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ABSTRACT

The consumption of intoxicating liquor while driving on a public road is regulated by legislators in many countries and states and the legal history of these legislative attempts are vast. Yet, the appearance of drunk driving cases in our courts, statistics on deaths due to drunk driving and other matters related to drunk driving are still a frequent topic of discussion in most jurisdictions and therefore remain a relevant subject matter in need of further research and debate. This article revisits the topic of drunk driving in South Africa by taking a closer look at the most important case law, relevant statutes and then also the more technical and scientific medical aspects concerning drunk driving. It is the aim and rationale of this article to provide a complete outline on the theme of drunk driving, taking into consideration all the relevant factors to better equip the layman, jurist, medical practitioner or any other professional involved in the administration and management of drunk driving cases.

1. Introduction

Statistics indicate that since 2003 the number of persons driving while under the influence of intoxicating liquor has increased by 15,56% in South Africa.[1] The first legislation making it an offence for a person to drive a motor vehicle upon a public road while under the influence of intoxicating liquor was enacted in South Africa in 1913. Despite the continuously stricter and more meticulous regulation of alcohol consumption and drunk driving in South Africa and other countries, accidents and fatalities related to drunk driving still remain high. Further research and discussion on this subject therefore remains warranted. This article focuses on the medico-legal aspects related to drunk driving.

It is the aim of this article to provide the reader with the necessary background information on the general scientific and medical facts explaining the effects of alcohol consumption, while providing

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1 E Smith 'Staat vat dronk ryer se motor' *Rapport* 15 February 2005.

guidelines for an accurate diagnosis of intoxication.[2] A thorough investigation of these scientific and technical aspects with regard to alcohol consumption and intoxication is necessary before any medico-legal investigation of the relevant case law and a discussion of some of the relevant evidentiary principles is possible. It will also be shown that incorrect inferences and misinterpretations sometimes exist due to a lack of knowledge about these aspects.

2. Alcohol consumption

It is necessary to examine the metabolic pathway of alcohol through the human body in order to understand the practical use and importance of blood alcohol concentrations (BAC), to interpret the clinical consequences of alcohol absorption and comprehend the various scientific methods of determining blood-alcohol and breath-alcohol levels. BAC refers to the blood alcohol ratio. A person's BAC is determined by his or her drinking rate and by the body's absorption, distribution and metabolism of alcoholic beverages.[3]

2.1 Absorption

The absorption of alcohol signifies the first phase of the metabolic pathway of alcohol in the human body. Alcohol is absorbed by the body without undergoing specific chemical changes and by way of diffusion through the mucosa of the organs into the capillary blood and lymph vessels. This diffusion takes place along the entire digestive tract and begins immediately once alcohol is ingested. Theoretically, this process of diffusion whereby alcohol is transferred across biological membranes and absorbed into the water component of the body fluids and surrounding tissues can be described by Fick's Law.[4]

About 20% of alcohol is absorbed in the stomach and 80% in the

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[2] This article will consequently only focus on ethanol alcohol, usually consumed by means of alcoholic beverages. Readers should, however, also take note of endogenous alcohol which is alcohol produced by the human body in minute quantities as a byproduct of metabolic processes and endogenous alcohol which is produced by the human body post mortem as a byproduct of micro-organisms' effect on glucose, lactose, amino acids and glycerol. For more information on endogenous alcohol and the possible effect on blood tests and autopsies see JC Geldenhuys *Regsgeneeskundige aspekte betreffende die bewys daarvan dat iemand onder die invloed van sterk drank was* LLM (UNISA) (1993) 7.

[3] R Hingson, M Winter 'Epidemiology and consequences of drinking and driving' (2003) 27 *Alcohol Research and Health* 66.

[4] WE Cooper, TG Schwär, LG Smith *Alcohol, Drugs and Road Traffic* (1979) 68:

'Fick's Law states that the amount of substance diffusing across a unit area in unit time is equal to the concentration gradient across the surface in question, multiplied by diffusion co-efficient which is characteristic of the diffusing substance and the membrane through which it is passing'.

first section of the small intestines. A minimal amount of alcohol may be absorbed from the colon, depending on the amount of alcohol consumed. Alcohol still present in these organs and not absorbed by the human body may be regarded as 'outside the body' and will not contribute to the individual's level of intoxication at that specific time.[5] Vaporized alcohol can also be absorbed by the lungs through inhalation[6] but it is unlikely that an illegal BAC may result from inhalation alone.

Much has been said on the various factors influencing the absorption rate of alcohol in the human body but it should be noted that each individual organism is unique and therefore no generalizations can be made. The rate of absorption remains the sum effect of a multiplicity of processes and no individual influences can be extrapolated, neither can a particular factor be indicative of only one effect as it is mutually dependent on the various other factors.

Figure 1[7] below aims to provide a summary of the most common factors influencing the absorption rate of alcohol, indicating the effect, while assuming that all other factors remain constant.

Factor	Effect
Anatomical factors	
Size of absorption areas	Absorption area ↑ = quantities absorbed ↑
Absorption capacity of mucosa	Thickness of mucosa ↑ = quantities absorbed ↓
Motility of digestive tract	Motility of tract ↑ = rate of absorption ↑
	Sympathicomimetic drugs ↑ = motility ↓
	Alcohol intake ↑ = motility ↑
	Chronic drinkers = motility ↑
	Food intake ↑ = motility ↑
Ingestion	
Temperature of intake	Temp. of intake ↑ = rate of absorption ↑
Gastric emptying of the stomach	Gastric emptying ↓ = rate of absorption ↑
	Volume food/fluid ↑ = Gastric emptying ↑
	Carbonated fluids ↑ = Gastric emptying ↑
	Habitual drinkers = Gastric emptying ↑
	After meal = Gastric emptying ↓
	Fat > Protein > Carbohydrates = Gastric emptying ↓
Alcohol Concentration	-10% > 10% - 20% < +20% = rate of absorption ↓
Presence of Food	Presence of Food ↑ = rate of absorption ↓
Milk	Milk = rate of absorption ↓
Nicotine, Caffeine, Adrenalin	Nicotine, Caffeine, Adrenalin = rate of absorption ↓
Emotional factors	
Shock	Shock = rate of absorption ↓
Medical conditions	
Nausea	Nausea = quantities absorbed ↓

Figure 1

5 Cooper op cit (n4) 84.

6 M Schneider 'Human physiology vs chemical breath testing in michigan' (1998) *Det. C.L. Mich St U.L. Rev* 1117.

7 Schneider op cit (n6); Cooper op cit (n4) 85-95; Geldenhuys op cit (n2) 9-10; TG Schwär, JD Loubser, JA Olivier *Die ABC van Geregtelike Geneeskunde: 'n Praktiese Handleiding* (1984) 323-5.

2.2. Distribution

Once absorbed, alcohol is distributed by the blood through a network of blood vessels to the various organs and bodily fluids. The fundamental characteristic of alcohol — its solubility in water — forms the basis of this distribution process. Alcohol will continue to transfer across biological membranes to contiguous organs and tissues, based on the water content of the specific organs or body tissues and until alcohol is evenly distributed throughout the organism.[8] Blood acts as the transport medium during this process of distribution — alcohol distribution will continue for as long as the alcohol concentration in the blood is higher than the alcohol concentration in the contiguous organs, tissues and body fluids.[9] Differences in the alcohol concentration of various organs and body fluids may occur due to distribution lags, which come about during rising and falling alcohol concentrations.[10] Such differences are most evident in arterial and venous blood, blood and cerebrospinal fluid and in different organs and tissues with dissimilar water content gradients.

In the case of *S v Burgers*[11] the court was asked, in terms of s 198(3) of the Magistrate's Courts Act,[12] to decide on the question whether the state should prove that alcohol is evenly diffused in the accused's blood and consequently, whether a blood sample taken from an accused is representative of the person's blood as a whole. During the cross examination of the district surgeon it was submitted that the distribution of alcohol does not progress evenly throughout the human body and the alcohol concentration in particular organs or body fluids may differ. He also stated that blood samples were not representative of the blood as a whole. This we know is scientifically correct, as was illustrated by the exposition on the absorption and distribution of alcohol above.

Before the amendment of s 140(2) of Ordinance 21 of 1966 (O) though, the court confirmed that the onus does rest on the state to prove that alcohol was evenly diffused in the accused's blood and that the accused's blood as a whole contained the illegal blood alcohol concentration.[13] Even if the wording of the Ordinance could be interpreted to include a more extended meaning of the word 'sample' and a

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8 Cooper op cit (n4) 84:

> 'Fick's Law states that the amount of substance diffusing across a unit area in unit time is equal to the concentration gradient across the surface in question, multiplied by diffusion co-efficient which is characteristic of the diffusing substance and the membrane through which it is passing'.

9 Cooper op cit (n4) 101.

10 Cooper op cit (n4) 100.

11 *S v Burgers* 1976 (4) SA 578 (O).

12 The Magistrate's Courts Act 32 of 1944.

13 *S v Vis* 1974 (2) SA 437 (O).

more relaxed approach on the even diffusion of alcohol in the blood, a restricted interpretation of the Ordinance was preferred. The amendment of s 140(2) in 1973 did not alter this evidentiary burden,[14] even though an amendment of the text in an Act usually suggests an altered intention by the legislature.[15]

However, a third amendment to s 140(2) in 1975 included the insertion of the phrasing '…any specimen of blood taken from any part of his body…'. This amendment brought about the much needed assistance the state required in drunk driving cases. It was generally accepted that the legislature intended to do away with the required medical evidence previously utilized to prove the even diffusion of alcohol in the blood of the accused — which was in any event scientifically incorrect and not possible. The Ordinance furthermore did not require that blood be drawn from any specific area and the legislature thus did not intend for blood to be drawn only from particular, prescribed areas.

The court also confirmed in *S v Jubelius*[16] that where a sample of blood is extracted the sample is prima facie representative of the person's blood as a whole. Judge Boshoff defined the word '[blood] sample' as a portion representative of the whole. It was clear that the only practical manner in which to determine a person's blood alcohol concentration was to make use of samples and that unnecessary absurdities to ensure that the sample is indicative of the whole should be avoided. The current National Road Traffic Act 93 of 1996 confirms in s 65(2) that a blood sample is prima facie representative of a person's blood as a whole and also that a blood sample need not be taken from any particular or specified area.

Factors influencing the distribution rate of alcohol include psychological and physiological states, such as excitement and exercise which increase the cardiac output and flow of blood through the body and organs. Other factors include pathological conditions which cut off or decrease the blood flow to particular organs and gravitational forces which influence blood circulation, hence stimulating blood flow in lower decumbent areas. The rate of diffusion is furthermore directly proportional to the blood alcohol concentration: if the concentration of alcohol in the blood is higher than in contiguous organs and body fluids, the diffusion rate whereby alcohol is transferred through biological membranes to organs and body fluids will also be high. Once the alcohol concentration in organs and body fluids is higher than the concentration found in the blood, the diffusion process will reverse:

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[14] *S v Iveson* 1975 (3) SA 90 (O); *S v Van den Berg* 1975 (3) SA 354 (O); *S v de Waal* 1976 (2) SA 289 (O).

[15] *Port Elizabeth Municipal Council v Port Elizabeth Electric Tramway Co Ltd* 1947 (2) SA 1269 (A).

[16] *S v Jubelius* 1976 (2) SA 295 (T).

alcohol will diffuse back from the organs and body fluids into the blood.

The alcohol occlusion of a specific organ or tissue is also directly proportional to the water content of the organ or tissue. The concentration of alcohol found in organs or body fluids will therefore differ due to the dissimilar water compositions of different organs and tissues.[17] To illustrate the relation between the water content of an organ/human body and the alcohol concentration, reference can be made to the Widmark-formula, which will be discussed in greater detail later on in this article. The Swedish scientist, Erik MP Widmark, is known for his research and widely used formulas in determining blood alcohol concentrations. Widmark made use of a distribution-factor, *r*, to indicate the distribution of alcohol in different body compositions by taking into account the average water content of a particular body composition.

The distribution-factor (also known as reduced-body-mass, r-factor or reduction-factor) illustrates the ratio between the alcohol concentration in the body as a whole and that of the blood. Obese people have relatively low body water content and the r-factor for such individuals will be low. Conversely, the r-factor is high for athletic individuals with greater muscle development and higher body water content. The value of the r-factor has no relation to the person's mass or the amount of alcohol consumed. For this reason the logical inference can be made that an obese person, with the same mass and same amount of alcohol consumed as an athletic person, will have a higher blood alcohol concentration than the latter.[18]

2.3. Elimination

Immediately after ingestion alcohol is broken down by the process of metabolism and is eliminated from the body. The metabolism of alcohol continues until all the alcohol consumed is eliminated from the body. BAC measurements therefore not only reflect the amount of alcohol consumed but also the rate of absorption, distribution and elimination. About 90% of the alcohol is broken down in the liver, while the remainder is excreted, unchanged, by the lungs, kidneys and sweat glands. The metabolism of alcohol in the body proceeds much slower than the absorption rate. The blood alcohol concentration will consequently increase with the consumption of additional drinks.[19] The rate of elimination is constant (0,01 tot 0,02g% per hour) and is not influ-

[17] Cooper op cit (n4) 105-6; Schwär op cit (n7) 323-5.

[18] Cooper op cit (n4) 116; Schwär op cit (n7) 323-6

[19] Hingson op cit (n3) 66

enced by factors like sleep, changes in temperature, physical activities, medicinal substances, head injuries or the amount of alcohol in the body.[20]

It is clear from the above that the consumption of alcohol immediately initiates biological processes of absorption, distribution and also elimination. The blood alcohol concentration will increase with continued absorption of alcohol whereas the BAC will decrease when no additional alcohol is consumed and the process of elimination surpasses the process of absorption. It is generally accepted that the blood alcohol concentration will reach its peak within one to two hours after the last alcohol was consumed — hence the legal requirement that a blood alcohol or breath alcohol test be administered within two hours after the alleged incident.[21] This is also referred to as the blood-alcohol-curve.

3. Determining the level of intoxication

3.1 The clinical examination

The first diagnosis of the level of intoxication of an alleged offender is usually made by way of a clinical examination. The clinical examination can be defined as the observation of external indicators of the effect of alcohol consumption. The observations of both lay witnesses as well as expert witnesses are admissible. This section of the article will investigate the legal importance of such a clinical diagnosis, the admissibility of observations made by both expert and lay witnesses and the various factors which may influence the observations made.

3.1.1 The effect of alcohol consumption

Before a clinical observation of the level of intoxication can be made a basic knowledge of the effect of alcohol consumption is required.[22] The pharmacological effect of alcohol on the human body and its biological systems forms the basis of a clinical examination.[23] Alcohol has both an acute and chronic effect on the human body — this article is largely concerned with the acute and immediate effects of alcohol consumption.

The effect of alcohol on the brain and nervous system is significant in the context of drunk driving cases. The effect is mainly of a suppressive nature: although neuronal excitability may increase the responses are of a poorer quality. The consequences of alcohol absorption on the brain

[20] Geldenhuys op cit (n2) 13

[21] National Road Traffic Act 93 of 1996, s 65 (3).

[22] Geldenhuys op cit (n2) 20.

[23] Schwär op cit (n7) 331.

and nervous system are primarily due to the inhibiting effect of alcohol on the control mechanisms of the brain and the suppression of the neurotransmitter systems of the nerve synapses in the brain and nervous system. This provides for a false sense of stimulation and has a detrimental effect on muscle and reflex coordination abilities. The intensity of the suppression is directly proportional to the concentration of alcohol in the brain and the susceptibility of the cells. The suppression will also be more intense when the blood alcohol concentration is increasing than when it is decreasing. This is also referred to as the Mellanby-effect.[24]

The effect of alcohol on the various parts of the brain may differ from person to person and may even fluctuate in the same individual with similar blood alcohol levels under different circumstances. This phenomenon may explain irreconcilable clinical diagnosis and blood alcohol concentrations in a particular individual. However, the consequences of alcohol consumption on the brain and nervous system can be generalized.

The effect of alcohol consumption on the more developed frontal cortical regions of the brain manifests itself from blood alcohol levels as low as 0,01%.[25] The reaction is interrelated to the individual's personality traits and includes reduced self-control, will-power, inhibitions and increased elation, candidness, talkativeness and confidence. The parietal regions of the brain show the effects of alcohol absorption in the somestheto-psychic area at 0,10% — 0,30% BAC and in the psychomotor area at 0,10% - 0,20% BAC, by way of distorted emotions and perceptions, poor speech, motor skills and coordination activities. The occipital lobe of the brain, which controls the visuo-psychic functions, are affected by alcohol levels of 0,20% to 0,30% and results in distorted visual effects and eye sight, like disturbances in colour perception, dimension, form, motion and distance. The cerebellar effects of alcohol include equilibrium instability at alcohol levels of 0,15% to 0,35% and may result in apathy, excessive sweating, numbness and eventually comatose states. The medulla, which controls the vital functions of the human body, are affected by alcohol levels of 0,40% and distortions and suppression of the respiratory functions and temperature controls may lead to ultimate death.[26]

The detrimental effect of alcohol consumption on muscle activity is mainly due to the harmful effect of alcohol on the nervous system

[24] Schwär op cit (n7) 331 and 345. The effect of a particular alcohol concentration on brain tissue is more evident while the concentration is increasing. Once the concentration decreases, the same alcohol concentration level will have a lesser effect, since the brain tissue and neurons have accustomed to the alcohol presence and are less susceptible.

[25] Cooper op cit (n4) 151.

[26] Cooper op cit (n4) 151-3.

rather than the direct influence of alcohol on the muscular system. The effect of alcohol on the eyes and blood vessels is also noteworthy. Initially the pupils will widen and a delayed reaction is observed. Thereafter the pupils may show no reaction to light. With high blood alcohol concentrations the pupils are notably contracted. Alcohol consumption may also result in nystagmus of the eyes, which will be discussed in greater detail later on in this section. The characteristic red eyes of an intoxicated person are a result of dilated small blood vessels in the eye ball. The dilatations of blood vessels in the skin also contribute to the typical red colouring of the skin and the warm sensation which intoxicated individuals may experience.

3.1.2 Degrees of intoxication

It is clear from the above that the effects of alcohol consumption are usually apparent from the physical actions and features of an intoxicated individual.[27] The lay public accordingly describe such individuals in their various states of drunkenness as 'under the influence', 'drunk', 'giddy', 'intoxicated' and 'paralytic'. These physical findings and descriptive phrases will be of little practical use in the judicial system unless they can be associated with an estimated BAC level. Hence, degrees of intoxication have been identified based on the effect of alcohol consumption and the physical features and actions of intoxicated individuals, that is, the clinical features.[28] These levels of intoxication are not absolute and rather represent a progression of change in a spectrum of behavioral and functional patterns.[29] They have a dual function: it is possible to estimate a possible BAC level from the clinical features present in the individual and it enables the estimation of the extent to which the individual was influenced by the alcohol consumed, if only the blood alcohol concentration of an individual is known.

The theory of degrees of intoxication is summarized in figure 2 below.[30] Again, it is necessary to emphasize that this correlation should only be used as a general guideline and individual differences and influencing factors should not be overlooked.

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[27] Individual differences and the various factors pertaining to the absorption, distribution and metabolism of alcohol in the human body should not be isolated from the clinical finding.

[28] Jetter 'Studies in Alcohol: Diagnosis of Acute Alcoholic Intoxication by correlation of Clinical and Chemical findings' (1938) 196 *American Journal of Medical Science*: 481; Rentoul and Smith *Glaister's Medical Jurisprudence and Toxicology* (1937) 610.

[29] Cooper op cit (n4) 155.

[30] Cooper op cit (n4) 155-7; Schwär op cit (n7) 345-6.

Blood alcohol concentration g%	Occasional Drinkers	Habitual Drinkers
0 — 0,05	*Sober* Although some individuals show no deviation, changes in mood, reaction time and coordination may be present	*Sober*
0,06 — 0,09	*Lightly intoxicated* Flushed face, dilated pupils, euphoria or depression, some loss of restraint, mental impairment, incoordination, defects of speech, increased confidence, altered judgement, loss of inhibitions, loss of concentration	*Sober*
0,10 — 0,15	*Moderately intoxicated* Lightly intoxicated and sluggish pupils, incoordination of fine skilled movements, rombergism, thickness of speech, tendency to stagger when turning, faculty impairment, impulsive, less self-critical, emotional instability, memory distortion	*Lightly intoxicated*
0,16 — 0,20	*Heavily intoxicated* Lightly and moderately intoxicated and pupils dilated and very sluggish, nystagmus, incoordination of skilled movements, staggering gait, reeling and lurching when making sudden movements or turns, functional impairment, slurred and thick speech, clumsy, senses are dulled, prolonged reaction time, balance disturbed	*Moderately intoxicated*
0,21 — 0,25	*Heavily intoxicated to very heavily intoxicated* Lightly, moderately and heavily intoxicated and face is flushed / pale, pupils contracted / dilated, apathy, mental confusion, disorientation, gross incoordination, rombergism, vomiting, possible memory loss, ataxy, agraphia	*Moderately to heavily intoxicated*
0,26 — 0,30	Very heavily intoxicated	Heavily to very heavily intoxicated
0,31 — 0,40	*Stuporose to comatose* Unconsciousness, slowed respiration, weak cardiac action, depression of reflex reactions	*Very heavily intoxicated to stuporose*
0,41 — 0,50	Comatose to death	Comatose to death

Figure 2

3.1.3 Clinical observations of lay witnesses

The clinical observations are usually made first by witnesses present at the scene and or the police officials called upon to investigate the incident. Such opinion evidence on the level of intoxication of an

accused is usually admissible.[31] The evidence of such witnesses will also be of more value to the court if the witnesses state the facts on which their opinions are based, which include the clinical observations as described above. It may also be required that a foundation is laid regarding the lay witnesses' experience with alcohol intoxication in general as well as the effects and indications of such intoxication, before such evidence will be allowed.

A thorough examination of the clinical observations made by lay witnesses, with the help of medical experts and the degrees of intoxication theory, will enable a court to conclude on the estimated BAC level of an accused where formal scientific methods to establish the BAC level were not used. In the case of *S v Fode*[32] a jury inferred intoxication after a police officer testified that the accused was speeding, driving on the wrong side of the road, walking in a faltering manner, had slurred speech, bloodshot eyes and a flushed face, smelled of alcohol and failed several field sobriety tests. Lay witnesses however should not be permitted to testify beyond their level of knowledge as was illustrated in *S v Ross*,[33] where the arresting officer commented on the accused's BAC level. Only expert opinion can ultimately use clinical observations and the degrees of intoxication theory to infer an estimated blood alcohol level. Still, the court will decide on the critical issue as to whether the accused drove a vehicle while under the influence of intoxicating liquor and is not bound to the opinion of either a lay person or expert witness.[34]

In the case of *S v Edley*[35] Judge Miller indirectly suggested the main reason why lay witness testimony regarding the level of intoxication of an accused is readily admissible: the physical manifestations of intoxication are so notoriously well known and understood, even by lay persons in the community.[36] He noted that the use of expert medical evidence may even be dispensed with the more gross and manifest the physical manifestations of intoxication observed by lay witnesses are. This was illustrated in the case of *S v Skeal*[37] where the defence appealed against conviction and sentence claiming, in particular, that the state failed to call proper medical evidence on the question of

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31 Cooper op cit (n4) 14.

32 *S v Fode* 452 N.W. 2d 779 (S.D. 1990).

33 *S v Ross* 147 Or. App. 634, 938 P.2d 797 (1997).

34 PJ Schwikkard and SE van der Merwe *Principles of Evidence* (2002) 84.

35 1970 (2) SA 223 (N) at 226D.

36 *S v Stokes* 354 N.W. 2d 53 (Minn. Ct. App. 1984). Witnesses were allowed to testify regarding their opinion as to whether the accused was under the influence of alcohol after a foundation was established by witnesses' testimony that they had in the past observed people under the influence of alcohol. See also *Dickerson v Town of Christianburg* 201 Va 342, 111 S.E.2d 292 (1959).

37 *S v Skeal* 1990 (1) SACR 162 (ZS).

intoxication. The appeal was dismissed and the charge of driving while under the influence of liquor was found justified based mainly on the evidence led on the clinical observations made by two policemen, as well as the evidence led by the accused himself on his actions on the night in question. It was concluded that the Road Traffic Act[38] of Zimbabwe does not require expert medical evidence in order to prove beyond a reasonable doubt a contravention of the Act.

3.1.4 Clinical examination by expert witnesses

The clinical examination of an accused by an expert witness is usually conducted by the expert (a qualified medic) on application by the police by way of a written request form, or a formal SAP 308(a).[39] During the clinical examination the following should be ascertained: whether the accused's faculties are impaired; the degree of impairment; whether the accused is fit to drive a motor vehicle with the necessary skill and care required and; whether the impairment is wholly or partly due to alcohol consumption.[40] The examiner has a responsibility to ensure that the accused's immediate medical welfare is seen to and that the appropriate medical care is administered. The accused also has the right to require that his own medical practitioner conduct the examination, if possible. The examiner has a responsibility towards the public to ensure that the public is not subjected to any dangerous conduct by the allegedly intoxicated individual, in so far as the examiner can identify and contain or report dangerous behavior. Furthermore the examiner has a responsibility towards the legal system to ensure that the examination is conducted in a just and proper manner and that the evidence collected adheres to procedures for admissibility in a court of law.[41]

The value of the clinical examination by qualified medical personnel has been questioned.[42] Not only is the examination based on subjective observations, with the possibility that the results of the examination may differ from one examiner to another, but at low levels of intoxication it is often difficult to accurately assess alcohol impairment in relation to a subject's driving skills. The clinical diagnosis made is also regarded as provisional and subject to modification when the result of blood alcohol or toxicological analysis becomes available. For this reason, formal blood alcohol level tests have superseded the clinical examination as medico-legal proof of alcoholic intoxication in many

[38] Road Traffic Act 48 of 1976 (Z).

[39] For an example of the SAP 308(a) see Cooper op cit (n4) 194.

[40] Cooper op cit (n4) 161.

[41] Schwär op cit (n7) 337.

[42] Cooper op cit (n4) 162.

countries.[43] Nonetheless, it is argued that despite the unreliability of the clinical examination it still provides an important support service to scientific BAC tests and ensures that serious medical conditions of the accused are identified and appropriately treated.[44] Due to the unreliability of the examination, efforts are made to standardize the examination as far as possible. Clinical examinations are therefore usually conducted in terms of form Health 475 in South Africa.[45]

3.1.5 Official tests

The nystagmus test is one of the official tests used by medical examiners and qualified police officers. Alcohol consumption may lead to nystagmus of the eyes. Nystagmus[46] in this context illustrates the inhibiting effect alcohol has on the vestibular reflexes of the eyes, consequently leading to deviations in eye movements.[47] It has also been described as involuntary, repetitive wavering of the eyes consisting of a slow movement in one direction and a quick movement in the opposite direction. Nystagmus should not however be confused with the normal oscillation of the eyes when fixed on a particular object. This is rather caused by the ocular muscles straining to maintain a state of constant balancing as a result of the reflex focusing on the particular object.[48]

The nystagmus test is nonetheless not a diagnostic sign of intoxication nor a reliable field test to conclude intoxication. In the case of *Finley v S*[49] the testimony of police officers who administered the nystagmus test was allowed and the court indicated that the officers need not be experts in ophthalmology in order to testify with regard to their observations. However, in *S v Torres*[50] the findings of a nystagmus test conducted by a police officer were only admissible once the prosecution established its scientific validity and provided evidence with regard to the officer's training and experience with regard to the test and also proof that the test was properly administered. I concur with the finding of the court in *S v Torres*. Not only is the test of a technical nature for which proper experience and training is required, but the inference of intoxication can furthermore only be made if the

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43 Cooper op cit (n4) 163.

44 British Medical Association *The Medico-legal Investigation of the Drinking Driver*, (1965).

45 For an example of the form see Cooper op cit (n4) 192.

46 See Schwär op cit (n7) 332 for more information.

47 Schwär op cit (n7) 332.

48 Cooper op cit (n4) 167.

49 *Finley v S* 809 S.W. 2d 909 (Tex. App. Houston 14th Dist. 1991).

50 *S v Torres* 1999-NMSC-010, 127 N.M. 20, 976 P.2d 20 (1999).

test is repeated with the same results. Nystagmus can also be caused by various factors other than intoxication, including physical disorders and psychological states.

Another official test is the Romberg test, used to test specific muscle coordination. The subject is asked to stand straight and independently with their heels together and feet lateral. The test should be repeated with eyes open and closed. The test conducted on a sober person will result in a regular, steady movement or swaying while an intoxicated person will sway irregularly and excessively. Such excessive exaggerated swaying constitutes a positive test, that is, rombergism.[51]

The 'walk and turn test' requires that the subject walk for some distance and turn at a specific point and walk back. The examiner will check for possible deviations, especially with the turn, the manner in which the person walks, swaying movements, ataxy and balancing problems. The subject should not be asked to walk on a straight line since most sober people will normally also find this a difficult task. For the same reason the subject should not be ordered to stand on one leg or to walk toe against heel on a straight line.[52]

Many opposing views for the validity and practical applicability of these tests used during a clinical examination exist. Some tests, like the MacEwens test, which were used in the past have been discarded as unreliable and not conclusive on the question of intoxication.[53] As was indicated earlier in this article, the relevance of the clinical examination is still a topic of much debate. Despite attempts at standardization and providing the examiners with general guidelines[54] the tests do not reveal the impairment of driving ability and are not diagnostic of alcohol intoxication.[55] Not only is the diagnosis of a subjective nature but various individual differences in intoxicated persons are also common. A differential diagnosis, where the clinical diagnosis and the scientifically tested BAC result produce an incompatible conclusion, is furthermore not uncommon.

To reduce the risk of a differential diagnosis the examiner should pay special attention to the following conditions which may produce similar effects associated with intoxication: injuries, including head injuries, hemorrhage and shock may imitate the symptoms or effects

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[51] Cooper op cit (n4) 173.

[52] Schwär op cit (n7) 343.

[53] Cooper op cit (n4) 167. A test used to establish the cause of a coma. It was believed that with an alcohol induced coma the pupils will dilate on stimulation of the patient.

[54] Health Form 475 in South Africa; various published reports from the British Medical Association in the UK, including *Tests for Drunkenness* (1927), *Recognition of Intoxication* (1954 and 1958) and *Alcohol, Drugs and Driving* (1978) a supplement to *The Drinking Driver*.

[55] Cooper op cit (n4) 173.

of alcohol intoxication or may worsen the effects of intoxication where alcohol was consumed.[56] Especially with head injuries the duty of the examiner to diagnose a possible head injury and to see to the immediate well being of the subject — as discussed earlier — is of the utmost importance. It was reported in a Sunday paper[57] that a driver involved in a motor vehicle accident was arrested for drunk driving and had to spend a night in jail while seven months pregnant. The blood tests later revealed that the driver had no alcohol in her blood. She is now suing the Minister of Safety and Security for damages amounting to R52 000 based on unlawful arrest, loss of dignity and malicious prosecution. Medical examinations later confirmed that the driver had sustained head injuries due to the accident and suffered from shock which may have resulted in physical features resembling that of alcohol intoxication. Natural diseases and functional disorders like epilepsy might also influence those physical attributes usually associated with intoxication.

3.1.6 Appropriate role of the clinical exam

It is clear from the above that a diagnosis of alcohol intoxication based solely on the findings of a clinical examination will in all probability not be enough to secure a conviction of drunk driving. Due to the technical nature of the clinical tests and the doubts and criticism already existing against the clinical examination, lay witness testimony in this regard should only be admissible if factually based and if a sound basis for the witness' experience and opinion on the matter can be established.

However, the clinical examination still has an important place in the medico-legal investigation on drunk driving and should not be discarded despite objections raised. In the case of *S v Conradie*[58] the appellant had been convicted of driving a vehicle on a public road whilst under the influence of alcohol. Although her blood analysis showed that her BAC was more than the then legally acceptable limit of 0,08gm/100ml, the findings of the clinical examination conducted by the district surgeon were irreconcilable with the alleged BAC level of 0,2gm/100ml.

The district surgeon described the appellant as slightly under the influence of alcohol and his clinical findings, which included slurred speech, fine nystagmus and moderate rombergism, could easily have been attributed to the severe head injury and concussion which the

[56] Schwär op cit (n7) 343.

[57] D Van Heerden 'Vrou eis van Staat na dronk-klag teen haar' *Rapport* 19 September 2004.

[58] *S v Conradie* 2000 (2) SACR 386 (C).

appellant sustained in the motor vehicle accident. The appellant's medical examiner, who examined her approximately 15 hours after the incident, also confirmed that she was in a state of shock which could explain her agitated and emotive behaviour after the collision occurred and which was observed by lay witnesses at the scene. The court also considered the amount of alcohol the appellant admitted to have consumed and the expected clinical signs associated with the blood alcohol level, as was alleged by the state. With a BAC of 0,2gm/100ml clearer clinical signs of intoxication should have been observed. After a careful consideration of all the evidence in light of the specific circumstances the court concluded that the appellant's blood analysis was completely irreconcilable with the clinical findings, that the clinical findings indicating intoxication were also doubtful due to the influence of the injuries sustained by the appellant and the risk of a differential diagnosis and, that the appellant should therefore have been acquitted.

With this ruling the Cape Provincial Division confirmed the clinical examination as a supporting agent to the blood alcohol analysis. In this case, due to the clinical findings together with the relevant circumstances, the clinical opinion superseded the scientific blood alcohol results — it was concluded that the blood analysis must have been faulty. It is doubtful though whether the court would have come to the same conclusion if the risk of a differential diagnosis did not exist, since the subtle clinical findings could otherwise be ascribed to, for example, an individual variation on the general clinical observances usually found with a BAC of 0,2gm/100ml.

In the case of *S v Strydom*[59] the results of the clinical examination conducted by the district surgeon and the blood analysis carried out by a Perkin-Elmer chromatograph machine were also irreconcilable. The appellant claimed that the analysis of the specimen did not give a reliable result based on two grounds: the manner in which the examiner prepared the specimen for analysis and his interpretation of the results which left room for error. It was clear from the evidence led that the examiner was not an expert on the working of the machine but only on the interpretation of the results. It could not be proved beyond a reasonable doubt that the analysis of the appellant's blood was reliable. With the clinical findings as a supportive element to the circumstances of the case in issue and with the clinical observations supporting the doubt as to the reliability of the blood analysis the appeal succeeded.

The findings of a clinical examination will therefore always play an integral role in the medico-legal investigation of drunk driving and should consequently be treated with the appropriate consideration but also caution. In Finland the problematic subjectivity inherent in clini-

[59] *S v Strydom* 1978 (4) SA 748 (E).

cal examinations was addressed by a three-tier evaluation scheme. A driver evaluation is conducted by the medical examiner. This is followed by an evaluation conducted by a specialist in the field, considering the findings of the medical examiner and the result of a blood test. Finally, an evaluation is conducted by the court in the light of all the circumstances and evidence led.[60]

3.2 Scientific tests

3.2.1. Blood tests

A properly administered blood test, indicating that the accused's BAC level was more than the legally acceptable limit, is still the most conclusive evidence in drunk driving cases. Blood testing performed by trained medical personnel furthermore does not carry the same risk of error as field breath testing by police officers and other officials.[61] Nor is it subject to the level of error and subjectivity of the clinical examination as described above.

Any registered medical practitioner, including a registered nurse, may take a blood sample from an alleged intoxicated person for the purposes of analysis by a state laboratory or other recognized facility.[62] It is also possible for other suitably qualified and fit persons to conduct such blood sampling under particular circumstances.[63] Medical officials, as described above, may take the sample on request of the police or out of their own accord if the person was admitted to a medical facility and a reasonable belief exists that a blood sample may be relevant at later criminal proceedings.[64]

The alleged intoxicated person need not provide his or her consent for the procedure, since s 65(9) of the National Road Traffic Act 93 of 1996 stipulates that nobody may refuse the taking of blood sample or the testing of his or her breath. In the case of *S v Binta* 1993 (2) SACR 553 (C) Judge Ackermann had to decide, inter alia, whether a refusal to undergo a blood test constituted an obstruction of justice and defeated the ends of justice. It was clear that obstruction of justice or defeating the ends of justice required a positive act by the accused and not

[60] A Pentilla and M Tenhu 'Clinical examination as medico-legal proof of alcohol intoxication' (1976) *Med Sci Law* 95.

[61] *State Dept. of Motor Vehicles and Public Safety v Tilp* 107 Nev. 288. 810 P.2d 771 (1991).

[62] Criminal Procedure Act 51 of 1977, s 37(2)(a).

[63] *S v Winquist* 247 N.W.2d 256 (Iowa 1976); *Bennett v S* 723 S.W.2d 359 (Tex. App. Fort Worth 1987).

[64] Criminal Procedure Act 51 of 1977, s 37(2)(b).

a mere omission as in this particular case.[65] Medical officials and the police have a duty to ensure the taking of a blood sample but it does not necessarily follow that the arrested person has a correlative positive duty to supply a blood sample or make him or herself available for the taking of such a sample. The appellant's conviction on defeating the ends of justice was consequently set aside.

The South African legislature did not introduce a criminal sanction by statute as the legislatures in the United Kingdom and Zimbabwe did.[66] In the Zimbabwean case of *S v Mazorodze* 1990 (1) SACR 256 (ZS) the legal duty of the offender to submit to a blood analysis or breath analysis test according to the Zimbabwean Road Traffic Act 48 of 1976 was confirmed by the court of appeal.

Section 65(9) of the South African National Road Traffic Act 93 of 1996 now places a legal duty upon the offender to submit to the necessary medical tests and only with a reasonable excuse will an offender be able to refuse blood analysis and breath analysis tests today. It is also suggested that a blood alcohol test performed on an accused while unconscious is also admissible under the implied consent statutory provision.[67] The administering of the blood test as well as the handling of the specimen thereafter should be conducted with great care. Relevant precautions should be taken to ensure that the specimen is not contaminated and that the results obtained are accurate and admissible in a court of law.

The appellant in *S v Brumpton*[68] appealed against his conviction and contended that it was not proved by the state that the substance used to clean the appellant's skin prior to the blood sample being taken did not itself contain alcohol. If the substance did contain alcohol, the alcohol content of the blood sample taken did not represent the actual alcohol content of the appellant's blood at that time. It is trite that great care should be taken to ensure that the substance used to clean the offender's skin before taking the blood sample should not contain any alcohol since the introduction of alcohol from an external source to the specimen of blood will render the specimen inadmissible. Even small quantities of alcohol or other impurities may influence the results greatly.[69] Judge Nestadt furthermore stated that in order to prove the contents of the substance used, no reliance can be placed on the manufacturer's label of the substance, since such labeling constitutes hearsay evidence.[70] Although there is a rebuttable presumption (operating in

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65 *S v Binta* 1993 (2) SACR 553 (C) at 559*e*; *S v Oberbacher* 1975 (3) SA 815 (SWA).

66 *S v Woldemar* 1991 (4) SA 497 (ZSC).

67 *Smith v S* 460 So. 2d 343 (Ala. Crim. App. 1984).

68 *S v Brumpton* 1976 (3) SA 236 (T).

69 *S v Pillay* 1969 (2) SA 248 (N).

70 *S v Greeff* 1970 (4) SA 704 (O).

favour of the state) that a blood sample was administered and handled correctly and is free of external contamination, where no evidence exists to the contrary, this presumption does not apply to the possible contamination of the sample by the substance used to clean the skin.[71] The state consequently failed to exclude the reasonable possibility that the substance used to clean the appellant's skin contained alcohol and the specimen of blood taken from the appellant could not be relied on. The appellant was acquitted.

3.2.2 The Widmark formula

Various methods of BAC analysis of blood specimens exist and can broadly be categorized in biochemical methods, chemical procedures and the gas chromatography methods. By 1959 more than 200 methods had already been published and the number has increased.[72] Although these methods will not be discussed in this article, the Widmark formula developed by the Swedish scientist Erik Widmark requires special reference.

The importance of the Widmark formula lies not only in the r-factor and the formula for alcohol quantification, which was briefly described above, but also in the possibility of back calculation of the BAC result from the time during which the specimen was taken to the time of the incriminating incident. This is of extreme importance since alcohol is never static in the human body, as was indicated by the exposition on the absorption, distribution and elimination of alcohol above. A blood alcohol curve, illustrated by multiple blood alcohol levels when plotted and joined together, therefore reflects the continuity of change in the alcohol concentration from absorption to elimination.[73] The normal blood alcohol curve has a rising limb, a peak and a declining limb. The peak of the curve is usually reached within two hours after drinking ceases and represents the point at which the rate of absorption into, and elimination of alcohol from, the blood is equal.

The scientific value of this blood alcohol curve is used as a premise in drunk driving cases, consequently the National Road Traffic Act provides for a rebuttable presumption that if a BAC test was administered within two hours of the alleged incident it can be presumed, in the absence of evidence to the contrary, that this was the BAC level at the time of the alleged incident.[74] Theoretically the Widmark formula and

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[71] This rebuttable presumption is now provided for in s 65(4) of the National Road Traffic Act 93 of 1996.

[72] Friedemann & K Dubowski 'Chemical testing procedures for the determination of alcohol' (1959) *Journal of the American Medical Association* 170.

[73] Cooper op cit (n4) 222.

[74] Section 65(6).

the method of back calculation could therefore be used to determine the BAC of an offender at the time of the offence where the blood specimen was not taken within two hours of the alleged incident. Needless to say this can be of great help to the state in drunk driving cases.

However, although this back calculation method is used by many scientists as well as Germany's Lower, Supreme and Federal courts, reservations are expressed by many scientists and this method has, to the author's knowledge, not been relied on in a South African court of law.[75] The main criticisms against the use of this calculation include that: no accurate value can be determined but only a fair estimate of a possible BAC level can be suggested; that the back calculation should not exceed two hours since there are too many factors influencing the metabolism of alcohol in the human body to guarantee a reasonable result and; the calculation requires exact information on the subject's alcohol consumption and any other nutritional intakes.[76] Judge WE Cooper also concurs that the results of back-calculations cannot be accepted as absolute proof of the blood alcohol level at a time prior to sampling.[77]

The Widmark method of back-calculation was nonetheless successfully invoked by the appellant in the case of *State of Utah v Boyd Lee Preece*.[78] The appellant claimed that he had consumed additional alcohol moments before he was stopped by the traffic officials and the blood sample was taken — the infamous 'hip-flask-defence'. About one-and-a-half hours elapsed between the stop and the blood test and according to the Widmark-formula the appellant's BAC level was rising at the time the blood sample was taken. An expert testified that a simple back-calculation would show that the appellant's BAC level was actually below the legal limit of 0,08 at the time of the traffic violation and the time the appellant was stopped by the traffic officials. The court of appeal allowed the evidence on the absorption and metabolic rates of alcohol and reversed his conviction.

In the case of *State of Hawaii v James L Vliet*[79] the Supreme Court of the State of Hawaii reviewed the admissibility of the Widmark formula and back calculations based on this formula. The court recognised that the formula is widely regarded as a reliable scientific principle, that the United States National Highway Traffic Safety Administration considered the Widmark formula as the basic formula for estimating a person's blood alcohol concentration and, that back calculations based on the formula may be used as long as there is sufficient evidence

[75] Cooper op cit (n4) 246.
[76] Cooper op cit (n4) 246-50.
[77] Cooper op cit (n4) 250.
[78] Case No 971576-CA, December 17 1998.
[79] No 22827 CR No 98 — 0690, March 15 2001.

about the variables necessary to calculate a fairly reliable result.[80] In the State of Georgia, however, the Court of Appeals has rejected the Widmark formula as not being reliable and accurate and therefore not admissible as scientific evidence in a court of law.[81]

3.2.3 Breathalyzer

In 1939 breath analysis gained recognition as a method for routine alcohol determination.[82] The first breathalyzer was invented by Robert Borkenstein from the Indiana University School of Medicine in 1954 and since then various similar instruments have been invented to determine breath alcohol levels.[83] The breathalyzer is not without controversy. While it is less invasive than blood tests, more objective than a clinical examination and requires less time than both these methods in obtaining an alcohol concentration reading, there are many controversial points about its accuracy.

The Breathalyzer is based on the principle that the concentration of alcohol in the air we exhale, or alveolar air, relates closely to the concentration of alcohol in our bloodstream, since the concentration of alcohol in the blood stream diffuses across the membranes of the lung's alveoli. This partition ratio may vary among and within individuals and may vary under different operating conditions, such as temperature changes. The person undergoing a breathalyzer test breathes deeply into a tube which captures the exhaled air sample and passes it to a sensor where a chemical reaction takes place in order to provide a breath alcohol concentration indicator. Various different instruments make use of different chemical procedures. A minimum amount of air is necessary for a set time period in order to obtain an accurate result. Due to the technical nature of the instrument, field officers are also required to undergo appropriate training before being able to administer the test and interpret the results accurately.[84]

Initially the results obtained by breathalyzers were not admissible in court proceedings but only served as a field test to identify possible offenders who had to undergo a clinical examination and blood tests

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[80] *S v Wolf* 592 N.W. 2d 866, 869; *S v Tibbetts* 604 A.2d 20, 22 (Me 1992); *Quinto v City and Borough of Juneau* 664 P.2d 630, 634 (Alaska App 1983).

[81] *Evans v S* 253 Ga. App. 71, 558 S.E. 2d 51 (2001).

[82] Cooper op cit (n4) 275.

[83] B Schweber 'How it works' *Electronics Design, Strategy, News,* 16 October 2003 available at www.edn.com, accessed on 6 August 2007. These instruments are generally referred to as breathalyzers although the name 'breathalyzer' is owned by Dräger Safety Inc see at www.draeger.com/ST/internet/us/en/Products/Detection/Breathalyzers/Accessories/pd_alco_accessories.jsp, accessed on 6 August 2007 .

[84] Schweber op cit (n83).

for a final result.[85] The National Road Traffic Act 93 of 1996 now makes provision for breath alcohol concentration results in ss 65(6) and (7). Accordingly the legal limit for breath alcohol concentrations is 0,24 mg/1000ml and 0,10 mg/1000ml for professional drivers as defined by s 32 of the Act. Only results obtained by instruments as prescribed and recognized by the Road Traffic Department will be admissible in a court of law. No person may refuse to undergo a breath alcohol concentration test (s 65(9)) and a rebuttable presumption also exists that a test taken within two hours of the alleged offence will, in the absence of evidence to the contrary be presumed to be the offender's breath alcohol concentration at the time of the offence (s 65(6)).

Many still claim however that breathalyzers are not reliable and accurate and that faulty readings occur regularly due to exposure to occupational or environmental solvents, alcohol present in the mouth of the subject undergoing the test from digestive system contents or alcohol retention in denture adhesive materials. In *S v Vorster* and four similar cases[86] the court reviewed five cases where the respective offenders were found guilty of driving with an illegal breath alcohol concentration. Judge Hugo highlighted various factors to be considered when dealing with breathalyzers and breath alcohol concentration results. He considered that the breathalyzer test is of a technical nature, thus appropriate certificates regarding the accuracy of the instrument and the recognition of the particular instrument should be available to the offenders at the time of the test on their request. Nonetheless the use of breathalyzers is allowed to make it easier for the state to eliminate drunk driving, and overzealous technical requirements should therefore be avoided. Further, the procedure to be followed and the working of the instrument should be explained to the subject undergoing the test.

4. Conclusion

It is clear from the above that the medico-legal investigation of drunk driving cases is a complex, interdisciplinary and sometimes contentious matter. Although allegations of drunk driving and other legal matters related to intoxication are usually regarded with the necessary caution by all involved and thoroughly regulated by most legislators in the world, the intricacy of the issue and the dire effect of drunk driving incidents remain a reality.

As this article explained, various scientific factors and the input and knowledge of laymen and professional officials from a range of vocations are involved in the investigation and conclusion of each drunk

[85] Schwär op cit (n7) 348.

[86] *S v Vorster* 2002 (1) SACR 379 (N).

driving incident. The issue is also of such a technical and specialized nature that more interdisciplinary research is required in order to comment on the road ahead. It is apparent however that the general public, police officials and other professions involved in the investigation of drunk driving cases require specialized information and training on alcohol consumption, its effects and the methods of regulation as stipulated in the National Road Traffic Act.

Alcohol is the most powerful depressant of the central nervous system that is freely available without a doctor's prescription,[87] it is suggested that legal matters regarding intoxication and drunk driving cases therefore be treated with the necessary priority.

[87] J Harvard 'Alcohol and the driver' (1978) 1 *British Medical Journal* 1595.