



Exposure and cancer risk assessment for formaldehyde and acetaldehyde in the hospitals, Fortaleza-Brazil

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ABSTRACT

The levels of internal and external concentrations of formaldehyde and acetaldehyde, as well as occupational risk based on individual exposure to and potential carcinogenic effects of these, were evaluated in eight environments of two hospitals in the city of Fortaleza-CE during September and October of 2009. The results depicted a variation of 1.98–24.87 $\mu\text{g m}^{-3}$ formaldehyde and of 9.38–55.10 $\mu\text{g m}^{-3}$ acetaldehyde; the main sources of emissions were internal. The exposure levels showed values above the allowable limits for some of the environments studied (permissible exposure limits estimated as an 8-h time-weighted average (PEL-TWA)). The estimation of total cancer risk is of a similar magnitude to other studies, and the risk is 12–18% greater for women than men.

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1. Introduction

Air pollution and how to control it has been extensively researched in recent decades and is now a major topic in environmental preservation, particularly with regard to human health. However, air pollution is not limited to the outdoors. Air pollution can be significant in occupational and home ambient air [1–4].

In the case of hospital environments that have intensive care units (ICU), neonatal units (UTN) and surgical sites (SC), air quality can exert a direct influence on the health and recovery of patients, as well as the occurrence of infections, thereby endangering the patients and employees of those establishments [5].

According to Wilburn [6], a complex mixture of chemicals circulates in hospital air, and the chemicals are recycled through heating, ventilation and air conditioning, which can function as a vehicle for disease transmission.

Some of the main chemicals present in air from hospital environments are carbonyl compounds (CCs), specifically formaldehyde

and acetaldehyde, which are present in materials used in routine cleaning and disinfecting supplies, sterilizing materials, chemical reagents, furniture, paints and construction materials [7–10]. These compounds are described in the literature as strong depressors of human health, due to high toxic and carcinogenic potentials [11,12]. Chronic exposure to formaldehyde causes cancer, and epidemiological studies show adverse effects on allergies and the respiratory system [13,14]. Acetaldehyde, however, is a potential carcinogen in humans and can cause irritation to skin, eyes and nose [15,16].

Because of the toxic nature of these compounds, some international agencies have established maximum exposure levels of formaldehyde and acetaldehyde in occupational environments. According to the organizations OSHA [17] and NIOSH [15], permissible exposure limits (PEL-TWA) for formaldehyde are 930 $\mu\text{g m}^{-3}$ and 20 $\mu\text{g m}^{-3}$, respectively, for an eight-hour workday. The exposure limits for acetaldehyde are 360,000 $\mu\text{g m}^{-3}$ and 180,000 $\mu\text{g m}^{-3}$, respectively.

In Brazil, the Regulatory Norm of January/2003 N° 09 [18], which establishes reference standards for indoor air quality in climate-controlled environments for public use and a value suggested by Aquino Neto and Brickus [19] are the main reference values for Brazilians. The scope of the regulatory standard N° 09 applies to hospital environments, but does not establish any standards or exposure

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