A REVIEW ON THE FUTURE OF WORK: PERFORMANCE-ENHANCING DRUGS

1 Introduction

This review article is undertaken on behalf of the European Agency for Safety and Health at Work (EU-OSHA). It examines some key questions concerning the use/abuse of pharmacological drugs for the purposes of cognitive enhancement in the context of employment and the workplace.

2 What are performance-enhancing drugs / cognitive enhancers?

2.1 Definitions: discussion of the contested nature of key terms

Enhancement technologies can be defined as interventions "for the purpose of restoring an impaired function to previous or average levels, or to raise function to a level considered to be 'beyond the norm' for humans" (Academy of Medical Sciences, 2012: 7). In terms of specific functions:

Cognitive–enhancing (CE) drugs (also described as neuro-enhancers, neuro-technologies, psycho-pharmaceuticals or 'smart drugs') are pharmaceutical substances which are claimed to improve mental performance, such as attention or focus, concentration, memory or motivation. More broadly, *performance–enhancing (PE) drugs* may also be seen as useful for improving the acquisition of motor skills[1], or affective skills, such as dealing with anxiety associated with performing certain work tasks or promoting feelings of trust and affiliation[2]. We will use 'CE' to designate both cognitive and performance-enhancing aspects in the report.

None of these definitions is straightforward to apply, for a number of reasons:

a. No drugs are licensed by state medical authorities to be prescribed as 'cognitive enhancers' as such. Indeed, the dominant view of medical intervention is that it is to be used for the therapeutic benefit of patients who have a medical condition, not for use by 'normal' or 'healthy' individuals who wish to improve/change aspects of themselves (sometimes known as 'cosmetic neurology'). Thus the term CE most commonly refers to the off-label[3] use of drugs prescribed for specific medical conditions (e.g. methylphenidate/Ritalin for attention deficit hyperactivity disorder (ADHD), or modafinil for narcolepsy) by individuals who do not have these conditions, for the purposes of enhancement.

b. It is not straightforward to measure and compare cognitive ability or activity, and thus measurable differences which can be described as 'enhancement' are difficult to ascertain objectively. Cognitive abilities differ not only between individuals, but in the same individual over time (ageing) and are affected by different contexts (e.g. stress, tiredness). It is also not clear whether 'enhancement' means an improvement beyond an existing individual's level of cognition (however high or low that level is) or beyond some norm of cognition.

c. In relation to this, a distinction has sometimes been made between 'enhancement' (i.e. something which is improved or augmented beyond a 'normal' level) and 'maintenance' (i.e.

[1] E.g. dopamine agonists are associated with greater neutral plasticity; and dextroamphetamine along with physical therapy appears to help motor learning after a stroke.

[2] E.g. beta blockers may be used to overcome anxiety related to forms of performance at work; serotonin reuptake inhibitors are believed to promote affiliative behaviour; and inhaling oxytocin believed to promote feelings of trust.

[3] Off-label is a term that refers to the use of a drug for a purpose that is not indicated in its official licence. Off-label use may be prescribed by a medical doctor (or other clinician) if deemed to be in the best interests of a patient. Otherwise off-label refers to non-medically authorised use/abuse.

preserving something at a particular level). However, this distinction is difficult to apply in practice, given the diversity of individuals' cognitive range as well as the difficulties of measurement noted above. Thus using cognitive enhancement drugs to maintain a particular level of attention by surgeons (Sugden et al 2012) during a long operation, for example, may also be described an enhancing their performance beyond what it would have been without the use of the drug. This is also why 'wakefulness', as promoted by drugs like modafinil, can be seen as a form of enhancement.

d. Wade et al (2014: 12-13) see the term 'cognitive enhancer' as problematic, in implying that improved cognition is both possible and beneficial. Often scientific research is misquoted or misleadingly presented in popular reports about cognitive enhancement (Wade et al; Dekkers and Rikkert 2007).

e. Although the science of enhancement may be in its infancy when one considers the substances that are currently available, there is no doubt that this is an area where there is desire both in sections of the public and in the pharmaceutical industry to continue pursuing the possibilities of safe and effective cognitive enhancers, not just for self-improvement beyond the norm but in relation to the decline of cognitive functioning experienced with ageing, and to treat disorders such as Alzheimer's Disease/dementia, Parkinson's, ADHD and Multiple Sclerosis.

2.2 Discussion of the diverse nature of substances described as performance enhancers

Given that there is no class of drug which can be simply described as a cognitive enhancer, the range of substances which are used in this way is diverse.

a. This diversity can be sub-divided into:

1. over-the-counter substances such as caffeine (coffee, caffeinated energy drinks and caffeine tablets), Ginkgo biloba and other products sold for CE purposes;
2. prescription drugs for particular disorders; and,
3. illicit drugs such as methamphetamine (crystal meth) or cocaine.

b. The boundaries between these may be blurred, for a number of reasons:

4. For example, a prescription drug bought and used without a prescription might be described as illicit use.
5. 'Stacks' (combinations) of substances sold for enhancement may include both nutritional products and prescription drugs.
6. Marketing and availability of these products through the internet has also changed the culture in which drugs are purchased and used: this can appear 'safer' (although of course there is no guarantee the drugs are what they are claimed to be) than the potential dangers and stigma of street drug dealing.
7. It must also be noted that prescribed drugs and classification of illicit drugs differs between countries.
8. There are a number of drugs being developed for various conditions e.g. Alzheimer's Disease/dementia, which at present may not be prescribed for medical conditions, but are obtained by individuals for the purposes of enhancement.

2.3 Historical precedents and continuities in cognitive enhancement

As well as changes, there are continuities in the use of CE drugs. For example, amphetamines ('speed') have been widely used as performance enhancers in the past (e.g. in military combat and civilian production during the Second World War). Although now widely perceived as illicit drugs, amphetamines are still in some cases used to treat ADHD (Adderall). Amphetamines have also been used by long distance transport workers to enable them to cope with long shifts; and there are recent media reports about amphetamines becoming the 'drug of choice' for city traders (Lopez, 2012), cocaine having reputedly long been used to increase the energy and confidence perceived to be required in a competitive culture. Thus there is no simple distinction between 'recreational drugs' and 'cognitive enhancement drugs'. The major drugs which are used as CE are listed under the next heading.

2.4 Discussion of the major CE drugs

As noted above, it is complicated to map the field of cognitive enhancers/performance-enhancing drugs. As an example, one of the online sites for nootropics claims a definitive list of over 120 substances for different aspects of enhancement (http://nootriment.com/nootropics-list/). Below we list the three main drugs which are commonly associated with CE and which occur most frequently in media reports of CE and scientific research on their effects. We follow this with a brief list of types of substances which are also claimed to enhance performance. We confine our account to pharmaceutical substances, not over-the-counter products.

a. Three Main CE Drugs:

Amphetamines – stimulants used to treat ADHD or narcolepsy. Amphetamines increase dopamine levels and are said to calm and focus individuals with ADHD. Adderall (trade name) is a mixture of amphetamine salts. It may be used off-label for the enhancement effects of increased focus (especially for study) or for euphoria ('high'), or for weight loss. Other branded amphetamines in this category include Dexamed (dexamfetamine sulphate), also branded in the EU as Attentin and Tentin.

Methylphenidate - is a central nervous system stimulant used for treating ADHD and narcolepsy. It increases levels of the neurotransmitters dopamine and norepinephrine. Trade names include Ritalin, Concerta, Equasym, Medikinet and Rubifen.

Modafinil/Armodafinil – is another stimulant to the central nervous system and promotes wakefulness. Its exact action on the brain is not fully understood but it is known to interact with neurotransmitters such as dopamine and norepinephrine. Trade names in Europe include Provigil, Nuvigil, Vigil, Modalert, Modasomil and Modiodal.

b. Other Drugs Associated With CE:

Anti-dementia drugs. There are various classes of these. Although some of these have been reported in mainstream media as possible cognitive enhancers, these drugs seem to be less likely to be used than those listed above. It is worth mentioning Donepezil (Aricept) which has been widely reported in the media to have CE effects, although reviews on healthy populations suggest there is insufficient evidence for this claim.[4]

Ampakines are a class of compounds claimed to enhance attention span and alertness, facilitating learning and memory (Lynch, 2004). They have been investigated by the US military and are under research for medical use. One class of ampakines is the Racetams, of which some, such as Piracetam,[5] are considered nootropics.[6]

Serotonin reuptake inhibitors have been discussed as performance enhancers which can achieve ''affiliative'' responses in the workplace. Serotonin is the neurotransmitter which is related to nerve impulses, mood, pleasure, and the ability to handle stress. There are claims that this class of drugs can balance emotions and combat depression.

Melatonin (Circadin)**.** Taken as a supplement to fight insomnia and restore healthy sleep patterns, especially associated with coping with jet lag or working long hours. A synthetically produced hormone, mimicking natural melatonin. Prescription-only in most of Europe although available on the internet.

[4] Wade, Forlini and, Racine (2014) note that much of the claim relies on interpretations of one limited study of older, non-demented pilots in a flight simulator.

[5] Piracetam (sold as Nootropil) is not approved by US FDA; in the UK it is mainly prescribed for involuntary muscular spasms. It is sold off-label for attentiveness, concentration and memory, as with other racetams, being popular on internet sites for nootropics, 'bio-hacking' and as part of 'stacks' of substances sold together for cognitive enhancement (e.g. see http://nootriment.com/nootropics-list/).

[6] In fact it was after first synthesising piracetam, that the lead scientist at the Belgium pharmaceutical company UCB, Corneliu Giurgea, coined the word 'nootropic'.

3 How prevalent is their consumption? Among which groups? How is it likely to evolve?

Ascertaining the prevalence of CE drugs is difficult. Accordingly, we first draw attention to some of the methodological problems that hamper the production of reliable evidence before going on to consider some of the research that has attempted to gauge prevalence amongst specific groups.

3.1 Methodological Issues

Over the past few years there have been increasing reports of the use of cognitive enhancers or smart drugs in academic journals, newspapers, television and online media. Many accounts centre on students (to assist in study or exam revision; Ragan, Bard and Singh, 2013) or individuals in high pressure business occupations (to maintain performance/focus for extended periods of time). But despite mounting anecdotal evidence, methodological issues make it difficult to arrive at an accurate picture regarding the actual patterns of use within different countries, demographic or occupational groups.

a. Studies of prevalence are almost wholly reliant on self-reporting in response to surveys or comments posted within online fora and warrant suitable caution (e.g. Bagot and Kaminer, 2013; Hall and Lucke, 2010; Quednow, 2010; Ragan, Bard and Singh, 2013). Survey samples may not be representative of the greater populations from which they are selected; suffer from response bias, such as the possible over-reporting by proponents of CE drugs (Pustovrh and Mali, 2014). Also crucial are the way the questions are phrased e.g. if respondents do not see the substances they use as 'drugs' (Shanker, 2011).

b. The very nature of non-medically supervised consumption may exacerbate the problem of under-reporting. For example, individuals may not want to be associated (even anonymously) with the potential risks connected with CE drugs; may fear that the blurring of the boundary between illicit recreational drugs and performance enhancing pharmacological drugs may lead to legal or employment ramifications; or may simply be averse to implicit or explicit judgements of their behaviour as being unethical; for instance as a form of cheating (in parallel with the negative discourse concerning performance enhancing drugs in sport).

c. Attempts to assess the consumption of drugs such as amphetamines, methylphenidate and modafinil for purposes of enhancement by reference to evidence concerning increasing prescription rates involve assumptions which may not be entirely evident, may vary between countries and thereby make global comparisons between them difficult. Moreover, in the case of ADHD inferences derived from prescription rates may be confounded by cases of patients reporting or feigning relevant indications or symptoms but not necessarily having an official diagnosis for ADHD. In the case of modafinil, evidence of off-label usage may account for a significant proportion of prescriptions (Peñaloza et al, 2013). Also relevant here are instances of patients with or without an official diagnosis who share their prescriptions with other people (Kaye and Darke, 2012; Novak et al, 2007).

d. The rise of online pharmacies has allowed the possibility for large numbers of individuals to access CE to a hitherto unprecedented degree and therefore adds to the difficulties of estimating either the scale of use or individuals' patterns of consumption.[7]

e. There is a danger that reporting may stimulate or add to the very phenomena that it seeks to assess since the media pick up on reports in scientific literature or popular science journals, but at the same time scientific researchers reproduce media accounts of the rising prevalence of CE abuse (Pustovrh and Mali, 2014).

3.2 Prevalence

Given the problems of methodology outlined above, research concerning the prevalence of CE drugs, particularly that based on self-reported behaviour in surveys, has yielded widely varying results. For example, considering the findings from a variety of international studies, Franke et al (2014) report a

[7] In addition to the health risks associated with official/genuine samples of such drugs, further potential risks derive from the issues of provenance and quality control pertaining to Internet based sources.

range of between approximately 1% and 20% of respondents acknowledging their use of CE drugs. Specific groups associated with CE drugs include:

Military: modafinil is made available to combat personnel serving with various military forces under medical supervision and clearly defined circumstances. For instance, the US military has funded various studies into the effectiveness of modafinil for the promotion of wakefulness in connection with aircrew who have to fly long-range missions (Krueger and Leaman, 2011; Moreno, 2006).

Students: the use of CE drugs as an aid to studying or exam performance has been much discussed and subject to numerous surveys (Novak et al, 2007; Partridge et al, 2013; Ragan et al, 2013; Teter et al, 2006). Further, online news media at various universities have carried articles about the use of 'study drugs' such as modafinil and Ritalin and these have been the subject of comments (both affirmative and cautionary) from readers (presumably students) about the practice.

Transportation workers: drug testing in the transportation sector has been an issue in several countries for decades; in particular, reports about the abuse of stimulants (principally amphetamines) amongst long distance truck drivers (Girotto et al, 2013; Krueger and Leaman, 2011; Labat et al, 2008). Evidence includes self-reporting in surveys but may also derive from the biochemical analysis of bodily samples. In a systematic review of the research data on truck drivers Girotto et al (2013) note that the presence of amphetamines in biological samples averaged 8.5%, ranging from 0.2% in Norway to 82.5% in Thailand.

Other groups: some research has been conducted to ascertain the prevalence of self-medication amongst doctors (Montgomery et al 2011). Various news media have frequently made reference to use by individuals in high pressure occupations, including financial services (Dean, 2013; Jacobs et al, 2014; Kolker, 2013) – a sector that in the recent past has been associated with the abuse of other drugs such as cocaine.

Shift workers (including emergency service workers): Shift Work Sleep Disorder is a diagnostic category in the USA with modafinil recognised as a medically approved treatment to promote alertness. Prescription in the EU was also possible for the condition Shift Work Sleep Disorder until the restriction imposed by the European Medicines Agency (EMA) in 2011.

3.3 How is CE consumption likely to evolve?

When it comes to considering the possible future direction and patterns of usage of CE drugs a number of factors are relevant.

a. Developments in the fields of neuroscience and pharmacology may lead directly to new CE drugs or, alternatively and indirectly, to treatments for conditions such as dementia that become used off-label for the purpose of CE. More widespread use is likely to depend on there being drugs which are recognised as safe and effective.

b. Cultural change and attitudes to CE in the workplace in particular, will influence the potential uptake of CE drugs.

c. We might expect greater uptake among groups who are already knowledgeable about, sensitive to, or have access to CE drugs compared to those for whom they are novel and shrouded in uncertainty. For example, students who have already used CE may be more likely to continue use as they move into graduate occupations.

d. Changing conditions in the workplace may be expected to have a strong bearing on the future use of CE drugs. In working environments where one finds a high degree of coercive control and pressure to attain high levels of productivity, individuals may turn to CE drugs to maintain performance. Alternatively, the use of CE drugs might attract interest in environments where pressure derives from a strong culture of competitiveness between individuals. For other employees who are struggling to cope with maintaining a reasonable work-life balance, including those who work shifts, recourse to CE drugs might seem to offer a form of technical fix.

4 What could be the effects on workers in the short and long term? How could these effects impact on a person's ability to work in the long and short term?

4.1 Discussion of different sorts of effects on workers:

In discussing the effects of CE it is helpful to note:

a. Although the focus of CE is on cognitive effects, drugs simultaneously have physical and emotional effects which should not be overlooked;

b. With regard to the effects of CE drugs on the body, the knowledge of physical effects, including side-effects, is more certain than in the case of cognitive/emotional effects;

c. The findings from a number of extant scientific studies (e.g. Baranski et al, 1998; Caldwell et al, 2000; Hall and Lucke 2010; Ilieva et al 2013; Rapantis et al 2010; Sugden et al, 2012) do not seem to be in agreement with regard to the enhancing potential of CE drugs, nor do they accord with the positive cognitive enhancing experiences reported by many users.

d. The controversial nature of some of the claims made for the positive effects of CE drugs vis-à-vis cognition is further complicated by the fact that different drugs have received different levels of scrutiny over different periods of time. For instance, the use of stimulants and other wakefulness promoting drugs has been of interest within the military for decades. Similarly, methylphenidate has been well studied amongst children with ADHD for several decades but there is less available information about usage among children or adults without this diagnosis. In contrast, CE drugs have risen to prominence within wider society only in the past 10 years or so.

CE drugs provide a stimulus to the body's central nervous system. In general terms they have the potential to produce a degree of alertness or the ability to concentrate on a task (e.g. increased attention span) with the effects and their duration depending on dosage and period of treatment/consumption, albeit subject to individual differences.

Although the neurochemical mechanisms of action of the stimulants methylphenidate and amphetamine based drugs such as Adderall are fairly well understood, those underlying the effects of modafinil are not.

The side-effects of these stimulants have been well documented over the years, again with more accumulated evidence pertaining to amphetamines and methylphenidate than modafinil. Adverse side effects can include:

Amphetamines: increased risk of heart problems, high blood pressure and stroke; tolerance and addiction; mental health problems; sudden discontinuation can produce withdrawal symptoms;

Methylphenidate: similar risks to amphetamines but potentially less addictive; more adverse symptoms through long term use, especially psychotic disorders in children;

Modafinil: skin reactions; cardiac events, high blood pressure and arrythmias; psychotic disorders. Considered to pose a low risk of dependency in short term use but dependence for long term use has not been ruled out. In 2011 the EMA stipulated strict rules on the prescription of modafinil because of heightened concerns following a review of safety data. Modafinil is now restricted to the treatment of narcolepsy only and no longer for sleep apnoea or Shift Work Sleep Disorder.[8]

Although there have been numerous articles published on the measurable positive effects of CE drugs (Baranski et al, 1998; Caldwell et al, 2000; Sugden et al, 2012) many other studies, including systematic reviews, have reported little or no effect in terms of cognitive enhancement. For example, an editorial

[8] The EMA report concluded that modafinil was "associated to a rare risk of serious, life-threatening skin reactions. This risk appears to be higher in children. Serious nervous system and psychiatric related events such as suicidal ideation, psychotic episodes, and depression have also been identified" (European Medicines Agency, 2011: 21)

for the journal *Addiction*, concluded that there are "doubts about whether using these substances [CE drugs] enhances real-world cognitive performance in normal subjects." (Hall and Lucke (2010: 2042).

Amphetamines: One study examining 13 parameters of cognitive ability in healthy people concluded that it has "no more than a small effect on cognition" (Ilieva, Boland and Farah, 2013: 496).

Methylphenidate: In a systematic review of available evidence Repantis et al (2010: 202) report that methylphenidate could produce an improvement in memory whilst effects on attention, executive functions and mood were not of statistical significance.

Modafinil: Repantis et al (2010) conclude that it can improve the attention of individuals who are well rested and can have positive effects on individuals deprived of sleep for relatively short periods. However, over longer periods it does not stem the deterioration of cognitive performance. Thus, maintaining wakefulness beyond what might be normally expected can actually confound an individual's ability to maintain normal cognitive performance. They also note that many of the studies reviewed were conducted on military personnel and so the results may not be replicated among the general population.

Surveying the scientific literature on CE drugs it is clear that claims regarding their positive effects on cognition remain controversial. A number of factors appear to contribute to this situation.

a. It is important to note that here is no such thing as cognitive enhancement per se. The term 'cognition' is used to refer to a variety of mental abilities and functions which in scientific terms may be subject to measurement according to specifically designed tests. The assessment of the effects of a particular CE drug has to be operationalised in relation to such tests applied to a given sample of human subjects with an inevitable constraint on what can be generalised from the results. Indeed, many studies that have been conducted have been on a small scale under laboratory conditions (BMA, 2007).

b. Accepting a CE drug's positive effect on a given cognitive task does not mean that other cognitive abilities remain the same or, indeed, are not degraded e.g. methylphenidate may lead to an improvement on tasks that are unfamiliar but at the same time can produce a worse performance on familiar tasks (Bagot and Kaniner, 2013).

c. Individual differences may play an important role in confounding efforts to assess the potential of CE drugs with the lack of measurement of test subjects' normal or baseline cognitive abilities rendering the interpretation of tests difficult (Repantis et al, 2010).

d. The effects of stimulants are such that several areas of cognition as well as mood and the limbic system can be affected, with users misinterpreting alertness as enhanced cognition (Bagot and Kaminer, 2013). In a systematic review of the research concerning use of amphetamine, methylphenidate and modafinil amongst 12-25 year olds, Bagot and Kaminer (2013: 551) detail certain positive cognition related effects but also affirm that "the expectations and perceptions of performance of those who abuse these drugs may exceed the actual efficacy." This accords with Repantis et al (2010: 108) regarding modafinil which can produce a degree of "overconfidence in a person's own cognitive performance"; and Ilieva et al (2013: 496) "users may perceive the drug as enhancing their cognition".

e. The disparity between some scientific studies and reported experiences among users (though with some variability) outside the setting of the laboratory may in part be accounted for by the difficulty of disentangling the cognitive and emotional impact of CE drugs. It could be that users of CE drugs who report a positive effect beyond the levels indicated in the laboratory may experience something that objective tests cannot measure or show. Alternatively, one could suggest that if CE drugs may impact a subject's mood, sense of wellbeing or judgement of their own abilities, then this may shape or distort their reported experience and help explain the disparity between subjective reports and evidence from laboratory studies (Bagot and Kaminer, 2013).

4.2 Discussion of effects in the workplace

CE drugs raise a number of issues in the specific context of the workplace. There is little by way of direct scientific evidence on this but various other sources such as internet fora and online blogs (e.g. http://modafinilorder.com/modafinil-reviews/; and http://allnurses.com/general-nursing-discussion/does-anyone-working-343034.html) on the topic of CE describe user experiences that have some relevance to the assessment of CE drugs.

a. The adverse side effects of CE drugs may pose a risk both to the organisation of work as well as to the individuals concerned.

b. As emphasized above, the effects on cognitive performance depend on the specific tasks involved. Although some areas may be improved this may be at the expense of others. In addition, overconfidence due to a misleading subjective experience that mistakes heightened arousal for improved cognition could be problematic in the context of decision making.

c. Any effect of CE drugs on mood, emotion or motivation has a potential to impact performance at work, including relationships with others/teamwork.

d. Other social aspects include:

- A trade-off between increasing concentration or focus and a decrease in sociability (Vrecko 2013:9). The former would be useful when individuals work alone on a task but could be problematic in the context of teamwork.
- Overconfidence could also pose a problem in the context of teamwork, potentially undermining group cohesion and co-operation.

5 What aspects could be relevant for employers?

5.1 Ethical issues

Issues related to the use of performance enhancing drugs in the workplace have been extensively discussed. The main concerns are:

a. The idea that the use of these drugs will give some employees an unfair advantage over others. Given the cost of the drugs, there are also implications for which employees may have access to them;

b. The concern that there may be either direct coercion or indirect expectations – social pressure to conform - on employees to use CE drugs, given the inherent imbalance of power in the employment relationship. Furthermore, some employees may have religious, social, or health reasons not to use cognitive enhancers. Following from this, the possibility of discrimination by employers against individuals who choose not to engage in such enhancement is a serious threat. As Appel (2008:615) comments: “The dilemma with regard to employment is complex, in that it pits the rights of some potential employees to choose to enhance against the rights of others to be free from the coercive pressure to enhance”.

c. The dangers of creating expectations of ‘medicated normality’ and a lack of tolerance of differences (including of disabilities and age) within the workplace.

5.2 Legal issues

Legal issues for employers include:

a. Use of these drugs as cognitive enhancers is predominantly not via a medical prescription, thus the employee has obtained the drugs by another means such as buying them off someone who does have a prescription or off the internet. Where the drugs are prescription-only, it is illegal to sell or distribute them. Where they are also controlled substances (e.g. Ritalin in the UK is a class B substance) it is illegal to possess them. Thus legal use of the drug will depend on whether it is classified as a controlled substance in a particular country.

b. Employers will need to ascertain whether employees are using substances with a prescription, since a number of employees rely on prescription medicines (either for their prescribed use or having obtained them on prescription but using them for performance/enhancement purposes) to cope with the demands of employment and other aspects of their lives (Ngoundo-Mbongue et al 2005).

5.3 Safety issues

Safety issues for employers include:

a. CE drugs will not predominantly be used under prescription and medical advice;

b. Long terms effects on healthy people are not known;

c. Doses used for performance enhancement will not be under medical supervision, and the chances of adverse side-effects and addiction increase with higher doses;

d. Individual tolerance to the drugs usually increases over time, therefore posing the problem of employees taking increasing amounts;

e. Drug-drug interactions are a concern;

f. The effects of the drugs mean that individuals are likely to mis-perceive their ability as greater than it objectively is, and thus pose a danger of employee over-confidence.

5.4 Connection with existing employee health and wellbeing policies and practices

a. Existing approaches to drug use and the workplace tend to focus on the individual worker as drug (ab)user, defining them as a problem to be treated either through disciplinary procedure or through welfare programmes. This is a very partial approach which brackets off the work environment itself and the interaction between employee and their working conditions.

b. Existing research into substance abuse in the workplace links individual behaviours with employment characteristics in such a way which would be useful to apply to CE. For example, Sonnenstuhl and Trice (1987, quoted in Cook et al 1996: 323) suggest 5 factors likely to contribute to workplace substance abuse problems: i) workplace culture; ii) social control, iii) alienation, iv) occupational stress, and v) availability of drugs. Other research shows that employees who are bullied at work are more likely to take sleep-inducing drugs and sedatives (Vartia, 2001). We might therefore expect that with increased access to CE drugs, employees in cultures of bullying or high pressure might also be more likely to deal with these environments by recourse to drugs. Welfare or wellbeing schemes which only focus on the individual employee will be unable to adequately address CE use in the workplace.

5.5 Managerial Issues In Relation To CE

a. The normalisation of more intensive working practices (Bloomfield and Dale 2015). The danger here is that the assumption that performance enhancement can be achieved by individuals taking CE might lead to cultures where it is accepted that employees will work longer hours, take on more intensive work loads, be able to cope with working at a greater pace etc. In the longer term this has consequences on the health of individuals, but also on the reputation of the organization and the risk to it from greater employee burnout and turnover;

b. The danger of CE drugs being seen as a technological ‘solution’ to problems within an organization. This might mean that other aspects of HR and good management practice are neglected, so CE becomes an alternative to adequately managing arrangements around work;

c. Related to this, enhanced employees might become seen as the norm, and yet as Appel (2008:618) comments: “Although an enhanced individual might garner an advantage, an unenhanced yet highly talented individual can often still perform at a comparable level”;

d. There are issues of changing forms of managerial control which emphasise coercion, or expectation that employees will enhance, and thus seriously reduce employee choice and discretion, with attendant consequences for employee motivation and commitment;

e. Traditional policy on drug use tends to see managers as those who deploy disciplinary procedures or counselling for employees who use drugs. However, in the case of CE drugs it is just as likely that managers and senior professionals themselves could be users, given the greater norms of high pressure and competitive working for these groups.

5.6 Shift work as a specific area of concern

Nearly 20% of the worldwide labour force work shifts that include working hours outside 07:00 h to 18:00 h. (Wright et al. 2013: 41). Shift work is common in many occupations that directly affect the health and safety of others (e.g. emergency services, transport, healthcare). However, shift work can adversely affect the health and safety, the quality of life, and ability to balance work and non-work, for workers in any field. Excessive sleepiness during shift work has been associated with occupational accidents and errors. Shift Work Sleep Disorder has become recognised as a circadian rhythm sleep disorder, which is characterised by excessive sleepiness during the night and insomnia during the day. As at 2013, modafinil and armodafinil were approved in Australia, Canada, Israel, New Zealand, Turkey, and the United States for the treatment of adults with excessive sleepiness associated with SWSD and are schedule IV federally controlled substances. As previously noted, the EMA recommended that prescriptions of modafinil for SWSD should be discontinued due to a review of its adverse effects. However, direct-to-consumer marketing of the drug in the US continues to advertise its use for shift workers, as do online pharmacies and blogs.

Issues for employers:

a. How and whether to determine if workers are using modafinil or other CE in order to cope with shift work.

b. Employers will need to consider the working conditions of shift workers that lead to this situation, considering for example: culture and expectations which normalise CE use; whether there are possible alternative working arrangements (rearranging schedules, adequate rest breaks, the use of bright light treatments (Horowitz and Tangigawa 2002) and education of shift workers in the management of circadian rhythms (Wright et al 2013; see also https://osha.europa.eu/en/faq/what-are-the-risks-of-shift-work-and-how-can-they-be-tackled/what-can-be-done-to-make-shift-work-less-strenuous).

6 Are there any other insights relevant for the management of health and safety at work?

In relation to existing health and safety, and drug testing policies, there are extensive arguments both for and against workplace drug testing (WDT). This report confines itself to relevance for CE drugs.

6.1 Existing discussions of WDT

Existing discussions of WDT – both for and against – assume that drug use (including alcohol) is primarily a non-work activity. Both intermittent 'recreational drug use' (use for enjoyment or leisure e.g. the use of legal highs) and addictive chronic drug abuse tend to be lumped together. Both are treated as a problem for the workplace, with traditional approaches assuming that any sort of drug use is inimical to work. They also assume that drug use increases the likelihood of accidents, errors and absenteeism. This is problematic in relation to CE drugs:

a. In traditional approaches, a clear demarcation between 'work' and 'non-work' is drawn, whereas drug use (illicit, prescription, and CE drugs) may be undertaken to cope with work itself (e.g. due to pressures of work, or to be more competitive) or to deal with work-life balance or spill-over, or the transition between work and non-work (e.g. as in shift work).

b. Individuals are already commonly prescribed drugs to deal with aspects of employment. For instance, a longitudinal investigation in France showed psychoactive medication prescribed for, *inter alia*, sleep disorders connected to work, the enhancement of workplace

performance, and the relief of stress, anxiety or nervousness (Ngoundo-Mbongue et al, 2005). The researchers contend that these factors parallel those identified with illicit drug use: "Our study suggests that workers easily rely on… psychoactive drugs… for social, professional, personal or interpersonal problems and are a good example of our medicated society" (Ngoundo-Mbongue et al, 2005: 87). For some employees it was about trying to retain their usual level of performance, whilst for others they might have been trying to push themselves beyond their 'normal' limits. In such cases we might say that we are witnessing a matter of individual adaptation as a means of coping with the demands of the workplace.

c. Thus, if existing workplace drug policy and procedure assume that drug use necessarily impairs performance, then this is not a useful basis to consider policy for substances that are at least intended to improve performance and safety (even if this is not substantiated in practice).

6.2 Attitudes to and practices around WDT are complex and vary considerably between countries.

Specific legislation exists only in Ireland, Finland and Norway. Elsewhere practices steer a course between the thorny issues of individual freedom compared to duty of care and a safe working environment; and employee consent balanced against a fundamental right to privacy. On the whole, European approaches tend to avoid the culture of random employee testing prevalent in the US, tending more towards a pragmatic consideration of occupations which are seen as 'safety critical' and of the health and wellbeing of individual employees. Good employment policy, as guided by the ILO (2006), proposes the importance of prevention, identification, counselling, treatment, rehabilitation and information on how and when disciplinary action would occur. These approaches would need to be significantly re-thought in relation to CE in the workplace.

6.3 Drug testing itself is problematic and controversial.

Existing tests do not measure the amount of drugs in an individual's system, but the enzymes into which the drugs metabolise. Testing uses hair, blood, urine or saliva for these traces. Thus drug tests cannot test for impairment or intoxication at the time of testing, but for metabolites of substances which may have been taken some time before the test and beyond the period of them affecting employee performance (Warren and Wray Bliss 2009). There is also a significant problem of the false positive. Additionally, some of the drugs commonly tested for, e.g. amphetamines, have a dual existence where they are demonised as a societal problem (crystal meth) and yet their prescription is escalating to deal with a perceived increasing societal problem (such as Adderall for ADHD).

All of these factors suggest that the discussion about Europe-wide random workplace drugs testing to deal with the increased use of performance-enhancing drugs, as proposed in the EU-OSHA Foresight Report on new and emerging risks associated with new technologies by 2020 (European Risk Observatory, 2014: 9, 13, 16, 17, 18), would in itself be inadequate to deal with the health and safety and other employment issues related to use of CE drugs in the workplace.

7 Concluding Remarks

As we hope this report has shown, the effect of cognitive enhancers/performance-enhancing drugs on workplace health and safety and other managerial issues is a complex and diverse one.

This is an evolving area, which suggests dynamic changes in the future. At present there is not a distinct group of drugs which can be obtained and used for CE. Existing prescription drugs used off-label, some illicit drugs, and over-the-counter nutritional and other substances are used for CE purposes. Health and safety, and managerial responses need to take this diversity and lack of medical guidance into account. Current health and safety, human resource management and employee wellbeing policies are unlikely to be sufficient to deal with the use of substances with the intention of improving workplace performance. Future changes will depend on particular economic and employment developments, including:

a. Both the pharmaceutical industry and some sections of the public may have an interest in seeing the development of specific drugs for cognitive/performance enhancement. New drugs and CE uses for existing drugs are constantly being developed and trialled.

b. Although at present, prescription is limited to medical therapy, either a change in attitude towards prescription for human enhancement purposes or the development of CE drugs which are acknowledged to be safe and therefore can be sold over-the-counter for enhancement, would significantly increase the availability and acceptance of enhancement through drugs.

c. Economic and employment relations which lead to high-pressure, highly competitive workplaces and/or high-stress, low employee control workplaces, are likely to exacerbate the perceived need and use of CE (cf. the 'Bonus World' scenario in the EU-OSHA Report 2014).

More work needs to be done to better understand the potential effects of performance enhancement drugs in the workplace. The amount of literature that continues to be generated on this is enormous, and the different views reflect the broad range of interested actors, including neuroscientists, ethicists, popular media, the biohacking community, and professional bodies representing various occupations.

Notes