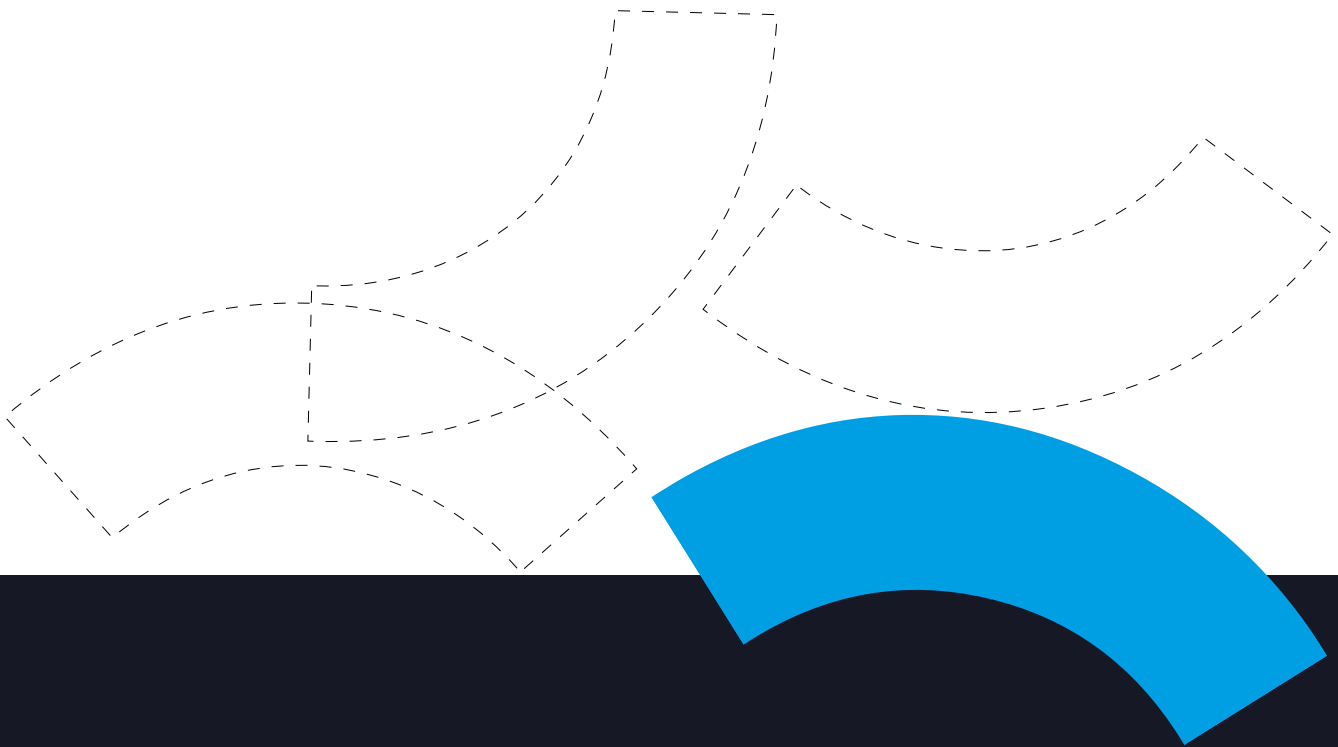


Overdose Prevention – new technology-based Solutions

Jean-Paul Grund & Graham Shaw
Stop Overdose Now (SON)



Colophon

Authors: Jean-Paul Grund & Graham Shaw, Stop Overdose Now (SON)
Review: Eberhard Schatz (C EHRN), C EHRN Overdose Prevention Expert Group
Editing: Graham Shaw

® **Correlation – European Harm Reduction Network, 2019.**

This publication of Correlation – European Harm Reduction Network is protected by copyright. Reproduction is authorised provided the source is acknowledged.

Recommended citation: Jean-Paul Grund & Graham Shaw(2019),
Overdose Prevention – new technology-based Solutions.
Correlation European Harm Reduction Network, Amsterdam.

Correlation – European Harm Reduction Network

c/o Foundation De REGENBOOG GROEP
Droogbak 1d
1013 GE Amsterdam
The Netherlands

www.correlation-net.org



Correlation - European Harm Reduction Network is co-funded by the European Union

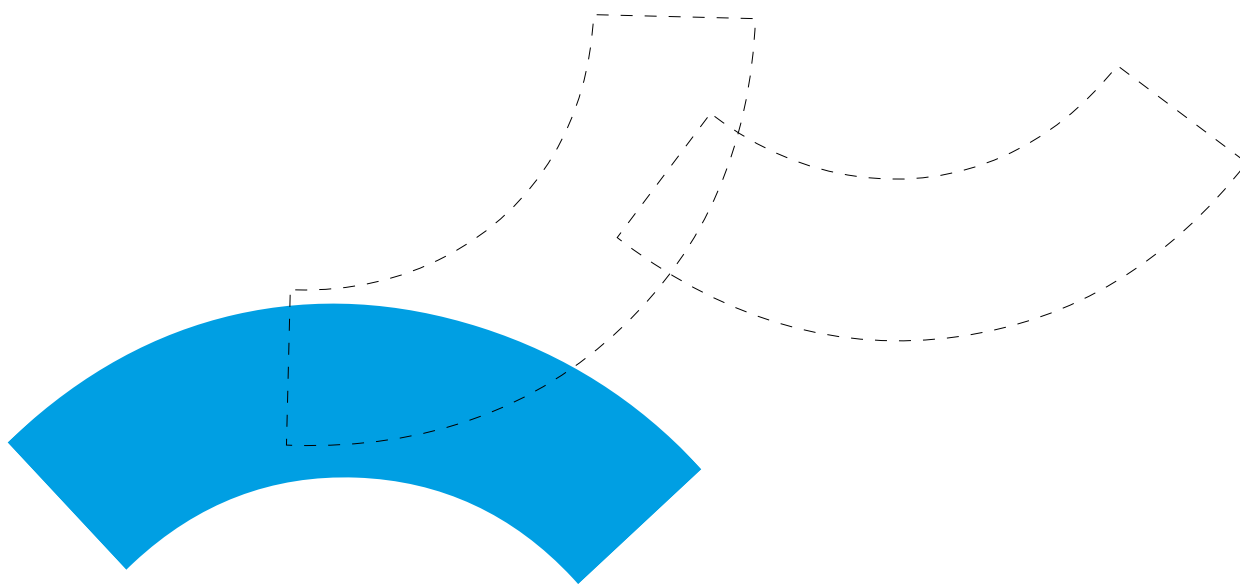
Executive summary

An innovative way of preventing opiate overdose deaths is through emerging online technologies. Online user forums as well as informative websites and mobile phone apps, are an asset in improving access to both information and naloxone itself. Web-based interventions are easily accessible from non-urban areas and across the globe, and help to circumvent stigma, punitive drug policies and harsh law enforcement. Besides, as the growing online drug market challenges traditional harm reduction service provision such as outreach work, innovative projects are using the same online channels to provide harm reduction services. High quality information websites and instructive apps increase access to information on overdose prevention, preparing PWUD and those near to them to properly respond in the event of an opioid overdose.

Overall, the use of technology in support of the response to opioid overdose falls into two overlapping categories, namely community-based networking of the response to overdose emergencies; and monitoring and research in support of risk management and response readiness. Among others, apps may offer geo-based information on naloxone availability and harm reduction services to PWUD (connecting people in need of naloxone/services with those who can provide it). Other apps concentrate on post event incident reporting and monitoring of overdose only. These can potentially generate important data for overdose prevention projects and policy planning.

Innovation, however, does not come without challenges. Not all people need possess mobile phones, and there are limits to current location technology to provide accurate geospatial location. Besides, safety, privacy and data security measures must be adapted to safeguard app users from law enforcement, hackers, and potential malicious behaviour by other app users. Finally, assuring uptake and acceptance by the PWUD community is essential, as well as securing funding to (further) develop tech-savvy initiatives to prevent overdose deaths.

This is the second part
of our Overdose Prevention Report.
Part One 'Challenges and Solutions' is accessible at:
www.correlation-net.org/publications



Contents

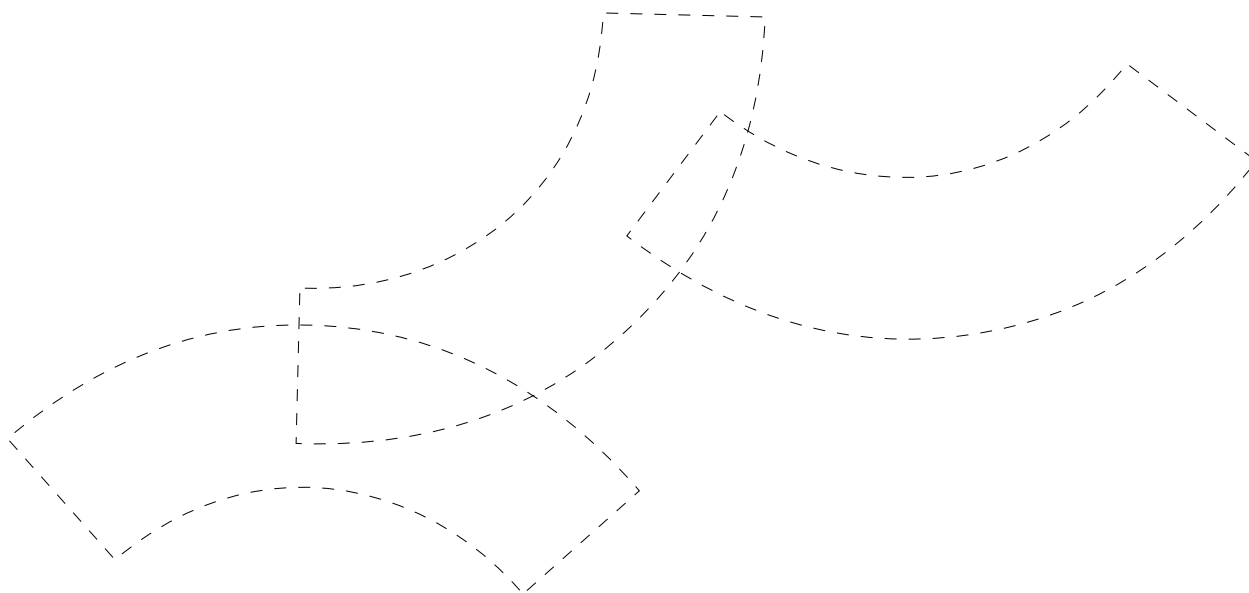
Acknowledgements	6
Conflict of Interest Statement.....	6
Acronyms	7
1. The rise of harm reduction technology.....	8
1.1. Introduction.....	8
1.2. Naloxone Locators.....	9
1.3. Increasing access to naloxone and other harm reduction resources.....	9
1.3.1. NEXT: Online Naloxone Mail Order	9
1.3.2. A Symbiosis of Outreach Work and Virtual Counselling using the Darknet	10
1.4. Increasing access to information on overdose prevention.....	11
1.5. Digitally empowering the response to acute overdose	12
1.5.1 The current response – Rationale and Risk Environment	13
1.5.2 Community-based overdose response networking technology.....	14
1.5.3 Smart Panic Buttons	18
1.5.4 Wearable and contactless devices for monitoring vital signs	18
1.5.5 Motion sensors	19
1.5.6 Naloxone auto injectors	19
1.5.7 Monitoring and research.....	20
1.6 Responding to the emerging influx of fentalogues and other NPS into traditional opiate markets	22
1.6.1 FenChecker	24
1.7 Increasing access to safe drugs	26
1.7.1 Opioid Dispensing Machines	26
1.7.2 Heroin compassion clubs	27
1.8 Costing and Ownership	27
2. Discussion.....	28
Taking Harm Reduction into the 21 st Century	28
Challenges.....	29
3. Recommendations	33
References.....	34

Acknowledgements

We thank Jamie Favaro (NEXT) and Igor Kuzmenko (Harm Reduction 2.0) for fact checking the sections that describe their initiatives and our friends in Kazakhstan for providing us access to the scientific literature.

Conflict of Interest Statement

Jean-Paul Grund and Graham Shaw are both involved in the Stop Overdose Now Foundation (SON). Jean-Paul is SON's executive director and Graham is its adviser strategy & resource mobilization.



Acronyms

API	Application Programming Interface
DCR	Drug Consumption Room
FTIR	Fourier Transform Infrared Spectrometer
FTS	Fentanyl Test Strip
GIS	Geographic Information Systems
GSL	Good Samaritans Law
Fentalogues	Fentanyl and its analogs
HAT	Heroin-Assisted Treatment
HIDTA	High Intensity Drug Trafficking Areas
NAL	Naloxone Access Law
NPS	New Psychoactive Substance(s)
OD	Overdose
ODMAP	Overdose Detection Mapping Application Program
OST	Opioid Substitution Therapy
OTC	Over-The-Counter
OUD	Opioid Use Disorder
OWN	Overdose Warning Network
P2PN	Peer-to-Peer Naloxone
QALY	Quality-Adjusted Life Year
SCF	Safe Consumption Facility
SIF	Safe Injecting Facility
SITD	Italian Drug Addiction Society
SON	Stop Overdose Now
THN	Take-Home Naloxone
TONI	Texas Overdose Naloxone Initiative
UNODC	United Nations Office on Drugs and Crime
WHO	World Health Organization

1. The rise of harm reduction technology

1.1. Introduction

The internet has become an integral part of contemporary society and, for most people, it has become the first source to turn to for health-related information, advice and, increasingly, counselling. Drug and alcohol treatment services and mental health services increasingly offer online treatments. In particular internet-based contingency management is on the rise. Mobile phones are now used in promoting smoking cessation¹ and to reinforce the reduction of alcohol use and abstinence outside of clinical settings². Online incentive-based treatment for alcohol problems is furthermore facilitated by mobile technology for remote objective monitoring of treatment compliance, such as breathalysers that verify the user's identity and monitor their alcohol consumption³ and transdermal alcohol sensors that continuously monitor alcohol intake^{4 5}. Importantly, a wealth of harm reduction information can be accessed online, through sites hosted by professional services and those that emerged from within drug using communities, such as [Bluelight](#)⁶, [Erowid](#)⁷ or [PsychonautWiki](#)⁸.

“New internet technologies have equally given rise to a host of virtual drug markets where both scheduled drugs and unscheduled drugs (new psychoactive substances or NPS) can be sourced from sites that can be accessed simply by googling.

New internet technologies have equally given rise to a host of virtual drug markets where both scheduled drugs and unscheduled drugs (new psychoactive substances or NPS) can be sourced from sites that can be accessed simply by googling or, after installing TOR, using one of its equivalents on the deep web. Paid with crypto currencies, the drugs are subsequently transported through the postal services – *from anywhere in the world to anywhere in the world*^{9 10 11}.

In response to the increasing *glocalization* of drug markets and the proliferation of NPS, drug testing is no longer only offered at brick and mortar drug services or on-site at e.g. festivals, but also provided online by organizations such as the *Welsh Emerging Drugs and Identification of Novel Substances* project¹² (WEDINOS) or *Energy Control*¹³.. The latter sites use rather sophisticated technology for reporting back the test results and protecting the privacy of their clients. *Energy Control's Doctor X*, a Spanish medical doctor, specialized in family medicine and drug dependency, has been providing free health advice on deep web drug market forums since 2013.

Use of mobile phone technology, in particular, is close to becoming ubiquitous. By the end of 2017, there were 465 million unique mobile subscribers in Europe, equivalent to 85% of the population, and 673 million SIM connections, or 123 mobile subscriptions per 100 people. Seventy percent of those are smart phone connections¹⁴. In 2016, almost 80% of internet users in the EU used a mobile phone to surf the web¹⁵. However, very few stud-

ies have been conducted of mobile phone use in PWUD communities. Nonetheless, PWUD were among the early adopters of this technology. Since the turn of the century, mobile phones play a key role in consumer level drug dealing¹⁶. More recently, local drug suppliers started using social media platforms, such as WhatsApp. In the Netherlands, for example, the drugs are subsequently delivered by car or scooter at your doorstep.

1.2. Naloxone Locators

Beyond the drug's legal and regulatory status, access to naloxone includes knowing where to find it. Take home naloxone programs and other certified Naloxone providers advertise their services on their websites. The [Center for Opioid Safety Education \(COSE\)](#) at the [University of Washington Alcohol & Drug Abuse Institute](#) maintain a searchable [map of naloxone providers](#) in Washington State on the internet.

NARCAN Now, developed by [Adapt Pharma](#) (now: Emergent Biosolutions), is the official app for the Narcan (naloxone HCL) nasal spray, the company's flagship product. The NARCAN Now app includes a GPS-based pharmacy locator, usage instructions for properly administering Narcan, and a training video, as well immediate access to local emergency 911 services.

1.3. Increasing access to naloxone and other harm reduction resources

Importantly, access to naloxone or other harm reduction supplies and information is dependent on where people live. Stigma, punitive drug policies and harsh law enforcement may equally

keep people from accessing these resources. Two potentially ground-breaking new harm reduction initiatives in the US and Ukraine are exploring new ways to circumvent these barriers by combining new technologies with well-known methods of service delivery.

“Most harm reduction services, including overdose prevention programs are located in urban areas. People who use drugs in rural and suburban areas may not have access to these services.”

1.3.1. NEXT: Online Naloxone Mail Order

Most harm reduction services, including overdose prevention programs are located in urban areas. People who use drugs in rural and suburban areas may not have access to these services. They may not have the means to travel to brick & mortar harm reduction services elsewhere, while (often substantiated) privacy concerns may keep them from obtaining harm reduction supplies locally.

[NEXT Distro](#) (NEXT) is a US-based online and mail-based harm reduction platform targeted at people who use drugs without access to offline harm reduction supplies, education or support, regardless of their (US-based) location. While harm reduction resources and education are widespread on the web and syringes and other supplies can be sourced online via e.g. Amazon or diabetic supplies sites, NEXT combines these two, aiming at “creating a community specifically for people who use drugs interested in learning more about harm reduction techniques”.

In New York State, NEXT is state-licensed syringe access program and registered as an Opioid Overdose Prevention Program. These channels allow NEXT to distribute harm reduction supplies and naloxone to communities impacted by drug use across the state at no cost to the individual through their online and mail-based service (www.nextdistro.org and www.naloxoneforall.org). Since launching www.naloxoneforall.org in November 2018, NEXT has received thousands of requests for naloxone across 49 US states and Puerto Rico. To support the legal expansion of online and mail-based distribution model, NEXT developed an affiliate program. Using a hub and spoke model, NEXT has affiliate programs in 25 states that mail naloxone to trained www.naloxoneforall.org enrollees within their state. Although founded in New York, NEXT is working to elevate their platforms to allow for nationwide harm reduction access.

1.3.2. A Symbiosis of Outreach Work and Virtual Counselling using the Darknet

“ Access to naloxone and other harm reduction services may also be hampered by punitive (local) drug policies and law enforcement targeting consumer-level drug markets.

Access to naloxone and other harm reduction services may also be hampered by punitive (local) drug policies and law enforcement targeting consumer-level drug markets. Such is the case in Kiev, Ukraine, for example. In response, local drug entrepreneurs are increasingly combining new and old technologies for getting their goods to their clients without attracting attention of the law. Their

services are advertised via graffiti in drug copping neighbourhoods but they use both the darknet and (encrypted) social media platforms, such as WhatsApp, Telegram or Jabber, for arranging drug transactions. Once an order is made, it is paid for at one of the many *IBOX terminals* in the city, where cash can be converted into electronic hryvnia anonymously. Upon sending proof of payment to the seller, the buyer receives the GPS coordinates of a convenient and safe ‘закладка’ (zakladka or stash) where the ‘клад’ (klad or treasure) can be picked up by direct message. Alternatively, they use one of the 40 *automated parcel collection and drop-off points* deployed at various supermarket outlets in the city – introduced in 2015 and used widely in Poland as well. As noted by the producer of this e-commerce distribution technology, these “easyPack” machines will “allow consumers to pick up online purchases outside office hours when they cannot be at home to receive parcels.” These market changes present a huge challenge to traditional harm reduction service provision, such as outreach work, as they are making street or venue-based drug markets – the comfort zone of outreach workers – obsolete.

Снижение Вреда 2.0 (Harm Reduction 2.0) is a peer driven harm reduction and outreach project that emerged from within the PWUD community in Kiev and is supported by the *Public Health Alliance* and the *Global Fund*. In response to these changes in the drug market, Harm Reduction 2.0 recently started using the same channels as the drug dealers in providing harm reduction services to the local PWUD community. Their peer outreach workers use a Ukrainian darknet market account to make contact with PWUD and receive their orders for harm reduction supplies, including HIV self-tests (with the test results reported back via encrypted direct messaging), fentanyl test strips and other drug testing strips. Subsequently, the

outreach workers go out to deliver the supplies, by hiding these at a stash or by leaving them in one of the automated parcel collection and drop-off points. Harm Reduction 2.0 furthermore plans on making anonymous counselling available through Telegram.

1.4. Increasing access to information on overdose prevention

“A number of instructive apps have been developed that prepare PWUD and those near to them to properly respond in the event of an opioid overdose.

Information on handling acute opioid overdose is available via the websites of many harm reduction organizations. Most of these are based in the US and Canada (ADD LINKS) but solid information on responding to overdose can be increasingly found on the sites of European harm reduction organizations as well. Many of these sites can be accessed via mobile phones.

A number of instructive apps have been developed that prepare PWUD and those near to them to properly respond in the event of an opioid overdose.

For example, *Stop OD NYC* (New York City Department of Health and Mental Hygiene; <https://apps.apple.com/us/app/stop-od-nyc/id1208260484>; https://play.google.com/store/apps/details?id=gov.nyc.health.stopod&hl=en_US) contains information on naloxone, interactive learning materials on the four Naloxone applications

available in the city and training videos and FAQs on overdose emergency management. It furthermore has a news section and app users can sign up to receive push alerts. *Stop OD NYC* is free and available in English and Spanish.

Opioid Overdose Prevention app (iHealth Ventures LLC; <https://itunes.apple.com/us/app/opioid-overdose-prevention-app/id1041432203?mt=8>; https://youtu.be/n8V_825FT-DI) includes real-time updated information for 'Patients, Family Members and Health Professionals' on how to respond to opioid overdose, but also on the signs of opioid use, and on how to provide recovery support, including a number of "Conversation Starters – to help bring up the conversation with people struggling with addiction". Similarly, the *OpiRescue app* (Rx Assurance, Inc.; <https://opirescue.com/>; <https://opisafe.com/>; <https://play.google.com/store/apps/details?id=com.rxassurance.oprescue>) contains information on rescue breathing and Narcan administration. *OpiRescue* apparently intends to offer geo-based information on naloxone availability and drug treatment services by (US) state, both in the app and on their website but clicking these online results in empty fields for now. *OpiRescue* is intended to serve as a patient support network application for *OpiSafe*, a prescriber dashboard which provides medical professionals access to all relevant opiate-prescribing patient data in one place.

The latter two apps are developed by commercial firms and tailored after a 5-step protocol for responding to an opioid overdose event developed by the US Substance Abuse and Mental Health Services Administration (SAMHSA). A European initiative, the *U-turn Opiate Overdose Response app* (U-Turn Training, Consultancy & Empowerment) is no longer available in the app stores.

“ There are furthermore a number of apps available that are designed for opioid prescribers and other healthcare professionals.

There are furthermore a number of apps available that are designed for opioid prescribers and other healthcare professionals. Most of these are developed in the US and based and follow CDC Guidelines. The CDC Opioid Prescribing Guideline app (<https://apps.apple.com/us/app/cdc-opioid-guideline/id1185581887>; <https://play.google.com/store/apps/details?id=gov.cdc.ondieh.ncipc.OpioidGuideline&hl=nl>) is a quick reference tool for healthcare professionals that supports clinicians prescribing opioids for chronic pain. This comprehensive tool provides information about the prescription opioid overdose epidemic in the US and supports clinical decision-making on initiation, titration, and dosage safety in prescribing opioids, as well as a glossary and an instructional section on using motivational interviewing with pain patients. The information and features in the app are not only of interest to medical providers, in particular its morphine equivalency calculator is likely of interest to people who use opioids and harm reduction workers alike. Other opioid conversion apps include [Safe Opioids](#), [Opioid Calculator](#) and [pH-Medical Opioid Converter](#).

Finally, several general toxicology apps are available that cover poisoning and drug overdose more broadly and help doctors and health care professionals to assess and treat patients who are potentially affected by exposure to a toxin. Some are open access, such as the *Clinical Toxicology Guidelines* app from the Austin Toxicology Services in Victoria, Australia (<https://play.google.com/store/apps/details?id=au.org.austin.toxicology&hl=nl>; <https://apps.apple.com/au/app/austin-health-toxicology/id1436266463>). TOXBASE (www.toxbase.org) is the primary clinical toxicology database of the UK National Poisons Information Service (NPIS), available both online and via an app. TOXBASE is available free to registered UK National Health Service (NHS) professionals (<https://play.google.com/store/apps/details?id=uk.co.issolutions.toxbasemobileAndroid.activity&hl=nl>; <https://apps.apple.com/gb/app/toxbase/id519248940>). *Poisoning & Drug Overdose* or *PoisonOD* is an app developed by a company related to the California Poison Control Center and costs \$65 (<https://play.google.com/store/apps/details?id=com.medpresso.Lonestar.poisonod&hl=nl>; <https://apps.apple.com/us/app/poisoning-and-drug-overdose/id480105551>). *Poisoning & Drug Overdose Ref*, a free app also created by the CA Poison Control System, covers the 25 toxins most commonly ingested, including information on clinical presentation, diagnosis, and treatment for each of these (<https://apps.apple.com/nl/app/poisoning-drug-overdose-quick-reference/id1231695953>; <https://play.google.com/store/apps/details?id=com.agilemd.Android.poisoningdrugoverdosequickreference&hl=en>).

google.com/store/apps/details?id=au.org.austin.toxicology&hl=nl; <https://apps.apple.com/au/app/austin-health-toxicology/id1436266463>). TOXBASE (www.toxbase.org) is the primary clinical toxicology database of the UK National Poisons Information Service (NPIS), available both online and via an app. TOXBASE is available free to registered UK National Health Service (NHS) professionals (<https://play.google.com/store/apps/details?id=uk.co.issolutions.toxbasemobileAndroid.activity&hl=nl>; <https://apps.apple.com/gb/app/toxbase/id519248940>). *Poisoning & Drug Overdose* or *PoisonOD* is an app developed by a company related to the California Poison Control Center and costs \$65 (<https://play.google.com/store/apps/details?id=com.medpresso.Lonestar.poisonod&hl=nl>; <https://apps.apple.com/us/app/poisoning-and-drug-overdose/id480105551>). *Poisoning & Drug Overdose Ref*, a free app also created by the CA Poison Control System, covers the 25 toxins most commonly ingested, including information on clinical presentation, diagnosis, and treatment for each of these (<https://apps.apple.com/nl/app/poisoning-drug-overdose-quick-reference/id1231695953>; <https://play.google.com/store/apps/details?id=com.agilemd.Android.poisoningdrugoverdosequickreference&hl=en>).

1.5. Digitally empowering the response to acute overdose

“ In many EU countries, concerns over rising overdose mortality must still be translated into action, both in the area of policy and that of practice.

At this point, the burden of the actual response to opioid overdose continues to rely largely on professional first responders, in particular in Europe. In many EU countries, concerns over rising overdose mortality must still be translated into action, both in the area of policy and that of practice. In this section, we zoom in on the currently developing practical response to overdose and present a number of technological innovations that may greatly empower community-based responses to acute overdose and further revitalise the provision of harm reduction services.

Before we do, we discuss the rationale behind the currently developing response, which is grounded in the successes and lessons learned in the response to HIV in the 1980s and 1990s.

“ At present most drug testing efforts are targeted at recreational drug consumers and relatively few opioid drugs are being tested.

1.5.1 The current response – Rationale and Risk Environment

Several examples of currently recognised good practice overdose prevention interventions exist. Specialised drug treatment and harm reduction services, such as heroin assisted treatment or drug consumption rooms, have been associated with reduced risk of overdose ([https://doi.org/10.1016/S0140-6736\(10\)62353-7](https://doi.org/10.1016/S0140-6736(10)62353-7)), but these services only target and attract only a small part of those at risk of opioid overdose. Similarly, at present most drug testing efforts are targeted at recreational drug consumers and relatively few opioid drugs are being tested.

Naloxone take home programmes, peer-to-peer naloxone programmes and prison and treatment pre-release programmes specifically target people who use (opioid) drugs with training on overdose prevention and management and provide naloxone free of charge. The Modus Operandi of these services is largely modelled on the experiences and lessons learned in the response to HIV in the 20th century. For example, peer-to-peer naloxone programmes are grounded in the same principles that gave birth to the practice of secondary needle exchange. Such interventions rely on existing mechanisms of peer support and the assumption that people will prefer using new syringes over used ones if these are available when and where.

“ While peer education and support continue to exist in the PWUD community, crucial differences exist in the risks associated with, on the one hand, HIV (or HCV) infection and overdose, on the other.

But this rationale cannot be applied one-on-one to the response to acute overdose. Unlike sterile injecting equipment, the odds that a unit of naloxone will actually be used once distributed are much smaller. A survey of 136 US overdose prevention programs reported that from 1996 through June 2014, these programs provided training and naloxone kits to 152,283 laypersons and received reports of 26,463 overdose reversals. Less than one in five of distributed naloxone kits were actually used to reverse an overdose. Likewise, while peer education and support continue to exist in the PWUD community, crucial differences exist in the risks associated with, on the one hand, HIV (or

HCV) infection and overdose, on the other. HIV and hepatitis may result in serious health consequences and death overtime. The emergence of antiretrovirals has fortunately turned HIV into a manageable disease and HCV can now be treated successfully. However, opioid overdose kills instantaneously and represents a very different risk environment. HIV spread thrives on social interaction. Using alone does protect against BBVs but most overdose deaths occur when people use alone and are disconnected. Thus, the assumption, implicit in current best practice overdose interventions, that those trained and equipped with naloxone will be in the immediate environment of people overdosing is only valid in part. Finally, the rapid spread of fentanyl from the darknet to the streets further attests to the drastic and disturbing changes in the risk environment of drug use we are currently witnessing and may likely expect in the near future.

Equally important is that the current response to overdose is characterized by 20th century communication infrastructures and tools, which do not facilitate rapid and accurately coordinated responses to overdose incidents. Response time, in particular, is a critical factor in responding to opioid overdose incidents and decisive in their outcomes. A recent US study suggested that EMS response times are between seven minutes in urban settings and 14 minutes in rural settings¹⁷. This falls significantly short of the standard EMS response time in the US – four minutes¹⁸. Furthermore, the incompatibility of local EMS communication systems and disconnected data systems, and the absence of communication systems for community-based initiatives obstruct learning from the accrued experience of the response to opioid overdose. In other words, valuable data that could effectively inform and bolster the response to overdose is not being collected and analysed.

In sum, the currently developing *best practice* response to opioid overdose is largely modelled after peer driven and community-based intervention models developed in the response to HIV, and rightfully so. Indeed, *“the most effective responses to the HIV epidemic grow out of people’s action within their own community and national context”*¹⁹.

But whereas provision of naloxone, training on its application and education are essential components of empowering drug using communities in responding to opioid overdose, the present response lacks an effective 21st century deployment strategy towards optimal use of the investments in naloxone distribution and training.

1.5.2 Community-based overdose response networking technology

Fortunately, there are now several initiatives that aim to address this critical gap, using innovative internet technology. The use of technology in support of the response to opioid overdose falls into two overlapping categories:

1. Community based networking of the response to overdose emergencies; and,
2. Monitoring and research in support of risk management and response readiness. Location positioning technology, using Global Positioning Systems (GPS), Wi-Fi and/or mobile phone signals is core to all of these applications. Searching the App Store, Google Play and the internet (up to August 2019), we came across ten initiatives that are relevant to closing the observed gap between the distribution of naloxone and its actual use in emergency situations. In addition, we found five initiatives that roughly use the same technologies for post event incident reporting and monitoring of overdose only.

Table 1. Overdose response networking applications

Name	Primary focus	Pricing	Ownership	Links
Be Safe	Intervention	free	NGO - Brave Technology Cooperative	https://play.google.com/store/apps/details?id=com.brave.besafe&hl=en_US ; https://apps.apple.com/us/app/be-safe-community/id1435653628
NOverdose	intervention		Business - Remitigate, LLC	Niet in app stores; https://www.remitigate.com
OD Buster	Intervention & research	free	NGO - Stop Overdose Now	https://play.google.com/store/apps/details?id=com.odbuster&hl=en_US ; IOS version via Testflight
ODSave	intervention	free	business	https://apps.apple.com/us/app/odsave/id1434890324 ; https://play.google.com/store/apps/details?id=com.odsavapp&hl=nl
UnityPhilly	Intervention & research	Free; research participants only	Dornsife School of Public Health, Drexel University, Philadelphia	https://play.google.com/store/apps/details?id=com.unityphilly.nfresponder.apis&hl=en_US ; https://apps.apple.com/sr/app/unityphilly/id1435324037?l=nl
NaloxoFind	intervention	Free	business - Altrix Medical	https://apps.apple.com/us/app/naloxofind/id1326220472 ; https://play.google.com/store/apps/details?id=com.altrixmedical.naloxofind
NalNow	intervention	(Free)	TeamMIT (a group of MIT alumni)	Niet in app stores
Naloxalocate	intervention	Free	Business - Block Aviation	Niet in app stores; https://github.com/simonmullaney/Naloxalocate ; https://blockaviation.com
Naloxone - Solution Green	intervention	-	-	Niet in app stores; https://www.youtube.com/watch?v=vrpZLld-i8c&feature=youtu.be
NALPAL	intervention	-	Academic - University of Victoria, Victoria, BC, Canada	Niet in app stores; https://link.springer.com/chapter/10.1007%2F978-3-030-02683-7_53

The ten response networking apps (See table 1) are in various stages of development but their core function is to connect people in need of naloxone with those in possession of the antidote. Except for one, all of these apps are being developed in Northern America. Several of these initiatives first saw the light in federal or state level competitions or code-a-thons. For example, the *Naloxone App Competition*, organized by the FDA in 2016 included 17 entries²⁰.

Six of these apps are presently available in the IOS and Android app stores, either in release or beta versions. Four are not (yet) available in the app stores. Their status is less clear. Some initiatives may no longer exist; others have joined forces. For example, Pwrdbly, a small startup based in Venice, California that won the 2016 FDA competition, joined forces with the Vancouver, Canada based Brave Technology Cooperative and their apps were worked into Brave's *Be Safe* and *Responder* apps that are presently available in both app stores. Scoring well in a competition is however no guarantee for success. The submission that ended as second in the FDA competition, the *NalNow* app, designed by a group of MIT alumni, never made it to the app stores and we have found no updates on the initiative dated after 2016.

“Location positioning technology allows for geo-locating people (using the app) in need of assistance with an overdose and connecting them with trained (peer) volunteers in possession of naloxone in the vicinity in real-time.

a) Core functionality

Location positioning technology allows for geo-locating people (using the app) in need of assistance with an overdose and connecting them with trained (peer) volunteers in possession of naloxone in the vicinity in *real-time*. In case of an overdose in progress, the app will alert nearby volunteers and direct them to the person's location to administer the life-saving antidote. Nearby volunteers will likely arrive before the ambulance and those extra minutes could mean the difference between life and death.

All the naloxone networking apps require registering before they can be used by setting up a user account and password. This allows using the account via multiple (IOS and Android) devices. After activating the app, the menu will generally offer two core options: a consumption function and one to indicate one's availability as a naloxone carrying volunteer. Activating the consumption function generally gives access to an *Overdose Alert* button and will notify the network that you are preparing to use drugs. Active volunteers can monitor the number of app users consuming drugs in their vicinity but do yet not have access to location data or other relevant personal information. Hitting the *Overdose Alert* button will automatically generate a request for assistance with an overdose. Once an overdose alert is raised, the server will automatically forward it to the active volunteers in the vicinity. Only when they respond to the request for assistance, they will be able to access the location data and are provided with map-based directions. Most apps include a short form to report the outcome of the intervention; whether the person was found, whether naloxone was administered and whether was reanimated or not.

Most of these apps also offer immediate access to local emergency medical services (112/911). One connects exclusively to EMS. Some apps will alert both volunteer responders and the EMS by default. For example, sending a request for assistance with an overdose emergency into the *UnityPhilly* app will automatically send a call to 911 to dispatch an ambulance to the location. *NARCAN Now*, discussed above under *Naloxone finders*, also allows for connecting with 911. In other apps, such as *OD Buster*, calling EMS is a user-controlled option, which app users will likely value, given the ongoing risk of arrest when present at an overdose in many jurisdictions.

“An important challenge faced by the developers of these apps is that most overdoses occur when people consume (opioid) drugs alone and in private settings

An important challenge faced by the developers of these apps is that most overdoses occur when people consume (opioid) drugs alone and in private settings. People may slip into an overdose before they can reach for their phone, in particular when fentologues or other synthetic opioids are involved. To counter this problem, a number of apps include an *Injection Buddy* or *Supervised Drug Consumption* mode. While varying in design, these all represent sophisticated *egg timers*; allowing people to set a timeframe in which the system will check in (repeatedly) on them with a simple question: “Are you okay?” In the absence of a response, the server will automatically send a request for assistance into the network. *Brave* actually uses two separate apps; one for remote su-

pervised drug consumption, *Be Safe*, which establishes a live call with a supporter until the caller is no longer at risk of overdose and one for response networking, *Responder*. Below, we discuss further approaches to support people who use alone in preventing overdose. But first we look at some of the other functions built into the networking app.

b) Other app features

Beyond the core function of closing the gap between the acute demand for naloxone and its actual, on the spot availability, these apps (are reportedly planned to) include various other features in support of responding to overdose. As noted, they are in various stages of development and their developers clearly follow different roadmaps in the development of their product.

Live communication tools, such as phone calls, chat and direct messaging (either built-in or using plug-ins into existing platforms) allow for direct communication between volunteers responding to an overdose emergency and those that generated the request for assistance (peers, bystanders).

Networking options are included in several of the apps. App users can develop their own personal response networks of drug using peers, friends, family or caretakers, giving people further control over who will be alerted in case of an overdose. But, when present in the area, they may also connect with larger volunteer initiatives, e.g. run by local harm reduction organizations and health services. Thus, organizations tasked with overdose prevention can use the app to organize and manage peer-based volunteer responses to overdose emergencies in the communities they serve.

Follow up, such as post-event outcome reporting and 'client' feedback and satisfaction forms will help the developers to tailor their applications to the needs of their users. Several apps (will) include area-based linkages to various services for PWUD, such as Take Home Naloxone projects and other harm reduction programmes, drug treatment and health and social services or drug user advocacy organizations. Survey options can generate important data on personal and contextual variables, supplementary to the data that are potentially generated.

News and info sections provide app users with information on overdose prevention and other harm reduction options available in their area. For example, drug user advocacy organizations and drug service organizations alike could use the app to inform PWUD about their services or local events, publish drug testing results or send out 'bad batch alerts' and other relevant news.

“ *The networking options would allow such organizations to build a more permanent, bi-directional flow of communication and exchange with the communities they represent or serve and potentially lead to increased numbers of PWUD involved in local advocacy and increased service uptake.* ”

Importantly, these news sections and the networking options would allow such organizations to build a more permanent, bi-directional flow of communication and exchange with the communities they represent or serve and potentially lead

to increased numbers of PWUD involved in local advocacy and increased service uptake.

Dose Calculators, are planned in future updates of e.g. Noverdose and ODBuster. These tools could help PWUD to better judge the strength of the drugs they are using, potentially leading to less hazardous dosing, in particular when accompanied with information that can help them to assess their drug intake and with geo-tagged drug testing results.

Alternative modes of naloxone delivery are also explored by some of these developers. For example, *Naloxone - Solution Green*, one of the applicants in the FDA competition mentioned previously, proposed using drones stationed in nearby pharmacies or installed in EMS and police vehicles²¹, which could help to decrease the response time in case of an overdose emergency in less densely populated areas in particular.

1.5.3 Smart Panic Buttons

The Brave Collective in Vancouver has developed a stationary internet-enabled smart button, called Brave Button that seem very useful for use in homeless shelters and supportive housing. The buttons are installed in people's private rooms and, when pressed, peers and building staff are alerted that the room occupant is about to use and they can check-in on the individual within a few minutes.

1.5.4 Wearable and contactless devices for monitoring vital signs

The apps discussed above will greatly facilitate networking the demand for and supply of naloxone in overdose emergencies. A number of other

initiatives are working on highly complementary technologies that focus on what comes before, the detection (and prediction) of an overdose through monitoring of motion and biometric changes in vital signs that precede an opioid overdose. These groups are developing or converting wearable devices, such as Fitbit wristbands and smart watches, as well as smartphones themselves to monitor individual respiration and/or blood oxygen levels – crucial measurements in detecting an opioid overdose.

For example, the Brave Cooperative in Canada is working on a wearable device to monitor respiration rate, a key early indicator of opioid overdose, called ODETECT. Researchers at the University of Washington have recently successfully completed a proof-of-concept trial with a phone app, Second Chance, which uses sonar to monitor chest motion and breathing rate and algorithms to detect the precursors of opioid overdose events. Reportedly, the app accurately detects overdose-related symptoms (e.g. opioid-induced central apnea, respiratory depression) in about 90 percent of the time within a meter distance²².

HopeBand, developed by students from Carnegie Mellon University in the US, uses pulse oximetry sensors in a wristband device to monitor blood oxygen level – the most reliable indicator of an overdose. When the device registers low blood oxygen levels, it will use sound and light alerts in attempting to wake up the wearer and send out an alert including their current location. After successful trials, the device will reportedly sell for around \$18/€15²³. Stop Overdose Now is developing a similar wearable pulse oximetry device that will be networked into ODBuster. They are exploring several early warning options, including sensory stimulation innovations currently being developed in the digital porn industry (Cf. a *Trapezius Squeeze*).

1.5.5 Motion sensors

In addition to well-known gadgets, such as GPS and Wi-Fi, most smartphones have built-in technology for tracking motion and position in three-dimensional space, atmospheric pressure, changes in light or specific sounds, such as voice. The technology is used by health and activity tracking apps, such as Google Fit, in home security (Cf. Ring video doorbells) and other domestic applications. These sensors can also turn a phone into e.g. a fall detector, breathing or heart-rate sensor.²⁴ The algorithms behind these apps could equally be programmed to detect the absence of motion and the preceding patterns of motion and behavior that may predict an overdose.

1.5.6 Naloxone auto injectors

Emotional reluctance and stigma associated with drug injecting and needles could present barriers to naloxone administration by bystanders untrained to administer an injection²⁵. These objections are puffed up in the marketing of non-injectable forms of naloxone, such as the Narcan® nasal spray. Likewise, Evzio® is an electronic voice-directed automatic naloxone injector that gives an intramuscular or subcutaneous injection of naloxone by pressing the device to a person's thigh, dressed or not²⁶ ().

These products are less suited for widespread distribution among PWUD. First of all, PWUD would have little problems using injectable naloxone. Importantly, they are very expensive. In the US, the wholesale price of Narcan averages at \$125 for two doses; Evzio costs over \$4,000 for a carton of two doses²⁷. Generic injectable naloxone costs between \$20 and \$40 per dose at a pharmacy²⁸ but US harm reduction programs pay significantly lower prices.

The Evzio kit is made by Kaleo Pharma, and adapted from the company's first product, the Auvi-Q® epinephrine auto-injector²⁹. The kit includes a trainer device that can be used “up 1,000 times” for practice purposes, raising questions about a reusable and cheaper device.

The Four Thieves Vinegar Collective, a “network of tech-fuelled anarchists taking on Big Pharma with DIY medicines”³⁰, has developed an epinephrine auto injector, called EpiPencil, which people can build themselves from off-the-shelf parts, for just over US\$30³¹. Stop Overdose Now is exploring the development of an affordable and reloadable strap-on auto injector that could be networked

with a vital signs monitor and the ODBuster app. Such a combined application could exclude the need for bystanders and be beneficial to people using alone.

1.5.7 Monitoring and research

In addition to the ten overdose response networking apps discussed above, there are five initiatives that concentrate on post event incident reporting and monitoring of overdose only, roughly using the same technologies. Four of these are being developed in the US and one in Europe (See table 2).

Table 2. Post event Incident reporting & monitoring applications

Name	Primary focus	Pricing	Ownership	Links
ODMAP - Overdose Detection Mapping Application Program	Monitoring	Subscription open to US law enforcement and health authorities only	US government	https://nij.gov/publications/Pages/notes-from-the-field-opioid-epi-demic-beeson.aspx
OpiRescue	Monitoring	Free; paid data services	business - OpiSafe	https://opisafe.com/products/opirescue
OWN - Overdose Warning Network	monitoring	Free demo + paid data services	business - Chooper's Guide and The Choopers Foundation	http://overdose-911.com/own/
TONI / TONI Overdose Recording	Monitoring & research	Free	NGO - Texas Overdose Naloxone Initiative/ Austin Harm Reduction Coalition (AHRC)	https://play.google.com/store/apps/details?id=org.overdoseanalytics.toni&hl=en_US ; https://apps.apple.com/us/app/toni-overdose-recording/id1361902244?app=itunes&ign-mpt=uo%3D4
GeOverdose	monitoring	NA	NGO - Italian Drug Addiction Society (SITD)	https://www.geoverdose.it ; http://www.neverdose.it/

“ All of these 15 initiatives could potentially generate important data for overdose prevention projects and policy planning.

However, whether emergency intervention or monitoring and research is their primary focus, when properly programmed, all of these 15 initiatives could potentially generate important data for overdose prevention projects and policy planning. These data are subjected to *spatio-temporal data analysis*, using geographic information systems (GIS), artificial intelligence, machine learn-

“ This will provide service organizations tasked with overdose prevention with a powerful organizational tool that will allow them to focus their energy and resources.

ing, supplementary data sources where available and predictive analytics, to identify geographic areas where overdose is likely to occur on a given day and time. This will provide service organizations tasked with overdose prevention with a powerful organizational tool that will allow them to focus their energy and resources. Geo and time specific forecasts of the risk of overdose will, for example, allow outreach teams to target specific areas or communities at the times their services are most needed. Such research will also provide health policy makers with novel and up-to-date information on trends in overdose emergencies, supporting more efficient, data informed planning of the response to overdose and more efficient and effective spending of public resources. Here we describe these four real-time reporting systems.

a) *The Overdose Detection Mapping Application Program (ODMAP)*

ODMAP is a mapping database developed in 2017 by the Washington/Baltimore High Intensity Drug Trafficking Areas (HIDTA), a federal program administered by the White House Office of National Drug Control Policy and now used by over 900 – government health and law enforcement – agencies in 40 US states. First responders can enter overdose data into ODMAP via any mobile device, such as the date, time, location of the event, the number of doses of naloxone administered and the status of the patient (fatal/non-fatal) at the scene of an overdose. ODMAP also uses application programming interfaces (APIs) to exchange data with law enforcement, EMS and other health services. Authorized criminal justice and public health personnel have access to the ODMAP dashboard, which enables (local to nationwide) analysis of the ODMAP data. Participating agencies can opt to receive “spike alerts” by email that identify potential overdose outbreaks in their county or in nearby and neighbouring counties when a pre-determined threshold of overdoses in an area is exceeded within a 24-hour period. Although ODMAP actively promotes shifting policing philosophies from zero tolerance to harm reduction, HIDTA was established specifically to address drug trafficking. The ODMAP data shared among participating agencies is very detailed. For example, ODMAP provides ‘authorized personnel’ of the exact addresses of calls to 911 for assistance with an overdose and the database can also be used to initiate a criminal investigation. Reportedly, ODMAP data provided law enforcement officials with the information they needed to dismantle a drug-trafficking organization in Maryland.

b) *The Overdose Warning Network (OWN)*

The Overdose Warning Network (OWN), developed by Chooper's Guide and The Choopers Foundation, also allows first responders to enter overdose incident data, which may then be accessed by licensed users and analysed on local, state and national levels. Just as ODMAP, OWN is designed for use by law enforcement, hospital, fire and EMS personnel but also allows individuals carrying naloxone can also use the (Android and iPhone) app.

c) *OpiRescue*

OpiRescue is a very similar app that includes the SAMHSA guidelines for naloxone administration and incident reporting forms that can be completed on location. The free app is intended for use by EMS services, public health departments and other government agencies. The app is complemented with a paid reporting and analytics dashboard, OpiRescue HQ, which provides subscribers with agency and area level reports on overdose and the outcomes of interventions. The platform is developed by OpiSafe, an opioid prescribing and monitoring platform, used by medical care providers in the US.

d) *TONI / TONI Overdose Recording*

Toni (the Android version) or TONI Overdose Recording (the iPhone version) is a similar but more modest tool developed by the Texas Overdose Naloxone Initiative and Overdose Analytics LLC in an effort to collect data on the actual administration of naloxone in the state of Texas. The app lets its users enter data on overdose incidents and naloxone administered and intended for use by PWUD in particular. The data will be used to develop data driven strategies to address the opioid epidemic in the state.

e) *GeOverdose*

GeOverdose, developed by the "Riduzione del Danno" Interest Group of the Italian Drug Addiction Society, is an automated search engine for identifying overdose deaths from online, national and local newspapers. The machine-read data is checked by humans and subsequently reported online in near real-time on a map of Italy with links to the sources. When compared to official overdose mortality statistics, the system seems to underestimate the total number of overdoses, which, given that not all overdoses are reported by the media, is not unexpected. Nonetheless, GeOverdose provides up-to-date and location specific information on the trend in overdose deaths in Italy and, where available, further information on their circumstances that could inform prevention, whereas official statistics are only published once a year. The GeOverdose website mentions the development of an overdose response networking app for PWUD, Never Dose, but the app is not yet online and no updates have been published on this initiative since at least a year.

1.6 Responding to the emerging influx of fentalogues and other NPS into traditional opiate markets

Since 2013, the overdose epidemic in North America has shifted gears with the rapid diffusion of fentalogues (fentanyl and analogues) in traditional heroin markets. These powerful synthetic opioids are not only found in heroin samples but also in cocaine and methamphetamine samples and changing the epidemiology of overdose. For example, in Canada, 80% of overdose deaths is now attributed to fentalogues. In a recent study in Vancouver, 91% of 906 samples submitted as heroin contained fentanyl. Europe may be facing the onset of a similar shift in the availability of opi-

“ *These powerful synthetic opioids are not only found in heroin samples but also in cocaine and methamphetamine samples and changing the epidemiology of overdose.* ”

oids. Between 2009 and 2016, 25 new opioids were detected in 10 EU countries; nine of those were reported first in 2016. Among these were 18 fentalogues and eight were reported for the first time in 2016. Fentalogues are reported in various European countries, including Finland, Sweden, the UK and Estonia, where fentalogues have reportedly completely replaced heroin in the local drug markets. Fentalogues were reportedly introduced into the heroin supply in the north of England in 2017 and associated with the increasing overdose rates in various parts of the UK. In the fall of 2018, mobile phone dealers in Bucharest, Romania sold the opioid next to heroin and several other drugs.

Drug testing may help PWUD to better assess the drugs they are taking. At present, most drug testing is likely conducted in drug treatment programs to determine abstinence and in drug checking programmes, which mostly work with recreational consumers, e.g. at festivals. These programmes

“ *Most regular opioid consumers are unlikely to bring part of their drugs to a testing site or send these to an online testing service (at significant cost) and wait a week for the results.* ”

test relatively few opioid drugs and attract few people who use opioids. Most regular opioid con-

sumers are unlikely to bring part of their drugs to a testing site or send these to an online testing service (at significant cost) and wait a week for the results.

A number of harm reduction programs in the US and Canada have recently started offering drug testing, using sophisticated devices, such as a Fourier transform infrared spectrometer (FTIR), which gives accurate results within minutes, including on the proportion of fentanyl and other potential contaminants in a sample.

Recently naloxone activists in the US significantly lowered this threshold by distributing FTS on the street along with naloxone. Originally designed for use in drug treatment, forensic or workplace settings, fentanyl urine test strips have reportedly 98%

“ *The introduction of sophisticated drug testing technology could potentially support harm reduction programs in tailoring their work to local drug market dynamics and provide reliable and insightful data on the diffusion of fentalogues and other synthetic drugs.* ”

accuracy when used for testing drugs before they go into the body. Peer activists have found the strips an important tool to start a conversation on overdose and harm reduction strategies with both PWUD and drug dealers. Use of FTS by people who inject drugs and receiving a positive test result was recently associated with changes in drug use behavior and perceptions of overdose safety (Peiper et al., 2019) the number of overdose deaths involving illicitly-manufactured fentanyl (IMF). They

are increasingly distributed by take home naloxone programs along with the antidote and can be ordered at moderate cost online. The Bunk Police sells drug testing kits online, including fentanyl test strips and ships these to more than 100 countries.

The introduction of sophisticated drug testing technology could potentially support harm reduction programs in tailoring their work to local drug market dynamics and provide reliable and insightful data on the diffusion of fentalogues and other synthetic drugs. However, these devices are expensive and so is their use and maintenance. They require a trained operator and can only be used in a sheltered – stationary or mobile – space, while their use is limited to staff working hours. Furthermore, PWUD must visit a harm reduction facility and relinquish some of their drugs or a used syringe. To do so for each new bag of drugs acquired seems rather cumbersome. Likewise, stigma and fear of arrest may keep people from visiting these services.

The distribution of fentanyl testing strips (along with naloxone) through (peer) THN programs is a low-tech, low cost (US THN programs source the strips at US\$0.50) approach that empowers people who use drugs with potentially life-saving information about the content of their cooker 'du moment' and 'on-the-spot', and can potentially reach a much wider part of the PWUD community. However, fentanyl testing strips only give a qualitative indication of the presence of fentalogues in a drug sample. Likewise, the collection of reliable data on their use and test results to steer interventions and inform policy, once the strips are distributed, is presently limited.

Thus, both drug testing approaches could benefit overdose prevention, but they come with different drawbacks and represent rather different philoso-

phies and interests. Where new drug testing technology provides better data for policy makers, widespread distribution of FTS will likely reach and

“Where new drug testing technology provides better data for policy makers, widespread distribution of FTS will likely reach and directly benefit many more PWUD at risk of fentanyl tainted drugs.”

directly benefit many more PWUD at risk of fentanyl tainted drugs. Yet, even the impact of peer strategies is limited by conventional network and other factors, such as the network size of peers or their status.

1.6.1 FenChecker

Stop Overdose Now (SON), the producer of *OD-Buster*, is developing a new approach to drug testing, suited to the needs of both people who take opioid drugs and people who make drug policy. The approach combines the strengths of peer strategies with sophisticated drug testing technologies and uses simple and existing internet technology to overcome the shortcomings of both.

FenChecker presents a novel, fast and easy to implement community-based 'cascade approach' to checking street drugs for fentanyl, its analogues and, potentially, other high risk (new) psychoactive substances, tailored to resource-limited environments. The mobile platform makes intelligent use of current drug testing technologies and mobile phone technology and combines the test results with spatiotemporal, contextual and experiential data into in a common framework for re-

al-time epidemiological monitoring and response, aimed at early detection and reporting of fentanyl, its analogs and, eventually, other high risk NPS.

FenChecker uses a simple and user-friendly app for collecting data from fentanyl urine test strips used in, and reporting the outcomes back into, the PWUD community. App users can check whether fentanyl has been reported in their environment on color-coded 'heatmaps.' They can also upload the results of test strips used, sample descriptions, pictures and 'consumer reports' on fentanyl tainted drugs. Positive test strips returned to the point of distribution will be tested for a range of fentanyl analogs in a certified laboratory. This results in a three-stage cascade:

Broad deployment of fentanyl urine test strips in the PWUD community via drug consumption rooms (DCRs), Take Home Naloxone (THN) programs and peer projects as the first line of defense (and gate-keeper to more expensive testing);

Input of test strip data, visual data and experiential data by local PWUD and DCR/THN staff or outreach workers. After buying drugs, app users can drop a pin on a map, opening a reporting form for describing the acquired sample. When preparing the acquired drugs for consumption, people can use the test strips to check the drug solution for the presence of fentanyl and upload a picture of the test result, *whether positive or not*. They can furthermore upload photographs of the substance and the packaging and add comments to their report. Uploaded test strip results will be displayed in the app on heatmaps that are adjusted in real-time as new test results come in. App users can furthermore compare their sample with photos of drugs uploaded in the vicinity.

Follow-up laboratory testing for various fentalogues. When a test appears positive, people will be encouraged to return it to the program when securing a new supply.

The collected test strips will be transported to a certified drug testing laboratory. At the laboratory these will be tested for the presence of 'a variety of fentanyl analogs, using in gas chromatography and tandem mass spectrometry. Both program

“*Drug testing strips are designed to detect trace amounts of metabolized drugs after excretion by the body. Due to their high sensitivity to low drug concentrations in urine and cross-reactivity, fentanyl assays are not only able to detect fentanyl but also its analogues, even more so before these have passed the body.*”

and laboratory staff can use the app to log-in samples, enter and check for test results. Once entered into the FenChecker database, the laboratory results will result in adjustments in the colorimetric heatmaps in the app and linked to certified information on actual drug content, tailored harm reduction advice and links to more information on the substances detected. Real-time push messages will be alerting people in a local area immediately when high risk adulterations are detected. The FenChecker database will provide researchers and health planners with powerful new information that will help to organize an effective response to overdose, using fewer public resources.

The FenChecker app aims to support PWUD in taking an active role in the prevention of overdose in their own community by sharing their experiences and test results with the FenChecker community. Reportedly, the app will furthermore include location-based information about local overdose prevention and other harm reduction programs and allow PWUD to connect with these services. Based on local needs and the availability of test strips, the FenChecker drug checking cascade can be easily adapted to other substances and newly emerging drug testing technologies.

1.7. Increasing access to safe drugs

Where the US is still hesitant to implement e.g. drug consumption rooms, Canada is taking a number of unorthodox measures to combat the country's overdose epidemic. Two of these aim to intervene in the illegal drug market, not by law enforcement but by trying to regulate these markets, offering access to hydromorphone or pharmaceutical heroin to people at high risk for overdose.

1.7.1 Opioid Dispensing Machines

A pilot programme is planned to begin in mid-2019 in Vancouver, Canada, in which vending machines will be used to dispense prescribed Dilaudid (hydromorphone) tablets to 50 people at high risk of opioid overdose³². The project is developed by Dr. Mark Tyndall, the then head of the British Columbia Centre for Disease Control in Canada and funded by Health Canada. The intent is to alleviate the participants' need to seek illicit opioids on the street and decrease their exposure to fentanyl analogues – the cause of most opioid-related overdose deaths³³.

Only individuals most at risk of opioid-related harms will be included in the pilot. Participation requires a doctor's prescription for the opioid tablets and creating a profile that determines the quantity and frequency of tablets to be dispensed, and includes frequent urine tests to assess whether the prescribed drug is actually used. Each vending machine weighs around 750 pounds and has a 24-inch shatter-proof video screen that can provide public health alerts or display information. A biometric scanner that reads the pattern of the veins – unique to every individual – is used to confirm people's identity. All biometric and personal data will reportedly be fully encrypted, and the vending machines will be equipped with alarms and cameras to monitor the supply of the prescription opioids.

The pilot evaluation team will include peers from the Vancouver drug using community. When positively evaluated, the researchers think the approach could be scaled-easily as it does not re-

“When positively evaluated, the researchers think the approach could be scaled-easily as it does not require significant investments in human resources.

quire significant investments in human resources. However, taking such a project beyond its pilot status is likely to meet many legislative and regulatory challenges. Not unexpectedly, critics argue that giving drugs to people will perpetuate drug use rather than reducing it. However, there seems to be a growing consensus in the country on the ethical imperative to take unorthodox action³⁴.

1.7.2 Heroin compassion clubs

Indeed, a recent study conducted by the British Columbia Centre on Substance Use and funded by the Canadian Institutes of Health Research proposed an even bolder step, investigating the feasibility of 'heroin compassion clubs'. When funded, the authors will conduct a pilot evaluation of a cooperative approach, inspired by cannabis compassion clubs and, as the authors argue, similar to grocery purchasing coops, through which legally obtained pharmaceutical heroin could be purchased by members only. They suggest that such purchasing cooperatives could be established virtually without public funding, undermine the illegal drug market and potentially reduce fentanyl-related overdoses and (ultimately) decrease opioid addiction³⁵.

The off-label use of diacetylmorphine is likely to meet even larger regulatory hurdles than the above initiative, but the authors suggest that, "in light of the national devastation of the overdose crisis", a more liberal interpretation of Canada's Drugs for Urgent Public Health Need mechanism (UPHN) (Cf. the WHO List of Essential Drugs) could accommodate the initiative.

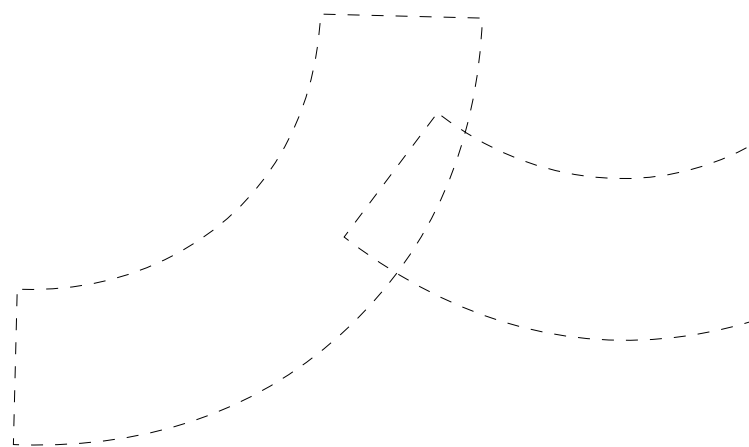
1.8 Costing and Ownership

Most of the apps discussed in this chapter are free to download and use. However, there is no such thing as a free app. The development, maintenance and ongoing innovation of such platforms require serious investments and these need to be earned back, by funding, paid services to interested parties, advertising or other means.

The 'earnings model' of the networking apps is in the data, which will indeed be extremely valuable

to both service providers and policy makers tasked with overdose prevention. Some of the apps are offering supportive data services to organizations tasked with overdose prevention, while others are reportedly planning to do so. Paid subscription plans ("Silver, Gold & Platinum") will offer various levels of access to a monitoring, analysis and reporting dashboard for real time monitoring of overdose and response planning.

We have found three types of ownership among the developers of the applications discussed in this chapter: (i) initiatives from activists, harm reduction groups or other non-profits, such as the Brave Cooperative, GeOverdose and Stop Overdose Now; (ii) initiatives initiated by academic researchers, e.g. UnityPhilly, or government entities, like OPMAP; and, (iii) business initiatives, for example NOverse or ODSave and the Overdose Warning Network (OWN) (see table 1, 2). Some initiatives fit more than one category and their legal status might be subject to change once they proceed, as noted in several cases.



2. Discussion

Taking Harm Reduction into the 21st Century

The increasing use of new technologies in the response to opioid overdose holds an important promise to all stakeholders involved in fighting this human tragedy. Moreover, it offers a window on the future of harm reduction services provision.

Apps that provide information on overdose and instructions for applying naloxone, naloxone locators and dose calculators could prove useful tools for people who use drugs. Most of these resources are developed in the US but these could easily be developed in Europe as well. Maintaining such resources and securing the accuracy of the information published does however require more serious investments – a feature that applies to all of the applications discussed in this report, it should be noted.

Availability of and access to naloxone is vital to saving lives. NEXT Distro in New York and Harm Reduction 2.0 in Kiev have ingeniously merged tested offline service delivery methods and novel technologies in a new service model for bringing naloxone and other harm reduction supplies to people most at risk of overdose who might not have access to regular sources. Their work is especially important as it demonstrates new approaches to harm reduction services delivery.

In particular the overdose response networking apps can potentially revolutionize the response to overdose and transform harm reduction for good – bringing it into the 21st Century. From Norman Zinberg's perspective, naloxone is the perfect (anti)

drug, trained volunteers are set to respond, but we have little control over the *setting* of overdose emergencies. And that is what these apps will exactly do; they will give people who use drugs and front-line harm reduction staff increased levels of control over the micro risk environment of overdose.

Practically, these apps can significantly increase the response *rates* after an opioid overdose, reduce the response *time* and increase the likelihood of finding an OD victim, maximizing the efficacy of every volunteer trained and the yield of every unit of naloxone distributed. They would allow harm reduction organizations tasked with overdose prevention to develop novel, real-time data driven methods for targeting areas at high risk of overdose at the times these services are most needed.

The current approach to drug testing – testing at drug services and festivals or online programs – is unlikely to attract people who use opiates regularly. Likewise, the introduction of high-tech mobile drug testing equipment into harm reduction programs come with a number of downsides (Willyard, 2019), making these devices out of reach of less well-endowed harm reduction programs. The low-tech and low-cost distribution of fentanyl testing strips into PWUD communities has been associated with more careful drug injecting behaviours³⁶ and is likely a more feasible approach for most harm reduction programs and, importantly, would allow PWUD to use them where and when most needed.

Whereas distribution of fentanyl test strips will empower PWUD to better assess the drugs they put in their body, the potential reach of the information these test generate is likely limited by traditional network boundaries and primarily shared within

the individual network of the person who did the testing. The *FenChecker* app can potentially multiply the reach of this lifesaving information exponentially by enabling PWUD to share their test results, sample descriptions, photos and trip reports and consult this collective knowledge base when and where they want. This offers them opportunities to both protect their lives and engage in their community in novel ways.

Indeed, rather than being *passive recipients* of information, services and policies, the overdose response networking apps and the *FenChecker* app empower PWUD to become *active brokers* of information and life-saving resources³⁷ – a vital ingredient in developing an effective community-based response to collectively experienced threats¹¹⁶, as is overdose. When properly implemented and maintained, these applications may well become important tools for personal and community empowerment. These apps equally open up new ways to harm reduction organizations and networks of people who use drugs for reaching out to the communities they serve or represent and maintaining contact with their clients or constituency on a more permanent base.

The overdose response networking apps and the *FenChecker* app, as well as the applications designed for monitoring and research, such as the US ODMAP, will produce a wealth of novel and important (big) data. When properly analyzed, this will contribute to a more comprehensive understanding of overdose in support of evidence-based policies. Importantly, these applications also generate important program evaluation data.

Opioid Dispensing Machines are scheduled to be implemented in Canada in the fall of this year. Once perhaps a *dopey phantasy*, their implementation is now funded by Health Canada. Like-

wise, heroin compassion clubs that would offer access to safe drugs to a larger group of consumers seem no longer an anathema in the country's mainstream policy discourse. Interestingly, at the height of the Dutch heroin epidemic in the 1980s, the authorities in the affected cities have tolerated indoor consumer level dealing for years, which made an important contribution to containing the spread of HIV that surfaced in the same period³⁸.

Designed as a practical response to a public health crisis, these two initiatives lay bare the root causes of the overdose epidemic – the polluted drug market; prohibition; the drug war. They also provide models towards further decriminalization and more effective regulation of drug markets. Indeed, technology does not replace the struggle to end the drug war and to put *people first* and human rights in the center of drug policy.

Challenges

Mobile phone ownership may vary among people who use drugs, in particular when homeless or living in unstable housing. When entrenched in street life, phones may be easily lost, stolen or bartered. However, mobile phones have become indispensable in consumer level drug dealing³⁹. Importantly, drugs are commonly used collectively and, both for ordering drugs or raising an overdose alert, not everybody present needs to be in possession of a mobile phone – one will suffice. The example of Harm Reduction 2.0 in Kiev furthermore suggests that people who use drugs and those who sell these are among the early adopters of these new technologies.

The limits of current location technology are an important challenge to the overdose response networking apps in particular. Current phone track-

ing, GPS and Wi-Fi technology theoretically allow for locating a mobile phone within several meters, in particular in modern smart phones in which these technologies are combined. However, in practice they may be off target up to 50 meters or more, depending on several factors, including the proximity of phone antenna towers, building density or the number of cell phones in the area. In indoor environment, such as high-rise apartment buildings or traditional buildings with thick walls, these may only be able to provide the approximate location of an overdose emergency.

To address this limitation, some of the apps, such as ODBuster, allow for entering additional address and access information of e.g. a home location and places frequently 'visited'. Furthermore, several technologies are being developed to improve locating mobile phones. Since 2016, all Android phones and, since 2018, all iPhones are enabled with Advanced Mobile Location (AML). AML is not an app but an AML-enabled smartphone recognises when emergency numbers are dialled and automatically activates the phone to send the phone's location to the emergency services by SMS (<https://eena.org/aml/>). Over half of the EU member states have implemented AML⁴⁰.

Likewise, companies, such as Purple⁴¹ and ZoneArts⁴² are using sophisticated location analytics and proximity software, geo-fencing technology or follow-spot technology in developing new Wi-Fi positioning systems that allow the identification of the exact location of a mobile phone to within a few centimetres. These technologies are already being used in Guest Wi-Fi systems in supermarkets and shopping malls. However, the software's algorithms used could equally be programmed to detect an individual experiencing an overdose. Note that the *FenChecker* app is less sensitive to this problem as this will reportedly only use trun-

cated GPS coordinates and the data generated will be 'fuzzed' to area/population sizes that will both protect the privacy of app users and allow for monitoring and research.

Safety, privacy & data security measures are indeed crucial to safeguarding the welfare of app users, with the overdose response networking apps in particular – both online and offline – protecting app users not only from law enforcement or hackers but also from potential malicious behavior by other app users. Importantly, these applications will all have to comply with privacy and data security regulations, such as the European Union's General Data Protection Regulation (GDPR) and its proposed privacy Code of Conduct for mHealth apps or Canada's Personal Information Protection and Electronic Documents Act (PIPEDA). Registration and location data should be stored separately in encrypted databases and only be released in sufficiently fuzzed formats. Technical and organizational measures should be implemented to ensure data confidentiality, integrity and availability and against data destruction, loss, unlawful access, processing, disclosure and other abuse.

An in-depth review of safety, privacy & data security measures or of ethical considerations is beyond the scope of this report but certainly opportune. For example, the 2016 FDA Naloxone App Competition did not mention privacy and data security considerations among the criteria for submission. More concerning, the ODMAP system shares detailed location and other data from overdose emergencies among the participating law enforcement and health agencies. Commercial entities could be tempted to sell their data.

Fortunately, several of the apps include features aimed at limiting abuse of the software. In addition to the creating personal (limited access) net-

works, these include use of local moderators, e.g. at THN programmes, that could use a basic dashboard to monitor e.g. the number of volunteers in the area; live communication; automated follow up feedback options after sending or responding to an alert; and, options to report malicious behavior of other app users.

Mapping the **Legal and regulatory challenges** these Initiatives may face will equally require a separate study. Such a study should chart, among other things, how these applications relate to government digital (freedom) policies and “aiding & abetting” laws.

Uptake and acceptance will be equally important to the success of these apps. The likelihood of reaching a person overdosing in time increases with the number of potential responders in the area. Likewise, the data generated and the ability of algorithms to generate forecasts of the risk of overdose will increase in strength and accuracy as more people who use opioids start using the platform. Buy-in from the PWUD community will be a prerequisite for the networking apps in particular. Thus, working closely with PWUD communities and harm reduction programs will be important in establishing trust and transparency and building a critical mass of early adopters and bringing the number of app users to scale. Conversely, the harm reduction community should actively engage in the development and implementation of these lifesaving initiatives.

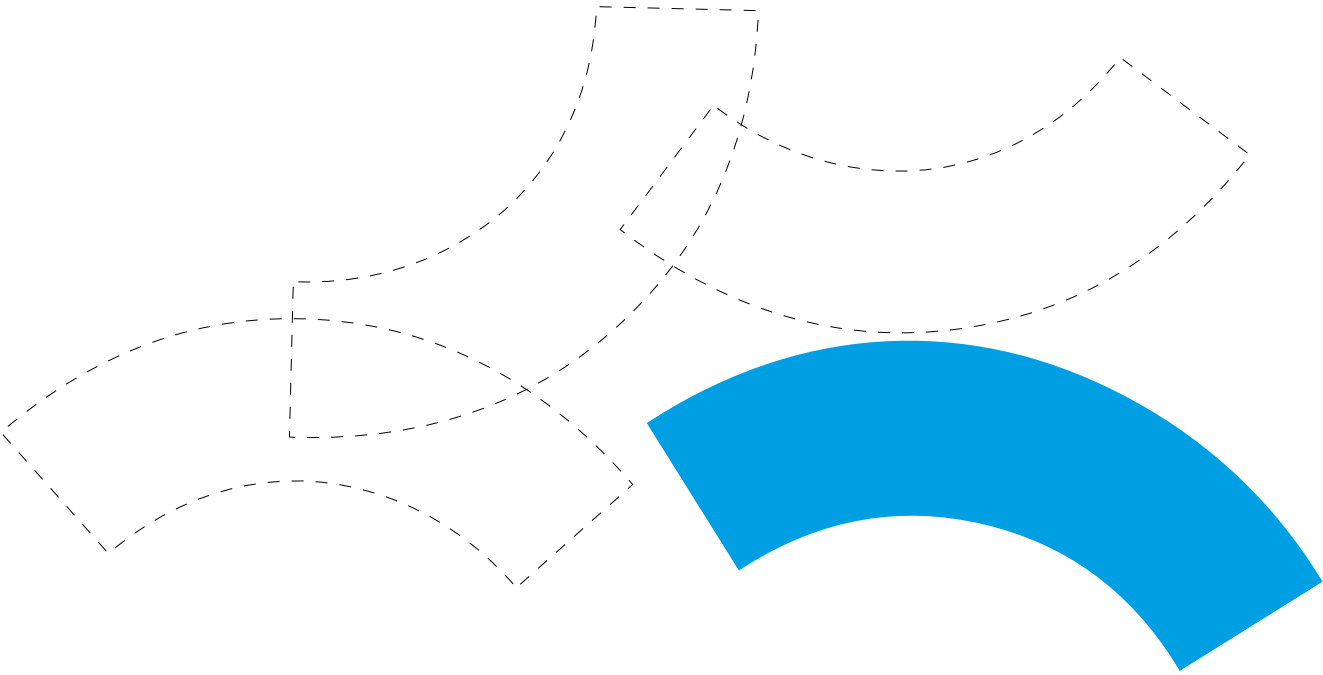
Another factor of importance is the **geographic coverage** of these initiatives. Some apps only seem to work with North American phone numbers, e.g. Be Safe. Implementation across larger numbers of sites in (geographically, culturally) varied localities will result in more powerful data and accelerated learning among the participating

agencies. Furthermore, people travel. Beyond the travel restrictions that people in medication assisted treatment may particularly experience, being cut off from your usual resources and network brings poses a significant challenge to any person using opioids on a regular basis. Buying unknown drugs from an unknown dealer in an unknown town may put people at increased risk of overdose. The challenge for these apps is thus to facilitate local responses to overdose, whether people are in their homestead or traveling elsewhere.

Funding. The development of technology in support of the response to overdose is stimulated in the US through several federal and state/province funding mechanisms, such as the FDA 2016 Naloxone App Competition or Impact Canada's Drug Testing Technology Challenge. Although opioid is gaining increasing concern, similar calls have not been published yet in the EU. Detailed funding information on the initiatives described in this chapter is not available. However, in our impression, in particular many of the non-profit initiatives are being developed on a shoestring budget, raised from donations, crowd funding and small pharma grants, and many volunteer hours.

Sufficient funding is however crucial to the success of these initiatives, not only for their development but also to their maintenance and scaling up, including the development of training materials for peers and frontline staff and research capacity to turn data into proper support.

Finally, these applications should be rigorous evaluated for their utility to the response to the opioid epidemic. Such evaluations should include representatives of the PWUD community to address barriers to their implementation and ensure their relevance to those they intend to serve.



3. Recommendations

As people who use opioid drugs are both those most at risk of overdose and the most important actors in preventing overdose, all stakeholders in overdose prevention should work collectively towards a coordinated community based and peer driven response to this public health treat.

- European Union and national legislative and regulatory authorities should ensure that naloxone becomes readily available to those most at risk of overdose at low cost. Likewise, abolishing legal barriers against lay application of naloxone and the implementation of (EU model) Good Samaritan Laws should be prioritized.
- Overdose prevention and harm reduction programs, as well as organizations of people who use drugs should actively participate in the development of harm reduction technology. This includes the development of materials and trainings in support of its implementation, but also organizing and securing a sustained community based response, making full use of the available technology. Ultimately, this will involve a critical re-evaluation of current MOs and staff roles in harm reduction service delivery and community organizing.
- The EU, member states and other funding bodies should actively support the development of tech-fuelled community based responses to overdose and invest in the technology in particular, e.g. through dedicated funding calls or competitions.

Stakeholders at every level are recommended to act without hesitation on the above to avoid repeating the experience in North America.

Recommendations apply for both parts of our Overdose Prevention Report: Part One 'Overdose Prevention - Challenges and Solutions' and Part Two 'New technology-based Solutions' both accessible at:
www.correlation-net.org/publications

References

1. Dallery J, Raiff BR, Grabinski MJ. Internet-based contingency management to promote smoking cessation: A randomized controlled study. *Journal of Applied Behavior Analysis*, 46(4), 750–764, Winter 2013. <https://doi.org/10.1002/jaba.89>
2. Alessi SM, Petry NM. A randomized study of cellphone technology to reinforce alcohol abstinence in the natural environment. *Addiction*, 108(5), 900–909, May 2013. <https://doi.org/10.1111/add.12093>
3. Koffarnus MN, Bickel WK, Kablinger AS. Remote Alcohol Monitoring to Facilitate Incentive-Based Treatment for Alcohol Use Disorder: A Randomized Trial. *Alcoholism: Clinical and Experimental Research*, 42(12), 2423–2431, December 2018. <https://doi.org/10.1111/acer.13891>
4. Barnett NP, Celio MA, Tidey JW, Murphy JG, Colby SM, Swift RM. A preliminary randomized controlled trial of contingency management for alcohol use reduction using a transdermal alcohol sensor. *Addiction*, 112(6), 1025–1035, June 2017. <https://doi.org/10.1111/add.13767>
5. Leffingwell TR, Cooney NJ, Murphy JG, Luczak S, Rosen G, Dougherty DM, Barnett NP. Continuous Objective Monitoring of Alcohol Use: Twenty-First Century Measurement Using Transdermal Sensors. *Alcoholism: Clinical and Experimental Research*, 37(1), 16–22, January 2013. <https://doi.org/10.1111/j.1530-0277.2012.01869.x>
6. <http://www.bluelight.org/>
7. <http://www.erowid.org/>
8. <http://www.psychonautwiki.org/>
9. Grund J-P C, Vavrincikova L, Janikova B, Fidesova H, Miovsy M. The emperor's new clothes?: Findings from the NPSineurope.eu rapid assessment and response study of consumption of new psychoactive substances among people who use drugs heavily in five EU member states. *Adiktologie*, 16(2), April 2016.
10. Janikova B, Fidesova H, Vavrincikova L, Miovsy M, Grund J-P C. New Psychoactive Substances among People Who Use Drugs Heavily in Europe: Novel Drugs, Vintage Problems & Responses. *Adiktologie*, 2016.
11. Mounteney J, Bo A, Oteo A. 'The internet and drug markets: shining a light on these complex and dynamic systems'. The internet and drug markets. European Monitoring Centre for Drugs and Drug Addiction: Insights 21. Luxembourg; Publications Office of the European Union, 2016. http://www.emcdda.europa.eu/system/files/publications/2155/TDXD16001ENN_FINAL.pdf
12. <http://www.wedinos.org/>
13. <https://energycontrol-international.org/>
14. <https://www.gsma.com/r/mobileeconomy/europe/>
15. Eurostat. *Internet Use by Individuals - Different Patterns across Member States in Managing Personal Information.*; 2016. <https://ec.europa.eu/eurostat/documents/2995521/7771139/9-20122016-BP-EN.pdf/f023d81a-dce2-4959-93e3-8cc7082b6edd>. Accessed December 19, 2018.
16. Barendregt C, van der Poel A, van de Mheen D. The Rise of the Mobile Phone in the Hard Drug Scene of Rotterdam. *Journal of Psychoactive Drugs*, 38(1), 77–87, 2006. <https://doi.org/10.1080/02791072.2006.10399830>
17. Mell HK, Mumma SN, Hiestand B, Carr BG, Holland T, Stopyra J. Emergency Medical Services Response Times in Rural, Suburban, and Urban Areas. *JAMA Surgery*, 152(10), 983–984, October 2017. doi:10.1001/jama-surg.2017.2230
18. <https://www.nfpa.org/codes-and-standards/all-codes-and-standards/list-of-codes-and-standards/detail?code=1710>

19. ANAIDS/IPU. (2007). Taking Action against HIV, Handbook for Parliamentarians N° 15. (http://data.unaids.org/pub/manual/2007/20071128_ipu_handbook_en.pdf)
20. <https://www.fda.gov/NewsEvents/PublicHealthFocus/ucm520943.htm>
21. <https://www.youtube.com/watch?v=vrpZLld-i8c&feature=youtu.be>
22. Nandakumar R, Gollakota S, Sunshine JE. Opioid overdose detection using smartphones. *Science Translational Medicine*, 11(474), eaau8914, 9 January 2019. <https://doi.org/10.1126/scitransmed.aau8914>
23. <https://spectrum.ieee.org/the-human-os/biomedical/devices/wristband-for-detecting-opioid-overdose-joins-national-race-for-tech-solutions>
24. Sim, I. (2019). Mobile Devices and Health. *New England Journal of Medicine*, 381(10), 956–968. doi:10.1056/nejm-ra1806949
25. Dwyer R, Fraser S, Dietze P. Benefits and barriers to expanding the availability of take-home naloxone in Australia: A qualitative interview study with service providers. *Drugs: Education, Prevention and Policy*, 23(5), 388–396, 2016. <https://doi.org/10.3109/09687637.2016.1150964>
26. <https://www.evzio.com>
27. <https://eu.usatoday.com/story/news/health/2018/11/19/kaleo-opioid-overdose-antidote-nalox-one-evzio-rob-portman-medicare-medicaid/2060033002/>
28. <https://time.com/5229870/naloxone-surgeon-general-cost-where-buy/>
29. <https://www.auvi-q.com/>
30. https://www.vice.com/en_us/article/43pngb/how-to-make-your-own-medicine-four-thieves-vinegar-collective?utm_source=reddit.com
31. <https://fourthievesvinegar.org/blog/2016/09/introducing-the-epipencil>
32. Lapowsky I. One Doctor's Answer to Drug Deaths: Opioid Vending Machines. *WIRED*, 17 April 2019. <https://www.wired.com/story/one-doctors-answer-to-drug-deaths-opioid-vending-machines/>. Accessed 22 May 2019.
33. The opioid death crisis in Canada: crucial lessons for public health. *Lancet Public Health*, Vol. 4, Issue 2, PE81–E82, February 1, 2019. DOI: [http://dx.doi.org/10.1016/S2468-2667\(18\)30232-9](http://dx.doi.org/10.1016/S2468-2667(18)30232-9). Accessed 22 May 2019.
34. <https://globalnews.ca/news/5891451/vancouver-opioid-vending-machine/>
35. Thomson E, et al. *Heroin Compassion Clubs. A cooperative model to reduce opioid overdose deaths & disrupt organized crime's role in fentanyl, money laundering & housing unaffordability*. Vancouver, Canada; British Columbia Centre on Substance Use, February 2019. <http://www.bccsu.ca/wp-content/uploads/2019/02/Report-Heroin-Compassion-Clubs.pdf>
36. Tupper KW, et al, Op.cit.
37. Broadhead RS, Heckathorn DD, Grund J-P C, Stern LS, Anthony DL. Drug Users versus Outreach Workers in Combating Aids: Preliminary Results of a Peer-Driven Intervention. *Journal of Drug Issues*, 25(3), 531–564, July 1, 1995. <https://doi.org/10.1177/002204269502500303>
38. Grund J-P, Breeksema J. *Drug Policy in The Netherlands*. In R. Colson & H. Bergeron (Eds.), *European drug policies: the ways of reform*. Abingdon, Oxon, England; Routledge, 25 July 2018, pp. 128–148. <https://www.routledge.com/European-Drug-Policies-The-Ways-of-Reform/Colson-Bergeron/p/book/9781138915206>
39. Barendregt C, et al, Ibid.
40. https://eena.org/wp-content/uploads/2019/07/2019_07_17_AML_Report_Card_Update.pdf
41. <https://purple.ai/>
42. <http://zoneartnetworks.com/>

