

# Administration of Anticancer Drugs: Exposure in Hospital Nurses

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## ABSTRACT

**Background:** Even though anticancer drugs are prepared in dedicated pharmaceutical units, nurses remain exposed to cytotoxic agents during administration to patients.

**Objective:** The aim of this study was to assess this occupational exposure during the intravenous line-purging procedure at the patient's bedside before administration in oncology departments.

**Methods:** This prospective study was conducted over a 4-week period in the hematology and oncology departments at a university hospital. Amounts of doxorubicin and cyclophosphamide on the surface of nurses' gloves were measured after the intravenous line purge of the infusion bag and the connection to the patient. For this purpose, gloves were washed with sterile water, following a validated procedure. Quantification of the 2 drugs into the water was performed using LC-MS/MS.

**Results:** After 59 chemotherapy administrations, 30.5% of gloves were contaminated. Despite extremely low volumes of contamination (0.08–6.28  $\mu$ L), amounts collected ranged from 190 to 2500 ng per pair of gloves that tested positive for doxorubicin (median, 1600 ng) and from 130 to 32,600 ng with cyclophosphamide (median, 2700 ng).

**Conclusions:** The intravenous line purge preceding antineoplastic infusion bag administration is a potential source of contamination in nurses. Contaminations

appear to be invisible but frequent (in >30% of cases). Therefore, intravenous line purging performed under appropriately safe conditions should be mandated in pharmaceutical units dedicated to injectable-drug preparation. This measure should be included as a standard hospital practice as a matter of urgency. (*Clin Ther.* 2014;36:401–407)   2014 Elsevier HS Journals, Inc. All rights reserved.

**Key words:** antineoplastic, intravenous line purge, nurses, occupational exposure.

## INTRODUCTION

Aside from their curative effects, the widespread use of antineoplastic agents in the treatment of cancer has led to an increased concern of handling these drugs by the pharmacy team, nurses, and physicians because of their potential carcinogenic, mutagenic, and/or teratogenic effects in humans.<sup>1</sup>

During the past 20 years, safety standards have been issued to protect health care workers.<sup>2,3</sup> In chemotherapy preparation, one of the first measures of preventing exposure in health care workers is to

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centralize the preparation of cytotoxic drugs in pharmaceutical-preparation units, using specific guidelines, appropriate organizational measures, and specialized technical equipment, such as vertical laminar airflow safety hoods, or isolators, and protective clothing, including double pairs of gloves. For the administration step, gloves must be worn by nurses at all times when hazardous drugs are being handled. Although these guidelines are advanced to reduce workers' exposure, recent studies have shown that recommendations were not always applied<sup>4-6</sup> and that workplace contamination<sup>4,5,7-10</sup> and occupational exposure have decreased but are still present. Worker exposures have been assessed by studies of biological markers. Cytogenetic effects, such as mutagenic activity in urine, micronucleus induction, chromosomal aberrations, and sister-chromatid exchanges, were reported.<sup>6,11-13</sup> More recently, early DNA damage revealed with single-cell gel electrophoresis (Comet-Assay, Trevigen Inc, Gaithersburg, Maryland) were shown in health care workers handling antineoplastic drugs.<sup>4,6,9,13-16</sup> Moreover, potential various acute (short-term) and chronic (long-term, eg, cancer) effects of residual exposure to hazardous drugs have been described in several epidemiologic studies.<sup>17-20</sup>

Although both the pharmacy team and nurses were regularly handling antineoplastic drugs, studies showed lower frequencies of genetic damage in pharmacists versus nurses,<sup>4,11,16</sup> which could be explained by greater protective measures applied by pharmacists versus nurses, for whom gloves were the only protective measure employed.<sup>11</sup> The procedure of purging the line with antineoplastic solution by nurses just before infusion-bag administration to patients was identified as a potential source of contamination, as has been the aerosolization or spilling of anticancer drugs. This route of contamination has been quantified in only 1 study.<sup>10</sup> The procedure of purging the line with saline solution during chemotherapy preparation in the centralized pharmacy unit could be a solution to avoiding nurses' exposure. However, for economic reasons (because of the necessary purchase of supplementary intermediate medical devices), this procedure is not applied in some hospitals. The aim of the present study was to assess occupational exposure in nurses during the intravenous line-purging procedure at the patient's bedside before administration of antineoplastic infusion prepared by the pharmacy. According to the results, this study could be a major argument for hospital decision makers to change practices.

## MATERIALS AND METHODS

### Study Design

This prospective study was conducted in a 1200-bed teaching hospital specializing in cancer patients' care in France. Antineoplastic-infusion bags were prepared in the centralized pharmaceutical preparation unit under laminar vertical air-flow safety hoods. During the chemotherapy-preparation step, pharmacy technicians wore protective clothing, nursing caps, safety glasses, masks, and a double pair of gloves. The pharmaceutical-preparation procedures do not include the purging-line step, which is realized at the time of the administration by the nurse. At the end of the preparation step, the chemotherapy-infusion bag is packed in a sterile field under the hood and placed in a disinfected plastic bag outside the hood by the pharmacy technician, limiting chemotherapeutic contamination on the plastic bag. Then the preparation is transported from pharmacy to the day care unit in a box intended for hazardous drugs.

### Nurse Recruitment

Fifteen voluntary nurses (only women) from a hematology and oncology day care unit were involved in the study. These nurses are usually involved in antineoplastic-drug administration; 100% had >2 years of experience. The day hospital performs up to 30 drug administrations per day. Before administration, the nurse inserts the spike of the line into the tubing port of the infusion bag containing the antineoplastic preparation. The intravenous line (Eurofix, Braun Laboratories, Pasadena, California) is then purged with the cytotoxic solution at the patient's bedside. An integrated end-line hydrophobic filter stopped the solution before expulsion from the set. Nurses were informed about the aim and the procedures of the study. Informed consent was signed by all participating subjects.

### Glove Contamination and Sampling

Two common cytotoxic drugs, doxorubicin and cyclophosphamide, were identified and quantified on the surfaces of the nurses' gloves after administration to the patient. A total of 60 infusion bags were selected for the 4-week period of the study. For each selected infusion bag, 1 pair of nonsterile gloves was worn by the nurse before the line was purged and connected to the patient. At the end of the procedure, potential traces of antineoplastic drug on the surface

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