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NOTHING ON THE BOTTLE

SYNTHETIC CANNABINOIDS IN E-CIGARETTES AND THE LIMITS OF REGULATING THE SUBSTANCE RATHER THAN THE DEVICE

Stavros Avgerinos · Tilman Fritsch

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This supplement series continues the monograph where the facts move faster than a book can. A supplement appears only when a new finding changes a recommendation – not when there is news. Each issue therefore opens with the section What changes in relation to the monograph, corrections to our own text included.

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SECTION 1

IN BRIEF

England has produced the first peer-reviewed measurement of where synthetic cannabinoids in seized e-cigarettes actually sit. The result is at once uncomfortable and useful for the German regulatory debate: what determines the risk is not the product category but the form factor. In unlabelled refill bottles these substances were found in nine out of ten samples; in single-use devices, in roughly two out of a hundred.

From this follows a proposition the research group states itself, and one that supports the central thesis of the monograph: banning the single-use form factor leaves the problem untouched and may shift use towards refillable devices, where the risk is many times higher. To regulate by product category is to regulate past the hazard.

The second finding concerns the substances themselves. Across the two years of sampling, the analyses identified not only six different synthetic cannabinoids but also THC, heroin, ketamine and MDMA – in a device that ranks among the most familiar everyday objects in the hands of minors. The individual finds are too rare and too dilute to support any finding about consumption; they are a finding about the form factor. Section 4 places the substances in pharmacological and toxicological context and states where the evidence ends.

The third finding concerns the route of supply. The simplest keyword searches on three platforms brought vendor accounts to light, and the younger a platform's user base, the higher the share of goods offered as 'THC' that probably contain something else. Two months later some three quarters of those accounts were still reachable – over a period spanning the date on which substantial content-moderation duties took effect under UK law.

For Germany this is not a prevalence finding. No comparable survey exists here, and the English figures cannot be transferred. What can be transferred is the regulatory lesson. Anchoring regulation in the capacity to endanger rather than in the product category, as Demand 3 of the monograph urges for the ongoing TPD3 procedure, now has a measurement behind it and no longer merely an argument from plausibility.

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TERMINOLOGY

German has three words for the same object, and the German edition of this supplement turns on the difference between them. E-Zigarette is the legal term: § 10(4) JuSchG and the German Tobacco Products Act speak of electronic cigarettes and electronic shishas. Vape is the everyday term of the target group. Verdampfer – vaporiser – is the descriptive term for what the law functionally means: a device in which liquid is vaporised by an electronic heating element and the resulting aerosol is inhaled. The German edition uses Verdampfer throughout and falls back on E-Zigarette only where the argument is made on the statute.
English has no neutral equivalent. Both studies on which this supplement rests use e-cigarette for every form factor, an unlabelled ten-millilitre bottle that has never been inside a device included. This edition therefore follows its sources and uses e-cigarette throughout – but the reader should notice what that word is doing. Naming the object after the product category imports the very category logic whose inadequacy is to be demonstrated here. An unlabelled ten-millilitre bottle with a refill tank is not a cigarette.

THE EVIDENCE BASE

Two surveys by the same research group at the University of Bath. The survey for the 2023/24 school year was published, peer-reviewed, in Addiction. The survey for the 2024/25 school year is so far available only as a preprint and is identified as such at every point in this supplement. Neither group declares any conflict of interest; funding comes from the United Kingdom's Engineering and Physical Sciences Research Council.

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SECTION 2

WHAT CHANGES IN RELATION TO THE MONOGRAPH

The monograph contains no statement on this subject that has become false. What changes is the evidential weight of two demands and the reach of one argument.

Demand 3 gains a measurement. For the German position on the revision of the Tobacco Products Directive, the monograph calls for regulation anchored in the capacity to endanger rather than in product categories. That was, until now, an argument of regulatory design. The English form-factor data now show, in a concrete case, that a category-based rule – here the ban on the single-use form factor – does not reduce the risk but may displace it.

Demand 1 is made more precise. It calls for nicotine-free imitation products to be captured on a technology-neutral basis. The English case shows why: the openness of the e-cigarette system to any liquid whatever is itself the product characteristic at which a regime must be aimed. At the same time, the text needs to state more sharply what § 10(4) JuSchG already achieves and what it does not – on which see Section 6.

Demand 4 acquires a second application. It is aimed at binding default settings for minors' accounts. The platform findings show the same mechanics in a further role: not only as a means of holding attention, but as a channel of distribution.

CORRECTIONS TO OUR OWN MATERIAL

Earlier working papers by the author cited the figures of the 2023/24 survey from the preprint: 596 samples from 38 schools, 16.6% positive samples, 28 positive schools. The peer-reviewed version gives 512 samples from 27 schools, 17.4% positive samples and 21 positive schools. Those papers likewise cited a share of 41% of 122 samples for the Welsh drug-checking service WEDINOS; the peer-reviewed version gives 41% of 211 samples for the period April 2023 to

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March 2024. The peer-reviewed version governs in each case.
A second correction concerns the 2024/25 survey. Its much-quoted headline figures – 1 933 samples from 114 schools, a regional mean of 12.9%, 9.5% pooled, and the form-factor shares with them – are pooled across both school years and already contain the previous year's data. The follow-up survey proper comprises 1 423 samples from 86 schools. Earlier working papers by the author, and much of the public reporting, attribute these values to the follow-up survey alone. Section 3.2 sets this right.

SECTION 3

THE FINDING: THE FORM FACTOR DECIDES, NOT THE CATEGORY

3.1 The 2023/24 survey – peer-reviewed

Cozier and colleagues examined 512 e-cigarettes and e-liquids that teachers at 27 secondary schools in England had seized during the 2023/24 school year under their usual procedures. The samples were collected without pre-selection through the police forces responsible. Two of the three regions were analysed in the laboratory by mass spectrometry and quantified by qNMR; the third, 84 samples, was tested on site with the research group's portable detector alone, because the samples remained with the police afterwards.1 Synthetic cannabinoid receptor agonists (SCRAs, below: synthetic cannabinoids) were found in 17.4% of samples and THC in 1.2%. Positive samples occurred in 21 of the 27 schools, that is in 77.8%. The median concentration was 0.42 mg/ml (interquartile range 0.77), with a maximum of 3.6 mg/ml.

A separately reported and deliberately biased sample from four further schools – 50 samples pre-sorted as suspicious – produced 32% positive findings. It served the authors as a cross-check and is to be kept apart from the unbiased survey.

Synthetic cannabinoids were not the only substances detected. The analyses identified six different members of this group – MDMB-4en-PINACA, MDMB-PINACA, ADB-BUTINACA, MDMB-BUTINACA, MDMB-INACA

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and 4F-MDMB-BINACA – and alongside them THC and, in a single sample, heroin at a concentration of 0.1 mg/ml, together with two synthetic cannabinoids in the same liquid. No further controlled substances were found in that year's material.

Form factor	Positive / examined	Share
Unlabelled bottles	36 of 40	90.0 %
Refillable devices	42 of 89	47.2 %
Labelled bottles	3 of 41	7.3 %
Single-use devices	8 of 342	2.3 %

2023/24 survey, peer-reviewed. Shares calculated by the author from the absolute figures published in Table 3 of that paper, and read throughout as the proportion of a given form factor that tested positive. Its form-factor columns sum to 512 samples; the running text of the paper gives 343 rather than 342 for single-use devices, which does not change the share. The percentages relate to all samples submitted, although only 454 of the 512 could in fact be analysed – a conservative choice by the authors.

A RESERVATION AGAINST OUR OWN FINDING

DThe portable detector with which the third region was tested has, on the authors' own statement, a limit of detection of 0.3 mg/ml for synthetic cannabinoids. Single-use devices in the same study show a median of 0.16 mg/ml, below that threshold – a median resting, it should be said, on only six quantified samples. In that region not one positive single-use device was found (0 of 37), and the authors expressly name the detector's limit of detection as a possible reason.

The consequence is that the already low single-use share is in part a threshold effect. Without that region the figure is 2.6% rather than 2.3%. The difference is small and does not change the ranking, but it belongs in the text because it cuts against our own thesis. For THC the same holds in the opposite direction: there the detector's limit is 5 mg/ml, so the reported share of 1.2% is more likely too low than too high. For completeness: five of the six THC detections come from that same region.

A second reservation, again the authors' own. Part of the positive findings in refillable devices lies at very low concentrations and in their assessment reflects previous rather than current

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use. The share of 47.2% therefore measures traces in the device, not necessarily a filled charge. That weakens the level of the figure, not its attribution to the form factor – traces arise only where something has been filled in.
And one reservation that points the other way. Seven of the eight positive single-use devices contained a quantity of e-liquid unlawful under UK law, more than two millilitres, and six of those came from a single school. Even the few single-use devices affected were therefore not compliant commercial products.

3.2 The 2024/25 survey – preprint, not peer-reviewed

This study requires a close reading of its Table 1, because its much-quoted headline figures are not what they are generally taken to be. The table expressly reports all of the group's sampling to date, the already published data of the preceding year included.2 Of the seven police force areas, three —London, South Yorkshire and Greater Manchester – carry the marker (23/24) and a footnote referring to Cozier et al. Only four areas are new: Merseyside, Devon and Cornwall, Essex and Lancashire.

The figures of 1 933 samples from 114 schools, a regional mean of 12.9% and a pooled value of 9.5% therefore cover both school years. The follow-up survey proper consists of 1 423 samples from 86 schools. Taking the four new areas alone gives a regional mean of 9.1% and a pooled value of 93 positive samples out of 1 423, that is 6.5%. The authors themselves note the fall against the previous year and attribute it to the wider selection of regions.

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Police force area	Year	Samples (schools)	Positive for SCs
London	23/24	156 (13)	36 — 23.1 %
South Yorkshire	23/24	270 (9)	40 — 14.8 %
Greater Manchester	23/24	84 (6)	14 — 16.7 %
Merseyside	24/25	207 (14)	2 — 1.2 %
Devon and Cornwall	24/25	255 (34)	14 — 5.5 %
Essex	24/25	746 (30)	19 — 2.5 %
Lancashire	24/25	215 (8)	58 — 27.0 %

Table 1 of the preprint. The three areas marked 23/24 are already published in Cozier et al. 2025. Range across all seven areas: 1.2% (Merseyside) to 27.0% (Lancashire).

The same applies to the form-factor values. The shares of 96.3% for unlabelled bottles, 21.1% for refillable devices, 5.7% for labelled bottles and 0.9% for single-use devices relate to all 1 933 samples; together they yield exactly the 183 positive samples of the overall table, and they therefore already contain the previous year's values.

A clean decomposition by year is not possible. For refillable devices the calculation yields some 41 positive samples out of 305, that is about 13%, against 47.2% the year before. For unlabelled bottles the same calculation yields 43 positive samples from only 42 bottles in the follow-up year. The discrepancy amounts to a single sample and is an inconsistency in the source, but it shows that the pooled values cannot reliably be resolved backwards.

What follows. The ranking of the form factors is the same in both years, and the distance between the open and the closed system remains wide: 21.1% against 0.9% across both years, about 13%against under 1% in the rough calculation for the new regions. The share for refillable devices does fall markedly, and more steeply than the pooled figures reveal. The argument of this supplement rests not on the level of any single share but on the ratio, and that ratio remains in double figures on any reading.

The figures for what was submitted are likewise regional means across all seven areas: single-use devices make up the largest share of the items seized at 61.9%, unlabelled bottles the smallest at 5.8%. Counting

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the visible unlabelled bottles predicts the share of positive samples in a sample set well (r = 0.962; p = 0.0005), which gives a monitoring tool of practical use – this correlation, too, is calculated across both years.

Specific to the year, and therefore unproblematic, are the concentration figures: a median of 0.65 mg/ml with a maximum of 3.7 mg/ml for 2024/25, against 0.42 and 3.6 the year before. The reservation set out in Section 3.1 does not apply here. In the follow-up survey everything was analysed by mass spectrometry and quantified by qNMR.

3.3 The device takes whatever is put into it

In the 2024/25 school year other classes of substance appeared for the first time: two samples contained ketamine and one MDMA, all from the newly sampled areas of Devon and Cornwall and of Lancashire and thus specific to that year, and all below 0.1 mg/ml and so at very low doses. Together with the heroin find of the previous year, the two surveys yield a range of substances that reaches beyond the group around which the public debate turns.

These individual finds say little about prevalence. They say something about the form factor. An e-cigarette is not a product for one particular substance but a device that takes up any sufficiently soluble substance and makes it inhalable. Which substance that happens to be is decided by the market, not by the legislator. That is precisely why a regulatory approach following a list of substances is structurally always a step behind, whereas an approach directed at the openness of the system itself works irrespective of what is filled in next.

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3.4 Social position – a contradictory picture

Both surveys find a positive relationship between the share of positive samples and the share of pupils eligible for free school meals, a British measure of social deprivation. They differ in its strength: 2023/24 gave $r = 0.65$ at $p = 0.003$, and 2024/25, on a wider data base, $r = 0.444$ at $p = 0.097$. The authors conclude that social deprivation does not on its own explain the regional differences. The common sharpening of this – that deprivation plays no part – is not supported by these data.

ASSESSMENT – SECTION 3

Established. In both surveys synthetic cannabinoids are concentrated in unlabelled refill bottles and refillable devices, while single-use devices are barely affected. The authors of the peer-reviewed study themselves conclude that the forthcoming UK ban on the single-use form factor will not appreciably affect their occurrence and could, as an unintended consequence, lead to a shift towards refillable devices. It is further established that across the two years THC, heroin, ketamine and MDMA were detected in seized material alongside synthetic cannabinoids.

The author's assessment, not a statement of fact. This is the clearest empirical evidence so far that regulation anchored in the product category can miss its target. It supports anchoring regulation in the capacity to endanger, as the Austrian amendment of 7 July 2026 does and as Demand 3 of the monograph requires for the German position on the TPD3.

Not established. Any transfer of these shares to Germany. Market structure, cannabis regulation and routes of supply differ, and both surveys rest on non-probability sampling, which the authors expressly name as a limitation. Nor is it established that heroin, ketamine or MDMA occur widely in e-cigarettes: these are four individual samples out of some 2 000 items examined.

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SECTION 4

THE SUBSTANCES AND THEIR EFFECTS

The following section places the substances actually detected in pharmacological and toxicological context. It does so not in order to paint a danger but because the regulatory question cannot be answered without it: it makes a difference whether an open e-cigarette system takes up a substance with a built-in ceiling of effect or one without.

4.1 Why the mode of delivery matters

Among minors the e-cigarette is not a marginal product but a normalised everyday object. In England in 2023, nine per cent of eleven- to fifteen-year-olds reported using e-cigarettes, and nineteen per cent of fifteen-year-olds alone; by comparison, three and seven per cent respectively smoked.3 A 2025 survey gives five per cent of eleven- to fifteen-year-olds and twelve per cent of sixteen- to seventeen-year-olds as current users.4

That is the decisive difference from every other form of consumption. A device that is flavoured, low in odour, socially inconspicuous and familiar lowers the threshold not for one particular substance but for any substance that will dissolve in it. The English samples come from secondary schools taking pupils from the age of eleven. The individual ages of those consuming were not recorded and cannot be derived from these data.

Indications as to age come from the clinical side. A case series from two British acute hospitals, covering seven analytically confirmed poisonings by MDMB-4en-PINACA from vaping devices, gives a median age of 17 years with a range from 14 to 37. On admission, 85.7% were agitated and 57.1% showed psychotic symptoms including hallucinations and delusions; in three cases the substance was the only one detected.5

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4.2 Synthetic cannabinoid receptor agonists

The substances detected were MDMB-4en-PINACA, MDMB-PINACA, MDMB-BUTINACA, ADB-BUTINACA, MDMB-INACA and 4F-MDMB-BINACA. They belong to the same chemical family and differ markedly in structure from the cannabinoids of the plant; what they share is the receptor target and nothing else. The term 'synthetic cannabis' is therefore misleading.

What matters pharmacologically is not 'stronger' but the nature of the receptor binding. THC is a partial agonist at the CB1 receptor: its effect reaches a maximum below what the receptor can deliver. Most of these substances, by contrast, act as full agonists and exhaust the receptor response.6 A full agonist too has a ceiling of effect – it simply lies higher. In practice this means a steeper dose-response relationship across the relevant range: the distance between the dose that works and the dose that harms is smaller, and one draw too many cannot be waited out as it can with cannabis.

Clinically this shows up as a different profile of symptoms. A retrospective cohort study across 36 centres in 24 countries between 2013 and 2020 found that, where exposure was to these substances alone, neuropsychiatric symptoms occurred significantly more often and admission to psychiatric wards more often, whereas exposure to cannabis alone was associated more often with cardiovascular symptoms.7 Documented effects include agitation, anxiety and panic, hallucinations, acute psychoses, seizures and loss of consciousness up to coma.

To this must be added that some of the metabolites are themselves active, and that several members of this group act in addition as selective inhibitors of monoamine oxidase A – a mechanism that has nothing to do with the cannabinoid receptor and that raises the risk of interactions.8 The composition also changes between one purchase and the next, without those consuming being able to tell. Strategies of dose reduction therefore do not work here.

As to the order of magnitude of the risk, there is a frequently cited estimate that the need for emergency medical treatment is some thirty times higher than with cannabis. It comes from a large international self-report survey and should be read with corresponding caution: self-selection and differing settings of consumption are not controlled for.9

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4.3 Heroin

In a single sample from the 2023/24 year, heroin was detected at a concentration of 0.1 mg/ml together with two synthetic cannabinoids.1 Heroin is an agonist at the μ-opioid receptor. What matters toxicologically is respiratory depression, which – unlike the intoxicating effect – knows no saturation and can set in at low doses in opioid-naive individuals. Inhalation produces a rapid onset of effect and makes self-regulation harder still.

4.4 Ketamine and MDMA

In the 2024/25 year, two samples contained ketamine and one MDMA, all below 0.1 mg/ml.2 Ketamine acts as a non-competitive antagonist at the NMDA receptor and produces dissociative states; what matters toxicologically with regular use is damage to the lower urinary tract together with cognitive impairment. MDMA releases serotonin, noradrenaline and dopamine; the effects of concern are hyperthermia, disturbances of fluid balance with hyponatraemia, and serotonin syndrome. Whether MDMA survives the thermal load in an e-cigarette intact to any relevant degree has not been investigated.

WHAT THE CONCENTRATIONS PERMIT – AND WHAT THEY DO NOT

Established. Established. Heroin, ketamine and MDMA were detected analytically, all at concentrations at or below 0.1 mg/ml. The authors of the preprint expressly classify the ketamine and MDMA findings as a very low dose compared with the customary use of these substances.
The author's assessment, not a statement of fact. At these concentrations a deliberate dose is barely plausible. Carry-over from shared filling or mixing equipment is the more likely explanation. That reading is not established – but if it holds, it matters more in regulatory terms than the find itself, because it points to uncontrolled small-scale manufacture in which nobody knows what will come along in the next batch.
Not established. That children or adolescents consume heroin, ketamine or MDMA through e-cigarettes to any appreciable extent. Four individual samples out of some 2 000 items examined will not carry such a statement. What they will carry is the statement about the device: it takes whatever goes into it, and nobody checks.

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SECTION 5

THE ROUTE OF SUPPLY: THE PLATFORM AS SHOP WINDOW

The 2024/25 survey includes a content analysis of three platforms carried out between June and August 2025. It forms part of the preprint that has not been peer-reviewed and rests on visual classification rather than chemical analysis; the authors point out that a test purchase by researchers is legally impossible in the United Kingdom.2

Searching directly for the relevant street terms produced 88 vendor accounts across all three platforms. That figure needs qualifying, and the authors qualify it themselves: such offers are almost always bound up with the sale of infused sheets of paper intended for the prison environment, and the authors expressly do not claim that this is liquid suitable for, or marketed for, an e-cigarette. For the question at issue here the figure therefore carries little. More revealing is the search for 'THC liquid': the share of offers that, on the classification criteria applied, probably contain synthetic cannabinoids is 12% on Facebook, 54.2% on Instagram and 67.5% on TikTok. The order follows the age profile of the platforms.

Feature	Finding
Funnelling into private channels	52% of the 203 accounts analysed
Links to external destinations	46.3%; of these Telegram 32.0%, Snapchat 8.9%
Postal service offered	11.9% of accounts
Median price	£30 per 10 ml – stated by only seven accounts
Still active after two months	74.7% (Instagram), 68.3% (TikTok)

The period of data collection spans 25 July 2025, the date on which substantial provisions of the United Kingdom's Online Safety Act 2023 became enforceable. The authors read the persistence of readily findable vendor accounts as evidence that the moderation systems are not meeting their duties proactively.

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TWO LIMITATIONS WE NAME OURSELVES

First, the classification 'synthetic cannabinoid' is here a visual judgement based on the form of the container, the appearance of the liquid and the price bracket – not analysis. The percentages denote presumed, not confirmed, classifications.
Second, the preprint contains three inconsistencies at this point. The passage on the longevity of accounts opens by referring to Instagram and Facebook before reporting values for Instagram and TikTok. The Instagram share for the 'THC liquid' search appears in Table 2 as 54.8% and in the concluding section as 54.2%; 54.2% is correct, since 45 of 83 accounts gives that value. And the form-factor values cannot be decomposed by year without contradiction (Section 3.2). None of this deprives the findings of their force, but all of it is reason to treat the figures as secure only after peer review.

On transfer to Germany the position is this. The Online Safety Act 2023 carries the British figures and those alone. For Germany and the Union the applicable instrument is Regulation (EU) 2022/2065, the Digital Services Act, and not the German Digital Services Act (Digitale-Dienste-Gesetz – DDG), which constitutes no more than the national implementing act. The relevant duties there are in particular those on the protection of minors and, for very large online platforms, those on risk assessment and risk mitigation.10

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Section 6

PLACING THE FINDING IN CURRENT GERMAN LAW

The finding touches three regulatory spheres that are regularly conflated in public debate.

Youth protection law. § 10(1) of the German Youth Protection Act (Jugendschutzgesetz – JuSchG) prohibits the supply of tobacco products and other nicotine-containing products, and of their containers, to children and adolescents in restaurants, retail outlets or otherwise in public; subsection (3) covers mail order. Decisive for the case at hand is subsection (4): subsections (1) to (3) apply expressly to nicotine-free products as well, such as electronic cigarettes and shishas in which liquid is vaporised by an electronic heating element, together with their containers.11 A nicotine-free e-cigarette thus falls under the same rules as one containing nicotine; for the loose refill bottle the reach of the provision is a matter of interpretation (see box). Infringements are subject to administrative fines under § 28(1) nos 12 and 13 JuSchG, with a maximum of €50 000. The reach is narrower, however, than the provision suggests at first sight: § 28(1) captures only those acting as the organiser of an event or as a trader. Subsection (4) extends this to persons over 18 who promote such conduct – but only in relation to no. 12, not to the mail-order provision in no. 13. Where a seventeen-year-old supplies a fourteen-year-old, § 28 does not apply. That is precisely the channel the platform findings in Section 5 describe.

AN OPEN QUESTION OF INTERPRETATION – AND WHY IT BELONGS HERE

§ 10(4) JuSchG captures nicotine-free vaping products and their containers. Not captured are nicotine-free imitation pouches, because in their case no liquid is vaporised by an electronic heating element. The gap in respect of nicotine-free imitation products described in the monograph therefore persists, but it is narrower than a blanket formulation suggests.
What is open is something else, and it concerns the very object of this supplement. The relative clause in subsection (4) attaches to the device – to the thing in which liquid is vaporised. Whether a separate bottle of nicotine-free liquid that sits in no device is a 'container' of such

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a product is thus not unambiguously answered. The purpose of the provision and the parallel with subsection (1), where the liquid is itself the product, speak for the wide reading; the wording speaks against it.

The author's assessment, not a statement of fact. This uncertainty is no marginal problem but is itself a regulatory deficit. The unlabelled ten-millilitre bottle is the form factor in which the finds are concentrated – and it is precisely for that form factor that coverage by youth protection law is a matter of interpretation. A statutory clarification would take few words and belongs in the product regime under Demand 1.

Narcotics and NPS law. Synthetic cannabinoids are captured as a substance group by the New Psychoactive Substances Act (Neue-psychoaktive-Stoffe-Gesetz – NpSG); they appear in its Annex 1 and are therefore substances within the meaning of § 2 no. 1(a). Individual members are additionally scheduled under the Narcotic Drugs Act (Betäubungsmittelgesetz – BtMG). The common talk of a 'grey area' or of 'legal highs' misses the legal position to that extent. The regulatory deficit here does not lie in the prohibition.12 A precise distinction must be drawn between prohibition and criminal liability. § 3(1) no. 1 NpSG prohibits, for these substances, trafficking, putting into circulation, manufacture, bringing into, out of or through the territory to which the Act applies, acquisition, possession and administration to others. The penal provision in § 4 NpSG, however, does not reproduce that prohibition in full: what is punishable is trafficking, putting into circulation and administration to others, together with manufacture and bringing into the territory for the purpose of putting into circulation. Acquisition and possession for personal use are prohibited but not subject to penalty; they are subject to administrative seizure. Among the aggravated offences is supply by a person over 21 to a person under 18.

Product law. This is where the deficit lies. The e-cigarette system is technically open: it accepts any liquid. Neither the admissibility of refillable form factors nor the sale of unlabelled empty bottles is tied under product law to any criterion of hazard. A ban on the single-use form factor – whatever the motive, environmental policy included and legitimate as that may be – does not address this point and, on the data available, may sharpen it.

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6.1 A German precedent from this year

The commonest objection to a product regime anchored in the capacity of the mode of delivery to endanger is that German law knows no such thing. Since 12 April 2026 that is no longer true.

The Act amending the New Psychoactive Substances Act of 7 January 2026, promulgated on 12 January 2026 and in force since 12 April 2026, brings nitrous oxide, gamma-butyrolactone and 1,4-butanediol under the NpSG and creates for them a new Annex 2 listing individual substances.13 What is remarkable is not the inclusion of these three substances but the technique of the rule.

The legislator works with two columns of properties and grades the depth of prohibition accordingly. Column 2 decides whether a substance or preparation counts as a new psychoactive substance at all; for nitrous oxide that is every preparation, for GBL and 1,4-butanediol only above a content of more than 20%. Column 3 decides at what point the full prohibition on handling under § 3(1) no. 1 applies – and what stands there for nitrous oxide is not a chemical property but a packaging specification: filling into containers holding more than 8.4 grams, and the supply of more than ten containers of up to 8.4 grams each in a single sale transaction.

Below that threshold nitrous oxide remains a new psychoactive substance but is subject only to the three subordinate prohibitions of § 3(1): no distance selling and no supply through vending machines (no. 2), no supply to persons under 18 (no. 3), and no acquisition or possession by minors (no. 4). These three prohibitions apply exclusively to substances in Annex 2, not to the substance groups of Annex 1. Exempted from them – and from them alone – are modes of delivery from which the substance can be extracted only at disproportionate effort, such as propellant permanently sealed into aerosol whipped cream.

A second point concerns enforcement and bears directly on Chapter 11 of the monograph – though differently from what one might at first assume. § 3(4) NpSG empowers the customs authorities, in the exercise of their functions under § 1(3) of the Customs Administration Act (Zollverwaltungsgesetz), to seize goods where there is reason to assume that they are new psychoactive substances brought into, out of or through the territory to which the Act applies contrary to subsection (1); the costs of seizure and safe custody are borne by the responsible person, several such persons being jointly and severally liable, and

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the costs may be recovered by administrative enforcement procedure.

This power is not new. The Government bill for the amendment expressly records, in its explanatory memorandum on § 3, that the existing subsections (3) and (4) are carried over unchanged, and the consolidated version contained subsection (4) before the amendment.12 Which act originally inserted it has not been conclusively established here; what is established is that it predates the amendment.

Therein lies the finding. The power of the customs authorities to seize new psychoactive substances unlawfully brought across the border has existed for years – and the gap in cross-border distance selling that Demand 1 of the monograph names persists alongside it. That is the definition of an enforcement deficit: what is missing is not the empowering provision but its application to the mass business of parcel post. The political core finding of the monograph is here established on the text of the law in force rather than asserted.

WHY THIS MATTERS FOR THIS SUPPLEMENT

Established. In 2026 the German legislator created a graduated system of prohibitions whose steps attach to container size, quantity supplied, route of distribution, age and extractability – and not to the identity of the substance alone.
The author's assessment, not a statement of fact. This disposes of the objection that anchoring regulation in the capacity to endanger is alien to the system, untried, or a peculiarity of Austrian practice. It is German law in force, adopted four months before this supplement appeared. What proved possible for nitrous oxide cartridges is not impossible for refill bottles and open e-cigarette systems.
What is new is the regulatory technique, not the enforcement power. The customs power in § 3(4) existed beforehand and was carried over unchanged by the amendment. To read the amendment as a step forward in enforcement is to misread it.
At the same time the amendment shows two limits. First, it responds to three substances by listing three substances; with the next molecule the procedure begins again. The advance lies in the technique of the rule, not in what the rule attaches to. Second, the penal provision in § 4(1) captures only contraventions of § 3(1) nos 1 and 2 – the two youth-protection prohibitions

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in nos 3 and 4 are left without any penalty, and the consolidated version confirms the wording 'contrary to § 3(1) no. 1 or 2'. The pattern is a familiar one: the prohibition stands, the enforcement does not.

THE POLITICAL POINT

In this case too, Germany has no deficit of rules; it has a deficit of a product regime and of enforcement. The supply ban stands; the criminal liability attaching to the substances stands. What is missing is a product regime anchored in the capacity of the form factor to endanger, and an enforcement practice that reaches cross-border distance selling and distribution through platforms.

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SECTION 7

CONSEQUENCES FOR THE FIVE DEMANDS

Demand	Change made by this supplement
1 – Enforce existing law and create a product regime	The technology-neutral inclusion of nicotine-free products is to be extended to the e-cigarette system itself: form factor, refillability and the sale of unlabelled empty containers belong in the product regime. The demarcation from § 10(4) JuSchG is to be stated more precisely in the text. That the same devices have also taken up heroin, ketamine and MDMA shows, at the same time, the limit of an approach built on lists of substances. The NpSG amendment of 12 April 2026 shows that a regime attaching to container, quantity supplied, route of distribution and age already exists in German law.
3 – A German position for the TPD3	Unchanged in substance, strengthened in its justification. Anchoring in the capacity to endanger can now be supported by a measured case in which a category-based rule displaces the risk instead of reducing it. The objection that such an approach is alien to German law has been overtaken by the NpSG amendment of 2026.
4 – Binding default settings	Unchanged in substance, strengthened in its justification. Anchoring in the capacity to endanger can now be supported by a measured case in which a category-based rule displaces the risk instead of reducing it. The objection that such an approach is alien to German law has been overtaken by the NpSG amendment of 2026.
2 and 5	Untouched.

One addition that goes beyond the five demands, and which is put as a suggestion rather than a demand: the English finding rests on the fact that seized material was analysed at all. In Germany there is neither a procedure nor a competence for this. A methodologically sound, anonymised analysis of seized devices following the English protocol would be possible at little cost and would create the evidential base that is currently missing.

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Section 8

THE INTERESTS BEHIND THE SOURCES

The Bath research group. Both papers declare no conflicts of interest and are publicly funded. It should nevertheless be stated that the group developed a portable detector for precisely this class of substance and used it, in one of the three regions of the 2023/24 survey, as the sole method of detection. A method of detection gains in importance when the problem is large. That does not devalue the data – the analysis is secured by mass spectrometry in two of the three regions, and the detector's limit of detection works in the direction of underestimation rather than overestimation – but it belongs on the record. See Section 3.1.

Official sources. Police reports reflect the intensity of investigation, not prevalence. They are valuable for reading the market and unsuitable for statements about prevalence. The fact that a police force area with high levels of drug crime showed the lowest share of positive samples likewise tells against any simple relationship.

The vaping industry. Its distinction between the legal nicotine product and the illegal black market is technically sound and is shared here. What is not shared is the exculpatory narrative drawn from it. That it is precisely the refillable form factor which serves as the vehicle is a finding about a product characteristic, not one about the black market alone.

Suppliers of semi-synthetic cannabinoids. They warn credibly against synthetic cannabinoids and, in the same text, position their own goods as a tested legal alternative. The sequence of prohibitions from HHC through THCP and H4CBD to 10-OH-HHC shows that 'legal today' says nothing about safety in this field.

OUR OWN POSITION

The first-named author is founding and honorary president of the German Society for Sports Dentistry and vice-president of the Austrian Society for Sports Dentistry and Medicine. Both authors are connected to the publishing institute as authors of earlier contributions.
A closer connection must be stated expressly. The second-named author belongs to the NAM

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> Institute, which publishes this supplement and assigns its DOI. Authorship and editorship therefore coincide in part. A monograph that takes the entanglement of commissioning party and evidence as its subject in Chapter 10 must disclose that in its own case first. No external peer review has taken place, and the legal check referred to in Section 6 is still outstanding.
> Anyone who works in prevention has a structural interest in a problem being large. Hence this: the supplement asserts no prevalence for Germany. It asserts that a regulatory approach would have failed in a measured case.

Section 9

WHAT IS EXPRESSLY NOT ESTABLISHED

There is no German survey of synthetic cannabinoids in e-cigarettes seized from schools. There are no nationwide figures on corresponding emergency admissions among adolescents. Regional clusters in police reports are reporting volume, not prevalence.

Further not established: irreversible brain damage from use by adolescents; the causation of individual deaths in which the authorities themselves write in the conditional; and the circulating claim that these substances are up to three hundred times stronger than cannabis, for which no primary source exists. The defensible statement is that most of these substances are full agonists at the CB1 receptor while THC is a partial agonist, and that the dose-response relationship is therefore steeper and less controllable across the relevant range.6 A full agonist too has a ceiling of effect; the common formula about a missing ceiling is pharmacologically imprecise.

Finally, confusion with the American wave of lung injury in 2019/20 is to be avoided. That was caused overwhelmingly by vitamin E acetate in black-market THC products – a different mechanism and a different market.

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ANNEX A

A FOUR-LEVEL ASSESSMENT OF THE EVIDENCE

The grid below separates what is established from what is plausible, simplified or open to challenge. It is intended as a working instrument and can be carried into presentations and briefing material unchanged.

Level 1 – well established

Statement	Basis
Synthetic cannabinoids in e-cigarettes at English schools are found overwhelmingly in refillable devices and unlabelled bottles, and barely at all in single-use devices.	Cozier et al. 2025, peer-reviewed; confirmed in the 2025 preprint, whose values are, however, pooled across both years – see Section 3.2.
A ban on the single-use form factor does not appreciably affect this occurrence.	Conclusion of the authors in the peer-reviewed study.
Most of these substances are full agonists at CB1; THC is a partial agonist.	Zagzoog et al. 2021; Dutta et al. 2022.
They are mis-sold as 'THC'.	Cozier et al. 2025; WEDINOS data, where purchase intent was not directed at these substances.
§ 10 JuSchG captures nicotine-free vaping products as well.	§ 10(4) JuSchG, as in force since 1 April 2016.
The e-cigarette system takes up changing classes of substance: alongside synthetic cannabinoids, THC, heroin, ketamine and MDMA were detected.	Cozier et al. 2025 (heroin, single sample); 2025 preprint (ketamine, MDMA).

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Level 2 – plausible, not conclusively established

Statement	Qualification
A single-use ban could increase exposure.	Logically derivable from the form-factor data; no evaluation since entry into force.
Distribution runs through platforms with funnelling into encrypted channels.	Preprint; visual classification rather than analysis; narrowly bounded in time; three platforms.
Occurrence is increasing in Germany.	Reporting volume and regional clusters; no representative survey.
Deprivation explains part of the regional differences.	Positive relationship in both surveys; significance inconsistent.
Part of the positive findings in refillable devices measures traces of previous use.	The authors' assessment in the limitations of Cozier et al. 2025. Affects the level of the 47.2% share, not its attribution to the form factor.
The very low single-use share in 2023/24 is in part a threshold effect.	In one of the three regions only the portable detector was used; its limit of detection of 0.3 mg/ml lies above the single-use median of 0.16 mg/ml. Without that region, 2.6% rather than 2.3%.
§ 10(4) JuSchG captures the loose, unlabelled refill bottle as well.	A question of interpretation. Subsection (4) extends subsections (1) to (3) to nicotine-free products 'and their containers'; the relative clause attaches to the device. Purpose speaks for the wide reading, the wording against it. See Section 6.

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Level 3 – common oversimplifications

Common statement	Correction
'Up to 300 times stronger than cannabis.'	No primary source. Receptor binding is not potency of effect and varies widely. Better: full agonism without the built-in ceiling of the partial agonist.
'A new drug.'	A new name, a known substance group, a new form of consumption.
'Synthetic cannabis.'	Misleading. No structural kinship with the plant, only the same receptor target.
'Legal highs, a grey area.'	Overtaken. The NpSG captures whole substance groups.

Level 4 – open to challenge on technical or legal grounds

Statement	Problem
'It causes irreversible brain damage.'	No sustainable evidence. Not to be used.
'X died of it.' (individual cases)	The authorities themselves write in the conditional; the assertion of causation will not hold.
'EVALI proves that vapes are dangerous.'	Two phenomena confused; EVALI rested overwhelmingly on vitamin E acetate.
'A flavour ban solves the problem.'	Addresses the appeal of the product, not the open architecture of the system.

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SOURCE APPARATUS

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9 Winstock A, Lynskey M, Borschmann R, Waldron J: Risk of emergency medical treatment following consumption of cannabis or synthetic cannabinoids in a large global sample. J Psychopharmacol 2015;29(6):698–703. Self-report data from the Global Drug Survey; self-selection and setting of consumption not controlled for. This is the source of the widely cited figure of a thirty-fold increase in treatment risk – not, as is occasionally cited, Craft et al. 2022, who describe the withdrawal symptom profile.

10 Regulation (EU) 2022/2065 of the European Parliament and of the Council of 19 October 2022 on a Single Market For Digital Services (Digital Services Act), OJ L 277, 27.10.2022, p. 1 – in particular Article 28 on the online protection of minors and, for very large online platforms and very large online search engines, Articles 34 and 35 on risk assessment and the mitigation of risks.

11 § 10 of the German Youth Protection Act (Jugendschutzgesetz – JuSchG) as amended by the Act on the protection of children and young persons against the dangers of consuming electronic cigarettes and electronic shishas of 3 March 2016 (Federal Law Gazette I p. 369) [in German], in force since 1 April 2016; administrative fines under § 28(1) nos 12 and 13 JuSchG.

12 New Psychoactive Substances Act (Neue-psychoaktive-Stoffe-Gesetz – NpSG) of 21 November 2016 (Federal Law Gazette Ip. 2615) [in German], in the version in force since 12 April 2026. Synthetic cannabinoids are captured as a substance group in Annex 1 and are therefore substances within the meaning of § 2 no. 1(a). For them only the prohibition on handling in § 3(1) no. 1 applies; the prohibitions in nos 2 to 4 concern substances in Annex 2 alone. § 4(1) makes trafficking, putting into circulation and administration to others punishable, together with manufacture and bringing into the territory for the purpose of putting into circulation; acquisition and possession are prohibited but not subject to penalty. What was checked was the amending act, not the consolidated version. On the fact that § 3(4) predates the amendment: Government bill, Bundestag printed paper 21/1504 of 8 September 2025, explanatory memorandum on § 3 [in German] – the existing subsections (3) and (4) are carried over unchanged.

13 Act amending the New Psychoactive Substances Act of 7 January 2026, Federal Law Gazette 2026 I no. 2, issued at Bonn on 12 January 2026 [in German]; in force since 12 April 2026 under Article 2. The provisions amended are § 1(2), § 2 no. 1, § 3 (replaced in full), § 4(1), § 6 first sentence and § 7; the former annex becomes Annex 1, and a new Annex 2 is inserted containing 1,4-butanediol, γ-butyrolactone and dinitrogen monoxide. Checked against the text as promulgated.

All figures in this supplement were verified against the primary sources named on 24 August 2026. The percentages for form factors in Section 3.1 are the author's own calculations from the published absolute figures.

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