



Commentary

Surrogate alcohol containing methanol, social deprivation and public health in Novosibirsk, Russia

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ABSTRACT

Surrogate alcohol, i.e. alcohol not intended or not officially intended for human consumption, continues to play an important role in alcohol consumption in Russia, especially for people with alcohol dependence. Among the different types of surrogate alcohol, there are windshield washer antifreeze liquids; these products are the cheapest kinds of non-beverage alcohol available and thus likely to be used by the most deprived and marginalised groups such as homeless people with alcohol dependence. Although it is well known, that non-beverage alcohol is used for consumption by various groups in Russia, and although there are laws to prohibit the use of methanol as part of windshield washer antifreeze liquids for the very reason that such products could be used as surrogate alcohol, we detected products in retail sale which were a mix of water and methanol only. Methanol poses serious health threats including blindness and death, and there had been repeated methanol deaths from surrogate alcohol in Russia over the last years. If law-enforcement does not change for surrogate products, we can expect more methanol-resulting deaths in the most deprived and marginalized groups of people with alcohol dependence in Russia. In addition, ingredients with questionable safety profiles such as formic acid should also be prohibited in non-beverage alcohol products that are likely to be consumed as surrogate alcohol.

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Unrecorded consumption, surrogate alcohol and Russia

Unrecorded alcohol continues to be a major part of alcohol consumption in Russia (Rehm et al., 2014, 2016; World Health Organization, 2014), despite some positive signs in overall and unrecorded alcohol consumption and mortality (Grigoriev & Andreev, 2015; Khaltourina & Korotayev, 2015; Neufeld & Rehm, 2013). Surrogate alcohol, i.e. alcohol not or not officially intended for human consumption, constitutes a major proportion of unrecorded alcohol for definitions see Lachenmeier, Gmel, and Rehm (2013); for impact of surrogate alcohol on Russia see Bobrova et al. (2009) and Rehm et al. (2014). While the major cause for

health burden stemming from surrogate alcohol, and from unrecorded consumption in general, still is ethanol (Rehm et al., 2014; Rehm, Kanteres, & Lachenmeier, 2010), there are exceptions (Solodun et al., 2011) and this short report gives a recent example from an ongoing study on unrecorded consumption.

The Novosibirsk study on unrecorded consumption

The Novosibirsk longitudinal study on unrecorded consumption uses a multi-methods approach to explore drinking patterns of unrecorded alcohol over time, and relevant links to alcohol-related harm in a clinical population. As part of the study, semi-structured in-depth expert interviews have been conducted with patients of two state-run inpatient narcological clinics (detoxification and rehabilitation units for people with substance use disorders) in the Siberian city of Novosibirsk, followed by a complementary document analysis of their medical records. The

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interview part of the study has been planned for the period 2015–2017 with a sample size of 60 participants diagnosed with alcohol dependence. We included all the patients present at the time of assessment, so the sample can be seen as a census for these specific time periods. During the first study phase between June 2015 and January 2016 a total of 40 participants (25 males and 15 females) were interviewed, while the ongoing survey phase in July 2016 aims to include 20 more participants to complete the baseline assessment. In the initial baseline interview, patients were asked about volume and patterns of drinking, usually consumed recorded and unrecorded beverages, and the self-perceived connections between the consumption of different types of alcohol, unrecorded alcohol and alcohol-related harm, as well as socio-economic and situational factors involved. In addition, sociodemographic indicators, medical diagnoses and further alcohol and health-related information from the patient files were collected. The interview focused specifically on the participant's personal experiences with different types of unrecorded alcohols: for instance price and availability of different unrecorded products, the typical selling locations and purchasing scenarios as well as common consumption situations. In addition, sociodemographic indicators, medical diagnoses and further alcohol and health-related information from the patient files were collected. Patients with repeated hospitalisation will be interviewed in several follow-ups to document the long-term course of their alcohol use disorder and the general state of health, and changes in the drinking variables listed above as well as in socio-economic factors. For major types of unrecorded alcohol, samples were collected. One of the main results already apparent from the baseline interviews was consumption of successively cheaper unrecorded beverages with level of marginalization. Samogon, i.e., artisanal distilled moonshine, smuggled and counterfeit alcohol were used by different socio-economic classes including by people not dependent on alcohol; diluted industrial alcohol was mainly used by people with alcohol dependence from lower classes, but often by people who still had employment and sought treatment; and the cheapest medicinal and industrial alcohols such as windshield washer fluids were only consumed by the most marginalised dependent people, often no longer in the treatment system.

Chemical analyses of surrogate samples

For the samples collected of the relevant types of unrecorded beverages, a chemical analysis was conducted, using nuclear magnetic resonance (NMR) spectroscopy, Fourier transform infrared (FTIR) spectroscopy and gas chromatography for details on methodology see [Lachenmeier et al. \(2011\)](#) and [Monakhova, Kuballa, and Lachenmeier \(2012\)](#). The inclusion criteria for the analysed samples were based on the interview material as well as on the results of our previous qualitative study on unrecorded alcohol in Russia ([Neufeld, 2015](#)). Additionally, a separate list of alcohol surrogates was created by the patients, who have been consuming surrogates themselves. The identified types of unrecorded alcohol were purchased based on the general descriptions of sales points given in baseline interviews in June and September 2015 and January 2016, parallel to the interview study. We included unrecorded alcohol types, which were reported to be consumed by the patients themselves (first hand accounts) as well as unrecorded products consumed by other members of the participant's communities (eyewitness accounts). Since unrecorded alcohol was reported to be widely common and generally available in Russian communities, the identified types of unrecorded alcohol were purchased following the convenience sampling method in Novosibirsk, including locations from the city center as well as areas of close proximity to the interview

locations. Additional samples were collected in nearby cities and settlements.

A total of 86 samples of unrecorded alcohol were collected in the reported typical selling spots such as pharmacies, kiosks, shops, taxi cabs and private homes. The sample included 56 different surrogates (mainly cosmetic products and medicinal compounds as well as non-beverage alcohol), 15 homemade beverages (samogon, homemade wine and other fermented beverages), 5 smuggled spirits (Kazakhstani vodkas and cognacs) and 6 (possible) counterfeits as well as 4 obvious counterfeits from an online shop. Toxicological evaluation of the sampled surrogates revealed that none of the analysed cosmetic or medicinal alcohols such as alcohol-based colognes, tinctures, mouthwash, skin antiseptics etc. exceeded the limits regarding potential health threats proposed by the Alcohol Measures for Public Health Research Alliance project ([Lachenmeier et al., 2011](#)).

Results of the chemical analyses

It is of note that the two compounds that were judged to be of health relevance in our last sample in Russia in 2011, diethyl phthalate (DEP) and polyhexamethyleneguanidine hydrochloride (PHMG) ([Solodun et al., 2011](#)), were not detected in any of the 2015 or 2016 samples. However, alarming proportions of methanol were found in six collected samples of windshield washer antifreeze fluids, with concentrations of 7%, 26%, 26%, 27%, 28% and 48%, respectively. All of the products were bought in regular retail sale in Novosibirsk or were obtained directly from local car owners and should have contained isopropyl alcohol according to the declaration of the listed ingredients (isopropyl alcohol was not detectable in the samples, however). The products were pure water-methanol mixtures). Moreover, in five of the products a claim "Does not contain methanol" was featured on the label. Methanol is a highly toxic alcohol, which can cause serious disability (e.g. blindness or movement disorders) or death, with lethal doses starting as low as under 100 ml ([Lewis et al., 2011](#); [Vale, 2007](#)).

In addition to the methanol problem in certain surrogate alcohols, the occurrence of formic acid was observed in some of the alcohol-containing medicinal products, which had been used as surrogates. According to the label, the products should have contained 1.4 g/100 g formic acid, while our analyses found only 1.1 g/100 g formic acid in the products but 0.5 g/100 g of ethyl formate (the ethyl ester of formic acid). The ester is formed when formic acid reacts with ethanol, which is contained in abundance in the medicinal alcohol samples (about 65% volume of alcoholic strength). Ethyl formate is a principal flavour compound of rum and raspberry ([Panda, 2010](#)). It can be speculated whether the formic acid may be indirectly used to make the taste of the products more palatable. Interestingly, the formic acid alcohol is mainly consumed by people with severe alcohol dependence in withdrawal state (according to own interviews of pharmacists during sampling). It was the cheapest medicinal alcohol available in the region sampled, and it comes in 50 ml flacons.

The Joint FAO/WHO Expert Committee on Food Additives (JECFA) has suggested a group acceptable daily intake (ADI) for formic acid and ethyl formate of 3 mg/kg bodyweight per day ([The Forty-ninth Meeting of the Joint FAO/WHO Expert Committee on Food Additives \(JECFA\), 1998](#)). For a 60-kg person, this would be 180 mg per day. For the surrogate alcohol containing 1.4 g/100 g (sum of formic acid and ethyl formate, expressed as formic acid), approximately 13 g (about $\frac{1}{4}$ of a bottle) need to be consumed to exceed the ADI. It should be noted that the JECFA ADI is conservatively estimated using safety factors of 100, so that acute toxic effects are not expected even at this level of intake. Serious formic acid poisoning (reversible intravascular coagulation and acute renal failure) was only observed following intake of 30 g of

formic acid or more, and high mortality (14 out of 15 patients) was recorded for ingestion of 45–200 g of formic acid (Jefferys & Wiseman, 1980). However, with usual consumption patterns for unrecorded alcohol, lethal levels of intake for formic acid do not seem to be likely reached.

The legal situation for using methanol in windshield washer fluids

The use of methanol as an ingredient for windshield washer fluids is prohibited by two laws in the Russian Federation; the resolution of the Russian Ministry of Health from May 2000, banning the use of methanol-based windshield washer fluid (Ministry of Health, 2000) and the resolution of the Chief Sanitary Inspector of Russia from July 2007 (Onishchenko, 2007), banning methanol-based motor-service fluids in general. In the first resolution the health risks caused by methanol are explicitly mentioned in connection to socially deprived homeless people. Apparently, there are still many methanolic antifreeze and washer fluids circulating on the Russian market, in spite of this long-lasting legal prohibition. News reports on counterfeit methanol-based antifreeze appear regularly throughout Russia, which points to a systematic market presence, rather than individual cases of violations. For instance, the online news agency “m24.ru” reported 14 different cases of illegal production and sale of methanolic antifreeze for the period 2013–2016, each case ending with a confiscation of several tons of the dangerous product (M24.ru, 2016). Some online sources report that counterfeit antifreeze and washing fluids remain highly popular in Russia due to the cheap price and certain chemical properties; methanol-based products have a lower freezing point than the legal isopropyl-based products and are less odor intensive (Karavaev, 2013; Kryuchkov & Sanin, 2013).

Potential health consequences of surrogate alcohol

As indicated above, methanol is a highly toxic substance, and consumption of liquids containing methanol with more than 2% bears a considerable risk of morbidity and mortality which of course increases with higher content of methanol (Paine & Dayan, 2001). According to our interview material, the consumption of antifreeze fluids is strongly associated with severely dependent drinkers, mostly impoverished lower social class individuals and homeless people, who do not get any treatment for their alcohol dependence. However, none of the interviewed patients indicated that they had consumed antifreeze fluids themselves, fearing the toxicity of the unknown ingredients since they believed the listed ingredients were unreliable and they feared toxic components. Moreover, some participants stated that they were familiar with the risks associated with methanol-based antifreeze fluids, including cases of methanol poisonings from vaporised windshield wiper in the car cabin.

Antifreeze windshield washer fluids was the cheapest surrogate available, being less than 1/15 of the price of the cheapest legal vodka. Other surrogates such as non-beverage alcohol, medicinal tinctures and cosmetic lotions were usually 1/3 or 2/3 of the cheapest vodka price. The low price makes antifreeze attractive to people from the lowest socio-economic status, who may no longer care about the associated risks or for financial reasons have no alternative for alcoholic beverages, and who are no longer part of the social and medical system, either with no access to state run health services or with no intention to use them. For instance in January 2016, in Novosibirsk six homeless people were hospitalised with severe methanol poisoning after consumption of counterfeit antifreeze, five of whom died subsequently (NTV.ru, 2016). Previous cases of deadly poisonings with methanol-based antifreeze were reported in

different regions of Russia on a regular basis and the affected consumers were predominantly unemployed or very poor working class people from the countryside (Interfax.ru, 2011; Kosorukov, 2015; Rogozina, Perova, & Astafev, 2015).

It should be mentioned that methanol containing windshield fluid also may incorporate hazards for the car drivers and passengers as methanol concentrations in the air of the passenger cabin in excess of 1000 ppm were recorded following the use of such products (Becalski & Bartlett, 2006). This exceeds for example the workplace limit value of 200 ppm (The MAK Collection for Occupational Health and Safety, 2012).

Conclusions

While the impact of ethanol remains the main public health problem associated with unrecorded consumption in Russia and elsewhere (Rehm et al., 2014), deadly methanol poisonings with illegal antifreeze used as a surrogate for alcoholic beverages are still happening in 2016. The numbers of death are likely to be underestimated, since they occur most commonly in socially excluded marginalised individuals (homeless, unemployed), where causes of death may not be recorded with the same accuracy as in other populations. These deaths are completely preventable, if existing laws banning the use of methanol were enforced. We are hopeful that our notification to the responsible authorities will result in stricter control of non-beverage alcohol, which is known to be used as surrogate by marginalised populations because of its price. Ingredients with questionable safety profiles such as formic acid should also be prohibited in alcohol products that are likely to be consumed. However, enforcement of the ban of methanol-based antifreeze fluids is the most important public health measure at this point.

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Conflict of interest

None declared.

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