

# Secondary Exposure of Family Members to Cyclophosphamide After Chemotherapy of Outpatients With Cancer: A Pilot Study

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**A**ntineoplastic drugs treat malignant tumor cells, but they also affect normal cells, leading to adverse effects. Healthcare workers such as the pharmacists and nurses who prepare or administer these drugs are aware of the risks of occupational exposure. The adverse effects of occupational exposure to antineoplastic drugs include acute symptoms such as allergic reactions (Kusnetz & Condon, 2003; Walusiak, Wittczak, Ruta, & Palczynski, 2002), genotoxicity (Burgaz et al., 2002; McDiarmid, Oliver, Roth, Rogers, & Escalante, 2010), teratogenicity (Hemminki, Kyyronen, & Lindholm, 1985; Meirow & Schiff, 2005), reproductive effects (Cardonick & Iacobucci, 2004; Fransman et al., 2007), and carcinogenicity (Althouse, Huff, Tomatis, & Wilbourn 1979; Skov et al., 1990). Therefore, measures should be taken to prevent occupational exposure to these drugs.

The people at risk for exposure to hazardous drugs are not only the healthcare workers who directly handle them, but also those who come in contact with the contaminated body excreta of patients with cancer. Those who do not directly handle drugs, such as volunteers, dietitians, and oncologists, also are at risk for exposure to drugs in the healthcare environment (Hon, Teschke, Demers, & Venners, 2014). Variable amounts of antineoplastic agents and their metabolites are excreted in the urine, stool, sweat, and other body excreta of patients receiving these drugs (American Society of Hospital Pharmacists [ASHP], 1990; Polovich, 2011).

Caregivers are at a higher risk for indirect drug exposure because they generally do not wear personal protective equipment (Nygren & Lundgren, 1997). Exposure to antineoplastic drugs can occur during routine nursing tasks; levels of drugs have been detected in patients' bedding and sweat (Fransman, Vermeulen, & Kromhout, 2005). A study comparing different sources of exposure in nonhospital environments demonstrated that workers dealing with contaminated hospital laundry were exposed to antineoplastic drugs

**Purpose/Objectives:** To measure the total amount of cyclophosphamide (CPA) excreted in the urine of patients with cancer and their cohabitating family members seven days after CPA administration.

**Design:** Biological monitoring.

**Setting:** Home setting with outpatients receiving chemotherapy.

**Sample:** 8 patients administered CPA, 10 cohabitating family members, and 10 control participants.

**Methods:** During the first seven days after CPA administration, urine samples were collected from the participants. The samples were analyzed for the unchanged form of CPA using gas chromatography in tandem with mass spectroscopy.

**Main Research Variables:** CPA levels.

**Findings:** CPA was detected in 112 of 276 patient urine samples. The last sample containing detectable CPA levels was collected after more than 48 hours in 63% of the patients, with a maximum length of five days post-treatment. In addition, 243 urine samples were collected from family members, and CPA was detected in the samples of five family members (17–252 ng per member). CPA was not detected in any control participants.

**Conclusions:** These findings indicate that family members in close contact with patients receiving CPA are at high risk for drug exposure as many as seven days post-treatment.

**Implications for Nursing:** Nurses should educate patients and their family members about preventing exposure to antineoplastic drugs in the home setting.

**Key Words:** drug exposure; chemotherapy; cyclophosphamide; family member

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through inhalation. In addition, they were exposed through their skin while cleaning toilets and washing patients in patients' homes and nursing homes (Meijster, Fransman, Veldhof, & Kromhout, 2006). These findings suggest that family members living with patients with cancer also are potentially at risk for exposure to antineoplastic drugs.