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REVIEW ARTICLE

Preventing, reducing and treating problematic drug use with digital technology

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Substance abuse disorder is a public health issue which causes significant biological, psychological, social and financial harm in families both in Malta and around the world. Although traditional interventions are well established and backed by significant amounts of literature, the relapse rate, particularly in young people, remains high. As such, technology has often been touted as an alternative to traditional therapy as well as a tool in the prevention and reduction of substance use. This paper analyses the literature surrounding some of the more frequently described examples of technology-based interventions to determine their roles and limitations in the prevention, reduction and treatment of substance abuse disorders whilst also briefly analysing COVID-19's effect on technology use in addiction treatment. As our ability to harness technology and novel forms of media in medicine increases, so too will the options for substance abuse treatment increase. Some examples of technology-based interventions discussed in this paper include online recovery groups, online forums, educational interventions, self-guided web-based therapeutic interventions, m-health and virtual reality software.

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Addressing Drug Use with Digital Technology

Around 29% of adults in the EU are estimated to have used illicit drugs at least once in their lifetime.[1] Young people in Malta are particularly vulnerable to substance misuse (figure 1) indicating that new interventions against substance abuse may be particularly useful in this demographic.[2] Some of the harmful effects associated with specific drugs can be found in Table 1.

In 2007, only 55% of the EU population had access to the internet but by 2016, this had increased to 81%.[3] In Malta, 95% of girls and 89% of boys use social media on school days and on weekends, internet use is even higher (Figure 2).[2] As such, there has been a lot of interest in expanding healthcare through innovative technology. Digital technology is already playing a very large role in various healthcare practices (Table 2).

Figure 1 Percentage of people who use specific drugs at the age of 16 or lower in Malta. Reproduced from: Arpa S, Borg P. Substance use. European School Survey Project on Alcohol and Other Drugs 2019 Malta National Report, Foundation for Social Welfare Services 2020:26-41.

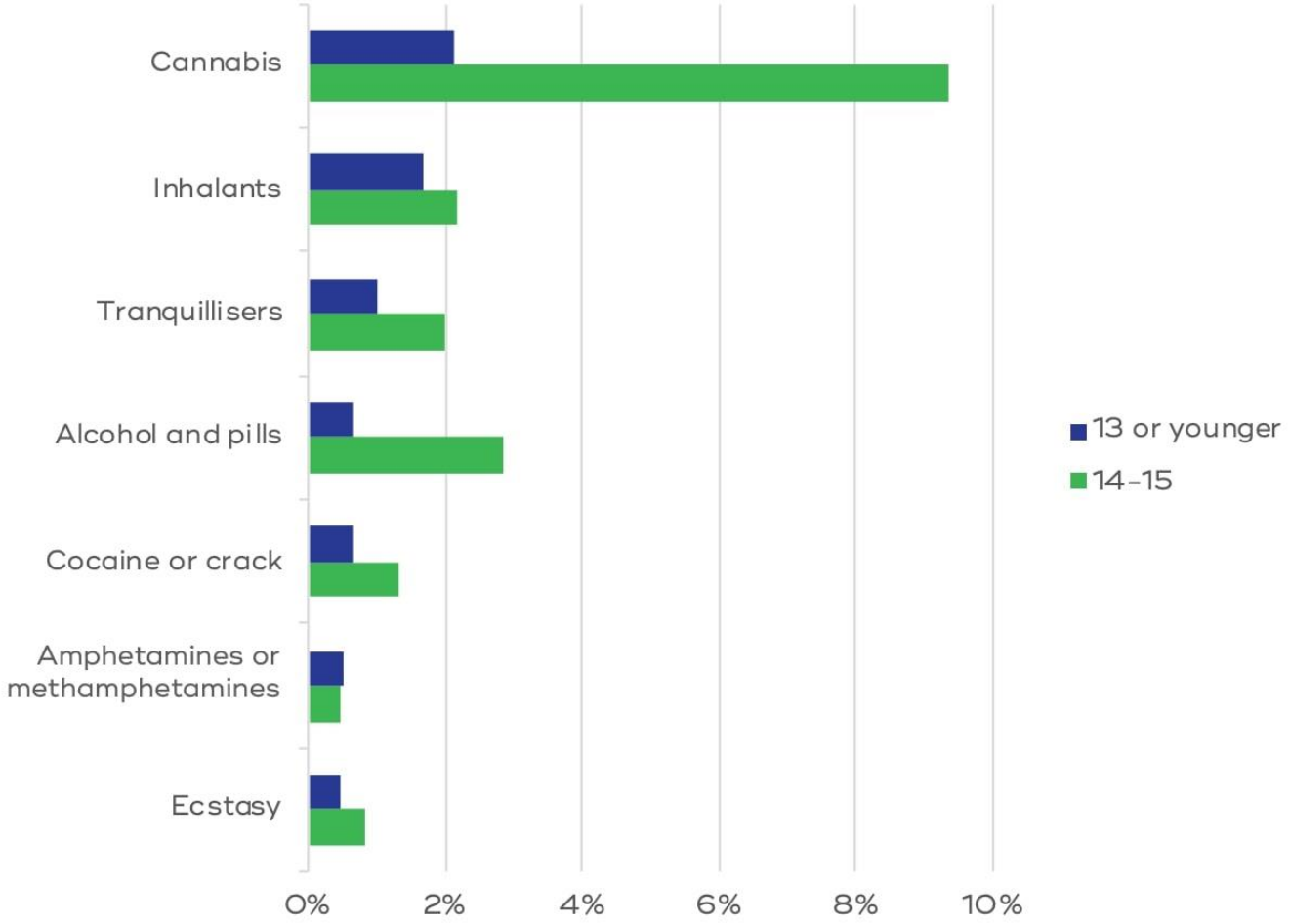


Table 1 Various figures concerning drug use in the EU

Drug	Prevalence and trends in the EU	Associated Health Problems
Alcohol	23 million people in the EU suffer from alcohol-use disorder- one of the most important predictors of morbidity and mortality.	Heart disease, liver disease, various cancers, stroke, cognitive problems including dementia.
Tobacco	The most preventable cause of death and disease. Around 28% of EU citizens smoke tobacco.	Coronary heart disease, stroke, lung cancer.
Cannabis	Most commonly used illegal drug and more commonly used by young adults, 13% of whom have taken cannabis in the last year.	Impaired memory, thinking and problem-solving- schizophrenia and psychosis especially in those who are predisposed. Also breathing problems.
Cocaine	An estimated 2.3 million young adults in the EU have used cocaine in the last year.	Heart disease, stroke, seizures, lung damage.
Heroin	Heroin and opioids are the main driver of fatal overdoses in Europe. 0.4% of European young adults are high risk opioid users.	Coma, respiratory depression.
MDMA /Ecstasy	1.7% of young adults in the EU have used it in the last year.	Impaired judgement, confusion, long-lasting damage to the brain, kidney failure, psychosis.
NPS	Mostly sold as 'legal' substitutes for illegal drugs, they include synthetic cannabinoids, stimulants, opiates and benzodiazepines. Over 790 NPS are monitored by the European Monitoring Centre for Drugs and Drug Addiction.	Vary significantly depending on the type of NPS being taken and method of ingestion.

Figure 2 Number of hours spent on social media by Maltese boys and girls in the last 7 days. Reproduced from: Arpa S, Borg P. Substance use. European School Survey Project on Alcohol and Other Drugs 2019 Malta National Report, Foundation for Social Welfare

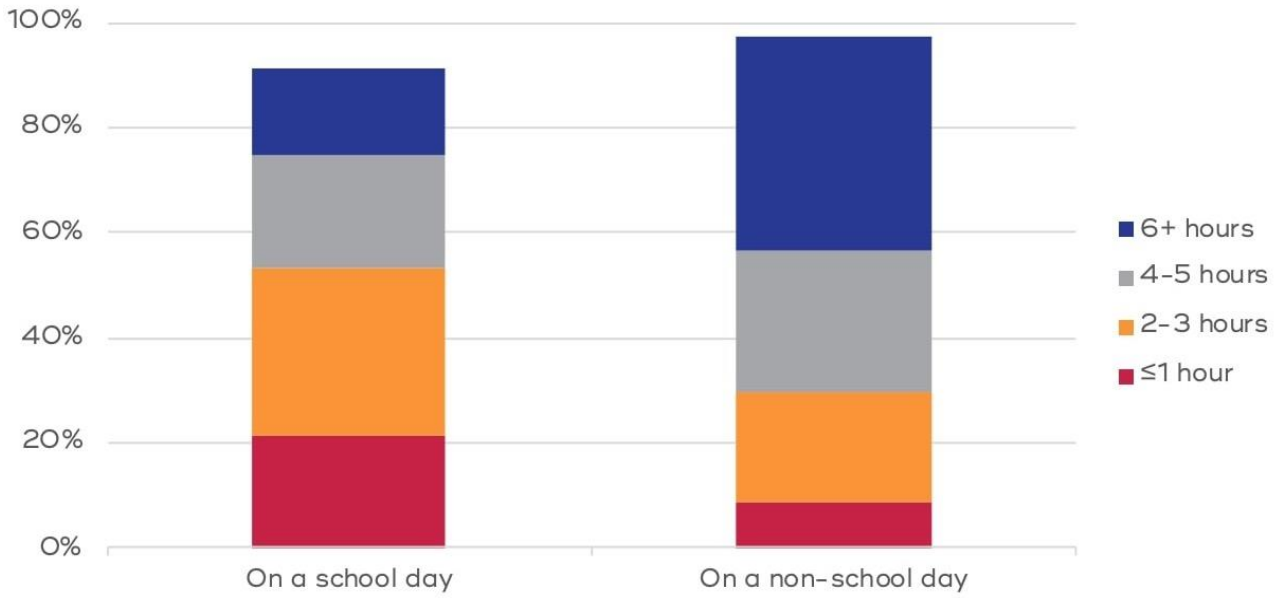


Table 2 Examples of e-Health technology and their function

e-health technology	Function
Computerised professional requests	Allows investigations and treatments to be ordered electronically and allows for results to also be received electronically.
E-Prescribing	Allows healthcare providers to securely transmit prescriptions through a computer device to a pharmacist.
Electronic health records	Allows easier access to previous records and better communication between hospitals and healthcare professionals.
Mobile-health/ m-health	Using mobile or smartphone devices as well as applications on said devices to collect patient data and provide more information to healthcare professionals etc…
Telemedicine	Diagnosis and treatments of patients at a distance.
Web-based education	Seeks to educate and inform patients about their condition as well as prevention and management without any face-to-face interaction.

Currently, around 40-60% of patients receiving treatment for substance abuse disorder relapse.[4] Although this does not necessarily indicate treatment failure, it could mean that there are improvements to be made in current protocols and treatments could be better tailored to the individual, possibly through technology. In fact, the amount of e-health interventions applied to this field of medicine have greatly increased in Europe over the past few years.[5] Some advantages and disadvantages of TBIs in drug use can be found in Table 3.[6-13]

While the effects of the COVID-19 pandemic are still being studied, preliminary studies indicate that although people are less likely to seek treatment, the amount of people suffering from substance abuse disorders has increased.[9] The pandemic has limited many traditional rehabilitation services (figure 3) and forced professionals to make use of online platforms in an attempt to mitigate the difficulties of face-to-face sessions (figure 4). Many experts have highlighted that e-medicine approaches will likely increase in use following the pandemic.[10] The COVID-19 pandemic has also affected the way people purchase illicit substances with online drug-dealing becoming more prevalent. As such, the Europol has set up a Dark Web Team and released various suggestions for policy changes to properly target online drug dealing.[14]

Table 3 Summary of some of the main advantages and disadvantages of TBI use in treatment of substance abuse disorders

Advantages of TBIs	Disadvantages of TBIs
Can be used to treat patients in remote areas or areas associated with stigma.	Computer illiteracy could generate a digital divide.
Allows for more tailored programmes.	Healthcare professionals and patients don't have confidence in e-health.
Particularly useful in young people.	Security and data protection concerns.
Possibly saves money long-term.	Possible high costs in setting up.
Information can be stored, accessed and shared between healthcare professionals efficiently.	More research required to take proper evidence-based decisions.
Very useful as an adjunct to traditional therapy.	Not recommended as a stand-alone type of therapy.
Can be accessed at any time of the day.	Not adequate in emergencies
Proven effectiveness to varying degrees especially when combined with other interactive interventions	Studies are relatively small and lack of randomised clinical trials.

Figure 3 Changes in the availability and supply of services in drug treatment in the EU and Norway due to the COVID-19 Pandemic. Reproduced from: European Monitoring Centre for Drugs and Drug Addiction. EMCDDA trendspotter briefing - Impact of COVID-19 on drug services and help-seeking in Europe. Publications Office of the European: Lisbon 2020.

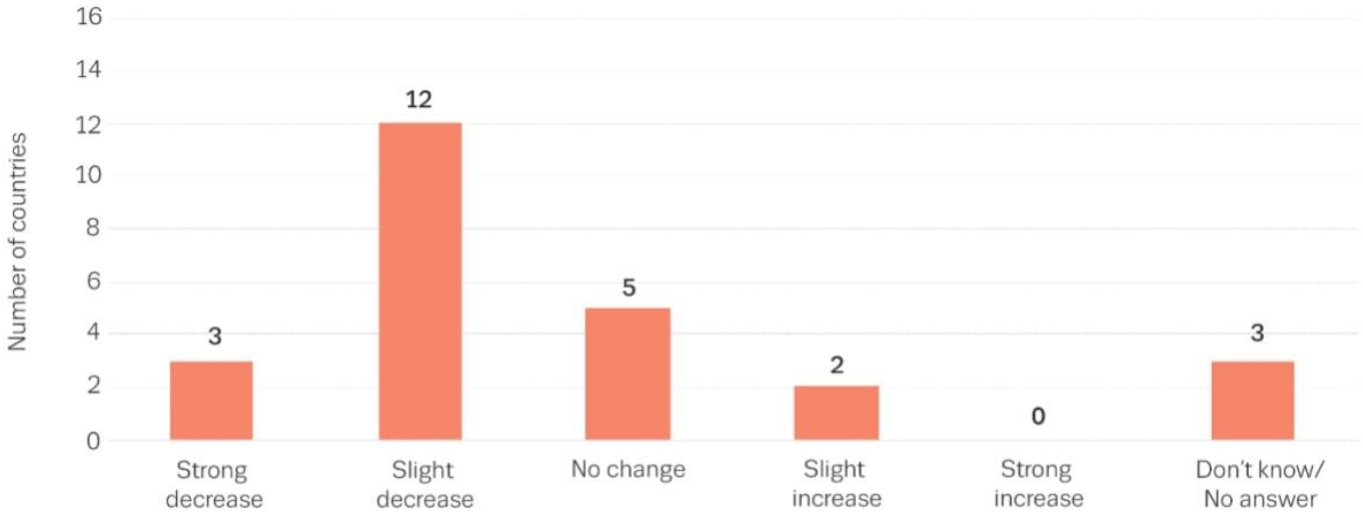
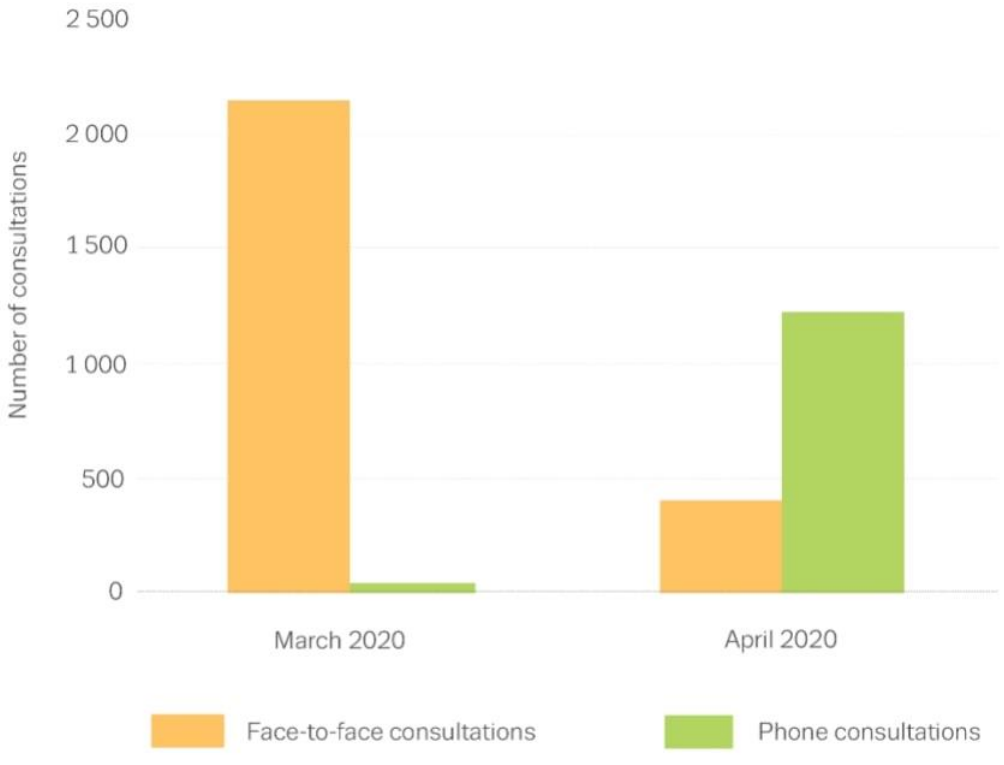


Figure 4 An example of the effect of the COVID-19 pandemic on addiction centres- in this case the numbers of face-to-face and phone consultations in the Riga Addiction Medicine Centre. Reproduced from: European Monitoring Centre for Drugs and Drug Addiction. EMCDDA trendspotter briefing - Impact of COVID-19 on drug services and help-seeking in Europe. Publications Office of the European: Lisbon 2020.



The European Brain Council[15] found that many healthcare professionals do not believe they are sufficiently informed about ICT-based interventions and few actually used TBIs in their practice with scarce infrastructure identified as the main barrier. However, there was a consensus that TBIs have a number of advantages over traditional treatment. Interviews with professionals revealed that although stand-alone ICT-based interventions may be enough for very self-motivated patients, interactive blended/combined interventions are seen as most effective improving adherence and engagement.[16]

Online recovery groups & forums

Group therapy has been a core aspect of substance abuse recovery for decades and has a proven track record of helping patients through support from peers and teaching said patients methods and behaviours they can use to maintain sobriety.[17] Face-to-face group therapy sometimes presents with problems such as dealing with social phobias and patients feeling uncomfortable sharing their stories in person. As such, online recovery groups have become an alternative to maintain patient goals/attitudes while providing resources which can be tailor-made for the patient. Online therapy can be accessed at different times of the day and so may be useful for patients who work long hours or have childcare commitments.[18] Various 12-step organisations make use of online recovery groups including Alcoholics Anonymous and Narcotics Anonymous.[19]

Online forums are similar, allowing patients to share their experiences and meet other people struggling with substance abuse disorder, obtaining support and learning behaviours that may have helped others maintain sobriety. While this can be helpful, lack of regulation by healthcare professionals may be problematic. An example of an online forum is 'Soberistas' although Facebook and Twitter groups may also serve as platforms for online forums.[19] A study found that forums are the most accessed type of online resource for substance abuse disorder. Patients engaging with online forums often felt a "sense of connectedness and belonging".[19] While literature is relatively consistent in that such systems are good supplements to promote rehabilitation, such therapy generally requires offline support and physical contact for full recovery and is not recommended as solitary treatment.[20]

Web-based self-help interventions

Self-help is when patients engage in interventions for self-improvement thereby helping in rehabilitation. Various different types of online self-help interventions exist.[21]

1: Web-based education interventions: Such programmes provide easy-to-understand information concerning problems like triggers, management etc... whilst often guiding patients towards professional help and self-help checklists.[22] Though such interventions are not inherently therapeutic, therapeutic information is sometimes provided too e.g. properly applying breathing control therapy.[23] A study found the best educational interventions are hands-on giving patients the liberty to navigate the system at their own pace. Overall, it was found that educational interventions promote increased performance of self-care behaviour during the rehabilitation phase.[24]

Such interventions may also be used in prevention, promoting education for at-risk patients such as those with mild alcohol use disorders (who may not perceive a need for treatment). Web-based education also has the potential to target children thus preventing

drug use from ever becoming a problem in their lives.[25]

2: Self-guided web-based therapeutic interventions: Such programmes go one step further providing personalised therapeutic feedback helping the patient learn about the causes of their behaviour and what they can do to self-improve.[21] One example is the Overdose Risk-Information Tool (ORION) for those at risk of drug overdose which asks questions to the user to assess overdose risk. Following the assessment, users are able to change their answers to see how it affects their risk allowing for self-help and facilitating discussion with doctors. In a study, 52% of ORION users learned something new about overdose, 48% considered changing drug use and 83% thought the tool was useful.[26] Another example is www.downyourdrink.org.uk.[27]

3: Human-supported therapeutic web-based intervention: Such interventions also ensure human contact (from professionals or peers) for support or therapy as human support can strongly support rehabilitation. This contact can come in many forms through emails, videos and so on.[21,28]

Internet/ technology-mediated therapy

Psychotherapy allows patients to learn skills and integrate better into society. Recently, many have attempted to emulate this online be it synchronous/real time (e.g. live video) or asynchronous (e.g. email). The clinician is usually at the centre of such interventions moving the subject towards specific treatment goals. Such therapy has been found to be effective in drug abuse treatment although proper training is recommended for professionals.[29] Studies are beginning to show that online Cognitive Behavioural Therapy specifically is also a durable treatment.[30-31] However, such therapy virtually eliminates nonverbal signals exchanged[32] and it is therefore avoided in severe psychiatric disorders. The therapist should also make sure that the patient is computer-literate and be aware that some patients may not be able to express themselves through a screen.

Ecological Momentary Assessment

The repeated sampling of data concerning real-time behaviour and experiences from patients is known as Ecological Momentary Assessment (EMA) and is typically carried out through an electronic diary. This is especially relevant for substance abuse, since drug use in itself is episodic and related to the mood and context of the user.[33] EMA asks individuals to initiate an entry or complete an assessment either at random times when not using drugs or when they engage in drug use allowing professionals to study both relapse and ongoing drug use.[34] One study with homeless crack-cocaine addicted individuals found compliance to be high.[35] EMA can also be used by the patients themselves for self-help by allowing them to correlate instances of cravings with maladaptive behaviours.[36]

M-Health

Mobile-health involves all technology that utilises a smartphone to promote good health. M-Health may involve SMS-based systems, apps or other devices like smartwatches.[13,37]

SMS-based interventions involve daily/weekly personalised messages to educate the patient, support change and generate automated feedback on drug consumption/wellbeing.[38] In one study, participants received texts throughout the week querying drinking plans and goals and tailored feedback was then delivered. It was found that such an interactive

system was effective in reducing drug consumption.[39]

Some applications educate users by providing information on different drugs whilst offering quizzes to test the knowledge learned (e.g. KnowDrugs). By targeting vulnerable groups, such apps can also prevent drug use in the first place. However, not all apps are set up by people who have a background in medicine, leading to concerns surrounding the reliability of the information provided especially about New Psychoactive Substances (NPS).[37,40]

Other apps make use of drug consumption diaries allowing users to monitor their consumption and set goals.[37] 'Quit the Shit' (QTS) is tailored for cannabis withdrawal in adolescents featuring an interactive diary while providing users with a counselling team for tailored weekly feedback. More than 90% of users have given the app positive feedback and studies have shown that QTS significantly reduces cannabis consumption over control groups.[41]

The 'miDOT' app by EMOCHA enhances patient-doctor communication while decreasing costs. It allows patients to report their symptoms and record asynchronous videos for directly observed therapy. This keeps addiction at bay and ensure doses are not abused. Moreover, clinicians have the ability to review the progress of their patients and quickly communicate with them should the need arise. Emocha has reached a 95% adherence rate compared to 50% without it.[37]

M-Health can also utilise sensor technology monitoring live data (including blood pressure, heart rate and substance concentration levels in blood) while also possibly sending it to providers at a distance thereby alerting them when patients are at risk of health consequences.[42] For example, researchers in Europe are investigating the use of electronic wristbands in heroin addiction. By monitoring heart rate, they can alert nearby healthcare professionals or family warning them of potential drug overdose.[43] Geospatial technologies including GPS and Wi-Fi can also collect real-time location and environmental data. Since the environment plays a significant role in addictive behaviour, healthcare professionals can determine where and when certain behaviour is occurring while possibly providing the location of nearby healthcare centres.[44] GPS technology can also be used in public health studies to quantify at-risk populations and focus services on such groups.[45] Such data can be combined with other EMA data collected allowing for a deeper understanding of the patient's behaviour and history.[46] Naturally these methods raise many questions concerning privacy and security. This applies especially for spatial data as the patient's home, work location and location of their peers may be inferred from such data. Therefore, healthcare professionals must exercise caution, ensuring that the personal data of their patients is protected and that they give proper informed consent for their data to be used in treatment.

Artificial intelligence and virtual therapeutic software

Sometimes healthcare professionals may find it necessary to use other advanced forms of technology for intervention. These practices offer promising adjuncts to traditional therapy but require technical expertise from both the patient and healthcare professional.[13]

Games and virtual 3D systems: By simulating a new online environment, patients can meet others and gain support while accessing information, blogs and more. Some games may also help train the impaired neurocognitive

circuits in patients with substance abuse disorder. These games help train inhibitory control and act as an add-on to more traditional therapy. Participants are encouraged to not only play the games but share and discuss strategies in order to complete as many trials as possible. A study found that such games can improve executive function and help with complete rehabilitation.[21]

Virtual Reality: Virtual Reality (VR) could allow healthcare professionals to simulate specific environments, triggers and social interactions allowing for a more accurate representation of the patient's natural environment whilst ensuring that in actuality, the patient is in a safe space and can practise their newly found skills. It may especially be useful in training patients to control their cravings.[47] MindCotine uses VR to simulate cue-exposure therapy to quit smoking. This is still very much in its infancy and more research is required, particularly in order to better simulate the range of emotions and sensations that often accompany cravings and triggers.[48] In order to help in such rehabilitation programmes, some have touted the possibility of combining VR with Non-Invasive Brain Stimulation. NIBS can help modify cortical pathways and plasticity in the cerebral cortex be it through transcranial magnetic stimulation or transcranial electric stimulation. Initial studies have given positive outcomes in the treatment of phobias and PTSD though more studies are needed.[49]

Discussion

When analysing the literature, it becomes increasingly clear that there exists a role for technology in the prevention, reduction and treatment of drug use. A consistent finding in research is that technology works as a great add-on to traditional therapy, supplementing it and keeping the patient motivated even outside of the clinical setting. Technology provides a medium for patients to find support, communicate effectively with healthcare professionals and learn to adopt healthy behaviours. Through data analysis and new online education methods, such programmes can also be used to stop people from using drugs in the first place. Even social media, through various online campaigns can duly inform entirely new audiences of the harms of drug use. By pushing services online, the COVID-19 pandemic has highlighted even further the importance such interventions can play in the treatment of substance abuse disorder.

Despite some very encouraging progress and promising data, technology-based interventions are still far from becoming commonplace in routine practice. Though evidence supporting the use of TBIs is increasing, the evidence is currently insufficiently developed to draw final conclusions on their effectiveness. Lack of evidence also exists as to which TBIs are the most effective and many doctors are not sure how to properly protect the data and privacy of their patients through these new interventions. Another issue is that most current research focuses on alcohol, tobacco and cannabis so more research is needed focusing on other drugs of abuse.

As such, a proper national and international strategy must be put into place to ensure those suffering from substance abuse disorder in the future are able to get the help they need, even if the optimal treatment is technology-based. More resources need to be invested in research so as to increase the amount of randomised control trials. Furthermore, resources should be pooled in to increase

digital literacy among both healthcare professionals and the general public through proper technical support and training. The current infrastructure and hardware should be upgraded too (e.g. increased bandwidth may make TBIs more viable in emergency situations). Proper standards for data collection, privacy and security must also be highlighted better through new legislation.

All in all, the possibilities of technology in the treatment of substance abuse are only just beginning to become clearer. As technology improves with time, so too will the health benefits of TBIs. VR technology could become more realistic, more closely emulating the real-life sensations that accompany cravings and addiction. Live sensors may be eventually programmed to deliver actual immediate treatment to patients (e.g. by delivering a dose of naloxone to people with dangerously high levels of heroin in their bloodstream). As such, new advances in technology should be followed closely by healthcare professionals working in the field of substance abuse and they should seek to harness and make use of new technology rather than avoid it.

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