

# *A Visit to the Dram Shop: Tequila shots and a traffic fatality*

## **Dram Shop Law for the Drug Expert—Driving Under the Influence of Alcohol**

### **The Use and Misuse of the Breathalyzer**

### **Retrograde Calculation of Blood Alcohol Concentrations**

### **Drug Recognition Experts—Marketing of the Drug Expert**

[Narrative]

*One evening, Mr. Henry Battler stopped at McKinneys, an Irish pub, and consumed five tequila-based alcoholic drinks over a three hour period. At approximately 1:30 am, Mr. Battler left the pub and proceeded to drive home. A mile from the pub, Mr. Battler ran a stop sign and crashed into the driver's side of a crossing vehicle. The driver was critically injured and died later that night at the hospital. A blood sample was obtained from Mr. Battler 90 min after the MVA which resulted in 0.72% BAC. The family of the decedent filed a civil lawsuit against Mr. Battler for wrongful death, and against the pub, in violation of the state's dram shop laws regarding the serving of alcohol to intoxicated patrons. The attorney hired by the decedents sought the counsel of a drug expert to calculate the BAC of Mr. Battler at the time of the fatal motor vehicle accident.*

## **Dram Shop Law for the Drug Expert**

“Dram shop” is an old 18th century English term for bars or pubs that sold alcohol. In London, gin was sold by the spoonful and called a “dram.”<sup>1</sup> Dram shop laws, known more formally as commercial host liability laws, arose from the religious pressure exerted by the Temperance Movement in the mid-19th century.<sup>2</sup> The first statutes were in response to saloons profiting from selling alcohol to known habitual drunkards. The societal cost of alcoholism was recognized in the destruction of families. Alcoholics were demonized with religious zeal. The first dram shop statutes were limited in scope and unused during Prohibition. After Prohibition ended, these earlier statutes were either repealed or ignored. Up until the 1960s, commercial host liability was adjudicated by common law (case law)<sup>3</sup> which held that the drinker was entirely responsible for his actions and any resulting harms.

During the 1960s, state courts began to establish common law such that the drinker and the establishment that served the drinker were jointly held liable for resulting harms.<sup>4</sup> The gradual shift to include serving establishments in lawsuits represented the growing awareness that alcoholism was not simply a moral failure of a drunk but a chronic disease called alcoholism. Courts were also sensitive to the fact that many plaintiffs were unable to receive just compensation for their harms from an individual drinker. Courts also ruled that an injured victim was entitled to compensation when the alcohol retailer acted in a negligent and illegal manner.<sup>5</sup>

<sup>1</sup> Roberts JR and Dollard D (2010) Alcohol levels do not accurately predict physical or mental impairment in ethanol-tolerant subjects: relevance to emergency medicine and dram shop laws. *J Med Toxicol.* 6:438–442.

<sup>2</sup> Mosher JF et al. (2013) Commercial host (dram shop) liability. *Am. J Prev Med.* 45:347–353.

<sup>3</sup> As opposed to statutory law created by legislators.

<sup>4</sup> Mosher JF et al. (2013) *Op cit.*

<sup>5</sup> Strategizer 57 Reducing alcohol-related harms through Commercial Host, Community Anti-Drug Coalitions of America (CADCA) in partnership with the Center on Alcohol Marketing and Youth (CAMY) at JHSPH, available at: [www.camy.org/\\_docs/resources/reports/alcohol-availability/strategizer-57-commercial-host-liability.pdf](http://www.camy.org/_docs/resources/reports/alcohol-availability/strategizer-57-commercial-host-liability.pdf).

At present, 42 states and the District of Columbia have a dram shop law in effect,<sup>6</sup> but they vary greatly in terms of liability, eligible parties, and other factors among the different states. It is not easy to prove that the alcohol vendor (bartender, e.g.) was negligent by serving an intoxicated patron. Some states have elements of proof that a plaintiff must meet in order to invoke the Dram Shop Act.<sup>7</sup> For example, there must be proof of sale of alcohol to the patron, injuries suffered by the patron, a proximate cause linking the alcohol sale and intoxication, and that alcohol intoxication was at least a contributing factor to any third-party damage.

Some states have only civil liability laws, whereas other states have both civil and criminal liability statutes for violating dram shop statutes.<sup>8</sup> While dram shop liability and social host liability (see later) are usually brought to court as civil suits, in cases of an innocent party's death from the behavior of an intoxicated person, both civil and criminal charges may be brought against him<sup>9</sup> and the retail establishment or bar that provided the alcohol. Only 10 states allow intoxicated patrons to sue the alcohol establishment if they only injure themselves. Dram shop liability laws are primarily designed to protect innocent third parties, like a person in another car killed by the intoxicated patron after leaving the bar.<sup>10</sup> Research shows that dram shop laws significantly reduce deaths due to drunk drivers.<sup>11</sup> Advocates for increasing the effectiveness of dram shop laws suggest a National Dram Shop Act that sets in place standards of liability, definitions, and penalties.<sup>12</sup>

Depending on the level of intoxication, it may not be easy to prove that the dram shop owner or bartender-server should have known the patron was inebriated and therefore not serve him alcohol. Studies show that experienced bartenders only correctly identified an intoxicated subject 25% of the time, even after watching them go up and down a staircase.<sup>13</sup> Nine out of 12 bartenders continued to serve a subject whose BAC was greater than 0.10%. Early studies show that 30 New Jersey police officers did worse than the bartenders in recognizing intoxicated persons, even after subjecting them to a field sobriety test. Later studies showed police officers were accurate only in detecting alcohol intoxication at higher BAC levels, above 0.12% BAC.<sup>14</sup>

Physicians were also not accurate in detecting alcohol intoxication levels by using clinical exams.<sup>15</sup> Surprisingly, one of the most reliable indicators among the physicians group was the smell of alcohol on the breath. This indication was shown to be reliable even in alcohol-tolerant individuals.<sup>16</sup>

Dram shop laws are gaining broader application as evidenced by the recent Oklahoma Supreme Court decisions for the plaintiff against a convenience store owner for selling beer to a presumably intoxicated buyer who then killed someone in an MVA.<sup>17</sup> There is also strong evidence and a call for dram shop laws to be enforced against valets so that they will not give car keys to an inebriated patron leaving an alcohol-serving establishment.<sup>18</sup>

Like dram shop liability, social host liability laws are also found in 33 states.<sup>19</sup> Social host liability laws hold the hosts of private functions, like a house party or pool party, liable for injuries (or death) caused by their negligence in serving alcohol to an inebriated guest, or not stopping an intoxicated guest from operating a motor vehicle. Although not as common as drug expert involvement in dram shop cases, a drug expert is also needed in a social liability case, for either the plaintiff or the defendant.

<sup>6</sup> Those states without dram shop laws are Delaware, Kansas, Louisiana, Maryland, Nebraska, Nevada, South Dakota, and Virginia.

<sup>7</sup> List taken from the Illinois Dram Shop Act. Findlaw.com at: [dui.findlaw.com/dui-laws-resources/dram-shop-laws.html](http://dui.findlaw.com/dui-laws-resources/dram-shop-laws.html).

<sup>8</sup> NCSL website at: [www.ncsl.org/research/financial-services-and-commerce/dram-shop-liability-state-statutes.aspx](http://www.ncsl.org/research/financial-services-and-commerce/dram-shop-liability-state-statutes.aspx).

<sup>9</sup> Gender-specific language intended here as men are responsible for 4 in 5 incidences (81%) of alcohol DUIs. Young men of the ages 21–34 are responsible for 32% of all drunk driving accidents even though they represent only about 11% of the population. From the CDC at: [www.cdc.gov/vitalsigns/DrinkingAndDriving](http://www.cdc.gov/vitalsigns/DrinkingAndDriving).

<sup>10</sup> From Insureon, a food and beverage insurance company, at: [www.foodservices.insureon.com/portals/0/liquor-liability-insurance.pdf](http://www.foodservices.insureon.com/portals/0/liquor-liability-insurance.pdf).

<sup>11</sup> Scherer M et al. (2015) Effects of dram shop, responsible beverage service training, and state alcohol control laws on underage drinking driver fatal crash ratios. *Traffic Inj Prev.* 16:S59–S65.

<sup>12</sup> Cafaro TW (2006) You drink, you drive, you lose: or do you? *Gonzaga Law Rev.* 42:1–28.

<sup>13</sup> Rubenzer S (2011) Judging intoxication. *Behav Sci Law* 29:116–137.

<sup>14</sup> Rubenzer S (2011) *Op cit*.

<sup>15</sup> Kumar A et al. (2018) The clinical evaluation of alcohol intoxication is inaccurate in trauma patients. *Cureus* 10(2): e2190. DOI 10.7759/cureus.2190.

<sup>16</sup> Bond J et al. (2014) Exploring structural relationships between blood alcohol concentration and signs and clinical assessment of intoxication in alcohol-involved injury cases. *Alcohol Alcoholism* 49:417–422.

<sup>17</sup> Sexton C (2018) Analyzing the Oklahoma Supreme Court's peculiar expansion of dram shop liability [Boyle v. ASAP Energy, Inc., 408 P.3d 183 (Okla. 2017)]. *Washburn Law Journal Online* 58:1–10.

<sup>18</sup> Mezger M (2015) Keys please: making valets refuse to give a drunk driver his keys after a night in the bar. Available at SSRN: [ssrn.com/abstract=2659256](http://ssrn.com/abstract=2659256) or <http://dx.doi.org/10.2139/ssrn.2659256>.

<sup>19</sup> As of 2015, there were 33 states that mandate social host liability through common law or state statutes. Like dram shop law, there is variability in those states with 4 states that limit the damages, 4 states which limit who may be sued, and 11 states that require stricter negligence standards than usual. *The September 2016 Report to Congress on the Prevention and Reduction of Underage Drinking, Policy Summary titled Social Host Liability*.

## Driving Under the Influence of Alcohol

Surely there were people operating a horse while under the influence of alcohol, but that was probably not a huge problem. But the convergence of the availability of mass-produced automobiles and the repeal of Prohibition caused an epidemic of alcohol-related motor vehicle accidents in 1930s.<sup>20</sup> In 1938 an influential study was published in the Journal of the American Medical Association (JAMA) that used a breath alcohol testing instrument called the *Drunkometer* to show that the risk of a motor vehicle accident was 6 times greater at a BAC of 0.10% and 25 times greater at 0.15% BAC.<sup>21</sup> This early testing technology developed into the portable breath alcohol detectors used today, such as the Breathalyzer discussed in the next section.

There is no question that consumption of alcohol impairs the ability to drive a car (operating a motor vehicle). Since the 1938 JAMA paper mentioned before, there have been hundreds of papers published examining the relationship between blood alcohol concentration (BAC) and driving performance measurements using simulation and on-the-road methods in clinical studies. With almost 100 years of research, it can be stated with certainty that increased BAC is strongly associated with increased crash risk and with more serious injury and fatality.<sup>22</sup> Impairment is seen in a number of different tests including reaction time, tracking, and more complex measures from driving simulator studies like lane deviation and obstacle avoidance. Impairment due to alcohol is not the same and does not occur at the same dose for all cognitive tasks.<sup>23</sup> Generally speaking, more complex tasks are impaired by alcohol at lower BAC than simple tasks.<sup>24</sup>

The overwhelming evidence for driving impairment after alcohol consumption is clear and convincing. Because of this, alcohol is the only drug that has a scientifically reliable and justified *per se* blood levels for establishing impairment (0.08% in the United States, but lower in most European countries and Japan). Even this *per se* limit of 0.08% alcohol in the blood may be too high; there are signs of driving impairment at 0.05% BAC and a significant number of lives could be saved by lowering the legal limit to 0.05% BAC.<sup>25</sup> The drug laws establishing a *per se* limit in blood samples for other drugs besides alcohol were discussed in the previous chapter. The most common method to measure BAC in intoxicated drivers is by a law enforcement officer employing an Alcohol Breath Testing device (Breathalyzer). Data on Breathalyzer accuracy and reliability are presented in the next section.

The future is now and legal scholars have already opined on the ramifications of semiautonomous and fully autonomous cars on drunk driving laws. This proactive approach to prepare legally for the future is admirable given the speed at which new technology is thrown upon us. Semiautonomous vehicles are defined as automated cars which signal a *take-over* by the driver when certain situations arise, like lane changing onto the shoulder in a work-zone. A recent study using semiautonomous cars found that 0.08% BAC produced significant delays in the take-over times, but not at 0.05% BAC.<sup>26</sup> Therefore current alcohol driving laws could be applied to semiautonomous cars. Those that desire to imbibe alcohol and drive will have to wait until the availability of fully autonomous cars where no take-over by a human is needed, wanted, or even possible.

Laws against alcohol use and the operation of a motor vehicle need not be limited to earth-bound cars and vehicles. It was recently reported that the State of New Jersey passed a law punishing “drunk droning,” a DUI statute for those operating a drone.<sup>27</sup> It seems like it would be hard for law enforcement to identify a drone being flown under the influence of alcohol given the baseline swaying flight and the ultimate crashing of most drones flown by sober operators personally observed by this author.

## The Use and Misuse of the Breathalyzer<sup>28</sup>

Blood sampling for alcohol content was introduced in [Chapter 9](#), and other drugs that interfere with the determination of the blood alcohol concentration (BAC) were detailed there. In this section, we examine the use and possible misuse of the roadside alcohol breath tester.

<sup>20</sup> Swartz J (2004) Breath testing for prosecutors: targeting hardcore impaired drivers. American Prosecutors Research Institute (APRI) Alexandria, VA, USA.

<sup>21</sup> Holcomb RL (1938) Alcohol in relation to traffic accidents. JAMA 111:1076–1085. According to this article, police methods used at that time to detect alcohol intoxication included properly enunciating the phrase “Methodist episcopal” and examining a hand-writing sample.

<sup>22</sup> Charlton SG, Starkey NJ (2015) Driving while drinking: performance impairments resulting from social drinking. Accident Anal Prevent. 74:210–217.

<sup>23</sup> Dry MJ et al. (2012) Dose-related effects of alcohol on cognitive functioning. PLoS ONE 7: e50977.

<sup>24</sup> Charlton SG, Starkey NJ (2015) *Op. cit.*

<sup>25</sup> Fell JC, Voas RB (2006) The effectiveness of reducing illegal blood alcohol concentration (BAC) limits for driving: evidence for lowering the limit to .05 BAC. J Safety Res. 37:233–243.

<sup>26</sup> Wiedemann K et al. (2018) Effect of different alcohol levels on take-over performance in conditionally automated driving. Accident Anal Prevent. 115:89–97.

<sup>27</sup> McFarland et al. (2018) Drinking and droning is now illegal in New Jersey. CNN online, posted 4/20/2018.

<sup>28</sup> *Breathalyzer* was once a trademarked name but now has become a genericized trademark like *Kleenex*, *Xerox*, *Aspirin*, and *Heroin*, among others, which were all trademarked names at one point.

In 1954 a new portable Alcohol Breath Testing device was tested and sold, called the Breathalyzer.<sup>29</sup> There are now a number of devices for evidentiary breath alcohol testing used in every county in the United States and around the world.<sup>30</sup> The National Highway Traffic Safety Administration (NHTSA) in the U.S. Dept. of Transportation (DOT) sets the standards for breath alcohol testing and publishes an *Approved Evidential Breath Measurement Devices* on their website.<sup>31</sup> States have their own list of approved breath alcohol testing devices and their own rules on testing.

The detection of breath alcohol using breath testing devices is accomplished by two different detection methods: electrochemical (EC) fuel cell detection and infrared wavelength (IR) detection. The EC fuel cell detector is an older technology that works by measuring the oxidation energy produced by the exhaled ethanol and converting this chemical energy into an electrical current. The greater the electrical current, the greater the breath alcohol content (BrAC). Newer Breathalyzers with IR detectors work by measuring the amount of infrared light absorbed by ethanol in the air sample; the more IR waves<sup>32</sup> absorbed, the greater the amount of ethanol present in the breath.<sup>33</sup>

Typically, the cheaper EC breath testers are used as preliminary breath testers and IR breath testers are used for evidentiary breath testers. As it can be difficult for police to detect alcohol impairment by physical observation and field sobriety tests alone (especially in an alcohol-tolerant individual) a handheld device that uses EC detectors resulting in a BAC<sup>34</sup> over 0.08% provides the police with the grounds to arrest a driver and obtain an evidentiary breath alcohol test using a device with an IR detector or a blood sample.<sup>35</sup> From an analytical point of view, the disadvantage of EC detector devices is that it measures only a single point of data (obtained from the end of the exhalation) whereas in an IR detector device, the BrAC is measured as a smooth curve over the whole exhalation breath.

There are clear rules in obtaining an evidentiary breath test by the feds and states. The Code of Federal Regulations<sup>36</sup> states that the first breath alcohol test is a screening test which must be followed by a blank air test yielding a 0.00 reading and a second confirmation test 15 min following the screening test. If this exact procedure is not followed, the alcohol test is considered to have a “fatal flaw” and “that the test was cancelled and must be treated as if the test never occurred.”<sup>37</sup> This is in accord with scientific studies that show duplicate samples in agreement within predetermined standards (within 0.02 BAC, for example) are needed to insure precision as the actual biological/sampling component is the largest source of measurement variability.<sup>38</sup>

The manufacturers of Breath Alcohol Testers certify the accuracy of their model as meeting the DOT specifications for breath alcohol readings, namely, that the readings at 0.020% BAC and 0.040% BAC are within  $\pm 0.005\%$  BAC.<sup>39</sup> The allowable interval between calibration verification tests should not exceed 30 days or 50 tests, whichever comes first. A log of these calibration verifications needs to be maintained as proof that these verifications are completed at these minimal intervals. This record-maintaining, strict calibration, and operational procedures are taken seriously by the courts; a recent Oklahoma Supreme Court case overturned the Appeals Court reversal of the trial court decision due to lack of records and procedures with the use of a Breathalyzer.<sup>40</sup>

The actual breath alcohol concentration (BrAC) tabulated by the Breathalyzer is not equal to the blood alcohol concentration (BAC). The software within the Breathalyzer automatically calculates the BAC from the BrAC by multiplication of the BrAC with a conversion factor and displaying the BAC. The conversion factor of 2100:1 (also called a partition ratio) was set by law following the advice of a federal panel, called the Committee on Alcohol and Other Drugs in 1976.<sup>41</sup> The conversion factor 2100 is widely accepted and written in the laws and regulations of alcohol breath testing of the states.

<sup>29</sup> Swartz J (2004) *op cit*.

<sup>30</sup> Its use varies widely as well as how many drivers take the alcohol breath test. In the United States, most states have implied-consent laws which make refusal of taking a Breathalyzer test result in the loss of a driver's license or other administration act. Other countries, like Britain and Canada, make refusal of a breath alcohol test equivalent to the crime of driving above the BAC limit. See: Voas RB et al. (2009) Implied-consent laws: A review of the literature and examination of current problems and related statutes. *J Safety Res.* 40:77–83.

<sup>31</sup> At: [www.transportation.gov/odapc/Approved-Evidential-Breath-Measurement-Devices](http://www.transportation.gov/odapc/Approved-Evidential-Breath-Measurement-Devices).

<sup>32</sup> Or photons. We don't want to forget that light is both a wave and a bunch of particles called photons.

<sup>33</sup> American Prosecutors Research Institute (APRI) (2004) Breath testing for prosecutors: targeting hardcore impaired drivers. [www.ndaa.org/wp-content/uploads/breath\\_testing\\_for\\_prosecutors.pdf](http://www.ndaa.org/wp-content/uploads/breath_testing_for_prosecutors.pdf).

<sup>34</sup> The breath alcohol concentration (BrAC) obtained by the Breathalyzer is automatically displayed as BAC, using a conversion factor that is discussed further below.

<sup>35</sup> Wigmore JG (2013) Breath Alcohol, in *Encyclopedia of Forensic Sciences* (Second Edition) Elsevier, pp. 313–317.

<sup>36</sup> CFR Title 49: *Transportation*. Part 40 – *Procedures for Transportation Workplace Drug and Alcohol Testing Programs*.

<sup>37</sup> CFR, Title 49. Part 40 §40.267.

<sup>38</sup> Gullberg RG (2006) Estimating the measurement uncertainty in forensic breath-alcohol analysis. *Accred Qual Assur* 11: 562–568.

<sup>39</sup> The Intoxilyzer Instrument Quality Assurance Plan (ver. 1.42 dated 08-01-2000), obtained from Ms. Pam Hagan, CMI, Inc.

<sup>40</sup> *Muratore v. State ex rel.* Dept. of Public Safety, case Number 111586, decided 01-28-2014.

<sup>41</sup> Okorocho O, Strandmark M (2012) Alcohol breath testing: is there reasonable doubt? *Syracuse J Sci Tech Law* 27:124–144.

However, the use of a standard 2100:1 ratio is not scientifically valid, as this ratio differs between individuals and ranges from 900 to 3700 to 1 among test subjects. This is one of the problems with alcohol breath testing results used in a legal setting. Other problems are briefly highlighted next.

Given that the Breath Alcohol Tester device is maintained and calibrated as needed, and that the breath alcohol technician performs the Breath Alcohol test as mandated, there are still a number of studies that demonstrate a large degree of variance in correlating breath alcohol levels with blood alcohol levels. Comparing devices that use the newer IR detection versus the older EC detection showed that the EC detector devices had the largest analytical variability.<sup>42</sup> In a study comparing the breath alcohol levels to standard blood alcohol analysis, it was noted that there was bias to the BrAC values compared to BAC values and that the bias increased as the BAC levels increased.<sup>43</sup> In general, there are many problems with Breath Alcohol Test devices including the blood-breath alcohol partition ratio (how much blood alcohol crosses into the lungs), blood water content (variability among individuals in hematocrit), breathing rate (hypo and hyperventilation), and body temperature (8.62% increase in breath alcohol level with 1 degree increase in body temp), to name some.<sup>44</sup> Another study found that the breath alcohol values might range from 23% below to 19% above the blood alcohol values.<sup>45</sup> For these reasons even Breath Alcohol Test devices using IR detection are recommended only as screening devices and the best evidentiary measurement is from a blood draw to determine BAC.<sup>46</sup>

Besides the Breathalyzer and other such BrAC devices, there are a number of new roadside devices for drug detection in development. Much effort is going into the development of an oral fluid test (spit tester) for the detection and quantification of nonalcoholic drugs. The holy grail of roadside drug testing devices, with a huge market, is a roadside drug tester for the active ingredient of marijuana, THC, and its metabolites.<sup>47</sup> The advancing *Green Revolution*, invading even the reddest and most conservative states like Oklahoma, creates a large demand for roadside detection of marijuana smokers who unwisely get into the driver's seat while high.

## Retrograde Calculation of Blood Alcohol Concentrations

We know from pharmacokinetics, the study of the time course of a drug in the body, that a drug (and remember, alcohol is a drug) goes through a cycle of increasing and decreasing concentrations in the blood and target tissues like the brain. Alcohol is absorbed through the gut and to a first approximation, reaches peak levels in the blood within 1 h (see Fig. 17.1). Alcohol, or more precisely ethanol, is eliminated at a constant rate from the body due to the saturation of the liver enzymes that metabolize ethanol.<sup>48</sup> The precise elimination rate for ethanol differs according to nutritional status, diet, concurrent food intake, frequency of alcohol intake, gender, individual genetics, and ethnicity.<sup>49</sup> However, it has been suggested that 0.010%–0.025% BAC/h is an accurate range of ethanol elimination for the vast majority of individuals.<sup>50</sup>

As shown in Fig. 17.1, after alcohol reaches its peak in the blood, alcohol concentration gradually decreases over time due to metabolism and excretion. Because alcohol freely passes into the brain, nearly the same time course would also model the amount of alcohol in the brain over time. Logically, given a curve of alcohol concentrations in the blood over time such as the one shown later, if one knew the BAC (blood alcohol concentration, in %) at one point on the curve, one could calculate the curve backwards to get the BAC at a point in time prior to the time the BAC was obtained.<sup>52</sup>

Calculation of the BAC backwards in time, called retrograde calculation of BAC, is a standard method to determine the BAC at the time of a motor vehicle accident.<sup>53</sup> The Defendant's blood samples were taken approx. 90 min or 1.5 h after the MVA. This number (1.5) is important as it is needed for the formula used to calculate BAC at the time of the accident (see Fig. 17.2). Because of the amount of alcohol research done over the decades, there are reliable formulae for the backwards

<sup>42</sup> Gullberg RG (2008) Employing components-of-variance to evaluate forensic breath test instruments. *Sci Justice* 48:2–7.

<sup>43</sup> Morey TE et al. (2011) Measurement of ethanol in gaseous breath using a miniature gas chromatograph. *J Anal Toxicol.* 35:134–142.

<sup>44</sup> Lablanca DA (1990) The chemical basis of the Breathalyzer. *J Chem. Educat.* 67:259–261.

<sup>45</sup> Jones AW (1993) Pharmacokinetics of ethanol in saliva: comparison with blood and breath alcohol profiles, subjective feelings of intoxication, and diminished performance. *Clin Chem.* 39:1837–1844.

<sup>46</sup> Rose S, Furton KG (2004). Variables affecting the accuracy and precision of breath alcohol instruments including the Intoxilyzer 5000. *Georgia DUI Law, A Resource for Lawyers and Judges.* ISBN 0-03271-6296-1.

<sup>47</sup> One could argue it might have been wiser to first have a roadside tester for cannabis-impaired driving before the legalization of recreational marijuana use.

<sup>48</sup> Cederbaum AI (2012) Alcohol metabolism. *Clin Liver Dis.* 16:667–685.

<sup>49</sup> Chan LN, Anderson GD (2014) Pharmacokinetic and pharmacodynamic drug interactions with ethanol (alcohol). *Clin Pharmacokinet.* 53:1115–1136.

<sup>50</sup> Jones AW (2010) Evidence-based survey of the elimination rates of ethanol from blood with applications in forensic casework. *Forensic Sci Int.* 200:1–20.

<sup>51</sup> Kovatchev B et al. (2012) *In silico* models of alcohol dependence and treatment. *Front Psychiatry* 3:4.

<sup>52</sup> Calculation of the BAC forward in time is also possible (anterograde calculation) however, tables of the BAC for men and women according to drinks and weight are available for this purpose. See Chapter 12 *Where There's a Will, There's a Way.*

<sup>53</sup> Posey D, Mozayani A (2007) The estimation of blood alcohol concentration: Widmark revisited. *Forensic Sci Med Pathol.* 3:33–39.

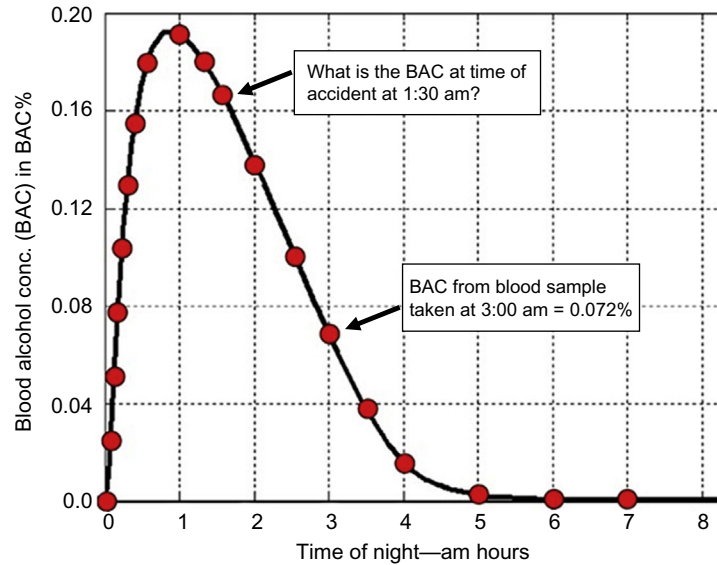


FIG. 17.1 Typical time course of BAC annotated with the specific BAC obtained from the driver in this chapter's case. The patron served by the bar had a BAC of 0.072% at the time of the blood draw, but the accident occurred 1.5 h earlier. (Figure adapted from Kovatchev et al.<sup>51</sup>)

$$\text{BAC}_{\text{at time of accident}} = \text{BAC}_{\text{of blood sample}} + (T_{\text{time elapsed (h)}} \times E_{\text{elimination rate per hour, \% BAC}})$$

FIG. 17.2 Equation for retrograde calculation of BAC.

or retrograde calculation of BAC. It has been stated that using alcohol elimination rates ranging from 0.010%/h to 0.025%/h will be accurate for the vast majority of individuals.<sup>54</sup> These low and high range values for the alcohol elimination rates are used below and plugged into the standard formula for retrograde calculation.<sup>55</sup>

The formula for calculating BAC back to the time of the motor vehicle accident is shown above in Fig. 17.2.

In the present case, the patron BAC from the blood draw was 0.072% and the time elapsed from obtaining the blood sample and the MVA was 1.5 h, which are plugged into the previous equation. Two values are used for  $E$  (elimination rate) in the equation: 0.010% elimination per hour and 0.025% elimination per hour. Calculations for these two values give 0.087 and 0.1095. Truncated to the usual two decimals for BAC,<sup>56</sup> the patron in this case had a calculated BAC ranging from 0.08% to 0.10% BAC at the time of the accident. This BAC is above the legal limit of alcohol intoxication when driving (0.08% BAC) and portrays how blood BAC may be below the legal limit for alcohol intoxication at the time of the blood draw but at or above the BAC limit at the time of the accident. See Appendix M for the complete calculations and formulae.

## Drug Recognition Experts

As noted before in the context of bar patrons, recognition of alcohol intoxication is not an easy or reliable task. Even harder is the recognition of intoxication from other drugs besides alcohol in impaired drivers. The Drug Recognition Expert (DRE) is a law enforcement officer who passed a certification class. A brief history of the DRE program is next.

Like many new ideas that originate in California and metastasize to the rest of the country, the Drug Evaluation and Classification Program was developed by the Los Angeles Police Department (LAPD) in the early 1970s. LAPD officers noticed that many drivers were apprehended for impaired driving but didn't blow an intoxicating level of alcohol and

<sup>54</sup> Jones AW (2010) *Op. cit.*

<sup>55</sup> Standard formula from American Prosecutors Research Institute (2003) Alcohol toxicity for prosecutors: targeting hardcore impaired drivers. APRI, Alexandria, VA. At: [www.ndaa.org/wp-content/uploads/toxicology\\_final.pdf](http://www.ndaa.org/wp-content/uploads/toxicology_final.pdf).

<sup>56</sup> Note that truncation is not the same as "rounding off." Rounding off 0.079% BAC yields 0.08% whereas truncating to two decimal points yields 0.07%. This can obviously make a difference in drink driving cases. I have testimony from our state's forensic toxicologist that they officially truncate to two decimals in their toxicology reports. It may be different in other jurisdictions but is something the detailed drug expert should know.

escaped prosecution.<sup>57</sup> Drivers who failed a field sobriety test (e.g., walking toe-to-toe, touching fingers to nose with eyes closed) but had low or nonexistent BAC were problematic. Such drivers were sometimes brought to a physician for evaluation, but physicians were reluctant to participate due to various reasons including their lack of knowledge of specific drug effects and drug-impairment effects on driving, and the onus of trial testimony. Sargent Studdard of the LAPD approached narcotics officer Leeds. They did drug research, consulted with experts, and developed the first methods for training and certifying a police officer as a Drug Recognition Expert (DRE). Eventually Officers Studdard and Lee got further support from the LAPD and the National Highway Traffic and Safety Administration (NHTSA, a federal agency).

The DRE officer is certified by the Drug Evaluation and Classification (DEC) Program, established in 1987 by the International Association of Chiefs of Police (IACP)<sup>58</sup> and the NHTSA of the U.S. Department of Transportation. Instead of relying on a pharmacologist or toxicologist expert witness, who are busy and expensive, certified DREs already employed by law enforcement agencies can provide DRE reports and testify in courts in cases of drug-impaired drivers. The ultimate goal of the DRE program is to “help prevent crashes, deaths, and injuries caused by drug-impaired drivers.”<sup>59</sup>

The DRE program is touted as a success, and there are some studies that examined DRE accuracy. Using a selected and verified sample of marijuana-impaired drivers, researchers found that DRE correctly identified marijuana-using drivers from control drivers.<sup>60</sup> Indications such as pulse, blood pressure, and pupil size were significantly different in marijuana drivers compared to control nondrug using drivers. Further studies in marijuana drivers showed that red eyes, droopy eyelids, altered speech, tongue coating, and the smell of marijuana were the best indicators of marijuana intoxication.<sup>61</sup> Unlike the earlier study however, these authors did not find a good correlation between pulse and blood pressure and marijuana use (THC blood levels) in this study.

The DRE evaluation consists of a number of tests and indications, taking about an hour to complete, and consisting of over 100 items (indications) to note. Research on the effectiveness of DRE drug evals and accuracy of drug identification shows that DREs are more accurate when only one drug is used by the driver and when drug levels are in the higher range.<sup>62</sup> Sensitivity of DRE evaluations differs for the different classes of drugs, ranging from 91% for PCP (angel dust) to 60% for marijuana to 19% for CNS stimulants in one study.

A Drug Recognition Expert is a law enforcement agent who has completed specialized training in the recognition of drivers operating under the influence of drugs. DRE reports are sometimes included in the official reports, but with the widespread use of blood kits and toxicology lab analysis, the role of the DRE is more limited. The proof is in the pudding, so to speak, in this case *blood pudding*.<sup>63</sup> The toxicological analysis of the drug-impaired driver’s blood sample, if confirmed and quantified, provides the scientific and legal standard for any drug detected in a putative drug-impaired driver.

The testimony of the DRE can be overvalued by the jury if they are not told that the DRE is a police officer who completed a short course in drug detection. The defense attorney should employ a drug expert when the prosecution plans to present the DRE report or testimony. In cases where a drug expert is pitted against a DRE, the drug expert’s attorney must make clear that the DRE only received training in detecting which type of drug the driver may have been using. The DRE has little foundation in pharmacology or toxicology and this can be shown during cross-examination. The major contrast is that the true drug expert does not work for a law enforcement agency and, just like police lab forensic toxicologists, DREs may have a conflict of interest between their testimony and their employment.

The complete 7-day course curriculum is available from the [Maine.gov](http://www.maine.gov) website.<sup>64</sup> The class handout provides examples of DRE reports for each class of drug recognized. DRE materials also contain the indicators and measures made by DRE investigators. These charts at the end of the class handout are useful for the prosecution and the defense as the strength

<sup>57</sup> Participant manual for Drug Recognition Expert class (2018) National Highway Traffic Safety Administration (NHTSA), Transportation Safety Institute (TSI) and International Association of Chiefs of Police (IACP).

<sup>58</sup> The IACP accredits DRE programs and offers DRE instructor training.

<sup>59</sup> Declues K et al. (2016) A 2-year study of  $\Delta^9$ -tetrahydrocannabinol concentrations in drivers: examining driving and field sobriety test performance. *Forensic Sci.* 61:1664–1670.

<sup>60</sup> Hartman RL et al. (2016) Drug Recognition Expert (DRE) examination characteristics of cannabis impairment. *Accid Anal Prev.* 92:219–229.

<sup>61</sup> Declues K et al. (2018) A two-year study of  $\Delta^9$ -tetrahydrocannabinol concentrations in drivers; Part 2: Physiological signs on Drug Recognition Expert (DRE) and non-DRE Examinations. *J Forensic Sci.* 63:583–587.

<sup>62</sup> Beirness et al. (2007) Evaluation of the drug evaluation and classification program: a critical review of the evidence. *Traffic Inj Prev.* 8:368–376.

<sup>63</sup> Blood pudding is actually made up of blood sausages in which goat or pig blood is obtained at slaughter and filled into sausage sleeves and boiled. It is a dish they (*still*) serve in the UK. Order it next time you are across the pond if you dare.

<sup>64</sup> [www.maine.gov/dps/bhs/impaired-driving/dre/documents/2018DRE7-DayFullParticipantManual.pdf](http://www.maine.gov/dps/bhs/impaired-driving/dre/documents/2018DRE7-DayFullParticipantManual.pdf).

of the defendant's DRE report might depend on the signs of drug effects noted. Each of the criteria used by DREs can be examined with the DRE during direct or cross-examination and each item is amenable to the input of a drug expert.

## Marketing of the Drug Expert

The marketing of the drug expert is simple because in most cases there is no marketing. There are companies, of course, that the drug expert can pay to list their name and description of expert services in a database for attorneys looking for an expert witness.<sup>65</sup> In the author's experience, most referrals come from queries to the state bar association email *listserv* or truly word of mouth between attorneys. Other experts also note that word-of-mouth referrals are the most likely source of continuing expert witness jobs. When asked why a certain drug expert was recommended by an attorney to another attorney, respondents told one author that "he or she wrote a good report."<sup>66</sup> Writing a good report was the number one reason for a personal recommendation, with "giving a good deposition" and "easy to work with" distant second and third reasons. This confirms the importance of producing a good if not great report when asked to do so.<sup>67</sup>

Like many career-advancing moves, the toughest part for a pharmacologist moving into the drug expert business is getting the first shot at it. Those interested should note such medico-legal interests on their faculty homepage, constructed so that the words "drug expert" will catch a high-ranking link in a Google search. It is also a good idea to tell your faculty colleagues, and any attorneys in the area, that you are interested in serving as a drug expert. Finally, the pharmacology department chair may field a request for a drug expert from an attorney so the pharmacologist-*cum*-drug expert should definitely let the department chair know of this career interest.

*[Narrative continued]*

*Mr. Battles entered the criminal judicial system to meet his fate on charges of vehicular homicide while driving under the influence of alcohol. The parents of the driver struck by Mr. Battles filed civil suit against the public establishment, McKinneys, which served Mr. Battles the five tequila-based drinks before the deadly car crash that killed their daughter. They claimed that the bartender at McKinneys should not have served Mr. Battles due to his obvious intoxication. Retrograde calculation of the driver's BAC from the time of the blood sample to the time of the accident showed that he likely had a BAC ranging from 0.08% to 0.10% when he struck and killed their daughter. The case was decided in favor of the plaintiffs but the trial court's decision was overturned on appeal. McKinneys celebrated the appellate verdict with a 2-for-1 special on tequila shots on the following Friday night.*

<sup>65</sup> I have not used this marketing approach so unsure of its success in obtaining more drug expert gigs. An example of an expert witness database is available on the SEAK website at: [www.seakexperts.com](http://www.seakexperts.com).

<sup>66</sup> Field DL (2013) *The Expert Expert: The Path to Prosperity and Prominence as an Expert Witness*. iUniverse Publishers, Bloomington, IN, USA.

<sup>67</sup> Key aspects of litigation report writing are discussed in Chapter 4 and a report excerpt is included in Appendix D.