Concentrations of Heavy Metals in Wastewater of One of the Largest Dentistry Schools in Iran

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Wastewater of dental units, due to the use of amalgam, chemical solutions for radiographic film processing, prosthetic appliances, *etc*, contains various heavy metals including mercury, silver, nickel, lead, copper, chromium, and cadmium. All these heavy metals are hazardous to health and regulatory limits have been set to control them.[1]

In a study for evaluating the waste stream of dental offices in Seattle, USA, the authors reported concentrations of nickel <400 µg/L, cadmium <14 µg/L, copper 19 000 µg/L, mercury 150 µg/L, and lead <300 µg/L, and concluded that most of the samples have mercury and copper above the local discharge limits.[2] Shraim, *et al*, studying wastewater of three public dental clinics in Madinah, Saudi Arabia in 2009, found the concentrations of copper 10 000 µg/L, mercury 5300 µg/L, and lead 600 µg/L, to be much higher than the local permissible limits.[3]

Schools of dentistry, due to the high workload of clinical dental activities with a large number of dental units, have a substantial contribution to waste production. We therefore conducted this cross-sectional study to evaluate the concentrations of heavy metals in wastewater of the Dentistry School of Shahid Beheshti University of Medical Sciences, Tehran, Iran.

In this dentistry school, wastewater of 253 dental units arrives into two buffer tanks and then discharges to an absorption well. All dental units are equipped with filters that prevent big particles from entering the wastewater pipes. The buffer tanks have also amalgam separators. The process of data collection included convenient sampling of 16 samples taken from the wastewater of the outlet of the buffer tanks once every two weeks during four months, from April to July 2018, plus one sample taken from the inlet water to the dental units of the school.

The samples were collected in a 500-mL plastic container and immediately transferred to the laboratory. At the first stage, 2.5 mL of nitric acid was added to the 500 mL of the wastewater sample; 100 mL of this solution was then subjected to 5 mL of hydrochloric acid and kept in a steam bath for 15 min. Concentrations of mercury, lead, cadmium, nickel, and copper were measured using direct air-acetylene flame atomic absorption spectrometry by a Hach® DR5000 spectrophotometer.

The Ethics Committee of Shahid Beheshti School of Dentistry approved this study. Due to the budget restriction, sampling of mercury was performed only one time through the four months.

The difference between the metal concentrations in the inlet water and wastewater reflected an approximate added metal to the environment due to dental practices. The concentration difference for lead was

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Table 1: Mean (SD) concentrations of five heavy metals measured in the inlet water and wastewater of the dental school studied, along with the maximum permissible limits for the metals set by the US Environmental Protection Agency (EPA)[4] and Iran Department of Environment (DOE). The unit of measurement is µg/L.

Heavy Metal	Inlet water	Wastewater	US EPA	Iran DOE
Lead	2.9	110.6 (16.5)	2000	1000
Copper	76.5	663.5 (469.1)	6000	1000
Cadmium	0.45	53.3 (6.1)	1500	100
Nickel	5.1	91.1 (28.1)	4000	2000
Mercury	0.1	9	2.6	<1

107.75 µg/L; copper, 587; cadmium, 52.8; nickel, 86.2; and mercury 8.9. The concentrations of the metals, but mercury, were below the maximum permissible values (Table 1).

We found that although practice of dentistry in this school adds some heavy metals to the environment, the amount is still below the permissible levels for lead, copper, cadmium, nickel; however, we need to have more control on the safe disposal of mercury.

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