Compliance With Universal Precautions Among Pediatric Residents

Scott Moore, MD; Hillary Goodwin, MD; Richard Grossberg, MD; Philip Toltzis, MD

Background: There are few data on the rate of compliance with universal precautions among pediatricians. We hypothesized that compliance in pediatrics would be poor because of the intrinsic difficulties in performing invasive procedures in small subjects.

Design: Prospective, observational study.

Setting: Tertiary care children’s hospital.

Study Participants: A convenience sample of pediatric house staff.

Main Outcome Measures: Pediatric house staff members were observed while performing invasive procedures. Procedure type, number of attempts required, and patient’s age and diagnosis were recorded. Degree of compliance with universal precautions was judged by means of Centers for Disease Control and Prevention guidelines. Comparisons between the compliant and noncompliant groups were analyzed by $\chi^2$ and 2-tailed t test.

Results: A total of 128 procedures performed by 43 house officers, 4 advanced medical students, and 3 chief residents or fellows were observed. Sixty-nine (53.9%) of the 128 procedures were performed correctly according to universal precaution guidelines. Rate of compliance did not appear to be influenced by small patient size, as judged by the lack of association with the age of the patient (mean±SD, 4.8±5.7 years among those in whom universal precautions were properly used vs 4.9±5.4 years among patients in whom precaution guidelines were breached; $P=96$). Moreover, the number of attempts required in compliant procedures (1.31±0.53) was almost identical to that in noncompliant procedures (1.28±0.49; $P=.73$). Additionally, compliance did not improve with advanced level of training.

Conclusions: Failure of compliance among pediatricians has no apparent association with procedure difficulty, and compliance rates continue to be poor through the course of pediatric training. These findings underline the need for effective education concerning universal precautions throughout pediatric residency, and they suggest that such efforts will not be precluded by obstacles intrinsic to performing invasive procedures on young subjects.


Editor’s Note: The aberrant 100% compliance with universal precautions for lumbar puncture is intriguing. Is it caused by (1) concern for the patient rather than “self,” (2) even the oldest faculty member was taught to do it that way (nothing new), or (3) something less obvious? Any thoughts?

Catherine D. DeAngelis, MD

From the Department of Pediatrics, Rainbow Babies and Childrens Hospital, Case Western Reserve University School of Medicine, Cleveland, Ohio.

In 1985 the Centers for Disease Control and Prevention outlined precautions designed to protect clinical and laboratory personnel from infection by pathogens borne by blood and other body fluids. In 1987 and 1988 these guidelines were presented under the name of universal precautions. Although several studies have examined the rate of compliance with universal precautions, particularly the proper use of gloves and other barriers, in a variety of medical settings, few have addressed this issue in pediatric populations. Moreover, no study, to our knowledge, has attempted to identify factors that determine compliance with universal precautions among pediatricians.

Like other physicians, pediatricians are at risk for inadvertent infection through medical accidents by viruses that cause substantial morbidity and mortality, such as human immunodeficiency virus (HIV) and hepatitis B and C. Therefore, it is critically important to assess compliance with universal precautions among pediatricians and to identify barriers to compliance that may be unique to pediatrics, as a means of rationally devising methods to promote adherence to these guidelines. This study was designed to test the hypo-
SUBJECTS, MATERIALS, AND METHODS

The study was performed at a tertiary care children's hospital in the American Midwest between December 1, 1995, and March 31, 1996. All pediatric house staff members employed in this hospital are instructed on the proper use of gloves and other aspects of universal precautions during a mandatory in-service at the beginning of internship. The in-service lasts approximately 1 hour and is administered by hospital infection control nurse practitioners. Appropriate use of gloves is discussed in detail; eye protection is recommended for any procedure likely to generate an aerosol. Latex gloves are readily available in all treatment areas.

Procedures were observed by 3 of us (S.M., H.G., and R.G.) on a convenience sample of house officers in the emergency department and on the inpatient wards. Observations were recorded during both the day and evening hours. To avoid introducing bias into resident behavior, subjects were told that they were being observed to study physician-patient interactions during painful procedures. The residents were assured that participation was voluntary, that the observations would be recorded by means of coded numbers instead of physician names, and that the results would not be used punitively. There were no refusals. The study was approved by the Institutional Review Board of University Hospitals of Cleveland, Cleveland, Ohio, which waived the requirement for informed consent.

For each observation, the following data were collected: type of procedure, whether gloves and protective eyewear were appropriately used, blood-skin contact, blood–mucous membrane contact, year of training of the resident, and patient age and diagnosis. Additional variables were recorded by means of definitions established before the beginning of the study. Patients were judged to be at high risk for infection with a blood-borne pathogen if they carried an established or suspected diagnosis of hepatitis or HIV infection or if they had a history of an illness that frequently required multiple blood transfusions, such as hemoglobinopathy, prematurity, or repaired congenital heart disease. The resident was designated as “busy” if, while he or she was in the emergency department, there were 8 or more patients waiting to be seen at the time of the observation (matching the number of examination rooms in that unit), or if, while on the inpatient wards, the resident was observing 10 or more patients.

Subjects were judged compliant with universal precautions according to Centers for Disease Control and Prevention guidelines. Specifically, gloves were required for venipunctures, arterial blood sampling, intravenous catheter (IV) placement, and lumbar punctures, and gloves and protective eyewear were required for irrigating and suturing a laceration. The resident was recorded as compliant only if protection was used throughout the entire procedure. The observation was judged noncompliant if gloves were intentionally torn to aid palpation of landmarks. Compliant and noncompliant groups were compared by X² for discriminant variables and by 2-tailed t test for continuous variables.

RESULTS

A total of 128 procedures performed by 43 residents (of a total of 67), 4 advanced medical students, and 3 chief residents and fellows were observed. The numbers of procedures observed by year of training were as follows: 5 by advanced medical students, 55 by interns, 41 by second-year residents, 23 by third-year residents, and 4 by chief residents or fellows. The mean number of observations per house officer was 2.5, with a median of 2 and a range of 1 to 6. A total of 65 procedures were observed in the emergency department and 63 on the inpatient wards.

Overall, compliance with universal precautions was recorded in 69 (53.9%) of the 128 observations. There was no difference in compliance rates between procedures performed in the emergency department and those completed on the inpatient wards (55.4% vs 52.4%, respectively). Compliance rates differed significantly according to procedure (Table). All suture procedures were judged noncompliant because of the uniform omission of protective eyewear while the wound was irrigated, although gloves were used in all instances. Excluding suture placement, compliance during IV placement was significantly worse than for other procedures (Table). Blood-to-skin contact was noted in 17 procedures. All blood-to-skin contact occurred when universal precautions had been breached. Twelve of these instances of blood-to-skin contact occurred during IV placement. No blood-to–mucous membrane contact was experienced.

There was little evidence that the intrinsic difficulty of performing procedures in small patients was the principal obstacle to complying with universal precautions. Specifically, there was no association between patient age and noncompliance. The age of the patients in whom compliance was observed (mean±SD, 4.8±3.7 years) was nearly identical to that of patients in whom compliance was breached (4.9±5.4; P=.96). Indeed, the rate of compliance during procedures performed in patients younger than 1 year (27/41 observations [65.9%]) exceeded the rate during procedures performed on older

### Table: Compliance With Universal Precautions According to Procedure

<table>
<thead>
<tr>
<th>Procedure</th>
<th>Compliant</th>
<th>Noncompliant</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intravenous catheter placement</td>
<td>24 (40)</td>
<td>36 (60)*</td>
</tr>
<tr>
<td>Arterial puncture</td>
<td>6 (67)</td>
<td>3 (33)</td>
</tr>
<tr>
<td>Venipuncture</td>
<td>23 (86)</td>
<td>12 (34)</td>
</tr>
<tr>
<td>Suture</td>
<td>0 (0)</td>
<td>8 (100)</td>
</tr>
<tr>
<td>Lumbar puncture</td>
<td>16 (100)</td>
<td>0 (0)</td>
</tr>
</tbody>
</table>

*Intravenous catheter placement vs all other procedures, P=.001; vs arterial and venous puncture, P=.01.
children (42/87 observations [48.2%]; \( P = .06 \)). Furthermore, there was no detectable association between apparent procedure difficulty, as reflected in the number of attempts required for its completion, and compliance. The mean number of attempts required for procedures in which universal precautions were observed was 1.31±0.53; procedures in which precautions were not observed required 1.28±0.49 attempts (\( P = .73 \)). The only indicator that suggested at least the perception of procedure difficulty may have influenced compliance with universal precautions was the lower compliance rate in IV catheter placement compared with the technically less demanding venous and arterial punctures, as noted above (Table).

We further hypothesized that resident compliance with universal precautions would be adversely influenced both by patient load and by the inexperience of the operator. Indeed, the first association was documented. Specifically, 39 (63%) of 62 procedures performed during nonbusy times were executed according to universal precaution guidelines, vs 30 (45%) of 66 procedures conducted when the resident was busy (\( P = .05 \)). However, compliance did not increase with level of resident experience. Indeed, overall compliance among senior residents (8/23 [35%]) was worse than that among interns and second-year residents (54/96 [56%]; \( P = .06 \)). These results were skewed by 1 of the 11 observed senior residents who breached compliance during each of the 5 procedures assessed. However, even after this 1 resident was eliminated from consideration, compliance rates among senior residents approximated that of more junior staff. Therefore, as experience and dexterity in performing procedures in young children presumably increased, compliance with universal precaution policies, at the very least, did not improve.

Finally, we tested whether behavior was positively modified when patients were perceived to be at increased risk for blood-borne pathogens. Twelve patients carried a diagnosis that was designated as high risk, although only 1 (with hepatitis) had a documented bloodborne infection. Compliance in this group was observed in 8 (67%) of 12 patients vs 61 (52.5%) of the 116 remaining patients (\( P = .35 \)).

Universal precaution guidelines were developed to prevent the transmission of infections borne in the blood and other body fluids to health care workers. Since their introduction, they have become standard operating procedure in all medical facilities. Recognizing the particularly high risk incurred in the emergency department setting, previous studies examining compliance with universal precautions have concentrated on their practice among emergency medical services staff and emergency department personnel. These studies have documented a wide range of compliance rates. Appropriate use of gloves has been recorded in 44% to 98% of procedures. A national survey of hospital-based workers not limited to the emergency department also indicated poor compliance with glove use, with only 32% to 43% reporting 100% use during phlebotomy or IV placement.\(^ {16} \) Surveys conducted in previous studies have identified lack of time of caregivers and interference with dexterity\(^ {17,18} \) as the principal hindrances to compliance.

However, data surrounding the compliance with universal precautions among pediatricians, where issues of time and dexterity are paramount, are lacking. The current study documented poor compliance with universal precautions among pediatric house staff a decade and a half after the recognition of the threat of HIV transmission through blood contact. There was little evidence that poor compliance rates were associated with the unavoidable difficulty of performing invasive procedures in small patients. Specifically, compliance had no apparent relationship to patient age, as would be expected if the principal barrier to universal precautions were the intrinsic difficulty in performing procedures on small subjects. Moreover, compliance with universal precautions was not influenced by the apparent difficulty of the procedure, as reflected by the number of attempts required for its completion.

This study was conducted in the Midwest, where the prevalence of pediatric HIV infection is low; compliance with universal precautions in areas where HIV infection is more commonplace may be higher than those recorded here. Additionally, this study was limited by the inherent difficulties in defining some of the potential mediators of compliance with universal precautions. For example, while the number of attempts made to complete a procedure was used as a reflection of its difficulty, this variable certainly was influenced by other factors as well, such as the skill of the operator and the abilities of the assistant. Similarly, the definitions of “busyness,” although commonsensical and established prospectively, were arbitrary and could not entirely reflect the acuity and stress of a particular resident's day. The observation that senior residents adhered no better to universal precautions than those more junior also may have been influenced by unrecorded factors. For example, the most difficult procedures may have been referred to the more senior house staff, and their poor compliance may have been a reflection of their perceived or real requirement for increased dexterity. Even assuming a legitimate underlying reason for the poor compliance among senior house staff, however, this observation is particularly troublesome, since the senior residents set an example for the interns and second-year personnel. Moreover, it is possible that their poor compliance may have been merely a reflection of diminished commitment to proper practice. Indeed, previous studies also have documented relatively poor compliance among more experienced nurses\(^ {14} \) and higher-level emergency medical services staff\(^ {5,8} \) compared with their less-experienced counterparts.

These data underline that, despite both public and professional awareness of the dangers of blood-borne pathogens, compliance with universal precautions is poor among pediatric house staff. The lack of association with the technical challenges inherent in pediatric procedures suggests that this poor compliance is amenable to correction. Interventions to increase compliance with universal precautions have had mixed and temporary results,\(^ {6,8,10,19,15} \) but some studies have suggested that per-

---

**COMMENT**

Universal precaution guidelines were developed to prevent the transmission of infections borne in the blood and other body fluids to health care workers. Since their introduction, they have become standard operating procedure in all medical facilities. Recognizing the particularly high risk incurred in the emergency department setting, previous studies examining compliance with universal precautions have concentrated on their practice among emergency medical services staff and emergency department personnel. These studies have documented a wide range of compliance rates. Appropriate use of gloves has been recorded in 44% to 98% of procedures.\(^ {4,6,12,14,15} \) A national survey of hospital-based workers not limited to the emergency department also indicated poor compliance with glove use, with only 32% to 43% reporting 100% use during phlebotomy or IV placement.\(^ {16} \) Surveys conducted in previous studies have identified lack of time of caregivers and interference with dexterity\(^ {17,18} \) as the principal hindrances to compliance.

However, data surrounding the compliance with universal precautions among pediatricians, where issues of time and dexterity are paramount, are lacking. The current study documented poor compliance with universal precautions among pediatric house staff a decade and a half after the recognition of the threat of HIV transmission through blood contact. There was little evidence that poor compliance rates were associated with the unavoidable difficulty of performing invasive procedures in small patients. Specifically, compliance had no apparent relationship to patient age, as would be expected if the principal barrier to universal precautions were the intrinsic difficulty in performing procedures on small subjects. Moreover, compliance with universal precautions was not influenced by the apparent difficulty of the procedure, as reflected by the number of attempts required for its completion.

This study was conducted in the Midwest, where the prevalence of pediatric HIV infection is low; compliance with universal precautions in areas where HIV infection is more commonplace may be higher than those recorded here. Additionally, this study was limited by the inherent difficulties in defining some of the potential mediators of compliance with universal precautions. For example, while the number of attempts made to complete a procedure was used as a reflection of its difficulty, this variable certainly was influenced by other factors as well, such as the skill of the operator and the abilities of the assistant. Similarly, the definitions of “busyness,” although commonsensical and established prospectively, were arbitrary and could not entirely reflect the acuity and stress of a particular resident’s day. The observation that senior residents adhered no better to universal precautions than those more junior also may have been influenced by unrecorded factors. For example, the most difficult procedures may have been referred to the more senior house staff, and their poor compliance may have been a reflection of their perceived or real requirement for increased dexterity. Even assuming a legitimate underlying reason for the poor compliance among senior house staff, however, this observation is particularly troublesome, since the senior residents set an example for the interns and second-year personnel. Moreover, it is possible that their poor compliance may have been merely a reflection of diminished commitment to proper practice. Indeed, previous studies also have documented relatively poor compliance among more experienced nurses\(^ {14} \) and higher-level emergency medical services staff\(^ {5,8} \) compared with their less-experienced counterparts.

These data underline that, despite both public and professional awareness of the dangers of blood-borne pathogens, compliance with universal precautions is poor among pediatric house staff. The lack of association with the technical challenges inherent in pediatric procedures suggests that this poor compliance is amenable to correction. Interventions to increase compliance with universal precautions have had mixed and temporary results,\(^ {6,8,10,19,15} \) but some studies have suggested that per-

---

**ARCH PEDIATR ADOLESC MED/ VOL 152, JUNE 1998**

©1998 American Medical Association. All rights reserved.
sonnel, particularly those who are less seasoned, may be positively influenced. The observations documented in this study emphasize the need to test such interventions in pediatric practice.

Accepted for publication December 12, 1997.
Reprints: Philip Toltzis, MD, Rainbow Babies and Childrens Hospital, 11100 Euclid Ave, Cleveland, OH 44106 (e-mail: pxt2@po.cwru.edu).

REFERENCES