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Drug Form and Expression of Concentration May also Lead to Prescription Errors

We read with interest the systematic review of the causes and factors associated with prescribing errors in hospital inpatients by Tully and colleagues that was recently published in *Drug Safety*.[1] The authors found that mistakes were frequently due to inadequate knowledge of the drug or patient, and skills-based slips and memory lapses. In a second review examining the prevalence of prescribing errors, the same group also describe the problem of dosage errors, especially in paediatric practice.[2]

Although they identified error-provoking conditions and discussed potential interventions, the authors did not discuss the difficulties prescribers face with drugs presented in different forms, when calculating drug doses on the basis of a patient's weight or body surface area, or when converting between different units of drug concentration such as ratios, percentages and units of concentration.

Drug labels are open to misinterpretation. One drug may be presented in several different forms, e.g. a 'delayed' or 'sustained' release preparation, an enteric coated preparation or solutions for administration via different parenteral routes, all aiming to facilitate final dose preparation processes or preparation for children, and ultimately improve patient convenience. However, such a wide variety of dosage forms increases the risk of prescription error. Prescribing errors involving medication dosage forms have repeatedly been found to account for more than 10% of all errors in a long-running error detection programme conducted in New York.[3,4] These investigators and others have identified a substantial deficiency in the understanding of drug formulations.[5,6]

Misinterpretation of labels can also lead to tenfold dosing errors, when an order-of-magnitude error results from a dose miscalculation.[7] When converting micrograms to milligrams, hundred or even thousand fold errors are also possible. Children are at particular risk because the required volume of stock solution is generally small, so even a tenfold higher volume may appear deceivingly normal. Nearly one-third of intravenous drug prescriptions on neonatal units are for doses less than one-tenth of a single drug ampoule.[8]

The extent of tenfold medication errors was examined in three Canadian tertiary children's hospitals using three detection methods.[9] Analysis of the data from the local incident reporting systems found the incidence to be 1 in 22 500 doses prescribed. However, an audit of 1500 prescription charts in the emergency departments revealed two tenfold errors in 1678 drug orders. A much higher rate of medication error occurring during mock resuscitation scenarios identified four tenfold errors in eight mock resuscitations that included 125 orders for drugs.[9]

High fidelity simulation of emergency scenarios may give a much more realistic idea of the prevalence of medication errors in clinical practice compared with error reporting or detection systems. Our group has examined the difficulties physicians face when managing severe anaphylaxis in a child. Physicians randomized to receive adrenaline (epinephrine) ampoules labelled with a ratio were more than 13 times more likely to give an overdose (mean overdose 213 μg) than those using ampoules labelled with mass concentration.[10] This work has built on survey evidence that doctors,[11-17] nurses[11] and medical students[11,18] struggle with ratios and percentages.

It may be that these studies were not included in the systematic reviews as they are perceived as drug administration errors rather than prescription errors. However, we believe that these factors contribute to both prescription and drug administration errors. The boundaries between the two may be blurred, especially in emergencies when the drugs are nearly always administered intravenously and may only be prescribed retrospectively, making them particularly prone to error and difficult to detect.[19] We believe that a great deal of patient harm may be caused by confusion about drug forms, concentration expression and dose calculation, and that these

factors should also be taken into account when considering the prevalence of and potential interventions to reduce prescription errors.

Vaithianadan Mani and *Daniel W. Wheeler*
University of Cambridge, Division of Anaesthesia, Addenbrooke's Hospital, Cambridge, UK

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The Authors' Reply

We would like to thank Drs Mani and Wheeler for their interest in our two systematic reviews.[1,2] The authors suggest that the studies they describe in their letter were not included in our reviews because they were possibly perceived as administration rather than prescription errors. The majority of their studies, however, did not fulfill our inclusion criteria. Some investigated single groups of drugs[3-6] or single types of error.[7-9] Others reported the opinion or knowledge of prescribers in general, rather than opinion or knowledge about individually identified errors.[10-15] Finally, some were comments or narrative reviews rather than reporting empirical data.[16,17]

That said, we wholeheartedly agree with the authors' statement that such dosage errors have the potential for considerable patient morbidity. There is much work still to be done to investigate how to effectively reduce the prevalence of all types of prescribing errors.

Mary P. Tully,[1] *Darren M. Ashcroft*,[1] *Tim Dornan*,[2] *Penny J. Lewis*,[1] *David Taylor*[3] and *Val Wass*[2]
1 School of Pharmacy and Pharmaceutical Sciences, University of Manchester, Manchester, UK
2 Manchester Medical School Education Research Group, Manchester, UK
3 Liverpool Medical School Education Research Group, Liverpool, UK