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Stuart graduated from the University of Bristol with a degree in Veterinary Nursing and Practice Administration. He is now the Clinical Manager at Cave Veterinary Specialists after five years as the Head Nurse.

Stuart believes that, while today's RVN must be adept at using the high-tech equipment available in modern-day veterinary nursing, they should not lose sight of the need to deliver holistic nursing care and believes this is essential in achieving the treatment goals.

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Cytotoxic safety

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Occupational exposure

Medical health workers have been delivering cytotoxic drug treatment to patients on a regular basis for much longer and on a more routine basis than have veterinary staff. In the medical environment there is evidence which shows that detectable amounts of the cytotoxic drugs can be found in the air where these drugs are prepared (Mason, Sottani, Ronchi, & Minoia, 2005). There have also been studies of health workers whose urine showed detectable amounts of these drugs (Turci et al., 2002). However, this was shown to have improved over a period of 10 years, when a similar study was performed (Sottani, Porro, Imbrinai, & Minola, 2012). Adverse effects reported in our medical counterparts include:

- damage to DNA
- contact irritation
- reproductive dysfunction including abortion and foetal malformation, although other factors such as smoking may contribute to this and cannot be ruled out.

Currently, there is no evidence to link the development of cancer in veterinary professionals directly to occupational exposure to cytotoxic drugs, because all the studies so far have focused on medical health care workers, who perform these procedures far more than we do in a veterinary setting (**Table 1**).

Classification

The WHO International Agency for Research on Cancer has classified many substances into different categories based on research. When handling a drug in this context, it is important to know its category so the correct assessment of risk can be made and the most appropriate control measures can be put into place.

Class 1

These are drugs which are definitely carcinogenic to people and include most alkylating agents such as lomustine/CCNU, cyclophosphamide, melphalan and chlorambucil, as well as some more common drugs not necessarily associated with chemotherapy protocols, such as azathioprine and cyclosporine.

Class 2

These are potentially carcinogenic to people, and include among others the anthracyclines, such as doxorubicin, epirubicin and mitoxantrone.

Classes 3 and 4

These classes include drugs for which there is no direct evidence of carcinogenicity in people, which fall in to Class 3, or drugs where there is evidence suggesting a lack of carcinogenicity in humans and experimental animals, which are included in Class 4.

Who is at risk in the veterinary setting?

Employers and practice managers must ensure that all procedures involving cytotoxic drugs conform to health and safety regulations (COSHH, 2012). Potential at risk groups in the veterinary practice include:

- veterinary nurses
- veterinary surgeons
- veterinary care support staff (animal care assistants and animal nurse assistants)
- receptionists
- cleaners
- laundry workers
- owners

Areas of risk for clinical staff

Clinical staff will be subject to risk associated with the preparation of the drugs. This can be through direct contact with the individual or contamination of the workplace. Workplace contamination can occur through inhalation of drug particles or aerosols produced during the preparation and administration of a drug. The drugs may be accidentally ingested

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Table 1. Confirmed and potential risks of cytotoxic drugs

Confirmed Risk	Potential Risk
Contact irritant	Carcinogenic (causes cancer)
Mutagenic (causes genetic mutation)	Teratogenic (causes developmental abnormalities in the foetus)
	Reproductive failure

if there is poor control over staff food consumption in, for example, patient hospitalisation areas. Therefore, strict policy and handling protocols must be implemented for the management of these drugs to minimise the risk of contamination of areas where food and drink can be consumed.

Clinical staff are most at risk of coming into contact with volumes of the concentrated cytotoxic drugs through the administration process. Therefore, it is of the greatest importance during cytotoxic treatments that personal protective equipment is worn and that clear protocols for safe preparation and administration are adhered to by staff who have received prior training.

Non-clinical staff

Non-clinical staff may come into contact with cytotoxic drugs. For example, the veterinary receptionist may clean up saliva, urine or faeces from a patient in the waiting room or may come into contact with drug contamination in the environment if protocols have not been adhered to by clinical staff.

Owners

As most clinics will perform chemotherapy as outpatient procedures, the risk posed by the patient and its waste products will be transferred to the owners and other people who come into contact with the patient outside the veterinary environment. It is therefore extremely important that owners are given an induction, which should include general advice on protecting themselves, and are questioned regarding the health status of family members and others who may come into regular contact with the pet receiving chemotherapy, including dog sitters and children/grandchildren.

What can be done to control the risk?

Designated area

A designated area should be allocated for the preparation and administration of cytotoxic medications. If practice design allows, this area will ideally only be used for the administration of cytotoxics. It should be subject to restricted access, away from thoroughfares, draughts and air movement that could spread contamination. There should be a strict ban on the consumption of food or drink in the area as well as provision for dealing with emergency situations, which will include facilities for dealing with skin and eye contamination and general spillage. A spill kit should be readily available – ready-made specialist kits (described later in the article) are available, which contain everything required for cleaning up and the appropriate disposal of spillage.

Storage

All cytotoxic drugs should be stored in accordance with the manufacturer's guidelines; ideally, they should be kept apart from regular pharmacy drugs stocks. If this is not possible, they should be kept in a separate section of the main practice pharmacy. Some of the drugs require refrigerated storage and best practice is to have a dedicated fridge for cytotoxics or, alternatively, sealable Ziploc bags can be used to seal the contents. These should also have cytotoxic labels on their exterior to indicate that they contain products that pose a risk to health.

Nominated trained staff

All staff handling chemotherapy drugs should:

- be over 18 years of age
- not be pregnant
- have received adequate training to perform the procedures involved and deemed competent

Individuals should also feel confident in their ability to handle these drugs and a documented training schedule and record ensuring compliance with COSHH regulations should be maintained.

Protective equipment

Personal protective equipment (PPE) for each procedure should reflect the level of protection required for the substance. When preparing and administering cytotoxic drugs, a gown, gloves, eye/face protection and respiratory protection must be worn. Each of these items should comply with specific requirements in order to provide the appropriate level of protection.

Gowns

Gowns should be worn to provide protection to the body and arms. The length and size of gown should be considered, as excessive amounts of material can pose a hazard through the risk of a trip, and particularly loose gowns can obstruct the user's view during drug administration. Consideration should also be given to the material type; cloth gowns will provide little or no protection against fluids. Coated chemo-rated gowns will provide the best protection, with breakthrough times (the time it takes for a specific drug to pass through a material or fabric) of several minutes. Gowns should also have a closed front and elasticated cuffs which can be tucked into gloves.

Gloves

Gloves should be worn at all times when dealing with both the drugs and the patient. The gloves used for preparation and administration should have increased breakthrough times compared with standard-use gloves. A number of leading brands have been tested for use with chemotherapy agents and their use should be considered part of normal protocol.

Generally, thickness of material is more important than the material itself; however, some materials, like vinyl, are more permeable and have shorter breakthrough times. Materials with longer breakthrough times include latex, nitrile and neoprene.

The gown cuffs should be able to be tucked into the gloves to leave no unprotected skin exposed, so gloves with longer cuffs are more desirable. When putting on the gloves it is important to ensure that the entire gown cuff is included inside the glove as gown cuffs tend to be wicking. Powdered gloves should NOT be used, as there is a risk the powder could carry contamination into the environment and, when used in biological safety cabinets, the powder will clog the filter system.

Eye and face protection

Eye and face protection is advisable and should make up part of the standard PPE requirement. Some patients will find face shields threatening and will shy away from them but will tolerate goggle/safety glasses more readily. It is essential that the eye

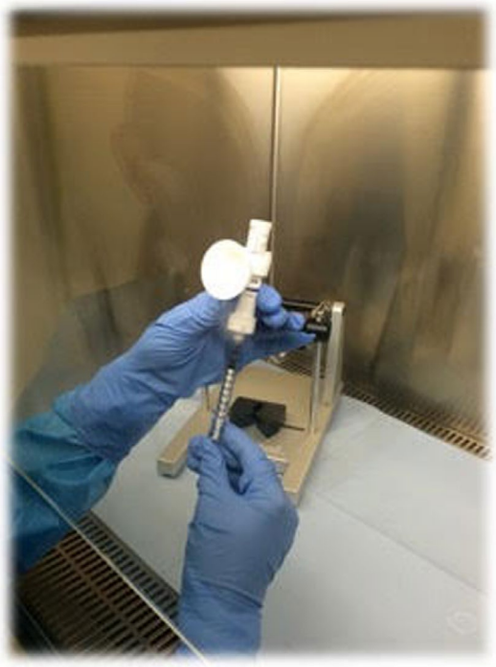

Figure 1. Using a fume cabinet

Figure 2. An example of a filtered vial access device

protection is compatible with the respiratory protection, allowing both to be worn without impeding the function of either.

Respiratory protection

Respiratory protection is used during administration and primarily in preparation where traditional open systems are used, where a simple needle and syringe technique is used (see later in the article for closed systems). The filtration level standard for a fitted face filter respirator mask is BS FFP3; therefore, surgical masks are not sufficient because they do not comply with this standard.

The respirator should fit the user's face well and be comfortable to wear for the duration of the procedure. All staff members taking part in the procedure should wear a respirator.

A Class 2 Type B biological safety cabinet (often termed a fume cabinet) (**Figure 1**) provides optimal respiratory safety for the user when preparing the drug for administration. A Class 2 biological safety cabinet is designed with an inward airflow which provides a pressure gradient that protects the user and prevents aerosol produced from the preparation of the drug escaping from the cabinet. The air within the cabinet is HEPA-filtered and passes in a downward vertical direction, (laminar airflow) forcing aerosol downwards away from the operator. The exhaust air from the cabinet is also HEPA-filtered, providing environmental protection if vented. Biological safety cabinets cost around £8000 and incur six-monthly service charges and are therefore only usually found in the referral environment. As an alternative, a BS standard FFP3 respirator can be used to reduce respiratory exposure.

Other ways to reduce risk

Whenever possible, the pre-constituted form of injectable medications should be used, so that the user is not exposed during mixing. Positive-pressure vials can give rise to aerosol spread, not only in the process of drawing up a drug, but also in the preparation of the powders for reconstitution. Some reconstituted drugs are readily available – for example, epirubicin and doxorubicin – however, drugs like cyclophosphamide for intravenous use are not available in this form.

Using filtered venting devices (**Figure 2**) may help to reduce the risk of material being vented into the environment; however, they are not a sealed closed system, and they are still open and can be easily dislodged.

An alternative is a completely sealed system which has compressed seals between each connection and a pressure-equalisation system. The two systems available which fit these criteria are the ChemoClave® system and the Phaseal® system (**Figure 3**).

The Phaseal® system is completely closed and operates using an equalisation chamber on the side of the vial adapter. The ChemoClave® system operates using an intra-vial balloon which allows air to diffuse into the vial creating a unidirectional flow.

When preparing injectable drugs, it is important to:

- avoid a build-up of pressure within the vial
- use luer-locking syringes
- reduce air bubble formation
- not re-cap needles (if needles are used), because the risk of needlestick injuries would pose a significant health risk to the operator
- ensure that all materials are disposed of appropriately
- wash hands afterwards

Splitting tablets and opening capsules will produce dust, contaminating the environment and posing a risk to personnel. Therefore, they should not be divided or opened at the point of administration, but should be given whole or prepared to the correct dosage in a controlled, specialist environment.

Administration of an intravenous bolus

To administer an intravenous bolus of cytotoxic medication (**Figure 4**):

- place the intravenous catheter cleanly at the first attempt to prevent the risk of extravasation of the drug being administered through multiple venepunctures which would cause significant problems for the patient
- to ensure that any extravasion is clearly visible; do not obscure the catheter or vein with a tap or bandage material
- check patency using 0.9% NaCl – do not use a heparin flush, because some drugs will precipitate in the presence of heparin and then either block the catheter or form an embolus
- monitor the vein and perivascular area constantly for extravasation
- when administering a bolus frequently, stop and "draw back" to ensure flash back of blood from the catheter

Accidental contamination

Accidents may happen, and all staff members involved in the administration of these drugs should be trained to deal with spillage and be equipped with the full range of PPE. If an individual is contaminated, their PPE should be removed carefully, to minimise the risk of further contamination, and placed

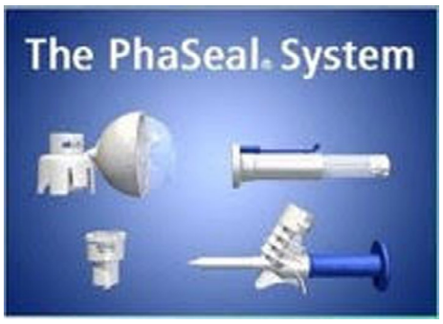

Figure 3. The Phaseal® system

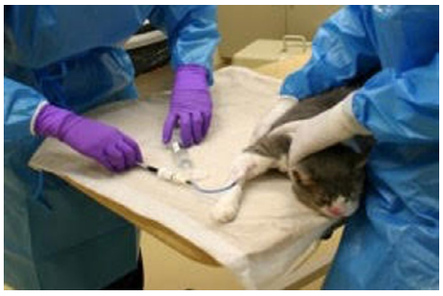

Figure 4. Administering a chemotherapy bolus

Figure 5. A spill kit

into the correct waste receptacle. If the skin or eyes have been contaminated with splashes, the affected area should be cleansed with copious amounts of water or eyewash. Medical assistance should always be sought and information concerning the product supplied to the medical practitioner. Finally, any accident should be documented immediately after the event and investigated at a later date with a view to updating the SOP as necessary.

Environmental contamination

It is advisable to be prepared for environmental contamination by having a "spill kit" readily available when a chemotherapy procedure takes place (**Figure 5**). The spill kit should contain equipment to confine a spill of both liquids and solids. Typical contents many include a full set of chemotherapy-rated PPE spill pillows which contain an absorbent material – gauze swabs may also be effective – a sharps container, disposable tweezers, scoop and a minimum of two cytotoxic drugs disposal bags (to enable double-bagging of contaminants). **Box 1** details the steps involved in environmental decontamination.

Safety during nursing

Chemotherapeutic drugs vary in the route of excretion and whether the drug is excreted unchanged or as an active or inert metabolite through urine and faeces. The drugs are excreted for approximately 48 h following administration and therefore can pose a risk. Full PPE should be used during nursing to protect from bodily fluids when dealing directly with both the patient and with bedding as well as cleaning any areas occupied by the patient.

There should be regimented separation of waste from patients who have undergone chemotherapy and this should be dealt with in conjunction with your waste carrier from whom guidance should always be sought. Segregation is generally achieved by means of placing chemotherapy waste in purple-topped waste containers or yellow bags with a purple stripe marked with the clinic post code, date and waste code. The waste code for chemotherapy products is 18.02.07 for bags and 18.08.08 for the containers.

Does all this work?

In the human field, there is evidence that good preparation against contamination provides good control both in the clinical environment and the environment (Ziegler, Mason & Baxter, 2002). However, in the veterinary field there have been no studies of the efficacy of staff training and PPE as yet. Nonetheless, it would be sensible to assume that following correct procedures when handling cytotoxic drugs will help to prevent unnecessary toxic contamination.

Legislation

There is a significant amount of legislation to ensure that control measures are put into place. The relevant legislation includes:

- Health and Safety at Work Act 1974 (Sections 2, 3, 4, 9, 37)
- Control of Substances Hazardous to Health regulations (2002) (COSHH2002)
- Management of Health and Safety at Work Regulations (1999)

Box 1. Decontaminating the environment after a toxic spill

Wearing PPE:

- confine spill
- scoop up broken glass (use tweezers to pick up smaller pieces)
- clean up spill – use absorbent material for liquids and wet gauze for solids
- wash the area more than three times with detergent
- place all materials used into waste bag
- double-bag waste
- record event

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