

# **Alcohol Analysis of Breath and Urine to Support Drink Driving Awareness in Students**

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## **Declaration**

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## **Acknowledgements**

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## **Abstract**

This project was in collaboration with the college awareness of road safety (CARS) initiative as part of the students learning with communities. The aim of this project was to promote awareness in drink driving issues in relation to student attitude's, motivation and behavior in areas of road safety. In order to observe people's awareness in relation to drink driving, breath and urine analysis were carried out on volunteers as well as an alcohol analysis questionnaire and online surveys.

Breath samples were provided by D.I.T students on a Friday morning as many students' go out on a Thursday night. A total of 30 students were breathalyzed but none of which were tested positive for alcohol on the BAChTrack. The students were asked to complete an alcohol analysis questionnaire, consent form and provide a sample of breath. A further 12 students were breathalyzed on another Friday, and 5 students determined to have positive results of alcohol in their breath after being out for lunch. 3 of the participants were over the legal limit.

Urine samples were provided by coaches from Grange Gymnastics Club on a Saturday morning, as many coaches go out on a Friday night. All analysis of the urine was carried out by gas chromatography. The Results of the analysis were then compared to the legal limits under section 4 and 5 of the Road Traffic Act. An overall of 13 urine samples were analysed, 9 samples were over the limit and 4 samples had negative results for alcohol.

An overall of 61 surveys were completed by participants by an online survey, survey in the urine pack or a survey when breathalyzed. The surveys illustrated that students were not aware of the legal limits for drivers as well as units of alcohol contained in drinks. The surveys provided information as to people's knowledge on legal drink driving limits, personal opinions on drink driving issues as well as give greater understanding of the demographic which would potentially drink drive and to determine if there is a relationship between alcohol consumption, driving and possible drug use.

## Abbreviations

Symbol or abbreviation	Name
BAC	Blood Alcohol Concentration
UAC	Urine Alcohol Concentration
CRA	Chemical Risk Assessment
DIT	Dublin Institute of Technology
EU	European Union
RSA	Road Safety Authority
MBRS	Medical Bureau of Road Safety
DCS	Diasys Check Standard
GC	Gas Chromatography
EtOH	Ethanol
g	Grams
mL	Millilitres
mg/mL	Milligrams per millilitre
min	Minute
%v/v	Percentage volume per volume
%w/w	Percentage weight per weight
%RSD	Percentage of relative standard deviation
$\sigma$	Standard Deviation
x	Mean

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## Chapter 1 Introduction

The consumption of alcohol in Ireland has been topic of debate for many years. Especially the concept of drink driving. Ireland is estimated to be one of the highest consumers of alcohol in the European union <sup>[1]</sup>. In the year 2008, an overall of 18,053 people were suspected to have been drink driving and arrested <sup>[1]</sup>. According to road safety authority approximately 1 in 3 fatal crashes are alcohol related.

The main legislation that involves road safety is the Road Traffic Act 1961, however this is updated regularly in order to reduce and eliminate drink-driving offences <sup>[2]</sup>. Statistics show that between the years of 2002 to 2004 that alcohol contributed to 33% of fatal crashes in Ireland, making Ireland the top 5 of the selected 24 countries researched<sup>[1]</sup>.

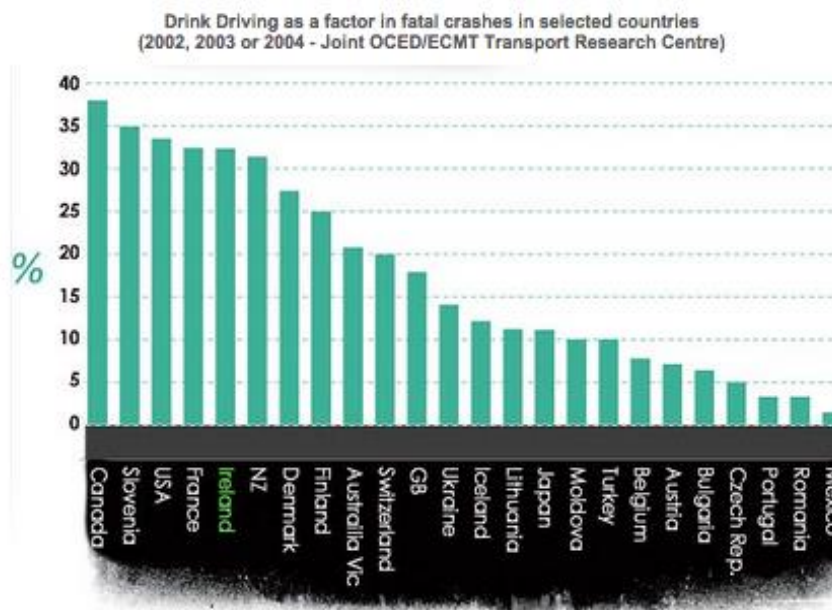


Figure 1:

Ireland now has a legislation of a blood alcohol concentration (BAC) limit of 0.05% like all other European union countries except for the UK (0.08%) and Malta (0.09%) <sup>[1]</sup>.



## 1.1 Alcohol

Alcohol is characterized by its hydroxyl functional group (OH) and gives the suffix *-ol* to all compounds, which contain this functional group. In general, the primary alcohol ethanol or ethyl alcohol is known as “alcohol” which is present in alcoholic beverages. Alcohol in alcoholic beverages is produced when sugar is converted to alcohol by a metabolic process known as fermentation [3].

Ethanol has a molecular formula of  $C_2H_5OH$ , the hydroxyl group found in ethanol and other alcohols is polar but the carbon chain however is non-polar. The size of the carbon chain will dictate how polar the overall compound is. Ethanol has a small carbon chain therefore it is very polar [4].

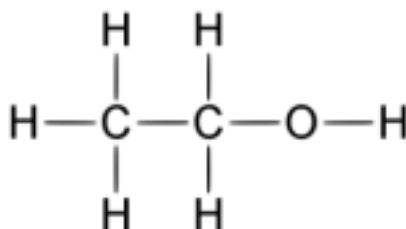


Figure 1.1: Chemical Structure of Ethanol

Propan-1-ol was used as an internal standard as it has a similar structure to that of ethanol. Propanol has a longer carbon chain than Ethanol, which contributes to it being less polar than Ethanol [4].

The strength of an alcoholic beverage will depend on the concentration of ethanol %v/v, in general it can range from 3-40%v/v depending on the beverage. The unit of alcohol in a drink is a measure of how strong it is. Half a pint of cider is 1 unit of alcohol as it is 218mL and 4.5%v/v. Half a glass of wine is also 1 unit of alcohol as it is 76mL and 13%v/v [5]. The higher the percentage of alcohol the less volume of liquid it will be in order for it to be one unit of alcohol. Knowing how much units of alcohol are in drinks, will help in being drink aware and less likely to drink drive [5].

## 1.2 Effect of Alcohol on the Body

The main pathway of entry to the body for alcohol is by ingestion. Alcohol is removed from the body by oxidation and excretion. Oxidation of alcohol occurs in the liver to produce carbon dioxide and water (*fig 1.3*).

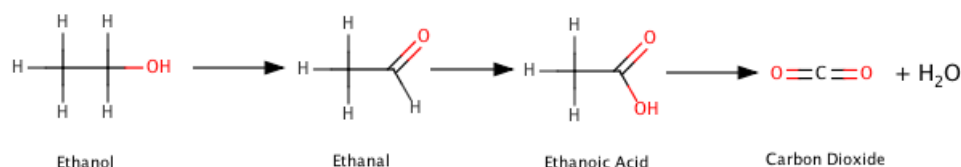


Figure 1.3: Metabolism of Alcohol in the liver.

Ethanol is converted to ethanol by the enzyme alcohol dehydrogenase which is the converted to ethanoic acid which then forms carbon dioxide and water. Alcohol is absorbed through the mouth, throat, stomach and intestines into the bloodstream [3]. The bloodstream does not chemically alter or digest the alcohol, therefore when blood flows through the lungs, alcohol moves across the membrane of the lungs alveoli into the air. The concentration of the alcohol in the alveolar air is directly proportional to the concentration of alcohol in the blood [4]. If someone has consumed alcohol and air is then exhaled, it can be detected by a Breathalyzer. The ratio of breath alcohol to blood alcohol is 2100:1.

The rate in which alcohol may be absorbed, distributed and eliminated from the body can depend on one's gender, fasting or fed states as well as their drinking patterns. A person who drinks often, generally can metabolize alcohol much quicker than a person who doesn't drink, this is due to their body.

Alcohol can affect the central nervous system (CNS) as it is also affected by the blood alcohol concentration (BAC). The high concentration of alcohol can cause impairment and decrease motor function.

There are many adverse effects from drinking alcohol short and long term. The short term effects can be seen in *table 1.2*. The long term effects are damaging. The liver is usually affected by alcohol-induced damage.

The dose specific of alcohol differ between individuals depending on their height, weight and gender

Table 1.2: Dose Specific Effects associated with Alcohol [5].

<b>%BAC</b>	<b>Ethanol in blood</b>	<b>Dose Specific Effects</b>
0.02-0.03	20-30mg/100mL	Slight Euphoria and Impairment can occur with some individuals
0.04-0.06	40-60mg/100mL	Euphoria and minor impairment can occur with reasoning and memory. Driving can be impaired at this level of intoxication due to lowering of caution.
0.07-0.09	70-90mg/100mL	Impairment of caution, reasoning and memory which leads to driving skills always being impaired at this level of intoxication
0.10-0.12	100-120mg/100mL	Motor coordination and loss of good judgment is greatly impaired. Balance, hearing, vision and reaction time are impaired
0.13-0.15	130-150mg/mL	Lack of physical control and major motor impairment.
0.16-0.20	160-200mg/mL	Dysphoria and nausea
0.25	250mg/mL	Mental confusion, requires assistance walking, some vomiting
0.30	300mg/mL	Loss of consciousness
≥0.40	≥400mg/mL	Possible death as respiratory arrest occurs. Onset Coma.

### 1.3 Effect of Alcohol on driving

The effect of alcohol on driving is determined by many factors, such as a person's weight, build, age etc. as well as how much and what type of alcohol one has consumed. The dose-specific effects of alcohol on a person can be observed in *table 1.2*. Depending on the person alcohol effects can differ; a person who consumes alcohol regularly will metabolize alcohol much quicker than that of a person who does not consume alcohol regularly. According to the Irish Road Safety Authority, reducing the BAC limit will save lives and prevent serious injuries nationwide [1]. Reducing speeds across the road network will also help in the prevention of accidents as the combination of alcohol and speed is most catastrophic especially for young and inexperienced drivers.

### 1.4.1 Detection of Alcohol in the Body

In general blood alcohol concentration (BAC) is more accurate than urine alcohol concentration (UAC), as it determines the amount of alcohol in the system at that time, however giving blood is much more invasive and most people would be happier to give urine samples than blood. If blood is to be taken from a suspect, it must be done so by a certified doctor. The errors, which would be considered for urine is elimination delay of alcohol through body fluid into the bladder. Urine samples provided could be free of alcohol if a person had not recently urinated. Therefore a second sample of urine is provided a half an hour after the first sample. Urine samples should have a preservative (sodium fluoride) added to them as well as be kept in a fridge in order to prevent degradation of the sample before sampling. The UAC as well as BAC are analyzed on a gas chromatograph. The basis of chromatography separation is that of differential migration which involves the components of a mixture partition between two phases and is delayed in their passing through the system in relation to their interaction with the stationary phase. Each of the components is distributed between the stationary phase and the mobile phase as it passes through the system. The column of the GC is coated by a thin layer of material which acts as the stationary phase [7]. In terms of urine samples, there are only two components measured in this project, ethanol and propan-1-ol. Ethanol which is the alcohol contained in alcoholic drinks and propan-1-ol being an internal standard. It is clear to determine which component is which based on polarity and retention time. UAC and BAC are always measured in mg/100mL in Ireland.

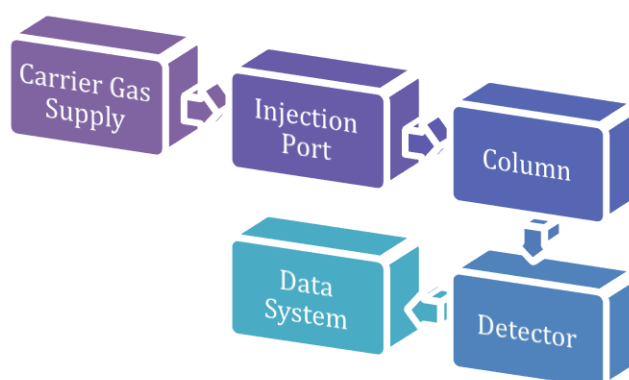


Figure 1.4.1: GC Schematic [7].

### 1.4.2 Analysis of Breath for Alcohol

In Ireland, there are two main methods of analyzing breath for alcohol by a handheld Breathalyzer called an Alcotest 6510 (Dräger Model) or by an instrument called an Evidenzer, which is in most Garda Stations. If someone has consumed alcohol, it can be exhaled through the lungs and the alcohol content will be present in their breath, therefore if they breathe into a Breathalyzer, it will be detected. Breathalyzers work on the same principle of a fuel cell with an oxidant. In the case of a Breathalyzer ethanol is oxidized by oxygen, which results in an electrochemical response that is measured by the Breathalyzer. The current is proportional to the volume of alcohol.

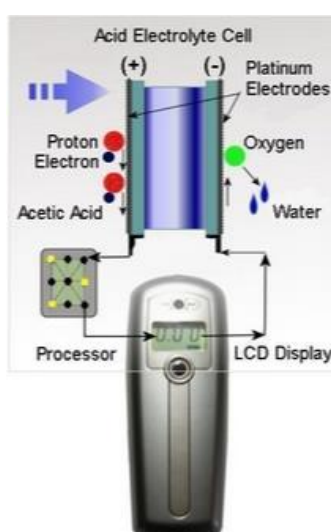


Figure 1.4.2: Fuel cell schematic in Breathalyzer.

The Evidenzer is based on infrared spectroscopy. Infrared works by passing the IR beam through the alcohol samples, which causes a decrease in light intensity that is then measured by a photoelectric detector. Henry's law states that at a constant temperature which  $34^{\circ}\text{C}$  in the case of the body, an amount of a certain gas dissolves in a volume of liquid which is directly proportional to the partial pressure of that gas. The concentration of alcohol in 1mL of blood is the equivalent of 2100mL of alveolar breath [6]. Both the Alcotest and Evidenzer measure in  $\mu\text{g}/100\text{mL}$  as is the standard unit of breath alcohol in Ireland; However the BACTrack can only measure in  $\text{mg}/100\text{mL}$  as it is an American Breathalyzer.

## 1.5 Legislations and Penalties

All drink driving information relating to legislation and Penalties can found in the Road Safety Act of 2010. Drink driving falls under section 4 and 5 of this act, stating a person should not drive under the influence of a level of alcohol that causes them lose control of a car <sup>[9]</sup>. Breath analysis falls under Section 10 of this act, stating only two breath specimens can be provided by the suspect for analysis <sup>[9]</sup> and the drink driving fixed penalty (DDFP) falls under section 29, which can be seen in *table 1.5*.

	Limit	Fine	Penalty
	(mg/100 mL)		
Blood	50-80	€200	3 penalty points
Urine	67-107		
Breath	22-35		
Blood	80-100	€400	6 months disqualification
Urine	107-135		
Breath	35-44		
For Specified Drivers			
Blood	20-80	€200	3 months disqualification
Urine	27-107		
Breath	9-35		

Table 1.5: Penalties determined by the Road Traffic Act<sup>[9]</sup>

The table displays the legal limits for both that of a fully licenced driver and a specified driver as well as the associated penalty. If a person is over the limit and tested positive to being over the limit, they can be subject to a court hearing in order to be prosecuted. The analysis of their blood, urine or breath will be used, as evidence to proof that alcohol was present in their system and the concentration of alcohol that was determined.

## **1.6 Focus of the Project**

The project is in collaboration with the College Awareness of Road Safety (CARS) initiative as part of the Students Learning With Communities. The aim of the CARS initiative is to get students to apply the knowledge they have gained from studies to improve awareness of road safety amongst young drivers. One of the main aims of this project is to promote awareness in drink driving issues in relation to student attitudes, motivation and behavior in areas of road safety. This was achieved through collection of samples from the D.I.T students and external volunteers.

## **1.7 Aims of the Project**

- To investigate the relationship between various environmental/genetic factors and peoples attitudes to alcohol and drugs.
- To compare results between breath alcohol analysis using a commercially available personal testing device and urine alcohol by GC from participants within D.I.T and a selected organisation.
- To interpret such data and obtain a greater understanding of the demographic which would potentially drink drive.
- To raise awareness of drink driving limits between D.I.T students and other coordinations.
- To determine the attitudes to drink and drug driving in the country.
- To examine the relationship between attitudes and alcohol consumptions through sampling events and surveys/questionnaires.

## Chapter 2 Experimental Details

A Chemical Risk Assessment (CRA) for the use of ethanol, propan-1-ol and sodium fluoride was carried out and signed off before work in the laboratory began. This CRA can be seen in Appendix.

Chemical	CAS No.	Concentration	Frequency	Duration of Exposure
Ethanol	64-17-5	100% Absolute	Frequent	10 mins
Propan-1-ol	71-23-8	99.5%	Frequent	10 mins
Sodium Fluoride	7681-49-4	0.150g	Occasional	10 mins

Table 2.0: CAS number, concentration, frequency of use and duration of exposure for use of chemicals.

### 2.1 GC Conditions

GC make and Model:	Shimadzu GC-8A
Injection Volume:	1 $\mu$ L
Injection Port:	2
Injection/Detector Temperature:	150°C
Column Temperature:	80°C
Carrier Gas:	Nitrogen
Flow Gas:	Hydrogen
Detector:	Flame Ionization
Run Time:	3.5 minutes
Column:	Packed, 10% Carbowax
Injection:	Splitless



## 2.2 Quantification of Wine by GC

The experiment was carried to become familiar with the instrument. Ethanol standards were prepared according to the procedure in the 3<sup>rd</sup> Year School of chemical and pharmaceutical laboratory manual. Wine samples were also prepared as per the manual. Propan-1-ol is used as an internal standard which has a known concentration as a method of calibration. The calibration utilizes the ratio of response between the analyte and internal standard.

Table 2.2: Wine Standards for GC Analysis

<b>Vol of Ethanol (12%w/w) added (mL)</b>	<b>mL of Propan-1- ol (10%v/v)</b>	<b>Final Volume (mL)</b>	<b>Final Working Concentration of Ethanol (%w/w)</b>
1	2	50	0.24
2	2	50	0.48
3	2	50	0.72
4	2	50	0.96

## 2.3 Preparation of Ethanol and Propanol Standards for Urine Analysis

Table 2.3.1: Preparation of Propan-1-ol Standards for Urine Analysis

<b>Concentration of Propan-1- ol Stock Standard (%v/v)</b>	<b>Volume of Stock Removed (mL)</b>	<b>Final Volume (mL)</b>	<b>Final Working Concentration (%v/v)</b>
99.5	10	100	9.95
9.95	10	100	0.995
0.995	15	50	0.299

Table 2.3.2: Preparation of Ethanol Standards for Urine Analysis

<b>Concentration of Ethanol Stock Standard (%v/v)</b>	<b>Volume of Stock Removed (mL)</b>	<b>Final Volume (mL)</b>	<b>Final Working Concentration (%v/v)</b>
100	10	100	10
10	10	100	1.0
1.0	6.0	10	0.6
1.0	4.0	10	0.4

1.0	2.0	10	0.2
1.0	5.0	50	0.1
0.1	5.0	10	0.05
0.1	2.0	10	0.02

5mL of each working standard was placed in 10mL volumetric flasks and 5mL of a 0.299%v/v propan-1-ol was used and made to the mark with deionized water.

Table 2.3.3: Final Ethanol Working Concentrations for Urine Analysis

<b>Final Working Concentration (%v/v)</b>	<b>Ethanol Concentration (mg/100mL)</b>
0.01	7.89
0.025	19.73
0.05	39.45
0.10	78.90
0.20	157.80
0.30	236.70

Calculations can be seen in the appendix.

#### **2.4 Preparation of Diasys Check Standards**

Four diasys check standards of concentration 50, 100, 200 and 300mg/100mL were prepared. A diasys check standard the ampule containing the standard was poured into a glass sample bottle (30mL) along with 0.5mL of a 0.299% Propan-1-ol solution. 1 $\mu$ L of each standard was injected onto the column before analysis of any urine samples. The diasys check standards were prepared weekly and run daily before urine analysis.

#### **2.5 Calibration of Glass Pipettes**

The balance was calibrated and tared before use. A 50mL beaker was placed on the balance and tared again. A 1ml of deionized water was dispensed into the beaker, weighed on the balance and recorded weight. This was performed ten times in total. The procedure was then repeated for a 2mL, 5mL and 10mL glass pipette. All glass pipettes must be within the tolerance limit stated by the manufacturer.

## 2.6 Breath Analysis of Student Volunteers in DIT Kevin Street.

A sampling event was scheduled for Friday of the 29<sup>th</sup> of January was chosen as many students go out on a Thursday night and most likely to come in to college the next still having had alcohol in their system. The breath analysis took place in the atrium in Kevin Street D.I.T between 10.20am to 1.00pm. A stand was set up in order to attract students as they entered the atrium. Project information sheets, consent forms and the alcohol analysis questionnaires were provided to participants. All volunteers were ensured to have consented to the Breathalyzer test and understood the objective of the project. Each volunteer filled out an alcohol analysis questionnaire prior to the test. The volunteer was then asked to take a deep breath and to blow into the Breathalyzer until the instrument made a clicking noise. A new mouthpiece was fitted on to the instrument for every volunteer and any used mouthpieces were placed in a labeled bag to ensure no contamination could occur. Consent forms and questionnaires were placed in separate envelopes to ensure confidentiality and it would remain anonymous. In total 30 samples were taken.



Figure 2.6: Breath analysis in DIT Kevin Street

### **2.7 Contact with Grange Gymnastics Club**

The club was very cooperative in terms of coaches supplying urine samples for the alcohol analysis. This was carried out on a Saturday morning over two weekends in which some coaches had been out on the Friday night. Each volunteer filled out the alcohol analysis questionnaire and consent form prior to providing a urine sample.

### **2.8 Collection of Urine Samples**

Sample packs were supplied to volunteers participating in the project. Each sample pack contained an information sheet (Appendix), consent form (Appendix), Alcohol Analysis Questionnaire (Appendix), a sealed plastic bag, 100mL plastic cup and lid. The questionnaire was filled out by each volunteer and after which the volunteer was asked to deposit approximately 15mL of urine into the sample bottle, ensure the bottle was wiped clean and then placed in the sealed plastic bag.

### **2.9 Preparation of Urine Samples**

Each urine sample was prepared in duplicates in glass sample bottles (30mL). 0.150g of Sodium Fluoride was added to each sample bottle. 10mL of the urine sample was pipetted into the sample bottle and inverted several times to mix the sample completely. 5mL of the 0.299% v/v Propan-1-ol standard was pipetted into each duplicate sample bottle and inverted several times again to ensure a homogenous solution. The prepared urine sample bottles were labeled appropriately and placed in the refrigerator.

### **2.9 Washing of Glassware and Disposal of Urine Samples**

A dilute bleach solution was prepared by diluting 5mL of Bleach in 250mL of water. All surfaces were wiped clean after sample preparation with the bleach/water solution. Any glassware used in the process was also rinsed with the bleach/water solution and a Pasteur pipette between samples in order to prevent contamination. All remaining urine waste was disposed in a labeled waste container in the fume hood. The waste container was emptied every week.

## 2.10 Visit to the Medical Bureau of Road Safety (MBRS)

To gain a better understanding of breath and urine analysis a visit was organized to meet with Helen Kearns of the Medical Bureau of Road Safety (MBRS) on the 12<sup>th</sup> of February. There was an opportunity to view the breath and urine analysis laboratories in which Helen provided an explanation of how samples were handled and stored as well as the protocol involved in retrieving the samples by the doctor in the garda station. All urine samples were analyzed on automated gas chromatographs on two different columns to ensure a broad analysis of the samples is carried out. Other chemicals can be observed in the urine, therefore the use of two different columns allows a much more accurate quantification of the alcohol. Any positive samples are taken to toxicology laboratories for further analysis. The MBRS also has breath analysis laboratories in which breathalyzers used by an garda Síochána are calibrated as well as simulation tests of breath.

## 2.11 Calibration of Breathalyzer in the Medical Bureau of Road Safety (MBRS)

On a subsequent visit to the MBRS an opportunity to calibrate a Breathalyzer and conduct breath simulations was provided. An Alcotest 6510 model was calibrated, as this is the handheld device used by an Gardaí Síochána in roadside testing.



Figure 2.11: Dräger Model Alcotest 6510 <sup>[10]</sup>

The system was first purged with a certified gas to ensure the system was clear. The Breathalyzer was then set to calibration mode and flushed with a  $9\mu\text{g}/100\text{mL}$  certified gas and allowed to calibrate. The calibration was then repeated with a  $22\mu\text{g}/100\text{mL}$  certified ethanol gas. The calibration of the instrument ensures no drifting occurs and accurate readings are achieved.

### 2.12 Breath Test Simulation in the Medical Bureau of Road Safety (MBRS)

The breath test simulation was carried out by setting all three simulators to a temperature of 34.0°C to simulate the temperature of breath as in *fig 2.12*. The simulators are used to mimic the breath of a person who has been drinking alcohol and ensure the handheld devices are providing an accurate reading of that breath. The simulators were filled with a simulator solution of 9, 22 and 35  $\mu\text{g}/100\text{mL}$  of ethanol. The simulators were labeled to ensure the solutions were not confused. Gas was bubbled through the simulator until air reached the Breathalyzer and Breathalyzer testing occurred on the instrument. The BACTrack which was initially used in D.I.T testing and Alcotest 6510 were both tested in triplicates each at the three different ethanol concentrations.

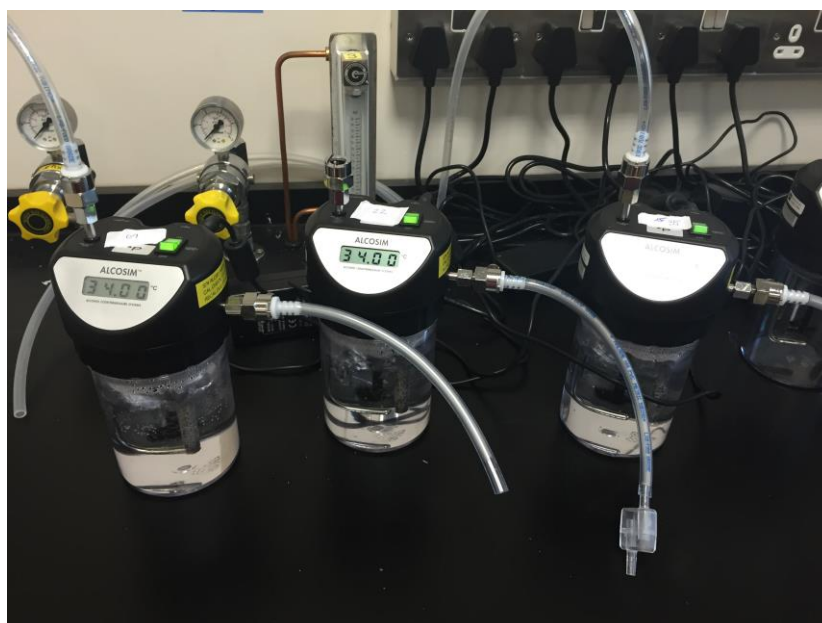


Figure 2.12: Breath Simulators in the MBRS.

### 2.13 Visit to Store Street Garda Station

A visit was also organized to meet with Garda Colm Reid in the Store Street Garda Station in order to observe the evidencer in operation *fig 2.13*. The tour started in the medical room in which breath analysis on the Evidenzer takes place. Before a person can be breathalyzed, their legal rights are explained to them as well as how the breath analysis works. In general, two Gardaí are present during breath analysis. In order to breathalyze a person on the Evidenzer, their details such as name and address are entered as well as the Gardaí's identification number. The

Evidenzer works by the suspect providing two breath specimens for analysis. A person must blow into the Evidenzer until the instrument has taken a sufficient amount of sample, if an insufficient amount has been provided, another sample must be provided. Two copies of the analysis are provided, one in which is for the person who has been breathalyzed and one for the gardaí (*fig 2.13.2*). The information provided from the Evidenzer can be used in court as part of a case to prosecute an offender if required. The breath analysis falls under section 10 of the 2010 road traffic act and drink driving fixed penalties (DDFP) fall under section 29 of the 2010 Road Traffic Act.



Figure 2.13: Evidenzer IRL in Store Street Garda Station.

<p>Apparatus: EvidenzerIRL          Serial Number: 90-0502</p> <p>Garda Síochána Station:          Store St          Dublin 1</p> <p>Test Number : 90-0502/000000          Date of start of test:          17/02/2016</p> <p>Person who provided specimens          -----          Name:</p> <p>Address:</p> <p>Date of Birth:</p> <p>Gender:</p>	<p>Analysis</p> <table border="1"> <thead> <tr> <th>Test</th> <th>ug/100ml</th> <th>Time</th> </tr> </thead> <tbody> <tr><td>Blank</td><td>0</td><td>14:30</td></tr> <tr><td>Simulator Check 1</td><td>8</td><td>14:31</td></tr> <tr><td>Blank</td><td>0</td><td>14:31</td></tr> <tr><td>Breath Specimen 1</td><td>0</td><td>14:33</td></tr> <tr><td>Blank</td><td>0</td><td>14:35</td></tr> <tr><td>Breath Specimen 2</td><td>0</td><td>14:37</td></tr> <tr><td>Blank</td><td>0</td><td>14:38</td></tr> <tr><td>Simulator Check 2</td><td>21</td><td>14:38</td></tr> </tbody> </table> <p>The specimen to be taken into account for the purposes of section - of the Road Traffic Act, 2010 is specimen 1 above. The concentration of alcohol in the breath for the purposes of that section is 0 microgrammes of alcohol per 100 millilitres of breath.</p> <p>Member of An Garda Síochána          -----          Name: C Reid          Number: 282800</p> <p>Signature</p>	Test	ug/100ml	Time	Blank	0	14:30	Simulator Check 1	8	14:31	Blank	0	14:31	Breath Specimen 1	0	14:33	Blank	0	14:35	Breath Specimen 2	0	14:37	Blank	0	14:38	Simulator Check 2	21	14:38
Test	ug/100ml	Time																										
Blank	0	14:30																										
Simulator Check 1	8	14:31																										
Blank	0	14:31																										
Breath Specimen 1	0	14:33																										
Blank	0	14:35																										
Breath Specimen 2	0	14:37																										
Blank	0	14:38																										
Simulator Check 2	21	14:38																										

Figure 2.13.2: Print Out of Evidenzer Breath Analysis.

## Chapter 3 Results and Discussion

### 3.1 Quantification of Wine by GC

The objective of the experiment was to familiarize the researchers with the GC system and to determine an accurate %v/v in the wine samples as well as ensure the gas chromatograph was in working order to analyse urine samples. A mid-polarity column was used in this experiment and therefor eluted propan-1-ol last as it interacted with the column longer than ethanol as ethanol is more polar than propan-1-ol.

Figure 3.1: The calibration curve determined from the results of the analysis of the wine sample by GC.

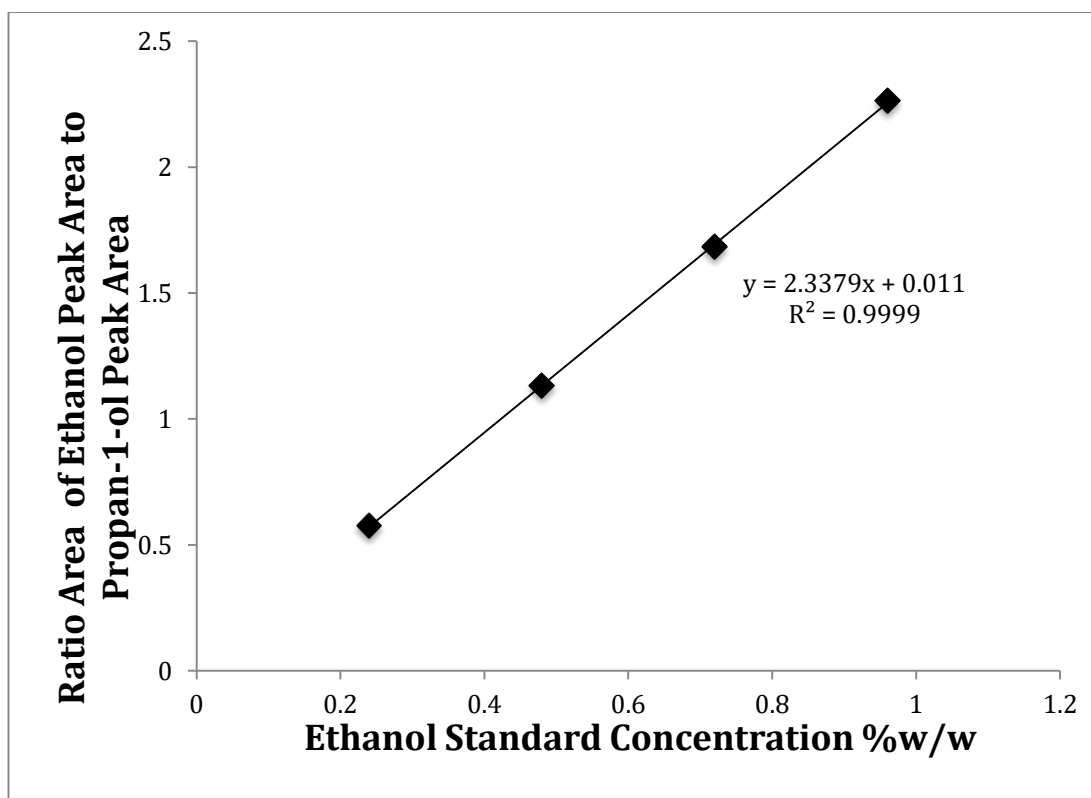


Table 3.1.2: Results of Wine Analysis.

Wine Sample	Area of ethanol	Area of Propan-1-ol	Ratio Area	% Recovery
1	318815	315410	1.0	13%v/v
2	289518	297624	0.97	12.6%v/v



Relative Standard Deviation Calculation:

Standard Deviation= 0.28

Overall Mean= 12.8%v/v

$$\%RSD = \frac{0.28}{12.8\%v/v} \times 100\% = 2\%$$

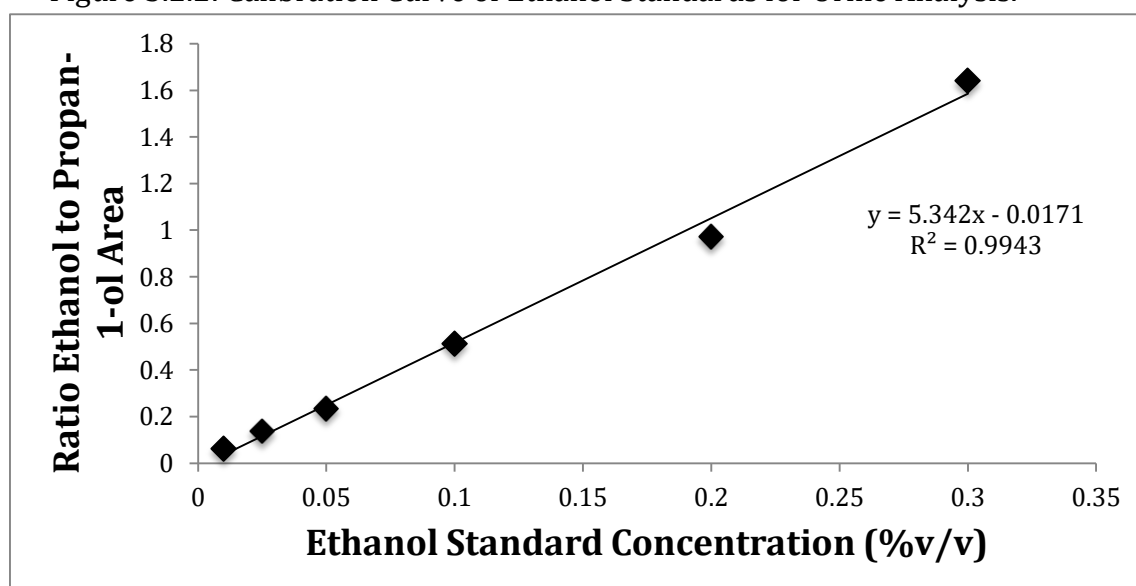
The wine bottle stated an alcohol content of 12.7%v/v, the percentage recovery of the wine samples satisfactory. All results obtained from the wine analysis were in compliance with the QC acceptance criteria of < 5% RSD, and  $R^2 > 0.99$  indicating good precision and linearity. Results and calculations can be seen in appendix.

### 3.2 Preparation of Ethanol and Propanol Standards for Urine Analysis

Table 3.2.1: Peak Areas of Ethanol and Propan-1-ol in Ethanol Standards prepared for urine analysis determined by GC.

%v/v of standard	Ethanol Concentration of Standards mg/100mL	Area of Ethanol Peak	Area of Propan-1-ol Peak	Ratio Area of Ethanol Peak Area to Propan-1-ol Peak Area
0.01	7.89	6812	111008	0.061
0.025	19.73	14505	105992	0.137
0.05	39.45	25479	108310	0.235
0.10	78.90	56382	109429	0.515
0.20	157.80	118928	122348	0.972
0.30	236.70	153088	92709	1.650

Figure 3.2.2: Calibration Curve of Ethanol Standards for Urine Analysis.



The ethanol standard concentration calibration curve is used to determine the concentration of ethanol in the urine samples and therefore it is an important experiment in terms of the project. The linearity was good with an  $R^2$  of 0.99 and is acceptable to be used. The equation of the line from this calibration curve was used in future analysis of the urine samples.

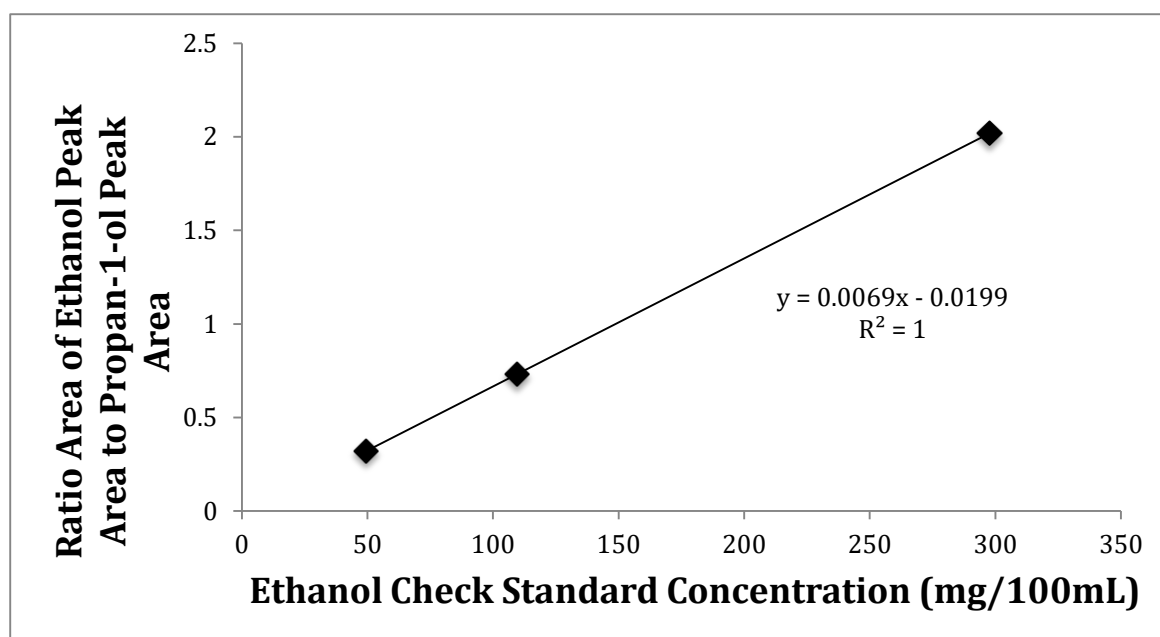
### 3.3 Preparation of Diasys Check Standards

Initially, there were issues with repeatability of the diasys check standards were due to a worn septum, which affected the results greatly as the sample would evaporate out of the GC before it could reach the column, to combat this issue a new septum was used which improved the results considerably. The diasys check standards were prepared weekly and run daily before urine analysis. It was observed that the 200mg/100mL Diasys check standard had issues throughout the project as it was past its expiry date and therefore a 50mg/100mL Diasys check standard was used instead. All Diasys daily results can be found in the appendix

Table 3.3.1: Diasys Check Standard concentrations determined by GC.

Concentration of Check Standard (mg/100mL)	Peak Area of Ethanol	Peak Area of Propan-1-ol	Ratio Area	Calculated Concentration (mg/100mL)	% Recovery
50	25795	81004	0.32	49.5	99
100	45770	62641	0.73	109.6	109.6
300	142066	70520	2.02	297.7	99.2

Figure 3.3.2: Calibration Curve of Standard Concentration against Ratio Peak Area.



### 3.4 Breath Analysis of Student Volunteers in DIT Kevin Street

A total of 30 student volunteers were breathalyzed on the 29<sup>th</sup> of January and a further 12 student volunteers on the 18<sup>th</sup> of February in D.I.T Kevin Street. All of the students provided a reading of 0.0 in the first session but 5 students gave positive results in the second session.

Table 3.4.1: Positive Results of Breath Analysis from Session Two

Student Volunteer	Reading ( $\mu\text{g}/100\text{mL}$ )	Sex	Age	Consumed alcohol	Type of Alcohol	Type of Licence
1	15.5	Female	18-21	2 drinks	Spirit/Wine	Provisional
2	15.0	Female	18-21	2 drinks	Wine/Spirit	Provisional
3	14.6	Female	18-21	1 drink	Wine	Provisional
4	6.4	Female	18-21	1 drink	Beer	Provisional
5	7.7	Female	22-25	1 drink	Spirit	Full

The alcotest 6510 provided a reading in  $\mu\text{g}/100\text{mL}$ . The legal limit for a provisional driver is  $9\mu\text{g}/100\text{mL}$  for breath alcohol content, therefore students 1, 2 and 3 are over the legal limit. The breath analysis was conducted after students had been drinking over lunch so the alcohol was still prevalent in their systems.

The student's mode of transport home from college was by bus and luas. However, it was still suggested that they do not drive for at least two hours after having consumed alcohol until it has been fully metabolized from their system as it takes one hour to clear the system of one unit of alcohol and depending on how much and what type of alcohol they had, this waiting time will vary. Only one student had a full licence and the legal limit for a fully licenced driver is  $22\mu\text{g}/100\text{mL}$  for breath alcohol content, this determines student 5 to be under the limit, however alcohol can affect people in different ways and it was suggested that they do not drive unless completely necessary and they feel completely safe doing so. This perception is up to the driver and may not necessarily be ok to drive.

The remaining students did not provide positive readings, however their surveys provided considerable information to their understandings of the legal limits and their opinions on roadside testing and drink driving issues. In addition to the results, all the survey results are discussed in the 3.6 Analysis of Surveys in this chapter.

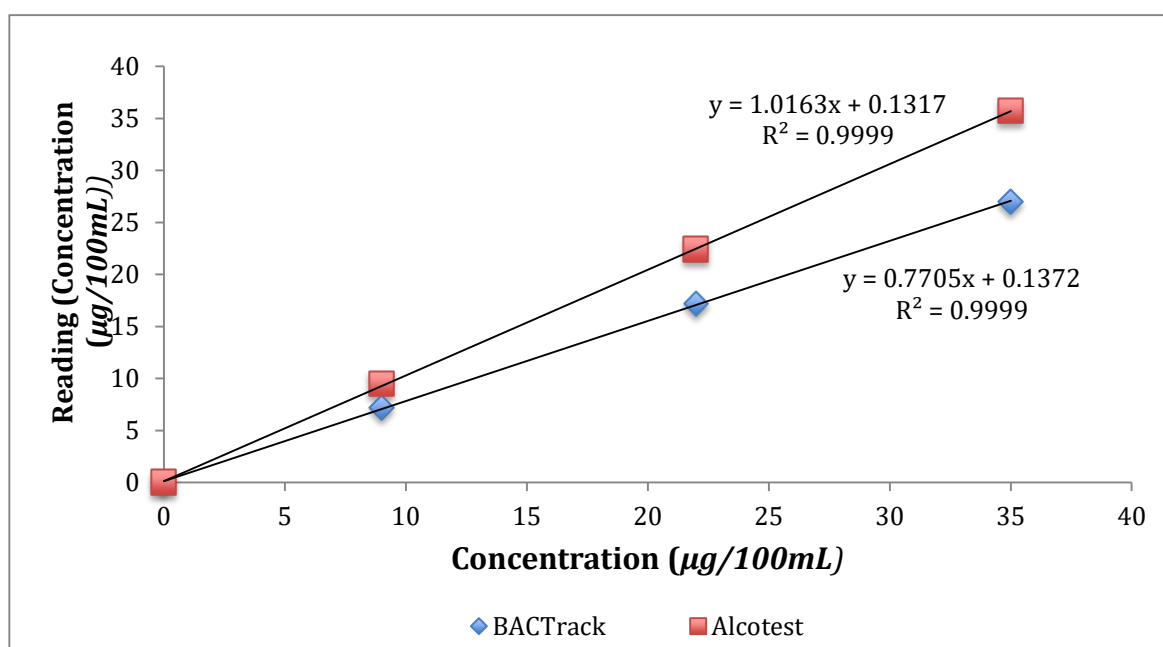
### **3.5 Breath Test Simulation in the Medical Bureau of Road Safety (MBRS)**

A simulator solution of three different concentrations was used to determine how accurate the breathalyzers are. It was observed from the results below that the BACTrack has a slight drift in calibration and therefore provides lower readings than the true concentration value. The BACTrack could not be recalibrated in the MBRS and must be sent to the manufacturer in order to be recalibrated. One issue with the BACTrack is that it has an inbuilt conversion factor to measure in % blood alcohol concentration, as it is an American Breathalyzer, however in Ireland breath is measured in  $\mu\text{g}/100\text{mL}$  and the alcotest gives a reading in these units. The BACTrack units can be converted to  $\text{mg}/100\text{mL}$  but then to  $\mu\text{g}/100\text{mL}$ . The Alcotest 6510 is used by the Gardaí and proved to be much more accurate. The students, which were observed to have a positive reading for alcohol in their breath, were breathalyzed using the Alcotest 6510. Although the BACTrack provided a lower reading, a person who had some alcohol content in their breath still would have provided some reading. Both of the handheld devices provided satisfactory linearity.

Table 3.4.1: The BACTrack Vs. the Alcotest in terms of accuracy of reading.

Concentration of Simulator Solution ( $\mu\text{g}/100\text{mL}$ )	BACTrack Reading ( $\mu\text{g}/100\text{mL}$ )	% Recovery of BACTrack	Alcotest 6510 Reading ( $\mu\text{g}/100\text{mL}$ )	% Recovery of Alcotest
0	0.0	0	0.0	0
9	7.2	80.0	9.5	105.6
22	17.2	78.0	22.4	101.8
35	27.0	77.0	35.7	102.0

Figure 3.4.2: Calibration Curve of BACTrack Vs. Alcotest



### 3.6 Analysis of Urine Samples

Overall 13 volunteers provided urine samples for analysis. In order to determine the alcohol content in each urine sample the line equation from the calibration curve in experiment 3.2 preparation of ethanol standards for urine analysis. The urine samples were prepared and analyzed in duplicates. The results from the analysis of the urine samples can be observed in the *table 3.6*.

Table 3.6: Results of Urine Analysis.

Sample	Area of Ethanol	Retention Time	Area of Propan-1-ol	Retention Time	Ratio	Equation of the line
A2 (I)	25717	1.319	105220	2.201	0.24	$y=5.3888x - 0.0184$
A2 (II)	38823	1.367	157658	2.280	0.24	$y=5.3888x - 0.0184$
A3 (I)	57063	1.317	134012	2.201	0.43	$y=5.3888x - 0.0184$
A3 (II)	62202	1.313	134635	2.198	0.46	$y=5.3888x - 0.0184$
A4 (I)	No Peak	N/A	95424	2.202	None	$y=5.3888x - 0.0184$
A4 (II)	No Peak	N/A	86708	2.210	None	$y=5.3888x - 0.0184$
A5 (I)	30945	1.316	77234	2.204	0.40	$y=5.3888x - 0.0184$
A5 (II)	36122	1.323	90571	2.210	0.40	$y=5.3888x - 0.0184$
A6 (I)	22438	1.323	123162	2.211	0.18	$y=5.3888x - 0.0184$
A6 (II)	22949	1.327	135526	2.216	0.17	$y=5.3888x - 0.0184$
A7 (I)	11995	1.329	137239	2.217	0.09	$y=5.3888x - 0.0184$
A8 (I)	2732	1.326	85283	2.203	0.03	$y=5.3888x - 0.0184$
A8 (II)	2709	1.325	91194	2.204	0.03	$y=5.3888x - 0.0184$
A9 (I)	90698	1.325	90496	2.215	1.00	$y=5.3888x - 0.0184$
A9 (II)	85131	1.331	84863	2.224	1.00	$y=5.3888x - 0.0184$
A10 (I)	5401	1.320	92989	2.191	0.06	$y=5.3888x - 0.0184$
A10 (II)	5353	1.326	100480	2.204	0.05	$y=5.3888x - 0.0184$
A11 (I)	16616	1.325	132023	2.206	0.13	$y=5.3888x - 0.0184$
A11 (II)	17920	1.332	137863	2.219	0.13	$y=5.3888x - 0.0184$
A12 (I)	No Peak	N/A	82785	2.215	None	$y=5.3888x - 0.0184$
A12 (II)	No Peak	N/A	83058	2.234	None	$y=5.3888x - 0.0184$
A13 (I)	No Peak	N/A	113654	2.259	None	$y=5.3888x - 0.0184$
A13 (II)	No Peak	N/A	129475	2.258	None	$y=5.3888x - 0.0184$
A14 (I)	No Peak	N/A	83058	2.234	None	$y=5.3888x - 0.0184$
A14 (II)	No Peak	N/A	81985	2.223	None	$y=5.3888x - 0.0184$

Table 3.6.2: Urine Sample Concentrations, Standard Deviation and %RSD.

Sample Number	Ethanol Concentration (mg/mL)	Standard Deviation	%RSD
A2 (I)	124	0	0
A2 (II)	124	0	0
A3 (I)	179	0.012	0.026
A3 (II)	188	0	0
A5 (I)	171	0.017	0.046
A5 (II)	171	0	0
A6 (I)	106	0.023	0.119
A6 (II)	104	0	0
A7 (I)	80	0.0006	0.007
A8 (I)	63	0.002	0.074
A8 (II)	63	0.003	0.078
A9 (I)	347	0.029	0.029
A9 (II)	347	0	0
A10 (I)	71	0.001	0.0175
A10 (II)	69	0.001	0.0110
A11 (I)	92	0.002	0.0179
A11 (II)	92	0	0

A ratio of 0.24 for the ethanol/propan-1-ol peak areas was calculated for the first run of urine sample A2

$$0.24 = 5.3888x - 0.184$$

$$0.24 + 0.184 = 5.3888x$$

$$x = \frac{0.24 + 0.184}{5.3888} = 0.048\%v/v$$

As 5 mL of the urine sample was diluted with 5 mL of propan-1-ol stock a dilution factor of 2 applies

$$0.048\%v/v \times 2 = 0.096\%v/v$$

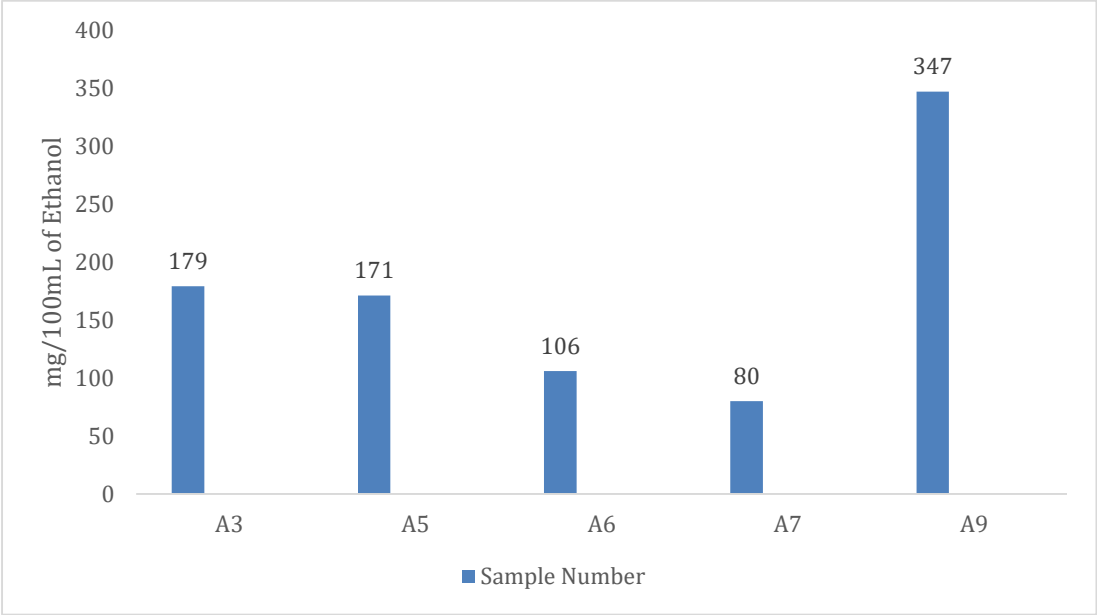
$$\text{Density of ethanol} = 0.789 \text{ g/mL}$$

$$0.096\%v/v \times 0.789 \text{ g/mL} = 0.075 \text{ g/mL}$$

$$0.075 \times 1000 = 75 \text{ mg/100mL}$$

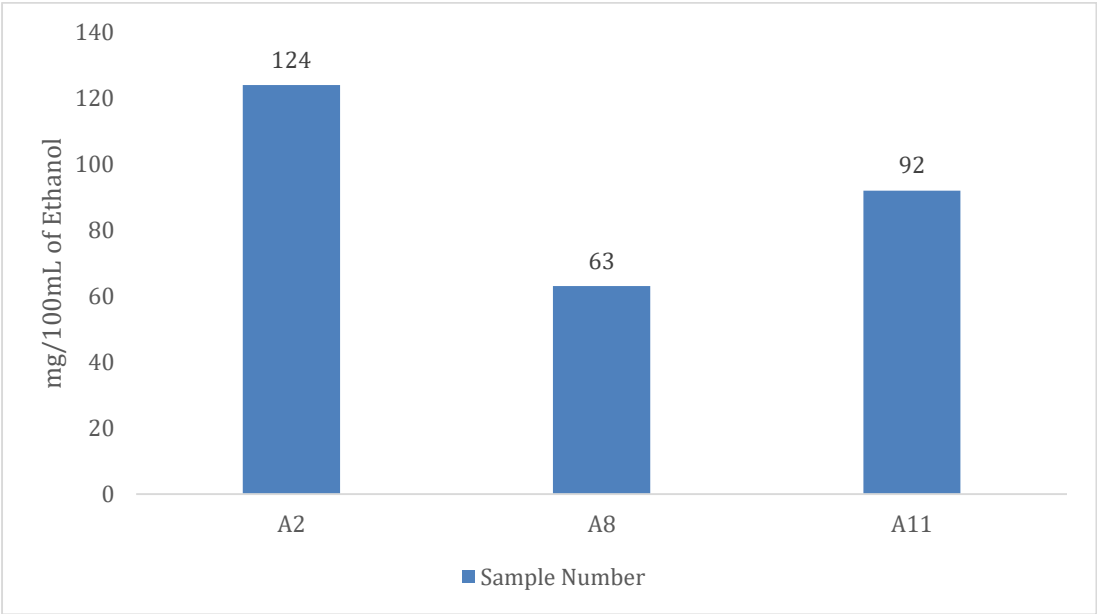
Out of the 13 samples only nine were shown to be over the limit, which are samples A2, A3, A5, A6, A7, A8, A9, A10 and A11. Both A3, A5, A6, A7, A9 and A10 were fully licenced drivers. The legal alcohol limit for a fully licenced driver in terms of urine is 67mg/100mL.

Table 3.6.3: Fully Licenced Drivers over the Limit.



Sample A2, A8 and A11 were provisional drivers. The legal alcohol limit for a provisional driver in terms of urine is 27mg/100mL.

Table 3.6.4: Provisional Licenced Drivers over the Limit.





The majority of the samples were provided the morning after a night out. However, sample A3, A5 and A9 were provided the night of drinking. This indicates that driving the morning after consuming alcohol is not recommended as alcohol still remains in the system. The amount of alcohol in the system could affect a person greatly and cause them to have major impairment in terms of reasoning and memory as well as impairment to their driving skills.

### 3.7 Repeatability Test of Urine

The experiment was conducted in order to determine if the urine analysis had good repeatability. This was carried out by choosing urine samples at random and analyzing them to obtain if they still had the same results as when first analyzed two weeks prior.

Table 3.7: Comparison of first analysis to the repeatability analysis.

<b>Sample</b>	<b>First Analysis Mean Ratio</b>	<b>Repeatability Analysis Mean Ratio</b>	<b>First Analysis Ethanol Concentration</b>	<b>Repeatability Analysis Ethanol Concentration</b>	<b>Percentage Difference between first analysis and Repeatability analysis</b>
A4 - Duplicate 2	No Peak	No Peak	None	None	0%
A5 - Duplicate 1	0.38	0.38	58mg/100mL	58mg/100mL	0%
A11- Duplicate 2	0.13	0.13	22mg/100mL	22mg/100mL	0%
A8 - Duplicate 1	0.034	0.034	7.7mg/100mL	7.7mg/100mL	0%
A2 – Duplicate 1	0.24	0.24	38mg/100mL	38mg/100mL	0%
A9 – Duplicate 2	1.00	1.00	149mg/100mL	149mg/100mL	0%

The repeatability test was satisfactory as there was no percentage difference between first analysis and the repeatability analysis, therefore both times the urine was analyzed it had the same concentration. This a good way of determining that there was no change in concentration over time which indicates the GC is still stable. It also indicates the urine sample has not decomposed over time.

### 3.8 Stability of Urine

The purpose of this experiment is to determine if the urine was still stable in comparison to when it was first analyzed almost three weeks previously.

Table 3.8: Comparison of first analysis to stability analysis.

Sample	First Analysis Mean Ratio	Stability Analysis Mean Ratio
A2	0.24	0.24
A3	0.45	0.45
A4	No Peak	No Peak

Three samples were chosen as they varied in concentration of ethanol to one another. The analysis in comparison to the first analysis and stability analysis was identical, therefore it can be determined that the sodium fluoride is an effective preservative as the stability of urine remained intact for at least three weeks of analysis. The cold temperature of 2-8°C it was stored at also ensured that the urine remain sterile.

### 3.9 Analysis of Surveys

Overall 61 surveys were completed by volunteers either by an online survey, a survey in the urine pack or a survey when breathalyzed. The surveys provided a great deal of information in terms of what peoples understanding of the drink driving limits and units of alcohol were. There were 33 males and 28 female's respondents to the survey. The results of the surveys were staggering as more than half of the people who completed the survey did not know the correct legal drink driving limits as evident in *fig. 3.7.1*. This is an apparent issue as there is not enough awareness in place in terms of the legal limit. In general people thought it was much higher than the set limit of 20 mg/100mL, however there some who thought it was much lower also.

### How many people knew the correct legal limit for Fully licenced drivers

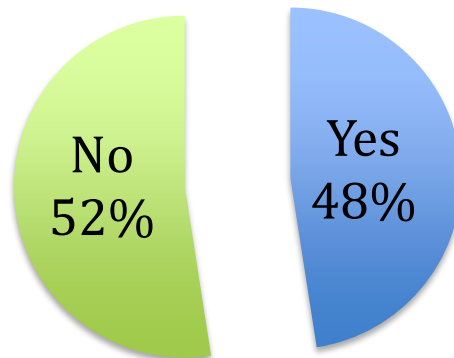


Figure 3.7.1: Percentage of people who didn't know the legal limit vs. those who did.

It could be suggested that ad campaigns clearly stating the alcohol limits for both a fully licenced driver as well as a specified driver be shown on television and on other online media platforms in Ireland, not only that but also show the units of alcohol in various types of alcoholic drinks as many of the participants were not aware of how much alcohol was a unit. If a person is unaware of a unit of alcohol, it could be easy to drink enough to be over the limit without the person realising.

### How Much Alcohol can be Consumed and Remain Under the limit?

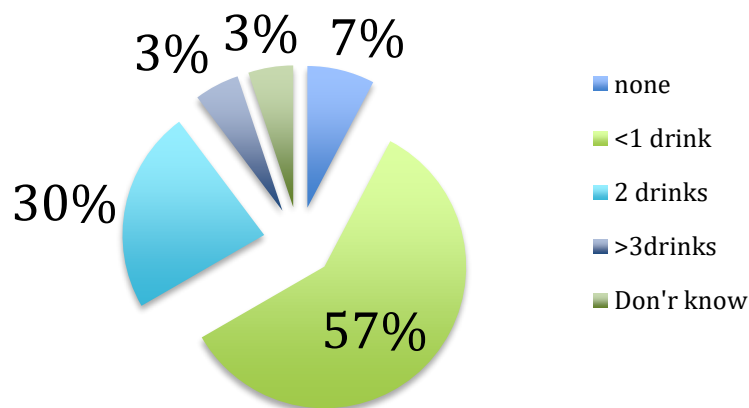


Figure 3.7.2: Amount of alcohol that can be consumed and remain under the legal limit according to participants of the survey.

When asked if they felt drink driving was an issue in Ireland 90% of the participants felt it was a major issue and according to the road safety authority 18,053 drivers were suspected of drink driving and arrested in 2008<sup>[1]</sup>. Out of the 61 individuals who completed the survey, 15% of the participants said they had driven with alcohol in the past year. Of this 15% the majority were aged 26-35, and both even in terms of males and females. It may be that young drivers are more cautious in terms of drinking especially if they have a provisional licence as the legal limit is much lower than that of the full licence legal limit. It could also be that more experienced drivers understand their limitations of drink and being able to drive as well.

82% of the participants also agreed that roadside testing of alcohol should be carried out by the Gardaí in order to combat this issue as well as promote drink-driving awareness.

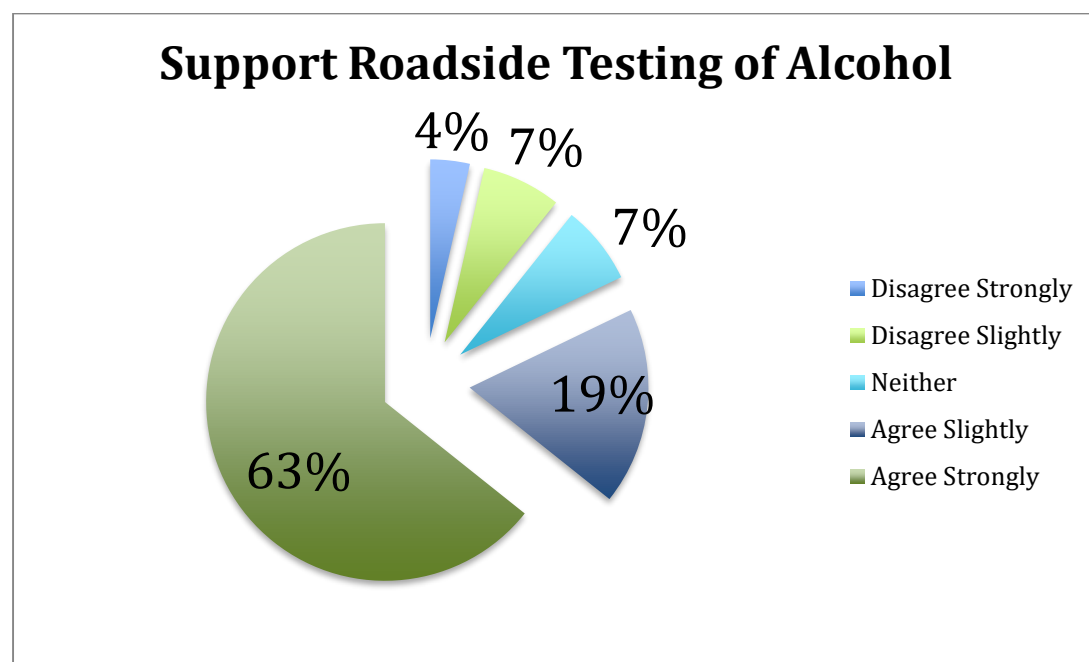


Figure 3.7.3: Percentage of participants, which support roadside testing of alcohol.

When asked if they would be more likely to consume drugs having had alcohol, 45% of the participants felt they would consume drugs having had alcohol.

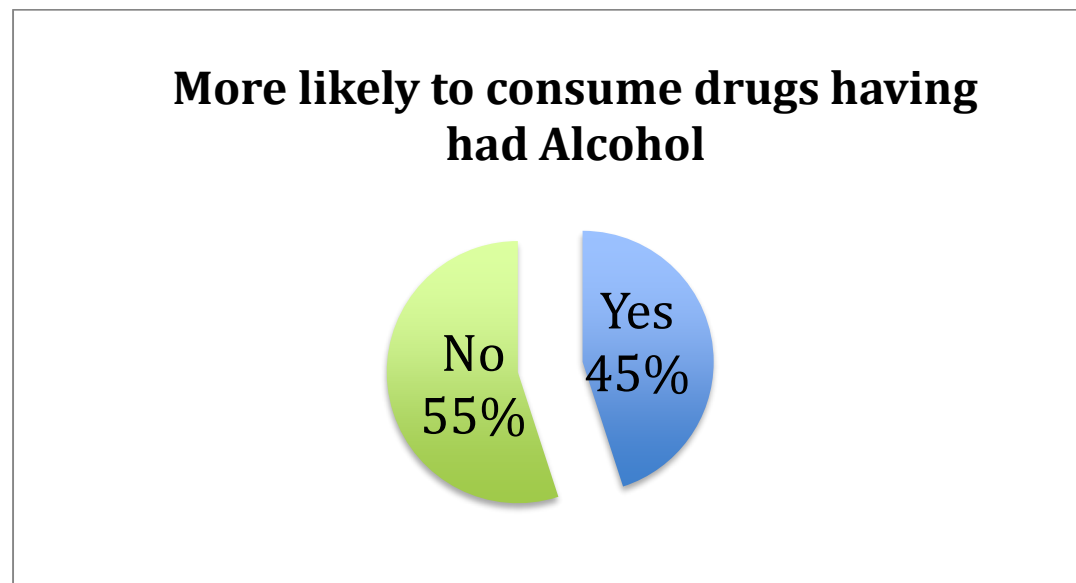


Figure 3.7.4: Percentage that would consume drugs under the influence of alcohol.

Driving under the influence of drugs has also become a concern in Ireland, in *table 3.7.5*, as the use of drugs while in charge of a vehicle has been on the rise since 2004 until 2009 where it was at its highest. Along with the Road Traffic Act of 2010 it was observed a decrease in the number of people drink driving as well as driving under the influence of drugs between the years of 2010 and 2011. Drug use is a prevalent issue as more than 20,000 people in Ireland are estimated to be Opiate users <sup>[14]</sup>.

Table 3.7.5: Number of offences while driving under the influence of alcohol/drugs <sup>[1]</sup>.

Year	'04	'05	'06	'07	'08	'09	'10	'11
Driving/In charge of a vehicle while over legal alcohol limit	12,168	14,075	18,598	19,822	17,940	13,771	10,682	9,013
Driving/In charge of a vehicle while under the influence of a drug	77	106	117	270	728	891	602	421

Many ad campaigns are promoted by the RSA in order to combat this issue and promote awareness of driving under the influence of drugs, as it can be as catastrophic as drink driving. Under the new legislation, Gardaí will be able to conduct roadside tests on drivers for narcotics. Tests will involve a saliva test, followed by a blood test. Motorists can face a €5,000 fine or 6 month's imprisonment depending on the severity of the offence. All such legislation will fall under the 2015 Road Traffic Bill <sup>[15]</sup>.

The surveys were an extremely useful method of obtaining a greater understanding of the demographic as well as determine if there is a relationship between alcohol consumption, drink driving and possible drug use. It was observed that many of the participants were unaware in terms of the legal limits as well as alcohol units, so it is suggested that more effort go into making students aware by the aid of posters around the college and with online campaigns on media platforms as part of the CARS initiative with the relevant information to educate the students in such issues. More roadside testing of alcohol and drugs could also be an effective way to make people more aware of the effects of alcohol and drugs on drivers.

## Conclusion

The project's main focus was to improve awareness in drink and drug driving issues in relation to student's attitudes, motivations and behaviors in areas of road safety. The use breath analysis, urine analysis, online surveys and questionnaires allowed students to become aware of such issues.

The breath analysis although carried out with a substantial sample size, should possibly be carried out after an event in D.I.T in which student's may have been drinking and inclined to drive home in order to obtain a greater understanding of the demographic in terms of drink driving. It would also be ideal to collect both a breath and urine sample from an individual to compare the alcohol contents in both substances and therefore determine which is a more accurate method of analysis. The concept of drink and drug driving being related could also be explored further by obtaining both a breath test and salvia test on individuals and comparing the results. It was evident that many of the participants agreed that drink driving is an issue in Ireland. The participants were also supportive of roadside testing of alcohol and drugs.

The breath and urine analysis had interesting results in terms of alcohol. The breath analysis displayed that drinking over lunch requires a person at least one to two hours to metabolize their drink depending on how much they drank before being safe to drive. The urine analysis also determined that not all alcohol will be removed from the system the morning after a night out either.

Overall the findings were interesting but can always be explored further and find news to create awareness of road safety.

## **Future Work**

Conduct breath analysis, urine analysis and surveys/questionnaires on a larger sample group in order to obtain more information about the demographics' gender, age, attitudes etc.

Conduct analysis on organizations such as societies within D.I.T to elaborate more on the CARS initiative.

Organize meetings with associates of the road safety authority to learn more about the statistics associated with drink and drug driving in Ireland.

Study further into the relationship between alcohol and drugs.

Meet with the CARS initiative to create a campaign of road safety to bring more awareness to students and determine if such campaigns have an effect on students

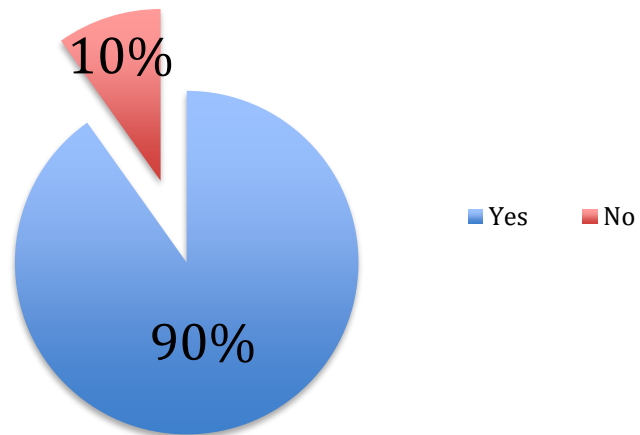


## References

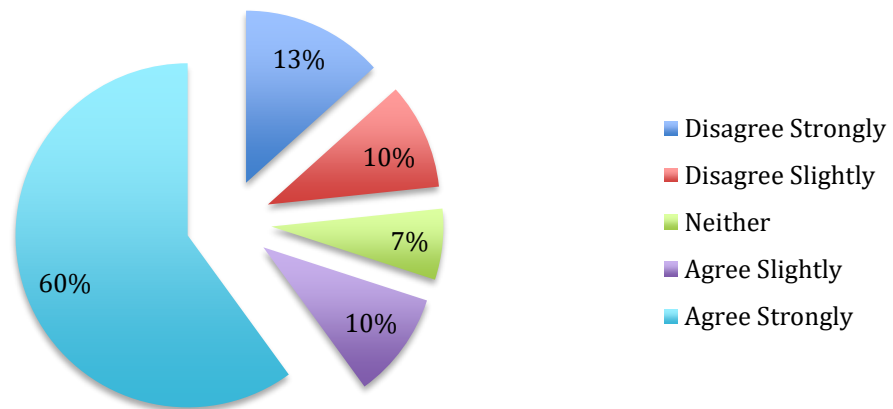
1. <http://www.rsa.ie/en/RSA/Road-Safety/Campaigns/Current-road-safety-campaigns/Drink-Driving/Alcohol-Driving-and-Road-Crashes-/>  
Accessed on the 10/04/2016
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## Appendix

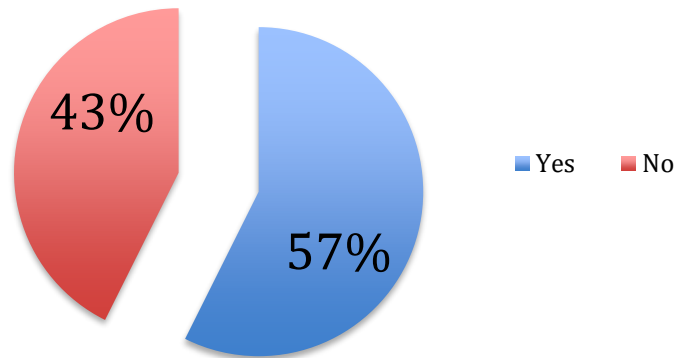
### Feel Drink Driving is an Issue in Ireland



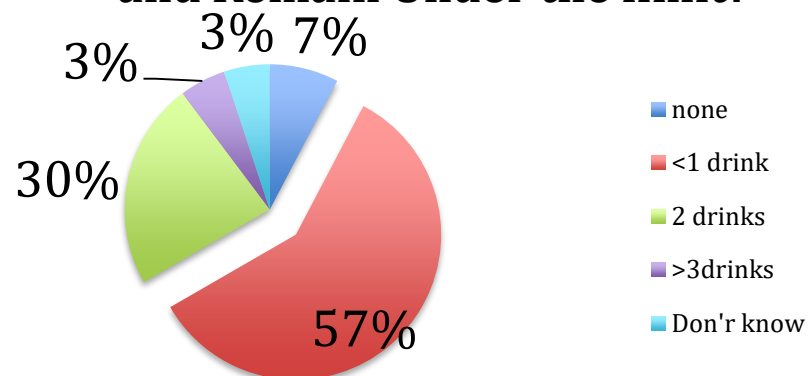
### Support Roadside Testing of Drugs

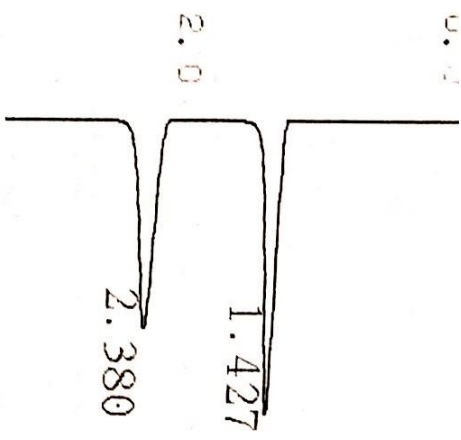


### How many people knew the legal limit for Specified Drivers



### How Much Alcohol can be Consumed and Remain Under the limit?





Ethanol

Propan-1-ol

Wine 1

C-R8A CHROMATOPAC CH=1

Report No.=5

DATA=1:@CHRM1.C00

28/01/13

16:31:14

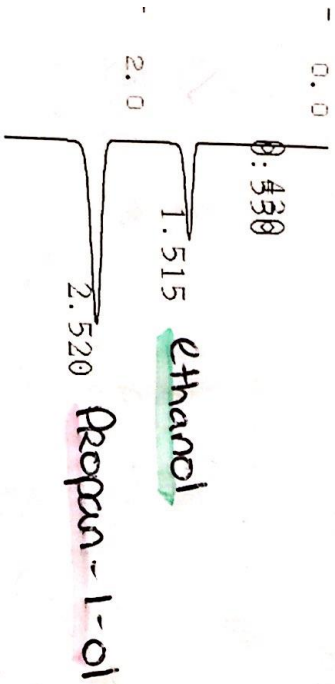
\*\* CALCULATION REPORT \*\*

CH	PKNO	TIME	AREA	HEIGHT	MK	IDNO	CONC	NAME
1	1	1.427	226681	40555			49.4902	
2	2	2.38	231351	28901	V		50.5098	

Chromatograms of diast check Standards.

100mg/100ml

-RSA CHROMATOPAC CH=1 DATA=1:@CHRM1.C00 ATTEN: 7 SPEED: 10.0



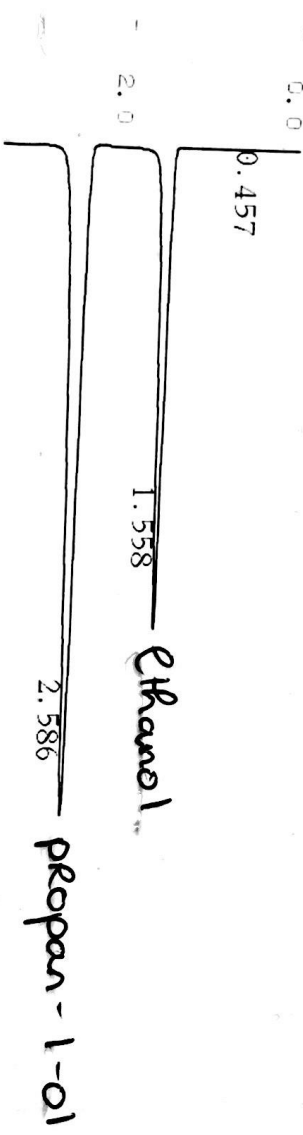
RSA CHROMATOPAC CH=1 Report No.=23 DATA=1:@CHRM1.C00 28/01/14 16:36:40

CALCULATION REPORT \*\*

PKNO	TIME	AREA	HEIGHT	MK	IDNO	CONC	NAME
3	1.515	48672	8988			26.3158	
4	2.52	136281	17172			73.6842	
TOTAL		184952	26160			100	

200mg / 100ul

C RSA CHROMATOPAC CH=1 DATA=1:@CHRM1.C00 ATEN= 5 SPEED= 10.0



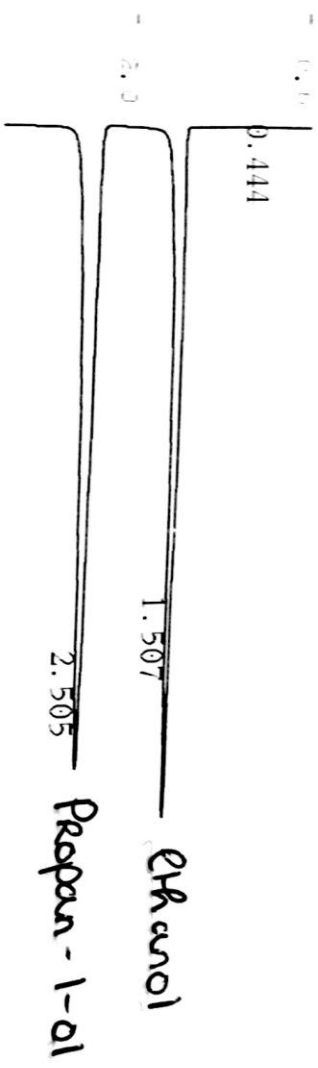
C RSA CHROMATOPAC CH=1 Report No.=26 DATA=1:@CHRM1.C00 28/01/14 16:50:00

\*\* CALCULATION REPORT \*\*

CH PKNO	TIME	AREA	HEIGHT	MK	IDNO	CONC	NAME
1	1.558	67372	12879			32.3981	
2	2.586	140580	17919	V		67.6019	
3							
TOTAL		207952	30797			100	

300mg/ml

RSA CHROMATOPAC CH=1 DATA=1:@CHRM1.C00 ATTEN= 5 SPEED= 10.0



RSA CHROMATOPAC CH=1 Report No.=29 DATA=1:@CHRM1.C00 28/01/14 17:02:16

\* CALCULATION REPORT \*\*

PKNO	TIME	AREA	HEIGHT	MK	IDNO	CONC	NAME
2	1.507	94138	18069			41.9959	
3	2.505	130022	16746	V		58.0041	
TOTAL		224161	34815			100	

# A2 - Duplicate 1

C-RSA CHROMATOPAC CH=1 DATA=1:@CHRM1.C00 ATTEN= 5 SPEED= 10.0



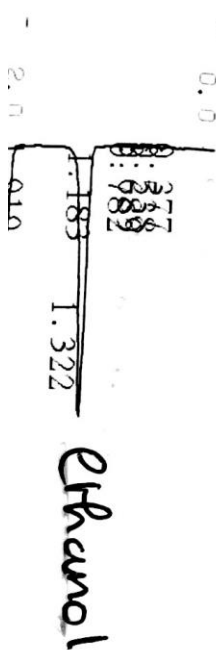
C-RSA CHROMATOPAC CH=1 Report No.=21 DATA=1:@CHRM1.C00 28/01/24 12:37:12

## \*\* CALCULATION REPORT \*\*

CH	PKNO	TIME	AREA	HEIGHT	MK	IDNO	CONC	NAME
1	6	1.319	25717	5319	SV		19.6407	
	8	2.201	105220	14685	V		80.3593	
TOTAL			130936	20003			100	

Ratio Area = 0.24

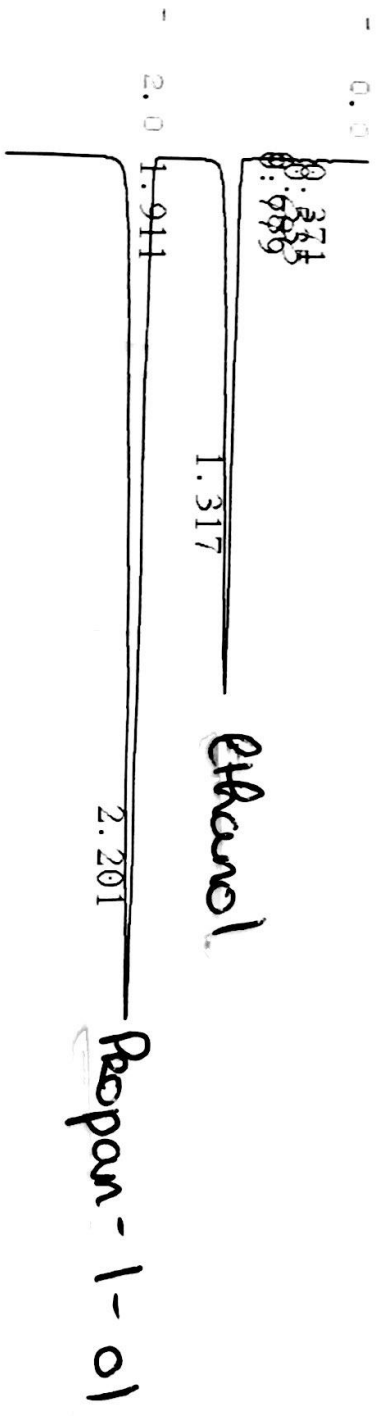
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# A3 - Duplicate 1

C-RSA CHROMATOPAC CH=1 DATA=1:@CHRM1.C00 ATTEN= 5 SPEED= 10.0



C-RSA CHROMATOPAC CH=1 Report No.=24 DATA=1:@CHRM1.C00 28/01/24 12:49:16

## \*\* CALCULATION REPORT \*\*

CH PKNO	TIME	AREA	HEIGHT	MK	IDNO	CONC	NAME
1							
5	1.317	57063	11485	S		29.8642	
7	2.201	134012	18402	V		70.1358	

TOTAL 191074 29887 100  
 Data Addn = 0.42



## Chemical Agent & CMR Risk Assessment Form<sup>1</sup>

Department assessment no.		Issue Date: 25/01/16
Title of work/project: Breath and Urine Analysis of Alcohol for drink driving safety awareness.		
Location (Lab where activity will be carried out): KE-G-041		Review Date: 25/01/16
Assessment carried out by: Megan Haverly.		

**1. Table(1) of chemicals used in process to be assessed and relevant safety information<sup>2</sup>**

Substance name	CAS no	Concentration <sup>3</sup>	Amount used	Hazard Classification (Section 2 of SDS)	Hazard statement/Risk phrase	Route of exposure	Frequency of use	Duration of exposure Minutes, hours	OELV <sup>8</sup>
Ethanol	64-17-5			Flammable liquids (Category 2), H225 Eye irritation (Category 2), H319	H225 Highly flammable liquid and vapour. H319 Causes serious eye irritation.	Skin Contact	Max: 20 days/year	>7 hours	15 min (STEL) 1,000 ppm
Propan-1-ol	71-23-8			Flammable liquids (Category 2), H225 Serious eye damage (Category 1), H318 Specific target organ toxicity - single exposure (Category 3), H336	H225 Highly flammable liquid and vapour. H318 Causes serious eye damage. H336 May cause drowsiness or dizziness.	Skin Contact	Max: 20 days/year	>7 hours	8 hrs (TWA) 100 ppm
Sodium Fluoride	7681-49-4			Acute toxicity, Oral (Category 3), H301 Skin irritation (Category 2), H315 Eye irritation (Category 2), H319	H301 Toxic if swallowed. H315 Causes skin irritation. H319 Causes serious eye irritation.	Skin Contact	Max: 20 days/year	>7 hours	8 hrs (TWA) 2.5 mg/m <sup>3</sup>