90,000 malpractice claims, medical error was the second most frequent cause and the second most expensive basis for litigation (3).

Sedation Errors
Closely associated with medication errors are adverse sedation events. A study reported in the Pediatrics Journal reviewed 95 incidents, 60 of which resulted in adverse outcomes. The most commonly used medication in combination with other sedating medications causing adverse events was nitrous oxide. Medications with long plasma half-lives such as a chloral hydrate, pentobarbital, promethazine and chlorpromazine were associated with deaths and injuries after discharge from medical supervision (6). Children receiving medications with long plasma half-lives may benefit from a prolonged period of post-sedation observation (7).

Previously, we identified as the second most expensive basis for medical liability for hospitals. The mortality rate was significantly higher for children than adults (54% versus 44%). It was reported that complications were more frequently thought to be preventable with additional monitoring. Payments for permanent injuries in pediatric claims were nearly five fold that of adult claims.

House Staff
Related pediatric liability issues include the use of residents in children’s teaching hospitals. As reported in Archives of Pediatric Medicine (1), 14% of patients at a teaching hospital were named in 26% of malpractice claims, a finding consistent in many studies. Reasons for this are numerous: they lack experience, have limited continuity of care with the patients, and work long hours. Frequently allegations were for failure to diagnose and treat. Failures to diagnose commonly included serious illnesses such as appendicitis or meningitis (41%). Problems with technique were also frequently identified, with many of the cases being operative complications. Forty one percent of claims involving surgical residents found that supervision was a critical issue.

Resident physicians represent a huge financial liability for hospitals. From 1980 through 1989 for cases tried or dismissed, payments ranged from $10,000 to $6.9 million. The mean payment was $716,000 with the median payment $275,500 (8). Risk management efforts are clearly focused on improving supervision and identifying strategies to reduce incidence of malpractice.

Critical Care
National Intensive Care Unit liability is significant. High-risk cases involved infants who were full term, white, privately insured and those with neurological conditions. Reasons cited include treatment error or delay in 48% of cases, general improper care 32%, missed or delayed diagnosis 16%, and equipment malfunction or misuse 6% (9).

Two separate studies were done addressing pediatric trauma and delayed diagnoses. A delay in diagnosis of injury is a serious injury first recognized after admission to the hospital and completion of the primary and secondary survey (10). While fractures are the most common, other are listed in table II. Multiple fractures of the extremities can be missed with a more serious injury. Cervical spine injuries often resulting from seemingly minor trauma have been missed in up to 14% of pediatric patients, yet these injuries often become readily apparent as a child awakes and begins to eat, speak, and move around. Children may be at increased risk for delayed diagnosis injuries because of the severity of their injuries and their compromised ability to participate in their physical examination. Severity of injury by itself is not an effective indicator of injury. Other variables associated with delayed diagnoses include: being female, motor vehicle accident, head injuries and alteration in consciousness.

Different variables were identified in another study specific to blunt trauma. Factors included in this study were severity of injury, blunt mechanisms of injury, clinical instability at presentation to the emergency department, altered level of consciousness from head injury or intoxication, level of training of the physicians, inadequate radiographic evaluation, and hospital admission to non-surgical services (14). Not only do delayed diagnoses increase patient morbidity and mortality, they raise the liability for the health care team. Twenty eight percent of autopsies revealed unrecognized injuries that either directly contributed to or were the primary cause of death (11). Children also have longer Pediatric Intensive Care Unit and hospital stays. Of the delayed diagnosis injuries, 17% required operative intervention and 86% required some alteration in treatment.

To minimize delay in diagnosis injuries, the authors recommend activation of the trauma team, admission to Trauma Service, admission to the Intensive Care Unit, and documentation of performance of tertiary survey.

Pediatricians
The Physicians Insurers Association of America reports that pediatricians remain at low risk for medical malpractice. Despite the fact pediatricians rates sixth among 16 medical specialties for medication related claims (average of $292,000 per case), pediatric settlements were twice that of other specialties (3).

Errors in diagnoses accounted for 33% of malpractice claims. Meningitis was the most prevalent condition that pediatricians allegedly erred in diagnosing (12). This was confirmed with new sub-specialists viewed the treatment of meningitis as well. When asked to rate the median time from emergency room presentation to administration of antibiotics in a child with suspected meningitis, errors were confirmed with new subspecialists fearing that the outcomes known to be desired, namely a shorter elapsed time. Emergency room physicians estimated time to the antibiotic administration was 46 minutes and institutional discharge physicians estimated time was 80 minutes. This consistently underestimated the actual median time determined by chart review, which was 120 minutes (13).

Appenicitis, while a common childhood illness is also a frequently missed medical condition. The accuracy of correct diagnosis for the managed care pediatricians was 46%, with 40% for private pediatricians (14). Incidence of perforated appendix was similar as well. 28% for managed care and 30% for private pediatricians. Authors reporting in the Journal of Pediatric Surgery conclude that there is not a significant difference in the accuracy of diagnosis for appendicitis in the two groups of pediatricians.

Other diagnostic errors included nonarteriographic anomalies, brain damage in infants, and congenital anomalies of the genitals. Errors in diagnosing meningitis resulted in the

References

Table II

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<th>Pediatric Trauma Delay in Diagnosis</th>
<th>Face</th>
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<th>Abdominal</th>
<th>Musculoskeletal</th>
<th>Cerebral</th>
<th>Orbital</th>
<th>Head-injured</th>
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<td>Failures</td>
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NOTE:
In this issue:

• Medical Errors
• Sedation Errors
• House Staff
• Critical Care
• Pediatricians

Medication errors

Medication errors are three times higher among children and infants than among adults (1). These errors commonly involve incorrect drugs or drug dosages. Nearly one in every 17 medications ordered for infants and children by hospital physicians is incorrect. A recent study report in JAMA 2001 stated most of the adverse drug events occur at the stage of drug ordering and involved incorrect dosing. Using computerized physician order entry could have prevented 93% of errors and 94% of adverse drug effects could have been prevented with a ward-based clinical pharmacist (2).

This serious problem has also been addressed by the American Academy of Pediatrics. In a study looking at medication errors in hospital settings, they found that antibiotics, analgesics and cardiovascular drugs were most frequently associated with errors (3). The most common error was incorrect dosing. The error rate was greatest for first year residents, followed by the attending physicians. Fortunately, 75% of medication errors were corrected before the drugs were administered to patients. Pediatric medication doses must be calculated by patient weight. There is considerable risk for mathematical errors when very small amounts of drugs are ordered. Decimal point misplacement is the most frequent serious error, occurring in 28% of pediatric errors reported (4). Toxicity with medications such as morphine and other opiates were a significant dose-related problem, particularly with the decimal point errors. In 16% of the cases, failure to divide the total daily dose into individual doses occurred.

In pediatric emergency departments, most errors occurred on the evening and night shifts. Thirty-nine percent of reported errors involved nurses, and the nurse and emergency physician were involved jointly in 36% of errors (5). Frequently these represented an incorrect medication or dose, failure to note drug allergies and incorrect IV fluids. In over one-third of the cases, the family was not made aware of the errors. Twelve percent of the children required additional treatment and were admitted to the hospital.

Medication errors are extremely costly. They represent a frequent cause of litigation and, when associated with morbidity and mortality, increase healthcare costs by an estimated $1,900 per patient. The Physician Insurers Association of America reports that in