A Small Dose of ™ Toxicology

A Demonstration of Dose Response and The Importance of Size

Key Words

Dose / Response

Hazard + Exposure = Risk

Individual Sensitivity

Definitions-1

DOSE - amount of exposure to an agent.

RESPONSE - the reaction to the dose.

For example, eating one green apple may be just fine but eating five green apples at one time may produce a very undesirable response.

Definitions-2

HAZARD – the possibility that an agent can cause harm

EXPOSURE – contact with an agent

RISK – the probability of harm or adverse effect (injury, disease, death) following exposure to an agent

Paracelsus

**"All substances are poisons;
there is none which is not a poison.
The right dose differentiates a poison
from a remedy."**

Paracelsus (1493-1541)

An Individual View

**"The sensitivity of the individual
differentiates a poison from a remedy.
The fundamental principle of toxicology
is the individual dose response curve."**

S. G. Gilbert (1997)

Materials Required

- Four large size glasses
  (Wine glasses work very well)
- One Small size glass
- Blue food color
  (In container to dispense drops)
- One pitcher of water

Instructions - Amount

- Demonstration of the importance of amount of the Dose (see first figure – next slide)
- Fill three large glasses with approximately ¾ water. This represents the approximate water content an individual. I usually ask the class how much water is in each of them – makes for a fun discussion.
- Put one drop of blue food color in the first glass, three in the second glass and then 6-9 in the last glass. Ask the class to count with you and how many they would like to have in the last glass.
- Stir with a pencil or pen and discuss the change in color as a response to increased dose of food color in each glass. Discuss how some chemicals, caffeine being one, distribute through out total body water.

Effects of Amount on Response

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Instructions - Size

- Demonstration of the importance of size (see second figure – next slide)
- Fill one large glass and the small glass with approximately ¾ water. The small glass represents a small child in contrast to the adult size glass.
- Put one drop of food color in the each glass. The small glass will be much darker and usually look like the high dose glass from the first demonstration.
- Discuss the importance of size, and the impact weight has on dose, depending on sophistication of the group. A small child that drinks one can of caffeinated soda will have a very different response than an adult because of the difference in the dose of caffeine relative to body size.

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Effects of Size on Response

Background Information

For exposure to a chemical agent, dose is usually expressed in relation to body weight. This is because for a fixed amount of toxic agent, the dose, and likewise the effect, depends directly on weight. We know, for example, that one shot of alcohol would have a very big effect on a child weighting 10 lbs and a much smaller effect on an adult weighing 200 lbs. To take this into account, dose is measured in units of milligrams of toxicant per kilogram of body weight, abbreviated mg/kg. If someone consumed 100 mg of caffeine, approximately the amount in a cup of coffee or two cans of caffeinated soda, and if they weighed 70 kg (about 155 lbs), the dose would be 100 mg/70 kg of body weight or 1.4 mg/kg. On the other hand, if a child weighing only 10 kg (about 22 lbs) consumed the same 100 mg of caffeine, the dose would 10 mg/kg, seven times as large because the body weight is one seventh. Thus size and amount of exposure determine the dose and are critical factors in toxicology. This principle can be an extremely important factor in home lead or pesticide exposures, where the dose a child receives is far greater than the adult due to the small size and extra sensitivity of the child.

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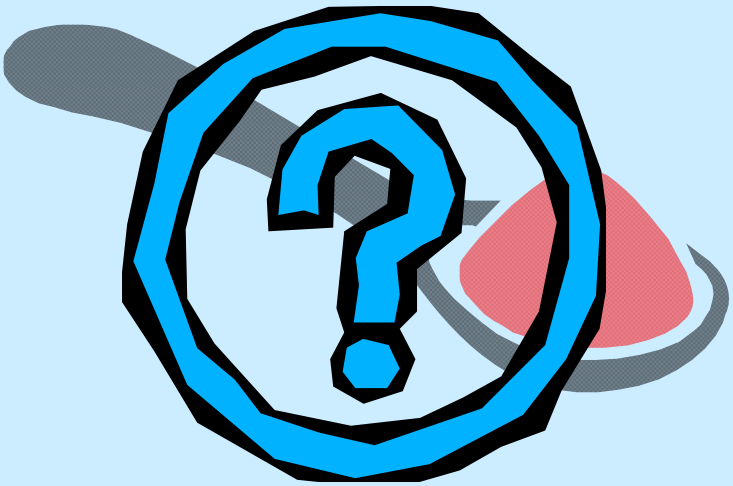

Authorship Information

This presentation is supplement to "A Small Dose of Toxicology"

For Additional Information Contact
Steven G. Gilbert, PhD, DABT
E-mail: smdose@asmalldoseof.org
Web: www.asmalldoseof.org