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LETTER TO THE EDITOR

Metal and bacterial contamination of illicit drugs

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Dear Editor-in-Chief

We read with great interest the article by Aghababaei et al. [1]. It is a valuable study that furthers the significant base of literature on contamination of illicit drugs. We wish to comment on several aspects of the study, and to evaluate the methodology and findings in the context of prior work.

The reasons for intentional drug contamination are diverse, including bulking or enhancement of drug effect. Unintentional contamination may follow manufacturing impurities or storage effects. Occasionally, the reasons for contamination are unclear, such as the recent outbreak of brodifacoum tainted synthetic cannabinoids in the United States [2].

Metal contamination of illicit drugs has been understudied, in part because many analyses have used techniques intended to detect volatile compounds, or utilized liquid chromatographic techniques without specifically evaluating for metals. Prior reports have investigated metals in methamphetamine, cannabis, heroin, opium, and several other drugs. Among those substances, reports have variably detected aluminum, cadmium, calcium, lead, zinc, and numerous other metals [3–5]. We applaud Aghababaei et al. for their use of graphite furnace atomic absorption spectrophotometry, though the authors do not explain their reasoning to specifically measure cadmium, chromium, and lead, and to exclude other metals. The authors provide estimates for Daily Intake of Metals, which is a worthwhile exercise, however it fails to consider several factors that may affect metal bioavailability, such as form of metal, nutritional status, and route of administration.

Lead has been found in a number of illicit substances previously, and has been detected as an opium contaminant in Iran [6–8]. Prior research has shown higher blood lead levels in opium dependent patients compared with controls, particularly with oral route of administration [9, 10]. Lead absorption is affected by several other factors. Fasted state likely affects bioavailability, with a small study suggesting oral lead bioavailability as 8.2% with food, versus 35% fasted. Lead has a low melting point, so the heat of smoked opium may affect the amount of lead inhaled. Aghababaei et al. do not speculate on the association between route of opium use and absorbed lead, however it is worthwhile to recognize route as a factor affecting lead absorption. It is not stated whether the lead detected in these samples was organic or inorganic; we expect it was likely inorganic based on methodology, similar to other studies. Organic lead compounds are known to have different bioavailability and toxicity profiles, and the presence of organometallic compounds in drugs is poorly studied.

It is noteworthy that Aghababaei et al. found several times the amount of chromium in tested drug samples, by weight, compared with lead. There is a paucity of information on chromium contamination of illicit drugs; it has previously been detected in cocaine and heroin, and atomic absorption spectrophotometry has been utilized [11]. The authors reference the important clinical distinction between hexavalent and trivalent chromium, but do not comment on valence of detected chromium, or the valence of spiked chromium.

A fascinating and alarming point in Aghababaei's report is the prevalence and characterization of bacterial contamination in tested illicit drug samples. The detection of 6 bacterial species puts users at risk for rare and atypical infections. It is often difficult to distinguish the etiology of clinical infection as microbial drug contamination, as opposed to unsterile preparation and injection. As the authors point out, infection has been previously documented from several of these bacteria in drug users. *C. novyii* and *C. sordelli* has previously caused infection in drug users, but was not detected in these samples [12]. Furthermore, drug users may have increased susceptibility to infection secondary to poor nutritional status, drug effect, or other contaminants. For example, lead has several immunosuppressive mechanisms, affecting both cellular and

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humoral immunity [13, 14]. Opium users have also been shown to have an increased overall risk for infection (adjusted hazard ratio 5.47) [15]. Fungal contamination was not tested for in this study, and there is a scarcity of data on fungal drug contamination beyond cannabis [16].

In summary, we believe Aghababaei's article add valuable data to the important research area of drug contamination. Future research can examine contamination of further drug types, can assay for additional metals, organometallic compounds, and chromium valence, and can correlate for biologic effect.

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