ADVANCED RELEASE

EUDA initial report on the new psychoactive substance 2-(methylamino)-1-(2-methylphenyl)propan-1-one (2-methylmethcathinone, 2-MMC)

In accordance with Article 9 of Regulation (EU) 2023/1322

Note: In the interests of public health protection the EUDA is releasing this report before formal page layout in the EUDA house style. The final report will be available on the EUDA website in due course.

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EUDA
EUROPEAN UNION DRUGS AGENCY

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Contents

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1. Introduction

2-(Methylamino)-1-(2-methylphenyl)propan-1-one (2-methylmethcathinone, 2-MMC) is a synthetic cathinone stimulant. It is a ring-substituted cathinone, which is structurally related to methcathinone ([1]), 4-methylmethcathinone (mephedrone) ([2]), and 3-methylmethcathinone ([2]).

In Europe, 2-MMC is monitored by the EUDA as a new psychoactive substance ([3]) through the European Union Early Warning System (EU EWS) in accordance with Article 8 of Regulation (EU) 2023/1322 ([4]).

2-MMC was formally notified as a new psychoactive substance ([5,6]) by the EUDA on behalf of Sweden on 8 May 2014. The notification was based on the identification of the substance in a customs seizure of approximately 100 grams of powder made on 14 March 2014 in Stockholm. However, seizure data indicates that 2-MMC has been on the EU drug market since 2013.

Since the formal notification, information on 2-MMC has been exchanged between the EUDA and the EU EWS Network (EUDA, Europol, Reitox national focal points, and the Commission); the EMA have been kept duly informed.

Based on signals suggesting increased availability and harms related to 2-MMC in some parts of Europe, on 10 July 2024, the EUDA added 2-MMC to the list of new psychoactive substances under intensive monitoring ([7]) and requested that the Network expedite reporting of any event involving 2-MMC to the EUDA until further notice.

The EUDA is currently monitoring 178 synthetic cathinones through the EU EWS that have been identified on the European drug market between 2004 and 2024.

After falling from a peak of 1.9 tonnes in 2016, the quantity of synthetic cathinones detected in Europe rose significantly between 2020 and 2024, increasing from 0.7 tonnes in 2020, to 8.5 tonnes in 2021, 26.5 tonnes in 2022, 36.7 tonnes in 2023, and preliminary data suggesting more than 43 tonnes reported in 2024 – representing a more than 6,000% increase in the quantity of material.

This significant increase is primarily due to European suppliers importing large quantities of synthetic cathinones from chemical companies in India since 2019, apparently principally

[1] Listed in Schedule I of the 1971 United Nations Convention on Psychotropic Substances.
[2] Listed in Schedule II of the 1971 United Nations Convention on Psychotropic Substances.
[3] As defined in point 4 of Article 1 of Council Framework Decision 2004/757/JHA of 25 October 2004 laying down minimum provisions on the constituent elements of criminal acts and penalties in the field of illicit drug trafficking (OJ L 335, 11.11.2004, p. 8).
[4] Regulation (EU) 2023/1322 of the European Parliament and of the Council of 27 June 2023 on the European Union Drugs Agency (EUDA) and repealing Regulation (EC) No 1920/2006. https://eur-lex.europa.eu/eli/reg/2023/1322/oj/eng
[5] EUDA. 2020. EUDA operating guidelines for the European Union Early Warning System on new psychoactive substances. p. 15–6. http://www.EUDA.europa.eu/publications/guidelines/operating-guidelines-for-the-european-union-early-warning-system-on-new-psychoactive-substances_en
[6] EUDA. 2020. EUDA operating guidelines for the European Union Early Warning System on new psychoactive substances. Guidance note 2. Formal notification of a new psychoactive substance. https://www.euda.europa.eu/system/files/media/publications/documents/12213/Guidance%20Note%202-%20Formal%20notification%20of%20a%20new%20psychoactive%20substance.pdf
[7] EUDA. 2020. EUDA operating guidelines for the European Union Early Warning System on new psychoactive substances. Guidance note 6. Intensive monitoring. https://www.euda.europa.eu/system/files/media/publications/documents/12213/Guidance%20Note%206-%20Intensive%20monitoring.pdf

through the Netherlands. Overall, such imports total at least 106.8 tonnes between 2020 and 2024, with 43.7 tonnes in 2024 alone. This has led to some cathinones previously sourced from companies in China and subsequently controlled there to re-emerge in apparently much greater quantities on the European drug market through this new supply route. These substances include 3-MMC and 3-CMC, that were subject to initial reports and later risk-assessed and controlled in the EU, and more recently, 2-MMC and 4-BMC. In addition, other cathinones that were still on the market, such as NEP, have also been imported in large quantities leading to a significant increase in availability. This increased supply has been associated with a rise in cathinone-related harms, including acute poisonings and deaths in several European countries.

In 2024, approximately 4000 seizures of three cathinones reported to the EU Early Warning System accounted for over 40.4 tonnes: 2-MMC (33.4 tonnes), NEP (6 tonnes), and 4-BMC (1 tonnes). For each of these substances, imports originating from India accounted for more than 99% of the total quantity seized in 2024. These three cathinones are currently the subjects of EUDA initial reports.

Article 9 of Regulation (EU) 2023/1322 requires that '*Where the Agency, the Commission or a majority of Member States considers that information on a new psychoactive substance collected in one or more Member States and shared with it or them gives rise to concerns that the new psychoactive substance might pose health or social risks at Union level, the Agency shall draw up an initial report on the new psychoactive substance*.'

The initial report is submitted to the Commission and the Member States. The purpose of the initial report is to provide scientific evidence to the Commission to allow it to make an informed decision regarding whether or not there is a need to request a risk assessment on a new psychoactive substance as set out in Article 10 of Regulation (EU) 2023/1322.

Based on the information reported by the Network, in February 2025, the EUDA assessed the existing information ([8,9]) on 2-MMC, based on the following criteria:

- reports of health problems;
- reports of social problems;
- reports of seized material;
- pharmacological and toxicological properties and analogy with better-studied substances; and,
- potential for further spread.

The EUDA concluded that the assessment gave rise to concerns that 2-MMC may pose health or social risks at Union level, and, consequently, determined that an initial report should be produced.

[8] European Monitoring Centre for Drugs and Drug Addiction (2019), EUDA operating guidelines for the European Union Early Warning System on new psychoactive substances, Publications Office of the European Union, Luxembourg. http://www.EUDA.europa.eu/publications/guidelines/operating-guidelines-for-the-european-union-early-warning-system-on-new-psychoactive-substances_en

[9] This included information reported to the EUDA through the Early Warning System, including case reports and aggregated datasets.

2. Information collection process

In accordance with the requirements of Article 9 of the Regulation, on 28 February 2025, the EUDA launched a procedure for the collection of additional information on 2-MMC in order to support the production of the initial report.

The EUDA collected information through:

- a structured reporting form to the Reitox national focal points in the Member States, Türkiye, and Norway (Article 9(4));
- routine monitoring of open source information;
- a search of open source information conducted specifically for the production of the initial report which included: scientific and medical literature, official reports, grey literature, internet drug discussion forums and related websites (hereafter, 'user websites'), and online vendors.

In addition, the EUDA also submitted requests to:

- The World Health Organization (WHO) in order to determine if 2-MMC is under assessment or has been under assessment within the system established by the 1961 Single Convention on Narcotic Drugs, as amended by the 1972 Protocol, and the 1971 Convention on Psychotropic Substances ('United Nations system').
- The European Medicines Agency (EMA) in order to determine if 2-MMC is used as an active substance in a medicinal product for human or veterinary use at Union or national level (Article 9(5)). Specifically, the EMA was asked if 2-MMC is an active substance in:
    a. a medicinal product for human use or in a veterinary medicinal product that has obtained a marketing authorisation in accordance with Directive 2001/83/EC of the European Parliament and of the Council ([10]), Regulation (EC) No 726/2004 or Regulation (EU) 2019/6 of the European Parliament and of the Council ([11]);
    b. a medicinal product for human use or in a veterinary medicinal product that is the subject of an application for a marketing authorisation;
    c. a medicinal product for human use or in a veterinary medicinal product whose marketing authorisation has been suspended by the competent authority;
    d. an unauthorised medicinal product for human use in accordance with Article 5 of Directive 2001/83/EC or in a veterinary medicinal product prepared

[10] Directive 2001/83/EC of the European Parliament and of the Council of 6 November 2001 on the Community code relating to medicinal products for human use (OJ L 311, 28.11.2001, p. 67).
[11] Regulation (EU) 2019/6 of the European Parliament and of the Council of 11 December 2018 on veterinary medicinal products and repealing Directive 2001/82/EC (OJ L 4, 7.1.2019, p. 43).

extemporaneously in accordance with Article 112(1), point (c), of Regulation (EU) 2019/6;

e. an investigational medicinal product as defined in point (d) of Article 2 of Directive 2001/20/EC of the European Parliament and of the Council ([12]).

- Europol in order to provide information on the involvement of criminal groups in the manufacture, distribution and distribution methods and trafficking of 2-MMC, and on any use of 2-MMC (Article 9(6)).

- The European Chemicals Agency (ECHA), the European Centre for Disease Prevention and Control (ECDC) and the European Food Safety Authority (EFSA) in order to provide the information and data at their disposal on 2-MMC (Article 9(7)).

The information collection process was largely concluded on 14 March 2025. The EUDA received responses from all 27 Member States, Türkiye, and Norway. In addition, the EUDA received responses from WHO, EMA, Europol, ECHA, ECDC, and EFSA.

3. Methodological note

2-MMC has been available on the drug market since 2013. Although 2-MMC is screened for in many forensic and toxicology laboratories in Europe, it cannot be excluded that some cases of 2-MMC are undetected or unreported, in particular in serious adverse events.

2-MMC has two positional isomers, whose discrimination poses analytical challenges. Due to differences in reporting practices across Europe, the discrimination of 2-MMC from its positional isomers is done in many, but not all, forensic and toxicology laboratories. For the purposes of preparing this report, all detections where the positional isomer of 2-MMC has not been specified to the EUDA have been excluded from the data analysis of physical and biological samples. However, due to different reporting practices across Europe, it remains possible that some detections reported as 2-MMC but that are actually a different positional isomer, have been included.

Complementary data sources have been used in the preparation of the Initial Report:

- For the period comprised between 1 January 2013 and 31 December 2024, annual aggregated data which is systematically reported to the EUDA has been used. Data for 2024 is preliminary. In addition, event-based data reported through the European Database on New Drugs between 1 January 2013 and 14 March 2025 has also been used.

- It is important to note that the data on seizures and imports from aggregated data may potentially include some instances of double-counting. Specifically, substances that are initially recorded as legal imports may later be seized by law enforcement. In such cases, the same physical material could be counted twice: first as an import and subsequently as a seizure. While the exact extent of this overlap cannot be

[12] Directive 2001/20/EC of the European Parliament and of the Council of 4 April 2001 on the approximation of the laws, regulations and administrative provisions of the Member States relating to the implementation of good clinical practice in the conduct of clinical trials on medicinal products for human use (OJ L 121, 1.5.2001, p. 34).

determined from the available data, this limitation should be considered when interpreting the total quantities reported.

- Only serious adverse events reported through event-based data are discussed in detail in Section 4.1.2.
- For the period comprised between 1 January and 14 March 2025, data reported through a targeted request for information (a structured reporting form sent to the Reitox national focal points and responses to ad hoc information requests) have been used. These data are not comparable to aggregated seizure data.
- Open source information identified through routine monitoring has also been used throughout the report, when confirmed by Reitox national focal points.

4. Information required by Article 9(2) of the Regulation

The order and titles of subsections 4.1 to 4.9, below, are as they appear in Article 9(2) of Regulation (EU) 2023/1322; sections 4.1 to 4.4 are cross-referenced with the headings of Article 9(2a) to Article 9(2d) of the Regulation.

4.1 Nature, number and scale of incidents showing health and social problems in which the new psychoactive substance may potentially be involved, and the patterns of use of the new psychoactive substance (Article 9(2a))

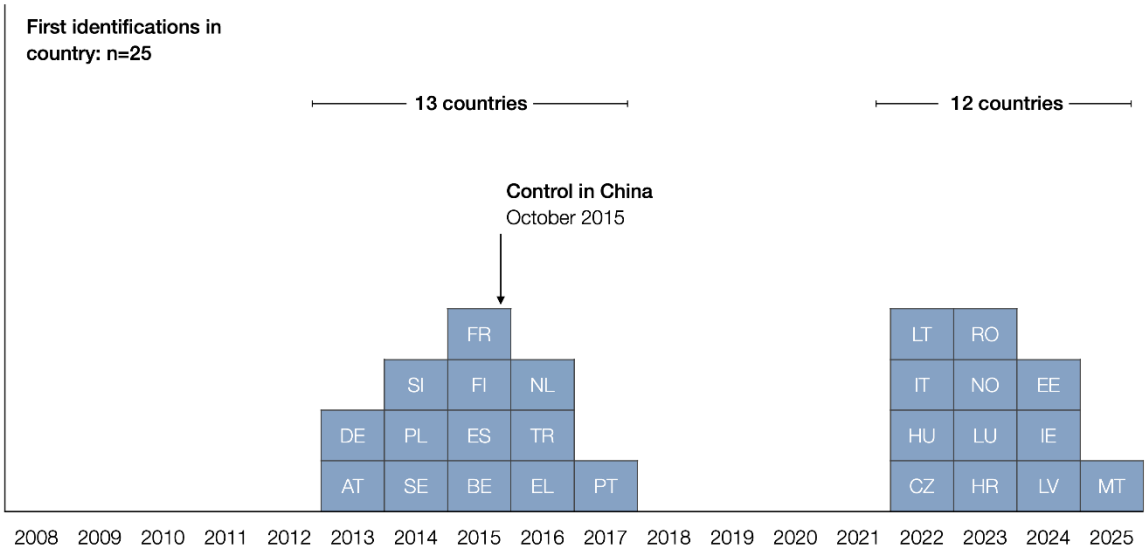
4.1.1 Information from seizures, collected samples and biological samples

First identifications in country

Between 1 January 2013 and 31 March 2025, a total of 23 Member States, Türkiye, and Norway have reported the identification of 2-MMC for the first time (Figure 1). The Member States are: Austria, Belgium, Croatia, Czechia, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, the Netherlands, Poland, Portugal, Romania, Slovenia, Spain, and Sweden.

Twelve countries (41%) first identified 2-MMC between 2013 and 2017, while 13 (45%) made their first identifications between 2022 and 2025. Four Member States (14%) have not reported the identification of 2-MMC in their country as of March 2025: Bulgaria, Cyprus, Denmark, and Slovakia.

Figure 1. Countries reporting the first identification of 2-MMC and year of identification, 2013-2025. Note: EU two-letter country codes are used to identify each country (e.g., AT=Austria, BE=Belgium).

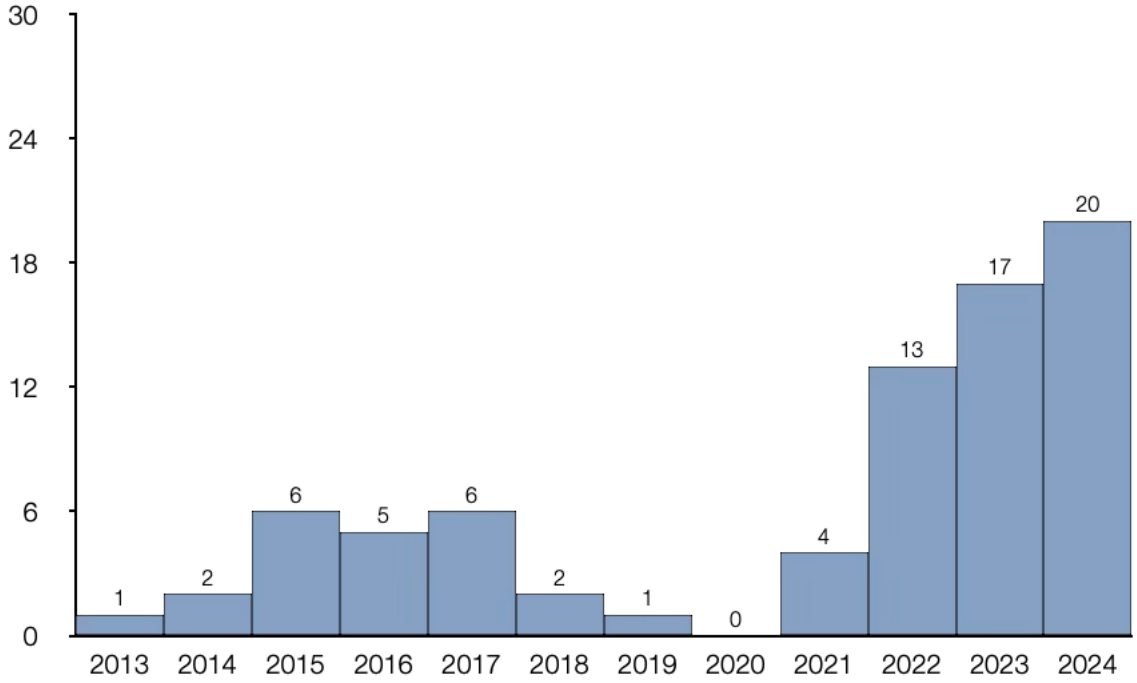


Information from seizures and imports

Between 1 January 2013 and 31 December 2024, a total of 2,397 seizures and imports (cases) containing 2-MMC across all physical forms were reported by law enforcement in 21 Member States, Türkiye, and Norway. The Member States are: Belgium, Croatia, Czechia, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Luxembourg, the Netherlands, Poland, Portugal, Romania, Slovenia, Spain, and Sweden.

Powders constituted 2,314 (96.5%) of all cases. The remaining 83 cases (3.5%) comprised various other physical forms: 20 cases of tablets and capsules, 4 cases of liquids, 1 case of plant material, and 58 cases reported as other or unknown. The number of countries reporting cases per year is presented in Figure 2.

Figure 2. Number of countries with 2-MMC seizures and imports reported by law enforcement by year, EU+2, 2013-2024.



Of 2,314 powder cases, 2,196 (94.9%) reported quantities in weight (kilograms) and were included in the analysis. The remaining 118 (5.1%) cases lacked information on weight and were excluded.

A total of 2,196 cases amounting to 45,832 kg (45.8 tonnes) of 2-MMC powder were reported between 2013 and 2024 (Figure 3 and Figure 4). Analysis reveals three distinct periods in the market:

1. **Emergence and first wave, 2013-2017:** 285 cases (12.9% of all cases) totalling 157 kg (0.3% of all quantity) were reported, including a single seizure by Spanish Customs of 54.6 kg from China in 2015.
2. **Low-level presence, 2018-2021:** Only 9 cases (<0.5% of all cases) amounting to just 0.039 kg (<0.1% of all quantity) were reported, with no detections in 2020.
3. **Re-emergence and second wave, 2022-onwards:** 1,902 cases (86.6% of all cases) totalling 45,675 kg (99.7% of all quantity) were reported. The Netherlands alone reported 148 imports from India amounting to 44,417 kg (97% of all 2-MMC quantity), with 33,207 kg (72.5% of all quantity) reported in 2024 alone.

When reported, the powders were typically described as white or off-white powders or crystals. The purity of the powders was not reported.

In 1,979 (90.1%) cases, 2-MMC was the only substance reported to be present. In 179 (8.2%) cases, 2-MMC was found in combination with one or more other substance, including other cathinones such as 2-CMC or 3-CMC. In the remaining 38 (1.7%) cases, the presence of other substances was reported as unknown or information was not available.

Figure 3. Number of 2-MMC powder seizures and imports reported by law enforcement in weight (kg), EU+2, 2013-2024.

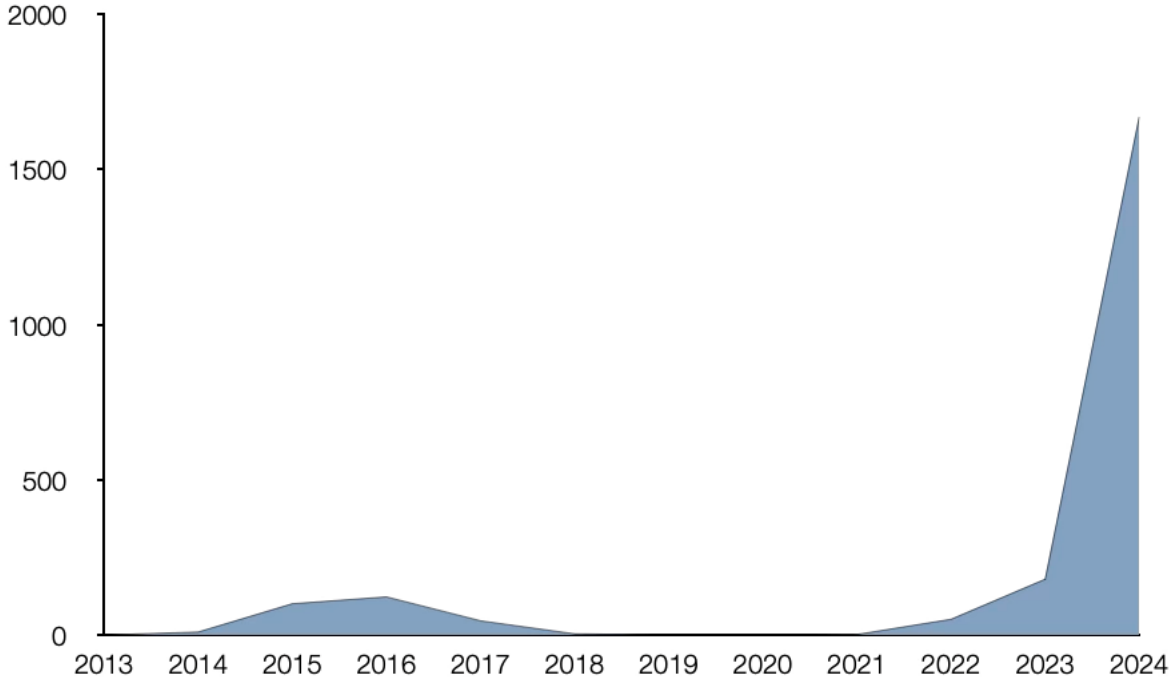
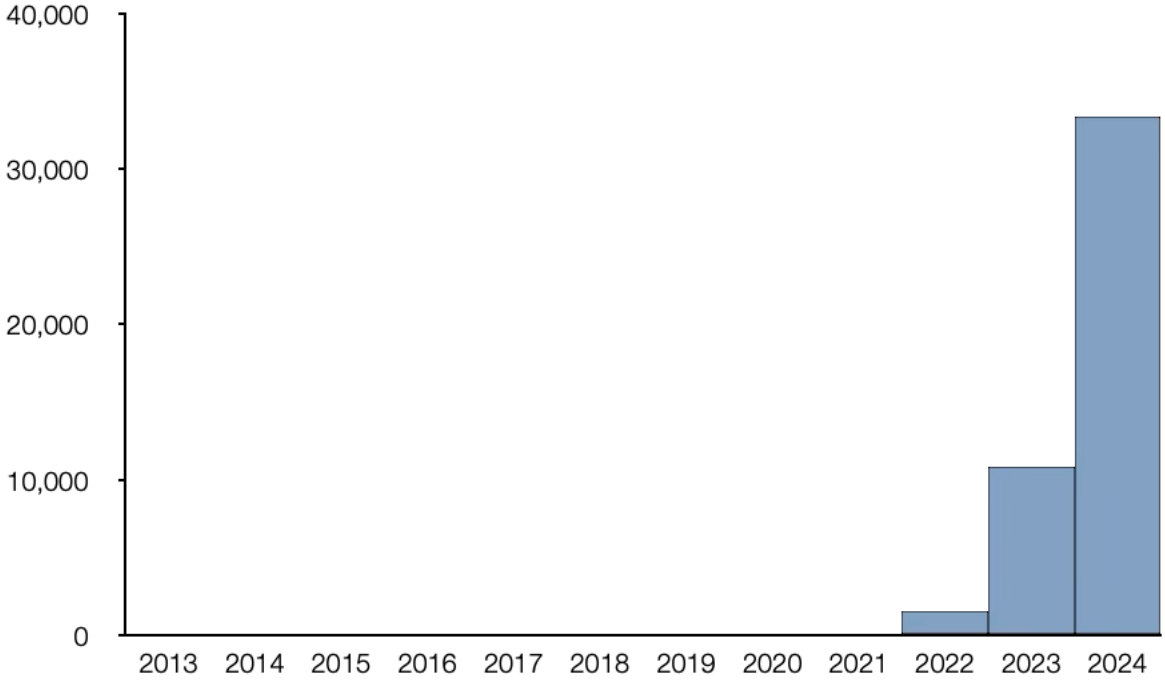


Figure 4. Quantities (kg) of 2-MMC powder seizures and imports reported by law enforcement, EU+2, 2013-2024.

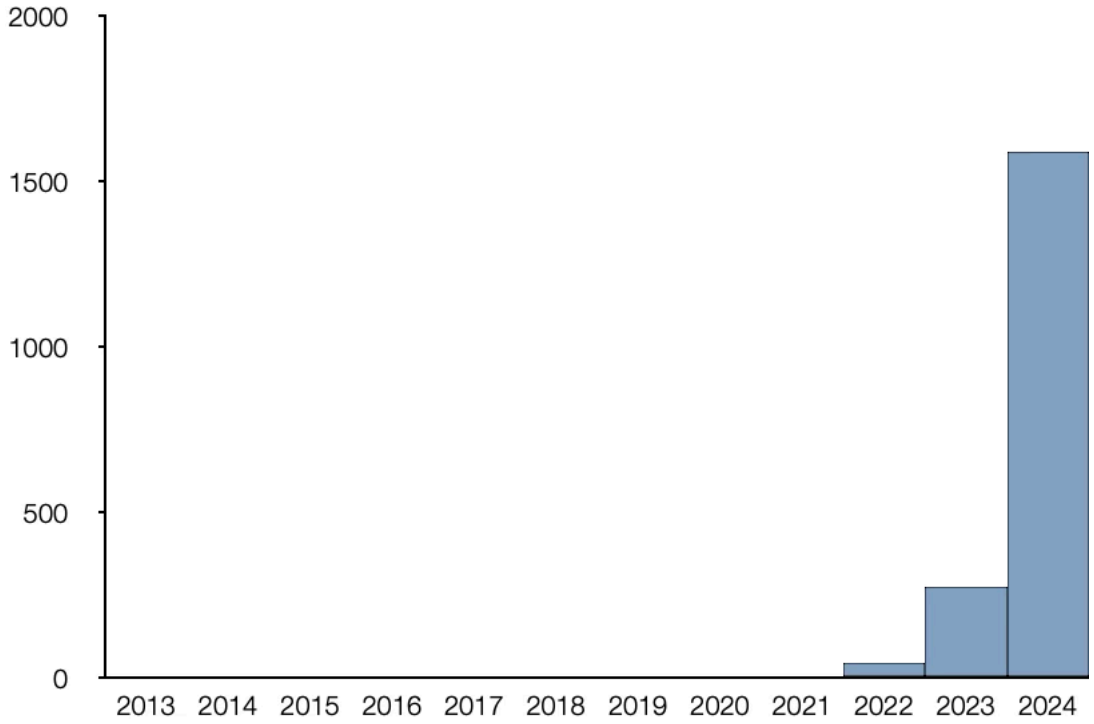


Separately, between 1 January and 14 March 2025, a total of 199 2-MMC cases were reported by six Member States: Czechia, Finland, Lithuania, Malta, Spain, and Sweden. Of these, 185 cases (92.9%) were powders, amounting to 13.1 kg. The purity of the powders was not reported.

Information from collected samples

Between 1 January 2013 and 31 December 2024, a total of 1,902 collected samples containing 2-MMC from drug checking services were reported by 7 Member States: Austria, Czechia, France, the Netherlands, Portugal, Slovenia, and Spain (Figure 5). Notably, 1,900 (99.9%) of the cases occurred since 2022, and 1,587 (83.4%) in 2024 alone. At least in part, this mirrors the re-emergence 2-MMC as reflected in seizures and imports reported by law enforcement during the same time period.

Figure 5. Number of 2-MMC collected samples reported by year, EU+2, 2013-2024.



The Netherlands reported 1,284 (67.5%) of all cases, followed by France with 391 (20.5%), Spain with 71 (3.7%), Portugal with 59 (3.1%), Slovenia with 51 (2.7%), Austria with 46 (2.4%), and Czechia with 1 (0.1%) case.

Powders constituted 1,863 (97.9%) of all cases. The remaining 39 cases (2.1%) comprised various other physical forms: 22 cases of tablets, 1 case of plant material, and 16 cases reported as other or unknown.

Given the predominance of cases involving powder, the subsequent analysis focuses on this physical form.

In 1,807 (97.0%) of the powder cases, 2-MMC was the only substance reported to be present. In the remaining 56 (3.0%) cases, 2-MMC was found in combination with one or more other psychoactive substances, typically other cathinones such as 2-CMC or 3-CMC.

In approximately 1,500 (78.8%) cases, 2-MMC was reported to be primarily mis-sold as 3-MMC. In addition, in a small number of cases, 2-MMC was also mis-sold as other cathinones such as 4-MMC and 3-CMC.

The amount of 2-MMC was quantified in 30 cases all reported by Slovenia:

- In 2023, 9 samples had a mean concentration of 85% 2-MMC HCl
- In 2024, 21 samples had a mean concentration of 94% 2-MMC HCl

Additionally, between 1 January and 14 March 2025, a total of 213 collected samples containing 2-MMC were reported by two Member States: Netherlands and Spain. Of these, 198 (92.9%) were reported as powders, with the physical form for the remaining 15 (7.0%) cases reported as unknown.

The Netherlands reported 212 (99.5%) of the cases. In most cases, 2-MMC was the only substance reported to be present. In 197 (92.9%) cases (all powders), the 2-MMC was primarily mis-sold as 3-MMC. In the remaining 15 (7.1%) cases where the physical form was reported as unknown, the substance was sold as 2-MMC. Spain reported 1 (0.5%) sample that was mis-sold as 4-MMC.

Information from biological samples

A total of 155 detections where 2-MMC was analytically confirmed in biological samples were reported either in aggregated data or event-based data by 7 Member States: Finland (1 sample), France (15), Lithuania (13), Poland (1), Spain (18), Slovenia (1), and Sweden (106).

The biological samples were reported between 2014 and 2025 as follows:

- Between 2014 and 2021: four samples, reported in 2014, 2015, 2016, and 2021;
- Between 2023 and 2024: 114 samples of which 9 were reported in 2023 and 105 in 2024;
- In 2025: 37 samples.

Aggregated reporting

A total of 138 detections of 2-MMC in biological samples were reported in aggregated datasets (13) by 5 Member States: France (14), Lithuania (12), Poland (1), Spain (6), and Sweden (105). These samples related to petty drug offenses (70 samples); cases of driving under the influence of drugs (30), including two traffic accidents; samples associated with unspecified forensic case work (20); samples associated with non-fatal intoxications (9); samples analysed for criminal justice purposes (4); associated with drug-facilitated sexual assault or violence (3); and deaths (2).

Event-based data

[13] These data were reported in aggregated datasets. It is important to note that the number of samples may not correspond directly to the number of cases, as multiple biological samples may be collected from a single case. It is therefore not possible to determine the exact number of unique cases represented.

A total of 17 biological samples were reported through event-based data. Of these, 9 serious adverse events with confirmed exposure to 2-MMC from biological samples were reported as follows and are discussed in Section 4.1.2:

- 1 acute poisoning reported by Sweden;
- 8 deaths reported by Spain (4), Finland (1), France (1), Lithuania (1), and Slovenia (1).

In addition to these, 8 cases of possible drug-facilitated sexual assaults were reported by Spain.

4.1.2 Health problems

Acute poisonings

Confirmed exposure

One case of acute poisoning with confirmed exposure to 2-MMC was reported by Sweden. The case occurred in 2015. Other substances were identified in biological samples, including butyrylfentanyl and benzodiazepines. This event was classified as life-threatening, requiring treatment in hospital.

Probable exposure ([14])

A total of 3 cases of acute poisoning with probable exposure to 2-MMC were reported by France. The cases occurred in 2023 (1) and 2024 (2). Of these 2 were male and one was female. One case was classified as life-threatening, requiring hospitalisation, while the other two were non-life threatening but still required hospital treatment. The individuals reported purchasing the products either online or through social apps. In two of the cases, the individuals reported that others also consumed the products and experienced similar effects. The reported effects included paranoia, seizures, respiratory difficulty, panic attack, and 'bad trip'.

Suspected exposure ([15])

A total of 40 cases of acute poisoning with suspected exposure to 2-MMC were reported by the Netherlands (36), Slovakia (2), France (1), and Sweden (1). Where known, the cases occurred between 2016 and 2025: 2016 (1), 2023 (2), 2024 (28), 2025 (7). Where reported, 21 were male and 18 were female. Where reported, the individuals were aged between 18 and 48 (mean: 30; median 27). The reported effects included disorientation, drowsiness, tachycardia, anxiety, dysarthria, hallucinations, dyspnoea.

Deaths

A total of 8 deaths with confirmed exposure to 2-MMC were reported by Spain (4 cases), Finland (1), France (1), Lithuania (1), and Slovenia (1). The cases occurred in 2024 (6) and

[14] *Probable exposure* means that information on exposure to the substance is limited to an epidemiologically-linked physical or biological sample that has been analysed by a valid method of chemical analysis and that there is a reasonable probability that the case was exposed to that drug sample.
[15] *Suspected* exposure means that the information on exposure to the substance is limited to the name of the substance that the case or someone else linked to the event believes that the case has consumed and/or from packages containing the drugs that the case is thought to have consumed

2025 (2). Where reported, 6 were male and one was female. Age was reported for 5 of the males. The males were aged between 33 and 55 (mean: 39; median 36).

In all of the cases, other substances were identified, including central nervous system depressants (such as alcohol, GHB/GBL, opioids, and benzodiazepines) and central nervous system stimulants (such as amphetamine, methamphetamine, and other synthetic cathinones).

In at least three of the cases, the individuals were found dead. The cause of death was reported in five cases. The extent to which 2-MMC contributed to the deaths was not reported.

Other cases

A total of 8 cases of possible drug-facilitated sexual assaults with confirmed exposure to 2-MMC were reported by Spain. Of these, 4 were male and 4 were female. The individuals were aged between 20 and 45 (mean: 31; median 29). In all of the cases, other substances were identified, including central nervous system depressants (such as alcohol and benzodiazepines) and central nervous system stimulants (such as MDMA, amphetamine, methamphetamine, and other synthetic cathinones). The role of 2-MMC in these cases was not reported.

ECDC reported that they do not have any information on 2-MMC.

4.1.3 Social problems

While specific information on the social risks of 2-MMC is limited, they may parallel those documented for similar synthetic cathinones, such as 3-MMC and 4-MMC, and stimulants generally. For related substances, these risks include negative impacts on socioeconomic status, family dynamics, academic/employment performance, and increased vulnerability depending on the user population (Brookman et al. 2016, de Jonge et al. 2021, Nijkamp et al. 2021).

Limited evidence suggests 2-MMC use among vulnerable populations, including young people and high-risk drug users, including those engaging in chemsex.

Additionally, as reported in Section 4.1.2, 2-MMC has been identified in eight possible cases of drug-facilitated sexual assault. The role of the substance in these cases is unknown.

4.1.4 Patterns of use

The limited information suggests that 2-MMC is sold both as a substance in its own right and mis-sold as other drugs, particularly 3-MMC. Usage patterns of 2-MMC likely resemble those of other similar synthetic cathinones, especially when users are unaware they are consuming 2-MMC. Similar to other cathinones such as 3-MMC and 4-MMC, 2-MMC is typically administered by insufflation (snorting) or orally, with some cases of intravenous injection and rectal administration.

2-MMC appears to be used primarily by existing stimulant users, including those who use cathinones, amphetamines, and ecstasy, who either use it in addition to substances they already use or as a replacement.

This includes both recreational use and, in some cases, high-risk behaviours such as injection as part of chemsex. Additionally, vulnerable groups, particularly young people, may be attracted to 2-MMC because of its availability, legal status in some countries, and relatively low cost.

2-MMC appears to be used in domestic settings (homes and private parties), recreational venues (nightclubs, bars, music festivals), and chemsex environments.

Anecdotal user reports indicate that 2-MMC lacks the empathogenic effects they expect from 3-MMC, leading some users to increase their dosage in attempts to achieve these perceived effects. When 2-MMC is mis-sold as 3-MMC, users expecting typical 3-MMC effects may repeatedly increase their dosage, potentially increasing the risk of toxic exposure.

4.2 Chemical and physical description of the new psychoactive substance and the methods and precursors used for its manufacture or extraction (Article 9 2(b))

4.2.1 Chemical description and names

2-MMC is a synthetic derivative of the naturally occurring substance cathinone which is internationally controlled ([16]), and one of the psychoactive principles in khat (*Catha edulis* Forsk). 2-MMC was described in the scientific literature prior to its first detection on the drug market in Europe in 2013 (Power et al., 2011; Daeid et al., 2014).

As with many other synthetic cathinone derivatives monitored by the EUDA through the EU Early Warning System, 2-MMC is an *N*-alkylated and ring-substituted cathinone.

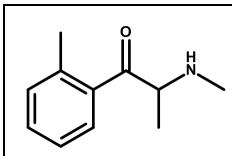
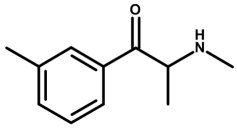
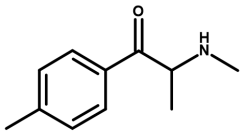
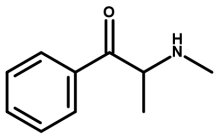
The common name 2-MMC is derived from 2-methylmethcathinone ([17]). 2-MMC is the 2-methyl derivative of methcathinone ([18]) and a positional isomer ([19]) of 3-MMC (3-methylmethcathinone) ([20]) and 4-MMC (4-methylmethcathinone) ([21]), which are both internationally controlled.

2-MMC is structurally related to 2-CMC (2-chloromethcathinone) ([22]), differing on the substituent present at the 2-position of the phenyl ring. 2-MEC (2-methylethcathinone) ([23]) is a higher homologue of 2-MMC. Both 2-CMC and 2-MEC are monitored by the EUDA.

[16] Listed in Schedule I of the 1971 United Nations Convention on Psychotropic Substances.
[17] The origin for the abbreviated common name is indicated by underlining the relevant letters in the common name.
[18] 2-(Methylamino)-1-phenyl-propan-1-one; listed in Schedule I of the 1971 United Nations Convention on Psychotropic Substances.
[19] Positional isomers (also known as regioisomers) have the same molecular formula and molecular weight, differing only in the position of a functional group or substituent.
[20] 2-(Methylamino)-1-(3-methylphenyl)propan-1-one; formally notified by the EUDA in September 2012; listed in Schedule II of the 1971 United Nations Convention on Psychotropic Substances; under intensive monitoring as of March 2021.
[21] 2-(Methylamino)-1-(4-methylphenyl)-1-propanone; formally notified by the EUDA in March 2008; listed in Schedule II of the 1971 United Nations Convention on Psychotropic Substances.
[22] 1-(2-Chlorophenyl)-2-(methylamino)propan-1-one; formally notified by the EUDA in March 2024; under intensive monitoring as of July 2024.
[23] 2-(Ethylamino)-1-(2-methylphenyl)propan-1-one; formally notified by the EUDA in October 2015.

The molecular structure, molecular formula and molecular mass of 2-MMC are provided in Figure 6.

Figure 6. Molecular structure, molecular formula, and molecular mass of 2-MMC. Information on methcathinone, 3-MMC and 4-MMC is provided for comparison

				
	2-MMC (orthomephedrone)	3-MMC (metaphedrone)	4-MMC (mephedrone)	Methcathinone
Molecular formula	$C_{11}H_{15}NO$	$C_{11}H_{15}NO$	$C_{11}H_{15}NO$	$C_{10}H_{13}NO$
Molecular mass	177.24	177.24	177.24	163.22

Common name(s):

2-MMC

2-Methylmethcathinone

Systematic (IUPAC) name:

2-(Methylamino)-1-(2-methylphenyl)propan-1-one

(*RS*)-2-(methylamino)-1-(2-methylphenyl)propan-1-one

Other chemical names:

1-(2-Methylphenyl)-2-(methylamino)propane-1-one

2-(Methylamino)-1-(2-methylphenyl)-1-propanone

2-(Methylamino)-1-(*o*-tolyl)propan-1-one

Other names:

2-Methyl-methcathinone

2-Me-methcathinone

2-Methyl-*N*-methylcathinone

2-Me-MCAT

2-Methyl MC

Ortomephedrone

Orthomephedrone

2-Mephedrone

EUDA framework name (Pulver et al., 2024):

2-Me-MC

Chemical Abstracts Service (CAS) registry numbers:

1246911-71-6 (base)

1246815-51-9 (hydrochloride salt)

2277338-19-7 (*R*-isomer)

2111020-66-5 (*S*-isomer)

IUPAC International Chemical Identifier Key (InCHI Key):

PRGXFAWAMOFULD-UHFFFAOYSA-N (base)

BNZJHCPXDZXUMH-UHFFFAOYSA-N (hydrochloride salt)

PRGXFAWAMOFULD-SECBINFHSA-N (*R*-isomer)

PRGXFAWAMOFULD-VIFPVBQESA-N (*S*-isomer)

IUPAC International Chemical Identifier String (InchI string):

InChI=1S/C11H15NO/c1-8-6-4-5-7-10(8)11(13)9(2)12-3/h4-7,9,12H,1-3H3 (base)

InChI=1S/C11H15NO.ClH/c1-8-6-4-5-7-10(8)11(13)9(2)12-3;/h4-7,9,12H,1-3H3;1H (hydrochloride salt)

InChI=1S/C11H15NO/c1-8-6-4-5-7-10(8)11(13)9(2)12-3/h4-7,9,12H,1-3H3/t9-/m1/s1 (*R*-isomer)

InChI=1S/C11H15NO/c1-8-6-4-5-7-10(8)11(13)9(2)12-3/h4-7,9,12H,1-3H3/t9-/m0/s1 (*S*-isomer)

Simplified Molecular-Input Line-Entry System (SMILES):

CNC(C)C(=O)c1ccccc1C (base)

Cl.CNC(C)C(=O)c1ccccc1C (hydrochloride salt)

CN[C@H](C)C(=O)c1ccccc1C (*R*-isomer)

CN[C@@H](C)C(=O)c1ccccc1C (*S*-isomer)

4.2.2 Physical description

The hydrochloride salt of 2-MMC is a crystalline solid, reported to be soluble in DMF (1 mg/ml); DMSO (2.5 mg/ml); ethanol (5 mg/ml); and PBS (pH 7.2) (10 mg/ml) (Cayman Chemical, 2024a). A λmax (ultraviolet wavelength of maximum absorbance) of 206, 249, 291 nm (Cayman Chemical, 2024a) and a pKa value of 8.59 by capillary electrophoresis have been reported (Woźniakiewicz et al., 2018). A melting point of 160 ˚C (Walther et al, 2019) and a melting point range of 163 – 165 ˚C (Power et al, 2011) have been reported for the hydrochloride salt of 2-MMC.

To date, seizures and collected samples containing 2-MMC reported to the EUDA have been mostly in powder form and to a lesser extent, in tablet, capsule and liquid form.

2-MMC has been identified in combination with other cathinones, including but not limited to: 3-MMC, 3-CMC ([24]) and 4-CMC ([25]). 2-MMC has also been identified in combination with internationally controlled substances such as cocaine and MDMA.

In most of the detections the form (base/salt) of 2-MMC was not reported. A small number of detections were reported as the hydrochloride salt form of 2-MMC.

4.2.3 Methods and chemical precursors used for the manufacture or extraction

Limited information is available about the chemical precursors or manufacturing methods used to make the 2-MMC which has been identified within Europe. General methods for the synthesis of cathinones, including 2-MMC are described below.

General methods for the synthesis of cathinones, including 2-MMC

Cathinones may be prepared using several synthetic approaches. For ring-substituted cathinones, such as 2-MMC and 3-MMC, the simplest approach involves a 2-step bromination-amination procedure which is a relatively straightforward process, using equipment and knowledge similar to those required for the synthesis of other synthetic drugs such as MDMA and amphetamine (EMCDDA, 2011; EMCDDA, 2022).

The first step of the process consists in the α-bromination of a suitable arylketone (commonly called a ‘propiophenone’), to produce an α-bromoketone under acidic or basic conditions. The bromine for this step can be commercially obtained as a liquid or prepared from a bromide salt (e.g. KBr), an acid (e.g. H_2SO_4), and an oxidizer (e.g. H_2O_2). Importantly, bromine is toxic by inhalation, accelerates the burning of combustible material, is very corrosive to tissue and to metals and dangerous for the environment.

After the preparation of the α-bromoketone, the product is reacted with an amine (for ring substituted cathinones the amine is typically methylamine hydrochloride and triethylamine in an acidic scavenger). This step promotes the nucleophilic substitution of the bromine to obtain a free cathinone base (EMCDDA, 2022; Wrzesień, 2018). Due to the instability of the free base, the product is converted into suitable salts (hydrochlorides or hydrobromides) which are then recrystallised (EMCDDA, 2022; Wrzesień, 2018). Unless steps are taken to

[24] 1-(3-Chlorophenyl)-2-(methylamino)propan-1-one

[25] 1-(4-Chlorophenyl)-2-(methylamino)propan-1-one

resolve the reaction products, the synthesis produces racemic mixtures. In case the starting arylketone precursor is unavailable or controlled, it can be easily prepared by a standard Friedler-Crafts reaction, mixing the appropriate aryl derivative (Step 0) with propionyl chloride in the presence of aluminium chloride (Wrzesień, 2018). A standard Grignard reaction with the corresponding ring-substituted benzene is also possible.

The preparation of cathinones using this method is an 'industrially efficient' process. Intermediates can be produced on a large scale, sub-divided into lots and each lot reacted with a different amine to produce a number of different cathinones (Collins, 2016).

Numerous alternative synthetic methods exist. One of the most relevant is the so-called 'permanganate process', which involves the direct oxidation of a suitable ephedrine analogue with a strong oxidant (potassium permanganate (VII) or potassium dichromate in diluted sulfuric acid) to yield the desired cathinone. If is obtained in a specific enantiomeric form, the synthesis is stereoselective and the resulting cathinone will be enantiopure, which may be of interest if one of the forms is more active than the other. Although this method can yield stereoselective products, it presents important disadvantages in that manganese impurities can contaminate the end products, unless careful and thorough purification steps are taken. Cathinone products contaminated with manganese may cause serious poisoning in consumers (EMCDDA 2022).

The synthesis of the hydrochloride salt of 2-MMC has been described in the literature (Power et al., 2011). 2-MMC (*compound 6a*) was synthesised through the reaction of 2-methylbenzaldehyde with ethyl magnesium bromide, followed by oxidation with pyridinium chlorochromate (PCC) on silica gel and bromination with hydrobromic acid/hydrogen peroxide, to obtain the bromo ketone. This was then reacted with ethanolic methylamine in acetonitrile and the product was purified by flash chromatography. The free base form of 2-MMC was converted to the hydrochloride salt of 2-MMC, using ethereal hydrogen chloride (Power et al., 2011). The synthesis of the hydrochloride salt of 2-MMC (*compound 2c*) has also been described by Walther et al. (Walther et al., 2018).

'Designer' Precursors

Other than standard organic synthesis methods using known precursors, cathinones can be prepared using so-called 'designer precursors'. These are 'purpose-made, close chemical relatives of controlled precursors and can easily be converted into a controlled precursor and usually have no legitimate use' (CND, 2020). They can be, for example, stable chemical intermediates, masked derivatives of controlled precursors, or masked derivatives of controlled drugs (CND, 2020). Amine compounds, including cathinones, are especially suited for the latter approach, in that 'masking' or 'protecting' groups (such as acetyl protecting groups, 'Boc' groups, CBZ groups and/or 'Tosyl' groups for example) can be easily introduced into the molecule (making it a different chemical entity) and then easily cleaved off, often in quantitative yields to produce the controlled amine of choice.

Illicit production of 2-MMC

Information on the synthetic pathways used to produce the 2-MMC seized in Europe can come from impurity profiling of seized/collected samples, from seizures of cathinone precursors and from law enforcement intelligence collected in seizures of illicit cathinone production sites.

No information exists on the synthetic impurities present in 2-MMC samples (synthetic impurity profiling). There are no reports on precursors related to 2-MMC reported to the European Union's Drug Precursors Database (EDPD) or to the International Narcotics Control Board (INCB) Precursors Incident Communication System (PICS).

There are no reports on 2-MMC illicit production sites through the European Reporting on Illicit Synthetic Substance Production Sites (ERISSP) database.

4.2.4 Detection and analysis

Methods documented in the literature for the identification of 2-MMC in physical samples and biological samples are referenced in Table 1.

Table 1. Methods documented in the literature for the identification of 2-MMC in physical samples and biological samples.

Physical samples	
Method	**References**
Gas chromatography–mass spectrometry (GC-MS)	Levitas et al., 2018 Kranenburg et al., 2019 Kranenburg et al., 2020a Kranenburg et al., 2020b Power et al., 2011 RESPONSE, 2014 SWGDRUG, 2013
Gas chromatography–infra red detection spectroscopy (GC–IRD)	Lee et al., 2019
Gas chromatography–vacuum ultraviolet spectroscopy (GC–VUV)	Kranenburg et al., 2019 Kranenburg et al., 2021a Skultety et al., 2017
High-resolution mass spectrometry (HRMS)	Power et al., 2011
Ion mobility–high-resolution mass spectrometry (IM-HRMS)	Majeed et al., 2023
Liquid chromatography tandem mass spectrometry (LC-MS/MS)	Grumann and Auwärter, 2018
Liquid chromatography– high-resolution tandem mass spectrometry (LC-HRMS/MS)	Che et al., 2024
High-performance liquid chromatography-ultraviolet (HPLC-UV)	Kadkhodaei et al., 2020 Taschwer et al., 2017
Fourier transform infrared spectroscopy (FTIR)	Christie et al., 2014 Power et al., 2011 RESPONSE, 2014 SWGRDUG, 2013
Infrared ion spectroscopy (IRIS)	Kranenburg et al., 2020c

Raman spectroscopy	Christie et al., 2014 Kranenburg et al., 2021b
^{1}H nuclear magnetic resonance spectroscopy (NMR)	Power et al., 2011 SWGRDUG, 2013
^{13}C NMR	Power et al., 2011
Capillary electrophoresis (CE)	Nowak et al., 2018a Nowak et al., 2018b Woźniakiewicz et al., 2018
Biological samples	
Method	**References**
GC-MS	Alremeithi et al., 2016 Alremeithi et al., 2018
GC-MS/MS	Woźniak et al., 2020
LC-MS	Labuz et al., 2019
LC-MS/MS	Adamowicz and Tokarczyk, 2016a Grumann and Auwärter, 2018 Maas et al., 2017 Pascual-Caro et al.,2020b Pascual-Caro et al., 2021 Pascual-Caro et al., 2022 Pascual-Caro et al., 2023
Liquid chromatography-high resolution mass spectrometry (LC–HRMS)	Stephanson et al., 2017 Pascual-Caro et al., 2020a Pascual-Caro et al.,2020b
Ultra-high performance liquid chromatography tandem mass spectrometry (UHPLC–MS/MS)	Liu et al., 2022
HPLC-DAD	Pascual-Caro et al., 2020a

Quantification of 2-MMC in products can be carried out according to the general procedure described by the UNODC (UNODC, 2020). Quantification of 2-MMC in biological samples can be carried out according to methods described by Woźniak et al., 2020, Liu et al., 2022 and Grumann and Auwärter, 2018.

Kerrigan et al., described the *in situ* degradation of synthetic cathinones during GC-MS analysis and the formation of enamine or imine cathinone artifacts (Kerrigan et al. 2016). Degradation can be minimised using lower inlet temperatures, minimising residence time in the inlet, and by eliminating active sites during chromatographic analysis (Kerrigan et al. 2016). Kranenburg et al. observed that methanolic extracts of cathinones exhibit a degradation effect over time, leading to reduced stability and peak broadening (Kranenburg et al. 2020a). This effect is more severe for the ortho-positional isomers like 2-MMC and can be minimised using derivatisation of the samples (Kranenburg et al. 2020a).

The current methods outlined in the literature for detecting cathinones in wastewater do not target the identification of 2-MMC.

Discrimination of 2-MMC from its positional isomers

2-MMC has two positional isomers, 3-MMC and 4-MMC, differing only in the position of the methyl group on the phenyl ring. Reference standards of the hydrochloride salt of 2-MMC (Cayman Chemical, 2024a), 3-MMC (Cayman Chemical, 2024b), and 4-MMC (Cayman Chemical, 2019) are commercially available. Reference standards are also commercially available for the base form and the *S*-isomer of 2-MMC (Aurora Fine Chemicals, 2025a; Aurora Fine Chemicals, 2025b) and also for the *R*-isomer of 2-MMC (UORSY, 2025).

Positional and structural isomers have the same molecular formula and molecular mass, therefore the discrimination of these isomers of 2-MMC poses analytical challenges, as techniques solely relying on mass will not allow an unequivocal identification. The positional isomers of 2-MMC, 3-MMC and 4-MMC, can be discriminated for in many, but not all, forensic and toxicology laboratories in Europe. The discrimination of positional isomers can be achieved through the use of analytical reference standards, and/or analytical methods in addition to GC-MS, such as FTIR or NMR. The discrimination of these isomers is described in further detail below.

Analysis of 2-, 3-, and 4-MMC by GC-MS will result in very similar mass spectrometry fragmentation patterns (Power et al., 2011; Lee et al., 2019). The ability to distinguish between these isomers requires the use of analytical reference standards, and/or additional analytical methods, such as FTIR (Lee et al., 2019) or NMR (Power et al., 2011). Christie et al., demonstrated the discrimination of the positional isomers of 2-MMC using Raman spectroscopy and FTIR (Christie et al., 2014). Lee et al. achieved the unambiguous identification of the positional isomers of 2-MMC using GC-IRD (Lee et al., 2019). Grumann and Auwärter highlighted that the unambiguous identification of positional isomers using LC–MS/MS can be challenging, however they successfully developed a liquid chromatography–electrospray ionization–tandem mass spectrometry (LC–ESI–MS/MS) method, with carefully optimised chromatographic conditions, which allowed for the separation of positional isomers, including those of 2-MMC, in different matrices such as seized materials, hair, serum, and urine specimens (Grumann and Auwärter, 2018). Maas et al. reported the application of an LC-ESI-MS/MS method capable of discriminating between the positional isomers of 2-MMC in real serum samples collected between June 2014 and August 2016 (Maas et al., 2017).

Majeed et al. developed a trapped ion mobility spectrometry time-of-flight mass spectrometry (TIMS-TOFMS) for the identification of ring-positional isomers of synthetic cathinones (Majeed et al., 2023). Che et al. developed a liquid chromatography-high-resolution tandem mass spectrometry (LC-HRMS/MS) combined with electron activated dissociation (EAD) and chemometrics for identification of cathinone positional isomers (Che et al., 2024).

Kranenburg et al. reported the capability of portable near infrared spectroscopy (NIR) for the identification of methylmethcathinone positional isomers in samples or mixtures containing more than 10 wt% of the psychoactive substance, proposing it as complementary analytical technique to GC-MS (Kranenburg et al., 2022). Kranenburg et al. also reported on the use of GC–VUV for analysis of isomeric mixtures (Kranenburg et al., 2019, Kranenburg et al.,

2021a), application of a derivatisation step for GC–MS-based NPS identification (Kranenburg et al., 2020a), and use of IRIS (Kranenburg et al, 2020c), for the discrimination of the positional isomers of 2-MMC. Kranenburg et al. and Skultety et al. described the discriminating potential of GC-VUV (Kranenburg et al., 2019; Skultety et al., 2017).

Differentiation of enantiomers

Cathinones, such as 2-MMC, contain a stereogenic centre thus allowing for the existence of a pair of enantiomers, (*R*)- and (*S*)-2-MMC. There is no information on the enantiomeric composition of the samples of 2-MMC detected within the European Union, which in part may reflect the fact that stereochemical analysis is not routinely undertaken in forensic laboratories.

Differentiation of enantiomers is possible using the following techniques: chiral chromatography, vibrational circular dichroism (VCD) spectroscopy and/or electronic circular dichroism (ECD) spectroscopy.

The separation of 2-MMC enantiomers by capillary electrophoresis has been described (Nowak et al., 2018a). Alremeithi et al. demonstrated the determination of synthetic cathinone enantiomers in urine and plasma using GC-MS (Alremeithi et al., 2016; Alremeithi et al., 2018). Kadkhodaei et al. and Taschwer et al. reported the use of isocratic HPLC methods with specific chiral stationary phases (CSP) to successfully separate enantiomers of a range of synthetic cathinones, including 2-MMC (Kadkhodaei et al., 2020, Taschwer, 2017).

4.3 Pharmacological and toxicological description of the new psychoactive substance (Article 9 2(c))

2-MMC is a ring-substituted synthetic cathinone. Similar to closely related cathinones such as 4-MMC and 3-MMC, 2-MMC is expected to interact with the monoamine transporter system and act as a psychostimulant. While currently the information on the pharmacology of 2-MMC is limited, 2-MMC has been shown to induce transporter-mediated neurotransmitter release, a feature also found in synthetic cathinones such as 4-MMC, 3-MMC, and methcathinone (Walther et al. 2019). Compared to 4-MMC, the potency of 2-MMC as a releasing agent at NET was comparable, while its potency as a releasing agent at DAT and SERT was lower (Walther et al. 2019).

The acute effects of 2-MMC are likely to share some similarities with related synthetic cathinones like 3-MMC and 4-MMC, including general stimulation and increased energy, elevated mood and euphoria, and increased sociability (Abdulrahim and Bowden-Jones, 2015; Soares et al., 2021).

Poisoning from synthetic cathinones, reflecting a sympathomimetic toxidrome, includes hyperactivity, mydriasis (dilated pupils), anxiety, agitation, hallucinations, hyperthermia, cardiovascular toxicity (tachycardia, hypertension, chest pain, cardiac arrest), respiratory effects, and seizures. In addition, psychotic episodes may occur (Baumann et al. 2018).

Synthetic cathinones have abuse liability and dependence potential (Bajaj et al., 2010; Batisse, et al., 2014; Dolengevich-Segal et al., 2016). While information specifically on 2-

MMC is limited, the chronic health risks may include dependence, similar to other synthetic cathinones like 4-MMC.

The concomitant use of 2-MMC with other central nervous system stimulants or other psychoactive substances (polysubstance use) may increase the risk of poisoning.

An unspecified number of anecdotal reports from consumers note the following effects: euphoria, mood elevation, increased energy and desire for communication.

4.4 Involvement of criminal groups in the manufacture or distribution of the new psychoactive substance (Article 9 2(d))

Europol received replies from 14 Member States: Austria, Croatia, Cyprus, Denmark, Estonia, France, Greece, Italy, Lithuania, Luxembourg, Slovakia, Slovenia, Spain and Sweden.

Replies were also received from Iceland ([26]), Moldova ([27]), Switzerland ([28]) and the United Kingdom (UK) ([29]).

Involvement of criminal groups in the manufacture or distribution of 2-MMC

Slovenia reported a seizure of 74.63 grams of 2-MMC during a house search, on 18 December 2024 in Maribor, linked to a lengthy investigation into a criminal group involved in the global distribution of drugs through the use of postal services.

Spain reported the identification of 2-MMC in March 2018 as part of Operation DRYER conducted by the Guardia Civil, in which a criminal organisation, based in Spain, was dismantled. New psychoactive substances (NPS), including 2-MMC, were produced, in part, at two production units located in the Netherlands (Amsterdam) and China. The products were marketed from Spain. In addition, the criminal organisation used two houses as a logistics point for the processing and packaging of substances that had originated from the Netherlands and China and which were subsequently distributed to more than 100 countries through the use of postal services. The NPS were marketed and sold exclusively online and their sale was restricted to specific web pages, normally operated under the protection of the Deep Web, and whose access was restricted to previously invited users. No other information was received on the involvement of criminal groups in the manufacture or distribution of 2-MMC.

Information on seizures of 2-MMC

Generally, seizures of 2-MMC, reported to Europol by Austria, Croatia, Denmark, Estonia, France, Italy, Lithuania, Luxembourg, Slovenia and Spain, occurred between 2018 and 2025.

[26] Iceland reported that they had no information on 2-MMC.
[27] Moldova reported that they had no information on 2-MMC.
[28] Switzerland reported that they had no information on the involvement of criminal groups in the manufacture, distribution and trafficking of 2-MMC. Switzerland reported, based on information gathered from forensic laboratories, one seizure of 2-MMC in 2023 and 32 identifications of 2-MMC in 2024, with the largest seizure being 500 grams of pure powder. Drug checking services have reported that pills containing 2-MMC are being sold as 3-MMC, 4-MMC, or 3-CMC.
[29] The UK reported that detections of synthetic cathinones are low and there is limited known use of these substances.

Cyprus, Greece and Slovakia reported that no information was available.

4.5 Information on the human and veterinary medical use of the new psychoactive substance, including as an active substance in a medicinal product for human use or in a veterinary medicinal product

According to Article 9(5) of the Regulation (EU) 2023/1322, the EMA requested that the national competent authorities responsible for human and veterinary medicinal products in the Member States, Norway, and Iceland provide information on whether 2-MMC is an active substance in:

a. a medicinal product for human use or in a veterinary medicinal product that has obtained a marketing authorisation in accordance with Directive 2001/83/EC of the European Parliament and of the Council (20), Regulation (EC) No 726/2004 or Regulation (EU) 2019/6 of the European Parliament and of the Council (21);

b. a medicinal product for human use or in a veterinary medicinal product that is the subject of an application for a marketing authorisation;

c. a medicinal product for human use or in a veterinary medicinal product whose marketing authorisation has been suspended by the competent authority;

d. an unauthorised medicinal product for human use as referred to in Article 5(1) and (2) of Directive 2001/83/EC or in a veterinary medicinal product prepared extemporaneously in accordance with Article 112(1), point (c), of Regulation (EU) 2019/6;

e. an investigational medicinal product as defined in Article 2, point (d), of Directive 2001/20/EC of the European Parliament and of the Council (22).

The following information was received:

- Twelve Member States ([30]) as well as Norway and Iceland reported that 2-MMC is not an active substance in medicinal products for human use;
- Twenty-one Member States ([31]) as well as Norway and Iceland reported that 2-MMC is not an active substance in medicinal products for veterinary use ([32]).
- The EMA reported that 2-MMC is not an active substance in a centrally authorised human or veterinary medicinal product.

Based on the available information, it appears that 2-MMC is not an active substance in any medicinal product for human use or in any veterinary medicinal product in Europe. However, the information for both human and veterinary medicines at national level is incomplete, particularly regarding human medicines. In addition, the use of 2-MMC as an active

[30] Austria, Croatia, Cyprus, Czechia, Denmark, France, Germany, Ireland, the Netherlands, Portugal, Spain, Sweden.
[31] Austria, Belgium, Croatia, Cyprus, Czechia, Denmark, Estonia, Finland, Germany, Ireland, Italy, Latvia, Luxembourg, the Netherlands, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, and Sweden.
[32] Regarding extemporaneous veterinary products Croatia, Denmark, Germany, and Slovenia reported that they have no information available.

substance in medicinal products prepared extemporaneously or in investigational medicinal products cannot be excluded in some Member States due to a lack of information.

4.6 Information on the commercial and industrial use of the new psychoactive substance, the extent of such use, as well as its use for scientific research and development purposes

2-MMC is available as analytical reference material for use in clinical and forensic case work and scientific research. There is currently no information that suggests 2-MMC is used for other legitimate purposes.

ECHA, ECDC, and EFSA reported that they do not hold any relevant data or information on 2-MMC.

4.7 Information on whether the new psychoactive substance is subject to any restrictive measures in the Member States

Twenty-one Member States, Türkiye and Norway reported that 2-MMC is subjected to restrictive measures at national level, as detailed below.

Six Member States (Bulgaria, Luxembourg, the Netherlands, Romania, Slovakia and Spain) reported that 2-MMC is not subject to restrictive measures at national level. The Netherlands reported that 2-MMC will be covered by a generic definition of cathinones, as of 1 July 2025. Romania reported that 2-MMC is in the process of being placed controlled under drug control legislation.

When reporting whether 2-MMC is subjected to restrictive measures, 9 Member States (Belgium, Denmark, Estonia, Germany, Hungary, Italy, Latvia, Lithuania, Poland) and Türkiye mentioned that this substance is covered by the generic definition of cathinones ([33]). Three Member States (Austria, Greece and Malta) reported that 2-MMC is controlled as an isomer of a controlled substance, 4-MMC.

Drug control legislation

Sixteen Member States (Austria, Belgium, Croatia, Cyprus, Czechia, Greece, Finland, France, Ireland, Italy, Latvia, Lithuania, Malta, Poland, Sweden, Slovenia), and Norway reported that 2-MMC is controlled under drug control legislation.

- Austria reported that 2-MMC is covered under drug control legislation as an isomer of 4-MMC;
- Belgium reported that 2-MMC is covered by generic definition as of 26 September 2017;
- Croatia reported that 2-MMC is controlled since 23 December 2024;

[33] Two Member States (Denmark and Estonia) reported that 2-MMC is controlled by ‘generic classification’, with no additional indication of dates or type of legislation.

- Cyprus reported that 2-MMC is controlled since 14 November 2011;
- Czechia reported that 2-MMC is controlled since 1 March 2017;
- Greece reported that 2-MMC is classified in Table A of Law 4139/2013, as an isomer of 4-MMC;
- Finland reported that 2-MMC is scheduled under the law concerning psychoactive substances banned from the consumer market since 20 December 2014;
- France reported that 2-MMC is controlled under drug control legislation since 2 August 2012;
- Ireland reported that 2-MMC is classed as a Schedule 1 controlled drug under the Misuse of Drugs Regulations 2017 since 4 May 2017;
- Italy reported that 2-MMC is covered by the generic definition of cathinones and is scheduled in Table I of the Presidential Decree 309/90 since 16 May 2014;
- Latvia reported that 2-MMC is covered by the generic definition of cathinones On the Procedures for the Coming into Force and Application of the Criminal Law since 2013;
- Lithuania reported that 2-MMC is regulated as a derivative of cathinone since 10 March 2015;
- Malta reported that 2-MMC is considered as a derivative of 4-MMC, and covered by Medical and Kindred Professions Ordinance;
- Poland reported that 2-MMC is covered by the generic definition of cathinones in a regulation of the Minister of Health since 21 August 2018;
- Sweden reported that 2-MMC is controlled as a narcotic drug since 9 June 2015;
- Slovenia reported that 2-MMC is controlled by Regulations on the classification of illicit drugs since 20 June 2014;
- Norway reported that 2-MMC is controlled since 19 December 2015.

New psychoactive substance legislation

Three Member States (Germany, Hungary, Portugal) and Türkiye reported that 2-MMC is controlled under new psychoactive substance legislation.

- Germany reported that 2-MMC is covered by the generic definition of cathinones of the New Psychoactive Substances Act (NpSG) since 26 November 2016;
- Hungary reported that 2-MMC is covered by the definition of cathinones in Annex III of Decree no. 78/2022 of the Ministry of Interior since 3 April 2012;

- Portugal reported that 2-MMC is controlled by Administrative Rule 154/2013 since 18 March 2013;
- Türkiye reported that 2-MMC is covered by the generic definition of cathinones since 2015.

Other countries

2-MMC is controlled in China since October 2015. The available information suggests 2-MMC is not controlled in India.

4.8 Information on whether the new psychoactive substance is currently or has been under assessment within the United Nations system

The World Health Organization is the specialised United Nations agency designated for the evaluation of the medical, scientific, and public health aspects of psychoactive substances under the Single Convention on Narcotic Drugs, 1961, and the Convention on Psychotropic Substances, 1971.

On 20 March 2025, the World Health Organization informed the EUDA that 2-MMC is not currently under assessment nor has it been under assessment by the United Nations system.

5. Analysis and assessment

2-(Methylamino)-1-(2-methylphenyl)propan-1-one (2-methylmethcathinone, 2-MMC) is a synthetic cathinone with stimulant effects that is monitored as a new psychoactive substance by the EUDA in accordance with Regulation (EU) 2023/1322.

The substance is an *N*-alkylated and ring-substituted cathinone and contains a chiral centre so two enantiomers may exist: (*R*)-2-MMC and (*S*)-2-MMC. It is a derivative of cathinone, the naturally occurring stimulant and main psychoactive substance in the khat plant *Catha edulis*. 2-MMC is also closely related to and likely shares similar stimulant effects with methcathinone, 3-methylmethcathinone (3-MMC), and 4-methylmethcathinone (4-MMC). Cathinone, methcathinone, 3-MMC, and 4-MMC are controlled under the 1971 United Nations Convention on Psychotropic Substances because of the public health and social risks that they pose.

2-MMC was first identified in Europe in 2013 based on a police seizure made in Germany. As of March 31, 2025, the substance has been identified in 23 Member States, as well as Türkiye and Norway.

Initially, 2-MMC was sourced from chemical companies in China. However, following China's control of the substance in October 2015, its availability in Europe declined. Between 2018 and 2021, there was only low-level availability and presence.

Since 2022, European suppliers began importing large quantities of 2-MMC from chemical companies in India, apparently primarily through the Netherlands. This shift coincided with the Netherlands' control of 3-MMC in October 2021.

This new supply route has led to 2-MMC's re-emergence on the European drug market, with law enforcement reporting significant increases in seizures and imports. Of the 2,196 cases reported between 2013 and 2024:

- 1,902 cases (86.6% of total) occurred between 2022-2024
- These recent cases amounted to 45.7 tonnes (99.7% of total quantity)
- These include 148 imports from India totalling 44.4 tonnes, of which 33.2 tonnes (72.5% of total quantity) was reported in 2024 alone

In addition, drug checking services from seven Member States reported 1,902 samples collected from users containing 2-MMC, with 99.9% of samples collected since 2022. Analysis revealed that 2-MMC was primarily mis-sold as 3-MMC.

The limited information suggests that 2-MMC is sold both as a substance in its own right and mis-sold as other drugs, particularly 3-MMC. Usage patterns of 2-MMC likely resemble those of other similar synthetic cathinones, such as 3-MMC and 4-MMC. Similar to other cathinones such as 3-MMC and 4-MMC, 2-MMC is typically administered by insufflation (snorting) or orally, with some reported cases of intravenous injection and rectal administration.

2-MMC appears to be used primarily by existing stimulant users, including those who use cathinones, amphetamines, and ecstasy, who either use it in addition to substances they

already use or as a replacement. This includes both recreational use and, in some cases, high-risk behaviours such as injection as part of chemsex. Additionally, vulnerable groups, particularly young people, may be attracted to 2-MMC because of its availability, legal status in some countries, and relatively low cost. 2-MMC is used in domestic settings, recreational venues, and chemsex environments.

Since 2023, an increasing number of harms associated with 2-MMC have been reported. This includes acute poisonings and deaths, specifically:

- A total of 40 cases of acute poisoning with suspected or probable exposure to 2-MMC have been reported by three Member States: France, the Netherlands, and Sweden.
- A total of 8 deaths with confirmed exposure to 2-MMC have been reported by five Member States: Spain, Finland, France, Lithuania, and Slovenia. In all of the cases, other substances were identified, including central nervous system depressants and stimulants. The role of 2-MMC in these deaths is unknown.

Currently, there is limited information on the involvement of criminal groups in the manufacture, trafficking, and distribution of 2-MMC within Europe. However, based on information reported to the EUDA, there is evidence of criminal acts, such as trafficking and supply offences, involving 2-MMC.

Based on the available information, it appears that 2-MMC is not an active substance in any medicinal product for human use or in any veterinary medicinal product in Europe. However, the information for both human and veterinary medicines from national level is incomplete, particularly regarding human medicines. In addition, the use of 2-MMC as an active substance in medicinal products prepared extemporaneously or in investigational medicinal products cannot be excluded in some Member States due to a lack of information. Aside from limited use as an analytical reference standard and in scientific research, there is currently no information that suggests that 2-MMC is used for other legitimate purposes.

2-MMC is subject to restrictive measures in 21 Member States, Türkiye, and Norway, sometimes covered by a generic definition of cathinones. However, it is not subject to restrictive measures in 6 Member States. The substance has been controlled in China since October 2015, while the available information suggests it is not controlled in India.

2-MMC has not been subject to assessment nor is it currently under assessment by the United Nations system.

The EUDA will continue to intensively monitor 2-MMC to ensure that new information is provided to the Member States, Europol, the Commission and the EMA through the European Union Early Warning System in a timely manner. This monitoring will enhance awareness and inform effective preparedness and response measures at both national and EU levels to protect public health.

The analysis of available data reveals that 2-MMC has recently re-emerged on the drug market with significantly increased availability as well as reported harms in the European Union. The EUDA considers these findings indicate potential health and social risks at Union level. We conclude that the potential health and social risks posed by the use, manufacture,

distribution and involvement of criminal groups could be comprehensively assessed through a risk assessment procedure as specified in Article 10 of Regulation (EU) 2023/1322.

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