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Advisory Council on the Misuse of Drugs

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Norman Baker MP, Minister for Crime Prevention
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10 June 2014

Dear Minister,

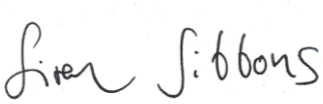
In December 2013, you commissioned the ACMD to begin a regular review of generic definitions under the Misuse of Drugs Act 1971, with the aim of capturing emerging new psychoactive substances. These drugs are variants of controlled drugs and fall outside the existing scope of the Misuse of Drugs Act 1971.

The ACMD has considered evidence available on tryptamines in the context of the Misuse of Drugs Act 1971 and I enclose the Advisory Council's advice and an expanded definition for tryptamine compounds with this letter. The ACMD's NPS Committee has firstly reviewed previous research and existing controls to identify those tryptamines now seen to evade the existing controls. The ACMD has also reviewed data provided by the Home Office's early warning systems and networks, clinical toxicology, prevalence and neuropharmacology in arriving at the expanded generic definition. This expanded generic definition will bring drugs such as alpha-methyltryptamine (AMT) as well as 5-MeO-DALT within the scope of the Misuse of Drugs Act 1971. These are highly potent hallucinogens which act on the $5HT_{2A}$ receptor, in the same way as LSD.

The ACMD therefore recommends that the tryptamines covered by the proposed expanded generic definition in this report, are controlled under the Misuse of Drugs Act (1971) as Class A substances. In addition, a number of materials related to LSD, which are also hallucinogenic and evade current controls have been recommended to be named under the Misuse of Drugs

Act 1971 as Class A substances. The Advisory Council is not aware of legitimate uses for the tryptamines and materials related to LSD and recommends that they be scheduled under Schedule 1 of the Misuse of Drugs Regulations 2001 (as amended).

Yours sincerely,



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CC: Rt Hon Theresa May MP, Home Secretary

ACMD

Advisory Council on the Misuse of Drugs

Update of the Generic Definition for Tryptamines

June 2014

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1. Introduction

1.1 Many of the emerging drugs of misuse are in the field of Novel Psychoactive Substances (commonly referred to as 'legal highs' or NPS). One mechanism to control new substances of concern through current legislation is by amending the chemical descriptions, referred to as 'generic definitions' under the Misuse of Drugs Act 1971.

1.2 These rapidly appearing drugs are variations around a central chemical backbone. The Advisory Council on the Misuse of Drugs (ACMD) has previously recommended amending generic controls for drugs using this approach to capture these new variations to ensure that drugs that are harmful, or have the potential to cause harm are controlled. In 2013, the ACMD established a Standing Committee (the NPS Committee) to consider groups of legal highs or specific compounds and to provide advice to Government on classification and scheduling.

1.3 In December 2013, the Minister of State for Crime Prevention commissioned the ACMD to begin a regular review of the generic definitions under the Misuse of Drugs Act 1971. As a component of this initial tranche of advice, the Home Office has requested the ACMD to review the generic definition for tryptamines.

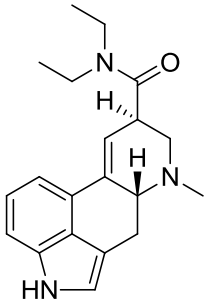
1.4 The aim of this report is to review the evidence currently available to the ACMD to specifically inform a revised generic definition for the tryptamine group of drugs under the Misuse of Drugs Act 1971 and associated classification and scheduling of these compounds.

1.5 With this specific purpose in mind, the ACMD has reviewed the following to generate a revised generic definition:

- existing UK controls and tryptamines currently on the market that fall outside these controls;
- Controls applicable in other countries;
- Neuropharmacology associated with tryptamines;
- Prevalence and fatalities associated with tryptamines; and,
- Clinical toxicology.

2. Background to Tryptamines

2.1 Two groups of tryptamine-related psychoactive materials are currently controlled by the Misuse of Drugs Act 1971. These are, firstly, the simple tryptamines, that is, structures directly derived from tryptamine and, secondly, the more complex materials related to lysergide (LSD- see ***Figure 1***), where the tryptamine structure forms part of a larger polycyclic structure.



Lysergide (LSD)

Figure 1

2.2 In recent years, there has been increasing interest in hallucinogenic substances of these types, and a number of such psychoactive materials with structures which are outside the scope of the Misuse of Drugs Act controls have been offered for sale as NPS.

3. Existing UK controls on simple tryptamines

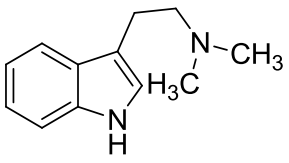
3.1 Four simple tryptamines were originally listed as Class A drugs in Part 1(a) of Schedule 2 of the Misuse of Drugs Act 1971 (see ***Figure 2***).

These were:
a) *N,N*-dimethyltryptamine (DMT);
b) psilocin (4-OH DMT);
c) *N,N*-diethyltryptamine (DET);
d) bufotenin (5-OH DMT).

3.2 As esters and ethers of Class A drugs are also controlled, the control also covered any esters and ethers of the two named ring-hydroxy derivatives, such as 5-MeO DMT and psilocybin (the phosphate ester of psilocin).

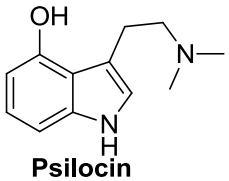
Figure 2

(a)



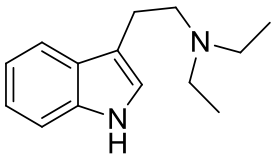
***N,N*-Dimethyltryptamine**

(b)



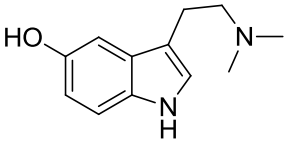
Psilocin

(c)



***N,N*-Diethyltryptamine**

(d)

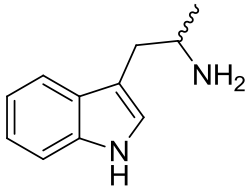


Bufotenin

3.3 In 1977, a broader generic control on simple tryptamines was added to Class A of the Misuse of Drugs Act as Part 1(b) of Schedule 2 (SI 1977/1243). This covered *"any compound….structurally derived from tryptamine or from a ring-hydroxy tryptamine by substitution at the nitrogen atom of the side-chain with one or more alkyl substituents but no other substituent."*

3.4 Again, any esters and ethers of ring-hydroxy materials also became controlled. However, alpha-alkyl materials were outside the scope of this generic, as were any materials which were *N*-substituted with groups other than alkyl or ring-substituted with other than hydroxy (or esters/ethers of hydroxy).

3.5 In 1998, etryptamine (alpha-ethyl tryptamine, AET) was added to Class A as a named substance (SI 1998/750), as a result of its addition to the UN Convention on Psychotropic Substances. This psychoactive material had been developed as an antidepressant 'Monase' by Upjohn in the 1960's, but was withdrawn after it was found to be linked to agranulocytosis. The closely-related alpha-methyl tryptamine (AMT- see ***Figure 3***), which is also psychoactive and had also been developed by Upjohn, as 'Indopan', was not controlled.



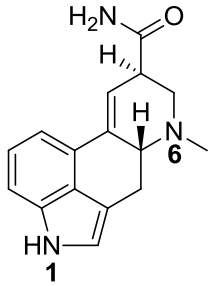
Alpha-methyltryptamine (Indopan)

Figure 3

4. Existing UK controls on lysergide-related materials

4.1 Lysergamide (lysergic acid amide, LSA, ergine) and lysergide (lysergic acid diethylamide, LSD) were specifically named as Class A drugs in Part 1(a) of Schedule 2 of the Misuse of Drugs Act 1971, which also included a generic control extending cover to *"and other N-alkyl derivatives of lysergamide".*

4.2 There are three nitrogen atoms within the lysergamide structure (see ***Figure 4***). The generic control covers any alkyl derivatives at the amide nitrogen and at the nitrogen within the indole structure (the 1- position), but not any such derivative at the third nitrogen (the 6-position) as, if the substitution at this nitrogen is other than methyl, the core structure is no longer lysergamide.



Lysergamide

Figure 4

4.3 Substitution at any of the nitrogen atoms with groups other than alkyl, or other substitution elsewhere on the lysergamide molecule, would also result in materials which are outside the current generic control. However, the phrase "*and other N-alkyl derivatives of lysergamide*" is considered by some experts to be ambiguous and could be taken to include the potentially useful non-hallucinogenic drug 2-bromo-LSD. For this reason King et al (2013) have proposed that the generic definition should be revised to specifically excluded 2-bromo-LSD.

5. Previous research on Tryptamines: 'TIHKAL'

5.1 In 1997, Alexander Shulgin published "TIHKAL, Tryptamines I Have known and Loved", a companion volume to his 1991 book on phenethylamines ("PIHKAL"). TIHKAL described his research in synthesising and evaluating psychoactive tryptamines and included details of the synthesis and effects of 55 tryptamine-related materials. Within the entries, it also includes less-detailed references to a number of related materials.

Simple tryptamines

5.2 Of the 47 tryptamines listed in TIKHAL, 19 are outside the scope of the generic UK controls, including:

- those with alpha-alkyl substituents (TIHKAL entries #5, 7, 8, 48 and 55);
- those with a methylenedioxy group attached to the six-membered ring of the indole core (#28, 29, 30, 31 and 32);
- those with a methyl group in the 2- position, that is, adjacent to the nitrogen on the five-membered ring of the indole core (#7, 33, 34 and 45); and,
- those where the amine nitrogen has been incorporated into a cyclic structure (#24, 43 and 52).

5.3 However, only some of the 19 uncontrolled materials were described by Shulgin as being effective hallucinogens.

Materials related to lysergamide

5.4 There are also 4 entries describing materials related to lysergamide in TIHKAL. These are:

- LSD itself (TIHKAL entry #26); and,
- three materials which involve replacing the methyl group at the 6-position nitrogen: AL-LAD (TIHKAL entry #1), ETH-LAD (#12) and PRO-LAD (#51). The ambiguity with the LSD generic means that we may be able to list these compounds as being controlled as they are effectively *N*-alkyl derivatives of LSD.

5.5 The LSD entry also includes a discussion of a variety of other modifications of LSD, by substitution at the 1-position indole nitrogen and/or the 2-position carbon (8 examples) or at the amide nitrogen (30 examples).

5.6 At the 1-position, only variants with an acetyl substitution ("ALD-52") or a methyl substitution ("MLD-41") are reported to be active, and MLD-41 is already covered by the UK's generic control on *"N-alkyl derivatives".*

5.7 The materials substituted at the 2-position are halogenated (Br, I) and are described as being inactive. At the amide nitrogen, most of the variants involve alkyl groups and are therefore covered by the UK's *"N-alkyl"* generic, while others are reported to be only weakly active, if at all. A few which include hydroxyl groups, such as methergine, ergonovine and UML-491 (methysergide) are pharmaceuticals which produce LSD-like effects when taken in dosages significantly above therapeutic levels.

Beta-carboline structures

5.8 Four further TIHKAL entries address beta-carboline structures, harmaline (entry #13), harmine (#14), harman (#44) and tetrahydroharmine (#54) and there is an additional entry for the related material ibogaine (#25). Several of these are naturally occurring in herbal materials used in ayahuasca mixtures, where they are believed to act as 'activators', as their monoamineoxidase inhibitory (MAOI) activity permits oral activity of tryptamines, which would otherwise be deactivated by enzymes. However, Shulgin did not regard the beta-carbolines as hallucinogenic materials and they are not considered further here.

6. ACMD consideration of TIHKAL (1998)

6.1 In 1998, a paper discussing the potential implications of TIHKAL was prepared for the ACMD Technical Committee by Dr Les King, assisted by Professor Geoffrey Phillips (TC 98/13). This suggested that, if it was

wished to control those TIHKAL materials not covered by the MDA, the generic control on tryptamines could be amended by replacing the phrase *"ring-hydroxy tryptamine"* with *"ring-hydroxy or ring alkoxy or ring-alkylenedioxy tryptamine",* which would bring 14 additional TIHKAL compounds within the scope of the generic, and by adding a further 14 materials to the MDA by name, as their structures were so diverse that bringing them within the scope of a generic would be challenging.

Note: the proposed *"or ring alkoxy"* phrase is unnecessary, as any ring alkoxy would be an ether of a ring hydroxy, and therefore already covered by the 'esters and ethers' provision for Class A materials.

6.2 However, the paper also stated that *"It is thought unlikely that youth culture will abandon the stimulants and empathogens of the phenethylamine family for hallucinogenic tryptamines."* This view, that there was no immediate threat from the uncontrolled TIHKAL materials, prevailed and no amendment to the Misuse of Drugs Act was recommended.

6.3 Dr King subsequently included a summary of the ACMD paper as Section 6.14.1 of his book "Forensic Chemistry of Substance Misuse" (2009), which also included in Appendix 20 a table setting out the legal status of 47 TIHKAL tryptamines.

7. Other developments

7.1 Shulgin continued to work on phenethylamines and tryptamines after the publication of PIHKAL and TIHKAL and it was announced that further publications would appear. In an interview in 'Vice' magazine in May 2010, Shulgin mentioned recent work on 5-methoxy variants of dialkyltryptamines.

7.2 **"**The Shulgin Index, Volume I" was published in 2011; this was a greatly expanded version of the chemical section of PIHKAL, covering many more phenethylamine-related compounds, without the autobiographical section. Scanned copies of his lab note books were also being made available. Volume II of the Index, to be a similarly expanded version of TIHKAL, was also announced but there is, to date, no indication of it being published.

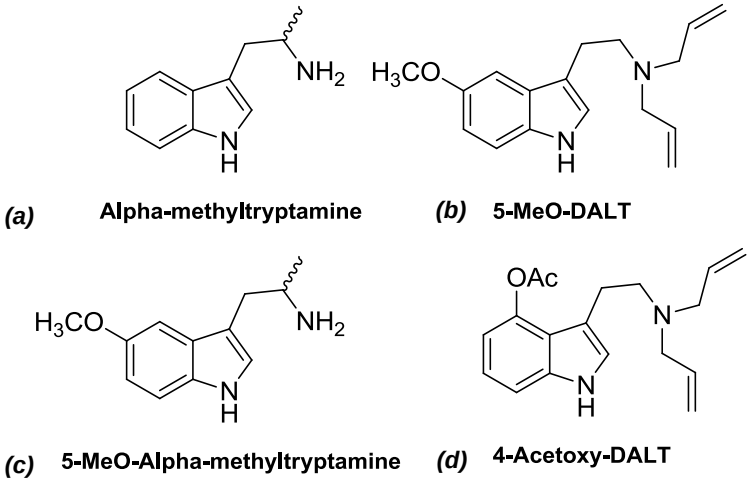
7.3 A variety of materials with alkyl or halogen substitution in the benzene ring of simple tryptamines have also been reported as being active, including 5- and 7-methyl DMT, 5-ethyl DMT, 5- and 6-fluoro AMT and 4- and 7-methyl AET.

8. Tryptamines in the current UK NPS market

Simple tryptamines

8.1 A number of psychoactive simple tryptamines which are outside the UK's controls have been offered as 'legal highs'. Two in particular, alpha-methyltryptamine (AMT) and 5-methoxy diallyltryptamine (5-MeO-DALT), have become widely available and have been routinely encountered in FEWS surveys (***Figures 5(a) and (b)*** respectively).

8.2 Other uncontrolled tryptamines have been reported to the EMCDDA, including 5-methoxy alpha-methyl tryptamine (5 MeO AMT) and 4-acetoxy diallyltryptamine (an acetate ester of 4-HO DALT) (***Figures 5(c) and (d)*** respectively).



(a) **Alpha-methyltryptamine** ***(b)*** **5-MeO-DALT**

(c) **5-MeO-Alpha-methyltryptamine** ***(d)*** **4-Acetoxy-DALT**

Figure 5

LSD-related materials

8.3 In addition, a number of materials related to LSD, which are hallucinogenic but which evade the UK's controls, have been offered for sale on specialist websites devoted to hallucinogens.

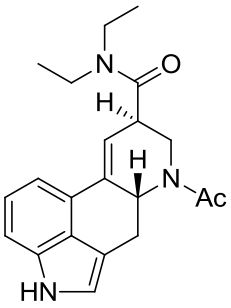
8.4 These include the TIHKAL materials shown in ***Figure 6***:

a) '**ALD-52**' (*LSD with an acetyl group on the tryptamine nitrogen*),

b) '**ETH-LAD**', '**PRO-LAD**' and '**AL-LAD**' (*LSD with, respectively, ethyl, propyl and allyl groups replacing the methyl group on the 6-position nitrogen*),

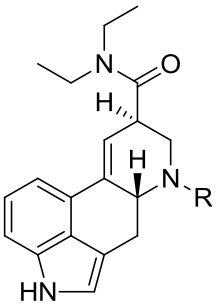
c) as well as '**LSZ**' (lysergic acid 2,4-dimethylazetidide), developed by Nichols' group at Purdue University, which has a rigid four-membered azetidine ring analogue of the diethyl groups on the

amide nitrogen of LSD and which is reported to be particularly potent.



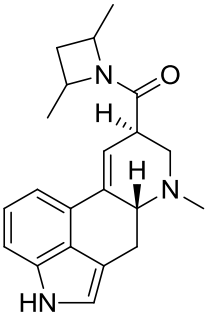
ALD-52

Figure 6 (a)



ETH-LAD R = ethyl
PRO-LAD R = propyl
AL-LAD R = allyl

Figure 6 (b)



LSZ

Figure 6 (c)

9. Neuropharmacology of AMT and 5MeO-DALT

9.1 The widely available alpha-methyltryptamine (AMT) and 5-methoxy diallyltryptamine (5-MeO-DALT), were recently profiled at Psychoactive Drug Screening Program (PDSP) (Arunotayanun et al., 2013). This showed that both compounds had high affinities for human cloned 5-HT_{2A-C} receptors the 5-HT transporter (SERT), and sigma-1 receptors. Notably, 5-MeO-DALT exhibited the greatest affinity for 5-HT_{2B} receptors.

9.2 The 5-HT_{2A} receptor is known to mediate the psychoactive effects of many hallucinogens (Keiser et al., 2009), the 5-HT_{2B} receptor mediates cardiovascular side-effects of legal and illicit medications (Roth., 2007) and 5-HT_{2C} receptors for mediating anorectic actions of drugs, AMT and 5-MeO-DALT were examined for their the effects on 5-$HT_{2A/B/C}$ functional responses. Both AMT and 5-MeO-DALT had low nM potencies for activating 5-$HT_{2A/B/C}$ receptors. Both compounds had greatly attenuated activity at various transporters. Given their high potencies and efficacies at 5-HT_{2A} receptors, these are likely to be essential for exerting their psychoactive effects in humans.

9.3 An analysis of self reports of users (Wilcox., 2012) showed that alpha-methyl-tryptamine appears to act like most traditional hallucinogens shortly after ingestion, with visual illusions and euphoria reported by most users in that study.

10. Deaths involving tryptamines between 2009-2013

10.1 There have a small number of confirmed post mortem toxicology reports on tryptamines rising from 1 in 2009 to 4 in 2013. Alpha-methyltryptamine has the greatest number of fatalities recorded in the UK to date with 4 reported in 2012 and 3 in 2013.[1]

11. Clinical toxicology

11.1 The National Poisons Information Service (NPIS) reported information to ACMD on cases after reported recreational use of alpha-methyltryptamine, 5-MeO-DALT and other tryptamines. Specifically, this information is on the number of accesses to information held on TOXBASE and numbers of telephone enquiries made to the service.

11.2 Alpha-methyltryptamine was the most commonly involved in telephone enquiries, with a total of 69 enquiries, of which 35 were made in 2012. Individual tryptamines less commonly involved in telephone enquiries were DMT (15 enquiries), 5-Meo-DALT (13 enquiries) and 5-MeO-DIPT (4 enquiries). There were a further 15 enquiries relating to unspecified tryptamines.

11.3 Alpha-methyltryptamine also recorded the highest number of TOXBASE accesses (208 in 2013).

11.4 The NPIS has recently published data on clinical characteristics of poisoning in reported cases of alpha-methyl-tryptamine exposure. In this study, telephone enquiry data were compared with those for mephedrone, collected over the same period of time. Clinical effects recorded more frequently in alpha-methyltryptamine than in those presenting following reported use of mephedrone, including stimulant features, acute mental health disturbances, seizures and hypotension. In that study, agitation, aggression, tachycardia, mydriasis, fever or abnormal sweating, hallucinations and confusion were reported in a higher proportion of enquiries involving alpha-methyltryptamine.

12. Prevalence in the UK

12.1 Data collected since 2011 by the Forensic Early Warning System (FEWS) project has identified 5-MeO-DALT and AMT, each from ten different collection plans, including at festivals. This shows that 5-MeO-DALT has been identified 36 times and AMT 46 times.

[1] Based on notifications received by NPSAD up to 7th February 2014.

12.2 As of 3 March 2014, the Home Office's 'Drugs Early Warning System' (DEWS) had provided limited observations, including:

- AMT had been seen in tablet as well as liquid form.
- 5-MeO-DALT had been seen in tablet as well as powder form.
- Packets purchased from a headshop in South Wales contained 5-MeO-DALT, ethyl phenidate and methiopropamine.
- Avon and Somerset police reported that AMT had been on sale at most 'legal high shops', though there were no seizures.
- 4 anecdotal user reports were highlighted for 5-MeO-DALT.

12.3 The DEWS results also reported the number of samples reported by the National Crime Agency (NCA) to have been analysed by UK forensic service providers (January to September 2013 – see ***Table 1***).

Drug	**Number of samples**
Alpha-methyltryptamine (AMT)	102
AMT / 5-IT	4
5-Meo-DALT	32
Psilocin	64
Bufotenin	8
LSD	28
5-Meo-DMT	1
Psilocybin	15
Other	1 suspected psilocin / bufotenin 1 psilocin / psilocybin A further suspected AMT

Table 1*- Number of samples analysed by UK forensic service providers (Data from National Crime Agency - January 2013 - September 2013*

13. Other countries' controls

13.1 Most countries control tryptamines by means of named lists. Some, however, have broader controls.

New Zealand

13.2 New Zealand has a generic control for the simple tryptamines:

"DMT (dimethyltryptamine) analogues in which the 3-(2-aminoethyl)indole nucleus has additional radicals, either alone or in combination, attached as follows:

(a) 1 or 2 alkyl radicals, each up to 6 carbon atoms, including cyclic radicals, attached to the amino nitrogen atom:
(b) 1 or 2 methyl groups, or an ethyl group, attached to the carbon atom adjacent to the amino nitrogen atom:
(c) any combination of up to 5 alkyl radicals and/or alkoxy radicals (each with up to 6 carbon atoms, including cyclic radicals) and/or halogen radicals, attached to the benzene ring."

13.3 This approach means that some additional TIHKAL materials, including alpha-methyl and alpha-ethyl materials, such as AMT, as well as methylenedioxy derivatives and materials where the amine nitrogen is included in a cyclic structure, are controlled, as are benzene ring alkyl or halogen materials, but it does not cover *N*-allyl derivatives, such as 5-MeO-DALT.

United States

13.4 In the United States, a number of simple tryptamines are named as Schedule I hallucinogens, including 5-MeO DMT, bufotenin, DET, DMT, 5-MeO DiPT and psilocin, as well as the alpha-alkyl materials AMT and AET. Related materials are then controlled by virtue of the US's analogue controls.

14. Extension of the UK controls

14.1 As identified in the 1998 ACMD Technical Committee paper, there are two possible approaches to extend the UK controls on tryptamine-related materials:

- extend the scope of the existing generics; or,
- list individual materials by name.

14.2 Given the diversity of the materials, a combination of these two approaches is necessary.

14.3 For the simple tryptamines, there appears to be a need to control:

(i) Alpha-alkyl derivatives
(ii) Benzene ring-substitution by alkyl or halide, or alkylenedioxy substitution on the amine nitrogen by groups other than alkyl, particularly allyl,
(iii) Inclusion of the amine nitrogen in a cyclic structure, such as a pyrrole ring.

14.4 This could be achieved by:

(i) expansion of the generic control as suggested in 1998 to *"ring-hydroxy or ring-alkylenedioxy tryptamine";*
(ii) expansion of the *N*-substitution term to include groups other than alkyl;
(iii) addition of further terms, similar to the wording used in the New Zealand legislation, to address benzene ring alkyl and halogen materials, alpha-alkyl materials, and possibly those where the amine nitrogen is part of a cyclic structure.

(Control would need to encompass materials which include more than one of these features such as 4-Me AMT and 4-Me AET).

15. Recommendation

15.1 ACMD recommends the following extension of the *existing* generic:

Tryptamines (**Class A – Schedule 2**, Part I, paragraph 1 (b))

(b) any compound (not being a compound for the time being specified in sub-paragraph (a) above) structurally derived from tryptamine or from a ring-hydroxy tryptamine by modification in any of the following ways, that is to say,

i. by substitution at the nitrogen atom of the side chain to any extent with alkyl or alkenyl substituents, or by inclusion of the nitrogen atom of the side chain (and no other atoms of the side chain) in a cyclic structure;
ii. by substitution at the carbon atom adjacent to the nitrogen atom of the side chain with alkyl or alkenyl substituents;
iii. by substitution in the 6-membered ring to any extent with alkyl, alkoxy, haloalkyl, thioalkyl, alkylenedioxy, or halide substituents;
iv. by substitution at the 2-position of the tryptamine ring system with an alkyl substituent.

> **Note**: The ACMD has reviewed various triptans (a family of tryptamine-based drugs, which have medicinal uses) and these are outside the scope of this proposed generic definition.

15.2 For the lysergamide-related materials, there is a need to control:

i. replacement of the methyl group at the 6- position by other groups (ethyl, propyl, allyl)
ii. substitution at the 1- position indole nitrogen by acetyl
iii. substitution at the indole nitrogen by other than *N*-alkyl

Given the relatively small number of materials involved: (AL-LAD (***figure 6(a)***), ETH-LAD (***figure 6(b)***), PRO-LAD (***figure 6(b)***), ALD-52 (***figure 6 (b)***) and LSZ (***figure 6(c)***)); this is most simply achieved by adding them to the Misuse of Drugs Act 1971 by name.

15.3 The ACMD is not aware of legitimate uses for the materials covered by paragraphs 15.1 and 15.2 and therefore recommends that they be scheduled under Schedule 1 of the Misuse of Drugs Regulations 2001 (as amended).

16. References

Arunotayanun W, Dalley JW, Huang XP, Setola V, Treble R, Iversen L, Roth BL, Gibbons S. An analysis of the synthetic tryptamines AMT and 5-MeO-DALT: emerging 'Novel Psychoactive Drugs' *Bioorg Med Chem Lett*. 2013 23: 3411-5.

"TIHKAL the continuation", Alexander and Ann Shulgin, Transform Press, 1997, ISBN 0-9630096-9-9

"Last interview with Alexander Shulgin", Vice Magazine, 2nd May 2010

Boland, DM; Andollo, W; Hime, GW; Hearn, WL. Fatality due to acute alpha-methyltryptamine intoxication. *J. Anal Toxicol*. 2005: 29(5): 394-7

D E Nichols et. al., Lysergamides of isomeric 2,4-dimethylazetidines map the binding orientation of the diethylamide moiety in the potent hallucinogenic agent *N,N*-diethyllysergamide (LSD). *J Med Chem,* 2002, 45, 4344-4349.

Kamour, A; James, D; Spears, R; et al. Patterns of presentation and clinical toxicity after reported use of alpha methyltryptamine in the United Kingdom. A report from the UK National Poisons Information Service. *Clinical Toxicology* 2014; 52: 192 – 197

King, L. A., Forensic chemistry of substance misuse, a guide to drug control. RSC Publishing, 2009, ISBN 978-0-85404-178-7

King, L. A., Ujváry, I. and Brandt, S. D. (2013), Drug laws and the 'derivative' problem. *Drug Test Analysis*. doi: 10.1002/dta.1523

Keiser, M. J.; Setola, V.; Irwin, J. J.; Laggner, C.; Abbas, A. I.; Hufeisen, S. J.; Jensen, N. H.; Kuijer, M. B.; Matos, R. C.; Tran, T. B.; Whaley, R.; Glennon, R. A.; Hert, J.; Thomas, K. L.; Edwards, D. D.; Shoichet, B. K.; Roth, B. L. *Nature* 2009, 462, 175.

Report on enquiries from UK health professionals relating to tryptamines- Prepared for the ACMD by the National Poisons Information Service

Report on deaths involving tryptamines between 2009-2013- presented to the ACMD by the National Programme on Substance Abuse Deaths

Roth, B. L. *N. Eng. J. Med*. 2007, 356, 6.

Wilcox, J. Psychoactive properties of alpha-methyltryptamine: analysis from self reports of users. *Journal of Psychoactive Drugs*, 2012, 44:3, 274-276