Screening for Lead Poisoning in an Urban Pediatric Clinic Using Samples Obtained by Fingerstick

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ABSTRACT. *Objective.* **To assess the false positive rate of blood lead (BPb) determinations on samples obtained by fingerstick from children screened in an urban clinic.**

Method. **From a single fingerstick (N = 1573), blood was collected in a capillary tube for determining lead concentration (CPb) by graphite furnace and an additional sample was absorbed onto a filter paper for determining lead concentration (FPb) by atomic absorption spectrophotometry with Delves cup. Zinc protoporphyrin (ZPP) was measured immediately and a confirmatory venous lead (VPb) specimen was obtained at the same visit if the ZPP was ≥35 μg/dL (0.6 μmol/L); children with either a CPb or FPb ≥15 μg/dL (0.7 μmol/L) were later recalled for determining VPb.**

Results. **For the 172 children who had a VPb on the same day as the screening tests, the false positive rates (95% confidence intervals) at a lead threshold of 15 μg/dL (0.7 μmol/L) were: CPb, 13.5% (6.7–20.3); FPb, 19.1% (11.8–26.4). Analyses using all 679 screens with a paired venous specimen (mean delay between screen and venous testing = 30 days) yielded much higher false positive rates (CPb, 31.3%; FPb, 46.0%).**

Conclusions. **Screening for lead poisoning is feasible within an urban pediatric clinic by direct measurement of lead concentration in blood samples obtained by fingerstick. The false positive rate that can be obtained is acceptable given the precision of measuring BPb concentration. Practitioners using a staged screening protocol may incorrectly attribute a higher false positive rate to the screening tests, when much of the error may be due to the temporal variability of BPb resulting from both biologic variability in BPb concentration and intermittent exposures.** *Pediatrics* **1994;94:174–179;** ***lead poisoning, lead, plumbism, screening, erythrocyte protoporphyrin, zinc protoporphyrin, laboratory screening.***

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ABBREVIATIONS. CDC, Centers for Disease Control and Prevention; BPb, blood lead; ZPP, zinc protoporphyrin; CPb, capillary lead; FPb, filter paper lead; VPb, venous lead.

In recognition of increasing evidence of the association of lower levels of lead exposure with adverse neurodevelopmental outcome in children, the Centers for Disease Control and Prevention (CDC) recently lowered the intervention threshold for blood lead (BPb) from 25 μg/dL (1.2 μmol/L) to 10 μg/dL (0.5 μmol/L) and recommended individual case management for children with BPb ≥15 μg/dL (0.7 μmol/L).[1]

The screening test recommended by the previous CDC guidelines,[2] erythrocyte protoporphyrin, often measured as zinc protoporphyrin (ZPP) by hematofluorometry, is an insensitive screen for even moderate lead poisoning[3–5] and is no longer felt to be a reasonable screening test for lead poisoning.[1,6] Instead, direct measurement of BPb is proposed as the only acceptable screening blood test. Venous BPb is the "gold standard" for determining the performance parameters of other screening tests, but phlebotomy of virtually all infants and toddlers is impractical. For universal screening to become a reality, BPb needs to be measured reliably and accurately on specimens obtained by fingerstick.

There is concern, though, that specimens obtained by fingerstick may be contaminated by lead-containing dust or dirt (such as from the skin surface) producing false positive results. Little information is available about the false positive rates of fingerstick screening samples and about the effectiveness of techniques to reduce contamination. This study compares three methods of screening for lead poisoning using fingerstick blood specimens: 1) zinc protoporphyrin (ZPP): measured by hematofluorometer; 2) Capillary Lead (CPb): blood collected in a capillary tube for direct determination of lead level by graphite furnace atomic absorption spectrophotometry; and 3) Filter Paper Lead (FPb): blood absorbed onto a filter paper for direct determination of lead level by atomic absorption spectrophotometry with Delves cup attachment. This project also studies the efficacy of a silicone protective barrier to decrease contamination by environmental dust on the skin surface.[1]

METHODS

Study Sample

Children who came for routine pediatric care to the Pediatric Primary Care Center at Yale New Haven Hospital between June 1991 and January 1992 were enrolled in the study. The Pediatric Primary Care Center is affiliated with Yale University School of Medicine and provides pediatric continuity care to an inner-city, minority, low-income population (16 500 pediatric visits per year; 90% Medical Assistance). Children had BPb screening according to pre-existing clinic guidelines: 9 to 36 months of age, every 3 to 6 months; 36 to 72 months of age, every 6 to 12 months. Children with known lead poisoning had repeat venous lead (VPb) determinations and therefore did not enter the screening protocol. During the 8-month study period, 1573 screens were performed on 1422 children; 131 children were screened two times and 10 children were screened three times. Ninety-eight percent of the screens were performed on children between 6 months and 7 years of age (31 children <9 months of age and 27 children >72 months of age were screened based on the clinician's judgement; their results are included in the analyses as well).

Protocol

Overview. Each subject had a single fingerstick from which blood samples for each of the methods to be evaluated were collected. ZPP was measured immediately in the clinic laboratory and those children with a ZPP ≥35 μg/dL (0.6 μmol/L) had a VPb determination at the same visit. Children with fingerstick CPb or FPb ≥15 μg/dL (0.7 μmol/L) were recalled later for a VPb. Before the release of the revised CDC guidelines[1] in October of 1991, verbal consent was obtained for children recalled for fingerstick lead levels of 15 to 24 μg/dL (0.7 to 1.2 μmol/L). Other procedures represented standard medical care and did not require informed consent. The protocol was approved by the Human Investigation Committee at Yale University School of Medicine.

Blood was drawn in the Pediatric Primary Care Center, at the time of the patient's appointment, by one of two trained technologists according to a standard protocol. Using gauze and a scrubbing motion, the distal ½ to ⅔ of the patient's index, middle, or ring finger was cleaned with green tincture of soap. The soap was removed with a sterile alcohol wipe, followed by a drying wipe with a gauze pad. Exposure to room air was minimized for all materials touching the finger or used to collect specimens. A puncture was made using either a monolet or microlancet. The first drop of blood was discarded, using a clean gauze pad, and subsequent blood drops were formed at the puncture site while maintaining the finger in an inverted position. Samples were collected in the following order and analyzed as described: 1) ZPP: one drop of blood was collected in a free erythrocyte protoporphyrin-Microhematocrit capillary tube and immediately measured on the clinic laboratory hematofluorometer (Helena Protofluor Z, Helena Laboratories, Beaumont, TX) following the manufacturer's protocol. The result was reported to the patient's nurse or physician before the clinic appointment. 2) Hemoglobin: one drop of blood was collected in a microcuvette and analyzed for hemoglobin on the laboratory hemoglobinometer (HemoCue System, HemoCue AB, Angelholm, Sweden). 3) CPb: capillary tubes (50 μL micropipettes; AccuFil 90 Micropet, Clay Adams, Parsippany, NJ) were handled by the rear or middle section to avoid contamination. The tip of the capillary tube was placed in a drop of blood formed at the puncture site and 50 μl were collected and immediately washed from the capillary tubes into 75 × 12-mm plastic tubes (Sarstedt, Newton, NC) containing 200 μl of 0.2% aqueous Triton X-100 containing 2 U/mL of sodium heparin (before lots of capillary tubes or plastic collection tubes were put into use, 5 random units were extracted for 1 hour with 50 μl or 250 μl, respectively, of 0.5% nitric acid; acid-extractable lead was <1 μg/dL [0.05 μmol/L] for all units). The diluting solution immediately lyses the specimen, thereby avoiding problems with nonhomogenous specimens due to clotting or settling. The capillary tubes were alternately filled and emptied for complete washout of the blood. Specimens were sealed and sent to the Clinical Chemistry Laboratory at Yale New Haven Hospital. Specimens were batched and analyzed 1 to 2 times per week by graphite furnace atomic absorption spectrophotometry, using a modification of the method of Carnrick and Slavin.[7] Results were reported on the day they were analyzed (ie, within 1 week of collection) and families were contacted by phone and/or mail if results were ≥15 μg/dL (0.7 μmol/L). 4) FPb: filter papers (Schleicher and Schuell #903, Keene, NH) were stored in individualized plastic bags. No more than 25 of these wrapped filter papers were exposed to room air at any given time. Keeping the finger inverted, 5 to 8 drops of blood were allowed to fall freely onto the filter paper until a circle 2.5- to 3.5-cm in diameter was obtained. Specimens were sealed and refrigerated until mailed in batches 1 to 2 times per week to the Connecticut Department of Health Laboratory where 3/16 inch circles were punched and analyzed by atomic absorption spectrophotometry with Delves cup attachment in a standard manner.[8] Families were contacted by phone and/or mail if results were ≥15 μg/dL (0.7 μmol/L). The average delay in receiving results was approximately 45 days.

At the request of the CDC, midway through the study (beginning October 21, 1991), children were assigned on alternate days to two skin preparation protocols: the protocol described above and the same protocol with the additional application of ethanolic silicone oil solution by dropper just before the skin was punctured. In total, 978 samples were obtained before using silicone; subsequently, 281 samples (18%) were obtained using silicone and 314 (20%) without using silicone. Each bottle of silicone (Silicone skin protective coating, Trace Metals Instruments, West Palm Beach, FL) was tested by the Clinical Chemistry Laboratory at Yale New Haven Hospital by extraction with an equal volume of 0.5% nitric acid after ethanol evaporation in a biosafety cabinet. Acid-extractable lead was <1 μg/dL (0.05 μmol/L). Before it was used, the silicone solution was transferred into a small acid-washed glass bottle with a dropper top.

Venous Lead. Children with a ZPP ≥35 μg/dL (0.6 μmol/L) had a venipuncture at the same visit for determining VPb. Children with fingerstick CPb or FPb ≥15 μg/dL (0.7 μmol/L) were recalled later for VPb determination. Venous blood was collected from an antecubital vein. The skin was cleaned using an alcohol wipe and blood was collected in 3-mL heparinized Vacutainer tubes (Becton Dickinson, Franklin Lakes, NJ) and sent for analysis to the Clinical Chemistry Laboratory at Yale New Haven Hospital. Aliquots of venous specimens were lysed before analysis with four parts of 0.2% Triton X-100 and the lysate was analyzed in duplicate by graphite furnace atomic absorption spectrophotometry as described for CPb analysis.

CPb specimens were analyzed once, whereas FPb and VPb samples were analyzed in duplicate and average values were reported. The Clinical Chemistry Laboratory at Yale New Haven Hospital is approved by the Occupational Safety and Health Administration for BPb determinations and participated in the Blood Lead Laboratory Reference System through the CDC.

STATISTICAL ANALYSES

Analyses were conducted using SAS/STAT System for Personal Computers (Release 6.04) proprietary software.[9] Agreement between the two methods of lead determination (eg, CPb and VPb) was measured by intraclass correlation coefficient.[10] This statistic is sensitive to any overall bias in one measurement method as compared with the other and adjusts the value accordingly. The Pearson product moment correlation measures only similarity in rank ordering for each set of paired measurements and overestimates the degree of agreement when bias is present. Performance of the screening tests was assessed using thresholds for BPb of 15 μg/dL (0.7 μmol/L; the level at which the CDC recommends venous confirmation) and 25 μg/dL (1.2 μmol/L; the threshold defined by the 1985 CDC guidelines[2]) as the definition of a positive test. These thresholds were applied to all lead determinations, whether the specimen was obtained by fingerstick or venipuncture. A false positive screening test was defined as a fingerstick sample that met or exceeded the threshold value when the paired VPb was less than the threshold value. All analyses were performed on the sample of all children with confirmatory VPb, as well as on the subsample of subjects who had VPb determinations on the same day as the screening tests.

The false positive rates (and 95% confidence intervals for the proportion estimates) were determined for each of the three screening techniques (ZPP, CPb, FPb). False positive rate was defined as the proportion of all positive screens that were false positives (false positive rate = false positives/[false positives + true positives]; equivalent to [1 − positive predictive value]). Analyses of the false positive rates for the first screens only were

comparable with those analyses including the second and third screens as well; therefore, all results reported treat each screen as an independent event.

The false positive rate of the CPb was compared between children who received additional silicone skin preparation and those who received routine skin preparation.

RESULTS

A total of 1573 screens were performed on 1422 children (53% male; 69% black, 20% Hispanic, 10% white, 1% other). The age at time of screening ranged from 3 months to 11 years, with 98% between 6 months and 7 years of age (mean = 2.5 years; SD = 1.5 years). Hemoglobin ranged from 8.3 to 18.7 g/dL (1.29 to 2.90 mmol/L); mean (SD) = 12.0 (1.0) g/dL [1.86 (0.16) mmol/L].

Descriptive statistics of the three screening blood tests and confirmatory VPb test are shown in Table 1. For ethical reasons, VPb was obtained only from children with at least one elevated screening test and is biased towards higher lead levels. Of 1573 screens (1422 children), 879 (56%) had an elevation in at least one of the three tests. A confirmatory VPb was obtained in 669 (76%) of these 879. The delay between screen and confirmatory testing ranged from 0 to 134 days (mean = 30 days; SD = 30 days; 57% were within 30 days and 80% were within 60 days).

Both fingerstick lead screening tests had excellent correlation with the confirmatory VPb.[11] Analyzing only the specimens where a paired venous sample was drawn on the same day (see Fig. 1), yielded the following correlation coefficients: CPb Intraclass R = 0.86 ($P < .01$; N = 172); FPb Intraclass R = 0.83 ($P < .01$; N = 170). As expected, analyses conducted using all subjects with paired venous specimens yielded lower correlation coefficients: CPb Intraclass R = 0.74 ($P < .01$; N = 674); FPb Intraclass R = 0.59 ($P < .01$; N = 673). The two fingerstick lead screening tests also showed good correlation with each other: Intraclass R = 0.70 ($P < .01$; N = 1535). The mean FPb value was significantly higher than the corresponding CPb value ($t_{(paired)} = 16.2$; $P < .0001$).

Table 2 presents the false positive rates (and 95% confidence interval for the proportion estimate) for the three screening tests for the 172 children who had a VPb determination on the same day. The CPb screen had a false positive rate of 13.5% at a lead threshold of 15 µg/dL (0.7 µmol/L) and 14.8% at a lead threshold of 25 µg/dL (1.2 µmol/L). The false positive rates for the FPb were 19.1 and 31.4% at thresholds of 15 µg/dL (0.7 µmol/L) and 25 µg/dL (1.2 µmol/L), respectively.

TABLE 1. Descriptive Statistics of Screening Blood Tests and Confirmatory Venous Lead Test

Test	Range (µg/dL)	Median (µg/dL)	Mean (µg/dL)	SD (µg/dL)	N
Capillary lead	1 to 109	11	13.3	9.0	1562
Filter paper lead	2 to 73	14	15.9	8.4	1546
Venous lead	1 to 71	14	15.7	9.8	679*
Zinc protoporphyrin	10 to 220	24	27.3	14.2	1571

* Venous lead determined only if capillary lead ≥15 µg/dL or filter paper lead ≥15 µg/dL or zinc protoporphyrin ≥35 µg/dL; missing in 210 cases (10 children had a venous lead obtained even though none of the three screening tests were elevated).

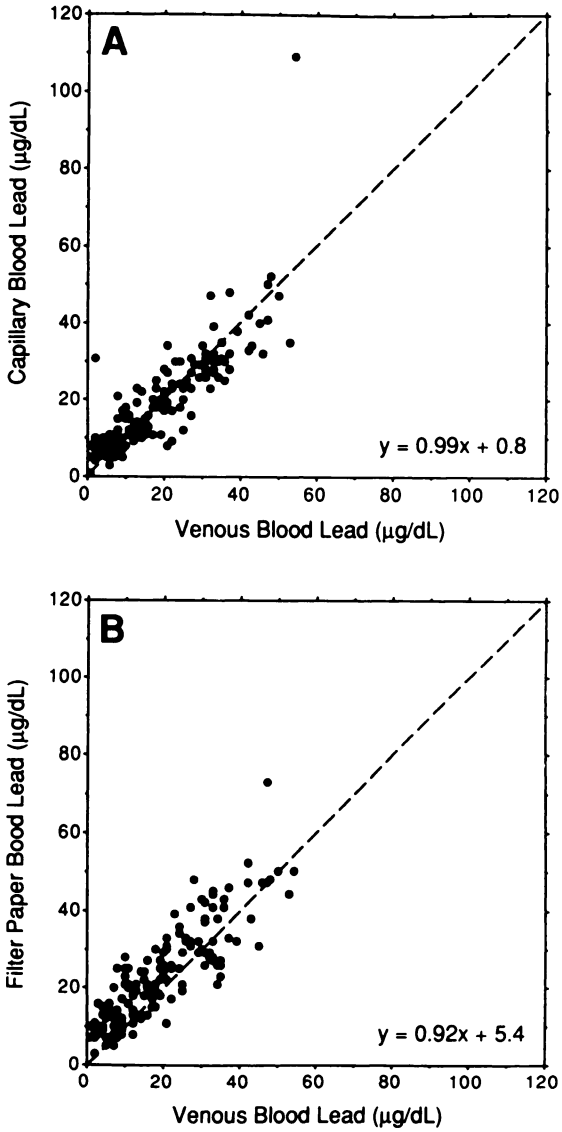

Fig 1. A, Scatterplot of capillary lead (CPb) versus venous lead (VPb) for subjects with Confirmatory venous lead on same day as screening tests. B, Scatterplot of filter paper lead (FPb) versus venous lead (VPb) for subjects with confirmatory venous lead on same day as screening tests. Dashed lines are lines of identity. Equations represent the best linear fit to the data as determined by Deming regression analysis. Cornbleet PJ, Gochman N. Incorrect least-squares regression coefficients in method comparison analysis. *Clin Chem.* 1979;25:432–438.

For ZPP, the false positive rates were very high: 42.1 and 67.8%. Because of concerns about the poor sensitivity of ZPP as a screening test for lead poisoning, individuals with false negative ZPP screens were identified. Of 109 children with VPb ≥25 µg/dL (1.2 µmol/L), 53 (49%) had a normal ZPP (<35 µg/dL; 0.6 µmol/L); of 320 children with VPb ≥15 µg/dL (0.7 µmol/L), 212 (66%) had a normal ZPP.

In comparison, analyses using all 679 screens with a paired VPb revealed significantly higher false positive rates for the two fingerstick lead tests (see Table 3). The false positive rates were approximately twice the values for the subsample of subjects with VPb determinations conducted on the same day.

TABLE 2. False Positive Rates of Fingerstick Screening Tests Subjects (N = 172) with Confirmatory Venous Lead on Same Day as Screening Tests

Test	False Positive Rate in % 95% Confidence Interval Threshold Lead = 15 μg/dL* N = Positive Screen	False Positive Rate in % 95% Confidence Interval Threshold Lead = 25 μg/dL* N = Positive Screen
Capillary lead	13.5% 6.7–20.3 N = 96	14.8% 5.3–24.3 N = 54
Filter paper lead	19.1% 11.8–26.4 N = 110	31.4% 20.5–42.3 N = 70
Zinc protoporphyrin	42.1% 34.3–49.9 N = 152	67.8% 60.4–75.2 N = 152

* Thresholds apply for all lead determinations, whether the sample was obtained by fingerstick or venipuncture.

TABLE 3. False Positive Rates of Fingerstick Screening Tests All Subjects (N = 679) with Confirmatory Venous Lead Specimens

Test	False Positive Rate in % 95% Confidence Interval Threshold Lead = 15 μg/dL* N = Positive Screen	False Positive Rate in % 95% Confidence Interval Threshold Lead = 25 μg/dL* N = Positive Screen
Capillary lead	31.3% 26.9–35.7 N = 422	35.8% 27.8–43.8 N = 137
Filter paper lead	46.0% 41.9–50.1 N = 557	51.1% 43.8–58.4 N = 182

* Thresholds apply for all lead determinations, whether samples were obtained by fingerstick or venipuncture.

TABLE 4. False Positive Rates for Capillary Lead (CPb) With and Without the Use of Silicone Barrier, All Children With Venous Lead Specimens After Beginning Use of Silicone (N = 106 With Silicone and 124 Without Silicone)

Test	False Positive Rate in % 95% Confidence Interval Threshold Lead = 15 μg/dL* N = Positive Screen	False Positive Rate in % 95% Confidence Interval Threshold Lead = 25 μg/dL* N = Positive Screen
CPb with silicone	34.6% 21.7–47.5 N = 52	58.3% 30.4–86.2 N = 12
CPb without silicone	36.2% 24.9–47.5 N = 69	65.0% 44.1–85.9 N = 20

* Thresholds apply for all lead determinations, whether samples were obtained by fingerstick or venipuncture.

Table 4 presents the comparison of the false positive rates of the CPb for all subjects with a paired VPb with (N = 106) or without (N = 124) silicone after alternate assignment began. The false positive rate of the CPb screen, at either lead threshold, was not significantly different between children receiving or not receiving silicone application. Because only 26 positive screens (≥15 μg/dL; 0.7 μmol/L) occurred in children receiving same day confirmatory VPb after beginning silicone application (10 with silicone, and 16 without silicone), meaningful analyses on this subsample could not be conducted.

Most of the false positive CPb results were only slightly elevated above the paired VPb. Of those children who received their confirmatory VPb on the same day (N = 172), four (5.6%) of 72 children with a CPb ≥20 μg/dL (1.0 μmol/L) and only one (1.9%) of 54 children with a CPb ≥25 μg/dL (1.2 μmol/L) had a paired VPb <15 μg/dL (0.7 μmol/L); none of the 14 children with a CPb ≥35 μg/dL (1.7 μmol/L) had a paired VPb <25 μg/dL (1.2 μmol/L). This would suggest that environmental contamination was not the principal cause of the observed false positives, because even small amounts of contamination would result in large increases in lead concentration (10 ng of lead in a 50-μl specimen will raise the concentration by 20 μg/dL [1.0 μmol/L]). Only two of the 172 children who had a VPb on the same day had a CPb value that exceeded the paired VPb by >15 μg/dL (0.7 μmol/L); excluding these two outliers that may have resulted from contamination of the capillary specimens, the mean difference between the VPb and CPb approached zero for the remaining 170 children (mean difference = 0.006 μg/dL [0.0003 μmol/L], with the mean VPb greater than the mean CPb). This would also suggest that significant contamination of the CPb specimens was a rare event and unlikely to be a major contributor to the false positive rates seen.

DISCUSSION

Several potential factors may have contributed to the observed false positive rates. When a control with a mean value of 13.3 μg/dL (0.64 μmol/L) was analyzed singly (as was CPb) over a series of runs, a standard deviation of 2.4 μg/dL (0.12 μmol/L) was

obtained. Analyses of the control in duplicate (corresponding to VPb) decreased the standard deviation to 2.0 μg/dL (0.10 μmol/L). Given that the threshold for labeling a test abnormal (15 μg/dL; 0.7 μmol/L) is within 1 standard deviation of both the mean for CPb and the mean for FPb for this population, misclassifications could be expected in a large number of cases simply as a result of analytic variability in both screening and confirmatory measurements. Even more analytic variability could be anticipated when comparisons are made between tests done in different laboratories (ie, FPb).

A staged screening protocol introduces a delay between the screening test and the confirmatory venous test and can produce an even higher false positive rate. The mean residence time of lead in the blood is about 1 month,[12] which was also the average delay between screening and confirmatory testing. If lead exposure was intermittent, peaking levels would have been expected with a subsequent decline to levels that were in equilibrium with the concentration of lead within the bone. Patients screened during a peak may have been truly positive at screening and truly negative at confirmation. Because the study was conducted for 8 months beginning in June, seasonal variation in BPb may have further contributed to the false positive rate. Children were more likely to have had their screening test obtained during a warmer month (when BPb tends to be higher) and their confirmatory venous testing done during a cooler month. Even in the setting of controlled, constant lead intake, significant fluctuations (ie, ±10%) in blood lead concentration can be seen as the result of intra-individual biologic variability.[12] When all screens with a paired venous specimen were considered, the false positive rate for either fingerstick lead test was approximately twice the value for the subsample of subjects whose VPb was obtained on the same day. This would suggest that a staged screening protocol may lead practitioners to incorrectly attribute a higher false positive rate to the screening tests, when in fact many of the discrepant values may be the result of the temporal fluctuations in BPb or the phenomenon of regression toward the mean.

This study concentrated on the false positive rates of the screening tests. The sensitivity of the screening tests could not be directly measured because venous specimens were not obtained from all subjects. Because many children received VPb determinations (the majority of the children had at least one screen that was elevated), many children underwent venous testing who were negative on at least one of the other screening tests. For example, of the 76 children with a negative CPb screen at a threshold of 15 μg/dL (0.7 μmol/L) and a VPb at the same visit, 10 had a VPb that was >15 μg/dL (0.7 μmol/L); only three of these children had a VPb that was at least 10 μg/dL (0.5 μmol/L) greater than the CPb. Using a threshold of 25 μg/dL (1.2 μmol/L), there was only one false negative of the 118 negative CPb screens with a paired VPb drawn on the same day. This would support the impression that fingerstick lead screening tests will rarely substantially underestimate the VPb.

Previous reports[3–6] of the poor performance of ZPP as an independent screening test for lead poisoning were confirmed in this study. The false positive rates were unacceptably high. Furthermore, nearly one-half of the children with a VPb ≥25 μg/dL (1.2 μmol/L) and two-thirds of the children with a VPb ≥15 μg/dL (0.7 μmol/L) had a false negative ZPP screen.

This study has three major limitations. For ethical reasons, VPb was not obtained from all children, and many children received their VPb after a delay that averaged 30 days. In addition, the study was not designed to allow direct comparisons between CPb and FPb. The CPb was analyzed in the same laboratory as the VPb (as opposed to a different laboratory and different analytic technique for FPb) and VPb was obtained after a shorter time delay for CPb than for FPb. Finally, false positive rates are highly dependent on the prevalence of the condition. The results of this study can not be directly generalized to other clinical settings serving populations with a different prevalence of lead poisoning and where screening blood samples are obtained under less controlled conditions (ie, multiple blood drawers with less training). The population studied had a very high prevalence of lead poisoning. In populations with a lower prevalence of lead poisoning, a higher false positive rate would be expected even though a lower percentage of the population would have a false positive test.

CONCLUSIONS

Screening for lead poisoning in urban areas is feasible by direct measurement of fingerstick CPb or FPb. False positive rates, with rigorous attention to skin preparation and avoiding contamination, are acceptable given the precision of BPb determination. ZPP, though, is an obsolete screening test for lead poisoning. Not only does ZPP have an extremely high false positive rate, it also fails to identify the majority of children with BPb ≥15 μg/dL, including nearly one-half of children with VPb ≥25 μg/dL (1.2 μmol/L). Applying silicone did not decrease the rate of contamination of CPb specimens.

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MPS VOTE TO BAN TOBACCO ADVERTISING

The United Kingdom edged closer to banning tobacco advertising last week after the Commons health committee endorsed proposals by the European Commission for a statutory ban. In a report to parliament the Conservative dominated committee said that the government could not afford to ignore the potential of a total ban on advertising if it was to achieve its target of a 30% fall in smoking during the 1990s.

The government's longstanding policy supporting voluntary control of advertising is already subject to review, and there is evidence that official resolve is weakening under internal and external pressures. Aides said that a statutory ban might be contemplated if it was shown that tobacco advertising—already confined to the press and posters—was manifestly undermining the government's health targets

The committee was unanimous in its view that government policy had signally failed to reduce the prevalence of smoking among young people, especially teenage girls. But the MPs were unable to agree that a ban on advertising was the answer. The minority, all Conservatives, argued that commercial freedom of speech was paramount and that other factors such as the price of cigarettes were more important than advertising.

MPs vote to ban tobacco advertising. *Br Med J.* 1993;306:291.