Unlicensed and Off-Label Drug Use in an Australian Neonatal Intensive Care Unit

Colm P. F. O’Donnell, MRCPI, MRCPCH; Robyn J. Stone, BPharm, Clin Pharm; and Colin J. Morley, DCH, MD, FRCP, FRCPCH, FRACP

ABSTRACT. Objectives. To determine the extent of unlicensed and off-label drugs prescribed in the level 3 neonatal intensive care unit (NICU) at the Royal Women’s Hospital, Melbourne, Australia.

Methods. A prospective cohort study was conducted of all infants who were admitted to the NICU during a 10-week period. Each drug prescribed was evaluated in relation to the licensed approved uses to determine whether the drug was administered in a licensed manner or was unlicensed or used in an off-label manner.

Results. There were a total of 101 admissions involving 97 infants. A total of 1442 prescriptions were administered; 42% were licensed, 11% were unlicensed, and 47% were off-label. Twenty-one percent were off-label for 2 or more reasons. Eighty percent of infants received either an unlicensed or an off-label prescription or both; this proportion rose to 93% of extremely low birth weight infants.

Conclusions. This is the largest study performed of unlicensed and off-label drug use in the NICU. This practice remains widespread despite clear recommendations to improve this undesirable situation. The attendant risks to infants and prescribers remain. It is time for legislation to be introduced to govern this area.

METHODS

We conducted a prospective, observational study of all prescriptions for the dynamic cohort of infants who were admitted to the NICU of the Royal Women’s Hospital, Melbourne, during a 10-week period (December 3, 2001, to February 10, 2002, inclusive). This is one of the largest NICUs in Australia, admitting >450 infants.

In Australia it is a requirement that drugs be licensed by the Therapeutic Goods Administration. This is to ensure that they are safe, efficacious, and of good quality. Most drugs that are administered to adults have licensed approval outlining the indications for which they may be used and the doses at and the routes by which they should be administered. However, many drugs that are given to children are unlicensed. Furthermore, many licensed drugs are prescribed to children outside of their approved terms of use (ie, off-label).

Several categories of unlicensed drugs have previously been described.1,2 Some are made in local pharmacies (referred to as homemade products) and not by pharmaceutical companies. An example in

ABBREVIATION. NICU, neonatal intensive care unit.

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unlicensed or off-label drugs.

In italics, as their use was either unlicensed or off-label during the 10-week study period. Four appear exclusively in adult volunteers. The use of these drugs in children is often based on the modification of adult formulations and extrapolation of doses used in adults. This neglects important differences in pharmacokinetics between adults and children in development. A review of the 1994 Australian Monthly Index of Medical Specialties showed that

The total number of prescriptions was 1442, and the median number that each infant received was 7 (range: 0–132). Sixty-nine different drugs were prescribed. A total of 609 prescriptions (42%) met the approved terms of use. A total of 152 prescriptions (11%) were for unlicensed medications; the most common reason for admission was respiratory distress.

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**RESULTS**

During the 10 weeks, there were 101 admissions of 97 infants (2 were admitted twice, and 1 was admitted 3 times). The median gestational age was 31 weeks (range: 22.7–41.4), and the median birth weight was 1560 g (range: 414–4790 g). Twenty-seven (28%) were term infants; the most common reason for admission was respiratory distress.

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Table 1 illustrates the 10 most frequently used drugs during the 10-week study period. Four appear in italics, as their use was either unlicensed or off-label. Table 2 illustrates the most frequently used unlicensed or off-label drugs.

**DISCUSSION**

Prompted by tragedies that affected developing fetuses (thalidomide) and newborns (chloramphenicol), drug licensing was introduced to ensure the safety and efficacy of drugs used in clinical practice. Drug trials, however, have been conducted almost exclusively in adult volunteers. The use of these drugs in children is often based on the modification of adult formulations and extrapolation of doses used in adults. This neglects important differences in pharmacokinetics between adults and children in development. A review of the 1994 Australian Monthly Index of Medical Specialties showed that >70% of

<table>
<thead>
<tr>
<th>Medication*</th>
<th>Number</th>
<th>Percentage</th>
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</thead>
<tbody>
<tr>
<td>Gentamicin</td>
<td>204</td>
<td>14.1</td>
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<tr>
<td>Morphine</td>
<td>119</td>
<td>8.3</td>
</tr>
<tr>
<td>Vancomycin</td>
<td>110</td>
<td>7.6</td>
</tr>
<tr>
<td>Benzylpenicillin</td>
<td>98</td>
<td>6.8</td>
</tr>
<tr>
<td>Theophylline</td>
<td>81</td>
<td>5.6</td>
</tr>
<tr>
<td>Aminophylline</td>
<td>79</td>
<td>5.5</td>
</tr>
<tr>
<td>Frusemide</td>
<td>69</td>
<td>4.8</td>
</tr>
<tr>
<td>Vitamin K</td>
<td>45</td>
<td>3.1</td>
</tr>
<tr>
<td>6% Sodium chloride</td>
<td>41</td>
<td>2.8</td>
</tr>
<tr>
<td>Phosphate</td>
<td>38</td>
<td>2.6</td>
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</table>

* Italics indicate unlicensed or off-label use.

The products that it contained had no information about the use of the product in children or had a partial or general disclaimer regarding their use in children. This proportion is similar to that found on review of the Physician’s Desk Reference in the United States. This illustrates that children do not have equity of access to safe, regulated drugs. Thus, drug legislation that originally was designed to protect patients and physicians against unsafe drug use has become an obstacle to making proper drugs available for a vulnerable minority of patients.

The use of unlicensed and off-label drugs in pediatrics was first raised as a matter for concern in the late 1960s in the United States. More recently, attention has been focused on the extent of unlicensed and off-label drug use in Europe. These studies have described the extent of such prescribing among inpatients in several countries. Only one study has described the extent of this in Australia. Unlicensed and off-label prescribing practices also have been described in European countries. Primary care, and pediatric intensive care. Five European studies have described such prescribing in neonates. One study showed an increased incidence of adverse drug reactions associated with the use of unlicensed and off-label medications compared with licensed medications in children on pediatric wards, including NICUs. One other study showed an increased number of adverse drug reactions associated with drugs used outside of the terms of their product license in pediatric intensive care.

The proportion of unlicensed and off-label drugs used in our study (11% and 47%) is similar to that described in France by Avenel et al (10% and 62%) and in the United Kingdom by Conroy et al (10% and 54.7%) and Turner et al (55% combined). The proportions are different to those found by ‘t Jong et al in the Netherlands (62% and 14%); this is explained by the extensive use of medications modified by and formulations manufactured by hospital pharmacies in that country. We found that in Australia, as in the United Kingdom, the incidence of unlicensed and off-label prescribing in NICUs is greater than among patients on general medical and surgical wards (16% combined). In our study, this is largely accounted for by the frequent use of drugs (eg, morphine, mexiletine, inotropics), which are not approved for use in newborns. The frequency of use of these drugs underlines their fundamental importance in the care of the sick newborn; the lack of licensed alternatives suggests that these are the drugs that most urgently require labeling.

The reasons traditionally given for the lack of proper testing of drugs in children has been that such trials are not economically viable for the small number of prescriptions that will be used and that consent for such trials is difficult to obtain. Concerns have also been raised about whether pharmaceutical trials are ethical in infants. The current situation—that drugs that have not been formally evaluated in children are in widespread use—is more unethical than undertaking proper studies to clarify whether these agents are safe and efficacious.
Concerns have been raised regarding prescriber liability in the event of adverse outcomes associated with unlicensed or off-label drug prescription.\textsuperscript{2,7,20,24} A recent statement from the American Academy of Pediatrics\textsuperscript{25} said that off-label prescribing does not necessarily constitute negligent practice; on the contrary, the practice of medicine may require the off-label use of drugs to provide the most appropriate treatment for a patient. Although this is the case, uncertainty still clouds the issue.

In 1997, the US Food and Drug Administration Modernization and Accountability Act introduced legislation to ensure that new drugs submitted for approval contain information and recommendations regarding their use in children unless the drug is specifically not intended for use in the pediatric age group. The “rewards” for conducting research in children include extension of the traditional period of patent and intellectual property rights to the formulation to increase financial return on the drug.\textsuperscript{23,24} Since the institution of such legislation, approximately 400 trials have been undertaken.\textsuperscript{4}

The European Commission invited submissions from clinicians, pharmacists, the pharmaceutical industry, and other interested parties for draft legislation regarding the proper licensing/registration of drugs used in children in the European Union.\textsuperscript{23}

In 1997, the report of the Working Party for Medicines in Children of the Australian Drug Evaluation Committee was issued.\textsuperscript{3} This report made a number of suggestions as to how the use of such drugs in children could be improved. Nearly 5 years later, few, if any, of these recommendations have been implemented.

**CONCLUSION**

This is the largest study that has specifically investigated unlicensed and off-label drug use in infants who require neonatal intensive care. It shows that, as in Europe and the United States, unlicensed and off-label drug prescribing is common in Australian NICUs and is more prevalent than in general pediatric practice. The extent of this prescribing illustrates that sick neonates do not benefit from the same safeguards as adults. Infants of extremely low birth weight are at greatest risk because of the high number of unlicensed and off-label drugs that they receive. Prescribing unlicensed and off-label drugs puts the neonatal pediatrician at risk of liability. Unfortunately, if they are to give their patients the best care they know, they have no choice. This is most unsatisfactory for the doctors and the children.

The Department of Health, pediatricians, pharmacists, and the pharmaceutical industry have a responsibility to ensure that the children are not discriminated against and are given treatment that has been appropriately tried and tested. This is going to be expensive and difficult, but if we do not start soon, we will be in the same position in another 5 years.

**REFERENCES**


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<table>
<thead>
<tr>
<th>TABLE 2. The 10 Most Frequently Used Unlicensed or Off-Label Drugs</th>
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<tbody>
<tr>
<td><strong>Drug</strong></td>
</tr>
<tr>
<td>Morphine</td>
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<tr>
<td>Theophylline</td>
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<tr>
<td>Aminophylline</td>
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<tr>
<td>6% Sodium chloride phosphate</td>
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<td>Dobutamine</td>
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<td>Paracetamol</td>
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<td>Spironolactone</td>
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<td>Dopamine</td>
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<tr>
<td>Phenobarbitone</td>
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17. ’t Jong GW, Eland IA, Sturkenboom MCJM, van den Anker JN, Stricker BHCh. Unlicensed and off label prescription of drugs to children: population based cohort study. BMJ. 2002;324:1313–1314
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