

# Shifting Narratives in Media Coverage: A Decade of Drug Discourse in The Philadelphia Inquirer

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## Abstract

**Background:** The media’s portrayal of illicit substance use can create harmful stereotypes and stigma for those dealing with addiction, impacting public perception, policy, and public health.

**Objective:** This study examines how the regional newspaper, The Philadelphia Inquirer, has covered events relating to illicit drug-use over time in an effort to highlight linguistic patterns and themes associated with specific types of substances.

**Methods:** We collected a dataset of 157k articles published in the Philadelphia Inquirer over a ten-year period and analyzed articles that mention at least one commonly abused substance (4k). Using Aspect-Based Sentiment Analysis (ABSA) methods, we extracted the most significant phrases mentioned in each distinct drug class on an annual basis and examined the sentiments around these aspects to provide insights into the shifting discourse within these articles over time.

**Results:** Our analysis revealed that cannabis and narcotics were the most frequently discussed drug classes. Through our topic modeling approach, we unveiled that the predominant themes in drug-related discussions encompassed crime, legislative matters, medical considerations, and elements of pop culture. Our ABSA analysis highlighted that the majority of the extracted aspects were portrayed negatively within each drug class, reflecting a more punitive and stigmatizing portrayal in these news articles. Our study also unveiled shifts in the sentiment surrounding recurring aspects within certain drug classes over the years, indicating their evolution in response to changing political perspectives and the impact of real-world events on news coverage.

**Keywords:** *natural language processing; drug use; news; sentiment*

## 1 Introduction

### 1.1 Background

The relationship between media representation and public perception is a complex interplay that has profound implications for societal attitudes and policies (1; 2; 3). Media, as a primary source of information for many, has the power to shape, reinforce, or challenge societal norms and beliefs (4; 5). When it comes to issues of public health, such as Substance Use Disorder (SUD), the media’s portrayal can either support evidence-based interventions or perpetuate misconceptions and stigmas (6).

Previous research underscores the media’s powerful role in shaping perceptions about drugs and issues related to SUD (7; 8; 9; 10). For instance, in the late 1990s in Australia, a program aimed at controlling heroin-related issues faced political defeat, largely due to the media’s negative portrayal of heroin users as “deviants” (11). Similarly, exaggerated media narratives around “bath salts” overshadowed clinical studies, leading to their prohibition

(12; 13). Denham's research further highlights the media's propensity to motivate moral panics about drugs, even when actual usage rates remain stable (14).

Moreover, media's portrayal of stigmatized subjects, such as illicit drug use, can lead to stigma, discrimination, and reluctance to seek treatment (15; 16). For example, the media often emphasizes punitive measures against users and dealers, potentially influencing public attitudes and behaviors (17; 18; 19). Caburnay et al. (2003) also found that media coverage can sway individual health behaviors, suggesting its potential impact on attitudes towards drug use (16).

Harm reduction, a public health strategy, seeks to mitigate the adverse effects of drug use without mandating complete cessation (20). However, media coverage often lacks a comprehensive view of this approach. A study on Canadian news outlets revealed a tendency to focus on singular, controversial harm reduction strategies (21). Yet, when conveyed appropriately, harm reduction messages can significantly diminish the societal repercussions of drug use, especially when they resonate with the audience's values and present a holistic solution (22). These examples show the importance of critically assessing media representations of substance use, ensuring they are both accurate and holistic.

## **1.2 Objective**

The pervasive issue of illicit drug use and its associated consequences has been a topic of concern in many urban areas across the United States. The city of Philadelphia, in particular, has been at the forefront of this crisis, dealing with the devastating effects of drug addiction and its ripple effects on the community. More specifically, Philadelphia is home to a significant open-air drug market and has the second-highest rate of overdose deaths (71 per 100k) in the country (23). It is commonly known as one of the epicenters of the "opioid epidemic" in the United States (24) and in 2021, there were over 1,250 unintentional drug overdose deaths in Philadelphia (25), the highest number on record. The majority of these deaths were caused by opioids, such as heroin and fentanyl (26). Despite the city's efforts to address the problem, such as expanding access to social services in the hardest hit neighborhoods, several challenges remain, such as the lack of affordable housing and the stigma associated with drug use and substance use disorder (SUD) (27). These challenges can make it difficult for people to seek help (28).

Engaging in constructive conversations, enriched by responsible journalism, is crucial to highlight these ongoing challenges and support the development and advocacy of well-informed policies and initiatives. Local media outlets, such as the Philadelphia Inquirer, play a crucial role in raising awareness of the complex issues facing individuals and communities. They not only inform and educate the public about the intricacies of problems, such as the science of addiction and available treatment options, but they can also shape political actions and policies. Through their platform, they can hold public officials accountable, amplify the voices of those affected, and promote evidence-based solutions.

In this study, we delve deep into the discourse surrounding illicit drug use as presented in the Philadelphia Inquirer. Our exploration seeks to uncover the evolution of discussions

about illicit drugs, emphasizing the nuances in the framing and contextual portrayal. By examining a decade of data that encompassed 157,476 articles, we focus on eight main drug categories: *stimulants*, *narcotics*, *cannabis*, *hallucinogens*, *depressants*, *designer drugs*, *drugs of concern*, and *treatment*. Leveraging natural language processing (NLP) techniques, we aim to extract and understand the thematic shifts in the Philadelphia Inquirer’s historical narrative on commonly abused substances. To this end, our research is guided by the following questions:

- RQ1: How have the characteristics and nuances of mentions related to commonly abused substances evolved over the decade?
- RQ2: In the context of these substances, which overarching themes and subtopics have dominated the discourse, and how have they shifted over time?
- RQ3: What are the multifaceted dimensions, sentiments, and narratives associated with the portrayal of commonly abused substances?

We curate a comprehensive list of substances that are commonly abused and filter articles that reference at least one of these drug names. Preliminary findings indicate that out of 150K articles from the past decade, approximately 3,661 articles directly mention one or more of these substances. By employing dynamic topic modeling and aspect-based sentiment analysis (ABSA), we analyze the extracted articles to distinguish dominant themes, detect shifts in discourse, and understand the sentiment trajectory concerning each drug class over the years. Our results show that although there is significant discussion on legislation and feature-based news, like overdose deaths, there is not much coverage on harm reduction or efforts to include topics around more positive events that could impact social attitudes towards people who use drugs (PWUD).

In contrast to prior works (as described in detail in 1.3), we study drug news reporting done by a regional outlet from a city with some of the worst drug-related outcomes in the United States over time. While we do not find language that would indicate sensationalism in the Philadelphia Inquirer, we do observe a lack of harm-reduction centered narrative that could equally negatively impact communities affected by SUD. The insights gained from this work could reassure the need for more informed journaling around SUD given its impact on public perception – perceptions that have the potential to affect drug policy decisions made by lawmakers and stigmatization towards those with SUD.

### 1.3 Prior Work

Few studies have investigated the media coverage of illicit drugs and their change over time, particularly in the United States (15; 16; 29). A recent study (30) investigating the coverage of illicit drug use by a Canadian newspaper found that it focused on basic social representations, such as attribution of the responsibility for the opioid crisis to a few collectives like pharmaceutical companies and physicians or the overall drug supply, and that a shift to less stigmatizing language could positively influence public perception. The

study suggests that closer collaboration between the media and the research community is needed to achieve a better understanding of the issue. Ketamine, a psychoactive drug that has attained positive outcomes in treating severe, treatment-resistant depression, was found to be most associated with themes of abuse, legality, and clinical utility as an anesthetic when it was reported in North American news outlets between 2000 and 2015 (31). This finding suggests that changes in news media reporting could influence how substances, like ketamine, are received as viable treatment options and that guidance is required for journalists on objective reporting of medical research findings.

Google News Archives and cause-of-death records published by the National Center for Health Statistics between 1999 and 2005 were explored for patterns in mentions of the opioid epidemic and discovered a noteworthy correlation between the number of news articles and the rates of opioid-related overdose deaths over time (32).

To comprehend the dissimilarities and similarities of media coverage based on drug types, Hayden et al. (19) analyzed 487 news articles published in a national media outlet in Malaysia over a two-year period. They found that amphetamines, opiates, and cannabis received the majority of media coverage, and the discussion of these drugs was primarily in relation to criminal justice. Similarly, Hughes et al. (18) conducted a framing analysis of Australian news media coverage on illicit drugs between 2003 and 2008. The study found that criminal justice topics are dominant, but non-legal issues are also highlighted. The media frames can differ between drugs, with amphetamines portrayed most negatively and cocaine most neutrally. Their findings suggest that sensationalized reporting of drug events is more prevalent during specific episodes and may not be representative of the norm. Our findings do not indicate that the Philadelphia Inquirer uses tactics that sensationalize the current state of drug use in Philadelphia; however, there is a lack of messaging framed around harm-reductionist principles that aim to normalize drug use.

## 2 Methods

### 2.1 Data

We used the *ProQuest* database to collect a total of 157,476 news articles from the Philadelphia Inquirer from January 1, 2013, to December 31, 2022. *ProQuest* is an online platform consisting of thousands of databases that provide access to a diverse set of publications, including journals and newspapers. To collect data, it was necessary to log in to the *ProQuest* database using our individualized credentials, after which we were able to extract/scrape the data. It is important to note that our dataset may not represent the complete set of articles published by the Philadelphia Inquirer, as *ProQuest*'s database may not be comprehensive. Our data comprises the complete text of news articles, along with several metadata attributes such as date, author, title, links, and subject keywords.<sup>1</sup>

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<sup>1</sup>The meta-data of news articles, list of drugs, and code can be found on [https://github.com/social-nlp-lab/drugs\\_in\\_inquirer](https://github.com/social-nlp-lab/drugs_in_inquirer)

## 2.2 Drug Name Extraction

We used the categorization provided by the *National Institute on Drug Abuse* (NIDA) to identify and extract drug names from news articles. To minimize irrelevant articles, we manually verified drug names and removed ambiguous terms with multiple meanings, for example, the term “pot” could refer to “flowering pot” or “cooking pot” in addition to drug “marijuana”. This allowed us to effectively discern articles that centered on drug-related topics from those that did not.

**Drug Class Assignment** We assigned each drug to one of the nine classes established by the Drug Enforcement Administration (DEA)(33). The DEA classifies drugs into nine categories:

- *Cannabis (C)*: marijuana is a mind-altering (psychoactive) drug, produced by the cannabis sativa plant. “Cannabis” and “marijuana” are often used interchangeably, resulting in the appearance of cannabis as both the drug class and the drug name.
- *Depressants (D)*: known to induce sleep, relieve anxiety and muscle spasms, and prevent seizures, e.g., barbiturates, and sedative-hypnotic substances like GHB.
- *Designer Drugs (DD)*: produced illicitly with a slightly altered chemical structure to mimic the pharmacological effects of controlled substances, e.g., synthetic marijuana or synthetic cathinones.
- *Drugs of Concern (DC)*: unregulated drugs that can be harmful if abused, e.g., kratom and xylazine.
- *Hallucinogens (H)*: derived from plants and fungi and renowned for their capacity to modify human perception and mood, e.g., LSD, mushrooms, and ecstasy.
- *Narcotics (N)*: refers to opium, opium derivatives, and their semisynthetic substitutes. “Opioid” is a more current and precise term to describe these drugs, e.g., heroin, OxyContin, codeine, morphine, and fentanyl.
- *Stimulants (S)*: drugs accelerating the body’s functions, e.g., methamphetamine, cocaine, and amphetamines.
- *Treatment (T)*: substances aiding the treatment of opioid addiction, e.g., methadone, Suboxone, and naloxone.
- *Miscellaneous (M)*: substances that can be abused but don’t belong to any classes, e.g., steroids.

Using our mapped list of drug names, we identify news articles that mention any of these drugs in either their title or body. Subsequently, we group these articles into clusters based on the respective drug classes. If an article mentions drugs from multiple classes, we assign it to all relevant drug classes. The number of articles per drug class and year is

shown in Table 1. Of a total of 157,476 articles analyzed, 3,661 references at least one drug class within their text.

In addition to assessing the frequency of drugs, we also examine co-occurrences of drugs in the same articles each year. To better understand these co-occurrences and the surrounding contexts, we extract the most significant words based on their TF-IDF scores from a subset of articles where drugs most frequently co-occurred.

## 2.3 Topic Modeling

To investigate the evolution of drug-related articles, we employ dynamic topic modeling (34) using BERTopic (35) to understand the distribution of topics over time. We performed this analysis per class of drug to understand the distribution of topics over time and capture the evolving trends in drug-related content (35). This approach provides us with a comprehensive perspective on how topics pertaining to each drug class have evolved, offering valuable insight into the discourse surrounding each specific drug. The pre-processing step involved converting the text to lowercase, removing URLs, extending contractions, and eliminating stopwords. These measures help minimize noise and dimensionality, enabling our models to detect important patterns and topics more effectively. It is important to note that BERT has a token limit of 512. However, the median length of news articles in our dataset is 749 tokens, with a standard deviation of 573. Since journalists typically use the Inverted Pyramid style (36), starting articles with key information and following with details and background, we assume that the first 512 tokens of news articles contain salient information that reflects the main points discussed in the subsequent text. This approach allows us to work within the token limit and retain the essential content for our analysis. In addition, we established parameters to optimize topic coherence. Aligning with BERTopic’s documentation recommendations, we capped the top number of words per topic at 10. Furthermore, we set the n-gram range to 1 and 2 for richer context, while

	C	D	DD	DC	H	N	S	T	Total
2013	138	23	3	2	20	<b>142</b>	108	16	452
2014	<b>146</b>	10	0	1	10	117	64	21	369
2015	<b>122</b>	6	0	0	15	117	49	30	339
2016	<b>150</b>	12	0	0	19	132	63	43	419
2017	194	12	0	0	9	<b>223</b>	53	78	569
2018	221	14	8	6	18	<b>228</b>	73	98	666
2019	<b>231</b>	10	4	2	11	148	90	48	544
2020	<b>113</b>	7	0	0	7	69	48	31	275
2021	<b>118</b>	7	0	0	16	86	41	41	309
2022	<b>142</b>	5	1	0	12	99	38	43	340
<b>Total</b>	1575	106	16	11	137	1361	627	449	

Table 1: Number of drug class occurrences per year, with bold values indicating the most frequent drug class per year. Drug classes include C (Cannabis), D (Depressants), DD (Designer Drugs), DC (Drugs of Concern), H (Hallucinogens), N (Narcotics), S (Stimulants), and T (Treatment).

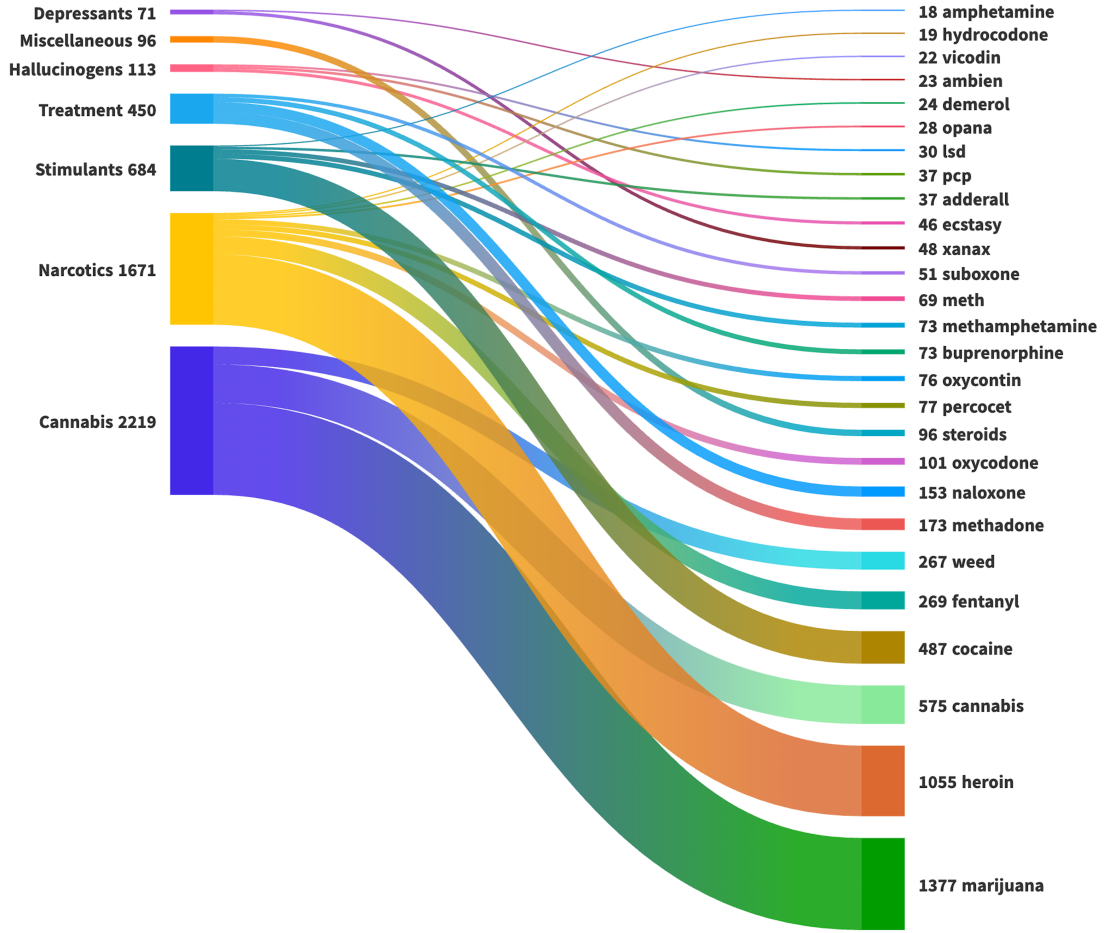


Figure 1: Number of substances per drug class in our dataset.

limiting the number of topics for each class to 4 to extract the most crucial themes within each class of drug.

## 2.4 Aspect-Based Sentiment Analysis

We used aspect-based sentiment analysis (ABSA) to gain insights into the sentiments associated with different aspects of drug-related articles. To extract aspects from the articles, we use keyphrase extraction to identify and extract words and phrases with the highest significance and relevance within a given news article. As keyphrases encapsulate the essence of an entire document, they serve as essential tools and aspects for retrieving critical information from large and diverse datasets (37).

While various tools and techniques are available for keyphrase extraction from documents, it is notable that most of these models generally focus on the statistical properties of text, rather than semantic similarity (38). As a result, our choice was KeyBERT (38), a phrase extraction model that leverages the TextRank algorithm (39), BERT-embeddings (40), and cosine similarity to identify and extract the most significant phrases, effectively capturing various facets of the content (38). To enhance the output of this model, we used vectorizers that leverage part-of-speech patterns to extract grammatically accurate

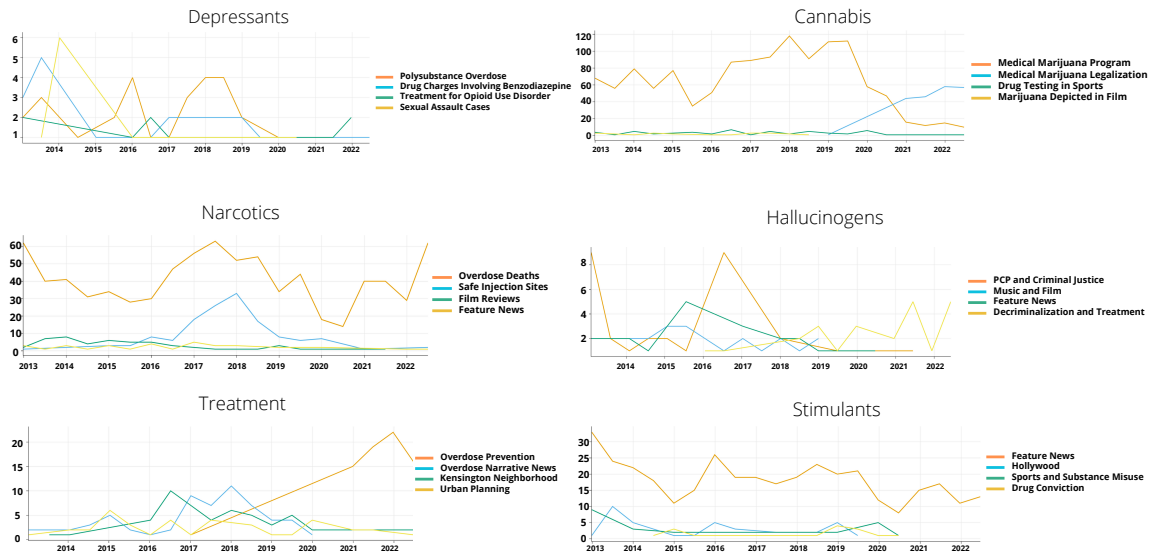


Figure 2: Topic evolution per class of drug per year.

keyphrases based on their part-of-speech tags without the need to specify an n-gram range. We performed keyphrase extraction within the articles of each drug class for every year in the range spanning from 2013 to 2022, allowing us to evaluate the trends and evolution of aspects of each drug class throughout time. Phrase embeddings resulting from KeyBERT were ranked based on their cosine similarity with the document embedding. We established a threshold of 40% to ensure that our analysis focused on the most relevant aspects. This threshold was determined deductively to find that 40% allowed a suitable balance between relevant aspects and aspects that could be considered false positives or noise.

Next, we searched the articles to locate paragraphs that contain each identified aspect. This step allowed us to isolate the paragraph relevant to each aspect and avoid potential noise in the sentiment analysis. To estimate the sentiments associated with each aspect per class per year, we utilized the NewsSentiment model (41) for target-dependent sentiment classification. The GRU-TSC model used in this model is trained on the NewsMTSC dataset (41), consisting of over 10k labeled sentences from political news articles<sup>2</sup>, which makes it domain appropriate for our task and data. The final sentiment assigned to each aspect, within each drug class, for each year is cumulatively derived from all paragraphs that reference the particular aspect within that year. These sentiments may fall into one of three categories: positive, negative, or neutral.

<sup>2</sup><https://pypi.org/project/NewsSentiment/>



	Drug 1	Drug 2	N		Drug 1	Drug 2	N
	heroin	methadone	52		fentanyl	cocaine	270
	heroin	cocaine	45		heroin	cocaine	194
	barbiturates	cannabis	16		heroin	marijuana	127
	heroin	naloxone	42		heroin	marijuana	115
	marijuana	cocaine	36		heroin	naloxone	77
	heroin	cocaine	34		heroin	cocaine	71
	heroin	marijuana	40		heroin	methadone	198
	heroin	methadone	19		heroin	buprenorphine	81
	heroin	meth	11		fentanyl	cocaine	53
	heroin	marijuana	51		buprenorphine	cannabis	108
	heroin	cocaine	45		heroin	cannabis	78
	heroin	naloxone	44		heroin	marijuana	41
	heroin	methadone	157		buprenorphine	cannabis	351
	heroin	cocaine	90		buprenorphine	marijuana	153
	heroin	naloxone	80		fentanyl	cocaine	114

Table 2: The most frequent co-occurred drugs per year.

### 3 Results

**RQ1: Drug Mention Characteristics:** As shown in Table 1, we observe a steady increase in explicit substance mentions, followed by a decline (COVID-19 effect, presumably around 2020) in the Philadelphia Inquirer over the past decade. Cannabis is the most frequently discussed drug class, followed by narcotics (i.e., opioids). The annual count of news articles indicates that 2018 saw the highest frequency of drug-related mentions. Narcotics are the second most discussed drug class, and also the most prevalent in 2017 and 2018, suggesting that the opioid crisis was a major focus of news coverage during those years.

Further analysis of drug mentions by class shows that cannabis is primarily associated with marijuana (Figure 1). Despite the controversial origins of the term “marijuana” (42), it has been consistently used in news articles over the years. Among the depressant drugs, Xanax and Ambien are the most frequently mentioned, likely due to their widespread use for anxiety and sleep disorders and their potential for abuse. Similarly, cocaine and ecstasy are the most frequently mentioned drugs in the stimulant and hallucinogen drug classes, respectively, indicating their enduring popularity.

Our co-occurrence analysis revealed an association between the frequency with which certain substances are discussed and provisional overdose and usage trends. Table 2 shows that heroin, one of the most prevalent substances in Philadelphia, was overtaken by fentanyl in 2018, by buprenorphine in 2021, and buprenorphine and fentanyl in 2022. Using TF-IDF weighting of terms, our analysis of articles containing heroin and methadone, as one of the most prevalent co-occurring drugs, identified several prevalent concepts such as “jail,” “fentanyl,” “funding,” “bill,” and “crime.” Additionally, we found that marijuana and heroin often discussed together in relation to legalization and fentanyl adulteration concerns. Furthermore, our analysis indicates that narcotics and treatment drugs, such as methadone, naloxone, and buprenorphine, are the second most commonly co-

located drugs in articles. These articles primarily focus on criminality, legislation, and overdose, as determined by TF-IDF analysis. Treatment drugs like methadone, naloxone, and buprenorphine are viewed as positive and proactive responses to opioid use disorder (OUD) (43). Buprenorphine, a safe and effective treatment for OUD, emerged in 2020 alongside heroin, followed by cannabis in 2021 and 2022.

**RQ2: Overarching Themes Over Time:** Utilizing dynamic topic modeling with BERTopic, we were able to generate a diverse set of topics covering various themes per class of drug. The review of the initial results revealed a number of overlapping topics. Therefore, we iteratively refined the model by decreasing the number of topics until we achieved a high-quality output. Furthermore, to enhance the topic titles generated by the model, we analyzed the representative articles within each topic, which enabled us to formulate more cohesive and informative titles. Figure 2 presents temporal changes of topic clusters in our data. Within cannabis-related articles, we note a predominant presence of topics emphasizing its legislative and medical aspects. Notably, discussions surrounding the medical marijuana program gained prominence in 2018, while conversations regarding its legalization began to trend in 2019 and continued to rise steadily until the end of 2022. The standout and consistently recurring theme within articles discussing stimulant drugs revolves around what we term “feature news”. Essentially, this involves the coverage of diverse stories about these drugs in various contexts, such as human interests stories (e.g. how a local who suffers from PTSD uses LSD to treat their symptoms (44)), providing a comprehensive exploration of different narratives. We observe a significant number of news articles discussing drug use in films and television series, particularly evident in discussions related to narcotics and hallucinogens, indicating the possible role of popular media in shaping public perceptions and attitudes toward drugs and social issues (45; 46). Another recurring theme in articles containing narcotic drugs involves discussions about overdose deaths within the city, as well as conversations surrounding safe injection sites. Both topics gained significant traction, particularly in 2017 and 2018. Furthermore, discussions about overdose deaths resurfaced prominently in 2022. We also observe an increasing trend in discussions concerning the legalization, treatment, and medical applications of hallucinogens and treatment substances with notable traction, especially in 2022. These trends offer insight into the evolving discourse surrounding these drugs in the Inquirer articles.

**RQ3: Sentiment of Themes Over Time:** The aspect-based sentiment analysis of news articles reveals the changing nature of key aspects discussed in drug-related coverage and the tones in which they are discussed. Generally, the proportion of positive aspects is highest for cannabis and treatment, and lowest for depressants and stimulants (Figure 3). The proportion of neutral aspects is similar for all classes. News articles with hallucinogenic drugs also have a more positive tone compared to other drug classes. Hallucinogens were discussed negatively when associated with drugs like crack cocaine (2014) and cannabis (2018), but more positively in relation to medicinal cannabis (2019) and

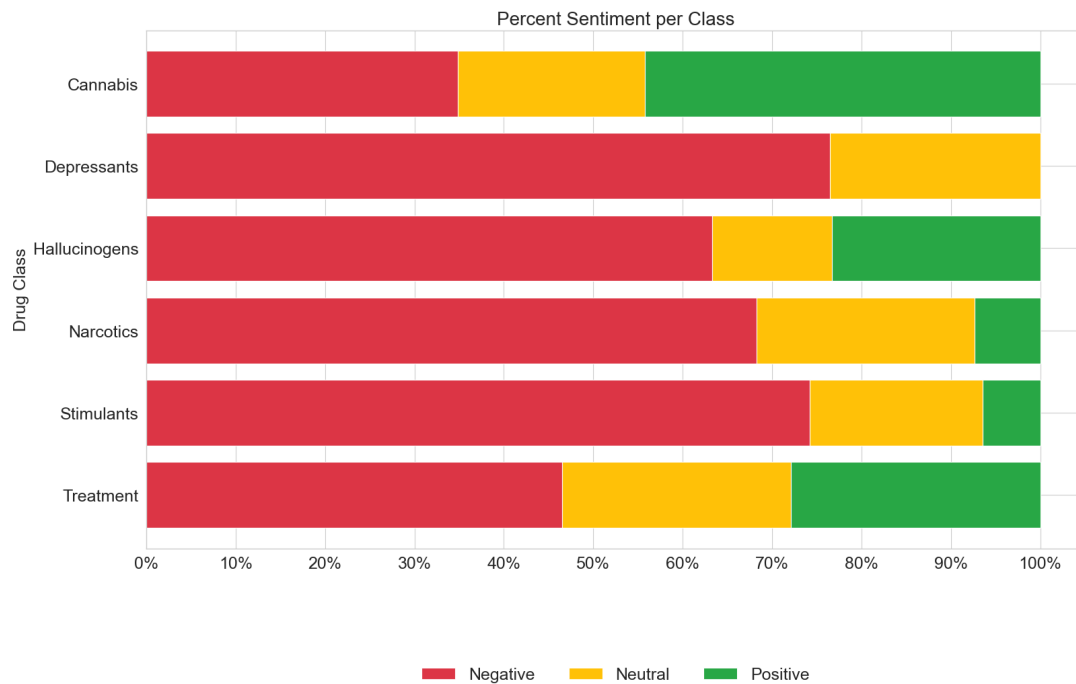


Figure 3: Proportion of aspects with positive, negative, and neutral sentiment per class.

new psychedelic therapies (2021) (See Table 5). The positive tone with hallucinogenic drugs may be attributed to recent studies on the use of psychedelic drugs as medicine for the treatment of mental health disorders such as treatment-resistant depression and post-traumatic stress disorder (PTSD). In 2021, articles frequently mentioned aspects such as “new psychiatric medicines” and “new psychedelic therapies”. Table 3 provides an excerpt from the Philadelphia Inquirer that reflect the positive sentiment regarding the therapeutic potential of hallucinogenic drugs for treating PTSD, along with examples of other aspects discussed in relation to narcotics and treatment drugs.

Among cannabis-related articles, the discourse surrounding decriminalization has gradually evolved from negative in 2013 to a more positive tone over time, as shown in Table 4. Another notable finding is that aspects associated with the term “marijuana” often carry a negative connotation. For example, in 2013, New Jersey Governor Christie expressed a negative opinion on marijuana decriminalization. On the other hand, aspects related to “cannabis” tend to be mentioned in a more positive light. For instance, an article described the MORE act, a cannabis legislation that moved through Congress in 2019, which would remove cannabis from the Controlled Substances Act. Interestingly, most aspects within the cannabis class are centered around decriminalization and legalization, as opposed to cannabis-related aspects within the narcotics class that center around the therapeutic potential of cannabis as supplemental pain-relief (e.g. for those attempting to recover from SUD). Within the cannabis class however, “medicinal marijuana” is expressed more positively than “recreational use”.

Interestingly, no positive aspects were found to be associated with depressants. However, most negative aspects were related to the combined use of benzodiazepines, which

Halucinogens (+)	<p><b>"new psychiatric medicines" - 2021</b></p> <p>"...last summer, the University of North Carolina received nearly \$27 million from DARPA, the research arm of the U.S. Department of Defense, to develop new psychiatric medicines from psychedelics...Hopkins, along with New York University, recently completed phase 3 clinical trials with the nonprofit multidisciplinary association for psychedelic studies for MDMA-assisted therapy for PTSD..."</p>
Narcotics (+)	<p><b>"medical marijuana" - 2017</b></p> <p>"... he said. marijuana helped him with sobriety, and also helped him get off oxycodone and several other medications he was prescribed over the years for the pain caused by his many parachuting missions and the anxiety that PTSD triggered, he said. Karpowich said he participated in at least a dozen protests at the statehouse in Trenton, holding signs and "ambushing lawmakers" to get them to consider expanding the medical marijuana program. "veterans have served their country, and no one should tell them they can't use marijuana if it helps them," ..."</p>
(-)	<p><b>"border protection" - 2022</b></p> <p>"...he unleashed the worst border crisis in U.S. history. u.s. customs and border protection reported more than 1.7 million encounters with illegal migrants at the southern border, nearly four times the number the year before, the highest annual total on record — including 378,000 who were not from Mexico, Honduras, El Salvador, or Guatemala. seizures of deadly fentanyl more than doubled in 2021, and is closely connected to a surge in overdose deaths, which reached a historic high."</p>
Treatment (-)	<p><b>"drug costs" - 2016</b></p> <p>"...basic lifesaving medicines that emergency workers use every day are getting so costly, officials are scrambling to figure out how to pay for them. and as patients struggle with drug costs, EMS workers and emergency room doctors are seeing the impact. the price paid by Philadelphia emergency medical services for naloxone, which reverses opioid overdoses, has risen 150 percent since 2013...the opioid epidemic rages and record numbers of people die of overdoses, the cost of generic naloxone has more than doubled..."</p>

Table 3: Example aspects and excerpts of article text with sentiment: '(+)' denotes a positive sentiment, '(-)' denotes a negative sentiment.

are commonly used to relieve anxiety, muscle spasms, and reduce seizures, with opioids ("opioid painkiller", Table 5), and the risk overdose deaths. Between 2013 and 2016, the discourse around "insomnia drugs" shifted from neutral to negative. This shift was influenced by factors around such as prescription policies for all sleeping pills and the lack of transparency in warning labels by pharmaceutical companies.

A significant portion of the aspects identified within the context of Treatment drugs revolved around overdose prevention, with extensive discussions on the utilization of naloxone (e.g., aspects such as "Narcan nasal spray", and "reversal medication"). Naloxone or Narcan was the most prevalent positive aspect between 2013 and 2016, being described as a "life-saving drug." However, between 2019 and 2021, "buprenorphine prescription", in association with the opioid use disorder, became the dominant positive aspect. However, this aspect shifted to a more negative tone in 2021 in relation to the potential for misuse and its higher street value. Other negative aspects discussed included "opioid use disorder," "buprenorphine misuse," and the "opioid epidemic." It is worth noting that in 2016, the only aspect related to costs and methadone programs was expressed negatively, as the cost of naloxone increased causing obstacles for EMS workers across the city.

## 4 Discussion

### 4.1 Principal Findings

The main objective of our study is to identify narrative shifts, including topics and sentiment, of drug news reporting within the Philadelphia Inquirer over a ten-year period. Our methodology involves grouping the articles based on drug classifications set by the National Institute on Drug Abuse (NIDA). We then identified the patterns in which the sub-

Article	Aspect	Year	Sentiment
"...Craig T. Steckler, president of the police officers' conference, led his introduction of holder by criticizing the justice department's decision this year not to challenge state laws in Colorado and Washington that allow recreational marijuana use..."	recreational marijuana use	2013	Negative
"...One question he answered: he said that he disagreed with U.S. Attorney General Eric Holder's memo Thursday saying the Obama administration would not challenge the new marijuana decriminalization laws in Colorado and Washington. "I think it's a mistake for him to turn his back and essentially by fiat legalize marijuana in Colorado and Washington," Christie said..."	marijuana decriminalization	2013	Negative
"...New Jersey is one of 23 states that have legalized medical marijuana despite a longtime federal prohibition against selling or using the drug for medical or recreational reasons..."this federal policy toward state-level marijuana legalization efforts creates a situation in which the medical marijuana industry is in existence, integrating into local, state, and national economies, and employing thousands of people, some of whom are represented by labor unions or involved in labor organizing efforts despite the industry's illegality," the opinion said..."	marijuana legalization efforts	2015	Neutral
"...marijuana is a schedule 1 drug, which means the federal government treats it as if it were as dangerous as heroin or lsd and has no medical benefit. The act would also require authorities to remove federal cannabis convictions from millions of criminal records. More than two-thirds of American voters support full marijuana legalization, according to poll results released Nov. 14 by the Pew Research Center... "It's the first piece of marijuana cannabis legislation in Congress to move this far. And this could lead to more local reform as well," said Goldstein, a South Jersey-based organizer for the National Organization for the Reform of Marijuana Laws. ..."	marijuana cannabis legislation	2019	Positive

Table 4: Changes of tone toward marijuana decriminalization. Pink: negative; yellow: neutral; green: positive tone towards aspects.

stances within each class are co-mentioned over time, visualized the salient topics within each class of substance that emerge across the ten years, and finally explored the general sentiment in which more fine-grained aspects surrounding the class of substance are reported.

As shown in the results, the co-occurrence analysis identified an expected connection between opiate narcotics (heroin and fentanyl, specifically) and substances like cannabinoids or methadone - commonly used to alleviate side effects of dependency, like cravings and withdrawal severity. These reports align with provisional drug use and overdose trends reported nationwide (47) and within the city (48). Additionally, concepts with higher TF-IDF weights within the articles in the narcotics class revolved around fentanyl adulteration, with terms like "fentanyl" and "overdose" emerging. The emergence of "cocaine" co-mentions in 2018 matches the growing concern of opiate/stimulant co-use trends (49). Unintentional overdose deaths due to fentanyl or a stimulant like cocaine, often used with an opiate to counter the sedative effects, are observed. Buprenorphine, a safe and effective treatment for OUD, is less likely to be abused than other opioid medications like methadone (50). We observe an emergence of buprenorphine mentions in 2020, with the most mentions in 2022, likely correlated to President Biden eliminating the restriction on the number of prescriptions providers could issue per month, making it more accessible compared to methadone (50).

When examining the salient topics that emerge over time through dynamic topic modeling, we observed a strong inclination towards articles that centered around overdose deaths in the narcotics class. This finding is consistent with prior literature findings of fear-based, more sensationalized, reporting when examining other news sources (51; 30; 18; 19). While we do not find evidence of sensationalism, we do suggest that the Philadelphia Inquirer balance reporting on drug events centered around narcotics, particularly in the case of overdose. Generally, a proper balance towards harm reduction in articles, emphasizing that not all overdoses lead to death and that overdose deaths are a small fraction of drug use and not the norm, has the potential to shift the social constructs that villainize PWUD. Fear-based narratives can contribute to moral panic and ultimately lead to sys-

Class	Aspect	Article	Sentiment	Year
Cannabis	[new] marijuana laws	"...Powell coauthored the report, "do medical <b>marijuana laws</b> reduce addictions and deaths related to pain killers," along with researchers from the University of California-Irvine, and the National Bureau of Economic research in Cambridge, mass. The study suggests that patients will substitute medical marijuana for addictive prescription opioids if cannabis products are available through dispensaries. between 2000 and 2010, opioid-related fatalities and reductions in treatment admissions in states with flourishing dispensaries declined by about 20 percent..."	Positive	2018
		"...police could also confiscate your marijuana, says Chris Goldstein, an activist and regional organizer for the National Organization for the reform of Marijuana laws. however, DeVaughn Ward, senior legislative counsel for the marijuana policy project, says they're not supposed to, because the law doesn't "give [police] the ability to search or seize your cannabis." the state's <b>new marijuana laws</b> also let local municipalities pass their own marijuana ordinances..."	Negative	2021
	medical marijuana decriminalization legalization	"...One question he answered: he said that he disagreed with U.S. Attorney General Eric Holder's memo Thursday saying the Obama administration would not challenge the new <b>marijuana decriminalization</b> laws in Colorado and Washington. "I think it's a mistake for him to turn his back and essentially by fiat legalize marijuana in Colorado and Washington," Christie said..."	Negative	2013
		"...marijuana is a schedule 1 drug, which means the federal government treats it as if it were as dangerous as heroin or lsd and has no medical benefit. The act would also require authorities to remove federal cannabis convictions from millions of criminal records. More than two-thirds of American voters support full <b>[marijuana] legalization</b> , according to poll results released Nov. 14 by the Pew Research Center. The share of U.S. adults who oppose legalization has fallen from 52% in 2010 to 32%. The bill has the support of several Philadelphia-area members of Congress..."	Positive	2019
		"...physicians statewide are also torn over the propriety of <b>medical marijuana</b> . Michael Fraser, executive director of the Pennsylvania Medical Society, testified that the doctors' group does not recommend marijuana for medical use, but supports additional research into its effectiveness. "We believe a compelling case exists for a serious scientific examination of the potential medical use of marijuana," said Fraser, but he added, "the legalization of marijuana for medical use is premature and unwise..."	Negative	2014
		"...for the first time in the history of the seven-year-old New Jersey <b>medical marijuana</b> program, a health department panel will consider adding chronic pain and other ailments to the list of about a dozen conditions that qualify a patient to use cannabis in the state. "I think cannabis can replace all three of the medications I take for anxiety, migraines, and chronic pain," said Bob Kane, 56, a retired landscaper from Ocean View..."	Positive	2017
Hallucinogens	[legal] psychedelic drugs	"...doctors and patients are awaiting the Food and Drug Administration's decision on another type of electrical stimulation that targets the vagus nerve. a trial that will for the first time scientifically test whether magic mushrooms really do help - no small feat in the risk-averse research world - may start soon. the question of whether illegal <b>psychedelic drugs</b> can help headache patients has been "radioactive," said Brian McGeeney, a Boston medical center neurologist who thinks the drugs deserve more study..."	Negative	2016
		"... "People are just really excited," said McLane, 40, who wants Philadelphia to be a leader in the field of <b>psychedelic medicine</b> . ...MDMA helps people with PTSD, backers say, because it allows people to tunnel into their traumatic memories, accept them, and then learn to live with them..."	Positive	2021
Depressants	opioid painkillers	"... "Women, in general, are more likely to pursue health care and they are more likely to be prescribed these therapies" - <b>opioid painkillers</b> - "for a medical reason," said Cynthia Reilly, a pharmacist, and director of the Pew Charitable Trusts' prescription drug abuse project. She said that women also are more likely to be prescribed benzodiazepines like valium, which make overdoses more likely when used in combination with opioids..."	Negative	2016
		"...we owe them safe spaces the result is overdose deaths on a previously unimagined scale, all because we decided that <b>opioid</b> use — unlike alcohol, cigarettes, valium, and other substances used to cope with the world — was unacceptable. while we should do everything to help those who compulsively use, we shouldn't simultaneously push users into the dangerous black market where each injection carries a substantial risk of death..."	Neutral	2022
	insomnia drugs	"...the FDA will now require that driving-simulation tests be conducted as part of any new application for <b>insomnia drugs</b> . IMS Health, a healthcare technology and information company with an office in Plymouth meeting, said that about 60 million prescriptions were written in 2011 for all sleeping pills, about two-thirds of those some form of zolpidem..."	Neutral	2013
		"...but Whitcraft noted that incident occurred in September 2006, six months before Ambien and other makers of <b>insomnia drugs</b> were ordered to include a warning that the pills could leave patients susceptible to sleep-driving..."	Negative	2016
Treatment	buprenorphine prescriptions	"...although any doctor with a drug enforcement administration license can prescribe the opioid painkillers that can spark addiction, federal law requires special training to prescribe a potential remedy. Sometimes, a bedside <b>buprenorphine prescription</b> can be enough to get patients started on treatment. it can ease patients' withdrawal pain, so they are willing to hear from someone like O'Donnell, rather than leaving the hospital in search of drugs..."	Positive	2019
		"...There are unscrupulous doctors who hand out <b>prescriptions</b> and pharmacists who fill them. Subutex, which consists of buprenorphine alone, is easier to misuse and typically has higher street value than suboxone, a combination of buprenorphine and the overdose-reversal drug naloxone. in the case against Njoku's pharmacy, an assistant U.S. attorney explained that the DEA "got slapped hard for being asleep at the switch as the opioid crisis ramped up. they're trying to make sure that Subutex doesn't become the next problem," according to court transcripts..."	Negative	2021
	drug costs	"...basic lifesaving medicines that emergency workers use every day are getting so costly, officials are scrambling to figure out how to pay for them. and as patients struggle with <b>drug costs</b> , ems workers and emergency room doctors are seeing the impact. the price paid by Philadelphia emergency medical services for naloxone, which reverses opioid overdoses, has risen 150 percent since 2013..."	Negative	2016

Table 5: Shifts in sentiment across various aspects

tematic changes that could result in more harm for the people impacted by SUD (52). The negative aspects extracted within the narcotics articles support our suggestion, with aspects like “overdose crisis,” “overdose victims,” and “public drug use” (See Appendix A). The only positive aspects that emerge in the context of narcotics were in 2017: “medical marijuana” and “New Jersey Drug Policy Alliance” - two policy-based entities that are solely focused on reducing the harm associated with narcotic use.

Another noteworthy finding is within the cannabis class of articles and the rise of medicinal marijuana-based articles. Articles focusing on legalization and aspects like “medical marijuana” and “marijuana policy issues” seemingly shift from positive to negative and then positive again with “marijuana decriminalization” between 2013-2017. What is interesting is that no aspects were found negatively in relation since 2017 until 2021 with “new marijuana laws”. Considering these trends in aspects and an increase in articles centered on the legalization of medicinal marijuana, we cannot help but wonder if there has been more social tolerance towards cannabis-based events. In 2018, several significant events around cannabis occurred, including a former player for the Philadelphia Eagles admitting to recreational cannabis use during his career (53), Philadelphia Mayor Jim Kenney advocating for the legalization of recreational cannabis use (54), and the City of Philadelphia hosting its first-ever Cannabis Opportunity Conference (55). From these findings, we can determine that our findings support the linguistically positive shift in cannabis-related reporting.

## 4.2 Implications

Our study has several important implications for harm-reduction reporting and drug policy. Firstly, it suggests that news reporting on drugs can play an important role in shaping public perceptions and attitudes. We found that news articles with hallucinogenic drugs tend to have a more positive tone compared to other drug classes. This could be attributed to, in part, to the growing attention on the potential therapeutic benefits of hallucinogens(56; 57; 58). Furthermore, the discourse around cannabis decriminalization has gradually shifted from negative to more positive over time. This may suggest that news reporting has the potential to normalize concepts (59). (59) demonstrated this phenomenon when investigating the normalization of “fake news”. By influencing the understanding of the concept beyond its original definition of disinformation to one completely unrelated, news media outlets have the power to shape broader perceptions. This influence could contribute to a more positive discourse around drugs. In addressing the stigma associated with illicit drug use, it is essential that media focus on language, narrative, and imagery that promote the values and diverse experiences of PWUD. This approach is key in the context of drug policy reform, where reducing stigma is paramount. By avoiding fear-based strategies, the media can greatly contribute to fostering a more empathetic and informed public discourse on drug use, reducing harm in affected communities (60; 61).

Second, our study found that news articles are increasingly discussing the use of naloxone, an overdose prevention medication, and buprenorphine, a safe and effective treat-

ment for opioid use disorder. Similar to previous work (62), our study suggests that news outlets can help to educate the public about these important treatments. News outlets have the potential to play a role in promoting evidence-based approaches to drug treatment and policy. Due to the ongoing opioid overdose “crisis”, it is necessary for public health and addiction experts to devise better strategies with the media and public to highlight the importance of medication treatment in reducing the health impacts and death rates linked to OUD (62).

Finally, news outlets can impact policy by reporting on the work being done to reduce harm versus criminality aspects of drug use (17; 61). Our study suggests that news outlets can help to promote a more balanced and nuanced understanding of drug use and its impact on society if framed appropriately (63). Recent research suggests that shifting news coverage from focusing on law enforcement to emphasizing prevention-oriented solutions may change the public’s and non-expert policymakers’ views on drug issues, shifting from blame to more health-focused and harm-reduction perspectives (22). Historically, the stigmatization of drug users in the U.S. resulted in punitive policies (64), but there has been a positive shift in recent years’ news narratives, as shown in the result, towards public health-oriented policies, such as expanding treatment and supporting overdose prevention laws (65). The recent positive shift in media portrayal towards treating addiction as a health issue rather than a criminal matter indicates a broader societal change in understanding addiction. However, discussions on harm reduction are still limited and haven’t been a prominent aspect of drug-related news in the past decade. This evolution in news reporting is significant for influencing public opinion and policy decisions. It is hoped that future coverage will increasingly focus on compassionate and effective harm-reduction strategies for affected communities and PWUD.

### 4.3 Limitations

Our findings should be interpreted in the context of several limitations. It is important to note that our study focused solely on news articles published in the Philadelphia Inquirer, and therefore our findings are specific to this source and its coverage of substance use within the Philadelphia and United States. Further research is needed to explore how the portrayal of substance use in the media varies across different regions and cultures. In addition, while previous research has established connections between news media coverage and public attitudes, our analysis of news did not enable us to evaluate the impact of this news exposure on public opinion regarding the issues. Additionally, the findings of our study do not correlate nor imply popularity in usage. As shown in Table 1, *designer drugs* and *drugs of concern* are mentioned in only 16 and 11 articles, respectively. Due to the sparse data on these topics in our corpus, we exclude them from further analysis.

### 4.4 Conclusions

This study aims to explore how the Philadelphia Inquirer, a prominent local newspaper covering Philadelphia, a city known nation-wide for its ongoing drug crises, mentions



commonly abused substances and how the narrativity and sentiment around these drugs change over time. To do so, we analyzed news articles published in the Philadelphia Inquirer between 2013 and 2022, using co-occurrence analysis, dynamic topic modeling, and aspect-based sentiment analysis, and found that cannabis was the most frequently discussed drug class, followed by narcotics. Aspects reported with hallucinogenic drugs tend to have a more positive tone compared to other categories of drugs, while articles on narcotics were the most negative. We also observed a large portion of overdose and death-related aspects, however a strong lack of aspects relating to harm-reduction principles. This study highlights the linguistic shifts reported across various drug classes. It provides compelling evidence of the influence that news media outlets have in shaping discourse around drug use. This, in turn, contributes to creating a more informed and compassionate society, ultimately reducing the harm associated with drug use.

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