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Will growth in cryptomarket drug buying increase the harms of illicit drugs?

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ABSTRACT

Background and aim Cryptomarkets—on-line, anonymous market-places for illicit goods and services that specialize mainly in drugs—account for a small but rapidly growing share of the illicit drug market in many countries. Policy responses so far are based generally on the assumption that their rise will only increase drug harms. In this contribution for debate, we question this assumption. **Methods** We provide a narrative review of the emerging literature connected to drug cryptomarkets. We use MacCoun & Reuter's formula to understand the effect of population-level increases in use on total harm as depending on the level of harm associated with each unit of use. We then consider the potential for cryptomarkets to increase or decrease the harms and benefits related to each unit of drug use, with specific attention to the quality of drugs sold and the non-drug-related harms and benefits for customers. **Results** It is likely that cryptomarkets will increase both the amount and the range of substances that are sold. However, we argue that the effects on harms will depend upon whether cryptomarkets also increase the quality and safety of products that are sold, provide harm-reducing information to consumers and reduce transactional conflict involved in drug purchasing. **Conclusions** There is an emerging and rapidly growing evidence base connected to the macro and micro harms and benefits of cryptomarkets for drug users. Future researchers should use appropriately matched comparative designs to establish more firmly the differential harms and benefits of sourcing drugs both on- and off-line. While it is unlikely that the on-line drug trade can be eradicated completely, cryptomarkets will respond to regulation and enforcement in ways that have complex, and sometimes unanticipated, effects on both harms and benefits.

Keywords Cryptomarkets, darknet, drug dealing, drug harms, drug prices, drug quality, harm reduction, illegal drug use, risk reduction, risk taking.

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INTRODUCTION

Cryptomarkets are on-line market-places that host multiple sellers or 'vendors'; provide participants with anonymity though their hidden web location and payment by cryptocurrencies such as 'bitcoin'; and aggregate and display customer feedback ratings and comments [1]. Transacting anonymously, buyers and sellers of illegal drugs thereby evade world-wide prohibitive controls; only a small proportion of postal deliveries can feasibly be intercepted by authorities. The cryptomarket drug trade is a growing area of interest for criminologists [2,3], public health researchers [4,5], drug policy analysts [6] and for law enforcement and policymakers [7,8]. Cryptomarkets offer a new channel for global drug diffusion [9]. While the proportion of drug users who report cryptomarket buying is currently small, research evidence using multiple methodologies points to an increase [10,11]. Cryptomarket drug sales nearly tripled from September 2013, with revenue estimated to be more than USD $14 million per month in 2016 [12]. Although mainstream media reports tend to focus upon the dangers posed by cryptomarkets [13], there has been limited specific examination of what harms cryptomarkets may produce for users, or ways in which cryptomarkets may reduce drug-related harm while increasing benefits to market participants.

Our aim here is to stimulate debate connected to the micro- and macro-level harms and benefits that arise from different types of retail drug markets, of which cryptomarkets are one recent development. MacCoun & Reuter [14]

conceptualize drug harm as resulting not just from the pharmacological effects of drugs, but also from the wider context within which illegal drugs are produced, trafficked, sold and consumed. They have suggested that the effect of population-level increases in use on total harm will depend upon the level of harm associated with each unit of use, expressed in this formula: total harm = prevalence (number of users) × intensity (units/user) × harmfulness (harm/unit). Following this suggestion, we consider the potential for cryptomarkets to increase or decrease the harms and benefits related to each unit of drug use, with specific attention to the quality of drugs sold and the non-drug-related harms and benefits for customers. We also consider population level effects, including prevalence and intensity of drug use. We alert readers to a growing research literature on cryptomarkets, and set out a number of questions we urge researchers to address in order to provide the evidence needed to inform policy and promote public health.

HOW MIGHT CRYPTOMARKETS AFFECT DRUG QUALITY, PRICE AND PURCHASE-RELATED RISKS?

Are cryptomarket purchased drugs of higher quality?

Cryptomarket vendors will have only limited capacity to control the quality of substances they sell. Cryptomarkets are 'anchored' in off-line drug markets [9], with products sourced ultimately within markets subject to the myriad factors that affect drug quality locally and globally [15]. However, might cryptomarket vendors be more likely than their off-line counterparts to sell 'as advertised' substances rather than substitutes, and less likely to adulterate their supplies with bulking agents that lower drug purity?

One reason this might be the case is that cryptomarket feedback systems allow customers to 'comparison shop' among vendors selling similar products and make judgements on the basis of accumulating product/vendor reputation scores [16]. Because cryptomarkets bring together multiple vendors for particular substances in a potentially global market-place [3], drug buyers can locate alternative sellers more easily. This ease contrasts with traditional, off-line drug markets where 'search costs' [17] are higher due to limited information available to buyers about alternatives, alongside the risks such searches carry [18]. As cryptomarket vendors have considerable scope to describe their products, customers can access more product quality information than would be feasible in off-line illicit markets [19]. Many cryptomarket vendors specify clearly the quality and purity of their products; some even provide chemical test results ostensibly backing up their claims [3]. Moreover, payments are typically held in 'escrow' by the market-place and released to sellers only when customers receive their purchases [20]. Buyers dissatisfied with product quality have recourse by leaving negative feedback [16]. Together, these factors may make vendors more accountable, with buyers, in turn, more likely to obtain 'as advertised' and higher-quality products than those buying off-line.

Research evidence is emerging in support of this possibility. Customer feedback is open to manipulation by vendors [16], but with most vendors holding perfect (5/5) feedback scores [21], it appears that cryptomarket-purchased drugs meet or exceed the expectations of the majority of buyers. Interviews with cryptomarket customers highlight product quality as a key reason for accessing drugs in this way [22–24]. User satisfaction, however, is at best a weak indicator of product quality [25]. Testing the content and purity of drugs provides a more robust benchmark. Two comparative studies using this methodology have been published to date. Forensic tests of 219 Spanish user-submitted cryptomarket drug purchases revealed that in 90% of samples the content matched the advertised substance, with purity for cocaine, 3,4-methylenedioxymethamphetamine (MDMA), amphetamine, lysergic acid diethylamide (LSD), cannabis and ketamine substantially exceeding samples that service users sourced off-line [26]. Similar but less pronounced differences were found with user-submitted samples to the Dutch Drug Information Monitoring System (DIMS). The average purity of samples of drugs obtained on-line tended to be higher than off-line purchases, and statistically significantly so for three of nine substance types [11]. Cryptomarket-sourced drugs are not, however, immune to adulteration. Four samples submitted to the above-mentioned Spanish testing service, reportedly advertised as heroin on cryptomarkets, actually contained the novel opioid ocfentanil [27]. Misreporting of substance purity by cryptomarket vendors was identified by Swiss researchers, who bought and tested four samples. While tested content matched advertised content, test results confirmed lower purity than vendors advertised [28].

Relationships of trust that develop between dealer and customer in off-line markets may function similarly to make off-line dealers accountable to their repeat customers; a social relationship which may be culturally normalized in some off-line markets [29,30] and incentivized by law enforcement practices in others [31]. So while cryptomarket vendors may provide higher-quality products than off-line dealers who base their business model on selling to strangers, the comparison with dealers who transact only with buyers that they already know may be less predictable. Future research assessing cryptomarket-sourced drug quality would benefit by comparisons within off-line drug market subtypes.

Are cryptomarket-purchased drugs less expensive?

Cryptomarkets enable their users to access market-place information about price. Buyers can compare prices among

vendors and vendors can set prices informed by unprecedented knowledge of their local and international competitors [21]. This abundance of market-place data should reduce the 'information asymmetries' inherent in illicit markets [32]. Drug dealers operating off-line are thought to capitalize on these information voids with increased prices: one reason economists use to explain the comparatively high prices for illegal goods. High prices for illicit goods also partly reflect the compensation that suppliers seek for bearing these risks [33]. If cryptomarket sales are also less risky for anonymous on-line vendors than off-line drug selling, this may reduce prices further; but alongside the factors that may reduce price, other factors unique to on-line selling may exert the opposite effect. First, cryptomarkets take a commission on each transaction, typically between 2 and 4% of the price [34]. Secondly, parcel loss or interception by borders officials are understood by vendors as costs of doing business [21]. Although similar losses will occur for off-line retail drug dealers (e.g. seizure, theft or 'taxing'), these seem likely to be more frequent and therefore costly for on-line sellers. Thirdly, postage, alongside costs entailed by 'stealth' packaging designed to reduce suspect cues of package contents [35], may increase costs and therefore price. Self-reports by cryptomarket buyers suggest that lower price may be a key reason for sourcing drugs in this way [36,37], but differences may vary by drug type, with some substances reported by cryptomarket customers to be more expensive than might be obtained locally off-line [23].

Three studies provide comparative evidence on price. The DIMS study (discussed above) additionally asked users submitting samples for testing to report the price paid for the drug. Prices were, in the main, significantly higher for on- than off-line-purchased drugs [11]. The other studies employed a different methodology. Drug prices extracted from cryptomarket listings were compared to street drug prices listed in official sources. Cryptomarket prices were mainly higher than street drug prices in 10 countries [38]. By contrast, drug prices available to Australians were substantially lower for cryptomarket-sourced drugs compared to relatively high street prices in this country [39].

Although these studies do not uniformly support the hypothesis that cryptomarket regulatory mechanisms might function to reduce drug prices, the question remains open for two reasons. First, neither study reported prices adjusted for purity; given evidence of higher purity for on-line-purchased drugs [11,26], purity-adjusted comparisons are essential. We would also suggest that researchers making price comparisons need to adjust for quantities/weights received by customers. Drug dealers in off-line markets report regularly selling deals under the stated weight [40,41], a finding corroborated by law enforcement seizures of drugs found consistently to be packaged in underweight deals at the retail and wholesale level [Drug Expert Witness and Valuation Officers Association, personal communication]. By comparison, cryptomarket deals may be at or above the advertised weight, given the system incentives described above in relation to drug quality. Recent forensic evidence is indicative, with the average weight of cryptomarket-purchased cocaine samples slightly exceeding the advertised weight [Rhumorbarbe *et al.*, personal communication]. Future research using appropriately comparative designs that control for both purity and quantity purchased is required to establish price differentials firmly between off- and on-line-sourced drugs.

Are cryptomarket purchases less risky for drug buyers?

In off-line retail drug markets, buyers face a number of risks connected to their transactions. They may be cheated: sold a product of which the quality or quantity is not as advertised [39]. In these 'lemon' markets [32], quality is ascertained only after the point of purchase. Although arrests per retail transaction are few [42], drug-buying carries the risk of apprehension by law enforcement and while violence is lower in retail markets than in wholesale supply activities [43], buyers in retail drug markets nevertheless risk threats and violence [44]. These risks may be moderated by relationships of trust [45,46] facilitated by face-to-face interactions, particularly in 'closed' marketplaces in which most drug sales now occur, where dealers sell only to known or 'vouched for' new customers [47]. Might the regulatory mechanisms of cryptomarkets reconfigure the transaction-related risks faced by drug buyers?

The virtual location of drug cryptomarkets, combined with anonymity provided by hidden web location and use of cryptocurrencies for payment, should function to reduce possibilities for violent confrontation [3,9]. Emerging evidence suggests that conflict resolution on cryptomarkets is primarily peaceable—typically, third-party intervention by marketplace administrators—with threats of blackmail rare, and of violence even more rare [48]. Interviews with cryptomarket buyers and sellers suggest that both are motivated by a desire to transact without the fear of violence associated with face-to-face trading [49].

Compelling comparative evidence of drug purchase-related risks of violence is provided in recent survey research. Cryptomarket buyers reported fewer threats to personal safety and violence than reported in connection to sourcing through known dealers, strangers and even friends. Regarding comparative rip-off risks, evidence was mixed. Some experiences of cheating were more common for cryptomarket-buying (losses due to scams on the market-place; paying for drugs not received), and others more common when buying off-line (being overcharged; receiving low/variable purity products). Respondents were three times more likely to report being caught by law enforcement in connection to their off-line drug buying than

reported for cryptomarket purchases, suggesting that cryptomarket buying may reduce the risk of arrest [50].

Cryptomarket buyers, however, are not immune to this risk. Publicly available information was used to catalogue cryptomarket-related arrests world-wide up to December 2016 [51]. Of 391 arrests of buyers and sellers, most (58%) were buyers. Even if law enforcement prioritizes the apprehension of drug suppliers over users, it may be easier to trace cryptomarket shipments to their intended recipients than to the sellers shipping them. Many arrests were effected not through sophisticated technology for breaking anonymity and encryption, but in connection to the off-line activities; in particular, making and receiving deliveries. These off-line activities are indeed the very locations in which cryptomarket users themselves identify vulnerability to arrest [35].

There are limits on the extent to which cryptomarkets may reduce drug market violence. The vast majority of the cryptomarket drug trade is generated by cannabis, ecstasy-type drugs, and psychedelics [12], rather than drugs such as cocaine and heroin that are associated with comparatively high market violence [14,52]. Violence related to the control of production, smuggling and wholesale supply may be relatively unaffected by cryptomarkets, as long as these activities remain illegal and highly profitable. However, it seems likely that strategies other than violence for the resolution of transactional conflict are likely to predominate in cryptomarkets. More research is required to tease out the comparative configuration of risks of scams, violence and arrest across drug market types.

WILL CRYPTOMARKETS INCREASE DRUG USE?

Drug cryptomarkets may generate increased population-level drug use in three ways. Because these market-places enable drug sellers to transact with customers across widespread locations, customers gain access to substances not otherwise available to them locally. Most common are recreational and 'party' drugs such as cannabis and ecstasy-type substances, alongside a wide range of psychedelic drugs, prescription medications and constantly emerging 'new psychoactive substances' (NPS). Less common are substances associated typically with problem drug use, such as heroin and methamphetamine [2,53–55]. Some cryptomarket buyers cite 'greater range' as key in their decisions to source drugs in this way [37]. Cryptomarkets are likely, therefore, to provide a new mechanism for the diffusion of specific drugs into new locales in which they were previously unavailable [9]. They may also produce a 'supply gateway' effect, where customers seeking one particular substance encounter many others. Cryptomarkets may therefore increase the population prevalence of the use of particular drugs by widening the repertoires of those who are already drug users.

Secondly, cryptomarkets may make available drugs to those who would not otherwise have accessed them through traditional markets, thereby increasing the population prevalence of drug users. A critical question, then, is whether cryptomarkets simply replace conventional trade or supplement it by bringing in new buyers [56]. The latter derives from the possibility that some potential drug users may lack the knowledge and contacts required to access drugs in off-line markets, or may be reluctant or deterred from doing so, but comparatively comfortable in making purchases in an anonymous, virtual market-place. By bringing in 'new' drug users cryptomarkets may boost drug user numbers, potentially reinforced by increased drug quality and lower price. There is also a third, indirect, route. By selling in wholesale amounts to dealers who sell off-line [9], cryptomarkets may effectively boost availability even in off-line markets, and so contribute to higher drug use/user prevalence at a population level.

If the examples of tobacco and alcohol are relevant to other psychoactive substances, then we would expect increased availability and reduced prices to lead to increased prevalence of use [57–60]. The majority of drug users access drugs from friends, colleagues, neighbours or family members [61]. Therefore, it may seem unlikely that lack of access to illicit markets is a major barrier for people who would like to use drugs but have abstained from doing so. Nevertheless, qualitative interviews with cryptomarket users ($n = 17$) have established that, for a small subgroup, use of cryptomarkets has marked the start of their drug use, due either to having no social supply contacts or being unwilling to access drugs through off-line means [62].

Large quantity/price purchases generate substantial revenue on cryptomarkets [9] with sizeable quantity discounts [2], making possible bulk purchase for personal use. Cryptomarket drug buyers may therefore intensify their use: increasing drug use frequency and/or quantity consumed per session. Interviews with a small number of cryptomarket buyers suggest this possibility, with the majority reporting increased frequency of drug use in the months following initial cryptomarket participation, before tapering down; a so-called 'honeymoon' effect [62]. Retrospective self-report study designs provide only limited evidence for the changing effects on use connected to cryptomarket access. Establishing these effects requires longitudinal research designs with substantial follow-up periods.

To the extent that cryptomarkets may function to increase the range and intensity of drugs used at the individual level and contribute to overall increases in population prevalence, this seems likely to apply primarily to the users of drug types that dominate cryptomarket selling: cannabis and ecstasy-type substances. Cryptomarket buying requires technological resources and skill, and purchases made days

in advance of intended consumption. Cryptomarkets may therefore not be a direct source of supply for many people with the most problematic patterns of drug use.

HOW MIGHT DRUG CRYPTOMARKETS AFFECT OVERALL HARMS AND BENEFITS?

We have suggested that if cryptomarkets continue to grow, we may see increases in the number of drug users in the population, their individual drug-taking repertoires and the intensity of their use. MacCoun & Reuter's equation ([14], pp. 329–31) suggests that harms are dynamic. Total harm will not depend simply upon the prevalence of use, but also on the intensity of use and harms per unit of use. There may be feedback effects between each element of this equation; increased perceptions of harmfulness per unit of use may reduce population prevalence; and the greater sharing of information between users that cryptomarkets enable may speed up such dynamics.

MacCoun & Reuter's equation could also be adapted to think about benefits of drug use. While there is a growing literature on the categorization and analysis of drug-related harms [14,63–66], benefits of drug use are studied much less frequently. They obviously exist, otherwise drug use would be far more rare than it is. People use drugs for a variety of reasons, most of which are volitional rather than dependent [67,68]. Users may derive pleasure, enhanced capacities for work and study, social bonds with other drug users and a variety of other benefits [69–72]. With substantial sales of prescription drugs on cryptomarkets, many customers may be self-medicating physical and psychological ill health, and in spite of the potential risks of doing so, some researchers have identified accompanying benefits of self-medication [73], even with non-prescribed opiate substitutes [74].

There are also benefits to drug users in their being able to access the drug they seek rather than unanticipated substitutes, a problem illustrated by the off-line sale of N-methoxybenzyl (NBOMe) compounds such as LSD [75] and fentanyl as heroin [76]. If cryptomarket customers are indeed more likely to receive the drug they expected to purchase, they should be less likely to experience unwanted or unexpected effects, and in turn the harms associated with those effects. 'Purer'—and therefore higher strength—is not always better: overdoses can increase when a purer product enters the market and users do not adjust their doses accordingly [77], and recent reports of 'super-strength' MDMA may be linked to deaths [78]. Disentangling the overall harms and benefits of higher-quality substances, even 'as advertised', is not straightforward. However, many people who take drugs would see increases in quality as beneficial, particularly when coupled with reductions in price and transactional risk.

Cryptomarkets may also provide benefits to drug takers through the provision of harm reduction information. The internet has massively expanded access to information about illegal drugs. From the 1990s, user-centred discussion forums and websites (e.g. Erowid, Bluelight) have emerged that facilitate drug harm reduction and benefit maximization information-sharing. Websites such as these enable drug users to access and generate 'folk pharmacologies' [79] or 'lay epidemiologies' [80], including information about dosing, determining drug content and purity, environments for use and combining drugs [81]. Drug cryptomarkets go a step further. Caudevilla [82] has argued that cryptomarkets and their associated discussion forums provide a step-change benefit for drug users: 'vendors communicate directly with users in forums, announce when a new batch of a substance is available, provide and share advice about safer use and openly discuss quality, purity, adulterants'. Harm reduction/benefit maximization advice on cryptomarkets can be accessed at the very location of drug purchase, whereas discussion forums hosted in the surface web typically have policies that prohibit discussions about drug sourcing, to protect their members and their organizations' reputation [83]. Caudevilla's own discussion thread on various cryptomarkets ('Ask a Drug Expert Physician about Drugs and Health') is one illustration of how these market-places allow users not just access to user-generated 'folk wisdom', but also to specialist advice and information from a qualified harm-reduction drug professional.

Not all user-generated discussions will provide accurate or contextually appropriate advice, and one risk of these forms of peer support is that group members may act on inappropriate information or may increase or sustain even harmful drug usage patterns within a context that normalizses use [84]. As with cryptomarkets themselves, there are mechanisms through which engagement with discussion forums may affect both benefits and harms. Future research should aim to assess the quality of harm reduction information on cryptomarkets and will benefit by comparisons to that made available by drug dealers in off-line markets [85].

The results of research on the effects on harm per unit of use will need to be combined in models with findings on the prevalence of use and its intensity if we are to generate a more accurate picture of the harms and benefits that arise from cryptomarket drug sales. Such models will need to be sophisticated enough to deal with effects that may be multiple, interactive and non-linear.

CONCLUSION

We have examined the complex effects of cryptomarkets on drug quality, price and transactional risk, allowing us to consider the consequences on range and prevalence

of use and on associated harms and benefits. Due to the limitations of currently available research, these considerations are proposed not as a list of predictions, but as suggestions to stimulate both debate and further research on the effects of cryptomarkets. These effects will be hard to discern at the population level while the market share of cryptomarkets remains small. We need to continue to develop a range of new tools to address the issues raised here, including innovative modelling, survey and ethnographic studies, as well as new 'digital trace' methods that harness the unprecedented drug market data that can be extracted directly from cryptomarkets [2,9,52,86].

Not all forms of illicit drug trading are equally harmful [87,88]. MacCoun & Reuter's equation [14] helps us to think about how cryptomarkets may increase drug harms through some mechanisms (e.g. increased range and intensity of drug use) but reduce them through others (e.g. better information on drug contents); and, similarly, increase some transactional risks (e.g. rip-offs) while reducing others (e.g. violence, arrest). The extent and nature of these harms and benefits will, importantly, also be affected by policy responses. Even if law-enforcement actors cannot resolve the encryption of cryptomarkets, they will continue to develop techniques for intervention. For example, market manipulation may increase both the financial price and the risks of buying drugs on-line by increasing uncertainty and reducing trust between buyers and sellers (e.g. fake vendor/buyer profiles, targeted site shutdowns, rumour-mongering). In deciding on these or other forms of intervention, policy makers will need to consider carefully how drug markets will innovate in response [35] and pay particular attention to potential unintended consequences. As with off-line sales, it is unlikely that the on-line drug trade can be eradicated completely; cryptomarkets will, however, respond to regulation and enforcement in ways that have complex effects on both the harms and benefits.

Declaration of interests

M.B. has a voluntary appointment as Director of Research at Bluelight.org, a not-for-profit harm-reduction website.

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