DOI: 10.1111/1745-9133.12652

CRIMINOLOGY & Public Policy

SPECIAL ISSUE ARTICLE

CYBERCRIME AND CYBERSECURITY

An examination of harm reduction strategies in Oxycodone and Adderall buyer feedback on AlphaBay

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Funding information
National Institute of Justice, Grant/Award Number: 2019-R2-CX-0018

Abstract

Research summary: Darknet marketplaces (DNMs) are global digital marketplaces used primarily to buy and sell illicit drugs online. High rates of adulterated substances have contributed to the creation of harm reduction policies by DNM administrators to address growing rates of overdose worldwide. This paper explores the extent to which harm reduction occurs in buyer feedback of Adderall and Oxycodone purchased on AlphaBay and how these comments are impacted by AlphaBay's administrator-led "harm reduction" policy. This study finds that harm reduction strategies are present in buyer feedback of Oxycodone and Adderall pills, but AlphaBay's policy has very little impact on the preexisting harm reduction communication within buyer feedback.

Policy implications: International policy proposals have placed emphasis on addressing the overdose crisis through harm reduction programs that provide people who use drugs with the necessary services and resources to buy and use drugs safely. There have been very few proposals that have considered how these programs can address the unique setting of buying and using drugs purchased on DNMs. Communication occurring among DNM buyers reveals how harm reduction strategies are being employed by users purchasing drugs from DNMs.

In particular, these findings offer insight into the shared experiences of drug buyers in anonymous settings and the strategies they are using to protect one another from overdose and other unwanted side effects often caused by adulterated substances. Understanding these strategies highlights the ways in which street-based harm reduction programs can extend their services to online environments to assist buyers with making safe and informed decisions when using substances purchased online.

KEYWORDS
Adderall, darknet, drug policy, harm reduction, oxycodone

1 | INTRODUCTION

A darknet marketplace (DNM) is a marketplace that allows for the private sale and purchase of products by "host[ing] multiple sellers or 'vendors', provid[ing] participants with anonymity via its location on the hidden web and use of cryptocurrencies for payment, and aggregates and displays customer feedback ratings and comments" (Barratt & Aldridge, 2016, p. 1). Although DNMs provide a wide variety of products, drugs are the majority of listings (Broadhurst & Ball, 2020; Cunliffe et al., 2017; Maras et al., 2023; Stringham et al., 2023). Synthetic opioids, such as hydrocodone and fentanyl, have grown substantially in both street-based and online markets due to their demand, affordability, and potency (Miller, 2020). The increased accessibility to these stronger, more affordable substances has led to a steady increase in drug dependency and overdoses around the world, most concentrated in the United States (Okie, 2010). As of 2019, the global standardized rate of opioid dependency is 510 people per 100,000 with the highest rates of opioid dependence in the United States nearly triple this, at 1,347 per 100,000 people (Degenhardt et al., 2019). These high rates of opioid dependency are reflected in increases of overdose, which have continued to grow since the COVID-19 pandemic (Spencer et al., 2022). In 2021, over 106,000 individuals died from drug-related overdoses in the United States, a significant increase since the estimated 75,000 drug-related overdoses in 2019 (Ahmad et al., 2023; Spencer et al., 2022). Research suggests that 66% of overdoses in the United States are attributed to synthetic opioids (Spenceret al., 2022). Consequently, policy makers are scrambling to address the growing presence of synthetic opioids in the drug market.

Initiatives to police drug markets have shown to be challenging and have led to over-criminalization and unintended health consequences for people who use drugs (PWUD) (Baker et al., 2020; Zhang et al., 2022). Other policy strategies have sought to reduce demand for drugs through increasing funding to treatment programs like opioid agonist treatment (OAT), which provide PWUD with alternative substances like methadone to lessen withdrawal symptoms and cravings (Nielsen et al., 2016). Despite the supporting evidence for these types of initiatives (Santo et al., 2021), there are many barriers to effectively implementing OAT programs, which has complicated the rollout of these programs (National Academies of Sciences et al., 2019). These challenges

have led to an increased call for education on the current drug market and protection against overdose that can allow for PWUD to use drugs safely without the immediate need for treatment.

Harm reduction policies aim to address the health-related harms for PWUD without reducing or eradicating drug consumption (Marlatt, 1996). This agenda operates under the public health model by surveilling drug usage, understanding the illicit market, and supporting one's management of one's own health. The knowledge and expansion of these services allow for increased communication between PWUD, who are often isolated due to criminalization and stigma toward illicit drug use (Friedman et al., 2007; Muncan et al., 2020). Several harm reduction initiatives have been developed to address overdose and fentanyl monitoring at the street level such as an expansion of naloxone access and the installation of overdose prevention vending machines (ABC 7 Eyewitness News, 2023; Crumpler, 2022; Mulvhill, 2023; New York State Office of Addiction Services and Supports, 2023), the implementation of overdose prevention centers (OnPoint NYC, 2021), the decriminalization of drug use (Heano, 2023; Kary, 2023; Westervelt, 2021), and the installation of drug testing centers (Barratt & Measham, 2022; Gozdzialski et al., 2023; Larnder et al., 2021; Wallace et al., 2020, 2021, 2022). Given the number of harm reduction-related policies and initiatives, it is surprising that only a small number of research articles have examined drug testing and monitoring on DNMs to inform public health policy (Caudevilla et al., 2016; Giné et al., 2017; Quintana et al., 2017; Van Der Gouwe et al., 2017). Most harm reduction research focusing on darknet spaces have been observational studies focusing broadly on the reception of specific initiatives rather than providing policy recommendations based on the needs of DNM users (Bancroft, 2020; Davitadze et al., 2020; Masson & Bancroft, 2018; Vale Pires et al., 2016; Rolando & Beccaria, 2019).

AlphaBay was one of the most popular DNMs over the last decade. The marketplace had two administrators: "Alpha02" from 2014–2017 and "DeSnake" from 2021–2023. During his leader ship, "Alpha02" implemented several harm reduction strategies to address the growing number of overdose deaths, such as incentivizing vendors to provide naloxone, an overdose reversal medication, to customers in exchange for waiving the vendor bond fee to sell on the DNM (Bancroft, 2017; Gilbert & Dasgupta, 2017). Additionally, AlphaBay and the other DNMs have placed bans[1] on fentanyl and other dangerous chemical mixtures to reduce unwanted attention from law enforcement (Gilbert & Dasgupta, 2017; see Supplementary Appendix B). In August 2022, "DeSnake," the second administrator of AlphaBay, implemented a "harm reduction" policy that required vendors to be transparent about the content of their products by disclosing all ingredients, including adulterants, in their product description. Recent studies have found that some DNM vendors use covert terms to inform buyers about adulterants in their products, whereas predatory vendors may omit potentially dangerous adulterants from their product title or description, highlighting the importance of vendor transparency (M. Maras, Logie et al., 2023; M.-H. Maras, Arsovska et al., 2023). To ensure that vendors followed these requirements, AlphaBay hired drug checkers to randomly purchase and test drugs being sold by vendors to confirm that the products contained the substances that were being marketed. Vendors found to be selling mislabeled products could be permanently banned from the marketplace by the site administrator.

Researchers have highlighted the benefits of harm reduction-related interventions for DNM users. Most of these studies have explored how harm reduction strategies can be implemented by external parties like nonprofit organizations or trained medical specialists who are able to access darknet forums to offer advice to potential users (Davey et al., 2012; Davitadze et al., 2020; Masson & Bancroft, 2018; Móró & Rácz, 2013; Vale Pires et al., 2016; Rolando & Beccaria, 2019; Sarker et al., 2022). Although these findings have generated promising results on the use of harm reduction programs in forums, little research has explored the harm reduction knowledge

and communication that is already present within the DNM itself. Given that successful harm reduction initiatives rely on the knowledge and expertise of the populations who are actively buying and using substances, more research is needed to consider how harm reduction can extend to buyers who are purchasing illicit substances on popular DNMs.

To address these important gaps in the literature, this study has two main objectives that assess the use of harm reduction initiatives on DNMs. First, it examines how the AlphaBay administrator integrated a "harm reduction" policy into the DNM. Second, it evaluates how harm reduction communication occurs among DNM buyers, specifically examining the information present in buyer feedback of Oxycodone and Adderall products and how this communication changes before and after the implementation of AlphaBay's "harm reduction" policy announcement in August 2022. Although we find that this initiative identifies and removes vendors selling mislabeled products from the DNM, it does not fundamentally alter buyer communication in our dataset. Instead, we find that buyers' harm reduction feedback on AlphaBay predates the implementation of the marketplace's harm reduction program, suggesting that buyers are already aware of the importance of harm reduction practices when buying and using Oxycodone and Adderall.

2 | PRIOR LITERATURE

There is a growing body of literature that explores DNMs, marketplace users, and the products available on DNMs. There is also a growing body of research that has reinforced the importance of implementing harm reduction strategies as a public health initiative, especially in light of the current overdose epidemic. Below we explore the development of harm reduction at the street level and how these strategies have permeated into DNMs.

2.1 | The history of harm reduction within drug policy

The harm reduction framework assumes that the total eradication of illicit substances is an unrealistic goal and pushes back on policies that criminalize drug possession, use, manufacturing, and sale. This philosophy emphasizes that drug criminalization increases harm to PWUD by reducing the ability to communicate strategies and practices that could reduce overdose and spread of blood-borne diseases when using drugs. Although antiprohibition movements have existed since the early 1900s (Roe, 2005), harm reduction programming did not emerge publicly until the 1980s when HIV and AIDS began to spread amongst PWUD (Friedman et al., 2007). During this time, local services, usually mobilized by networks of PWUD, communicated the importance of sanitizing syringes using common household items like bleach or only using one syringe per person to mitigate the risk of spreading blood-borne virus through unsanitary or used syringes (Szalavitz, 2021). More recently, brick-and-mortar facilities like syringe exchange services and overdose prevention sites have been introduced as a formal public health initiative to address the increase in synthetic adulterants and subsequent overdose amongst communities that use drugs (Jones et al., 2020). These programs provide participants with free syringes and resources for drug testing, overdose reversal training, and resources for PWUD alone.

Since the integration of the harm reduction paradigm in Western drug policies, evaluations of harm reduction programs have revealed positive public health outcomes. Several studies have found that syringe exchange programs reduce risky behavior, like sharing syringes, and increase sanitary drug use practice (Bartholomew et al., 2021; Gibson et al., 2001). Overdose prevention

centers have also been found to promote safe injection practices (Kinnard et al., 2014; Karamouzian et al., 2018; Wood et al., 2006), reduce overdose (Kerr et al., 2007; Marshall et al., 2011), and increase treatment enrollment of PWUD (DeBeck et al., 2011). Research suggests that harm reduction initiatives establish open communication between PWUD, which helps them to identify trusted street-level dealers to reduce the likelihood of taking a dangerous adulterated product without one's knowledge (Carroll et al., 2020). In addition, studies have shown that harm reduction programs improve the agency of at-risk individuals to manage their own health and mental well-being (Kerman et al., 2020). This increased agency for one's health allows for PWUD to assist each other in the midst of ongoing stigma toward communities who use drugs and rising harms associated with drug use. Friedman et al. (2004) define this as a form of intravention or a "culture of support" amongst people who are at risk, pushing back on the public perception that PWUD are merely sources of social and medical problems (Friedman et al., 2004, p. 251). Successful intravention focuses exclusively on the expertise of the very populations who are at risk to best address the harms associated with risky behavior like illicit drug use. Intravention outlines how harm reduction attitudes can manifest on DNMs and thereby create spaces for individuals to use their personal experiences to reduce future harm to themselves and others.

DNMs have become an outlet for people who buy drugs for either personal use or resale. These markets have become increasingly popular, especially during the COVID-19 pandemic–related lockdowns in 2020 (Bancroft, 2022). Purchasing through DNMs can also protect individuals from street-level violence or arrest, which are often risks of purchasing illicit substances in person (Buxton & Bingham, 2015). However, DNMs often present their own unique set of risks to buyers. For example, some vendors may engage in exit scams that would cause financial losses to buyers, or other vendors may mislabel their products, giving buyers a false sense of security about the purity of their products. DNMs are also difficult to monitor and police because of restricted access to the sites and user anonymity (Ball et al., 2021; Buxton & Bingham, 2015). This anonymity of users and the continued secrecy of these marketplaces make it difficult to establish communication between buyers and vendors on DNMs and present challenges to recognizing the risks that online buyers face.

2.2 | Previous studies of online harm reduction initiatives

Research shows that people often rely on virtual spaces to form anonymous support groups around stigmatized behaviors like suicidal thoughts, eating disorders, and drug use. Harm reduction strategies are also present in virtual environments (Davey et al., 2012; Davitadze et al., 2020; Masson & Bancroft, 2018; Móró & Rácz, 2013; Vale Pires et al., 2016; Rolando & Beccaria, 2019; Sarker et al., 2022). Some studies have explored specific spaces where harm reduction can be implemented for PWUD within darknet forums (Davitadze et al., 2020; Vale Pires et al., 2016). Vale Pires et al. (2016) describe the implementation of an Ask a Drug Expert Physician thread on the forums controlled by popular DNMs like Silk Road, Silk Road 2.0, and Evolution using the moniker Doctor X. The Doctor X thread created an anonymous space for users to inquire about different drug use topics, such as information on drug side effects and proper dosages, which received over 1,000 inquiries during its two years of operation. In addition, Doctor X provided unsolicited strategies for safe consumption and informed users about the potential risks of certain drug and adulterant combinations. Similarly, Davitadze et al. (2020) examined a brick-and-mortar Russian harm reduction program that created several harm reduction threads on the Hydra DNM's open discussion board. Although there were few exchanges on the forum itself, many individuals used the

NGO's telegram[2] account to connect with the organization's web outreach employees, resulting in an 89% increase in service requests after integrating into the Hydra marketplace. In addition, an interview with the NGO's Deputy Director about harm reduction strategies was viewed over 100,000 times. These studies reveal that harm reduction strategies exist in virtual environments, particularly for guiding open communication on personal experiences and safe consumption. In addition, these studies indicate that drug buyers within this space are open to sharing their experiences and will utilize harm reduction programs in virtual spaces. Despite these positive findings, the current body of literature related to harm reduction programs on the darknet is limited to analyzing communication on darknet forums. Researchers have identified shortcomings and limitations of studying darknet forums (Bancroft, 2020; Sumnall, 2018). For example, Bancroft (2020) found that 1% of users contribute 99% of the forum posts, suggesting that there are a significant number of DNM users who are not actively participating in these networks. This lack of forum engagement by DNM users suggests that harm reduction policy research should explore other modes of communication on DNMs such as buyer feedback and reputation systems.

2.3 | Communication, reputation, and online markets

Buyer feedback is another way in which DNM and clearnet users can communicate within a marketplace. In order to understand how harm reduction can manifest within DNM buyer feedback, it is necessary to examine how trust and reputation are built through buyer and seller communication. Trust, in the context of this study, refers to a buyer's willingness to purchase an item from a seller on a DNM. The three traditional sources of trust on DNMs include reputation systems, governance, and social ties (Munksgaard, 2023). On DNMs, trustworthiness is often built by vendors, who provide information about shipping, vending experience, and scores on their vendor profiles (Bakken et al., 2018; Tzanetakis et al., 2016). Research suggests that seller trustworthiness is an important factor for attracting new customers and keeping old ones on DNMs (Décary-Hétu & Quessy-Doré, 2017; Duxbury & Haynie, 2018). The trust built through these mechanisms allows a vendor to establish a reputation that keeps buyers engaged with the vendor.

Part of the process of building trust is maintaining a positive reputation. Seller reputations are created from product reviews, market ratings, and internal forums (Hardy & Norgaard, 2016). Reputation systems, through either written feedback or numerical ratings, allow administrators to regulate market behavior (Bakken et al., 2018). They also operate as an incentive for cooperative behavior, thereby decreasing the possibility of scams (Espinosa, 2019; Przepiorka et al., 2017). Hardy and Norgaard (2016) posit that the reputation on DNMs is a self-enforcement mechanism that incentivizes sellers to deliver quality service to buyers. Research shows that individuals often participate in reputation systems, despite not having any tangible incentive to do so (Diekmann et al., 2014; Resnick & Zeckhauser, 2002). On DNMs, it is common for both administrators and vendors to encourage buyers to leave feedback (Bakken et al., 2018; Tzanetakis et al., 2016). However, research on clearnet markets suggests that buyer feedback falls on the extreme values of the feedback scale (positive or negative), thereby distorting the public feedback available in online marketplaces (Dellarocas & Wood, 2008; Resnick & Zeckhauser, 2002; Ullah et al., 2016). This distortion means that a vendor is always attempting to maintain a feedback rating that projects trust to buyers.

One of the principal reasons why trust and reputation are important is their impact on the economic aspects of marketplaces. On clearnet marketplaces, it is well established that marketplaces that use reputation systems have higher quality sellers, more competitive prices, and higher seller

profits (Saeedi, 2019). On these platforms, a seller's reputation has a positive impact on the price of goods (Diekmann et al., 2014; Fan et al., 2016; Houser & Wooders, 2006). Specifically, sellers with successful selling records will sell more often, reach more buyer regions, and sell in more categories (Cai et al., 2014). Buyers are likely to assess a seller's reputation from their product feedback. Well-reviewed sellers command a higher price for goods whereas negative reviews can cause a drop in sales (Cabral & Hortaçsu, 2010; Resnick et al., 2006; Zhang, 2006). Negative feedback can also impact the frequency of future listings because sellers become more likely to exit the market due to low reputations (Cabral & Hortaçsu, 2010; Khopkar et al., 2005). These findings emphasize the importance of drug vendors maintaining their reputations on DNMs.

Trust is an important factor on DNMs given the anonymity of its users and the dubiety of some of the products sold. DNM research during different time periods has found that those who buy drugs via DNMs believe that these markets are capable of supplying better products than those purchased in person (Barratt et al., 2016; Munksgaard et al., 2023). Moreover, research also suggests that a vendor's reputation on DNMs is an important factor for first-time buyers (Munksgaard, 2023; Norbutas et al., 2020). Sellers on DNMs with better ratings charge higher prices and sell their products faster (Espinosa, 2019; Nurmi et al., 2017; Przepiorka et al., 2017). However, recent research shows that this relationship is more nuanced. Munksgaard and Tzanetakis (2022) find that price does not increase or decrease consistently with positive or negative feedback, instead finding that when a vendor's aggregate feedback is positive, the vendor will increase their prices. Using transaction size as a proxy for trust, Munksgaard (2023) suggests similar patterns by finding that authentication and transaction history on DNMs are more influential than reputation. This finding echoes studies that have found that buyers are more likely to trust and transact with those whom they have had prior exchanges (Décary-Hétu & Quessy-Doré, 2017; Duxbury & Haynie, 2018; Norbutas et al., 2020). These findings reveal that DNM buyers may depend more on the trustworthiness of the vendor and less on a single marketplace rating.

Whether built through reputation systems, prior history, or other factors, trust plays a crucial role on DNMs. The reputations of the DNM administrators and vendors are created through a combination of vendor product information, buyer feedback systems, and darknet forum posts. Although the literature suggests that the reputation on DNMs may not have a large role in setting prices, it does have an important role in attracting new customers. Once vendors and buyers develop a relationship, these customers play a meaningful role in future transactions and customer loyalty. Maras et al. (2023) identified a number of trust signals that reveal the reliability of the vendor and the type of product available for sale. These covert, semi-covert, and overt signals are used by vendors and buyers to communicate on DNMs about products and services publicly without compromising the operational security of the marketplace. Given the importance of buyer feedback in developing reputation and trust on DNMs, the communication and information shared by buyers should be explored as a vehicle for communicating harm reduction-related information on the growing concern of mislabeled substances sold by untrustworthy vendors.

2.4 | Knowledge sharing on darknet marketplaces

Similar to the harm reduction framework, communication on DNMs is built around knowledge sharing. Maras et al. (2022) identified two dominant types of knowledge creation and sharing on DNMs: communities of practices (CoPs) and criminal enterprise. Criminal enterprise knowledge sharing refers to the information that is "created within the criminal organization and maintained by it" (Maras et al., 2022, p. 1). In contrast, CoPs' knowledge sharing on darknet forums and mar-

ketplaces is generated by informal networks of darknet users with shared interests (Maras et al., 2022). The development of these two forms of knowledge sharing suggests that communication occurs at the administrative, vendor, and buyer levels on DNMs.

On AlphaBay, administrators and moderators utilized criminal enterprise knowledge sharing through the marketplace's announcements, policies, and guides, which are available on the website for users to read. CoP knowledge sharing is also present in the product feedback on the marketplace and is provided primarily by the buyers and occasionally by vendors. The content of buyers' feedback includes more specific information regarding drug quality, experiences of taking the drug, results of different drug tests, recommended dosage size, quantity or weight of drugs received, and physical characteristics of the drugs delivered. The administrator shares knowledge regarding the DNM vendor policy, rules and protections for buyers, and policies to monitor and protect buyers from misleading or predatory marketing. The many forms of knowledge sharing present on DNMs reveal how communication within feedback and administrator announcements can be leveraged to learn more about illicit drug markets online.

2.5 | Global drug use and policy

The risk and legality of drugs have long been debated in international organizations. During the Single Convention of Narcotic Drugs of 1961, the United Nations classified narcotic substances (such as cannabis, heroin, and opium) into four categories based on their risk of addiction, abuse liability, and medical use (UNODC, 2013). Subsequently, the Convention on Psychotropic Substances of 1971 addressed other drugs emerging in popularity and further classified them based on their medical value and their risk of addiction such as LSD, ecstasy, sedatives, and other types of amphetamines. The development of these categories outlined the importance of certain substances for therapeutic purposes and scientific research while preventing them from entering into illicit markets and increasing public health risks such as addiction or death by overdose (UNODC, 2013).

Although the UN convention established a general framework and classification for different substances, many regions and countries have specific regulations on the importation of substances within their borders and how they should be distributed. For example, within the United States, attention-deficit hyperactivity disorder (ADHD) medication like Adderall and pain management medication like Oxycodone require a medical prescription to be legally purchased. Refilling this prescription can only occur within a limited time frame and at a specified pharmacy (United States Drug Enforcement Administration, 2020, 2023). However, these rules do not necessarily apply to other countries. For example, Adderall is illegal in many European countries (Children and Adults with Attention-Deficit/Hyperactivity Disorder, 2020), Japan (U.S. Embassy & Consulates in Japan, n.d.), and Saudi Arabia (Saudi Food and Drug Authority, n.d.). Even if a patient has a valid prescription, Adderall cannot be transported into these countries without government approval prior to entering the country. These strict regulations may have led to an increased demand for regulated substances in illicit markets such as DNMs from domestic vendors of ADHD and pain management medications.

In addition to country restrictions on certain substances, sudden changes in the drug availability have increased the use of illicit drug markets to acquire substances that are less available in legal markets (Mars et al., 2019). This change in the U.S. drug market is evident in pharmaceutical prescriptions for people in need of pain management and ADHD medications. In the late 1990s and the early 2000s, a rise in addiction to pharmaceutical prescription opiates led to a decline in

clinical opiate prescriptions for patients with acute and chronic pain (Okie, 2010). This shift in legally available opiates led to a rise in demand for opioids in illicit drug markets (Pardo et al., 2019). In the case of Adderall, the U.S. Drug Enforcement Administration (DEA) issued a temporary rule in 2020 (extended until 2024) that allowed for substances like Adderall to be prescribed via telemedicine to mitigate in-person doctor visits during the COVID-19 pandemic (United States Drug Enforcement Administration, 2020, 2023). As a result of this easy access, Adderall became heavily prescribed to patients diagnosed with ADHD. The unexpected increase in Adderall disbursement and caps placed on its production led to an Adderall shortage, announced by the Food and Drug Administration (FDA) in 2022 (United States Drug Enforcement Administration, 2022). These changes in ADHD and pain management medication supply demonstrate a need to explore how these types of substances are provided in street-level drug markets and on DNMs.

Illicit markets have become more dangerous to buyers with an increase in the adulteration of pills to reduce the cost of these products. Additionally, these marketplaces have created a false sense of security by posting rules that ban the sale of known adulterants like fentanyl, while doing little to curb the sale of cheap adulterated products. This is particularly dangerous for individuals seeking alternative sources for pharmaceutical products like ADHD and pain management medications. Given this increase in potential harm to PWUD, there is a need to consider how harm reduction strategies are used by buyers on DNMs. Currently, limited research examines the trends in ADHD and pain management pills on DNMs. There is even less literature that has explored how and when DNM buyers use strategies of harm reduction when purchasing drugs on illicit marketplaces. In order to address these gaps in DNM research, we explore how the administrator-led "harm reduction" policy alters the way buyer harm reduction strategies are shared through buyer feedback on AlphaBay.

3 | PRESENT STUDY

Our study expands upon existing harm reduction literature within virtual environments by exploring the impact of an administrator "harm reduction" policy on the harm reduction strategies shared in buyer feedback by customers who purchased pain management and ADHD pills on AlphaBay. In order to do this, we use a mixed methods design that examines both the themes and content of the "harm reduction" policy and the buyer feedback. Our work addresses the following research questions:

1. What are the harm reduction principles represented on AlphaBay in buyer feedback on pain management and ADHD pills?
2. Is there a difference between the content of pain management and ADHD pills buyer feedback before and after the "harm reduction" policy on AlphaBay?

To address research question 1, we create a typology categorizing the types of communication that encompass harm reduction principles. For research question 2, we code the buyer feedback based on the typologies identified to determine if there is a statistical difference between the types of buyer comments before and after the announcement of AlphaBay's "harm reduction" policy. The following sections detail AlphaBay's relaunch and global reach, its approach to harm reduction, and the roles of content analysis and buyer feedback in this study.

3.1 | AlphaBay relaunch and global reach

AlphaBay initially launched as a DNM in 2014 and was shut down in 2017 by an international operation led by the United States Department of Justice (The United States Department of Justice, 2017). In 2021, AlphaBay's marketplace was relaunched by an individual claiming to be the security administrator of the original site, known as "DeSnake." During relaunch, "DeSnake" sought approval to use the original name AlphaBay, rather than adding a number to indicate a distinction from the first marketplace (e.g., as seen in other DNMs such as Silk Road, Silk Road 2, Silk Road 3, and Silk Road 4) in order to borrow the credibility of the original marketplace. To continue using the name AlphaBay, other darknet administrators undertook a rigorous vetting process to verify "DeSnake's" identity, which was outlined in AlphaBay's relaunch announcement on the darknet forum Dread. The process included verifying "DeSnake's" ability to use the historic PGP key associated with the moniker and demonstrating knowledge of internal events from the first launch of AlphaBay only known to high-ranking administrators. Using the original AlphaBay name and logo along with the community welcoming the DNM relaunch allowed AlphaBay to have an extensive geographical reach during its first year of operation.

By November 2022, AlphaBay had vendors listing 47 product origin countries and 177 product destination countries. However, recent findings suggest that pills on DNMs are typically bought and sold within the same country (Lamy et al., 2023). AlphaBay pain management and ADHD medications vendors indicated that they shipped from 11 countries[3] and shipped to 14 countries.[4] Domestic shipping for these products was dominant on AlphaBay with 60% of the 1,190 products categorized as "Adderall" and 70% of 867 products categorized as "Oxycodone" listings shipping domestically within the United States, the United Kingdom, and Canada. Products categorized as "Adderall" and "Oxycodone" were listed as only shipping within the United States on 63% of "Adderall" listings and 39% of "Oxycodone" listings on AlphaBay. Many UK vendors indicated their willingness to ship both products worldwide. Nevertheless, many buyers prefer local shipping, which means the 11 origin countries have the highest concentration of Adderall and Oxycodone buyers.

This study examines specific listings of pain management medication (Oxycodone, Oxycontin, Percocet, and Hydrocodone) and ADHD medication (Adderall, Ritalin, Concerta, and Vyvanse). These two types of drugs are chosen for our study because they both have experienced a change in their legally available supply. Additionally, research shows that increased opioid-related deaths are linked to a growth of synthetic adulterants being pressed into pills advertised as commonly used pharmaceutical brands (Cunliffe et al., 2019; Singh et al., 2020; Wilde et al., 2019). For example, pressed or illegally manufactured pills that are listed as Adderall and Oxycodone often contain synthetic cutting agents which mislead buyers about the contents of the product they are purchasing. Our analysis focuses on the themes communicated when the product is listed generically (Oxycodone and Adderall) versus a pharmaceutical name (Oxycontin, Percocet, Hydrocodone, Ritalin, Concerta, and Vyvanse). Although Oxycodone and Adderall are pharmaceutical brands, they have evolved into generic terminology for pain management and ADHD medications, not unlike the terms Kleenex or Band-Aid. By observing the feedback left by buyers of these substances, we observe buyers' harm reduction comments and how they differ before and after AlphaBay's "harm reduction" policy in August 2022.

3.2 | Analyzing feedback on AlphaBay

Most studies have relied on data from darknet forums to understand harm reduction strategies amongst buyers and people considering which drugs to use. These studies provide a detailed description of conversations on darknet forums. However, we argue that the scope and discussions available on these outlets do not coincide with the information that can be collected from DNM feedback. Also, forum comments do not necessarily reach AlphaBay buyers, especially first-time buyers. The number of registered buyers on AlphaBay exceeded 1 million registered buyers, whereas darknet forums generally have fewer than 100,000 registered users. Leading darknet forums' ability to reach AlphaBay buyers is further complicated by AlphaBay extending its reporting policy and marketplace rules to their sub-forums in darknet forums. These rules led to the removal of claims that have not been reported to AlphaBay or are unsubstantiated after being reported. These restrictions increase the importance of feedback associated with a specific product and vendor page on AlphaBay to inform buyers about dangerous products.

There are several reasons why feedback data are informative for identifying harm reduction strategies on AlphaBay. First, we argue feedback data are informative for future buyers to understand the risks of buying and using substances from DNMs. Buyer feedback is more likely to be consumed by people who actually purchase and use the substance, rather than someone who is simply curious about using the DNM or looking for more general information on drug use. Cautionary feedback could be particularly influential for potential buyers. Clearnet marketplace research has found that individuals who are buying goods are more likely to pay closer attention to negative comments than positive comments when purchasing a product (Chen et al., 2022). This suggests that detailed feedback cautioning future buyers of the potential risks of substances could be particularly influential for buyers to avoid and mitigate the risks of substance use highlighting the importance of feedback as an informative data source for understanding harm reduction strategies.

On AlphaBay, buyers were encouraged by administrators to submit feedback, even though it is not required to do so. When a buyer submitted feedback on AlphaBay, the vendor was allowed to write a response to the feedback. However, AlphaBay imposed some restrictions on buyer feedback. A buyer and vendor on AlphaBay were only allowed to make one comment on a purchase, and can only edit this comment and rating once. AlphaBay administrators identified the type of comments for buyers to focus on through its rating system (quality, price for value, and stealth). At one point, AlphaBay's administrators and moderators were accused of removing a limited number of buyer feedback comments in external AlphaBay sub-forum posts, and posts from their internal forum. Although this may be seen as censorship, the AlphaBay administrators operated the DNM and affiliated services using a criminal enterprise knowledge-sharing model. This top-down approach from the DNM staff imposes stringent rules that require complaints to be submitted through its ticketing system or ScamWatch program. As a result of the DNM's strict rules, harm reduction comments appearing on products carry significant weight since staff members have the ability to remove negative unsubstantiated comments. For these reasons, we argue that relevant harm reduction feedback messages are a small but meaningful portion of the DNM's buyer feedback.

4 | METHODS

4.1 | Data collection

Although several DNMs were operational during the data collection phase, this study focuses on AlphaBay because it was the only DNM at the time of data collection that had implemented an administrator-led harm reduction program. Additionally, AlphaBay's content was accessible to the researchers. The data for this study were obtained from DNM scrapes previously collected between 2019 and 2022 (Maras et al., 2019).

This data collection process started with accessing the darknet using the tor browser.[5] We created an account using a 6-digit PIN and two user names (private login and public username) to access the DNM. We then examined the marketplace to understand the site's structure, such as the patterns of the category pages, product pages, and vendor profile URLs. Understanding the structure of the website allowed for the creation of data collection programs that can sort and label the pages collected by category, product, and vendor profile. The program was created using JavaScript, a scripting language designed specifically to work with web pages. The order in which the pages were collected minimized the amount of information needed by the program to collect the relevant data from the DNM.

Once we gained access and determined the best methods for gathering data, the category URLs from AlphaBay's homepage were inputted into the program to collect data. First, the program utilized the URL pattern identified during our research and observation of the marketplace. Next, it opened pages matching the category page pattern for collection while extracting all the URLs on each page and storing these values in a separate file. Then, the product pages were scraped using the URLs collected from the category pages. Similar to the category collection process, the program limited the scraped URLs to web links that match the pattern of product page URLs. Finally, the vendor profile pages were collected using the URLs that were scraped from the category pages. This process was repeated five times from April 2022 to November 2022 and collected as HTML data which was then stored as text files.

Once the data were collected, a parsing program written in Python, designed specifically for the AlphaBay DNM, was used to extract the data stored on the HTML pages. The collected data were then organized into folders based on the page types: categories, vendors, and products. The data parsing program used the folder location of the collected data as a starting point. The program read and parsed the data stored in a single file and then identified the page type by examining the data for unique features. This ensured that the page was an AlphaBay page, then it determined the page classification (category, product, or vendor) using the regular expressions that were unique to each page. Once the page type is identified, the data are sent to the correct module for processing and storage. The extracted data are added to a database in the category, product, vendor, or product feedback (located on the product pages) table. Once the parsing process was completed, the database tables were searched for the following terms: Oxycodone, Hydrocodone, Percocet, OxyContin, Adderall, Ritalin, Concerta, and Vyvanse. The results obtained from these search terms were extracted from the product table and the feedback table and placed into Excel sheets for further analysis.

We then cleaned the data on each data sheet containing feedback data using Excel. We kept the feedback for products from April 2022 to November 2022, feedback posted outside of this time frame was removed. Next, feedback messages from April 2022 to July 2022 were coded as "pre," whereas feedback messages from August 2022 to October 2022 were coded as "post." The

"pre" label was used to indicate feedback on ADHD and pain management medications in the 4-month time frame prior to the implementation of AlphaBay's "harm reduction" policy in August 2022. The "post" label was used to indicate feedback in the 3-month time frame after the policy implementation.

4.2 | Data coding

The data were coded according to major harm reduction principles defined by leading harm reduction organizations (Harm Reduction Coalition, 2020). These principles broadly outline the importance of the agency and open communication on the experiences of PWUD and drug use in general, identify the harms directed to PWUD and drug use, and recognize the need for protective resources for PWUD. Additionally, we drew from DNM literature that explores harm reduction networks (Bancroft, 2017). Bancroft (2017) indicates that harm reduction networks manifested on DNM forums communicate the following themes: legal/policy, chemical potency, and cultural normalization/pathologization. Drawing from these general harm reduction principles and Bancroft's (2017) harm reduction-related themes we outlined four central themes that apply to the buyer communication on DNMs: Experience,[6] Testing, Scam,[7] and Pharmaceutical. Experience refers to detailed comments on an individual's experience with using the substance. Testing refers to detailed communication about using resources such as reagent tests and lab tests to analyze what the substances contain. Scam refers to warnings of a discrepancy between the drug that the vendor describes and the actual products that are being sold and consumed. Pharmaceutical considers the quality of the product and whether it was manufactured by a pharmaceutical company or manufactured illicitly (i.e., pressed and/or added with adulterants). After identifying these themes, each feedback message is coded 1 if it met the criteria for one or more of the four themes and 0 if it did not. In the case of indecision or uncertainty about a specific comment, the comment was flagged and the team met to discuss which themes best applied to the comment.

4.3 | Data analysis

Data analysis is separated into four phases. First, we used the harm reduction data collected to quantify the harm reduction typologies and how they appeared in our dataset. Next, all coded buyer feedback was imported into Stata as a dataset to display the percentage of relevant feedback within different products and themes (Tables 3–5). A chi-square test was performed on each typology with the data coded as pre-harm reduction policy announcement or post-harm reduction policy announcement. Third, the DNM marketplace tester reviews related to ADHD and pain management products are identified (see Appendix C). These examples were selected because the testers reviewed Adderall or Oxycodone products and in most cases the vendors were subject to administrative actions to ensure compliance with AlphaBay's "harm reduction" policy.

5 | RESULTS

The initial dataset contained 8,799 buyer feedback messages and 94 products (64 vendors) receiving harm reduction reviews provided by the AlphaBay staff. We started with the 8,799 buyer feedback records collected from Adderall and Oxycodone vendors and product pages. First, we

removed duplicate records from the dataset. Feedback relating to operational security and delivery was also removed. Additionally, we excluded feedback messages that contained one-word descriptions of potency and quality without context, i.e., "A+," "good," "great," or "potent." The reason for the exclusion of these terms is that these one-word feedback messages are not descriptive enough to convey proper information about the product's purity, potency, or consistency (Bancroft & Scott Reid, 2016; Mounteney et al., 2018). After coding the remaining records, 1,276 buyer feedback records met our harm reduction criteria. The 1,276 buyer feedback records included 1,086 unique pairs of vendors and buyers, about 15% of the original dataset. Given the strict criteria that we outlined as harm reduction-related and the aforementioned influence of cautionary and negative feedback, we maintain that this dataset is a sufficient size for the context of our study. Finally, we observed that 85% of buyer monikers commenting on products were unique.

5.1 | AlphaBay's "harm reduction" policy in action

Before the official launch of AlphaBay's 2022 "harm reduction" policy, DeSnake announced that over 400 orders from 100 vendors had already been randomly tested for DNM users to view (see Supplementary Appendix A). In a darknet forum, an AlphaBay's administrator provided a list of 102 vendors that were tested and the feedback on the quality of their products as part of the "harm reduction" policy. We examined these vendors and found that 16 of the vendors tested were removed or left the marketplace before the official launch of the harm reduction program. After the official start of the harm reduction program, an additional 14 vendors had no activity after September 2022 and the remaining 72 vendors were still active during the last data collection in November 2022.[8]

Additionally, the AlphaBay staff held a Q&A session on a darknet forum answering questions and outlining the current and future goals on their "harm reduction" policy (see Appendix B). We identified 86 products tested by the "harm reduction" policy and 8 products tested by ScamWatch.[9] These reviews revealed that 6 tests were conducted on ADHD products, 8 tests on pain management products, 21 tests on other pill products, and 58 tests on other drug products (see Appendix A and Appendix C for excerpts from some of these reviews). The reviews showed that 29 of these products were lab tested, 46 were tested using reagents, and 24 tested positive for adulterants. Sixty-three vendors tested had accessible profiles, 46 of these vendors were randomly tested once, whereas 17 were tested multiple times.

The "harm reduction" policy existed on a spectrum when punishing vendors rather than a compliance/noncompliance approach to punishment. Further analysis of the ADHD and pain management products reviewed provided insight into how vendors were punished when random testing results showed that their product descriptions did not comply with AlphaBay's "harm reduction" policy (see Appendix C). In Appendix C, Example 1 shows that it is possible for a product listing's sales to be unaffected by a positive adulterant test result. Example 2 shows that a negative test result can lead to a significant increase in sales for the product listing. On the other end of the spectrum, adulterant results, such as Examples 3, 4, and 6, show that vendor profiles can be removed[10] from the DNM; vendors may also choose to abandon their profile or have their vendor privileges restricted.[11] Finally, Example 7 shows a vendor abandoning their vendor profile and one buyer speculating the vendor may be engaging in an exit scam. In an exit scam, a vendor develops relationships with a number of buyers (fulfilling orders), then accepts funds for orders they have no intention of fulfilling and leaves the marketplace with these funds. The vendor in Example 7 also appears to have restricted access to their vendor and product pages.[12]

5.2 | Research question 1

Tables 1 and 2 display examples of the content we collected and coded as harm reduction buyer feedback. Based on the content of the feedback, the DNM has two types of buyers: personal use and resellers. Reseller's feedback detailed the appearance of the product, which is important when performing face-to-face sales, whereas buyers for personal use, focused significantly on the experience and feelings while using the product. Buyers for personal use are also not a homogeneous group; some seek products to create a specific experience, others purchase to supplement or replace their prescription with an inexpensive alternative. Most buyers accept that the pressed pills and generically labeled pills contain an active ingredient that may not match the active ingredient used by pharmaceutical brands. These buyers are generally not opposed to this arrangement, especially when vendors provide extra pills. A small number of buyers who test their drugs show outrage at the lack of transparency related to the active ingredient. In the best case, these pills are similar to pharmaceutical pills, while in the worst case, these pills may contain deadly dosage levels of an unknown active ingredient. Buyers often describe their own experiences and give advice on how to have optimal experiences. Most buyers appear unconcerned when they experience unexpected side effects but do communicate the specific side effects. For example, some discuss the ability to ingest pills in multiple ways. Others place emphasis on deciding the right dosage for ADHD and pain management pill users; these discussions include overdose avoidance strategies and mitigation plans, tolerance levels, and achieving the best experience while using these drugs. Finally, testing is discussed in approximately a sixth of the purchases containing harm reduction comments. Buyer feedback about testing is not monolithic. Many buyers test products to ensure the absence of fentanyl and other adulterants, whereas other buyers test to ensure compliance with their workplace drug policies. These findings were divided into harm reduction-related categories used to answer research question 2.

The results from Table 3 were generated by combining the product listings. Scam feedback was almost nonexistent regardless of the product type compared with the other three themes. The percentage of Testing and Experience was similar for the generic listings, whereas there was a greater range in the percentages of pharmaceutical listings with Testing and Experience themes. The variation in the proportion of feedback received for each product may be explained with the addition of a time component. Specifically, the percentage of each type of feedback received before and after the harm reduction announcement.

5.3 | Research question 2

The results from Table 4 are generated by combining the Generic and Pharmaceutical listings and the time component "pre" and "post" "harm reduction" policy announcement. The percentage of feedback coded as Pharmaceutical or Scam declined after the "harm reduction" policy announcement for both Generic and Pharmaceutical listings. Also, the percentage of feedback coded as Experience and Testing increased after the harm reduction announcement for both Generic and Pharmaceutical listings.

The "pre" and "post" time frame was combined with each type of listing (see Table 5). The percentage of Testing and Scam feedback remained relatively unchanged before and after the "harm reduction" policy announcement for each type of listing. Pharmaceutical and Experience feedback on Adderall also remained consistent over the time frame. However, Oxycodone, OxyContin,

TABLE 1 Examples of Oxycodone (Generic and Pharmaceutical) Listings Harm Reduction Buyer Feedback.

Product Listing	Relevant Message Quote
Hydrocodone	hes never failed to provide real pharma. You can not accurately reagent test hydros, so I used a trick I learned and put one into 30 ml of water and tested with a urine test. There was nothing but opiates in it, and a fent test came back negative.
OxyContin	some of them are broken and there is a decent amount of powder.customers dont want broken ones. I thought I was receiving prescription like the picture, these are pressed. Im wary about fent.I have personally OD off of fent laced oxy and did 2 weeks on a ventilator in a coma. Morally I cannot flip these if they are not clean.
Oxycodone	BUYER BEWARE – This is an RC with zero opiates. Vendor was upfront about that and responsive, I made the mistake of thinking it was an actual opiate of some kind not something mimicking the effects of morphine cooked up in his lab.Tested positive for amphetamines and something else using reagents. Buy at your own risk.
OxyContin	Failed fent test somehow wins dispute honestly ridiculous dealing with this vendor, product & service would not recommend at all BEWARE
Oxycodone	Took half orally and threw up violently once pill kicked in. I don't know if its something that just didn't agree with me or what. I have a high tolerance so it wasn't the fact it was too strong. Based on others loving the product maybe it has to be ingested by other means instead orally.
Oxycodone	Product not optimal. tastes like some xans that i had a while ago. hand pressed.So super thick pills. Feeling i think no fent i didnt test it but i had fent stripes in my mouth for years and they dont feel nor taste the same.i had one extra in thats a plus as well.
Oxycodone	USE WITH CAUTION! These are very strong, I am on 8 mg Suboxone after 1 day off, 1/4 of one of these pills had me lifted. Very good press and quality.
Oxycodone	these buy is a scam sell fentanly pills pure garbage don't waste your money on this idiot look at the pills pure garbage dont waste your money https://ibb.co/8zT9m4v
Oxycodone	im writing this to save a life. someone i am very close to overdosed on one of these m30 pills and died. i heard a thud and found them on the floor, blue lips, a blank stare and no pulse. these pills vary extremely in strength, some very weak and some very strong. this death was caused by one singular pill, snorted. it contained fentanyl, oxycodone, and THC. if you buy these pills be extremely careful when using them or it may mean your death. dont be retarded, BE SMART.

TABLE 2 Examples of Adderall (Generic and Pharmaceutical) Listings Harm Reduction Buyer Feedback.

Product Listing	Relevant Message Quote
Adderall	Little confused about what type of amphetamine these contain. It says M-amphetamine and dextroamphetamine. Perhaps its a mixture of methamphetamine and amphetamines. I tried one and a half and it feels like adderall so overall Im pleased
Adderall	Orange Marquis and orange Liebermann, but bright blue Simon's, indicating likely presence of methamphetamine. Might be fine if you're ok with that form of amphetamine.Be careful out there.
Adderall	started w/2, got the sweats, hot flashes, dizzy, nausea. Not sure what's in these but way different than other addy presses. Gave them several chances but no bueno on the side effects.
Adderall	product tested VERY blue on the Simons reagent (i.e. meth). Proceed with caution…Update: unfortunately, not satisfied with this product after trying. Increased heart rate and anxiety, with none of the attentiveness and focus that's expected from adderall
Adderall	Tested positive for both amphetamines and methamphetamines. Adderall would only pop for amphetamines. Maybe thats ok with you guys but if youre looking for a cheap medical alternative like me I thought it was important you know what youre putting in your body
Adderall	addys are a salting of meth and mdma. stay away unless u want a headache and trashy mood
Adderall	bit big, color could be a bit better but they work and came with a few extras which was nice for test purposes, negative for fent and positive on marquis for methamphetamine but using a mandellin yielded a whiter starting tone indicitave of amphetamine presence. Do with that info as you want.
Adderall	great quality product, feels like pharma but need a press or something, dont see how you could resell these since the caps they are in are not 30 mg ir addy caps. they look like vyvanse or the 10/20 mg ir gel addy caps
Adderall	on par with more expensive presses, cleaner high than straight meth. im a bit of a meth head and three of these had me right for half the day. thats good.
Ritalin	This Vendor is absolutely a scammer! I ordered from him over 3 weeks ago and still haven't received anything. And the Ritalin tablets should be shipped from NE to GE. These two countries are neighboring countries, a few kilometers apart. When I asked the vendor to give me the tracking link so I can see where my package is, he refused. This clearly proves that he didn't send the package with the order at all. Please stay away from this scammer. All the positive reviews are fake.

TABLE 3 Percentage of Feedback Type for Each Product Listing Label.

Product Listing Label	Pharmaceutical (%)	Experience (%)	Testing (%)	Scam (%)
Generic	15.38	31.36	17.75	1.89
Adderall	3.50	29.92	18.06	0.54
Oxycodone	24.68	32.49	17.51	2.95
Pharmaceutical	58.47	48.03	15.31	0.93
Concerta	12.50	62.5	0.00	0.00
Hydrocodone	17.54	10.53	28.07	0.00
OxyContin	26.14	38.64	8.52	0.57
Percocet	89.17	83.33	28.33	0.83
Ritalin	20.69	43.1	1.72	3.45
Vyvanse	25.00	25.00	0.00	0.00

TABLE 4 Percentage of Feedback Type During the Pre/Post Harm Reduction Announcement Time Frame.

Product Listing Label	Pharmaceutical (%)	Experience (%)	Testing (%)	Scam (%)
Generic	15.38	68.64	17.75	1.89
Pre-Harm Reduction Announcement	18.33	62.67	17.00	2.33
Post-Harm Reduction Announcement	13.76	71.93	18.17	1.65
Pharmaceutical	58.47	48.03	15.31	0.93
Pre-Harm Reduction Announcement	67.48	38.04	12.88	1.23
Post-Harm Reduction Announcement	52.99	54.10	16.79	0.75

Percocet, and Vyvanse feedback showed a noticeable drop in the percentage of pharmaceutical feedback after the "harm reduction" policy announcement. Oxycodone, OxyContin, Percocet, and Vyvanse feedback showed an increase in the percentage of Experience feedback after the "harm reduction" policy announcement. Hydrocodone and Ritalin showed an increase in the percentage of Pharmaceutical feedback and a decrease in Experience feedback. Concerta feedback was different in comparison with the other product types experiencing a drop in the percentage of Pharmaceutical and Experience feedback. We calculated a chi-square value and the results showed that the Pharmaceutical ($p = 0.001$) and the Experience ($p = 0.00$) themed buyer feedback were associated with the "harm reduction" policy announcement. There was not enough evidence to reject the null hypothesis that the Testing ($p = 0.322$) or Scam ($p = 0.414$) themed buyer feedback was not associated with the "harm reduction" policy announcement.

6 | DISCUSSION

Our study reveals two important findings about AlphaBay's buyer feedback and its relationship with AlphaBay's "harm reduction" policy. First, we find evidence of harm reduction information

TABLE 5 Percentage of Feedback Type for Each Listing Type During the Pre/Post Harm Reduction Announcement Time Frame.

Product Listing Label	Pharmaceutical (%)	Experience (%)	Testing (%)	Scam (%)
Pre-Harm Reduction Announcement	35.64	54.00	15.55	1.94
Adderall**	3.65	68.61	18.25	0.73
Oxycodone**	30.67	57.67	15.95	3.68
Concerta*	100.00	66.67	0.00	0.00
Hydrocodone*	71.43	14.29	28.57	0.00
OxyContin*	83.87	25.81	8.06	0.00
Percocet*	18.75	78.13	25.00	0.00
Ritalin*	74.19	45.16	0.00	6.45
Vyvanse*	85.71	14.29	0.00	0.00
Post-Harm Reduction Announcement	26.69	66.05	17.71	1.35
Adderall**	3.42	70.94	17.95	0.43
Oxycodone**	21.54	72.67	18.33	2.57
Concerta*	80.00	60.00	0.00	0.00
Hydrocodone*	93.10	6.90	27.59	0.00
OxyContin*	68.42	45.61	8.77	0.88
Percocet*	7.95	85.23	29.55	1.14
Ritalin*	85.19	40.74	3.70	0.00
Vyvanse*	60.00	40.00	0.00	0.00

*Pharmaceutical Labeled Listings.
**Generically Labeled Listings.

being shared through buyer feedback prior to the start of AlphaBay's "harm reduction" policy. This information is communicated through sharing reagent test results, discussing personal experiences with using purchased substances, and outlining the pros and cons of pharmaceutical, pressed, and adulterated pills. Second, comparing pre and post periods of the "harm reduction" policy, we find some changes in how this information is shared through buyer communication. This includes a slight increase in buyer feedback that contains experience and testing-related harm reduction themes. Our discussion first outlines the significance of our findings, then it discusses the importance of harm reduction-related buyer feedback on DNMs, and finally ,we highlight how these findings on communication amongst PWUD on AlphaBay can be understood within the current context of national and international drug policy.

6.1 | Insights gained from AlphaBay's buyer harm reduction feedback

Harm reduction operates under the public health model by surveilling drug use, understanding the illicit market, and supporting the agency of PWUD to manage their own mental and physical health (Marlatt, 1996). In our literature review, we identified four attributes of harm reduction that are relevant to DNMs: Experience, Pharmaceutical, Testing, and Scam-themed data.[13] Our results demonstrate that DNM buyers communicate these themes through sharing detailed experiences

when using purchased substances, explaining reagent testing practices, and discussing the quality of the products and how to distinguish between pressed and pharmaceutical pills. Recent research indicates that buyer feedback is useful for first-time buyers who rely on vendor reputation and available information before making purchases (Munksgaard, 2023; Norbutas et al., 2020). Unlike forums, feedback is available for specific products and vendors and is provided by individuals who most likely have direct experience using the substance. The importance of buyer feedback aligns with current strategies used in street-level harm reduction programs, which highlights that fostering communication between PWUD reduces the risk of overdose (Friedman et al., 2004, 2007; Kerman et al., 2020).

Drawing from these harm reduction-related themes, we analyzed whether harm reduction strategies changed before and after the administrator-led "harm reduction" policy. Our results demonstrate that there was a statistically significant relationship between the themes of Experience feedback, Pharmaceutical feedback, and the "harm reduction" policy announcement. The percentage of feedback with these themes also changed after the "harm reduction" policy announcement. Pharmaceutical-themed feedback decreased from approximately 36% to 27% of total harm reduction feedback after the "harm reduction" policy announcement and Experienced-themed feedback increased from approximately 54% to 66% of total harm reduction feedback after AlphaBay's "harm reduction" policy announcement. Previous research indicates that users are actively willing to engage with harm reduction resources on DNMs (Davitadze et al., 2020; Vale Pires et al., 2016). In their study on the use of a harm reduction thread on a popular DNM, Davitadze et al. (2020) found that the users in virtual settings readily engaged with the materials that they posted. Similarly, Vale Pires et al. (2016) outlined the engagement received by Doctor X, a doctor working undercover to answer questions of individuals who wanted to know about the dosage and side effects of marketed substances on a DNM. These findings, whereas specific to DNM forums, indicate that buyers are engaging with harm reduction strategies. Our findings contribute to this body of research by identifying the sharing of harm reduction strategies between buyers on a platform that has not been previously identified as a harm reduction network.

When examining pre and post changes between specific harm reduction-related themes, we found that there was an increase in Experience feedback following the "harm reduction" policy announcement. These findings indicate that the "harm reduction" policy may have increased buyer awareness of the potential risks on DNMs and prompted others to share their personal experiences when using substances. Examples from our study similarly revealed the intimacy of these experiences shared through the feedback. For example, one buyer said that "[they] hadn't used opiates in over 1.5 years.…[and] started by snorting a few small lines"; another discusses physical reactions to a product they purchased such as "[getting] the sweats, hot flashes, dizzy, nausea." These findings demonstrate users feel comfortable sharing their experiences through feedback, possibly due to the anonymity of the darknet and DNMs. Buxton and Bingham (2015) found that forums and chat rooms encourage users to share their personal experiences due to the anonymity provided by the darknet and specifically the use of monikers in the forum. Discussions of experiences were also linked to recommendations to future buyers such as one comment stating that the substance "felt good; not as euphoric as actual oxycodone. Overall I'd recommend this to beginners, they were very safe." These findings demonstrate that buyer feedback allows for the discussion of experiences that are specific to the product that is being purchased. Our findings align with the observations proposed by Vale Pires et al. (2016) and Buxton and Bingham (2015) on the uniqueness of DNMs and sharing experiences with others.

When examining pre and post "harm reduction" policy changes, we found a moderate increase in the percentage of Testing feedback. These findings suggest that the "harm reduction" policy

may be associated with a marginal increase in drug testing for fentanyl and/or other adulterants in certain substances. It is worth pointing out that the nonsignificant change from before and after the "harm reduction" policy may demonstrate that individuals have always been aware of testing even before the "harm reduction" policy. The use and results of these tests are communicated in the buyer feedback and communicate how buyers protect themselves from potentially dangerous purchases. For example, one buyer writes that "[they were] suspicious of the adderall and tested it with Mecke, Mandelin, and Marquis reagents" providing the results of the tests and their conclusion that the product they purchased is "without a doubt NOT adderall." Others provide details of the test and recommendations to potential buyers as one comment states that their tests reveal "orange Marquis and orange Liebermann, but bright blue Simon's, indicating likely presence of methamphetamine. Might be fine if you're ok with that form of amphetamine." One buyer indicated, "Negative for fent on test strips," whereas another buyer said, "Tested negative for fent, which is more important to me than dimensions." Resources for testing substances for adulterants have become more available in street-level harm reduction services considering the increase of deadly amounts of fentanyl in certain products. The growing availability of reagent testing and fentanyl test for purchase online on legal marketplaces further indicates the importance of these strategies on DNMs.[14]

Finally, findings show that there was a decrease in Pharmaceutical feedback after AlphaBay's "harm reduction" policy. This theme provides information on whether the product purchased is "legit" or manufactured by a pharmaceutical company. Previous literature has shown that there is less interest in pharmaceutical products in part because they are more expensive and less potent than products containing fentanyl (Karamouzian et al., 2020). The decrease in Pharmaceutical feedback could be explained by the shift away from pharmaceutical brands in favor of cheaper products. Additionally, these findings show that there is less focus on the quality of the product and more on whether it is safe, highlighting the importance of personal experiences and testing practices over the authenticity of the product.

6.2 | Policy implications

Our findings show that harm reduction strategies are being used amongst buyers on DNMs to communicate about specific products. These strategies have been used before and after the implementation of an administrator-led policy. This means that buyers are already aware of the use of harm reduction resources such as reagent and fentanyl testing, as well as the importance of communicating to others on their personal experiences taking drugs and how to take drugs safely.

The rise in fentanyl-related overdoses in the United States highlights the importance of these strategies amongst individuals both online and offline who use drugs. Street-level harm reduction programs are generally oriented toward individuals who buy drugs from street dealers and are designed to serve particularly vulnerable populations such as individuals experiencing homelessness or those who do not have access to health or social support resources (Marlatt, 1996). The findings from our study suggest that current street-level harm reduction policies should integrate their services and resources virtually to address the needs of online buyers. For example, harm reduction programs could consider ways of training staff on how to create resources for DNM users, as seen in Davitadze et al. (2020), which demonstrates the work of a street-level harm reduction program implementing services within the DNM platform.

Next, our findings on the use of testing amongst DNM drug buyers suggests that policies should be considered that provide increased access to reagent testing resources, test strips, and online

testing services. Currently, there are several reagent tests and fentanyl test strips brands that are available on legal marketplaces such as Amazon. In some select areas of the United States, these resources have been available through street vending machines allowing individuals instant access to reagent and fentanyl tests (ABC 7 Eyewitness News, 2023; Crumpler, 2022). New York State Office of Addiction Services and Supports (2023) will mail naloxone and test stripes (fentanyl and xylazine) to any valid address within the state, whereas the Wisconsin Department of Health Services (2022) has paid to have several health centers and organizations within the state receive fentanyl test stripes and doses of NARCAN directly from pharmaceutical companies. Additionally, at least 20 U.S. states have decriminalizing fentanyl test strips (Hendrickson, 2023). Reducing the legal barriers and expanding access to these types of resources would increase access and awareness of these products.

One limitation of fentanyl and reagent tests is that they do not provide information on the levels of substances that are in the product (Green et al., 2020). This means that although fentanyl may be detected in the product, there is no indicator on whether the amount is deadly to the user. Because fentanyl has been shown to be consistently present in substances, individuals will often continue to use fentanyl-positive substances when unable to find unadulterated versions (Karamouzian et al., 2020). To address this issue with testing, more consideration should be directed to online testing sites such as Energy Control, DrugsData, and Wedinos, which allow individuals to send their substances to a lab to receive detailed information on the contents of their specific product. Reagent testing is currently being improved through partnerships with online testing labs such as DrugsData to reveal more detailed results on the contents of substances (Clark, 2023). There also exist some handheld products, such as the Raman spectrometer and the Fourier-Transform Infrared Spectrometer typically used by law enforcement agencies (Green et al., 2020). These alternatives to reagent tests and test strips are not easily accessible and are expensive (the Raman spectrometer costs about $18,000 and individual lab testing can cost up to $150 per substance tested). Given the limitations of reagent tests and test strips, more access and awareness should be oriented toward these alternative testing processes, which could reduce the risks of overdose amongst individuals using adulterated substances. Faster mailing and accessible substance drop-off locations to send test samples to labs could help increase the accessibility of quick and detailed results. The use of testing amongst DNM drug buyers could be greatly improved if individuals could have access to more detailed information on the substances they are buying in a reasonable amount of time.

Our findings also demonstrate that buyers on DNMs are willing to share their personal experiences about taking substances on an anonymous platform. Knowledge sharing is a key component of the harm reduction philosophy (Friedman et al., 2007). Previous research has shown that this can be challenging in street-level harm reduction programs because most staff members do not buy or use drugs which hampers client willingness to engage in open knowledge-sharing processes (Poliquin et al., 2023). This suggests that sharing experiences with other users about buying and using drugs could be a form of harm reduction that is more accessible on DNM platforms. From a policy perspective, our findings on sharing experiences in product feedback are noteworthy because they shed light on the buyer's experience with a vendor, a relationship that is often overlooked in street-level harm reduction programs (Blanchard, 2019). This communication reveals details on the specific product purchased, products purchased from the vendor previously, and comparison with the potency and quality of other vendors. What makes this information shared by buyers unique is the insight into the consistency of the vendor's batches and the relationship between a buyer and the vendor over time which is not captured in any other platform utilized by DNM buyers. It is clear that buyers communicating about experiences with vendors is

key for informing others of product quality and safety. Therefore, dedicating resources and personnel to observing vendor and buyer interactions on DNMs could provide insight into trends in the drug supply in unregulated markets.

There has been a global push toward decriminalizing drug use as seen in countries such as Portugal and U.S. states like Oregon (Davies, 2018; UN News, 2021). There are some attempts to regulate the illicit drug market within the parameters of drug policies that criminalize drug possession, use, and consumption. For example, some countries have implemented programs that provide "a legal and regulated supply of drugs" that are accessible "only through the illicit drug market," also known as Safer Supply programs (Canadian Association of People Who Use Drugs, 2019). Early findings have shown that these programs increase client autonomy and safety when using drugs (Gagnon et al., 2023; Haines & O'Brian, 2023). Additionally, research suggests that regulated supplies of opioids help clients monitor and decrease their fentanyl intake over time, thereby mitigating addiction to opioids and decreasing the risk of overdose (Gagnon et al.,2023). Although these programs are still in their infancy, they invite the possibility of exploring how the regulation of drug supply could exist in virtual spaces to address the potential dangers of drug markets on DNMs and provide buyers with a supply of quality medical-grade products. The findings from our study provide an outlook of how individuals can use their agency to communicate with others on the quality and safety of illicit products. Safer Supply programs are potential resources that could build upon these feedback loops to provide individuals with best possible substances to address their needs.

7 | LIMITATIONS AND FUTURE RESEARCH

There are some limitations in this project that need to be addressed. First, the initial coding of each comment was done by a single coder who was responsible for a subset of the data used for analysis. This could have led to some bias between coders. Second, it is important to note that these data were collected as part of a research grant not specifically for this project which prevented us from controlling the time intervals of the data collection. The lack of control over this process means we can only verify the completeness of the data for the days collected. Specifically, if updates occurred between the days the data collection was performed, these pages would be lost. Next, we did not use a case–control DNM to observe whether changes in feedback are attributed to "harm reduction" policy or other confounding factors. The complexity of DNMs such as the differences between the available products and each DNM's downtime makes it difficult to undertake a one-to-one comparison of buyer feedback between two distinct marketplaces. Additionally, our research focuses on a smaller subset of products and feedback that is written in English and only observes products that can be obtained legally and take the form of pills.

The data analyzed were limited to only 15% of the initial dataset. We acknowledge that this percentage is marginal in comparison with earlier online content analyses. For instance, Holt et al. (2008) found that in forums for sex worker clients, 70% of the posts were related to sex work and included detailed information about identifying and soliciting sex workers at specific times and locations. Nevertheless, more recent research using larger websites catering to multiple interests found smaller percentages of relevant posts when performing content analysis to identify particular themes (Garg et al., 2021; Spadaro et al., 2022). These research teams analyzed fentanyl-related subreddits on Reddit, finding only 3% to 25% of the content of subreddits was directly related to fentanyl. Our dataset aligns with these findings, demonstrating that sites such as AlphaBay and Reddit provide a range of information that may or may not be directly related to the content of the

product or topic. One potential solution to increase the percentage of relevant feedback is investigating whether buyers use one-word or feedback with only symbols to inform other buyers about a specific vendor or product covertly. Research suggests that vendors engage in this covert practice by using colors, one-word phrases, and combinations of words to convey hidden messages to buyers (M. Maras, Logie et al., 2023; M.-H. Maras, Arsovska et al., 2023). The inclusion of these terms would increase the size of the dataset available to researchers analyzing harm reduction feedback on DNMs.

To address these limitations, more research is needed to understand how administrator-led "harm reduction" policies on DNMs could impact harm reduction awareness amongst buyers and sellers on DNMs. Additionally, consideration should be given to the covert and semi-covert communication strategies used amongst buyers and sellers, as well as feedback left in other languages and the behaviors of predatory vendors who sell drugs across multiple DNMs. Finally, future research should focus on buyer feedback on substances that are illegal in most countries and/or sold in other forms besides pills to determine if harm reduction strategies observed in this study are generalizable to other drugs sold on DNMs.

8 | CONCLUSION

In the 1990s and early 2000s, addictive opioids were overly prescribed to individuals for pain management. This overprescription increased addiction amongst individuals leading to restrictions on opioid disbursement in pharmaceutical settings and increased demand amongst users (Okie, 2010). There has also been a similar increase in the demand for ADHD medication in the 2010s among school-age and college-age students for both medical and nonmedical benefits (Benson et al., 2015; Cunliffe et al., 2019). Drug markets on DNMs addressed the demands of buyers when legitimate pharmaceutical companies restricted availability. These markets are less violent than open-air drug markets, yet are more challenging to monitor and police. This is particularly worrying considering the current overdose epidemic. Identifying how harm reduction initiatives can unfold within these markets helps understand how PWUD themselves can address the dangers of drug consumption without the need for criminalization. Actual oversight and regulation by governments and an affordable unadulterated supply of these products supplied at a level meeting the demand are needed to curb the demand for DNMs products. Nevertheless, our research shows that buyers on these illicit markets urge others to be aware of the ongoing dangers of untrustworthy vendors and drug use without administrator-led harm reduction programs. Our research also demonstrates that there is a desire by individuals using these spaces to have access to harm reduction information and services. Further research should continue to explore harm reduction initiatives and communication within virtual spaces and policy interventions should consider ways of providing harm reduction resources to DNM buyers and creating a feasible game plan to regulate illicit drug markets.

ACKNOWLEDGMENTS

We would like to thank two faculty members of the John Jay College of Criminal Justice/CUNY Graduate Center Criminal Justice Ph.D. program. Dr. Kevin Wolff, the research adviser for the Ph.D. program, for providing feedback on earlier drafts of this paper. We thank Dr. Marie-Helen Maras, the Center for Cybercrime Studies director, for her feedback on earlier drafts of this paper and permission to use the center's darknet database.

CONFLICT OF INTEREST

The authors confirm that they have no conflict of interest to declare.

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ENDNOTES

[1] Fentanyl was banned on AlphaBay by both administrators, but they had different intentions and approaches in implementing the ban.

[2] Telegram is a cross-platform encrypted communication application that is accessible worldwide.

[3] Australia, Belgium, Canada, France, Germany, the Netherlands, Poland, Sweden, Switzerland, the United Kingdom, and the United States.

[4] Australia, Austria, Belgium, Canada, France, Germany, Italy, Luxembourg, the Netherlands, Spain, Switzerland, Turkmenistan, the United Kingdom, and the United States.

[5] Darknet onion webpages can be accessed only using the tor browser. AlphaBay was also accessible using another darknet page type I2P which requires another specialized browser and cannot be accessed using the tor browser.

[6] The use of the five senses, dosage, feeling after using product, colors of pills.

[7] Vendors who provided fake pills, a significant number of pills are missing, or the comment contains the word scammer.

[8] At least 8 vendors who should have had harm reduction reviews had no feedback attached to their profiles. We assume either the test did not meet the required standard for posting or there is a mechanism for vendors to dispute the harm reduction review, and feedback is not posted until a decision is made regarding the validity of the feedback.

[9] ScamWatch was a testing program implemented by AlphaBay to test vendors reported by AlphaBay buyers with supporting evidence demonstrating they were engaged in a scam or selling dangerous products.

[10] The removal of a vendor can be voluntarily done by the vendor or can be the result of the DNM administrator taking action against the vendor for violating the marketplace policy.

[11] The vendor's store and listings are made inaccessible, and the vendor's trust level displayed on the vendor's profile page and listings was reset to 1.

[12] This restriction was either self-imposed by making parts of the page private or restrictions placed by the DNM administrator.

[13] Scam-related feedback comments from Adderall and Oxycodone buyers were almost nonexistent on Alphabay and therefore are not included in the discussion.

[14] Marquis, Simon, Liebermann, Mandelin, and Mecke, Available from DanceSafe as part of their 6 or 9 reagent test kit. Each of these tests reveal different types of substances (e.g., Simon, Marquis, Mandelin, and Mecke react to MDMA while Liberman and Mandelin react when cocaine or ketamine are present). Fentanyl test stripes are available on platforms such as Amazon along with reagent tests which are produced by other manufacturers.

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SUPPORTING INFORMATION

Additional supporting information can be found online in the Supporting Information section at the end of this article.

How to cite this article: Logie, K., Pugliese, K., & Acevedo, A. (2023). An examination of harm reduction strategies in Oxycodone and Adderall buyer feedback on AlphaBay. *Criminology & Public Policy*, *22,* 695–733. https://doi.org/10.1111/1745-9133.12652

APPENDIX A: EXAMPLES OF THE MARKETPLACE TESTERS' HARM REDUCTION REVIEWS ON OTHER PRODUCTS

Vendor #	Product Listing	Reviewer(s)	Excerpts from Marketplace Harm Reduction Review
1	Cocaine	Harm reduction reviewer	coke is not uncut, it seems like the coke is repressed with amphetamine (speed)coz the effects was similar to speed orit may be the levamisole itself. Not pure coke for sure.
2	Cocaine	Harm reduction reviewer	Product quantity received as advertised. Laboratory confirmed the product to only contain cocaine, with no adulterants.
3	Ketamine	Harm reduction reviewer	Product quantity received as advertised. Laboratory confirmed product to only contain Modafinil.
4	Sinaloan BTH	Harm reduction reviewer	Negative for fent.
5	Xanax	Harm reduction reviewer	Dedicated test indicated benzos
6	MDMA	Harm reduction reviewer	Listing as described, high quality MDMA
7	Modafinil	Harm reduction reviewer	laboratory confirmed product to only contain Modafinil.
8	Meth	Harm reduction reviewer	Fent strip extremely faint (+). One has the right to sell to whomever they want, but what are they hiding?
9	Methylphenidate	Harm reduction reviewer	Product quantity received as advertised. including the Data Matrix code and serial number, verified the product to be authentic. Reagent testing confirmed the product to only contain methylphenidate.
10	Tapentadol	Harm reduction reviewer	Came in blisters but took a while. Negative for fent. Felt different than my previous personal experience from the drug.

(Continues)

Vendor #	Product Listing	Reviewer(s)	Excerpts from Marketplace Harm Reduction Review
11	LSD	Harm reduction reviewer	Potent and pure LSD. Product is as described.
12	Cocaine	Harm reduction reviewer	Product quantity received as advertised. At initial evaluation appears to be high quality product.
13	Cocaine	Harm reduction reviewer	Product quantity received as advertised. laboratory displayed a minor presence of levamisole contained in the product.
14	(a) Etizolam	Harm reduction reviewers	(a) Less than half of the amount had been shipped by the vendor.
	(b) Diazepam		(b) Less than half of the amount had been shipped by the vendor. Potentially mild paracetamol cut detected within the product using reagent testing.
	(c) Etizolam		(c) paracetamol cut indicates weaker product, delivery stealth and quantity accurate. the cut is minimal though
15	(a) Cocaine	Harm reduction reviewers	(a) Product quantity received as advertised. laboratory displayed a minor presence of levamisole contained in the product.
	(b) Weed		(b) Product quantity received as advertised. The product is high quality and appropriate given the descriptions/pictures provided by the vendor.
	(c) Weed		(c) weight adequate.
	(d) Weed		(d) Product quantity received as advertised. The product is high quality and appropriate given the descriptions/pictures provided by the vendor.
16	(a) MDMA	(A) Harm reduction reviewer	(a) Product quantity received as advertised. laboratory confirmed the product to only contain MDMA, with no adulterants.
	(b) MDMA	(B) Scamwatch staff	(b) received 5 pills as advertised, reagent tests, as well as lab tests confirmed that the product is as advertised.
	(c) Mephedrone	(C) Harm reduction reviewer	(c) Listing as described, high quality mephadrone.
17	Crystal Meth	Harm reduction reviewer	Positive for fent. Other than that, shows mainly heroin.
18	Mushrooms	Harm reduction reviewer	Excellent stealth, tried and no foreign substances detected. As advertised, slightly overweight and potent. Arrived next day.
19	MDMA	Harm reduction reviewer	Product quantity received as advertised. laboratory confirmed the product to only contain MDMA, with no adulterants.
20	Xanax	Scamwatch Staff	The vendor had shipped double the amount ordered. However, ScamWatch check had been done in response to information of product possibly containing flualprazolam, which is pending confirmation by laboratory.

(Continues)

Vendor #	Product Listing	Reviewer(s)	Excerpts from Marketplace Harm Reduction Review
21	(a) Cocaine	Harm reduction reviewers	(a) Product quantity received as advertised. At initial evaluation appears to be high quality product.
	(b) Cocaine		(b) Product quantity received as advertised. At initial evaluation appears to be high quality product.
	(c) Cocaine		(c) Weight as advertised
	(d) Cocaine		(d) Very pure product, especially for the substance.
22	DMT	Harm reduction reviewer	Overweight by a considerable degree, and delivery as advertised.
23	MDMA	Harm reduction reviewer	Product clean but came in poorer condition than others.
24	(a) Speed	(A) Scamwatch staff	(a) Caffeine cut detected—major. ScamWatch staff received X grams of the product as advertised. The product is of not advertised quality, due to lab. testing detecting the product to be cut with caffeine at a major level.
	(b) Speed	(B) Harm reduction reviewer	(b) Caffeine cut detected
	(c) Speed	(C) Harm reduction reviewer	(c) All appropriate reagents indicate Amphetamine with no cuts. Delivery and stealth adequate, quantity exceptional (over a gram overweight)
25	(a) Heroin	Harm reduction reviewer	(a) Product quantity received as advertised. At initial evaluation appears to be high quality product.
	(b) Cocaine		(b) Product overweight
	(c) Heroin		(c) Quantity adequate
26	Weed	Scamwatch staff	received above the amount of product ordered. The product is high quality and appropriate given the descriptions/pictures provided by the vendor.
27	MDMA	Scamwatch staff	Received as advertised, reagent tests, as well as lab tests confirmed that the product is as advertised
28	Diazepam	Harm reduction reviewer	Blister packaging all exceptional
29	(a) Cocaine	Harm reduction reviewer	(a) Product quantity received as advertised. laboratory confirmed the product to only contain cocaine, with no adulterants.
	(b) Cocaine		(b) Product quantity received as advertised. laboratory confirmed the product to only contain cocaine, with no adulterants.
30	Heroin	Harm reduction reviewer	Product quantity received as advertised. results displayed that the product contains some adulterants, as well as lacks purity to a minor extent. Nonetheless, product quality is satisfactory and relatively safe for use.
31	Cocaine	Harm reduction reviewer	Smells potent. Note: Definitely not as clean as they claim. contains at least a couple of adulterants including Levisomole. Also there was a faint (+) for fent.

(Continues)

Vendor #	Product Listing	Reviewer(s)	Excerpts from Marketplace Harm Reduction Review
32	(a) Accutane	Harm reduction reviewers	(a) Product quantity received as advertised. verified the product to be authentic.
	(b) Antibiotic		(b) Product quantity received as advertised. verified the product to be authentic.
	(c) Armodafinil		(c) Product quantity received as advertised. the Data Matrix code and serial number, verified the product to be authentic. Reagent testing using Mecke, Froehde, Marquis, and Mandelin reagents confirmed the product to only contain armodafinil (reacting similarly to modafinil to reagents)
	(d) modafinil		(d) Product quantity received as advertised. the Data Matrix code and serial number, verified the product to be authentic. Reagent testing using Mecke, Froehde, Marquis and Mandelin reagents confirmed the product to only contain modafinil.
33	Hash	Harm reduction reviewer	High quality hash. Slightly underweight (3.1 g rather than 3.5 g), otherwise good and as described
34	Ketamine	Harm reduction reviewer	High quality ketamine. product is as described. Slightly overweight, reagent tested positive for ketamine.
35	2-FMA	Harm reduction reviewer	Negative for Fent.
36	Cocaine	Harm reduction reviewer	Quantity very good—minor cut on quality
37	Speed	Harm reduction reviewer	Negative fent result
38	MDMA	Harm reduction reviewer	Product quantity received as advertised. Reagent testing displayed that product contains MDMA of potentially high potency and quantity due to fast response to reagents.
39	Rivotril	Harm reduction reviewer	Rivotril (Clonazepam) had been shipped in response to an order of 0.5 mg Xanax, thus, vendor shipped a different product completely. Nonetheless laboratory testing showed that the product also contains Tramadol, which implies that pills are pressed, and not straight from the pharmacy as claimed by the vendor.

APPENDIX B: GOALS OF ALPHABAY HARM REDUCTION PROGRAM FROM A Q&A POST WITH ALPHABAY STAFF

Topics	Comments
False advertising	• Vendors who continue falsely advertise a substance, the marketplace administrators, and staff believe that the punishment has to fit the crime. Vendors won't be punished as severely (not at first, at least) as those who the administrators and staff believe will have a deadly impact on a user. The marketplace's end goal is to certainly have everyone abide by the rules regardless of the impact of the falsely claimed substance. This is not a program that is solely for "punishing" vendors. The market strives to have complete transparency between vendors and buyers.
Testing	• We do not get physically involved in testing listing products as it would result in an opsec risk. • Harm Reduction results are from multiple independent reviewers as well as laboratories. The results are sent to labs in most cases. However, sometimes only reagent tests are done. In such cases, at least two reviewers check the product listing to confirm the same results. The harm reduction reviewers do not know what other reviewers are testing. • Most of the tests have lab results you can see in the Laboratory Reference field so users can make their mind up themselves if they have the technical understanding to do so. Reagent tests are only published if they have been tested at least twice, each time by a different drug checker independently. Some listings need lab testing, while for others, a reagent is sufficient unless there is a serious difference and serious reports about it. We use several people to test with reagents before compiling results. We do lab testing if there is an issue or if any tester feels one is needed. • Kits are sourced individually and depending on the location of the tester. We do several tests at different times, then rerun the test in a month or two since anyone can get a "not so good" batch as they usually do. That is why we also note that the reviews should not be considered total and absolute. • In the off-chance there is an issue, you can raise a dispute as vendor and we can review it—of course, in any way, we are reasonable, but the way it is set up enforces a methodology that keeps such issues away.
Harm reduction rating	• The rating is fairly accurate. We consider many factors, but until there is some more streamlined (as well as simple) flow/grading system, I do not see this changing.
Buyers submitting testing results	• There is a high potential for abuse, so we are not accepting such submissions. However, you are free to post it on the AlphaBay Forum, so when people search it up can see your experience.
Professional drug testers	• Most, if not all, are reviewers with previous history so they know their stuff. Where there is doubt or depending on the product/situation we send to labs so they can confirm. The only part where we need to trust is actually the checker receiving and checking, nothing more nothing less as I said it is cross-referenced from multiple reviewers. Some drug checkers might use the drugs shipped but for the most part they rely on the reagent test kits and labs. Whether a drug checker likes the product is not factored in these reviews.
Anonymizing testing	• They need to know who the vendor is right before purchasing as they have to PGP encrypt their address with the vendors PGP (we only fund the account, everything else is up to them to complete).

(Continues)

Topics	Comments
Impact and Benefits for Vendors	• Vendors with good products will shine thanks to this program. At the end of the day if you have quality product that will be evident especially compared to those that mislead about their purity. Some vendors selling bad batches will likely be exposed due to this new initiative, but these vendors moving away from the market is not a bad thing; it's the desired effect (other than incentivizing them to sell a better product, of course). This initiative is not an opt-in initiative; any vendor can and eventually will be checked, whether they agree or not. Otherwise, harm reduction programs would have little effect. We want our vendors to be honest and transparent with their products to maintain a high standard on AlphaBay.
Market benefits	• Keep our buyers, healthy, happy, and as risk-free as possible. Maintain a high standard for our vendors, and also keep them happy, and as risk-free as possible. Harm reduction is for the good of the community, and as a market I cannot think of any ulterior motive that would invalidate the harm reduction data collected. It's a system whose individual gears are made up of the community, and whose function is to serve the community. • There's a distinct difference between being a "criminal," and being a "bad actor." Vendors are also just regular people, selling a particular product that governmental institutions outlawed. They can do that the right way, by being transparent and forthcoming in what they sell, or they can do it in a poor way, by potentially endangering their customers. That is the distinction between a "bad actor" and an individual otherwise considered a "criminal." That is also the distinction that the harm reduction program wants to draw; for the sake of the community. It is an initiative aimed at protecting buyers, and encouraging the sale of good product all across the board. It's a win-win, except for vendors that aren't true to their word. When lives are at stake, honesty should not be too much to ask. • The marketplace can only control the activity of a vendor, whereas it is nearly impossible to control users and their reports, especially whether they're true or not. I'll have you know though, without naming the vendor, with this model, they'll eventually either have to conform to the rules of harm reduction or get exposed by our checks and this goes for everyone. • We are focused on using a randomized model to accumulate a large enough sample size of checked substances. The idea is that this would allow us to recognize specific trends and targeted abuse by competitors.

APPENDIX C: EXAMPLES OF THE MARKETPLACE TESTERS' HARM REDUCTION REVIEWS OF ADDERALL AND OXYCODONE PILLS

#	Product Listing	Excerpts from Marketplace Harm Reduction Review	Vendor and Buyer Responses
1	Percocet	Adulterants detected, it was a faint fentanyl test for a large pill. He did provide and extra joint of weed and some sweets with the shipment	Although an adulterant was detected in this listing, the listing sales and the vendor's sales remained constant. The vendor was also not penalized by the site administrator, and similarly to many buyers' feedback, the inclusion of extras appears to have eased any negative feelings toward the vendor.
2	Oxycodone	This is the first no fent, oxy we got. Resembles Codeine from reagent testing.	This listing experienced an increase in sales of approximately 100% after the harm reduction program implementation. The sales from this listing accounted for 100% of the vendors' sales after the harm reduction announcement.
3	Oxycodone	ScamWatch staff received 10 pills as advertised, however, the pills do not contain the chemical advertised in the title. But, the vendor does state that the product does not contain Oxycodone, instead, is made using a research chemical. Laboratory Reference (if available): W025505	This vendor has removed the listing tested by the DNM's harm reduction program and, while the vendor's profile is still accessible, it appears to have been abandoned in September.
4	Oxycodone	POSITIVE FENT TEST. Some reactions were concerning. In the claim that it's potent, maybe yes, with the fent in it. Took 5 days to arrive and seems to be a dangerous product.	After testing conducted by the DNM's harm reduction staff, the vendor and their listings were removed from the marketplace. It is not possible to tell if this was done voluntarily by the vendor or an action taken by the DNM's administrator.
5	Adderall	Got extras. Narrowed down the sample to 3 substances. 2-fa, 4-fma, and Methylone.	This vendor experienced an increase in sales of 327% after the harm reduction announcement and a 270% increase in positive comments. This listing had a 364% increase in sales after the harm reduction announcement.
6	Adderall	Reagent test confirmed the presence of a 2nd amine, some sort of meth, i.e., 4-FMA. Lab results should be interesting.	After the harm reduction program staff tested the listing, this vendor's listings were restricted, the vendor's privileges were limited (a message was placed on the vendor's profile page), and the vendor's trust level was reset to 1.
7	Oxycodone	Product quantity received as advertised. At initial evaluation appears to be high quality product. Laboratory Reference (if available): W026756	After implementing the harm reduction program, the vendor abandoned their vendor profile page and had no sales. One of the last buyers to interact with the buyer hypothesized he may have been a selective scammer (exit scammer).

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