



K23 Ethanol Elimination Rates From Time Discrete Blood Draws in Impaired Driving Cases

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After attending this presentation, attendees will gain insight into the pharmacokinetics of ethanol, specifically, its elimination in men. In this study, apparent elimination rates were calculated from 173 cases involving two time-discrete blood draws where the male driver was charged with the offense of driving while intoxicated.

This presentation will impact the forensic community and/or humanity by providing additional data that can be used by testifying forensic scientists in determining more accurate estimations of blood alcohol levels in drivers at the time of the incident.

Ethanol intoxication is a leading cause of motor vehicle accidents in the U.S. with a reported rate of alcohol involvement in 39% of all traffic fatalities in 2005^[1]. During the same time frame in Texas, 46% of all traffic fatalities involved alcohol.^[1] The Federal Bureau of Investigation estimated that about 1.4 million drivers in the U.S. were arrested in 2005 for driving under the influence of either narcotics or alcohol with males accounting for 81% of these arrests.^[2, 3]

Current Texas law states that any accident resulting in serious bodily injury or loss of life allows for the collection of a suspect's blood for toxicological analysis. Since 2002, the Bexar County District Attorney's Office has requested that two blood specimens be obtained with an intended elapsed time interval of two hours between the blood draws. For the cases studied, from the years 2003-2007, the actual average elapsed time was 104 minutes. Blood draws were taken at local hospitals and transported to the Bexar County Medical Examiner's Office under the chain-of-custody by the arresting officer. The blood samples were then analyzed for ethanol concentrations using a direct-injection gas chromatography (GC) method.

Sample Preparation: 0.2 mL of sample blood was added to 4.0 mL of the internal standard (IS) solution, using a Repipet dilutor (LabIndustries, Dubuque, IA). The IS solution was composed of 0.25 mL n-propanol brought up in 1 L of deionized water (0.025% v/v). The analyte solution spiked with the IS was then transferred to a GC vial and loaded onto the injection tray.

Analysis: The samples were then analyzed on a Hewlett Packard 6890 GC. The method utilized an isothermal oven temperature of 40°C and a run time of 3 minutes. The gas chromatographic column employed was the Restek Rtx – BAC1 (30m x .53mm id, 3µm film thickness). The carrier gas was helium at a velocity of 11.2 mL/min and detection was accomplished by a flame ionization detector. Autoinjection and collection parameters were controlled by Agilent GC ChemStation software.

Ethanol elimination rates were calculated using the following:

$$\frac{[BAC]_1 - [BAC]_2}{\Delta T}$$

where [BAC] represents the reported ethanol concentrations in g/dL and ΔT equals the elapsed time between the two draws in hours.

Results: Ethanol was not detected in six cases out of the 173 studied and thus were excluded from data analysis. The range of calculated ethanol elimination rates were 0.0005 to 0.0682 g/dL/hr. The mean, median, and mode ethanol elimination rates were 0.0198, 0.0175, and 0.0175 g/dL/hr, respectively. Initial blood alcohol concentrations reported in the study ranged from 0.018 to 0.397 g/dL. Table 1 describes the relationship between the age of the male subject and the elimination rate while Table 2 examines how the elimination rate varies with a change in the initial blood alcohol concentration.

Table 1.

Age Range	N	Average Elimination Rate (g/dL/hr)
16-19	20	0.0194
20-29	73	0.0204
30-39	29	0.0156
40-49	27	0.0198
50+	18	0.0246
All Cases	167	0.0198



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Table 2.

Initial BAC Range (g/dL)	N	Average Elimination Rate (g/dL/hr)
< 0.0499	6	0.0156
0.05-0.099	18	0.0170
0.1-0.149	42	0.0184
0.15-0.199	50	0.0201
0.2-0.249	35	0.0205
> 0.25	16	0.0248

No correlation was observed between a person's age and their elimination rate, however an increase in the rate of ethanol elimination was observed with increasing initial blood alcohol concentrations.

The overall variability of the elimination rates can be attributed to a mixture of genetic and acquired factors such as decreased enzyme activity, gastric contents, as well as a difference between the time of the incident and the first blood draw.

References:

- ¹ <http://www-nrd.nhtsa.dot.gov/pdf/nrd-30/NCSA/TSF2005/810616.pdf>
- ² http://www.fbi.gov/ucr/05cius/data/table_29.html
- ³ http://www.fbi.gov/ucr/05cius/data/table_41.html

Ethanol, Elimination Rate, Impaired Driving