Harm Reduction Journal

RESEARCH

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US drug policy does not align with experts' rankings of drug harms: a multi-criteria decision analysis

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Abstract

Background United States drug policy is primarily based on the Controlled Substances Act of 1970 and largely contradicts scientific evidence about how to mitigate drugs' harms. Expert consensus on drug harms could inform policy that improves the health of people who use drugs while reducing negative societal impacts of drug use. Therefore, this study adapted and extended the relevant 2010 United Kingdom multi-criteria decision analysis, rating drug harms by criteria comprising health and social impacts to people who use drugs and their families, communities, and society.

Methods Seventeen experts on drug use in the US, including three with lived experience of drug use and recovery, assessed 19 drugs across 18 criteria. Drugs were scored from 0 to 100 points on each criterion. Then, criteria were weighted to represent the experts' view of their relative importance, and each drug was assigned an overall harm score. We also created a numerical rating to represent Controlled Substances Act-defined harm.

Results Fentanyl (scoring 90), methamphetamine (84), crack (83), and heroin (82) were the most harmful drugs. Cannabis (32) ranked in the middle, and mushrooms (3) were the least harmful. Drug-specific mortality and economic cost were the largest overall contributors to harm, while environmental damage was the smallest. The correlation between Controlled Substances Act-defined harm and experts' harm ratings was −0.26.

Conclusions These findings add to the growing international literature highlighting how drug policy contradicts expert assessments of drug harms across nations. To reduce these harms, public health strategies informed by evidence and expert input should be prioritized over punitive approaches.

Keywords Drug harms, Controlled substances act, Substance use disorders, Drug policy, Public health, Harm reduction, Multi-criteria decision analysis

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Background

United States (US) drug policy is poorly aligned with scientific evidence. For example, fentanyl, heroin, methamphetamine, and crack have been associated with various epidemics but punitive approaches remain more widely utilized than public health and harm reduction approaches [1]. This is the case despite scientific evidence showing that public health and harm reduction approaches to drug use save lives and do not increase crime [2, 3]. Psilocybin and cannabis are associated with less harm than many other drugs and with potential medicinal benefits but people who use them remain subject to punishment in many jurisdictions [4–6]. This is because the Controlled Substances Act (CSA) of 1970, which classifies drugs according to abuse potential, accepted medical use, and physical and psychological dependence risk, places these drugs in Schedule I; thus, per federal law, they are considered to have high abuse potential and no approved medicinal use [7]. This status also hinders researchers' ability to study their potential therapeutic effects [5]. These examples indicate that scientific evidence is undervalued and poorly integrated in US drug policy. The mismatch between drug harms and policy exists partly because expert knowledge has not been fully considered with national drug policy decisions [6–8]. Moreover, addiction, including its related harm to individuals and to society, is a complex condition that requires input from multiple professional disciplines and from people with lived experience to comprehensively address.

To scientifically define harms associated with specific drugs, research teams in the United Kingdom, Europe, Australia, and New Zealand have engaged experts in a systematic group decision-making approach known as multi-criteria decision analysis (MCDA). This approach convenes experts who engage in a facilitated debate to reach consensus on a complex issue, thereby creating guidance that decision makers can use [9]. The first was the 2010 UK study [9], which used 16 criteria divided into two domains: harm to people who use drugs (PWUD), such as drug-specific mortality, dependence, and loss of relationships, and harm to others, such as economic cost, crime, and family adversities. Both the UK study and the 2015 EU study ranked alcohol, heroin, and crack (in that order) as the most harmful drugs [9, 10]. The 2019 Australian study and the 2023 New Zealand study ranked alcohol and methamphetamine as the most harmful drugs [11, 12]. Notably, the New Zealand study added two culturally relevant harm criteria: non-physical/spiritual damage (to PWUD) and intergenerational harm (to others) [12]. Some drugs, such as alcohol, tobacco, and cannabis were ranked in each previous MCDA, while others were varied from the UK study due to local drug use preferences. Moreover, across the four previous MCDAs, cannabis was rated as moderately harmful, and psilocybin/other hallucinogens among the least harmful drugs to both the people who use them and to society [9–12].

The US is in a public health crisis that costs nearly half a billion dollars [13] and claims over 250,000 lives annually due to overdoses or drug-related mortality [14]. Importantly, previous MCDAs considered various health (e.g., cirrhosis, blood-borne viruses) and social impacts (e.g., family adversities) not considered in CSA scheduling criteria. However, no US MCDA has been conducted, limiting the applicability of expert input from MCDAs to relevant US policy that could help abate the public health crisis. Moreover, neither drug withdrawal nor legal consequences were considered as separate criteria in previous MCDAs. These issues are vitally important in the US context. Withdrawal creates considerable harm on its own, and in the US, it may be more challenging to address because of an under-resourced public health system and because individuals do not have guaranteed access to healthcare [1]. Withdrawal may be precipitated or worsened by inadequate treatment within the criminal legal system, increasing the likelihood of returning to use, rearrest, and overdose when released [2, 15–17].

Furthermore, legal consequences must be disentangled from other criteria because of the longstanding "War on Drugs," which has treated drug use as a criminal issue (versus a health or social issue) in the U.S. Two-thirds of individuals incarcerated for drug convictions are detained in state facilities, about a quarter of them for drug possession [18]. In some states, possession of any amount of illegal drugs (e.g., heroin, methamphetamine, psilocybin) is a felony, and the defendant must meet various criteria to avoid a prison sentence [19]. Moreover, substance use treatment and other health services are often inadequate in prisons, and scholars have long recommended treatment be prioritized over incarceration [2, 15, 17]. Felony drug convictions (including use and/or possession) compound harm by limiting economic and educational opportunities, as well as eligibility for housing and income support [16].

Because legal consequences and related harms may ensue at the federal or state level, policy must be addressed at both levels. Expert-informed drug policy derived from consensus on drug harms could improve the interrelated health, legal, and economic status of impacted individuals, families, and communities. Such policy could also enable researchers to study the potential medical uses of various drugs. Moreover, previous MCDAs have identified various professionals (e.g., researchers, clinicians, emergency medical personnel, drug policy advocates), but only Crossin et al. (2023) identified which experts had lived experience of drug use and recovery. Identifying these individuals positions their

experiential knowledge equally with research or clinical expertise. Plus, as drug use preferences shift, people with lived experience may be first to know about new methods of use or increased drug potency and have unique perspectives on harms. Thus, the authors are all US-based experts in drug harms through research, clinical practice, and/or lived experience of problematic drug use and subsequent recovery. Accordingly, we engaged in an MCDA conference to (1) rate the personal and societal harms of 19 drugs in the US, (2) compare our harm rankings with those of previous MCDAs, (3) compare our harm rankings with CSA-defined legal classifications, and (4) inform public policies that prioritize the health and well-being of people who use drugs and of the impacted communities.

Methods

Study design

This study is an adaptation and extension of the 2010 MCDA conference in the UK. Data for the current study comes from an MCDA conference held at the Ohio State University (OSU) in July 2024. This meeting included 17 experts on drug use (hereafter "participants") from across the US (see Table 1), all of whom are also authors of the present manuscript. To select these individuals, the first five authors consulted their networks and examined literature related to harms of specific drugs. Therefore, some invitations were sent to individuals known to the first five authors, and others were "cold calls." There were a total of 45 invitations sent, and among the 17 participants, there were at least two people with expertise for each drug examined in the MCDA (so a participant could be an expert on more than one drug). While the participants were not required to do any studying before the decision conference, the invitations included a list of the 19 drugs to be rated. Therefore, participants could brush up on their knowledge before the decision conference, if they deemed it necessary to do so.

One of the authors (LP) facilitated the decision conference and moderated the discussions, due to his extensive experience in doing so with other MCDAs. To begin the decision conference, LP prompted participants to select drug harm criteria, encouraging them to consider whether they should add any criteria to those used in the UK MCDA. Participants decided that two additional criteria, withdrawal and legal consequences, should be added (see Fig. 1). The remainder of the two-day decision conference involved participants ranking 19 drugs (see Table 2) against these criteria (see Table 3 for descriptions of these criteria). Similar to the three drug harms MCDAs conducted since 2010 [10–12], the prevalence and history of various drug use in the US led us to consider some drugs not included in the UK study (i.e., fentanyl, electronic nicotine devices, ayahuasca, prescription opioids, and prescription stimulants) and to eliminate others considered in that study (i.e., amphetamine, GHB,

Table 1 The participants in the decision conference

Person	Institution	Position in institution
Mitch Earleywine	University at Albany	Professor, Department of Psychology
Brandon Weiss	Johns Hopkins University	Research Associate, Center for Psychedelic & Consciousness Research
Cecilia Bergeria	Johns Hopkins University	Associate Professor of Psychiatry and Behavioral Sciences
David Mathai	Johns Hopkins University/Sattva Medicine	Owner (Sattva Medicine); Volunteer Assistant Professor, Johns Hopkins Department of Psychiatry and Behavioral Sciences
Chuck Nichols	Louisiana State University	Associate Professor of Pharmacology
Brooke Arterberry	University of Michigan	Research Investigator, Survey Research Center, Institute for Social Research
Nathan Menke	University of Michigan	Clinical Assistant Professor, University of Michigan Medical School
Kathryn Gex	Medical University of South Carolina	Assistant Professor, College of Medicine
Nefize Yalin	King's College London	Post-Doctoral Fellow
Mike Broman*	Ohio State University	Assistant Professor, College of Social Work
Alan Davis	Ohio State University	Associate Professor, College of Social Work; Director, Center for Psychedelic Drug Research and Education
Tom Gregoire*	Ohio State University	Associate Professor, College of Social Work
Hillary Shaub*	Ohio State University	Social Worker, Center for Psychedelic Drug Research and Education
Alayna Tackett	Ohio State University	Assistant Professor, Division of Medical Oncology
Jamey Lister	Rutgers University	Associate Professor, School of Social Work; Co-Director & New Jersey Director, Northeast & Caribbean Rural Opioid Technical Assistance Center
Nicky Mehtani	University of California, San Francisco	Assistant Professor, Division of General Internal Medicine at UCSF Zuckerberg San Francisco General Hospital
Gustavo Angarita	Yale University	Assistant Professor of Psychiatry; Director, Yale Cocaine Research Clinic, Psychiatry; Inpatient Chief of the Clinical Neuroscience Research Unit (CNRU), Psychiatry; Medical Director, Forensic Drug Diversion Clinic (ForDD)

*These experts identify as having lived experience of substance use and recovery

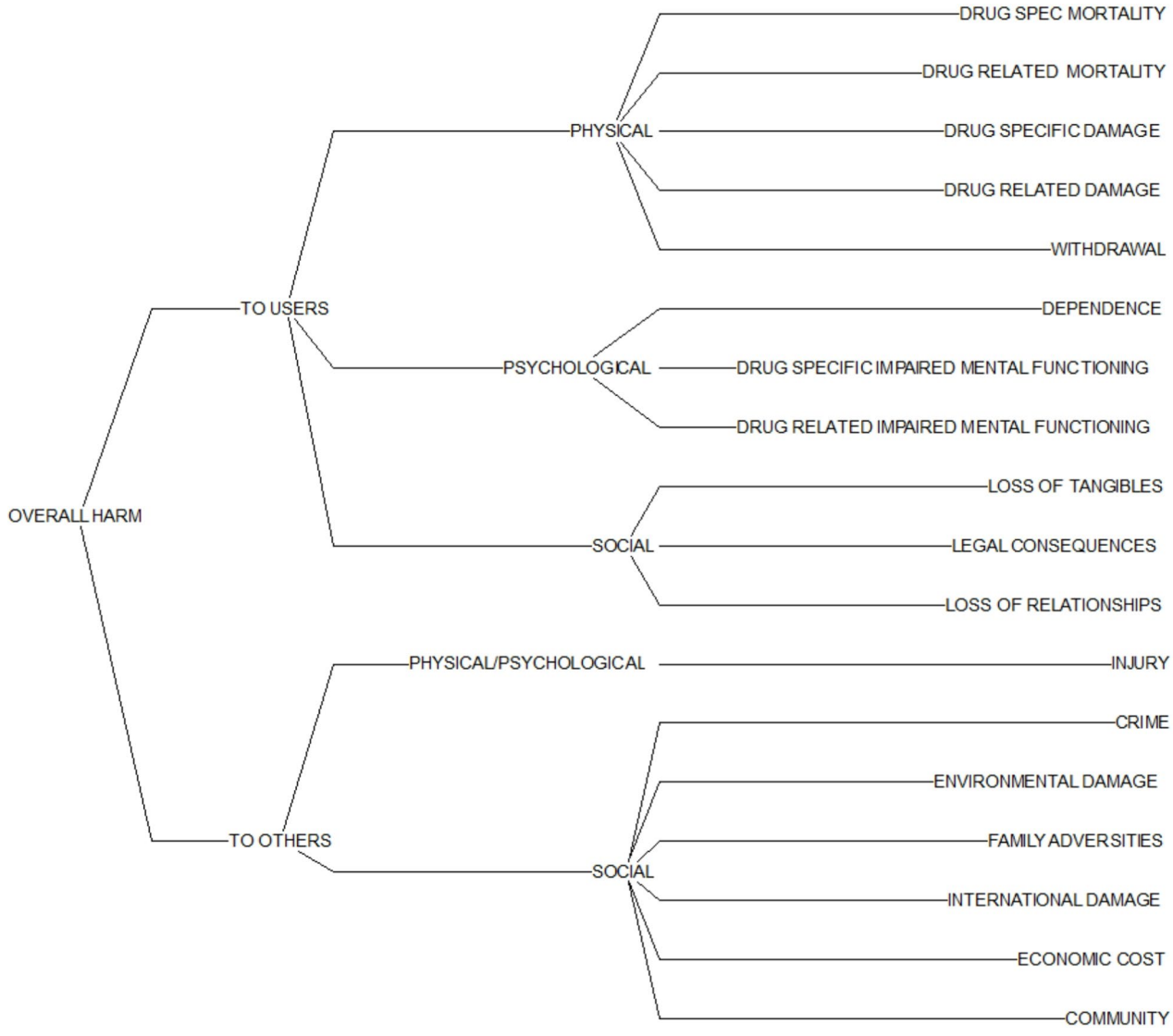

Fig. 1 The evaluation criteria organized by harms to people who use drugs and harms to others, and clustered under physical, psychological and social effects

mephedrone, butane, khat, and anabolic steroids). Moreover, while crack and cocaine are not distinguished from one another in CSA classifications, varying use patterns, health impacts, and consequences for use (e.g., harsher sentencing laws for crack) led us to consider them separately. Also, while alcohol, tobacco, and electronic nicotine devices are not listed in CSA Schedules, we rated them because previous MCDAs found that they are more harmful than various illegal drugs. Finally, in keeping with the approach of previous MCDAs [11, 12], "fentanyl" included various analogues.

Participants not affiliated with the host institution (OSU) were compensated with paid travel expenses and a $500 honorarium for their efforts, except for those who were working as government employees at the time of the meeting. LP was paid a $10,000 consulting fee for facilitating the conference and analyzing and writing the first draft of the results. The study was deemed exempt by the Institutional Review Board at OSU.

The criteria

The 18 criteria against which the drugs were scored for their harms are shown in Fig. 1. The tree shows categories of harm at the branch nodes and the criteria against which each drug was evaluated at the far right. Figure 1 also depicts the separate branches of harm to those who use the drug and harm to others (resulting from drug use). Each branch is further separated into categories of physical, psychological, and social harms associated with drug use. Compared to the criteria used in the UK study, two more harms were added to harm to people who use drugs: withdrawal (physical harm), and legal

Table 2 The 19 drugs considered during the decision conference

Drug	CSA SCH	Examples
1. Alcohol	None	
2. Tobacco	None	
3. Electronic nicotine devices	None	
4. Cannabis	I	
5. LSD	I	
6. Ayahuasca	I	
7. MDMA/ecstasy	I	
8. Heroin	I	
9. Magic mushrooms	I	
10. Methadone	II	Dolophine, Methadose, Amidone
11. Methamphetamine	II	ICE, Crank, Speed, Meth
12. Prescription opioids	II	Vicodin, Oxycontin, Percocet
13. Fentanyl/high-potency opioids	II	Fentanyl, carfentanil, acetyl fentanyl, furanyl fentanyl
14. Crack	II	
15. Cocaine	II	
16. Prescription stimulants	II	Desoxyn, D-desoxyephedrine, Dexedrine, Adderall, Obetrol
17. Ketamine	III	
18. Buprenorphine	III	Suboxone
19. Benzodiazepines	IV	Valium, Xanax, Ativan, Klonopin

consequences (social harm), due to their potentially reinforcing relationship on drug use and importance in the context of the US War on Drugs. The UK model's 'loss of tangibles' included criminal record and imprisonment. The US model moved these to the new legal consequences criterion, which included stigma and the on-going impact of drug use.

Scoring the drugs

Drugs were scored using points (0-100). In this scoring system, a score of 100 is assigned to the most harmful drug on a given criterion, and a score of 0 means 'no harm.' In scoring the drugs, participants were encouraged to consider how harmful one drug is relative to another. For example, scoring prescription opioids at 50 on drug-specific mortality meant that fentanyl (score of 100) was twice as harmful on that criterion. Participants were also asked to consider common routes of ingestion and how those impacted harms (e.g., injection for heroin, snorting for cocaine). Harm to people who use was defined as both the extent of harm to each individual and the number of people experiencing the harm (i.e., drugs with more widespread use were considered more harmful). In response to some participants suggesting these should be separate criteria, LP explained that for previous drug-harm models, the experts considered both factors to define harm. Thus, prevalence of use was an important factor in the discussion of each drug's harm.

For each criterion, discussion began with LP prompting participants to determine the most harmful drug on that criterion. Then, participants engaged in debate to score the remaining drugs. These debates generally consisted of participants presenting their experiential or observational expertise, as well as data from their or others' research. During this process, scores often changed from those initially suggested to produce a final set of scores for each criterion. LP's experience facilitating decision conferences shows that precision in these scores of harms, plus or minus 5 points, does not affect the overall results. He therefore suggested choosing a median score if, after debate, the differences among participants were no more than ±5. Participants completed scoring the drugs on all the criteria during the decision conference. After the decision conference, preliminary results were sent to participants to ensure that the original scores were consistent with their perceptions of harm. This follow-up did not result in any changes to the scores from the decision conference. These means of consistency checking were used to minimize bias in the scores.

Weighting

Scoring of the drugs on each criterion began with the group identifying the most harmful drug for that criterion and scoring it 100. However, different criteria do not necessarily represent the same extent of harm. Some criteria were judged to be more important (e.g., drug-specific mortality), and weighting ensured that a single unit of harm emerged across all the criteria. That was accomplished by weighting the criteria for relative importance through swing weighting [20], which ensures that units of drug harm, represented on different scales, are equivalent. This strategy enables the comparison of weighted scores and allows scores to be combined across criteria.

In this weighting approach, the compared scales are considered preference value scales, meaning that the more harm, the more negative preference value. Harm therefore expresses a level of damage, while value indicates how much that level of damage matters. Thus, to judge the harm-value of a specific drug, two steps must be completed. First, it is crucial to assess the added harm going from the lowest level of harm (=0) to the highest level of harm (=100). Second, it is essential to examine how much that difference in harm matters. These questions were posed to the participants when comparing the 0-to-100 swing in harm on one criterion scale with the 0-to-100 swing on another criterion scale.

During the decision conference, participants assessed weights within each criteria grouping and then across the groupings. Thus, the units of harm on all scales were equated. A final normalization, ensuring that the final criterion weights summed to 100 (their decimal equivalents were multiplied by the scores), preserved the original

Table 3 Definitions of the evaluation criteria

Name	Description
Drug-specific mortality	The risk of death associated with single use consumption.
Drug-related mortality	The extent to which life is shortened by the use of this drug (excludes drug specific mortality). E.g. road traffic accidents, lung cancers, HIV, suicide.
Drug-specific damage	Drug-specific damage to physical health e.g. cirrhosis, seizures, strokes, cardiomyopathy, stomach ulcers.
Drug-related damage	Drug-related damage to physical health, including consequences of, e.g., unwanted sexual activities, self-harm, infectious diseases, damage from cutting agents.
Withdrawal	Extent to which the drug creates harm associated with acute physical withdrawal.
Dependence	The extent to which this drug creates a propensity or urge to continue to use despite adverse consequences (ICD10 or DSM4).
Drug-specific impairment of mental functioning	Drug-specific impairment of mental functioning, e.g. amphetamine-induced psychosis, intoxication.
Drug-related impairment of mental functioning	Drug-related impairment of mental functioning, e.g. mood disorders secondary to drug use.
Loss of tangibles	Extent of loss of tangible things (e.g. income, housing, job, educational achievements).
Legal consequences	Criminal record, imprisonment, continued supervision, stigma and on-going impact.
Loss of relationships	Extent of loss of relationship with family and friends.
Injury	The extent to which the use of this drug increases the chance of injuries to others both directly and indirectly, e.g. violence (including domestic violence), traffic accidents, fetal harm, drug waste, secondary transmission of infectious diseases.
Crime	The extent to which the use of this drug involves or leads to an increase in volume of crime directly or indirectly (at the population level, not the individual level).
Environmental damage	The extent to which the use and production of this drug causes environmental damage locally, e.g. toxic waste from amphetamine factories, discarded needles.
Family adversities	The extent to which the use of this drug causes family adversities, e.g. family breakdown, economic disruption, emotional trauma, future prospects of children, child neglect.
International damage	The extent to which the use of this drug in the US contributes to damage at an international level, e.g. deforestation, destabilization of countries, international crime and new markets.
Economic cost	The extent to which the use of this drug causes direct costs (e.g. healthcare, police, prisons, social services, customs, insurance, crime) and indirect cost (e.g. loss of productivity, absenteeism) to the US.
Community	The extent to which the use of this drug creates decline in social cohesion and/or decline in the reputation of the community.

CSA: Controlled Substances Act. SCH: Level of potential for abuse, I high and no acceptable medical use, II high and sometimes allowed for medical use with "severe restrictions", III medium and accepted for medical use, and IV moderate and accepted for medical use. Ayahuasca use is prohibited by the CSA as it contains DMT (Schedule I)

ratios of all weights. By adding the weighted scores, harm scores could be combined within any grouping. Scores and weights were entered into the Hiview3 software program. This program was used to calculate the weighted scores and to create figures depicting the results. Moreover, sensitivity analyses were conducted, in which criterion weights were varied to examine the impact on rankings.

Comparing our scores to CSA classifications

CSA schedules invoke three criteria (abuse potential, currently accepted medical use, and potential for physical or psychological dependence), and range from I to V. Drugs that are listed in Schedule I are the most harmful according to the CSA, with high potential for abuse and dependence and no currently accepted medical use. To represent CSA-defined harm numerically, we simply created an ordinal harm rating corresponding to drug schedule. Specifically, Schedule I drugs were assigned 5 points, Schedule II drugs were assigned 4 points, and so forth. Drugs that are not scheduled were assigned 0 points.

Role of the funding source

The study's sponsor had no role in the study's design or in data collection, analysis, interpretation, or writing this manuscript. All authors had unlimited access to all study data, and agreed to submit this manuscript for publication.

Results

Figure 2 shows the relative scores at the extreme left Overall Harm node of Fig. 1 as stacked bar graphs, sorted from the most to least harmful drug. The sections of each bar graph show each criterion's contribution to the overall score. Drug-specific mortality and economic cost were tied for the largest weighted contributor to harm for all drugs, with a cumulative weight of 8.1 each, while environmental damage was the smallest weighted contributor to harm, at a cumulative weight of 2.4. Fentanyl (overall

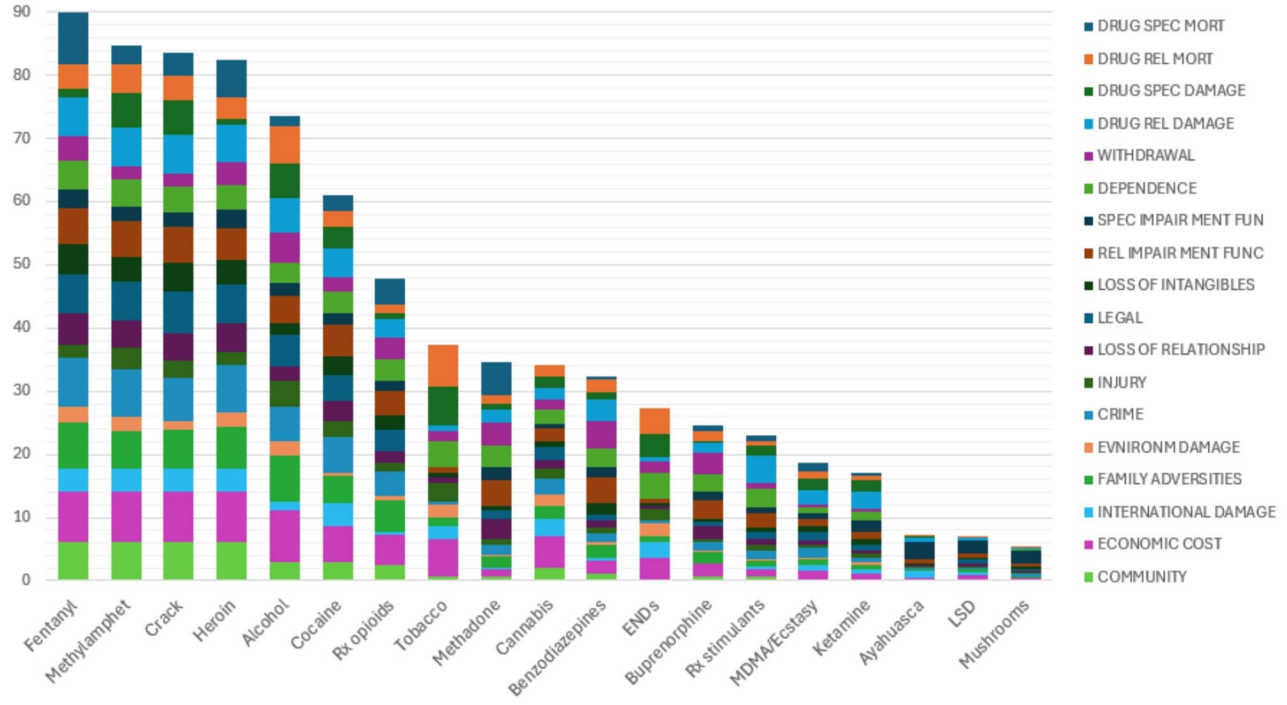

Fig. 2 The overall weighted scores for each of the drugs. Fentanyl, with an overall score of 90, is judged to be most harmful, followed by methamphetamine at 84, then crack with a score of 83 and heroin at 82. Just seven drugs score above 35 overall. The colored bars indicate the part scores on each of the criteria. Drug-specific mortality, the upper pink bars, are substantial contributors to three of the drugs, fentanyl, heroin, and methadone, while economic cost contributes heavily to fentanyl, methamphetamine, crack, heroin, alcohol, and tobacco. The Cumulative Weight column shows the normalized weight on each criterion. Higher weights mean larger differences that matter between most and least preferred drugs

harm score = 90) was deemed the most harmful drug, followed by methamphetamine (84), crack (83), and heroin (82), then alcohol (73), cocaine (60), and prescription opioids (46). Fentanyl mainly contributes to harm via drug-specific mortality and economic cost. Crime and family adversities were the next largest contributors to fentanyl's harm, followed by legal consequences, drug-related damage, and community harms. Economic cost was also a large contributor to the overall harm of the other drugs listed above. All except alcohol had drug-specific mortality as a major harm contributor, while drug-related mortality, drug-specific damage, drug-related damage, injury, and family adversities added considerably to alcohol's harm.

A few other drugs that have prompted considerable public debate and scrutiny are also discussed here. Tobacco was ranked eighth-most harmful (coming in after prescription opioids) with a score of 35, with drug-related mortality, drug-specific damage, dependence, and economic cost as the largest contributors to its harm. Interestingly, ENDs were scored at 25, indicating a relatively small difference between their harms and those of combustible tobacco. ENDs were judged to cause slightly more harm in terms of dependence. Lastly, cannabis ranked in the middle of the 19 drugs (tenth-most harmful) with a score of 32, while mushrooms (3) were rated as least harmful. Stacked bar graphs showing the separate contributions to harm to people who use drugs and harm to others are also displayed (see Fig. 3). All drugs except cannabis were rated as more harmful to people who use them than to others.

Various sensitivity analyses did not meaningfully change these results. For example, the weight of drug-specific mortality could be increased from 8.1 to 15 before the order of the top four most harmful drugs would change. In this case, the next three most harmful drugs (alcohol, cocaine, and prescription opioids) would remain in the same position. Moreover, fentanyl remained the most harmful drug even if the weight were reduced to zero. Similarly, an analysis that increased the total weight of the "harm to others" criteria showed that fentanyl remained the most harmful drug even if the "harm to people who use drugs" criteria were reduced to a total weight of zero. In this case, the only change in rankings among the seven most harmful drugs (fentanyl, methamphetamine, crack, heroin, alcohol, cocaine, and prescription opioids) would be between crack, which would move up to second place, and methamphetamine, which would move down to third place. Additionally, the bottom five drugs (MDMA/ecstasy, ketamine, ayahuasca, LSD, and mushrooms) would remain in the same positions.

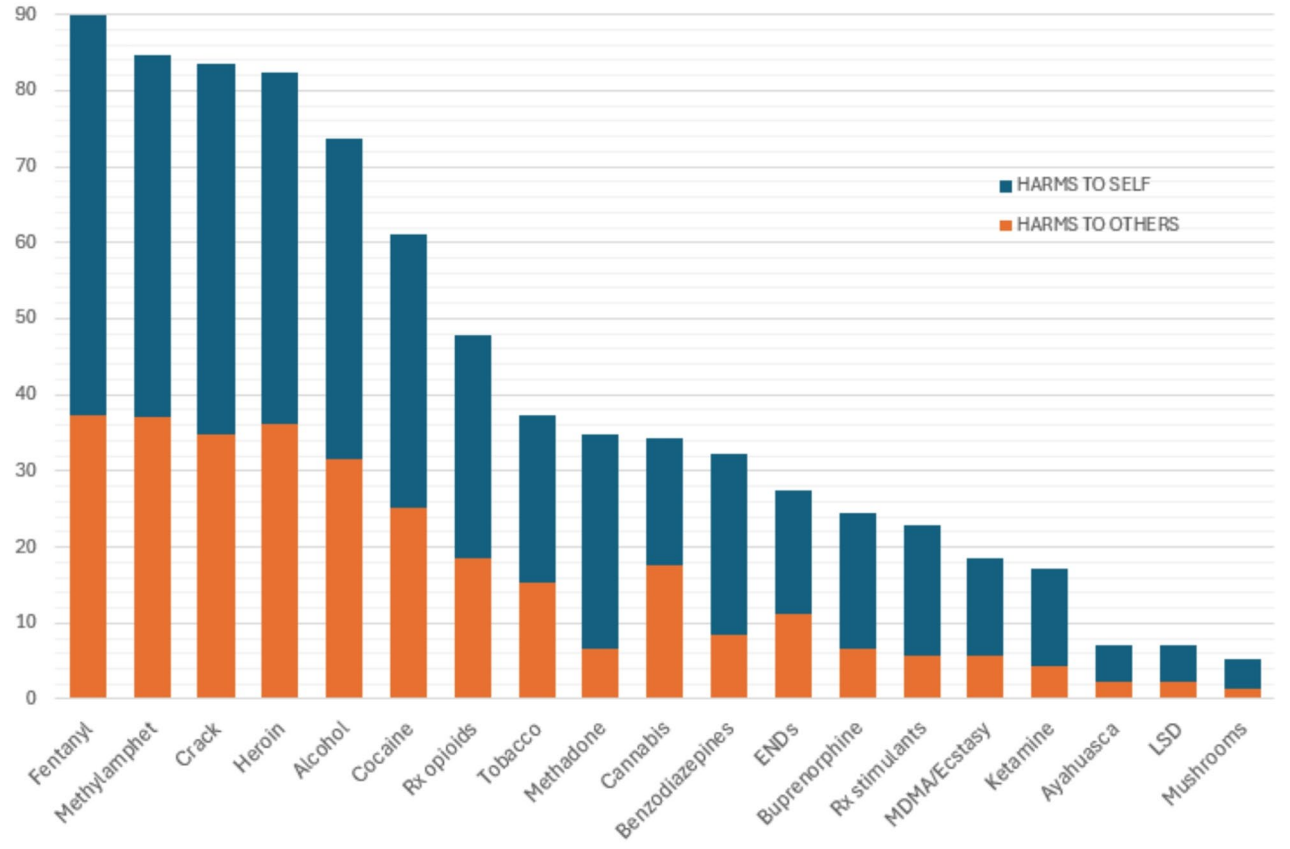

Fig. 3 The drugs ordered by their overall harm scores, with the stacked bar graphs showing the contribution to the overall score of harms to people who use drugs and harm to others

Moreover, the results of the US MCDA showed a strong correlation with the results of other MCDAs. For example, the Pearson's correlation coefficient between the final weighted results for the drugs in common between the US and UK studies was $r = 0.87$. Between the US and European MCDAs, the correlation coefficient was $r = 0.85$. The correlation coefficient between the US and Australian MCDAs was $r = 0.89$ and between the US and New Zealand, it was $r = 0.72$. Notably, the correlation was significant at the $p = 0.01$ level in each case.

Finally, the Spearman's rank correlation between CSA-defined harm and the US model's final weighted harm scores was $\rho = -0.26$ (see Table 4). Thus, there appears to be little relationship between the CSA system—and related policy—and the US MCDA results. Specifically, Schedule I drugs, which are the most harmful according to CSA classifications, were scattered throughout our rankings. Heroin appears in fourth place with a harm score of 82 and cannabis is in tenth place with a score of 32. The remaining Schedule I drugs—ecstasy/MDMA (16), ayahuasca (5), LSD (4), and mushrooms (3)—take four of the last five spots. This is notable because Schedule I drugs are associated with relatively severe penalties for people caught using them.

Discussion

This study adapted and partially replicated the 2010 UK drug harms MCDA study for the US. Fentanyl, methamphetamine, crack, and heroin were rated as most harmful. Moreover, sensitivity analyses show that overall scores remain similar even when varying the weightings. While previous MCDAs found methamphetamine and heroin to be among the more harmful drugs, they rated alcohol as the most harmful [9–12]. Additionally, the first two MCDAs [9, 10] did not include fentanyl because it was not yet a concern [11], while the two more recent MCDAs [11, 12] rated fentanyl as less harmful than did the present study. These variances may reflect the prevalence of these drugs in the US, and different weighting based on how specific harms manifest in the US (e.g., legal consequences, crime). For example, fentanyl has partly fueled the US drug overdose epidemic, and drug-specific mortality had the highest cumulative weight of any criterion in our study. The US has also suffered methamphetamine epidemics both in the 2000s and recently. The current epidemic has been partly attributed to the decline in prescription opioid availability and concerns about fentanyl's lethality [21], highlighting the importance of context to drug harms. Additionally, time

Table 4 Schedules and scores for each drug

Drug	CSA schedule	CSA-defined score	MCDA-defined score
Fentanyl	II	4	90
Methamphetamine	II	4	84
Crack	II	4	83
Heroin	I	5	82
Alcohol	None	0	73
Cocaine	II	4	60
Rx Opioids	II	4	46
Tobacco	None	0	35
Methadone	II	4	33
Cannabis	I	5	32
Benzodiazepines	IV	2	30
ENDs	None	0	25
Buprenorphine	III	3	22
Rx Stimulants	II	4	21
MDMA/Ecstasy	I	5	16
Ketamine	III	3	15
Ayahuasca	I	5	5
LSD	I	5	4
Mushrooms	I	5	3

The Spearman's rank correlation coefficient between CSA and MCDA-defined scores was $\rho = -0.26$

appears to be a key contributor to variances in drug harm ratings. Drug preferences and availability shift, which should impact their relative harms over time because the MCDA accounts for prevalence.

Despite these differences, the high correlations between this study and previous MCDAs attest to the validity of the findings that now comprise the judgements of more than 100 experts. The experts' scores also correspond with existing research that has examined the effects of various drugs separately. For example, methamphetamine, fentanyl, heroin, crack, cocaine, and alcohol have contributed to considerable health burden and mortality in recent years [14, 21–23]. Conversely, psychedelics have been associated with less harm and with potential mental health and substance use treatment benefits [4, 8].

Lastly, our finding that the correlation of 'CSA harm' and the US model's final weighted harm scores was only $\rho = -0.26$ lends further support to the contention that US drug policy is not aligned with expert knowledge [6–8]. If policy were aligned with expert rankings, one would expect that Schedule I drugs were ranked as most harmful, Schedule II drugs were ranked as next most harmful, and so forth. However, this is not the case, based both on the correlation coefficient and a look at the overall rankings. No Schedule I drug appears until fourth place (heroin), and this is followed by alcohol, which is not a controlled substance. Furthermore, it is notable that the three least harmful drugs per our rankings are all listed in Schedule I.

Implications

Nearly every drug scored higher on harm to the person using it than to others, so an array of harm reduction strategies should be considered. Rates of use have increased in tandem with the punitive strategy of the War on Drugs [2], while various drug epidemics and overdose crises have occurred in the US [21–23]. Fentanyl's overall harm score of 90 was driven partly by its score of 100 on drug-specific mortality. And, a recent report utilizing the Centers for Disease Control and Prevention's (CDC) State Unintentional Drug Overdose Reporting System found that most illicitly manufactured fentanyl overdoses occurred at home [23]. Therefore, fentanyl test strips and naloxone should be widely distributed, and prevention education should teach people to regularly check on family or friends who may be using fentanyl [23]. Also, safe consumption sites offer staff trained to help if someone overdoses, without increasing crime or drug use [3], and wider implementation may be in order based on our findings and previous research. In addition, fentanyl, methamphetamine, crack, and heroin all scored among the highest in health-related criteria, including drug-related damage and drug-related impairment of mental functioning, suggesting that health interventions (e.g., medical care, mental health care) should be prioritized.

A focus on health and wellness interventions, rather than punitive strategies, may also reduce social harms. For example, illegal drug use is associated with high economic cost, partly due to the legal consequences. It was recently estimated that incarceration costs the US at least $182 billion annually, with 20% of inmates being convicted of drug crimes [18]. Incarceration is also associated with family adversity and community decline [16]. Redirecting resources towards harm reduction may reduce social harms by reducing the economic cost of policing and surveilling people who use drugs. Concurrently, PWUD could remain contributing members of their families and communities. These ideas are consistent with a public heath approach to illegal drug use, which involves shifting away from a criminal justice approach, and towards wider implementation of harm reduction measures [24].

The negative physical health impacts of alcohol are well-documented [14, 25], and we scored alcohol among the highest in drug-related mortality, drug-specific damage, and drug-related damage. Strategies to reduce demand and convenience, like those implemented with cigarette smoking, may work. These included TV advertising bans, higher prices, reduced availability, and requirements to place images of smoking-damaged organs and printed health warnings on cigarette

packaging. Combined with access to resources to help people quit smoking [26], these marketing and public health strategies reduced daily or almost-daily smoking rates in the US from 20.9% in 2005 to 11.5% by 2021 [26]. We therefore join the World Health Organization [27] and other scholars who have called for a public health approach to alcohol use that involves regulation of advertising, pricing, and availability [24]. Finally, treatment providers should make medications for alcohol use disorder (e.g., acamprosate, naltrexone) available. By extension, these strategies might also reduce alcohol-related injury and family adversities.

Lastly, the weak correlation of 'CSA harm' and the US model's final weighted harm scores may help advance the case for rescheduling various drugs. For example, cannabis was rated as less harmful than its Schedule I status suggests. In August 2023, the US Department of Health and Human Services (HHS) completed an evaluation after which they recommended that the Drug Enforcement Administration move cannabis to Schedule III. However, this recommendation has still not been implemented. Expert consensus that cannabis ranks moderately in harm may augment the HHS recommendation. Another example is various psychedelics, which scored the lowest in both harm to people who use them and to others. As evidence accumulates that these drugs may also have therapeutic benefits [4, 7, 8], rescheduling would make it easier for researchers to conduct further study of these potential benefits.

Limitations and directions for future research

In constructing an MCDA model, weighting is exclusively a matter of judgment; data cannot provide weights. While the magnitude of harm of the most harmful drug on each criterion can be informed by objective data, how much that difference matters requires an act of judgment. In this way, MCDA separates matters of fact from value judgments. As value judgments are at the heart of political debate, a public consultation exercise inviting different constituencies to express their views of the weights would be valuable. This could initiate a structured deliberative discourse about drugs, as politicians, law enforcement, PWUD, and other groups of people might weigh the harm criteria differently. Future drug harms MCDAs should also include people with lived experience of substance use issues who are currently structurally vulnerable (e.g., due to current drug use, underemployment or unemployment, etc.). The three individuals with lived experience who participated in this MCDA are all professionals who are in recovery, and thus may have very different views of drug harms than people who do not have these statuses.

Similarly, the selection of drugs can be informed by data (e.g., prevalence of use, associated physical or mental health consequences, cost to society, etc.), and is simultaneously an act of judgment of what is deemed most important during study design. This drug harms MCDA was not designed to include an exhaustive list of drugs, and another group of experts may determine that other drugs or analogues are worth including in a future MCDA. Relatedly, the US CSA lists hundreds of drugs (including chemical variations). It therefore follows that another MCDA, selecting different drugs and/or moieties, may reach different conclusions. Thus, our MCDA is one of multiple possible ways to test alignment of US drug policy (as rendered by the CSA) with scientific evidence. Lastly, no participant in the present MCDA was fully knowledgeable about all 19 drugs but rather, each participant had expertise regarding some of the drugs. Thus, another expert panel with different levels of combined knowledge about each drug may finish with different scores.

Additionally, all drugs have benefits to people who use them at least initially, and some may have ongoing benefits. For legal drugs, there may be social benefits like employment in related industries and taxation to fund public services [9]. Therefore, future MCDA panels should assess these potential drug benefits, because doing so may help to refine health approaches and policy.

Furthermore, many people who use drugs engage in polysubstance use, which can be understood as using multiple substances within a 30-day period [28]. Simultaneous use of some drug combinations is especially risky. For example, overdose risk increases when people ingest combinations such as fentanyl and heroin [28], fentanyl and methamphetamine [21, 22], or alcohol and any opioid [14]. Simultaneous use of alcohol and cannabis may be associated with other risky drug use behaviors like high-intensity binge drinking [29]. Future MCDA panels should thus consider harms of polysubstance use. Relatedly, although we considered common routes of ingestion in our discussions, there would be value in systematically examining harms by route of ingestion in a future MCDA [9]. This could further target strategies to reduce various drugs' harms.

Finally, this MCDA accounted for drug use among US adults. A future MCDA should rate drug harms to youth, which will likely vary for several reasons. For example, END use among youth has become a concern among health experts, partly because nicotine has a deleterious effect on the developing brain [30]. Likewise, adolescent cannabis use may increase risks of long-term cognitive impairments and various mental health challenges [31]. Thus, assessing experts' judgments of harms applicable to youth could drive targeted prevention and treatment approaches.

Conclusion

As the first drug harms MCDA to be conducted in the US, we provide a ranking of drug harms that can be used to amend existing policy approaches. Our consensus that nearly all drugs pose more harm to the people who use them than to others suggests that resources should be focused on health and wellness, not on incarceration. Moreover, this MCDA provides a useful starting point for future work in the US that could account for additional drugs, drug benefits, vulnerable subpopulations (e.g., youth), and various methods of use and routes of ingestion. Finally, we add to a growing body of work that presents experts' ratings of drug harms in various nations and finds that drug policy is not aligned with these ratings. Collectively, this work can be used to advance scientific debate about the best ways to reduce harms to people who use drugs and to redress societal impacts at the same time.

Abbreviations

MCDA	Multi-criteria decision analysis
CSA	Controlled Substances Act
CDC	Centers for Disease Control and Prevention's
HHS	US department of health and human services
OSU	Ohio State University
UK	United Kingdom
EU	European Union
PWUD	People who use drugs

Acknowledgements

Not applicable.

Author contributions

MB: Conceptualization, funding acquisition, writing—original draft. AKD: Conceptualization, funding acquisition, writing—original draft. SA: Conceptualization, data curation, formal analysis, funding acquisition, writing—original draft. AL: Conceptualization, funding acquisition, writing—original draft. KA: Conceptualization, funding acquisition, writing—original draft. GAA: Writing—review & editing. BJA: Writing—review & editing. CB: Writing—review & editing. ME: Writing—review & editing. KSG: Writing—review & editing. TG: Writing—review & editing. JJL: Writing—review & editing. DSM: Writing—review & editing. NJM: Writing—review & editing. NM: Writing—review & editing. CDN: Writing—review & editing. HS: Writing—review & editing. APT: Writing—review & editing. BW: Writing—review & editing. NY: Writing—review & editing. LDP: Data curation, formal analysis, investigation, methodology, writing—original draft, writing—review & editing.

Funding

This study was supported by a seed grant from the College of Social Work and the Drug Enforcement and Policy Center in the College of Law at Ohio State University.

Data availability

Data from this study will be made available after publication of this manuscript via reasonable request to the corresponding author. Data will be made available after a proposal is approved and a signed data access agreement is completed.

Declarations

Ethics approval and consent to participate

The study was deemed exempt by the Institutional Review Board at Ohio State University.

Competing interests

GAA, BJA, ME, KSG, JJL, DSM, NJM, NM, CDN, and BW received travel expenses and an honorarium to attend the decision conference. CB received an honorarium to attend the decision conference. LP received a consulting fee to facilitate the decision conference. DSM serves as a paid medical advisor for West Eastern Health. This organization was not involved in the design, execution, interpretation, or communication of findings of this publication. DSM was also a paid speaker at the 2023 annual meeting of Psych Congress Elevate. AKD is a board member at Source Research Foundation. AKD, SBA, and AWL are supported by the Center for Psychedelic Drug Research and Education, funded by anonymous private donors. NJM is supported by the National Center for Advancing Translational Sciences (NCATS) award #KL2TR001870. NY delivered a paid presentation to the British Association of Psychopharmacology (BAP) Masterclass in 2022. NY has also worked as a researcher in clinical studies conducted together with H. Lundbeck A/S and Sosei Heptares and Neurocentrx in the last three years with no direct payment from pharmaceutical companies. JJL was provided a $300 honorarium by Montclair State University to be a speaker on a panel about harm reduction strategies for drug use. The panel was part of a project supported by funding to Montclair State University from Vital Strategies and Open Society Foundations. JJL is also on the Advisory Council of the Montclair State University Center for Harm Reduction Education, Training, and Research, which is supported by funding to Montclair State University from Vital Strategies and Open Society Foundations, and on the Advisory Board of the Behavioral Health Excellence—Technical Assistance Center, which is supported by a grant to the University of Wisconsin-Madison from the Health Resources and Services Administration. The Advisory Board role pays an annual honorarium of $1,000. JJL receives funding as the site PI on subawards from grants funded by the USDHHS through two different Public Health Service agencies, SAMHSA and HRSA. All these grants address the continuum of care for people who use drugs or other substances. CDN is Founder and Board member of 2 A Biosciences, with a Sponsored Research Agreement (funds made to institution). CDN also receives royalties, as an inventor, from the licensing of two LSUHSC owned patents based on his research in psychedelics. CDN also receives consulting fees as a scientific advisor to Palo Santo VC. Additionally, CDN is an unpaid board member of Heffter Research Institute. CDN also receives payments quarterly for editorial services in his role as Co-Editor in Chief of the Mary Ann Leibert Publishing journal Psychedelic Medicine. GAA has received payments from the University of Pennsylvania, Maximus Inc, and Northwell Health and has also received payment for expert testimony.

Consent for publication

Not applicable.

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Received: 7 August 2025 / Accepted: 16 December 2025
Published online: 31 December 2025

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