Editor's note: Any and all future citations of the above referenced paper should read Seward GH. Practical implications of charge transport model for electrostatic detection apparatus (ESDA). [published erratum appears in J Forensic Sci 2000;45(2)] J Forensic Sci 1999;44:832–6.

Commentary on Wu AHB, Hill DW, Crouch D, Hodnett CN, McCurdy HH. Minimal standards for the performance and interpretation of toxicology tests in legal proceedings. J Forensic Sci 1999;44(3):516–522

Sir:

The article of Wu et al. is a thought-provoking discussion of a number of relevant points concerning interpretation of toxicological testing results. The authors make the statement that there is no published conversion factor relating concentrations of 11-nor-delta-9-tetrahydrocannabinol-9-carboxylic acid (THCA) in serum to those in whole blood. While it is inconsequential to the authors' conclusions, that is not quite accurate. The data of Hanson et al. (1) quite clearly show that, in a series of nearly 50 subjects, the blood/serum concentration ratios for both delta-9-tetrahydrocannabinol (THC) and THCA are the same and that they average 0.57 (range, 0.50–0.67). I apologize for not stating this more explicitly in the 1983 article.

Randall C. Baselt, Ph.D.
Chemical Toxicology Institute
of National Medical Services
P.O. Box 8209
Foster City, CA 94404

Reference

1. Hanson VW, Buonarati MH, Baselt RC, Wade NA, Yep C, Biasotti AA, Reeve VC, Wong AS, Orbanowsky MW. Comparison of ^{3}H- and ^{125}I-radioimmunoassay and gas chromatography/mass spectrometry for the determination of Δ^{9}-tetrahydrocannabinol and cannabinoids in blood and serum. J Anal Tox 1983;7(2):96–102.

Commentary on Keto RO. Analysis and comparison of bullet leads by inductively-coupled plasma mass spectrometry. J Forensic Sci 1999;44(5):1020–6

Sir:

It appears to me that there is more information in Keto's (1) bullet lead impurity data than the author supposes.

Keto (1, pp. 1024–25) computed the equivalent of the scalar products of 1,770 pairs of bullet impurity concentration profiles, considered as 8-dimensional vectors. He is thus able to show that sample bullets of the same brand tend to resemble one another more often than they resemble bullets of another brand, sometimes even to the exclusion of other brands.

However, citing data insufficiency, he feels unable to assign a complete set of probabilities of brand membership to each of the concentration profiles he has available (1, Table 4). He claims only that his data "suggests that when two element signatures match, it is unlikely that the bullets originated from different sources," and that "[g]iven a sufficient database, [the scalar product] could be a useful tool in establishing the 'rarity' or 'commonality' of a specific elemental signature, and the probability of a random match [between bullets] could be estimated."

I decided to see whether a Bayesian (2,3) treatment of Keto's data might yield useful brand membership probabilities, and this appears to be the case.

By means of a multivariate Bayesian analysis of the data in Keto's Table 4, I computed brand membership probabilities. Because I lacked a separate test set, I used Keto's sample bullets both collectively, as the parametric data set, and individually, as the test set. The mutual independence of the concentration data for different elements permitted me to do this. Keto (1, p 1023) states that "[s]catter plots of each element against each of the other elements showed no visual correlations, either linear or non-linear."

Because of software limitations, I limited my analysis to ten of Keto's 12 bullet brands, ranging alphabetically from Defence through Toledo. I did, however, use all eight of Keto's element concentrations for each bullet.

I compiled, for each of 50 bullets, a probability distribution over ten bullet brands, as a function of that bullet's concentration profile. For the sake of brevity, and because the probability for the "correct brand", even when low, generally dominates the other nine values, Table 1 displays only "correct brand" assignment probabilities. Note that the table's probability scale runs from 0.50 to 1.00. (The complete parametric data set and the complete set of brand probability distributions are available on request. In only one case out of the 50 was there some ambiguity about the correct brand.)

With Table 1 in hand, one can now consider the question of decision threshold. A juryman may want a defendant's ammunition connected to the crime with a probability greater than 0.999 (odds of ~1,000 to 1), in order to vote "guilty." A prosecutor may want a probability greater than 0.85 in order to bring a case to trial. A police officer may feel that 0.75 is enough to justify arrest, and that 0.60 or more indicates "prime suspect." Assuming all this, Table 1 suggests that a Bayesian comparison of a crime scene bullet with the perpetrator's ammunition would exceed the "prime suspect" threshold about 96% of the time, that it would exceed the arrest threshold about 90% of the time, and that it would exceed the prosecution threshold about 78% of the time. As for the juryman, the bullet-brand evidence may not be quite enough, by itself, to support a "guilty" vote. The highest brand probability value I obtained was 0.998.

In closing, I point out that the issue of bullet source identification is not necessarily related to brand differences. Conceivably, several suspects may each possess a box of ammunition of the same brand (which is stamped on the case heads), each box being the result of a different production "run", with a more or less distinct set of bullet lead impurity profiles. Or so we must hope.

TABLE 1—*Distribution of 50 "test" bullets by the probability which was computed for the correct brand.*

	Correct Brand Probabilities									
Probability Range	0.50–0.55	0.55–0.60	0.60–0.65	0.65–0.70	0.70–0.75	0.75–0.80	0.80–0.85	0.85–0.90	0.90–0.95	0.95–1.0
Number of Bullets	1	1	0	2	1	3	3	4	12	23