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The Opioid-Overdose Crisis and Fentanyl: The Role of Online Information Seeking via Internet Search Engines

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ABSTRACT

Opioid abuse is a severe public health threat. Recent evidence points to a disturbing increase in the illicit use of fentanyl, a potent synthetic opioid, with abuse often involving illicitly produced opioids mixed with heroin. Public health experts have emphasized that there is an urgent need for new, effective harm-reduction strategies and technologies. We asked whether Internet search engines could contribute toward this goal. Using state-level data from the USA, we provide evidence for a cross-sectional and longitudinal statistical relationship between opioid-related overdose deaths and the number of Google searches using the term "fentanyl." This finding points to the relevance of Internet search engines: Users – who may be non-addicted vulnerable individuals, addicts, addicts' friends and family members, or physicians – do in fact search for fentanyl online. We argue that during such searches, an info box including a warning (i.e., awareness material to educate users about the risks) and a help message (i.e., references to professional help) can be presented to target users and possibly prevent both unintentional and suicidal overdoses. Even if this info box only helps some users, the high number of daily Google searches renders this a promising public health intervention to supplement other opioid harm-reduction strategies.

Drug overdoses are a serious public health threat (World Health Organization, 2018). In fact, opioid abuse is among the most consequential of the preventable public health threats (Gostin et al., 2017). Importantly, epidemiological and forensic medical data have shown a disturbing increase in the illicit use of fentanyl during recent years (Kuczyńska et al., 2018). For example, of 42,249 overdose deaths due to opioids in the USA in 2016, a total of 20,145 were associated with synthetic opioids other than methadone (often fentanyl), 15,446 were from heroin, 14,427 were from natural and semi-synthetic opioids or prescription opioids, and 3,314 were from methadone (Manchikanti et al., 2018). Presenting data from West Virginia, Dai et al. (2019) showed that the presence of prescription opioids (without fentanyl) decreased by 75% from 2005–2014 to 2015–2017, while fentanyl's involvement in deaths increased by 122% for the same period. They noted that greater difficulty obtaining prescription opioids along with heroin availability may have contributed to an increase in illicitly-manufactured fentanyl use.

Fentanyl is a potent synthetic opioid used as a narcotic analgesic. With robust data regarding fentanyl's potency being approximately 50–100 times more potent than morphine and carfentanil's (i.e., a fentanyl analog) potency being 10,000 times that of morphine (Armenian, Vo, Barr-Walker & Lynch, 2017), it is safe to say that fentanyl and fentanyl analogs are highly potent and thus pose a serious health threat. Importantly, the death statistics involving fentanyl and the newly identified fentanyl analogs may only represent the "tip of the iceberg" since fentanyl derivatives are often not readily detected (Dai et al., 2019). Of interest, toxicological data show that fentanyl use is inextricably linked with poly-drug use (Kuczyńska et al., 2018): Fentanyl is often mixed up with heroin ("fake heroin") to increase its potency at a little cost. Taken together, during recent years, fentanyl-related overdose deaths have skyrocketed and have thus become a huge contributor to the current overdose-death crisis in the USA (Spencer et al., 2019).

The urgent need for effective harm-reduction strategies

Kuczyńska et al. (2018) noted that there was an urgent need for new, effective harm-reduction strategies and technologies to tackle the growing opioid crisis. The present paper contributes to this avenue of research. We asked whether a specific adaptation of online information seeking via search engines could act as a large-scale harm-reduction strategy.

Anecdotal evidence confirms that search engine users (including non-addicted vulnerable individuals, addicts, addicts' friends and family members, or physicians) can search for drugs such as fentanyl online: For instance, the *Washington Post* recently reported that some suppliers said they preferred to ship fentanyl through regular express mail services, and they were found by investigators by using simple Google searches such as "fentanyl for sale" (Horwitz & Higham, 2019). This is thought-provoking. Actually, this

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comes as no surprise given that new digital media technologies such as search engines are pervasive and are thus an essential part of the everyday lives of most people.

The role of search engines in the current drug overdose crisis has already been acknowledged in recent scholarly work. A study by Young et al. (2018) presented evidence that there were regional differences in terms of where and how users searched for opioid-related information on the Google search engine – the market leader. In addition, they provided evidence showing a statistical relationship between the search volume of opioid-related search terms and emergency department heroin visits. The authors emphasized that Internet search modeling might be an inexpensive method for analyzing changing drug-use trends. Search engine data may thus be used for monitoring. According to the authors, this is especially important given that data on heroin use have often been of poor quality due to fiscal and practical reasons. Without a doubt, monitoring both opioid abuse and the prominence of the epidemic is important (see also Xu & Cao, 2019), and if search engine data can help in this regard, this avenue should definitely be pursued.

Beyond mere monitoring: Internet search engines – an effective harm-reduction strategy?

As noted in detail above, Young and colleagues argued that search volume can be used as an inexpensive method for analyzing changing drug-use trends, contributing to monitoring. Consistent with Young et al.'s (2018) assessment of the possible importance of Internet search engines, the present study aims to contribute to harm-reduction efforts by taking a different, supplementary perspective. Whereas Young et al. (2018) focused on the search engine's role in monitoring efforts, we emphasize its potential role as a public health intervention strategy: As already noted, non-addicted but vulnerable individuals, addicts, addicts' friends and family members, and even physicians can search online for drugs such as fentanyl. We argue that a public health intervention should build on this fact and present an info box including a warning (i.e., awareness material to educate users about risks) and a help message (i.e., a reference to professional help) when users Google for fentanyl (and related terms).

There is already existing research related to using Google as a public health intervention (Scherr et al., 2019): The info box in the drug domain should be similar to the suicide domain where the search engine Google already presents an info box called the "suicide-prevention result" to some of its users (e.g., when searching for "painless suicide method"; see). This info box in the suicide domain is prominently displayed at the top of the search results and depicts important online and offline help resources such as country-specific helpline telephone numbers, crisis chat rooms, and websites. We argue that a similar strategy could be used to fight against the overdose-death crisis. In fact, drug overdose-related warning and help messages can be targeted at both unintentional and suicidal overdoses, depending on the search terms used (e.g., "fentanyl chemical structure" versus "fentanyl lethal dosage for suicide").

Such an info box can be understood as a tailored awareness message that appears exactly when users search for drug-related terms (Scherr et al., 2019): Accordingly, this info box can present potentially protective information at the exact moment when it is apparently needed, which is a beneficial temporal contiguity. Thus, while Young et al. (2018) focused on opioid-related search engine use for monitoring opioid use (because of the poor data quality) – a very important endeavor –, we emphasize the search engine's potential as a public health intervention. In fact, such an info box would not only provide knowledge about the health risks and specific professional help resources but would also function as a prompt for their existence during fentanyl-related searches. Thus, such an info box may elicit an effect on both the *learning of new information* (e.g., on a crisis intervention center with professional help) and the *priming of already known information*, potentially acting as a *nudge* (Thaler & Sunstein, 2008) in a specific (possibly otherwise lethal) situation. While (non-suicidal) individuals with chronic pain who overdose on their opioid analgesics may benefit from a reference to addiction treatment programs, (suicidal) individuals with a primary opioid use disorder may benefit from a reference to counseling services targeted at suicidal crises. For example, the National Suicide Prevention Lifeline (USA) provides a free and confidential support for individuals in distress and crisis resources. Thus, users of search enginges can *learn* (see Lang, 2006) the specific telephone number or website where to find professional help. In addtion, even if some users already know the specific number and website (i.e., they already learned it), exposure to an info box can act as a prompt for their existence during suicide crises. Such prompting effects are distinguished from learning because no new information has been acquired (see Bandura, 2001). Conversely, information that is already available in the memory is reactivated (i.e., primed, see Ewoldsen & Rhodes, 2020) by exposure to the info box.

Taken together, search engine providers can be seen as "choice architects" (Thaler & Sunstein, 2008), meaning that they have a responsibility for organizing the context in which users make decisions. Thaler and Sunstein (2008) argued that good architects make design choices that will elicit benefical effects. Importantly, the relevance of an info box containing potetnially protective information such as a reference to counseling services cannot be underestimated (Scherr et al., 2019): First, there was an estimated increase in hotline calls in the United States of around 9% in the months after the implementation of an info box in the suicide domain which presented the telephone number (Google Official Blog, 2010, November). Second, field studies show that callers' suicidal ideation, suicidal urgency, intent to die, hopelessness, and psychological pain could be reduced during telephone counseling, and even continued to decrease in the weeks after the call (Gould et al., 2017; Knox and Bossarte, 2009). Thus, there is evidence that an info box can increase the number of calls and that suicidality tends to decrease as a concequence of the counseling process. Therefore, even if such an info box only helps some users, the very high number of daily Google users and the fact that such an info box could be important for very different types of users (i.e., non-addicted but vulnerable individuals, addicts, addicts' friends and family members, or even physicians) renders this a possible public health intervention that deserves scholarly attention.

The present study

Before elaborating further on the info box (i.e. a "drug overdose-prevention result"), research has yet to show, in a first step, that users' searches for fentanyl are actually linked to opioid-related overdose deaths (for a similar argumentation, see Scherr et al., 2019). In fact, the strength of the relationship between the number of fentanyl searches and actual death statistics points to the potential importance of such info boxes. If there is a strong cross-sectional relationship (i.e., more fentanyl searches when there are more opioid-related deaths) and a covariation pattern over time, the importance of Internet search engines will be emphasized. This would then indicate that searches for fentanyl are associated to the strength of the drug crisis. The present study targeted this first step: We used state-level data from the USA to test whether there were cross-sectional (research question 1) and longitudinal (research question 2) statistical relationships between the number of Google searches using the term "fentanyl" and opioid-related overdose deaths. The test for a statistical relationship is important information when elaborating on a public health intervetnion relying on search engines.

Method

The present study measures online information seeking via the search engine Google using the search term "fentanyl" and opioid-related overdose-death statistics. We assess the cross-sectional and longitudinal relationships between both concepts in the USA.

Online information seeking

The search volume data came from Google Trends that provides the frequency of specific

search terms entered into the search engine expressed on a normalized scale from 0–100 (Lazer et al., 2014). For the cross-sectional analysis, we relied on state-level data and analyzed the search volume for the term "fentanyl." In fact, we downloaded the query share volume for "fentanyl" for *each state* for the whole year of 2017, the year where opioid-related death rates were available (see below). The higher the query share of "fentanyl" in a given state, the more users searched for fentanyl in this state. The state in which users searched most often for fentanyl takes a value of 100. The values for all the other states are then expressed as query share scores relative to this state. Note that the scores represent relative scores (i.e., the score controls for population size). Taken together, a higher "online information-seeking" value in the cross-sectional analysis indicates more fentanyl searches in a given state relative to other states.

For the longitudinal analysis, we relied on national US data: We analyzed the search volume for the term "fentanyl" within *the USA* and downloaded the query share volume for the period from 2004 (i.e., the year in which Google Trends data began) to 2017. Taken together, a higher "online information-seeking" value in the longitudinal analysis would indicate more fentanyl searches within the USA in a given year relative to other years. Given the fact that most fentanyl abuse involves illicitly produced drugs mixed with heroin, we also assessed the query share volume for the term "heroin," thus allowing for a more thorough interpretation of the temporal covariation patterns.

Opioid-related overdose deaths

The National Institute of Drug Abuse (2019) provides data on opioid-related overdose deaths calculated from raw data provided by the Centers for Disease Control and Prevention. The data are expressed as age-adjusted death rates calculated as deaths per 100,000 population. Reliable opioid-related overdose-death rates were available for $N = 35$ states (see National Institute of Drug Abuse, 2019, for a list of these states).

Additional variables

For the cross-sectional multivariate analysis, we used a number of state-level controls to test whether the bivariate statistical relationship between the number of fentanyl Google searches and opioid-related deaths held when controlling for these factors (i.e., the state's median age, sex ratio, education level [% college degree], per capita income in the past 12 months, percentage of Whites, income, population per square mile). In addition, we used the number of opioid prescriptions per 100 persons (2017) from the National Institute of Drug Abuse (2019) as an additional control.

Results

Research question 1 asked whether there was a cross-sectional relationship between opioid-related deaths and the number of "fentanyl" Google searches (i.e., online information seeking). Figure 1 visualizes the scatterplot. As can be seen in this figure, there was a strong correlation, $r(33) = .80$, $p < .001$. In the next step, we used an ordinary least-squares hierarchical regression model to test whether this relationship held

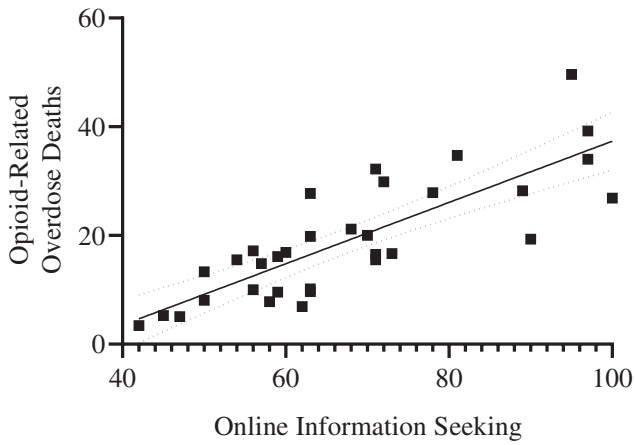

Figure 1. Opioid-related overdose deaths as a function of online information seeking via Internet search engines using the term "fentanyl". Each data point represents one state ($N = 35$ states). The fitted line is based on an ordinary least-squares regression and the corresponding curves represent the 95% confidence band.

when the controls were implemented. We included all the controls in the first step and added online information seeking in the second step. As can be seen in Table 1, online information seeking added explanatory power, ΔF (1, 26) = 14.05, $\Delta R2$ = .15, p = .001. In fact, the more users searched for fentanyl in a given state, the higher the state-level opioid-related death rate was in that state, B = .39, SE = .10, β = .55, p = .001. Interestingly, even though some controls elicited a significant effect in the first step of the hierarchical regression model (i.e., per capita income, population per square mile, percentage of Whites), none of these variables elicited a significant effect when online information seeking was included in the model in the second step, emphasizing the strength of the explanatory power of online information seeking.

Research question 2 asked whether there was a longitudinal relationship between opioid-related deaths and the number of "fentanyl" Google searches. As can be seen in Figure 2, there was a strong covariation pattern between death rates and the number of Google searches for both fentanyl, r (12) = 96, p < .001, and heroin, r(12) = 94, p < .001. Interestingly, a sharp increase in fentanyl-related deaths and fentanyl searches has occurred during recent years, as was expected based on the epidemiological data (see above). Conversely, the increase in heroin-related death rates and heroin searches occurred earlier. Of interest, there was a decline in heroin-related death rates and heroin searches in the last year of the observation period, indicating the beginning of a decline in heroin-related death rates and online information seeking. Taken together, the analysis indicates a cross-sectional and longitudinal relationship between opioid-related deaths and the number of Google searches for fentanyl.

Table 1. Hierarchical regression model predicting opioid-related overdose deaths by fentanyl-related online information seeking.

	B	*SE*	β	*p*
1st Step ΔF (7, 27) = 5.23, ΔR2 = .58, p = .001				
Age	0.96	0.76	.23	.217
Gender	−0.96	0.66	−.29	.157
Education	−1.26	0.66	−.74	.067
Income	0.00	0.00	.74	.048
Population per square mile	0.00	0.00	.45	.046
Percentage of Whites	0.26	0.11	.37	.025
Opioid prescriptions	0.10	0.15	.14	.526
2nd Step ΔF (1, 26) = 14.05, ΔR2 = .15, p = .001				
Age	0.47	0.64	.11	.470
Gender	−0.54	0.55	−.16	.338
Education	−0.70	0.56	−.42	.223
Income	0.00	0.00	.42	.182
Population per square mile	0.00	0.00	.22	.255
Percentage of Whites	0.10	0.10	.15	.313
Opioid prescriptions	0.01	0.13	.02	.931
Online information seeking (fentanyl)	0.39	0.10	.55	.001

Note. Full model: *F (8, 26) = 8.55, R2 =.73, p <.001*

This regression model relies on state-level data: Search volume for the term "fentanyl" was used to predict opioid-related overdose deaths. The analysis builds upon N = 35 states. Opioid-related overdose deaths and fentanyl-related online information seeking was measured for each state for the whole year of 2017. Reading example: The more users searched for fentanyl in a given state, the higher was the opioid-related death rate in this given state (β =.55).

Additional analysis

Fentanyl abuse often involves illicitly produced drugs mixed with heroin, as we have already outlined above. Based on this empirical fact, we investigated whether the search engine volume also shows evidence of polydrug use. In fact, we tested whether the number of Google searches for fentanyl (as stated in research question 1) is moderated by the number of Google searches for heroin. The idea was that online information seeking is an even stronger predictor of opioid-related deaths when users in a given state searched for more drugs ("polydrug googling"). To test this *post hoc* idea, we reran the hierarchical regression model that we reported as a test of research question 1 (see Table 1) and added a third step. We put the number of heroin searches into the third step. This variable was measured in the same way as the number of fentanyl searches was. Next, we put the interaction term (i.e., number of fentanyl searches × number of heroin searches) into the fourth step.

We found a significant change in the explained variance of the third step, ΔF (1, 25) = 30.30, $\Delta R2$ = .15, p < .001. Interestingly, both Google search factors were significant in the third step and thus explained a unique variance: fentanyl, B = .19, SE = .08, β = .27, p = .023; heroin, B = .39, SE = .07, β = .64, p > .001. Of central interest for the test of the *post hoc* idea, however, was that we found a significant change in the

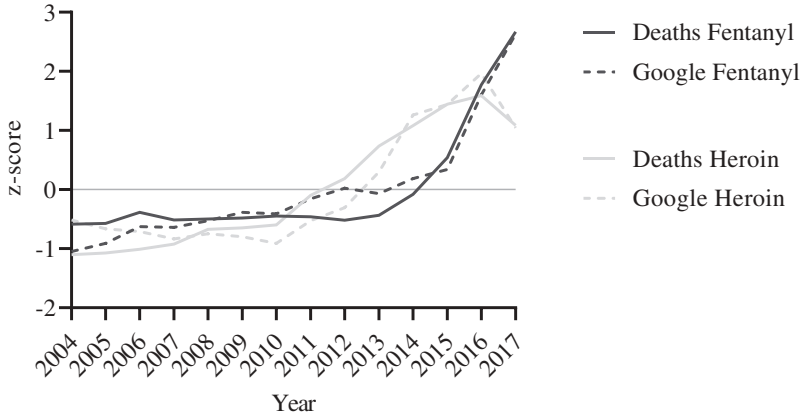

Figure 2. Fentanyl and heroin-related overdose deaths and online information seeking via Internet search engines in the United States. This figure presents z-standardized time series data. A higher z-score i indicates (1) more searches or (2) more deaths within the USA in the respective year.

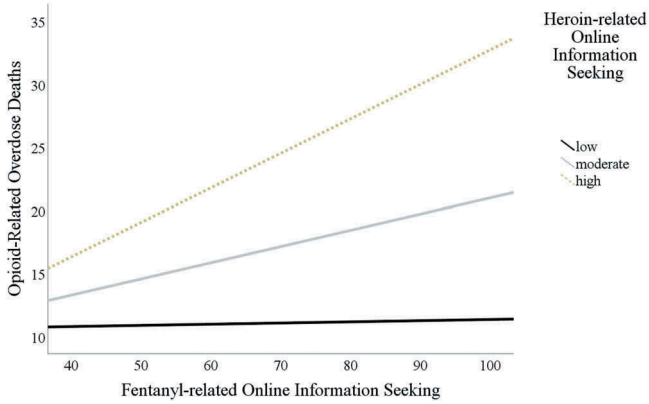

Figure 3. Probing the interaction effect based on a Johnson–Neyman analysis. Fentanyl-related online information seeking predicted opioid-related overdose deaths in a given state when heroin-related online information seeking in that given state was at a moderate or high level. Fentanyl-related online information seeking did not predict opioid-related overdose deaths when heroin-related online information seeking was low.

explained variance of the fourth step when entering the interaction term, ΔF (1, 24) = 6.54, $\Delta R2$ = .03, p = .017. We used the Johnson–Neyman technique to probe this interaction effect. We obtained a moderator value of 57.93 that defined the Johnson–Neyman significance region. This means that fentanyl-related Google searches only predicted opioid-related deaths in states in which Google searches for heroin reached moderate and high volumes (i.e., states with heroin searches > 57.93). Figure 3 visualizes this interaction effect.

Discussion

Epidemiological and forensic medical data point to a disturbing increase in the illicit use of fentanyl, a highly potent synthetic opioid whose abuse often involves illicitly produced drugs mixed with heroin. Fentanyl-related deaths have skyrocketed during recent years and, based on this fact, public health experts have emphasized that there is an urgent need for new, effective harm-reduction strategies and technologies. We asked whether a specific search engine adaptation could contribute to this endeavor through presenting warning and help messages as an info box in response to specific Google searches. However, in a first step, research has yet to provide evidence that the number of Google searches is related to actual overdose-death rates. This was the focus of the present study. Using state-level data from the USA, the analysis indicates that there is a cross-sectional and a longitudinal statistical relationship between opioid-related overdose deaths and the number of Google searches using the term "fentanyl." This finding of a strong relationship (i.e., more fentanyl searches when there are more opioid-related deaths) emphasizes the potential importance of Internet search engines for a targeted public health intervention. In addition, unplanned explorative analysis showed that online information seeking was an even stronger predictor of opioid-related deaths when users in a given state searched for more drugs ("polydrug googling"). Given the fact that most fentanyl abuse involves illicitly produced drugs mixed with heroin ("polydrug use"), future research may assess whether there is a conceptual relationship between polydrug use and "polydrug googling."

We argued that the presentation of an info box including warning and help messages in an "info box," which would be prominently displayed at the top of the search result list, could be implemented in a similar way to the info box that is already in use in the suicide domain. As a tailored awareness message that would appear exactly when users searched for specific drugs (e.g., when looking for the interaction effects of polydrug use or lethal dosages for suicide), this info box could present helpful information at the exact moment when it would apparently be needed. This renders such an info box a promising opioid-related public health intervention strategy, and as such, further scholarly attention is warranted.

That said, strategies to tackle the harms of substance misuse and addiction remain among the most controversial in the area of public policy and new ways of thinking are slowly emerging (Socías & Wood, 2017). In a recent paper on reframing prevention strategies for the opioid crisis (due to the increasing importance of fentanyl), Manchikanti et al. (2018) proposed a 3-tier approach: Whereas Tier 1 includes an education campaign targeted at the public, physicians, and patients, Tier 2 includes the facilitation of easier access to non-opioid techniques and the establishment of a National All Schedules Prescription Electronic Reporting Act (see Manchikanti et al., 2005). Furthermore, Tier 3 includes making buprenorphine more available for chronic pain management as well as for medication-assisted treatment.

An info box could substantially contribute to Tier 1 and, as already noted, given the high number of Google users, it could elicit a beneficial effect on the current opioid/fentanyl-related drug overdose crisis on a broad, diverse part of the population, including – but not limited to – addicts. This is consistent with Suzuki and El-Haddad (2017) notion based on their review of the literature on fentanyl, where they state that there "is an urgent need to educate clinicians, researchers, and patients about this public health threat" (p. 107). Given that it costs virtually nothing to implement, even if it only helps to save the lives of a few individuals, it may elicit a substantial public health effect due to the high number of daily Google searches. In addition to the possible preventive effects (i.e., the pragmatic effect perspective), we argue that it

is simply the responsibility of society to provide help to vulnerable individuals – whether people accept that help or not (i.e., the humanistic perspective). Given the fact that digital media technologies are so pervasive, search engines are a good (supplementary) means through which to achieve this goal.

Whereas legacy media such as newspapers may also beneficially contribute to the drug overdose crisis – for example, the *Cincinnati Enquirer* started a "heroin beat" in January 2016 (Willis & Painter, 2019), the large number of Google users globally makes search engines an especially powerful tool for public health interventions. That said, research is necessary to test the most effective formulations of warning and help messages prior to implementation.

We offer some starting points for future research: First, even small changes such as the use of verbal quantifiers (e.g., "common") as an alternative to the numerical presentation of risk information about drugs may influence a user's risk perception (Cox, 2019). Similar effects arising from the change of even a single word have been confirmed in the suicide domain (Arendt et al., 2018). Given that the number of words is limited in an info box, future research should test different versions and investigate which formulations elicit the most beneficial effects.

Second, it should also be noted that effective messages for the prevention of overdose deaths in suicidal people will likely differ from interventions targeted at accidental overdoses (Oquendo & Volkow, 2018). However, we do not really know exactly how they differ. Future studies should derive predictions from the available literature and test them prior to implementation. Third, the message in the info box can also be used to include highly tailored content (see Arendt & Scherr, 2017) when specific search terms are entered into the Google search engine. For example, Bauerle Bass et al. (2018) emphasized that an estimated 70–90% of current methadone users have Hepatitis C but less than 10% of methadone patients initiate treatment that can cure the infection in 8–12 weeks. The authors emphasized that engaging methadone users in treatment is an important strategy to lower both morbidity and mortality from liver disease and eliminate a significant reservoir of Hepatitis C in communities. An info box presented when users google for methadone may present awareness material related to this fact (a warning message) and provide a reference to how and where a given treatment is available (a help message).

Limitations

This study has a number of limitations. First, there are limitations related to the validity and reliability of Google Trends data (i.e., transparency issues related to Google's data; absolute query share volume data are not available; uncertainty regarding who searches for specific search terms and why; see Lazer et al., 2014,; Tran et al., 2017). Nevertheless, Google Trends data have been used successfully in previous research (see Nuti et al., 2014), including research on opioid-related overdose deaths (Young et al., 2018). Second, the analysis indicated that a higher number of fentanyl-related searches predicted a higher opioid-related death rate. Unfortunately, we could not assess users' underlying search motives. In fact, users can search for fentanyl for a number of different reasons such as looking for chemistry-related information on the substance, gaining knowledge regarding epidemiological facts, what the lethal dosage is for suicide, finding out where to buy illicit drugs, help websites, crisis intervention centers, self-help groups to fight against addiction, or simply to learn more about an overdose-death case that has recently gained media attention. This aspect requires clarification in future (survey) studies. Related to this point, fentanyl-related search volume can be caused by different categories of users such as (suicidal and non-suicidal) non-addicted vulnerable individuals, (suicidal and non-suicidal) addicts, addicts' friends and family members, or physicians. Macro-level data used in the present study can not be used to test which categories of users are most important for search volume. Third, the focus of the analysis was restricted to only one substance (i.e., fentanyl). This was due to the growing importance of this drug in the overdose-death statistics in recent years.

Conclusion

Despite these limitations, the present study provides evidence for a cross-sectional and a longitudinal relationship between the number of fentanyl searches on the Google search engine and opioid-related overdose deaths. This indicates that online information seeking covaries with drug overdose-death rates, pointing to the importance of search engines for the current overdose drug crisis. Internet search engines seem to have great promise as a public health intervention. An info box that is presented following drug-related search requests may be a cost-effective intervention to warn users about the dangers of (mis)use and provide references to professional help.

References

Arendt, F., & Scherr, S. (2017). Optimizing online suicide prevention: A search engine-based tailored approach. *Health Communication*, *32* (11), 1403–1408. https://doi.org/10.1080/10410236.2016.1224451

Arendt, F., Scherr, S., Niederkrotenthaler, T., & Till, B. (2018). The role of language in suicide reporting: Investigating the influence of problematic suicide referents. *Social Science & Medicine*, *208*, 165–171. https://doi.org/10.1016/j.socscimed.2018.02.008

Armenian, P., Vo, K., Barr-Walker, J., & Lynch, K. (2018). Fentanyl, fentanyl analogs and novel synthetic opioids: A comprehensive review. *Neuropharmacology*, *134*, 121–132. https://doi.org/10.1016/j.neuropharm.2017.10.016

Bandura, A. (2001). Social cognitive theory of mass communication. *Media Psychology*, *3*, 265–299. https://doi.org/10.1207/S1532785XMEP0303_03

Bauerle Bass, S., Jessop, A., Maurer, L., Gashat, M., Al Hajji, M., & Gutierrez, M. (2018). Mapping the barriers and facilitators of HCV treatment initiation in methadone maintenance therapy patients: Implications for intervention development. *Journal of Health Communication*, *23*(1), 117–127. https://doi.org/10.1080/10810730.2017.1414902

Cox, J. (2019). Verbal quantifiers and communicating painkiller side effect risk. *Health Communication*, 1–10. Advance online publication https://doi.org/10.1080/10410236.2019.1632402

Dai, Z., Abate, M., Smith, G., Kraner, J., & Mock, A. (2019). Fentanyl and fentanyl-analog involvement in drug-related deaths. *Drug and Alcohol Dependence*, *196*, 1–8. https://doi.org/10.1016/j.drugalcdep.2018.12.004

Ewoldsen, D. R., & Rhodes, N. (2020). Media priming and accessibility. In M. B. Oliver, A.A. Raney, & J. Bryant (Eds.). *Media effects:*

Advances in theory and research (pp. 83–99). New York, NY: Routledge.

Gostin, L. O., Hodge, J. G., & Noe, S. A. (2017). Reframing the opioid epidemic as a national emergency. *JAMA*, *318*(16), 1539–1540. https://doi.org/10.1001/jama.2017.13358

Gould, M. S., Lake, A. M., Galfalvy, H., Kleinman, M., Munfakh, J., Wright, J., & McKeon, J. (2017). Follow-up with callers to the national suicide prevention lifeline: evaluation of callers' perceptions of care. *Suicide and Life-threatening Behavior*, *48*, 75–86. https://doi.org/10.1111/sltb.12339

Horwitz, S., & Higham, S. (2019, August 23). *The flow of fentanyl: In the mail, over the border*. *Washington Post*. https://www.washingtonpost.com/investigations/2019/08/23/fentanyl-flowed-through-us-postal-service-vehicles-crossing-southern-border/?arc404=true

Knox, K. L., & Bossarte, R. M. (2009, January 12–15). Suicide prevention research—enabling activities funded through VA's office of mental health. In: *Proceedings of the 2009 Department of Defense/Veterans administration suicide prevention conference*. San Antonio, TX.

Kuczyńska, K., Grzonkowski, P., Kacprzak, Ł., & Zawilska, J. (2018). Abuse of fentanyl: An emerging problem to face. *Forensic Science International*, *289*, 207–214. https://doi.org/10.1016/j.forsciint.2018.05.042

Lang, A. (2006). The limited capacity model of mediated message processing. *Journal of Communication*, *50*(1), 46–70. https://doi.org/10.1111/j.1460-2466.2000.tb02833.x

Lazer, D., Kennedy, R., King, G., & Vespignani, A. (2014). The parable of Google flu: Traps in big data analysis. *Science*, *343*(6176), 1203–1205. https://doi.org/10.1126/science.1248506

Manchikanti, L., Sanapati, J., Banyamin, R., Atluri, S., Kaye, A., Hirsch, J., Sanapati, J., Banyamin, R., Atluri, S., Kaye, A., Hirsch, J., Banyamin, R., Atluri, S., Kaye, A., Hirsch, J., Atluri, S., Kaye, A., Hirsch, J., Kaye, A., Hirsch, J., & Hirsch, J. (2018). Reframing the prevention strategies of the opioid crisis: Focusing on prescription opioids, fentanyl, and heroin epidemic. *Pain Physician*, *21*(21;1), 309–326. https://www.painphysicianjournal.com/current/pdf?article=NTMwMQ%3D%3D&journal=112 https://doi.org/10.36076/ppj.2018.4.309

Manchikanti, L., Whitfield, E., & Pallone, F. (2005). Evolution of the National all schedules prescription electronic reporting act (NASPER): A public law for balancing treatment of pain and drug abuse and diversion. *Pain Physician*, *8*(4), 335–347. https://www.painphysicianjournal.com/current/pdf?article=NTEx&journal=26

National Institute of Drug Abuse. (2019). *Opioid summaries by state: Revised May 2019*. https://www.drugabuse.gov/drugs-abuse/opioids/opioid-summaries-by-state

Nuti, S., Wayda, B., Ranasinghe, I., Wang, S., Dreyer, R., Chen, S., & Murugiah, K. (2014). The use of Google Trends in health care research: A systematic review. *PloS One*, *9*(10), e109583. https://doi.org/10.1371/journal.pone.0109583

Oquendo, M., & Volkow, N. (2018). Suicide: A silent contributor to opioid-overdose deaths. *New England Journal of Medicine*, *378*(17), 1567–1569. https://doi.org/10.1056/NEJMp1801417

Scherr, S., Haim, M., & Arendt, F. (2019). Equal access to online information? Google's suicide-prevention disparities may amplify a global digital divide. *New Media & Society*, *21*(3), 562–582. https://doi.org/10.1177/1461444818801010

Socías, M. E., & Wood, E. (2017). Epidemic of deaths from fentanyl overdose. *BMJ*, *358*, j4355. https://doi.org/10.1136/bmj.j4355

Spencer, M. R., Warner, M., Bastian, B. A., Trinidad, J. P., & Hedegaard, H. (2019). Drug overdose deaths involving fentanyl, 2011–2016. *National Vital Statistics Reports*, *68*(3), 1–19. https://stacks.cdc.gov/view/cdc/77832

Suzuki, J., & El-Haddad, S. (2017). A review: Fentanyl and non-pharmaceutical fentanyls. *Drug and Alcohol Dependence*, *171*, 107–116. https://doi.org/10.1016/j.drugalcdep.2016.11.033

Thaler, R., & Sunstein, C. (2008). *Nudge: Improving decisions about health, wealth and happiness*. Penguin Books.

Tran, U., Andel, R., Niederkrotenthaler, T., Till, B., Ajdacic-Gross, V., & Voracek, M. (2017). Low validity of Google Trends for behavioral forecasting of national suicide rates. *PloS One*, *12*, e0183149. https://doi.org/10.1371/journal.pone.0183149

Willis, E., & Painter, C. (2019). The needle and the damage done: Framing the heroin epidemic in the *Cincinnati Enquirer*. *Health Communication*, *34*(6), 661–671. https://doi.org/10.1080/10410236.2018.1431023

World Health Organization. (2018). *Information sheet on opioid overdose*. https://www.who.int/substance_abuse/information-sheet/en/

Xu, J., & Cao, X. (2019). Young adults' (mis)use of prescription opioid drugs: An exploratory study. *Health Communication*, 1–8. Advance online publication https://doi.org/10.1080/10410236.2019.1636343

Young, S., Zheng, K., Chu, L., & Humphreys, K. (2018). Internet searches for opioids predict future emergency department heroin admissions. *Drug and Alcohol Dependence*, *190*, 166–169. https://doi.org/10.1016/j.drugalcdep.2018.05.009