor's role, as defined in this document, is to oversee the components of the individual's customized monitoring agreement. The independent monitor further has a non-therapeutic, non-treating relationship with the monitored individual, and is expected to administer monitoring recommendations, as derived from a mental and behavioural disorder independent medical examination (IME). The monitor must not change the IME recommendations for monitoring and it is the role of the designated monitor to report adherence to the agreement, as well as ongoing fitness for duty to the employer or oversight authority. It is vital for monitors to remain neutral, and to maintain clear boundaries when implementing the requirements of the written monitoring agreement. The monitored worker must be aware of, and consent to the prompt reporting of, any non-adherence to the oversight entity. The monitoring agreement must further allow for regular face-to-face or secure video-conferencing meetings with the monitor, and at an agreed-upon frequency.

2. The Medical Review Officer (MRO)
The MRO is an impartial, independently contracted licensed physician with additional training in reviewing biological test results obtained through chain of custody procedures, acting as gatekeeper to oversee the integrity of tests on safety-sensitive workers. The MRO is usually employed or engaged by the monitoring provider. When the MRO reviews a monitoring drug test result, they are providing neither a diagnosis nor treatment [40]. MROs are responsible for ensuring the accuracy and final determination if non-negative test results are in fact positive or not. The process includes facilitating split specimen testing—where a second sample, collected at the same time as the original specimen, can be tested at the worker's request at a different laboratory to confirm the reproducibility of positive results [40]. The MRO interviews the individual concerning results which are initially reported as 'non-negative' and seeks to identify medical explanations for non-negative test findings. This ensures that participants have an opportunity to explain non-negative results before the MRO issues the final decision.

3. The Treating Primary Care Professional (PCP): Physician or Nurse Practitioner
In contrast to the monitor, the PCP provides a therapeutic and supportive (versus the impartial) role for monitored individuals and has a duty to act as a patient advocate [41, 42]. The PCP-patient relationship is a fiduciary one, built on trust and professionalism [43]. PCPs may lack the specialized expertise needed to interpret toxicology test results accurately [44] and typically do not have routine access to chain-of-custody biological sample collection or an MRO for independent review of biological samples.

4. Frequency of testing
Testing must be truly random with same-day notifications, collected under chain of custody conditions, and should ideally take place seven days per week, as opposed to only on weekdays. From a medical perspective, testing should include multiple common substances of abuse, not just the substance(s) of choice [45]. Individuals with a diagnosis of substance use disorder have increased susceptibility to developing dependence on additional substances [46] and use of other mood-altering substances may increase the risk of relapse to the substance of choice [47]. Testing frequency must take into account the detection windows for individual substances of concern and an individualized combination of matrices may need to be tested (e.g. urine, oral fluid, breath, blood, nail or hair). In most testing programs [31, 48, 49], similarly to other treatment and/or monitoring programs [45, 50, 51], frequency is typically highest in the first 1–2 years of monitoring and may initially be as frequent as weekly, based on relapse risk factors and safety concerns. Frequency should be individualized, flexible, random, and based on a clinical assessment, as well the monitor's clinical judgment. Practical minimums include 24–36 urine tests annually initially, potentially decreasing over time, and allowing monitor discretion (in collaboration with the assessor) for recommending additional tests if there are concerns present, suggesting an increased risk of relapse.

5. Monitoring logistics and implementation
Monitors generally meet with the monitored individual on a weekly basis initially, and less often once early remission is established. However, it should be at least monthly and this flexible frequency of contact should be included in the agreement. The monitor also assists in early detection of relapse risk factors; ideally before a return to use occurs.

6. Recovery support and accountability
Supportive recovery activities such as mutual support meetings are evidence-based and attendance requirements should be included in the monitoring and accountability agreement [52–54]. Mutual support meetings serve the sole purpose of attendees supporting each other to remain abstinent from all mood-altering substances. Meeting attendance is generally required three times weekly early in recovery with frequency spread across the week [55, 56]. Commonly recommended in Alcoholics Anonymous (AA) and other 12-step programs is to attend 90 meetings in 90 days in early recovery, but this frequency may not be achievable for all individuals. Hence, the recommendation is to individualize for each person to ensure adequate intensity of care and risk mitigation. Acceptable meeting options include 12-Step or 16-Step AA meetings, Narcotics Anonymous (NA), Wellbriety, SMART Recovery meetings, AA for Agnostics, Secular Organizations for Sobriety, and Refuge/Dharma Recovery (a Buddhist path to recovery). Cohort-specific, or specialty support groups, such as those for healthcare professionals, first responders or pilots, are often available and should be accessed, as appropriate.

7. Medication management and liaison

To allow for maximum medical improvement, the use of psychosocial interventions is often combined with pharmacotherapy. It is critical to avoid the use of potentially abusable prescription medications (e.g. benzodiazepines, barbiturates, opioids, Z-drugs) and over-the-counter medications containing mood-altering compounds (e.g. dextromethorphan, dimenhydrinate, e.g. in cough medicines or decongestants), as well as recreational and/or substances of abuse, licit and illicit. Potentially abusable medications are generally proscribed and this should be specified in the monitoring agreement. However, each case should be reviewed on its own merit; considering whether the prescribed medication is medically necessary and appropriate, when considering individual BFORs. Prescriptions for therapeutic drug use should be issued by a single provider, with knowledge of the worker's history, unless an emergency arises. If a prescription for a controlled substance is deemed medically necessary and appropriate, rigorous medical oversight and documentation is required. Monitoring agreements should outline liaison with primary care providers, specialists, and therapists/counselors. Without assuming a duty of treatment, adherence to caregiver appointment attendance (including for treating comorbidities) should be confirmed, at least quarterly, and by the monitor. Early identification of concerns with adherence offers an opportunity for intervention before risk of relapse becomes a salient concern. Regular review of medication databases is recommended, with appropriate consent and as allowable in the arena.

8. The workplace liaison
With the necessary consent, liaison between the monitor and a designated workplace contact, who performs a separate behavioural monitoring role, is recommended [56]. The workplace liaison reports to the monitor any change in demeanour or behaviour, or any reasonable suspicion of, or the appearance of, impairment in the workplace. These may all constitute a reasonable basis for increasing frequency of toxicology testing, which is a decision that should not be unilaterally made by the monitor.

Duration of Medical Monitoring

In Canada's safety-sensitive sector, random drug and alcohol testing generally occurs for a limited period of time. Most commonly, two years of testing has been considered reasonable by labour arbitrators considering unionized, safety-sensitive workplace contexts [24]. This is contrasted with the longer duration of monitoring in physician and nurse healthcare health settings [48, 56], on the basis that substance use disorders are chronic and relapsing in nature, requiring a longitudinal approach to risk mitigation. There currently exists significant variation in recommendations for duration and nature of monitoring among agencies [57–60] within Canada. The duration of medical monitoring should be individualized and determined on a case-by-case basis, taking into consideration several variables:

Duration of monitoring is determined by several key considerations:

1. Severity and chronicity of the disease: The recommendation for healthcare professionals and airline pilots in Canada and the United States is a minimum of two years for mild disorders, extending up to five years for moderate to severe disorders [48, 56, 58, 61].

2. Degree of occupational risk: Safety-sensitive occupations exist along a spectrum, with varying degrees of potential harm depending on the nature of the work and its responsibilities. Some professions/occupations carry inherently higher risks where even a single lapse can result in catastrophic outcomes, e.g. those in the oil, gas and mining sectors, conveyance, nuclear safety workers, flight engineers, and forestry workers.

3. Treatment and recovery history: Individuals who have experienced multiple previous relapses may require a longer duration of monitoring.

Arbitral jurisprudence notwithstanding, a duration of monitoring range of two to five years is widely supported and considered justifiable in clinical monitoring practice, as well as, among others, by the Federation of State Physician Health Programs (FSPHP), Physician Health Program and Nursing Guidelines and recommendations [48, 56], American Society of Addiction Medicine [49], Transport Canada Civil Aviation Medicine Directive – Substance Use [58] and HIMS [61]. In the healthcare setting, it has been demonstrated that five years of monitoring, including a toxicology testing component, supports long-term recovery [31, 32, 34, 48, 49, 56, 62]. Duration of monitoring should be iteratively reassessed as there does not exist a medical basis to support a fixed and inflexible duration of monitoring.

Detection Techniques

Unlike clinical settings, biological monitoring by a non-treating professional for the primary purpose of mitigation of workplace safety, must adhere to standard forensic specimen collection and testing standards, which includes chain-of-custody and split-specimen testing. Even when an individual has an isolated alcohol substance use disorder, reliance solely on breathalyzer testing may well not sufficiently mitigate risk, as alcohol consumed immediately following a test may be undetectable at the time of the next breathalyzer test. Combining breathalyzer with urine drug screen testing for alcohol metabolites [63] and PEth testing [64] improves the likelihood of detecting alcohol consumption [65].

Monitoring for Other Substances

Chain of custody urine collection and drug testing screening, with the addition of other matrices such as oral fluid, hair or nail, typically forms the basis of screening for substances of abuse. Oral fluid testing has been validated for chain of custody biological testing in the United States [66] and is also used in Canada. Oral fluid has a shorter window of detection for cannabis, may be useful to detect recent use and may be helpful in remote settings, where appropriate collection of oral fluid can be witnessed virtually (on-line) by the monitor. Hair and/or nail testing should be utilized at the monitor's discretion and following appropriate consultation, and may be useful after extended absences, where there is suspected undetected use, or where the half-life of a substance is particularly short and the risk of a false negative is salient.

Testing Matrices

As noted, there are various biological testing matrices, each differing in detection range, sensitivity, and specificity for different substances. Each matrix also has its own risks and benefits; and targets either the parent substance and/or its metabolite(s). All collection must be under chain of custody conditions with testing carried out in an accredited laboratory.

Urine Testing

Urine remains the most commonly tested biological matrix, capable of detecting a wide range of substances. After appropriate, supervised collection, the initial sample is split into two identical specimens under chain of custody procedure to allow for split specimen testing in the event of positive sample results (see MRO, above). It takes approximately two hours post-ingestion for a substance to be detectable in urine [40]. Dilute urine samples, indicated by low creatinine and specific gravity criteria [40], may affect substance detection and necessitate level-of-detection testing [67]. Initial screening results must be followed by chromatography confirmation [40]. Cut-off concentrations are dependent on the substance tested and may vary between individual laboratories.

The on-site/point-of-care urine drug screen tests used in the context of individuals with substance use disorders are immunoassay tests and have a high-margin of error [40, 68, 69]. All immunoassay urine tests must be confirmed by chromatography (GC/MS or LC/MS) due to the risk of both false positive and false negative results. These are not deemed defensible as stand-alone tests in Canada and the United States [40].

Detection periods vary by substance and range from approximately one to four days [40]. Some substances (e.g. clonazepam, select synthetic opioids, psychedelics) may require specialized testing beyond standard toxicology test panels [40]. Testing panels vary by laboratory and coordination may be needed to ensure relevant substances of concern (e.g. ketamine, psilocybin, kratom), which may not be included in a given testing panel, are included. Cut-off levels for declared positive results also vary by laboratory and may be an important consideration in detection of intentional dilution of a urine sample. Witnessed urine collections may be required on rare occasions where there are grounds to suspect falsification of samples [40, 70].

Due to considerable variation in the substances of concern, the available testing panels and matrices, detection times and cut-off levels, advice from the monitoring agency should be sought as indicated to ensure an appropriate monitoring and maintenance protocol.

Phosphatidylethanol (PEth) Blood Testing

PEth testing is specific for detecting phosphatidyl ethanol homologues of alcohol metabolites. PEth is measured through whole blood or dried blood spot tests for up to approximately four weeks after heavy alcohol consumption [64], although positive tests have been reported after six weeks of self-declared abstinence [71]. PEth tests also can be performed remotely and virtually for individuals where in-person specimen collection is not available.

Hair Testing

The substance or metabolite is not detectable in hair immediately after use, but only after the substance has been

accumulated into the hair follicle. It will not be detected until the hair has grown sufficiently to appear above the scalp, i.e. a minimum of eight days [40]. Usually, head hair is tested, but other body hair (including pubic) may be used as appropriate. Given the longer detection window, hair testing may be used to determine abstinence over a longer period of time than other forms of testing [72]. Head hair offers detection within the previous three months approximately, with body hair offering detection up to 12 months [40]. A salient limitation is that hair testing may be subject to environmental contamination and may be affected by hair dyes and hair colour, and variation based on ethnicity [73].

Nail Testing

Testing of fingernails typically detects substance use over the previous six months. Toenail testing can detect substance use for up to one year [74].

Oral Fluid

Like other specimen collection, oral fluid must be collected under chain of custody conditions and can also be observed virtually if in-person collection is not feasible. We generally recommend the sequential collection of two samples (to permit split specimen testing when required), although simultaneous collection from two individual swabs is also possible. Recently a testing device has become available which offers simultaneous collection of both samples [75]. Similar to urine drug screen tests, all immunoassay oral fluid (screening) tests must be confirmed by chromatography (GC/MS or LC/MS). The detection window for oral fluid is typically measured in hours; for example, the Department of Transportation in the US reported that delta-9 tetrahydrocannabinol (from cannabis) has a detection window of up to 24 h, and other substances 1–4 days [76]. Cutoff levels are often determined by the particular industry, based on the level of risk and degree of aversion to such.

Management of Non-Adherence and Relapse/Return To Use

Non-adherence is associated with a range of behavioural patterns usually associated with an elevated risk of relapse, but without an actual return to substance use. Examples of non-adherence include missing mutual support meetings, monitoring appointments or meetings with other healthcare providers as outlined in the monitoring agreement, or where the donor offers excuses for missing a test. These behaviors often serve as reliable warning signs, and detection of non-adherence creates an opportunity for early intervention before a return to substance use. Relapse (or return to drug use) is associated with the recurrence of symptoms associated with renewed substance use, following a period of remission [77, 78].

Management of non-adherence and of relapse varies by occupation and is dictated by employer or professional regulatory body protocol. Prompt notification of a return to substance use is reported by the monitoring entity to the oversight authority. This is essential to allow for the appropriate level of intervention and, if necessary, removal from safety-sensitive duties. Relapse usually requires a clinical reassessment, possible additional treatment interventions (e.g. detoxification, medical stabilization), and potentially (not always) a revision of the monitoring agreement. This often results in modifications to monitoring duration, frequency of testing and selection of test matrices to sufficiently mitigate future risk.

Addressing Worker Concerns: Ethical Considerations

Like offering safe and effective evidence-based treatment for substance-related conditions, monitoring and accountability are key issues in the integrated approach to achieving maximum medical improvement and at the same time, mitigating risk in safety-sensitive occupations. The ultimate goal is to strike reasonable balance between potentially competing rights and interests of worker, the safety of the public, and the reputation of the profession or the employer. This approach is primarily informed by applying the framework of principlism for ethical decision-making, with its enshrined four core principles: respect for autonomy, non-maleficence, beneficence, and justice [79]. In a principles-based analysis, ethical obligations can be clarified by asking what the provider's duty is in light of the key principles, and aiming to balance any discrepancy that arises between the principles.

Common ethical dilemmas arising in applying monitoring and accountability in safety-sensitive workers with a history of substance-related disorders include balancing worker autonomy with beneficence-based paternalistic expectations, balancing worker well-being with public safety, utilizing the least restrictive level of intervention that is proven to be safe and likely to be effective, avoiding dual agency bias, and maintaining confidentiality and privacy.

Issues of dual agency bias were addressed earlier in this paper. In relation to privacy and confidentiality, several issues arise. When a monitoring agreement is entered into as a condition of ongoing safety-sensitive employment, it may appear in the form of a "last chance agreement" or similar with a worker. Such an agreement is not a monitor's domain

and represents an agreement between an employer and an employee (and their union). It should expressly acknowledge the mutual objectives of the agreement, as well as the employment-related consequences for a potential violation of the same. Provisions safeguarding the worker's privacy of health information as much as reasonably possible, as well as setting out information sharing protocols that take care to ensure confidentiality and circulation of the worker's personal information on a "need to know" basis should be express, i.e. information is *only* shared with individuals who require it to perform their official duties or a specific task, and following defensible protocols for protection of privacy and confidentiality. Directly addressing worker concerns, and setting agreed-to, and signed, expectations for all parties to best protect the worker's personal dignity in a respectful manner while achieving the employer's goals, helps promote greater worker understanding of, and compliance with, such an agreement. Rigorous, ongoing record-keeping is also crucial to ensure the legal and ethical defensibility of any monitoring agreement.

In summary, when applying an evidence-based monitoring and accountability program, the monitoring practitioner is expected to seek a reasonable balance between applying the tenets of principlism as it relates to the worker, and the protection of the public.

Conclusions

This paper offers guidance and recommendations for evidence-informed monitoring practice. It is important to create customized and individualized monitoring agreements and testing paradigms based on factors such as drug of choice, access to biological sample collection services, the individual's duration in the program and their current stage of monitoring. A balance must be struck between the level of flexibility, standardization and restrictiveness to reasonably accommodate individual circumstances, while avoiding arbitrariness. Finding a balance that ensures fitness for duty, preservation of privacy and confidentiality, protection of human rights, and ensuring safety in the workplace is a key priority. Future research needs to address operationalizing the above-mentioned principles in practice and study of the optimal duration of monitoring under different circumstances.

Similarly, if employers decide to implement random alcohol and drug testing requirements on safety-sensitive workers in appropriate circumstances, they should engage monitoring agencies that adhere to evidence-based best practices. Agencies and employers that are so engaged should remain up-to-date with respect to relevant legislative (and accordant case law) parameters, particularly with respect to human rights and privacy considerations. Workplace rules and protocols related to substance use and testing should be transparent, reasonable, non-arbitrary, and specific to the workplace/occupational category. As well as promoting individual recovery, monitoring and accountability for persons with a history of substance use disorders represents a key component of ensuring safe and productive workplaces. These practices also assist in reducing overall risk exposure due to worker impairment from occupationally relevant substances.

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References

1. Martin S. Determining fitness to work at safety-sensitive jobs. BCMJ. 2010;52(1):48–9.

2. Canadian Human Rights Commission. Impaired at Work – A guide to accommodating substance dependence. 2017. https://www.chrc-ccdp.gc.ca/sites/default/files/publication-pdfs/chrc_impaired_at_work_v2018-3_eng.pdf. Accessed 8 Oct 2025.
3. Fan X, Els C, Corbet KJ, Straube S. Decision-critical" work: a conceptual framework. J Occup Med Toxicol. 2016;11:22.
4. National Research Council (US) and Institute of Medicine (US) Committee on Drug Use in the Workplace. Under the Influence?: Drugs and the American Work Force. In: Normand J, Lempert RO, O'Brien CP, editors. Washington (DC): National Academies Press (US); 1994.
5. Ramchand R, Pomeroy A, Arkes J. The Effects of Substance Use on Workplace Injuries Rand Center for Health and Safety in the Workplace. 2009. https://www.rand.org/content/dam/rand/pubs/occasional_papers/2009/RAND_OP247.pdf. Accessed 8 Oct 2025.
6. Zwerling C, Ryan J, Orav EJ. The efficacy of preemployment drug screening for marijuana and cocaine in predicting employment outcome. JAMA. 1990;264(20):2639–43.
7. Transportation Safety Board of Canada. TSB Recommendation A17-02: In-flight breakup. 2024. https://www.tsb.gc.ca/sites/default/files/recommandations-recommendations/aviation/eng/rec-a1702.pdf. Accessed 8 Oct 2025.
8. Canadian Centre of Occupational Health and Safety. Substance Use in the Workplace. 2022. https://www.ccohs.ca/oshanswers/psychosocial/substance.html. Accessed 8 Oct 2025.
9. Canadian Centre for Occupational Health and Safety. Impairment at Work- Policy and Recognition. https://www.ccohs.ca/oshanswers/hsprograms/impairment/impairment.html. Accessed 8 Oct 2025.
10. McQuaid RJ, Malik A, Moussouni K, Baydack N, Stargardter M, Morrisey M. Life in Recovery from Addiction in Canada. Canadian Centre on Substance Use and Addiction. 2017. https://www.ccsa.ca/en/life-recovery-addiction-canada-technical-report. Accessed 8 Oct 2025.
11. Frone MR, Casey Chosewood L, Osborne JC, Howard JJ. Workplace supported recovery from substance use disorders: defining the construct, developing a model, and proposing an agenda for future research. Occup Health Sci. 2022;6(4):475–511.
12. Wang G, Li DY, Vance DE, Li W. Alcohol use disorder as a risk factor for cognitive impairment. J Alzheimers Dis. 2023;94(3):899–907.
13. Substance Abuse and Mental Health Services Administration. Chronic Substance Use and Cognitive Effects on the Brain: An Introduction. 2016; https://library.samhsa.gov/sites/default/files/sma16-4973.pdf. Accessed 8 Oct 2025.
14. Li S, Stewart-Patterson R, Menten J, Straube S, Els C. Workplace-facilitated recovery through substance use policies. SN ComprClin Med. 2025;7:350.
15. National Safety Council. Supporting Employees into Recovery Leads to Positive Results. 2025. https://www.nsc.org/workplace/safety-topics/drugs-at-work/supporting-employees-into-recovery?srsltid=AfmBOorINTHOF2rD-IyB1n6DNIV0hL8A9vLrFvy9Ffkc-jd-IZQ4OOCj. Accessed 8 Oct 2025.
16. National Safety Council. Implications of Drug Use for Employers. 2025. https://www.nsc.org/workplace/safety-topics/drugs-at-work/implications-of-drug-use-for-employers?srsltid=AfmBOorWP3NmqubteNO2hH7DStjSC2gefAVgbDWqBninHtCSrlqtRyyi. Accessed 8 Oct 2025.
17. National Institute of Drug Abuse. Principles of Drug Addiction Treatment: A Research-Based Guide (Third Edition). 2018. https://nida.nih.gov/sites/default/files/podat-3rdEd-508.pdf. Accessed 8 Oct 2025.
18. US Department of Health and Human Services, Office of the Surgeon General. Facing Addiction in America: The Surgeon General's Report on Alcohol, Drugs, and Health. 2016. https://www.hhs.gov/sites/default/files/facing-addiction-in-america-surgeon-generals-report.pdf. Accessed 8 Oct 2025.
19. Goplerud E, Hodge S, Benham T. A substance use cost calculator for US employers with an emphasis on prescription pain medication misuse. J Occup Environ Med. 2017;59(11):1063–71.
20. Slaymaker VJ, Owen PL. Employed men and women substance abusers: job troubles and treatment outcomes. J Subst Abuse Treat. 2006;31(4):347–54.
21. Els C, Jackson TD, Milen MT, Kunyk D, Wyatt G, Sowah D, et al. Random drug and alcohol testing for preventing injury in workers. Cochrane Database Syst Rev. 2020;12(12):CD012921.
22. Silverman K, Holtyn AF, Morrison R. The therapeutic utility of employment in treating drug addiction: science to application. Transl Issues Psychol Sci. 2016;2(2):203–12.
23. Christie T. A discussion of the ethical implications of random drug testing in the workplace. Healthc Manage Forum. 2015;28(4):172–4.
24. Communications E, S.C.R. 458. and Paperworkers Union of Canada, Local 30 v. Irving Pulp & Paper, Ltd, 2013 SCC 34, 2. 2013. https://decisions.scc-csc.ca/scc-csc/scc-csc/en/item/13106/index.do. Accessed 8 Oct 2025.
25. Construction Owners Association of Alberta. Canadian Model for a Safe Workplace. 2023. https://coaa.ab.ca/wp-content/uploads/2023/05/Canadian-Model-v6.1-rev-1.0-FINAL_May-1-2023-1.pdf. Accessed 8 Oct 2025.
26. Canadian Nuclear Safety Commission. REGDOC-2.2.4, Fitness for Duty, Volume II: Managing Alcohol and Drug Use, Version 3. 2025. https://www.cnsc-ccsn.gc.ca/eng/acts-and-regulations/regulatory-documents/published/html/regdoc2-2-4-v2-version3/. Accessed 8 Oct 2025.
27. Toigo S, McFaull SR, Thompson W. Impact of substance-related harms on injury hospitalizations in Canada, from 2010 to 2020. Health Promot Chronic Dis Prev Can. 2023;43(3):130–8.
28. Silverman K, DeFulio A, Sigurdsson SO. Maintenance of reinforcement to address the chronic nature of drug addiction. Prev Med. 2012;55(SupplSuppl):S46–53.
29. Aklin WM, Wong CJ, Hampton J, Svikis DS, Stitzer ML, Bigelow GE, et al. A therapeutic workplace for the long-term treatment of drug addiction and unemployment: eight-year outcomes of a social business intervention. J Subst Abuse Treat. 2014;47(5):329–38.
30. Frone MR. Does a permissive workplace substance use climate affect employees who do not use alcohol and drugs at work? A U.S. national study. Psychol Addict Behav. 2009;23(2):386–90.
31. Goldenberg MDO, Miotto KMD, Skipper GEMD, Sanford JBA. Outcomes of physicians with substance use disorders in state physician health programs: a narrative review. J Psychoact Drugs. 2020;52(3):195–202.
32. McLellan AT, Skipper GS, Campbell M, DuPont RL. Five year outcomes in a cohort study of physicians treated for substance use disorders in the United States. BMJ. 2008;337:a2038.
33. DuPont RL, McLellan AT, White WL, Merlo LJ, Gold MS. Setting the standard for recovery: physicians' health programs. J Subst Abuse Treat. 2009;36(2):159–71.
34. Smiley RS, Reneau K. Outcomes of substance use disorder monitoring programs for nurses. J Nurs Regul. 2020;11(2):28–35.
35. Merlo LJ, Campbell MD, Skipper GE, Shea CL, DuPont RL. Outcomes for physicians with opioid dependence treated without agonist pharmacotherapy in physician health programs. J Subst Abuse Treat. 2016;64:47–54.
36. Gastfriend DR. Physician substance abuse and recovery: what does it mean for physicians–and everyone else? JAMA. 2005;293(12):1513–5.
37. Davidson L, Rowe M, DiLeo P, Bellamy C, Delphin-Rittmon M. Recovery-Oriented systems of care: A perspective on the Past,

Present, and future. Alcohol Res. 2021;41(1):09. Published 2021 Jul 22.
38. Substance Abuse and Mental Health Services Administration. Recovery-Oriented Systems of Care (ROSC) Resource Guide. 2010. https://www.samhsa.gov/sites/default/files/rosc_resource_guide_book.pdf. Accessed 8 Oct 2025.
39. Melhorn JM, Talmage JB, Ackerman WE, Hyman M, Katz RT, editors. AMA guides to the evaluation of disease and injury causation. 2nd ed. American Medical Association; 2013.
40. Swotinsky R. Medical Review Officer's Handbook Manual: MROCC's Guide to Drug Testing. 6th Ed. OEM Press; 2021.
41. Medical Council of Canada. Health Advocate. 2025. Mcc.ca/objectives/health-advocate/. Accessed 8 Oct 2025.
42. Government of Canada. Occupational Profile: National Occupational Classification Occupational and Skills Information System 31102. General practitioners and Family Physicians. 2024. https://noc.esdc.gc.ca/OASIS/OASISOccProfile?code=31102.00&version=2023.0. Accessed 8 Oct 2025.
43. Ludewigs S, Narchi J, Kiefer L, Winkler EC. Ethics of the fiduciary relationship between patient and physician: the case of informed consent. J Med Ethics. 2025;51:59–66.
44. Reisfield GM, Webb FJ, Bertholf RL, Sloan PA, Wilson GR. Family physicians' proficiency in urine drug test interpretation. J Opioid Manag. 2007;3(6):333–7.
45. Forman RF, Nagy PD. Substance Abuse: Clinical Issues in Intensive Outpatient Treatment. A Treatment Improvement Protocol. TIP 47. U.S. Department of Health and Human Services, Substance Use and Mental Health Services Administration, Center for Substance Abuse Treatment. 2006. https://www.samhsa.gov/resource/ebp/tip-47-substance-abuse-clinical-issues-intensive-outpatient-treatment. Accessed 8 Oct 2025.
46. Crummy EA, O'Neal TJ, Baskin BM, Ferguson SM. One is not enough: understanding and modeling polysubstance use. Front Neurosci. 2020;14:569.
47. Subbaraman MS, Metrik J, Patterson D, Swift R. Cannabis use during treatment for alcohol use disorders predicts alcohol treatment outcomes. Addiction. 2017;112(4):685–94.
48. Federation of State Physician Health Programs (FSPHP). Physician Health Program Guidelines. 1st ed. FSPHP, inc; 2019.
49. Hurford M, Baxter L, Brown L, Jacobs W, Kleinschmidt K, Kushner M, et al. Appropriate Use of Drug Testing in Clinical Addiction Medicine. Consensus Statement. American Society of Addiction Medicine; 2017.
50. Gudin J, Mehta N, McClure FL, Niles JK, Kaufman HW. Shorter drug testing intervals are associated with improved drug misuse rates. J Opioid Manag. 2020;16(5):357–73.
51. Morin KA, Dabous JR, Vojtesek, Marsh D. Evaluating the association between urine drug screening frequency and retention in opioid agonist treatment in Ontario, canada: a retrospective cohort study. BMJ Open. 2022;12:1–7.
52. Kaskutas LA. Anonymous effectiveness: faith meets science. J Addict Dis. 2009;28(2):145–7.
53. Kelly J, Author, Interview. Alcoholics Anonymous and other 12-step programs for alcohol use disorder. 2020. https://www.cochrane.org/about-us/news/author-interview-alcoholics-anonymous-and-other-12-step-programs-alcohol-use-disorder. Accessed 8 Oct 2025.
54. Kelly JF, Humphreys K, Ferri M. Alcoholics Anonymous and other 12-step programs for alcohol use disorder. Cochrane Database of Systematic Reviews 2020, Issue 3. Art. No.: CD012880. https://www.cochranelibrary.com/cdsr/doi/10.1002/14651858.CD012880.pub2/full?cookiesEnable. Accessed 8 Oct 2025.
55. Krentzman AR, Robinson EAR, Moore BC, Kelly JF, Laudet AB, White WL, et al. How alcoholics anonymous (AA) and narcotics anonymous (NA) work: cross-disciplinary perspectives. Alcohol Treat Q. 2010;29(1):75–84.
56. Bettinardi-Angres K. Nurses with substance use disorder: promoting successful treatment and reentry, 10 years later. J Nurs Regul. 2020;11:5–11.
57. Transport Canada. Seafarers Medical Examinations: A Physician Guide. 2013. https://tc.canada.ca/sites/default/files/2023-01/TP11343E.pdf. Accessed 8 Oct 2025.
58. Transport Canada. Staff Instruction. Civil aviation medicine Directive- substance Use. RDIMS # 15846979-V10. Medicine: Civil Aviation; 2022.
59. Canadian Council of Motor Transport Administrators. National Safety Code. Standard 6: Determining Driver Fitness in Canada. 2025. https://www.ccmta.ca/web/default/files/PDF/National%20Safety%20Code%20Standard%206%20-%20Determining%20Fitness%20to%20Drive%20in%20Canada%20-%20MAY%202025.pdf. Accessed 9 Oct 2025.
60. Railway Association of Canada. Canadian Railway Medical Rules Handbook (For Positions Critical to Safe Railway Operations). 2025. https://www.railcan.ca/wp-content/uploads/2024/02/RAC-Guidelines-2025-05-27.pdf. Accessed 9 Oct 2025.
61. Human Intervention Motivational Study. https://himsprogram.com/monitoring/. Accessed 8 Oct 2025.
62. Dennis ML, Foss MA, Scott CK. An eight-year perspective on the relationship between the duration of abstinence and other aspects of recovery. Eval Rev. 2007;31(6):585–612.
63. Substance Abuse and Mental Health Services Administration (SAMHSA). The role of Biomarkers in the Treatment of Alcohol Use Disorders. 2012 Revision. 2012. https://www.niaaa.nih.gov/sites/default/files/SAMHSA-Advisory-Role-of-Biomarkers-in-the-Treatment-of-Alcohol-Use-Disorder-2012.pdf. Accessed 8 Oct 2025.
64. Ulwelling W, Smith K. The PEth blood test in the security environment: what it is; why it is important; and interpretative guidelines. J Forensic Sci. 2018;63(6):1634–40.
65. Reisfield GM, Teitelbaum SA, Opie SO, Jones J, Morrison DG, Lewis B. The roles of phosphatidylethanol, Ethyl glucuronide, and Ethyl sulfate in identifying alcohol consumption among participants in professionals health programs. Drug Test Anal. 2020;12(8):1102–8.
66. U.S. Department of Transportation. DOT Rule 49 CFR Part 40 Sect. 40.210. 2023. https://www.transportation.gov/odapc/part40/40-210. Accessed 8 Oct 2025.
67. Price JW. Dilution of urine drug tests: is it random? J Addict Med. 2013;7(6):405–9.
68. Algren DA, Christian MR. Buyer beware: pitfalls in toxicology laboratory testing. Mo Med. 2015;112(3):206–10.
69. Tenore PL. Advanced urine toxicology testing. J Addict Dis. 2010;29(4):436–48.
70. Code of Federal Regulations. 26.115 Collecting a urine specimen under direct observation. 2022. https://www.ecfr.gov/current/title-10/chapter-I/part-26/subpart-E/section-26.115. Accessed 8 Oct 2025.
71. United Drug Testing Laboratories (USTDL). Adult PEth testing. 2025. https://www.usdtl.com/testing/peth-alcohol-test-labs. Accessed 8 Oct 2025.
72. Usman M, Naseer A, Baig Y, Jamshaid T, Shahwar M, Khurshuid S. Forensic toxicological analysis of hair: a review. Egypt J Forensic Sci. 2019;9:17.
73. Hubbard JA. Review on toxicology testing in hair. J Appl Lab Med. 2025;10(4):983–1000. https://doi.org/10.1093/jalm/jfaf026.
74. Baumgartner MR. Nails: an adequate alternative matrix in forensic toxicology for drug analysis? Bioanalysis. 2014;6(17):2189–91.
75. Abott. Quantisal™ Oral Fluid Collection Devices. 2025. https://www.toxicology.abbott/us/en/products/quantisal-oral-fluid-collection-devices.html. Accessed 8 Oct 2025.

76. Department of Transportation. Procedures for Transportation Workplace Drug and Alcohol Testing Programs: Addition of Oral Fluid Specimen Testing for Drugs. 2022. https://www.govinfo.gov/content/pkg/FR-2022-02-28/pdf/2022-02364.pdf. Accessed 8 Oct 2025.
77. Waller RC, Boyle MP, editors. The ASAM critieria: treatment criteria for Addictive, Substance-Related and Co-Occuring conditions. 4th ed. Maryland: American Society of Addiction Medicine, Rockville; 2023.
78. National Council for Mental Wellbeing. Demystifying Relapse: A Recurrence of Symptoms. 2024. https://www.thenationalcouncil.org/wp-content/uploads/2025/02/Brief-1-Demistifying-Relapse_A-Recurrence-of-Symptoms.pdf. Accessed 8 Oct 2025.
79. Beauchamp TL, Childress JF. Principles of biomedical ethics. 6th ed. New York: Oxford University Press; 2009.