

# Accuracy of a State Immunization Registry in the Pediatric Emergency Department

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**Objective:** The purpose of this study was to ascertain whether either parental recall or a state immunization registry was as accurate as the medical record in determining immunization status in the emergency department (ED).

**Methods:** A convenience sample of children younger than 5 years who presented to the ED between July 2004 and May 2005 were enrolled prospectively. After obtaining informed consent, parents were asked about their child's immunization status. All children then had their immunization data accessed in the Arizona State Immunization Information System. The information obtained from the state registry, as well as the information from the parental interview, was then compared with the information on the medical record obtained from the primary care physician (PCP). Data were analyzed using simple descriptive statistics.

**Results:** A total of 332 children were enrolled in the study. A total of 302 (91%) children enrolled were found in the state database, and 222 (74%) of these had a medical record available for comparison. The database agreed with the PCP record in 130 (59%) cases; parental report agreed with the PCP record in 149 (62%) cases.

**Conclusions:** Although most children can be found in the state immunization registry, it seems to be similar in accuracy to parental recall of immunization status when each is compared with the medical record. This may have been due to either underreporting of immunizations from the community or a delay in updating the state database. At this time, neither parental recall nor the database would accurately determine a child's immunization status during an ED visit.

**Key Words:** immunizations, immunization registry, parental recall, vaccines, vaccine registry

The numbers of emergency department (ED) visits have reached all time highs in the past few years with more than 110 million visits in 2004, including nearly 23 million children younger than 15 years.<sup>1</sup> Only 9% of these ED visits for children were considered emergent and 36% were urgent.<sup>1</sup> This means that the ED is used by a majority of children for nonurgent, primary care type services.<sup>1</sup> Children found to have low rates of continuity of care are at high risk of ED utilization.<sup>2</sup> Because these children may not be

properly immunized, recent studies have examined the feasibility of administering immunizations in the ED in order to keep children current.<sup>3</sup> In Maricopa County, Arizona, only 77.8% of children ages 19 to 35 months were fully vaccinated in July 2005.<sup>4</sup> This does not meet the expected rate of vaccination of 90% set out by the Center for Disease Control in *Healthy People 2010*.<sup>5</sup> To improve the vaccination rates of our children, the Center for Disease Control has suggested that vaccine registries should be a "cornerstone" of the Nation's immunization system and hopes that 95% of children younger than 6 years are participating in a registry by 2010.<sup>6</sup>

In addition, assessing immunization status is crucial in guiding care in the ED. An accurate immunization status would help guide testing and treatment, for example, in febrile children without a source. Those with documented immunization against pneumococcus and *Haemophilus influenzae* type b may be at less risk for serious bacterial infection than those without immunizations.<sup>7</sup>

In New York and Pennsylvania, immunization registries have been set up to assist health care providers in determining the immunization status of their patients. However, studies have shown that they are not accurate enough to use in determining vaccine status in children.<sup>8,9</sup> In Arizona, there is an online immunization registry called the Arizona State Immunization Information System (ASIIS), which was implemented to provide information regarding immunization status to physicians. It is accessible 24 hours a day, 7 days a week. Currently, providers in Arizona are required to report all immunizations administered to children from birth through 18 years of age to the registry. This study was designed to determine if the information provided on ASIIS is accurate and reliable so that it can be used in the ED to assess immunization status and to compare ASIIS and parental recall with primary care medical records.

## METHODS

Approval from the hospital's Institutional Review Board was obtained in July 2004. The hospital is an urban tertiary care center whose ED sees approximately 56,000 children per year. Age was the only inclusion criteria. Children were excluded from participating in the study if primary care was received in another state. Children between the ages of birth and 5 years were enrolled prospectively using convenience sampling between July 2004 and May 2005 when they presented to the ED. A majority of samples were obtained between 0800 hours and 1700 hours when a research assistant was available; however, a small proportion

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**TABLE 1.** ASIIS Versus Medical Record

	Medical Record: Up to Date	Medical Record: Behind	Total
ASIIS: up to date	61	24	85
ASIIS: behind	68	69	137
Total	129	93	222

Comparison was made between the immunization information found on the state registry (ASIIS) and the medical record obtained from the primary care physician office. The state database agreed with the medical record in 130 of 222 (59%) cases.

was also surveyed during evening hours. After obtaining informed written consent, parents were asked about their child’s immunization status using a standardized questionnaire administered by a research assistant. If the parents were Spanish speaking, a hospital interpreter was used to aid in the processing of the paperwork. Information collected included date of birth, ethnic background, name of primary care physician (PCP), and parental recall of immunization status.

All children then had their immunization data accessed in the ASIIS. This system is a statewide registry that collects and uploads children’s immunizations onto an Internet accessible database. All health care workers who provide vaccines to children are required under state law to report those vaccines to the state registry. There is an electronic system that is available to practitioners and automatically reports vaccines to the registry when the provider bills for the vaccine. Some providers who may not administer many childhood vaccines may report by paper mail every 30 days. The information received by the state, whether electronically or manually, is then analyzed for quality assurance and uploaded onto the Internet database. This takes only 1 or 2 days if received electronically or up to 2 weeks if received manually. The lag time between when the shot is given and when the shot is reported to the state was as much as 95 days during the data collection for this study.

The immunization record from the PCP’s office was used for comparison as the “gold standard.” Among physicians in our community, vaccinations are transcribed into the medical record on the date of administration. The information obtained from the state registry, as well as the information from the parental interview, was then compared with the information on the medical record obtained from the PCP.

Children were determined to be current in their immunization status based on the age-appropriate immunization schedule from the American Academy of Pediatrics and the Immunization Practices Advisory Committee (2003). A child was labeled deficient if he or she needed 1 or more vaccines based on his or her age on the day of presentation to the ED.

Data were entered into an Excel spreadsheet program and exported to and analyzed with the use of a statistical software package (SAS version 9.2; SAS Institute, Cary, NC) by a trained biomedical statistician. Data analysis involved simple descriptive statistics and 95% confidence intervals (CI) to describe the characteristics of the sample.

**RESULTS**

A total of 332 children were enrolled in the study. The ethnic background of those enrolled was 216 Hispanic (65%), 78 Caucasian (23.5%), 15 African American (4.5%), and 23 other (7%). Eleven (3%) children were not included in the analysis because they were not found in the state database and had no medical record available when the PCP was contacted. Of those enrolled, 302 (91%) were found in the state database. The PCP record was obtained for comparison in 241 (73%) cases. In the remaining 91 (27%) cases, the child did not have a PCP or when contacted, the PCP had no record of the patient. Of those 241 children with records available, only 138 (57%) were found to be up to date for age according to their medical record.

Of the 302 children found in the state database, 80 (26%) of them had no medical record available for comparison. This left 222 (74%) children with information in both the state database and the medical record to be analyzed. The database agreed with the PCP record in 130 (59%) cases (Table 1). Also evident in the table is the disproportionate number of children who were behind on ASIIS but current per their actual immunization record. Of the 129 children who were current on their medical record, only 61 (47%) were also current on the ASIIS database. The ASIIS database has a specificity of 74% (95% CI: 64–82) and the sensitivity is only 47% (95% CI: 38–56). The negative predictive value of ASIIS reporting a child’s immunizations to be behind was 50% (95% CI: 41–59). The positive predictive value of ASIIS reporting a child’s immunizations to be current was found to be 72% (95% CI: 60–81).

Parental recall was then compared with the PCP record. Ninety-one (27%) children had unattainable medical records, leaving 241 (73%) children with immunization records that were available for comparison. Parental report was accurate when compared with the medical record in 149 (62%) cases (Table 2). Parental recall has a sensitivity of 96% (95% CI: 90–98) but a specificity of only 16.5% (95% CI: 9–25). The positive predictive value of a parent reporting a child’s immunizations to be up to date was found to be 61% (95% CI: 53–67), whereas the negative predictive value of a parent reporting delay is 74% (95% CI: 51–89).

It was thought that parental recall of vaccines may be more accurate when the child is younger and vaccine administration more recent. However, when our data were

**TABLE 2.** Parental Recall Versus Medical Record

	Medical Record: Up to Date	Medical Record: Behind	Total
Parental recall: up to date	132	86	218
Parental recall: behind	6	17	23
Total	138	103	241

Comparison was made between the immunization information provided by the parents and that found in the medical record obtained from the primary care physician’s office. Parental recall agreed with the medical record in 149 of 241 (62%) cases.

analyzed for children 2 years and younger, there was no statistically significant difference in outcomes.

## DISCUSSION

Several studies have examined ED assessment of immunization status. Cunningham enrolled 9321 children in an ED-based study that assessed vaccination status. Children were eligible for enrollment from birth to 5 years of age. A total of 59% of the children were documented on their immunization card or in their medical record to be under-immunized.<sup>3</sup> In our population, 103 (43%) of the children were found to be underimmunized according to their medical record.

Determining vaccine status in the ED may become even more important in the management of well-looking febrile children in the age of conjugate pneumococcal vaccine. Before the advent of the vaccine, occult pneumococcal bacteremia occurred in 2.5% to 3% of highly febrile children 3 to 36 months of age.<sup>10</sup> Kaplan et al<sup>11</sup> found that the number of invasive pneumococcal infections declined in 2002 after the advent of the pneumococcal vaccine by 66% in children younger than 2 years when compared with the years 1994 to 2000.<sup>11</sup> Lee et al<sup>12</sup> performed a cost-effectiveness analysis of febrile workups on well-appearing children after the introduction of the conjugate pneumococcal vaccine and found that once the rate of bacteremia declines to 0.5%, clinicians will likely need to eliminate empiric testing and treatment. A recent study by Herz et al<sup>13</sup> calculated the "occult bacteremia rate" to be 0.25% after the introduction of the pneumococcal vaccine. If a patient's vaccine status could be determined in the ED, it would help decrease testing and treatment.

Previous studies have suggested that if parents could provide an accurate immunization history, delinquent vaccines could be delivered in the ED.<sup>14-17</sup> However, Goldstein et al<sup>14</sup> found that accompanying adults provide inadequate information to determine accurately which children need immunizations in the ED. They found that 64% of adults reported that their child's immunizations were "up to date," but only 65% of them had records to support this.<sup>14</sup> Moreover, 45% of adults accompanying children 16 months and older provided inaccurate information regarding previous receipt of measles immunization.<sup>14</sup> Our study found that parental report was accurate when compared with the medical record only 62% of the time, with parents underestimating when the children were behind. These results are similar to previous studies in this area and conclude that parents cannot be relied upon for correct information regarding vaccine status. Some other document or database is needed to adequately assess a child's immunization status.

For vaccines to be administered in the ED, an accurate database of immunizations already received needs to be available to ED staff. Some states are trying to maintain a statewide registry of vaccines to aid providers in determining accurate immunization histories. A recent study by Callahan et al<sup>8</sup> found that only 34% of children who presented to an ED in New York were registered in the regional immunization registry there. This registry is voluntary and encom-

passes 14 counties in central New York. Of those in the registry, 61% were actually found to be up to date, whereas 96% of these parents thought that their children were up to date.<sup>8</sup> They concluded that having an immunization registry available would assist in increasing vaccination rates by providing accurate immunization information to all health care workers utilized by the child and his or her family.

In Arizona, where reporting is mandated, 91% (302/332) of children were actually found in the registry, meaning most children are being captured by the state database. Although 89% (295/332) of parents interviewed thought that their child was up to date, only 37% (112/302) of the children were fully vaccinated according to the state registry. However, the medical record indicated that in fact, 57% (138/241) were up to date.

This is comparable to a study by Kolasa et al<sup>9</sup> in Pennsylvania. They found that 92% of kids were found in a state registry. This state registry maintains its data using the following: manual logs sent to the registry, electronic medical records and billing records transferred via a Web file repository system, or data submitted via a disk or direct electronic transfer. The data in the medical record showed the kids to be 80% covered, whereas the state registry only showed 62% coverage.<sup>9</sup> There seemed to be better correlation between the registry and the medical record when electronic data transfer systems were used. They also found that hospital-based clinics were better at reporting than other private clinics.

With several states now using statewide vaccine registries, it may be helpful to perform a study similar to this one in several different states, looking at the accuracy of each state's system. If one system is found to be superior, other states may want to use that system to track their vaccinations as well. If several states begin to use the same type of registry, states may be able to share immunization information easily. This may eventually lead to the development of a nationwide vaccine registry.

From our results, it seems that not all immunizations are being reported to ASIIS or there is a delay in uploading the information. The processing time to upload the data onto the system may be the limiting factor. If immunizations were entered into the database and available for physician use in real time, the registry would be a more accurate means of determining immunization status. However, at present, there is not a timely system in place. Every physician has the choice of how to send the information to the state registry. Providers may use a billing system that is linked to the state registry or they may mail the immunizations within 30 days. Approximately 50% of registered providers report by paper and mail their immunizations within 30 days. However, these are providers who do not provide a large number of the vaccinations in Arizona because they only represent 6% of the data entered. The physicians that mail their immunization records to the state registry in batches still must have that information entered into the computer system after it is reviewed for completeness. This may take up to 2 weeks once the information is received by the state. In addition, some physicians do not report. Electronic users account for 94% of the data entered. The information sent electronically



is still reviewed by the registry before it is uploaded and available for viewing. This takes only a day or two once the information is received by the state. However, the lag time between the date of shot administration and the date of reporting the shot to the state seems to be the rate-limiting step. During our study, the lag time was approximately 95 days at the beginning of our data collection but slowly decreased to approximately 55 days by the end of our study. Many improvements to the efficiency of the system have been made since this study, and a follow-up study may show that more accurate information is now available on the registry.

If a method could be devised to more efficiently upload data directly from the physician's office onto the Internet, the registry could be used for real-time assessment of a child's immunization status. Not only would it help us to assure that every child is properly vaccinated, it may help reduce excessive testing and treatments in the ED as well.

### LIMITATIONS

This study was performed using convenience sampling during weekly daytime and evening hours. Therefore, results are representative of the population who uses the ED during these hours.

In our study, ASIIS reported 24 patients to be up to date, whereas the medical record was not up to date. If patients received vaccines at places other than their PCP office, there is the possibility that the proxy-gold standard is incorrect and ASIIS is accurate in these instances. A study by Smith et al<sup>18</sup> showed that in Arizona, approximately 70% (95% CI: 65%–75%) of children who were eligible for the "Vaccines for Children" program and had a medical home actually received all of their vaccine doses from their medical home. This means that among "Vaccines for Children" eligible children who have a medical home, in as many as 30% of cases, the medical record may not be accurate because the child may have received vaccines elsewhere.

In addition, registry data were retrieved on the date of service in the ED. Given this "real-time" accession of the database, our results may underestimate the accuracy of ASIIS given the lag time in reporting from some offices as well as the time to process data and upload onto the Internet, as previously discussed. This makes its use in the ED limited at this time. However, its utility in a primary care office cannot be determined based on this study.

We also only looked at young children younger than 5 years because the ASIIS system was fairly new at the time. After several years of uploading immunization data, the database may be more valuable in determining immunization status in older children.

### CONCLUSIONS

Although most children can be found in the state immunization registry, it seems to be similar in accuracy to parental recall of immunization status when each is compared with the medical record. This may be due to underreporting of immunizations from the community or a delay in updating the state database. The database, although accessible, does not provide immediately up-to-date information that is useful

in practice in the ED. At this time, neither the database nor parental report can be used to accurately determine a child's immunization status during an ED visit.

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