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Comparative Analysis of Opioid Queries on Erowid.org: An Opportunity to Advance Harm Reduction

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ABSTRACT

Background: Many individuals who use opioids turn to online resources to gather information on effects, availability, and safety. Objective: Describe opioid index page views on Erowid.org to assess trends in public interest in particular opioids. Methods: Retrospective analysis of Erowid.org site traffic was performed to identify unique average daily visits to opioid pages. All data was normalized to that of visits to the heroin index page. Average daily visits to the index pages of each of 6 commonly abused opioids were assessed during the period of 2009 to 2015. Similarly, visits to 15 distinct opioid index pages at 5 time points (July, October 2014 and Jan, April, and July 2015) were described. Results: From 2009 to 2015 a decrease in the number of page visits versus heroin (1.00) occurred for hydrocodone (0.87 to 0.59, −32%), oxycodone (1.38 to 0.99, −28%), and morphine (0.26 to 0.25, −6%). Increases in page visits compared to heroin occurred for fentanyl (0.18 to 0.47, +157%), tramadol (0.43 to 0.88, +106%), hydromorphone (0.19 to 0.24, +29%), and oxymorphone (0.11 to 0.13, +18%). Indexed to heroin (1.00) average opioid page visit frequencies from July 2014 to July 2015 were highest for oxycodone (1.02) and tramadol (0.81). Conclusion/Importance: Oxycodone and tramadol represent the greatest number of Erowid.org opioid page visits compared to heroin. The largest increase in visits over the study periods was for fentanyl and tramadol. The relationship of page visits on Erowid.org creates a unique opportunity for real-time evaluation of emerging drug trends and epidemiological study.

Paintinf opioids are responsible for a large part of the current epidemic of opioid-related morbidity and mortality in the United States and globally. In the United States, from 2001 to 2014 deaths from prescription opioids increased 3.4 fold and opioid overdose deaths now exceed death from all other drugs of abuse combined. The rise in prescription opioid use is causally linked to a steep rise in heroin use (Cicero, Ellis, & Harney, 2015). In 2014, there were 18,893 overdose deaths from prescription opioids and 10,574 deaths from heroin (National Institute on Drug Abuse, 2015).

The landscape of illicit opioid use is constantly evolving. More judicious opioid prescribing patterns, and newer tamper-resistant formulations have, respectively, limited the availability and consequences of prescription opioids. Concomitantly, the increased purity, availability, and affordability of illicit opioids, such as heroin, has led a proportion of opioid-dependent individuals to seek alternative agents (Centers for Disease Control and Prevention [CDC], 2007). The rate of drug overdose deaths involving synthetic opioids such as tramadol and fentanyl (including both prescription and non-prescription formulations) nearly doubled between 2013 and 2014 (Rudd, Aleshire, Zibbell, & Gladden, 2016) and new “research opioids,” largely fentanyl derivatives, have appeared on post-mortem overdose analysis (Mohr et al., 2016). Warnings to avoid extremely potent opioids (e.g., fentanyl) have been issued by the CDC, DEA, and local health departments (CDC, 2015; DEA, 2016), but it is unclear if they reach the opioid-using population. Indeed, there is some concern that warning information from these sources leads to drug users seeking these substances for additional perceived potency (Kerr, Small, Hyshka, Maher, & Shannon, 2013).

Unfortunately, use of mortality data to characterize emerging drug use trends often provides information too belated to enable adequate implementation of targeted harm reduction education. Additional methods to try to highlight new drug use patterns have been used with variable success. These data are derived from user surveys, drug abuse treatment centers, hospitals, medical examiners, and law enforcement and criminal justice systems.

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In addition, in Europe the European Monitoring Centre for Drugs and Drug Addiction, a centralized agency of the EU that works with Europol, compiles detailed information on the manufacture, trafficking, and use of new psychoactive substances when first detected (EMCCDA, 2016). Unfortunately, at this time new drug use trends are not easily assessed by traditional epidemiologic tools or health service channels and real-time epidemiologic surveillance remains limited (Mounteney & Haugland, 2009).

Individuals who are considering using opioids may turn to online resources to gather information on opioid effects, availability, formulations, administration, and precautions or dangers (Chiauzzi, Dasmahapatra, Lobo, & Barratt, 2013). Although many governmental organizations (SAMSHA, NIDA), pharmaceutical companies, and health websites provide online drug information, they may be promoting abstinence rather than offering practical insight on harm reduction. Despite extensive efforts by the federal government to create and promote anti-drug-use websites, non-governmental drug information and harm reduction websites dominate Internet search results (Boyer, Shannon, & Hibberd, 2001).

Prior studies demonstrate that online discussions, web posts, and social media such as Twitter are useful to gain better understanding of how drugs are used and also to evaluate trends over time (Boyer, Babu, & Macalino, 2007; Daniulaityte, Carlson, Brigham, Cameron, & Sheth, 2015; Daniulaityte et al., 2013; Shutler, Nelson, Portelli, Blachford, & Perrone, 2015). Internet drug information website traffic may present an early warning system for the observation of emerging drug trends and enable improved public education and targeted harm reduction. Erowid.org, which receives 93,000 visitors/day, is among the most popular (visited) recreational drug information websites on the Internet (Erowid Center, 2014). The website is a library and a portal that focuses on education and harm reduction through the availability of multi-disciplinary information from scientific and lay literature. It also contains a compendium of self-reported experiences (Coyle, Presti, & Baggott, 2012).

This study was a pilot project to evaluate the traffic to the various opioid index pages on www.Erowid.org in order to understand and quantify comparative interest in individual opioids. We also sought to reflect on trends over time to determine if variations in web-based traffic to the website’s opioid pages could be a useful epidemiologic monitoring tool to track future emerging patterns of opioid use. This project is part of a larger ongoing opioid harm reduction study with the goal to improve opioid risk information in a targeted manner across the Erowid website.

Methods

Retrospective analysis of Erowid website traffic identified unique average daily visits to opioid index pages for the quarterly sample months of January, April, July, and October. For these months during the period of 2009 to 2015, average daily visits to the index pages for the prescription opioids oxycodone, hydrocodone, fentanyl, hydromorphone, morphine, oxymorphone, and tramadol normalized to that of the heroin index page were evaluated. Quarterly sample months were chosen to obtain a representative, seasonally-diverse sample, and data from the years 2009 to 2015 were evaluated based on data and resource availability. In addition, visits to the index pages of 16 distinct opioids normalized to that of heroin, at 5 time points (July, October 2014 and January, April, and July 2015), were also described. Descriptive statistics were utilized. Visits were “normalized” to heroin because Erowid.org has had a heroin index page for twenty years and this provides a standardization of visits that accounts for large monthly and seasonal variability in visitors to Erowid.

Results

During the studied period 2009 to 2015, a decrease in the number of page visits versus heroin (1.00) occurred for hydrocodone (0.87 to 0.59, −32%), oxycodone (1.38 to 0.99, −28%), and morphine (0.26 to 0.25, −6%). Increases in page visits compared to heroin occurred for fentanyl (0.18 to 0.47, +157%), tramadol (0.43 to 0.88, +106%), hydromorphone (0.19 to 0.24, +29%), and oxymorphone (0.11 to 0.13, +18%). See Figure 1.

During the study period July 2014 to July 2015 normalized to heroin (1.00) average unique opioid index page visit frequency from most to least was oxycodone (1.02), tramadol (0.81), hydrocodone (0.59), codeine (0.53), opium poppies (0.44), fentanyl (0.38), opium (0.34), buprenorphine (0.29), hydromorphone (0.23), methadone (0.23), morphine (0.23), oxymorphone (0.13), dihydrocodeine (0.08), meperidine (0.05), and naloxone (0.05). See Figure 2.

Discussion

On the Erowid website during the years 2009–2015 visits to hydrocodone and oxycodone pages decreased compared to visits to the heroin page (see Figure 1). In addition, tramadol visits versus heroin increased substantially during the study period and in 2015 exceeded visits to the hydrocodone page (0.88 vs. 0.59), suggesting that visitors are demonstrating increased interest in tramadol. Fentanyl page visits had the largest increase when referenced to heroin (+157%) page visits, which may reflect...
interest generated by recent outbreaks of fentanyl-tainted heroin or direct interest in fentanyl for its psychoactive effects (CDC, 2015).

Among the index pages for the 16 opioids covered on Erowid.org from 2014 to 2015 the finding that only visits for oxycodone exceeded those for heroin is consistent with the popularity of this prescription opioid analgesic (see Figure 2). Of note, page views for poppies and opium were highly prevalent during the same time period, perhaps because they represent the two non-pharmaceutical, non-heroin opioid forms. Naloxone page visits were low despite the increasingly important role of this antidote in harm reduction but, while disappointing, this is not unexpected since naloxone is not a psychoactive drug. Tramadol, which became a schedule IV drug in July 2014, had more page traffic on Erowid than hydrocodone, the most frequently prescribed opioid in the US. There are several possible explanations for this traffic increase, including interest because of legal rescheduling of tramadol and media attention. The evolving landscape of illicit opioid use, as noted by formal epidemiological assessment, is reflective of trends seen in opioid index page visits on Erowid.org (Rudd et al., 2016). This suggests that changes in web traffic on drug information websites such as Erowid.org could reflect public interest in various drugs and be a useful epidemiologic tool for rapid identification of new and emerging drug use patterns.

Online drug discussion forums and drug information websites are used by health care providers, recreational drug users, and the general public to learn about and

Figure 1. Trends in prescription opioid site visits compared to heroin 2009–2015 on Erowid.org.

Figure 2. Rank visits to opioid pages indexed to heroin from July 2014–2015 on Erowid.org.
exchange drug information in real-time (McNaughton, Black, Weber, & Butler, 2015). A survey of adolescent drug users revealed that Internet-based information shaped the way they used psychoactive substances and that the majority of participants modified their behaviors based on safety information obtained on the Internet (Boyer, Shannon, & Hibberd, 2005). Content analysis of prescription opioid-related posts on the social media website Twitter provides useful insight into the discourse underlying the opioid epidemic (Shutler et al., 2015). In addition, a survey of visitors to the opioid pages of Bluelight.org, a popular online drug forum, revealed that the most common reason that people state they visit the site was to learn how to more safely use drugs. The majority of forum readers surveyed shared drug-related use, safety, and experience information with other drug users (Chiauzzi et al., 2013).

Given these studies, websites that attract people interested in sharing information on drug use present an excellent opportunity to disseminate information to these focused visitors on the dangers of opioids. Knowledge of the current status of opioid page visit frequency and trends in various opioid page traffic over time on Erowid.org, one of the most frequently trafficked drug information websites, enables ongoing targeted harm reduction efforts via supplemental risk education information on the Erowid website and provides a valuable tool to highlight and track emerging trends in drug use.

**Limitations**

Several factors limit the conclusions that can be drawn from this data. During the study period, the landscape of access points to the Erowid site changed substantially due to widespread use of mobile devices and mobile apps, and this study could not accurately capture all mobile access site visits. In addition, changes in link placement, frequency, and appearance can affect frequency of visits to opioid pages. Issues related to page caching, multiple visits by the same person or IP address, and changes in search engine linking, among other factors, can affect results and could not be measured. Furthermore, whether an individual visitor read the information on the page(s) they accessed was not assessed.

It is not clear that increased or decreased visits to the Erowid.org opioid index pages correlate with rates of use of a drug in the community. It is possible that visit frequency may match other variables such as availability, street price, or new scientific, medical, or media attention. Seasonally-representative months were selected in order to try to control for seasonal variation in site visits. However, use of results from representative months could skew data or miss trends occurring in months that were not sampled. In addition, in the rank order frequency assessment of 16 opioid pages indexed to heroin average page visits for the month of July were oversampled compared to other representative months. Also, visitors to Erowid.org are a select population and may not be representative of the general population.

In order to attempt to control for some of these variations data was normalized to heroin. However, use of heroin as a reference to index other opioid page visits has its own limitations. Although heroin page visits remained relatively steady over the study period, small fluctuations in frequency of heroin page visits over time can affect trends and results. Of note, recent national data suggests that although prescription opioid abuse has plateaued, concurrent heroin abuse has increased with important regional variations (Cicero et al., 2015). Drug overdose deaths in the US from heroin more than tripled from 2010 to 2014 (Rudd et al., 2016). The recent surge of heroin use nationally is closely tied to prescription opioid misuse as the majority of current heroin users report nonmedical use of prescription opioids prior to initiation of heroin (Cicero, Ellis, Surratt, & Kurtz, 2014). However, the rise in heroin use predated the implementation of most prescription opioid policy changes, which suggests that market factors including increased availability, high purity, and low cost of heroin compared to prescription opioids are also involved (Compton, Jones, & Baldwin, 2016). These factors complicate the use of heroin as a normalizing value and make data interpretation of Erowid opioid page visit trends difficult.

**Conclusion**

When compared to heroin, opioid index page visits may reflect the level of public interest in specific opioids and demonstrate trends. Overall, oxycodone and tramadol represent the greatest number of Erowid.org opioid page visits compared to heroin. Evaluation of opioid page traffic on the Erowid website creates a unique opportunity for real-time evaluation of emerging drug use trends and can provide a useful supplemental tool to current epidemiologic monitoring efforts.

**Declaration of interest**

The authors report no conflicts of interest. The authors alone are responsible for the content and writing of the article.

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