

Comment on 'Prevalence, Incidence and Nature of Prescribing Errors in Hospital Inpatients: A Systematic Review'

We note with interest the systematic review of the prevalence and incidence of prescribing errors in hospital inpatients recently published in *Drug Safety*.^[1] The authors are to be congratulated on pulling together the literature in this large and diverse field. We agree with many of the key points they highlight that need to be considered when studying this topic. However, we are concerned that the summary error rates produced could be misleading for several reasons – partly due to the inclusion and exclusion criteria adopted for the review and partly related to the mixing together of several different methodologies when calculating rates of erroneous orders. In this letter we make a case for the improved differentiation of studies in future reviews, and recalculate the prescribing error rates accordingly.

First, we would argue for the exclusion of certain classes of paper from such systematic reviews, i.e. conference abstracts and letters to the editor, as well as those based on incident reports. Prescribing error research is still an inchoate subject with wide variations in research practice. Conference abstracts and letters to the editor are unlikely to include enough information to adequately determine the definitions, the sample or the methods used to measure and calculate error rates. They have not always been peer reviewed. Incident reports are known to be subject to significant (orders of magnitude) under-reporting, as recognised by Lewis et al.^[1] We would therefore suggest that abstracts, letters to the editor and studies based on incident reports be excluded from systematic reviews of this type.

Second, we were surprised to find that the authors excluded some studies from analysis on the basis of using an estimated denominator.^[2-5]

In hospitals where medication orders do not have to be entered into a computer system prior to administration (in many countries outside the US) and the denominator used is all medication orders written during the study period (regardless of whether or not they were seen by a pharmacist), it is necessary to count manually the medication orders in patients' case notes. Since it is rarely possible to retrieve all sets of case notes, it is necessary to base the denominator on a sample of retrieved records. This is unlikely to be a significant source of error, compared with the many other sources of variation between studies. One of the studies excluded took a random sample of case notes, with a sample size calculated to give a suitable level of precision,^[2] another calculated the denominator based on extrapolation where a small percentage of the patients' case notes could not be located.^[3] Others calculated the error rate based on ascertaining both numerators and denominators in a smaller subset of medication orders.^[4,5] Estimation of population characteristics based on a sample is standard practice in clinical research and we find it rather odd that papers using this approach were excluded.

Our third point relates to another potentially important source of variation between studies – the types of medication order included. Some include all inpatient items; others exclude some or all medication orders for continuous infusions of fluids, 'once only' doses of medication, and discharge prescriptions. In other papers, only medication orders written on discharge were studied.^[6-8] Some of these types of medication order are likely to be associated with higher or lower rates of error and we would recommend that future reviews highlight and explore this issue in more detail. In particular, we suggest that studies focussing only on medication orders written on admission, or only at discharge, are analysed separately.

Our final point relates to the denominator used to calculate the error rate. The review rightly differentiates between studies that use different denominators – medication orders, patient days, and patient admissions. However, for the studies that expressed rates of erroneous orders, the authors conflate five different methods of identifying

Table I. Different approaches to determining the incidence of erroneous handwritten medication orders for hospital inpatients^a

Denominator	Numerator	No. of studies in this category	Median error rate [% (range)]
All medication orders entered into computer system by pharmacy staff (in a system where all medication orders have to be sent to pharmacy prior to administration)	Errors identified in these medication orders by the screening pharmacists	11 ^[9-19]	2.7 (0.3–20.3)
New medication orders screened for the first time by ward-based pharmacists (does not include medication orders that are not seen by ward pharmacists)	Errors identified in these medication orders by ward-based pharmacists	4 ^{[20-22]^b}	9.9 (7.7–14.6)
Medication orders (both new and existing) screened by ward-based pharmacists on the day(s) of the data collection. Each medication order may be counted more than once	Errors identified in these medication orders by ward-based pharmacists	4 ^[5,23-25]	4.6 (2.2–27.0)
All medication orders written during the study period that were retrospectively reviewed by researchers	Errors retrospectively identified by researchers in the medication orders reviewed	2 ^{[26]^b}	8.0 (7.4–8.6)
All medication orders written during the study period, regardless of whether or not they were seen by ward pharmacists	Errors identified by ward pharmacists	2 ^[2,3]	2.7 (1.5–3.8)

a Figures in this table include studies excluded by Lewis et al.^[1] on the basis of using an estimated denominator, but exclude studies in which the methods used are unclear,^[27-29] those focussing only on discharge medication,^[6,7] those where it is not clear whether or not each medication order can be associated with more than one error,^[4] and those published only as abstracts or letters to the editor.^[30-36]

b One reference included two separate studies.

errors and ascertaining denominators (table I). There are arguments in favour of each, depending on study objectives, practicalities relating to the setting and the resources available. However, each approach may yield substantially different error rates (there is a nearly 4-fold difference between the largest and smallest median rate of the five methods in our table). Prescribing errors may be more likely to be identified when medication orders are seen by ward-based pharmacists for the first time, and this is what the literature shows – a median of 9.9% (range 7.7–14.6%) for the four such studies included in the review. It is therefore not meaningful to summarize the results of multiple studies unless they have all used the same approach.

These issues, together with those already highlighted by Lewis et al.,^[1] demonstrate the difficulties in comparing the disparate literature in this field.^[37,38] Standardization of definitions, denominators and data collection methods would be beneficial. Until such time, reviews of the literature need to be very sensitive to the subtleties of the research methods. The production of a single summary median error rate will be potentially misleading and we suggest that future reviews

group results according to the samples, definitions, methods of detection and denominators.

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The Authors' Reply

We thank Professor Franklin and colleagues for their letter commenting on our systematic review.^[1] We are pleased to note, in particular,