

Alcohol Limits and Public Safety^a

D. V. Canfield*

Civil Aerospace Medical Institute
US Federal Aviation Administration
Oklahoma City, Oklahoma
United States of America

K. M. Dubowski

University of Oklahoma Health Sciences Center (Retired)
Oklahoma City, Oklahoma
United States of America

M. Cowan

Texas Department of Public Safety
Austin, Texas
United States of America

P. M. Harding

Toxicology Section (Retired)
Wisconsin State Laboratory of Hygiene
Madison, Wisconsin
United States of America

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* Corresponding author: Dr. Dennis V. Canfield, Bioaeronautical Sciences Research Laboratory, AAM-610, Civil Aerospace Medical Institute, US Federal Aviation Administration, P. O. Box 25082, Oklahoma City, OK 73125; +1 405 954 6252 (voice); dennis.canfield@faa.gov.

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ABSTRACT: On May 14, 2013, the National Transportation Safety Board (NTSB) recommended lowering the legal blood-alcohol limit to 0.05 g/dL for motor vehicle operators in the United States, in an effort to reduce the risk of injuries and deaths caused by a driver's alcohol impairment (NTSB/SR-13/01). This recommendation has prompted other organizations and agencies, including the National Safety Council, to evaluate and consider supporting this action. In order to determine the scientific and legal feasibility and advisability of lowering or establishing 0.05 per se laws, we examined 554 alcohol-related publications. Risk factors, instrument reliability, law enforcement, and adjudication issues were considered in this overview of the literature. The extensive scientific literature reviewed provides ample support for lowering the operation of motor vehicle alcohol limits to 0.05, and for supporting the NTSB recommendations. Research clearly demonstrates that impairment begins at very low concentrations, well below the recommended NTSB limit, and increases with concentration. Lowering the limit to 0.05 will save many lives and prevent injuries. Breath, blood, and saliva samples have proved to be accurate and reliable specimens for legal acceptability in a court of law.

KEY WORDS: Adjudication, alcohol, concentration, enforcement, impairment, instruments, limits, risk.

INTRODUCTION

Recently the National Transportation Safety Board (NTSB) recommended lowering the legal blood-alcohol limit to 0.05 g/dL for motor vehicle operators in the United States [75]. This recommendation has prompted other organizations, including the National Safety Council (NSC), to consider this proposed action. The authors were asked to evaluate the NTSB recommendation and to submit a scientific report on the feasibility of lowering the blood-alcohol limit to 0.05 g/dL for drivers. The authors have conducted this study based on the available published scientific literature and herein provide an overview of alcohol limits and public safety. Alcohol concentrations in this article are expressed in g/dL in blood and g/210 L in breath.

Approximately 133 million (51.8%) Americans aged 12 or older reported being current users of alcohol in 2012; approximately 58.3 million (22.6%) reported participating in binge drinking and approximately 15.9 million (6.2%) reported being heavy drinkers [86]. The direct and indirect economic costs of alcohol abuse have been estimated at \$223.5 billion for 2006 [11]. This does not include the psychological toll associated with loss of human life and recovery from serious injuries.

Robert F. Borkenstein, in his groundbreaking study correlating accident rates with breath-alcohol concentrations, provided the first clear and convincing scientific evidence that individuals who drink and drive are at greater risk of being involved in a traffic crash [10]. His study has been repeated several times using more modern techniques by research scientists with similar results (**Figure 1**) [8,56,57,93]. It has been proved that the relative risk of having a motor vehicle crash increases

as a function of alcohol concentration with, for example, an 18% increased crash risk at 0.04. It took many years after Professor Borkenstein's original work was published for the documented dangers associated with drinking and driving to be recognized in the form of per se driving laws. Professor Borkenstein's original research is also supported

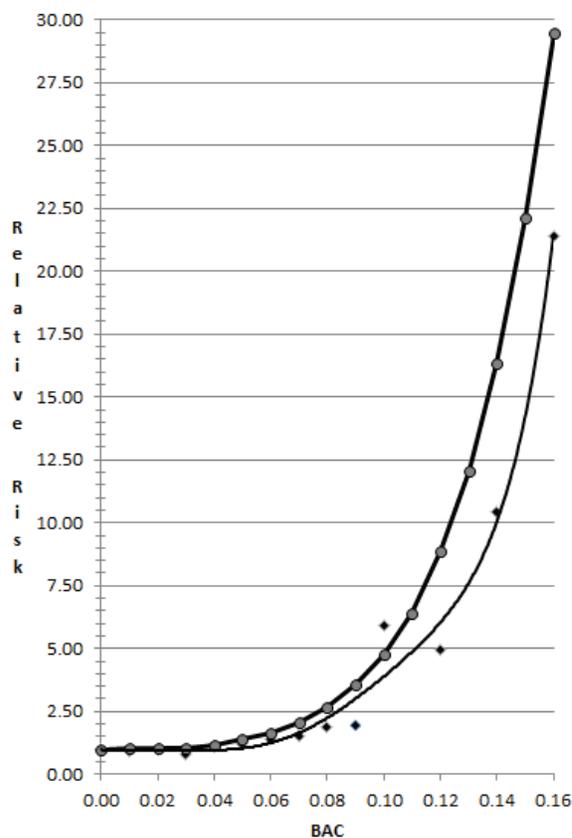
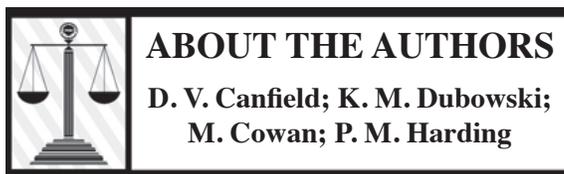


Figure 1. Comparison of Long Beach crash data (circles) with Grand Rapids data (diamonds). (Figure is constructed based on data appearing in Ref. [8,10].)



Dennis V. Canfield received a Ph.D. in forensic chemistry from Northeastern University (Boston, MA) in 1988. He received an M.S. degree in forensic science from John Jay College of Criminal Justice, New York City University (New York, NY) in 1976 and a B.S. degree in biology from Lynchburg College (Lynchburg, VA) in 1971. He completed his police officer training at the New Jersey State Police Academy (Sea Girt, NJ) in 1965. He also completed U.S. Army medical corpsman training at Fort Sam Houston Medical Hospital (San Antonio, TX) in 1961. Dr. Canfield currently serves as the laboratory manager for the Bioaeronautical Sciences Research Laboratory, Federal Aviation Administration, Civil Aerospace Medical Institute (Oklahoma City, OK), where he has worked since 1989.

Dr. Canfield's laboratory conducts forensic toxicology, biochemistry, functional genomics, radiobiology, and bioinformatics research for the Federal Aviation Administration and the Department of Transportation. The laboratory is responsible for the analysis of specimens for alcohol, drugs, and toxic gases from all aviation accidents and high-profile surface accidents for the Department of Transportation. The laboratory is often called upon by state and foreign governments to provide unique toxicology services not available in most toxicology laboratories.

Dr. Canfield's long career has revolved around practicing and teaching law enforcement and forensic science. From 1964 to 1971, he served as a police officer in Morris County, NJ. He worked at the New Jersey State Police Crime Laboratory from 1971 until 1976, serving in all sections of the laboratory including toxicology, drug identification, trace evidence, tool marks, serology, explosives, arson, starting as a laboratory technician and quickly rising to senior forensic chemist. He started his teaching career in 1973 at a small community college in New Jersey where he taught courses in forensic science. His teaching career continued at Northeastern University as an adjunct professor in forensic science and criminalistics from 1976 until 1978. In 1978 he accepted the position of director of forensic science at the University of Southern Mississippi (Hattiesburg, MS) and taught forensic science there from 1978 until 1989. He served as an adjunct professor at the Oklahoma Health Science Center (Oklahoma City, OK), University of Central Oklahoma (Edmond, OK), and the University of Oklahoma (Norman, OK). As an undergraduate student in 1969, he began conducting research and published the results (Canfield DV, Ramsey OW: Preliminary karyotype studies of eastern North American cimicifuga; presented at the Virginia Academy of Science; Richmond, VA; May 1970). Over his 40-plus-year career he has published more than 200 research articles, books, chapters, and government reports that include:

- The crystal and molecular structure of diacetylmorphine (Canfield DV, Barrick J, Giessen B; *Acta Cryst* B35:2806; 1979)
- Postmortem alcohol production in fatal aircraft accidents (Canfield DV, Kupiec T, Huffine E; *J Forensic Sci* 38:914; 1993)
- Carbon monoxide and fatalities: A case study of toxicity in man (Nelson GL, Canfield DV, Larsen JB), In *Carbon Monoxide and Human Lethality, Fire and Non-fire Studies* (Hirschler MM, Ed; Elsevier Science Publishers: Essex, UK; Chapter 6; 1993)
- Abnormal glucose levels found in transportation accidents (Canfield DV, Chaturvedi AK, Boren H, Veronneau SJH, White VL; *Aviat Space Environ Med* 72:813; 2001)
- Alcohol testing in the workplace (Dubowski K, Caplan Y, Canfield DV); In *Garriott's Medicolegal Aspects of Alcohol*, 5th ed (Garriott JC, Aguayo EH, Eds; Lawyers & Judges Publishing Company: Tucson, AZ; Chapter 17; 2008)
- Increased cannabinoids concentrations found in specimens from fatal aviation accidents between 1997 and 2006 (Canfield DV, Dubowski KM, Whinnery JE, Lewis RJ, Ritter RM, Rogers PB; *Forensic Sci Int* 197:85; 2010)

Dr. Canfield is a member in good standing of the Society of Forensic Toxicology, a fellow in the American Academy of Forensic Sciences, delegate to the National Safety Council, and a member of the Sigma Xi Research Society. He is an officer in the Alcohol, Drug, and Impairment Division of the National Safety Council, where he has served as a member of the Executive Board for over 10 years. He was appointed to the University of Central Oklahoma Forensic Science Advisory Board in 2006. He was elected to the Executive Board of the Alcohol and Other Drugs Subcommittee in 1999 by the National Safety Council. Dr. Canfield was elected the vice chair of the National Safety Council's Committee on Alcohol and Other Drugs in 2009 and chair of the National Safety Council's Committee on Alcohol and Other Drugs in 2011. The National Academy of Sciences appointed him as a research advisor for their postdoctoral and senior scientist program in 2000. Dr. Canfield is recognized in Who's Who in Science and Engineering and has received numerous awards including:

- Education Excellence Award (Office of Aviation Medicine; 1993)
- Outstanding Manager of the Year Award (United States Federal Air Surgeon; 1994)
- Officer of the Year Award (United States Federal Air Surgeon; 2000)
- Mission Support Award (United States Federal Air Surgeon; 2004)
- Outstanding Innovator Award (United States Federal Air Surgeon, The Office of Aerospace Medicine; 2008)
- Robert F. Borkenstein Award (National Safety Council Highway Traffic Safety Division; 2010)

Kurt M. Dubowski was educated at Johns Hopkins University (Baltimore, MD), New York University (New York, NY; A.B.), and The Ohio State University (Columbus, OH; M.Sc., Ph.D.). He holds an honorary Doctor of Laws degree conferred by Capital University (Bexley, OH). Dr. Dubowski joined the medical faculty of the University of Oklahoma (Oklahoma City, OK) in 1961, and is now George Lynn Cross Distinguished Professor Emeritus of Medicine. He is also principal research scientist, Civil Aerospace Medical Institute, Federal Aviation Administration, US Department of Transportation (Oklahoma City, OK). He is also chairman emeritus of the Board of Tests for Alcohol and Drug Influence and state director emeritus of tests for alcohol and drug influence of the State of Oklahoma. He has been a charter member of the Indiana University (Bloomington, IN) Borkenstein Course faculty since 1958 and is now the senior faculty member. He has been certified by the American Board of Clinical Chemistry (Clinical Chemistry, Toxicological Chemistry) and by the American Board of Forensic Toxicology.

Dr. Dubowski's professional activities have focused on the twin tracks of laboratory medicine and forensic science, especially clinical and forensic chemistry and toxicology, resulting in about 180 major publications in the scientific literature. His research has involved various aspects of clinical chemistry and toxicology methodology as well as many clinical studies with human subjects. He has been particularly active in studies on the analysis, metabolism, and pharmacokinetics of ethanol as well as in various forensic science practice aspects of ethanol, and in issues of drug-impaired driving. Over the past 40 years, his research has also included studies on the behavioral toxicology of marijuana and other substances that affect the central nervous system and are subject to abuse. That work includes development and evaluation of tests for drugs of abuse in biological specimens, and consultation for many governmental agencies.

Active in many professional organizations, Dr. Dubowski is past president of the American Academy of Forensic Sciences, of the American Association for Clinical Chemistry, and of the American Board of Forensic Toxicology; and is president emeritus of the American Board of Clinical Chemistry. He has been a member of the National Safety Council Committee on Alcohol & Other Drugs since 1950; and is a past member of the Committee on Alcohol, Other Drugs, and Transportation of the Transportation Research Board, National Research Council, National Academy of Sciences. He was a charter member of the Drug-Testing Advisory Board of the U.S. Department of Health and Human Services.

Mack Cowan received a B.S. degree from Texas Wesleyan University (Fort Worth, TX) in 1976 with a major in chemistry. He currently works for the Texas Department of Public Safety Crime Laboratory (Austin, TX) as the scientific director of the breath-alcohol testing program.

Mr. Cowan has 36 years of professional experience in breath-alcohol testing. He has published numerous peer-reviewed papers in the field of breath-alcohol testing and made many presentations to a variety of groups and associations. Mr. Cowan is a member of the National Safety Council Alcohol, Drugs and Impairment Division and is currently co-chair of the Alcohol Section. He is a charter member and former president of the Alcohol Testing Alliance. He is currently a member of the DPS Criminalist Association, the International Association for Chemical Testing, and the Department of Public Safety Officers Association. Mr. Cowan was the 2008 recipient of the National Safety Council's Robert F. Borkenstein Award.

Patrick Harding received his B.S. degree from the University of Wisconsin (Madison, WI). He retired from the Wisconsin State Laboratory of Hygiene (Madison, WI) in December 2012 after more than 35 years of service, the last 10 years as the supervisor of the Toxicology Section. Mr. Harding is currently a forensic toxicology consultant, assistant course director for the Robert F. Borkenstein Course on Alcohol and Traffic Safety: Testing, Research and Litigation at Indiana University, and serves on the Canadian Society of Forensic Science Alcohol Test Committee.

Mr. Harding has over 34 years of experience in forensic toxicology, focusing primarily on the analysis of ethanol and the interpretation of ethanol results. He has authored or co-authored numerous research papers, book chapters, articles and monographs in this area. Mr. Harding has testified in over 700 impaired-driving trials, presented at scientific meetings and training courses, and has been a faculty member at the Robert F. Borkenstein Course on Alcohol and Highway Safety: Testing, Research and Litigation since 2002.

Mr. Harding is a fellow of the American Academy of Forensic Sciences, a member of the Canadian Society of Forensic Science, an emeritus member of the International Association for Chemical Testing, a member of the Society of Forensic Scientists, and a member and past chair of the National Safety Council Division of Alcohol, Drugs and Impairment (formerly the Committee on Alcohol and Other Drugs). He has been honored to have received the National Safety Council Robert F. Borkestein Award, The International Association for Chemical Testing Kurt M. Dubowski Award, and the American Academy of Forensic Sciences Toxicology Section Ray Abernathy Award.