Collecting and Analyzing Cryptomarket Data on Novel Synthetic Opioids

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**R21 DA044518:** eDarkTrends: monitoring cryptomarkets to identify emerging trends of illicit synthetic opioids use (Lamy, Daniulaityte, Sheth, PIs)

**R21 DA042757:** Characterizing fentanyl outbreaks: Ethnographic and Forensic Perspectives (Daniulaityte, PI). Thanks to Co-Is Dr. Matthew Juhascik, Dr. Ioana Pavel Sizemore, Mrs. Kraig Strayer.
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OUTLINE

• BACKGROUND:
  • Increases in Novel Synthetic Opioid-Related Harms;
  • Dark Web Environment.

• METHODS (eDarkTrends Platform: Data Collection, Processing, Analysis)

• RESULTS:
  • Types of Novel Synthetic Opioids Advertised;
    • Volume of Ads; Source and destination;
    • Comparing Data from Spring 2015 to Spring 2018
  • Examining Changes in Novel Synthetic Opioid-Related Ads, March-August 2018.

• CONCLUSIONS AND IMPLICATIONS
BACKGROUND: INCREASES IN OPIOID-RELATED MORTALITY FUELED BY NOVEL SYNTHETIC OPIOIDS
BACKGROUND: NATIONAL TRENDS

- Unprecedented increases in opioid-related overdose mortality in the U.S.
- Fueled by illicit fentanyl and other novel synthetic opioids

Source: CDC Wonder
Novel synthetic opioids include:

1. Non-pharmaceutical fentanyl
2. Fentanyl analogs (e.g., carfentanil, acetyl fentanyl, furanyl fentanyl)
3. Other novel synthetic opioids (not structurally related to fentanyl, e.g. AH-7921, U-47700 and U-49900)

- Variation in potency and other pharmacological features.
CRYPTOMARKETS AS A SOURCE OF FENTANYL AND OTHER NOVEL SYNTHETIC OPIOIDS

- Increased reports about novel synthetic opioids being sold on cryptomarkets (Buxton and Bingham, 2015; EMCDDA, 2017).

- Cryptomarket data could be used as a novel epidemiological surveillance tool for early identification of emerging patterns and trends.

OPERATION “DARKNESS FALLS” BRINGS DOWN THE BIGGEST FENTANYL VENDOR IN THE US

According to an announcement from the United States Department of Justice, a joint operation conducted by several branches of law enforcement led to...

DARKWEB VENDOR “DARKKING22” ADMITS FENTANYL DISTRIBUTION

According to a press release from the U.S. Attorney’s Office of the Western District of Pennsylvania, a man from Euclid, Ohio, has admitted to the crime of fentanyl distribution. He further admitted that he had imported fentanyl...

ALPHABAY VENDOR “ZANE61” PLEADED GUILTY TO FENTANYL DISTRIBUTION

On August 8, a father and son from Staten Island, New York, pleaded guilty to selling fentanyl and other opioids through the dark web. The duo sold several...
BACKGROUND:
DEEP WEB ENVIRONMENT AND CRYPTOMARKETS
Deep Web and Dark Web represent more than 95% of the Internet
Cryptomarkets host the infrastructure necessary for sellers and buyers to conduct anonymous transactions;

- Requires specific browsers to access (e.g., Tor, I2P);

- Several levels of security measures;

- Use of untraceable cryptocurrencies (e.g., Bitcoin).
DARKNET ECOSYSTEM AND INSTABILITY

• First cryptomarkets: The Farmer’s Market and Silk Road 2010-2013;
• Since 2013, over 100 cryptomarkets have been created;
• Cryptomarket average “lifespan”: 8 months;
• Three main reasons for cryptomarket closure:
  • Law enforcement raid;
  • Exit scam;
  • Closed for security reasons/voluntarily.
• Summer 2017: “Operation Bayonet and Gravesac” took down AlphaBay Market and Hansa;
• Fall 2017: remaining markets highly unstable; additional security measures; access inconsistent.
CURRENTLY ACTIVE CRYPTO MARKETS

- Approximately 30 are currently active;
- Top 3 crypto markets:

<table>
<thead>
<tr>
<th>Type of Ads</th>
<th>Dream Market</th>
<th>Wall St Market</th>
<th>Point/Tochka Free Market</th>
</tr>
</thead>
<tbody>
<tr>
<td>All Ads</td>
<td>147,126</td>
<td>12,832</td>
<td>9,157</td>
</tr>
<tr>
<td>Drug Ads</td>
<td>73,337</td>
<td>6,065</td>
<td>3,926</td>
</tr>
<tr>
<td>Opioid Ads</td>
<td>5,065</td>
<td>512</td>
<td>135</td>
</tr>
</tbody>
</table>

* Advertisement numbers on 10/16/2018
NAVIGATING CRYPTO MARKETS: PRODUCT CATEGORIES

- Massive inventory of products and services is categorized to make it easier for buyers to find items of interest;
- Site navigation and individual product page organization principles resemble mainstream online shopping experiences.
NAVIGATING CRYPTOMARKETS: DRUG CATEGORIES

- Drugs and drug-related products are among the key categories;

- Drugs are categorized further into drug classes and subclasses to make it easier for customers find drugs of interest.
EDARKTRENDS PROJECT: KEY AIMS

1. Develop a semi-automated platform (eDarkTrends) to collect and analyze cryptomarket data to inform substance use epidemiology research.

2. Collect and analyze data on fentanyl and other novel synthetic opioid availability on cryptomarkets.

3. Identify new fentanyl analogs and other novel synthetic opioids emerging on cryptomarkets.
METHODS
Data collection and processing capabilities of eDarkTrends platform
Main DATA: Dream Market was selected for data collection

- It is the largest cryptomarket after July 2017 shutdown of AlphaBay Market;
- Data collection was started in March of 2018 and is on-going.

Supplementary DATA: Agora Marketplace Data (July 2014-August 2015), accessed through Grams Archive available on gwern.net

- Agora was in operation between 2013 and 2015 and was one of the largest markets at the time.
eDarkTrends Platform
DATA COLLECTION:
DEVELOPING CRAWLERS

• Data extraction followed strict security measures that were reviewed and approved by the Wright State University’s Information Security Office and the University’s Legal Department;

• The custom web crawler was developed using the Scrapy framework;

• Crawler’s outputs are raw HTML files of drug advertisements;

• These raw data files are processed using an HTML parser (Xpath) to transform the data into a CSV format.
Key data elements collected through web scraping:

1. Product advertisement
2. Vendor name
3. Price (BTC, US$)
4. Ships to
5. Ships from
6. Escrow
7. Product description
8. Terms and Conditions
eDarkTrends Platform: DATA PROCESSING

- HTML parsed data are processed using the eDarkTrends-dedicated Named Entity Recognition (NER) algorithm;
- NER integrates natural language processing (Natural Language ToolKit and Regular Expressions) and Semantic Web technologies (Drug Abuse Ontology);
- **Drug Abuse Ontology** is a formal model of drug use and abuse domain knowledge expressed as a set of concepts and relationships among them;
- NER identifies **brand-names, slang names, misspellings** and resolves other **ambiguities** (e.g., “china white,” “fent,” “carfent”).
<table>
<thead>
<tr>
<th>RAW DATA</th>
<th>PROCESS DATA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Product Advertisement</td>
<td>Pharma. (PF)/ Non-Pharm. (NPF)</td>
</tr>
<tr>
<td>Drug Name</td>
<td>Type</td>
</tr>
<tr>
<td>&quot;14gr high grade BTH&quot;</td>
<td>Black Tar Heroin</td>
</tr>
<tr>
<td>&quot;1 gram u47700&quot;</td>
<td>U-47700</td>
</tr>
<tr>
<td>&quot;75mcg denpax / durogesic patch&quot;</td>
<td>Fentanyl</td>
</tr>
</tbody>
</table>
Data are stored on Wright State University Kno.e.sis server;

Highly flexible data query and visualization capabilities are empowered through Kibana (ElasticSearch plugin) tools;

Kibana tools are also used to extract numerical data for further analyses;

Supplementary qualitative data analyses are conducted using QDA Miner to assess accuracy of data processing tools and explore product marketing themes.