

Medication Safety Forum

Reduce spillage when preparing cytotoxics



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needed. If you dissolve a powder in 10 mL water, and try to draw out 5 mL directly, you have a guaranteed mess. You must get rid of the surplus volume. To do this you have to make an opening in the system, and the pressure has to be negative when the opening is made.

There are two golden rules for reducing spillage when preparing solutions: keep the pressure negative, keep the needle empty.

Introduction

Preparing cytotoxics is hazardous. There should always be guidelines for handling such substances. But you have to know what you are doing, not only in theory, but also practically. You should understand the processes and physical laws behind spillage in order to be in control of it. There are systems that can be used to reduce spillage (and hazard). But there are very many places and situations where such devices are not available. And they do not rescue you in all situations.

Everybody knows that in a vial, air is on top and fluid is below. And that if you draw something out from the vial with a syringe and needle, this something (air or fluid) comes from where the needle point is positioned. But those who work with preparing cytotoxics know that it took a lot of practice before they had this 'in their fingers'. Theory and understanding is necessary, but so too is practice.

Figure 1: No spillage can occur with negative pressure



Less air in than fluid out.

Figure 2: The major point of spillage



Cannula tip at the stopper.

Negative pressure and openings

In order for spillage to occur there has to be positive pressure and an opening. Both conditions must be fulfilled. Think of an eye drop bottle, the opening is there all the time. The drop comes only when the bottle is squeezed.

The syringe connected to the vial can be regarded as a closed system, and as such it can have positive pressure without spillage occurring. An opening is made when the needle is pulled out of the vial stopper or disconnected from the syringe. Always. Positive pressure in this situation causes spillage. Always.

How to ensure negative pressure

Insert less volume than you draw out. Insert 9 mL of air if you need 10 mL of fluid. The negative pressure should preferably not be so strong that it moves the plunger of the syringe; see Figure 1.

The original pressure in the vials must be considered. Pressure is usually not visible, so this has to be learned by experience. Luckily, positive pressure is rare. Strong negative pressure can sometimes make the vial stopper bulge inwards.

Inserting 90% of the wanted volume is a good rule of thumb. But the amount of air to insert must be related to the total air volume inside the system, and not related to the fluid volume that you need to take out. Consider drawing 5 mL from a half-full 100-mL vial (55 mL air) and from a normal 10-mL vial (1 mL air). Inserting 4.5 mL will create a 1% pressure reduction in the first case and 33% in the second.

Particular situations

Part of a volume

An especially difficult situation occurs when only part of a reconstituted volume is

Draw 11 mL of air from the vial into the syringe to create negative pressure. Then pull out the needle from the vial stopper, or disconnect the needle from the syringe. Be careful not to touch the needle. Draw a little more air into the syringe to be sure there is no fluid left inside the needle lumen or syringe nozzle. Adjust the syringe to 4.5 mL. Inject this into the vial. Then the desired 5 mL can be drawn out the usual way. Alternatively a fresh syringe and needle can be used.

Heavy liquid

For large syringes the weight of the liquid can be sufficient to move the plunger. A full 50-mL syringe will leak if the tip is pointing downwards, merely because of gravity.

Empty needle

The only way out from a syringe is through the tip and needle. If the needle is filled with fluid, ANY increase in pressure or volume will cause spillage. Even the pressure needed to make the cannula penetrate the vial stopper is sufficient to make a droplet appear at the needle tip. Fluid expansion caused by temperature rise can give the same result, see Figure 2.

Draw a little air in through the needle after you have measured the volume you want. In this way you create a buffer volume for the inevitable small volume or pressure increases.

Conclusion

The aim of this article is to reduce spillage. There are additional challenges like maintaining aseptic procedures and administering cytotoxics to patients. Sometimes you have to make compromises. But a basic understanding of what you are doing will help you to make better decisions.

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