PROBLEM: Errors, some resulting in serious patient injuries, have been reported when practitioners rely on the “rule of 6” as a shortcut to calculate pediatric critical-care drug infusions that are dosed in micrograms per kilogram per minute. The formula, which is referenced in The Harriet Lane Handbook, is as follows:

\[ 6 \times \text{weight (kg)} = \text{the amount of drug in mg that should be added to 100 ml of solution.} \]

The infusion volume in milliliters per hour (ml/hour) will then equal the mcg/kg/minute dose ordered.

For example, a drug ordered at 10 mcg/kg/minute would equal an infusion rate of 10 ml/hour using the rule of 6; similarly, a “rule of 15” exists where 15 x weight in kilograms equals the amount of drug per 250 ml of solution. Nurses and house staff may find the method convenient, but there are problems with its use.

First, in some facilities, the rule of 6 is not followed consistently. Some practitioners use it; others don’t. Thus, physicians or nurses who consistently use the rule of 6 might assume that all solutions dosed in mcg/kg/minute are prepared in this fashion. However, if a solution with a different concentration is used, these practitioners might adjust rates inaccurately. One facility reported that some nurses who routinely use the rule of 6 often recalculate the dose, prepare a new solution, and hang it at the beginning of their shift if the current solution has not been dosed according to the rule of 6. This practice has the potential to unnecessarily introduce an error, such as the wrong diluent or volume.

Next, the rule of 6 requires that critical-care drug doses be calculated mathematically. This calculation process is always prone to error. Mistakes have been reported when nurses confuse “mg” with “ml” and add the drug to the solution by volume rather than by weight (e.g., adding 30 ml instead of 30 mg). Ensuring accurate pump settings can also be problematic if “ml/hour” is confused with “ml/24 hours.” At a minimum, an independent double-check system is indicated for all prepared and calculated drugs and for all rate settings on infusion pumps when the rule of 6 is used. Despite great efforts, however, this safeguard is sometimes omitted.

When hospitals use the rule of 6, the nurses often prepare the intravenous (IV) solutions on patient-care units; again, this is an error-prone process that bypasses pharmacy preparation and subsequent double-check systems to verify accurate IV admixtures. Some drugs, such as dopamine, are available in vials of varying concentrations, thus increasing the potential for serious errors.

In facilities where the pharmacy department prepares solutions using the rule of 6, obtaining the patient’s accurate weight is often difficult. Sometimes miscommunication as to whether the patient’s reported weight is in kilograms or in pounds has resulted in errors.

Pediatric drug solutions that have been prepared using the rule of 6 can result in fluid overload when dose adjustments are necessary. For example, if a dopamine infusion rate were increased from 5 mcg/kg/minute to 10 mcg/kg/minute, a small infant would receive 10 ml/hour, or the daily fluid requirement with this solution alone. As a result, the physician might order an atypical (e.g., a double or triple) concentration, which increases the likelihood of a dosing error. Practitioners are more familiar with the typical rule of 6 dosing concentrations.

Finally, use of the rule of 6 results in drug waste. The amount needed to prepare solutions in this manner is usually only a portion of the drug vial. Either the remaining drug is wasted, or single-dose containers are reused inappropriately.

SAFE PRACTICE RECOMMENDATION: Simplification and standardization can reduce the potential for errors. The use of standardized concentrations of critical-care drugs and corresponding dosing charts, dosed in mcg/kg/minute (which can be made available on preprinted labels), can help simplify the process by preventing error-prone calculations, by avoiding the use of the wrong diluent or volume, by reducing the number of discarded doses and necessary dose preparations, and by facilitating the use of premixed IV solutions.

REFERENCE