AWARENESS OF OCCUPATIONAL EXPOSURE TO HAZARDOUS SUBSTANCES AND MEDICINES IN THE PHARMACY

Shiwai Ng[1], Madeleine Sirks[1]
1) Laboratory of Dutch Pharmacists, Royal Dutch Pharmacists Association (KNMP), The Hague, Netherlands

Contact: s.w.ng@knmp.nl

INTRODUCTION

Practicing safe pharmaceutical compounding and handling medicines helps to protect the pharmacy staff from exposure to harmful substances. Small-scale preparation of medicines in pharmacies may involve many different active substances and pharmacy staff frequently have to handle or adapt medicines prior to use. Some substances and medicines have hazardous properties that may pose a health risk to healthcare professionals handling them. Occupational exposure to hazardous substances and medicines has to be controlled in order to prevent occupational diseases.

AIMS

To create awareness about occupational exposure when preparing and handling medicines in pharmacies and to improve the occupational safety and health of the pharmacy staff by advising on protective measures.

METHOD

To ensure safe preparation and handling of medicines it is important to identify those substances that have hazardous properties and avoid or minimise exposure. The concept of risk can be captured in the following equation: **risk = hazard x exposure.**
Not all hazards represent a risk; it is exposure that makes all the difference. We conducted two studies in collaboration with TNO Innovation for life and developed an inhalation exposure model, based on exposure measurements of some typical situations and handlings in Dutch pharmacies. A classification model for hazard classes is supplementing this exposure model. A risk assessment, by combining the hazard of the substance and the possible exposure, will help to determine what protective measures should be taken to control the health risk.

1. HAZARD CLASSES OF SUBSTANCES AND MEDICINES

Substances and medicines are classified into 5 hazard classes based on ranges of indicative limits on internal exposure (µg/day). The hazard is derived from data on the intrinsic properties of the substance or medicine, such as occupational exposure limits and hazard statements. The hazard increases from class 1 to 5. Table 1 gives examples of the classification of some substances and the related medicines.

Table 1 Hazard classification of some substances and the related medicines

Substance	Hazard class	Medicine	Hazard class
Paracetamol	1	Paracetamol tablets 100-1000 mg	1
Ibuprofen	2	Ibuprofen tablets 200-600 mg	1
Naproxen	3	Naproxen tablets 250-500 mg	2
Dexamethasone	4	Dexamethasone injection 4 mg/ml and 20 mg/ml	1
Methotrexate	5	Methotrexate injection 25 mg/ml	5

2. EXPOSURE MEASUREMENTS

Inhalation exposure during preparation and handling of medicines were measured in Dutch pharmacies. Preparation in the pharmacy is characterized by a variety of methods, batch sizes and a heterogeneous group of pharmacy assistants. Therefore measuring the exact exposure in each individual situation is not feasible. We identified several typical exposure situations. Inhalation exposure was also measured for the most common handlings with medicines (see table 2) in Dutch pharmacies. The handlings were simulated with non-hazardous medicines. For each handling, the scenario in which the highest exposure occurs was determined. In this way a worst case scenario has been measured.

Table 2 Common handlings with medicines in the Dutch pharmacies

- Reconstitution of powder for injection/infusion, either on a work bench without any form of local ventilation or in a laminar air flow cabinet (horizontal flow)
- Deblistering (manual) tablets/capsules from strips/blisters
- Crush tablets in a mortar
- Split tablets in half, by hand or with a tablet-splitting device
- Reconstitution of powder for oral suspension/solution
- Opening capsules and pour the contents
- Repackaging of tablets/capsules into small packs from bulk supply (with a tablet counter, manual)

3. RISK MATRIX

The hazard combined with the exposure gives an estimation of the health risk. Table 3 shows the estimated inhalation risk in 3 levels: small, moderate and high.
The health risks of almost every type of small-scale preparation and common handlings of medicines can be estimated and minimised by the risk model which has been developed.

Table 3 Risk matrix: the hazard combined with the exposure gives the estimated inhalation risk

	Hazard class	1	2	3	4	5
	Limit value	> 5,000 µg/m³	5,000-1,000 µg/m³	> 10-1,000 µg/m³	> 1-10 µg/m³	≤ 1 µg/m³
Exposure	Very low GM = 0.1 µg/m³	Small	Small	Small	Small	Small
	Low GM = 13 µg/m³	Small	Small	Small	High	High
	Medium GM = 71 µg/m³	Small	Small	Moderate	High	High
	High GM = 329 µg/m³	Small	Moderate	Moderate	High	High

GM = geometric midpoint

RESULTS

The actual risk for the pharmacy staff is a resultant of the inherent toxicity of the handled substances or medicines and the potential exposure, stemming from the type of work that has to be executed. Inhalation exposure during preparation appeared to depend on the physical appearance (solid or fluid) of the substance, the amount of the substance (< 10 g or 10-100 g), the duration and the effectiveness of ventilation to remove the substance before inhalation. The type of handling (weighing, mixing, pouring, etc.) and the substance being fine powder or crystals were less relevant for the inhalation exposure. The outcomes of the inhalation air measurement for preparation were put into a exposure model (figure 1).

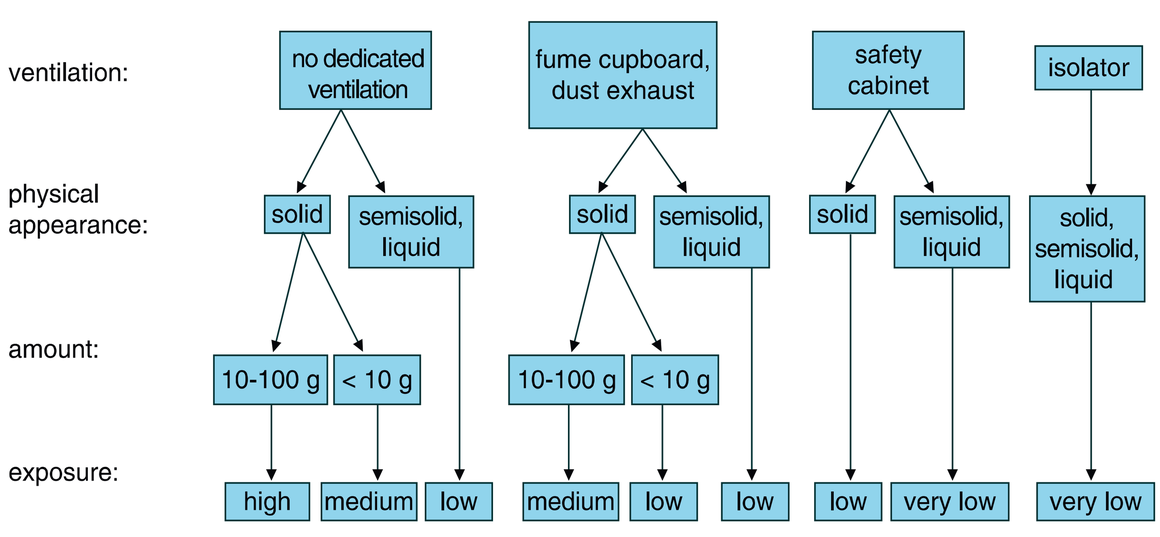

Figure 1 Inhalation exposure model for different ventilation situations

Exposure during handling or adapting medicines prior to use differs per handling. Measurements showed that the level of inhalation exposure depends on the type of handling, with crushing tablets and opening capsules given the most inhalation exposure and reconstitution of parenteral medicines the least. Depending on the hazard of the medicine, additional control measures are needed to control the risks at the workplace. In some cases, for example crushing tablets and opening capsules with hazard class 4 or 5 during a maximum of 15 minutes/day, it is necessary to take ventilation measures and/or combine it with a respirator to reduce exposure and eventual risk (see table 4). Overall, measurements also show that the risk associated with exposure can be eliminated, or at least greatly reduced, by shortening the duration of the preparation and handlings with medicines.

Table 4 Risk levels of the most common handlings during 15 minutes a day

	Hazard class				
Handling	1	2	3	4	5
Reconstitution of powder for injection/infusion, either in a laminar air flow cabinet (horizontal flow)					
Deblistering (manual) tablets/capsules from strips/blisters					
Crush tablets in a mortar					
Split tablets in half, by hand or with a tablet-splitting device					
Reconstitution of powder for oral suspension/solution					
Opening capsules and pour the contents					
Counting tablets/capsules with a tablet counter (manual)					

Small risk	No ventilation measures needed
Moderate risk	Ventilation measures needed: a dust exhausting device
High risk	Ventilation measures needed: a dust exhausting device combined with a respirator (P2/P3)

CONCLUSIONS

Occupational exposure during preparation and handling of medicines can occur, but the risks vary greatly with the nature and duration of the tasks. It is important to be aware of the potential health risk when preparing or handling hazardous substances and medicines. To prepare or handle safely it is necessary to control occupational exposure and thus risk, especially with the most hazardous substances and medicines (hazard class 4 and 5), such as cytostatics.

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