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by
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INCIDENCE OF "INVALID SAMPLE" SCREEN MESSAGES ON THE INTOXILYZER® 5000C OBTAINED FROM ARRESTED DRINKING DRIVERS IN TORONTO. IS A 15 TO 20 MINUTE WAIT PERIOD WARRANTED?

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ABSTRACT

A five-year retrospective study of "INVALID SAMPLE" screen messages obtained on the Intoxilyzer® 5000C from drinking drivers arrested in the City of Toronto was undertaken. There were 196 "INVALID SAMPLE" screen messages generated by 184 drivers and they could be classified as single or multiple occurrences and as to whether they were associated with the first or subsequent or multiple breath tests. The incidence was 1.7% of the total number of the drivers tested. Single "INVALID SAMPLE" screen messages (n=173) occurred with much greater frequency than multiple messages (n = 11). The distribution of single "INVALID SAMPLE" messages was nearly evenly divided, with 88 occurring prior to the first breath test and 85 prior to the second breath test. The time in police custody to the time of single "INVALID SAMPLE" message ranged from 27 to 223 minutes and from 59 to 199 minutes for multiple occurrences of "INVALID SAMPLE" messages. This time period precluded an exogenous mouth alcohol effect influencing the results. The time between the "INVALID SAMPLE" and the subsequent breath sample retest after single "INVALID SAMPLE" messages ranged from 2 to 61 minutes (mean 5 minutes), while the time period to retesting after multiple messages ranged from 3 to 65 minutes. The duplicate breath test results for all cases (single and multiple messages) were within 0.02 g/210L (truncated) and no third breath test was required. For breath tests that were conducted less than 20 minutes from the time of the "INVALID SAMPLE" screen message, no evidence of a mouth alcohol effect resulting in the next breath test being significantly higher due to mouth alcohol was observed. Although highly transient mouth alcohol cannot be excluded as the cause of the messages in this study, we provide evidence in support of the view that most of instances of "INVALID SAMPLE" screen messages are instead likely due to variation in the breath exhalation pattern of the drinking driver. Therefore, a mandatory 15 to 20 minute wait period following every occurrence of an "INVALID SAMPLE" message is not required, but only in those instances where the qualified breath technician has reasonable grounds to suspect that mouth alcohol may be a factor.

RÉSUMÉ

Une étude rétrospective a été effectuée sur les messages « INVALID SAMPLE » obtenus à la suite de tests d'haleine effectués avec l'Intoxilyzer® 5000C dans la ville de Toronto au cours d'une période de cinq ans. Il y a eu 196 messages « INVALID SAMPLE » générés par 184 sujets et ces messages peuvent être classés selon s'ils

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apparaissaient sur un seul test ou sur plusieurs tests; ou selon s'ils apparaissaient au premier test, au second test ou à plusieurs tests pour chaque sujet. Leur incidence fut de 1,7% pour l'ensemble des sujets testés. L'apparition du message « INVALID SAMPLE » une seule fois (n=173) a été plus fréquente que l'apparition du message à plusieurs reprises (n=11). Lorsque le message « INVALID SAMPLE » survenait une seule fois, la distribution de l'apparition du message s'est avérée pratiquement uniforme : 88 apparitions lors du premier test et 85 apparitions lors du second test. La période d'observation sous surveillance policière avant l'apparition unique du message « INVALID SAMPLE » variait entre 27 et 223 minutes alors que cette période variait entre 59 et 199 minutes lors des apparitions multiples de ce message. La durée de la période d'observation exclut la possibilité que la présence d'alcool résiduel dans la bouche puisse influencer les résultats. Le temps écoulé entre l'apparition du message « INVALID SAMPLE » et le test d'haleine subséquent à ce message variait entre 2 et 61 minutes (moyenne de 5 minutes), alors que le temps écoulé avant de refaire un test après plusieurs apparitions du message se situait entre 3 à 65 minutes. Dans tous les cas, qu'il y ait apparition d'un seul ou de plusieurs messages, l'écart entre les résultats tronqués des tests était inférieur ou égal de 0,02g/210L et l'exécution d'un troisième test n'a jamais été requis. Dans les cas où les tests ont été effectués moins de 20 minutes après l'apparition du message « INVALID SAMPLE », la présence d'alcool résiduel dans la bouche n'a pas été démontrée par le résultat du test qui aurait pu être significativement plus élevé que le test suivant du à la présence d'alcool résiduel de la bouche. Même si la présence d'alcool résiduel transitoire ne peut pas être exclue comme étant la cause de l'apparition du message, nous apportons une preuve tendant à démontrer que, dans la plupart des cas, la présence du message « INVALID SAMPLE » serait causée par une variation du profil d'expiration lors de l'échantillonnage de l'haleine du sujet. En conséquence, une période d'observation obligatoire de 15 à 20 minutes suivant l'apparition du message « INVALID SAMPLE » n'est pas nécessaire, à moins que le technicien qualifié ait des motifs raisonnables de suspecter la présence d'alcool résiduel dans la bouche.

INTRODUCTION

The Intoxilyzer® 5000C and the BAC Datamaster C™ are the two most frequently used evidential infrared breath alcohol testing instruments in Canada. Both instruments are equipped with a built-in slope detector system to assist in obtaining suitable breath samples and the detection of mouth alcohol (1, 2). If the drinking subject provides a uniform exhalation of breath, the breath alcohol concentration (BrAC) should have a positive slope that with time will eventually reach an alveolar plateau (3). If mouth alcohol is present, the slope will initially be positive and may reach a plateau before starting to decline towards the end of the exhalation. Activation of the slope detector in the Intoxilyzer® 5000C and BAC Datamaster C™ requires identification of this negative slope. A decrease in the BrAC of 0.001 grams of alcohol in 210 Litres of breath (g/210 L) over 0.75 seconds during exhalation on the BAC Datamaster C™ will result in an "INVALID SAMPLE" message. On the Intoxilyzer® 5000C, if there is a decrease in BrAC of more than 0.001 g/210 L over 0.6 seconds, then the instrument will indicate that this breath sample is an "INVALID SAMPLE" (hereafter referred to as IS).

The 1996 CMI Inc. Operator's Manual (4) for the Intoxilyzer® 5000 stated for an IS that ...

> *'The instrument detected residual mouth alcohol in the subject's breath sample. ... Since the normal body processes eliminate residual mouth alcohol within 20 minutes, observe the subject for at least 20 minutes before beginning another breath analysis. During the observation time, the subject may not smoke, eat,*

drink, or introduce any substance into his mouth. Furthermore, if the subject regurgitates, note the time, and delay beginning a breath test analysis for at least 20 minutes.'

The current recommendations (5) of the Canadian Society of Forensic Science Alcohol Test Committee (ATC) and the Centre of Forensic Science (CFS) in Ontario for breath testing procedures and the prevention of mouth alcohol from influencing the breath test result is to include an at least 15 minute deprivation period prior to the first breath test being conducted, duplicate breath alcohol tests conducted at least 15 minutes apart and that the two results be within ± 0.020 g/100 mL truncated of each other. The slope detector on an approved instrument, such as the Intoxilyzer® 5000C, will provide an additional safeguard against mouth alcohol affecting the breath results.

However, it has been recognized that an IS message may not be due solely to the presence of mouth alcohol, but may be due to other factors. One laboratory study has showed that the IS message obtained on the BAC Datamaster C™ can be produced by the discontinuous manner of breath sample delivery by the subject, such as huffing and puffing and sucking back (6). Thus, a change in the exhalation pattern of a drinking driver during an individual breath test could result in a breath profile that could activate the slope detector on the Intoxilzyer® 5000C.

In 2000, CMI Inc. revised their Intoxilyzer® 5000 Operator's Manual (7) to include an expanded explanation of possible causes of an IS screen message and reduced the recommended wait time between appearance of the message and retesting from at least 20 minutes to at least 15 minutes.

'The instrument detected an invalid sample. ...This test was originally designed for mouth alcohol detection, but any breath sample that meets the profile for an invalid sample is considered an invalid sample and may not necessarily be mouth alcohol. An "INVALID SAMPLE" can be caused by puffing into the instrument or by moving the mouthpiece during a test. If mouth alcohol is suspected, observe the subject for at least 15 minutes before beginning another breath analysis. During the observation time, the subject may not smoke, eat, drink, or introduce any substance into his mouth. Furthermore, if the subject regurgitates, note the time and delay beginning a breath analysis for at least 15 minutes.'

The purpose of our study was to retrospectively examine the incidence and characteristics of IS screen messages obtained in the field over a period of five years, and to determine if the 15 to 20 minute wait period is still warranted in all instances after the appearance of this message.

METHODS

This five-year retrospective study from January 1st 1999 to December 31st 2003 was undertaken in co-operation with Toronto Police Services. The Intoxilyzer® 5000C (CMI Inc. Owensboro, KY, USA) is the sole evidential breath alcohol testing instrument used by Toronto Police Service and is designated by the Federal Minister of Justice as an approved instrument in Canada. The Intoxilyzer® 5000C is a computerized and automated instrument that uses infrared light to determine a blood alcohol concentration (BAC) from a BrAC (1).

The BrACs in this study are reported as grams of alcohol in 210 litres of breath (g/210 L). This is equivalent to a blood alcohol concentration (BAC) in grams of alcohol in 100 millilitres of blood (g/100 mL), the units recorded by the Intoxilyzer® 5000C using the

forensically acceptable blood to breath ratio of 2100:1. When these BrACs are multiplied by 1000, this is equivalent to a BAC in milligrams of alcohol in 100 millilitres of blood (mg/100 mL) as required by the *Criminal Code* and the recommendations of the ATC (5).

The breath testing sequence in Ontario with the Intoxilyzer® 5000C uses the following steps: a blank test, followed by a series of internal standard and system checks, a calibration check, another blank test, followed by another series of internal standard and system checks, a subject breath test and a final blank test (1). This sequence is repeated for each breath sample provided. Each calibration check is done using a wet bath simulator (e.g. Model 34C, Guth Laboratories Inc., Harrisburg, PA, USA). Calibration checks are required to be between 0.090 and 0.110 g/210 L with a target value of 0.100 g/210 L, as recommended by the ATC and the CFS. In Ontario, two breath tests at least fifteen minutes apart are conducted for each arrested driver according to the current requirements of the *Criminal Code* and the ATC (5).

The instrument automatically records details of the breath testing sequence including the values of the air blanks, calibration checks and subject BrACs to three digits, and any error message such as "INVALID SAMPLE." Data and information from drivers arrested for alcohol-impaired driving offences in Toronto were downloaded from the instruments and recorded. During the period of time of the study, approximately 13 Intoxilyzer® 5000C instruments were in use.

RESULTS AND DISCUSSION

There is a paucity of data in the forensic literature on the incidence and significance of IS screen messages on the Intoxilyzer® 5000C. This paper serves to facilitate the evaluation of cases where an IS screen message is obtained during a breath test through the examination of 5 years of historical data.

Over the five-year period (1999 to 2003) of this retrospective study, 11,038 drinking drivers were tested in the city of Toronto and 196 IS messages were obtained from 184 drivers (1.7%). The classification of the 196 IS screen messages is shown in Table 1. A single Invalid Sample (SIS) message was obtained from 173 drivers and multiple (two or more) Invalid Sample (MIS) messages were obtained from 11 drivers. The distribution of SIS messages was nearly evenly divided with 88 occurring prior to the first breath test and 85 occurring prior to the second breath test. There were seven occurrences of two consecutive MIS screen messages either prior to the first (n = 6) or second breath test (n = 1) and one case of three consecutive messages prior to the second test. Three individuals were able to generate a single message prior to both their first and second tests.

The frequency of IS screen messages for each year of the study is shown in Table 2. The frequency ranged from 1.2 to 2.0% with a mean of 1.7%.

The age and gender distribution of the drivers who obtained an IS message are shown in Table 3. Most of the 184 drivers were male (n = 159, 86%) and most drivers were between 20 and 49 years of age (n = 149, 81%). This distribution of gender and age is typical of the general drinking and driving population identified in the literature (8-10). Therefore, those drivers who were able to generate an IS message do not appear to be part of a particular subpopulation of drinking drivers.

For the 88 cases where a SIS message occurred prior to the first test, the untruncated BrACs ranged from 0.065 to 0.380 g/210 L with a mean and median of 0.182 and 0.168 g/210 L, respectively. For the 85 cases where a SIS message occurred prior to the second test, the untruncated BrACs ranged from 0.039 to 0.316 g/210 L with a mean and median

TABLE 1

Classification and number of INVALID SAMPLE messages obtained.

SINGLE MESSAGES	Number	% of 184
Prior to 1st test	88	48%
Prior to 2nd test	85	46%
TOTAL	173	94%
MULTIPLE MESSAGES		
Two consecutive messages prior to 1st test	6	3.5%
Two consecutive messages prior to 2nd test	1	0.5%
Three consecutive messages prior to 2nd test	1	0.5%
One message prior to both 1st and 2nd test	3	1.5%
TOTAL	11	6%

TABLE 2

Distribution and frequency of INVALID SAMPLE messages.

YEAR	Male	Female	Total	No. of drivers tested	Percentage
1999	24	4	28	1,891	1.5 %
2000	39	3	42	2,078	2.0 %
2001	39	5	44	2,468	1.8 %
2002	27	2	29	2,419	1.2 %
2003	30	11	41	2,182	1.9 %
TOTALS	159	25	184	11,038	Mean 1.7 %

TABLE 3

Age and gender of arrested drinking drivers who generated an INVALID SAMPLE message.

Age (y.o)	Male	Female	Total
≤ 20	4	2	6
20-29	40	5	45
30-39	54	5	59
40-49	37	8	45
50-59	21	4	25
60-69	2	1	3
≥70	1	0	1
Total	159	25	184

TABLE 4

Frequency distribution data for SIS and MIS screen messages

BrAC (g/210L)	Frequency	Relative Incidence	Cumulative %
up to 0.099	21	11.2%	11.2%
0.100 to 0.149	36	19.3%	30.5%
0.150 to 0.199	64	34.2%	64.7%
0.200 to 0.249	40	21.4%	86.1%
0.250 to 0.299	16	8.6%	94.7%
0.300 to 0.349	9	4.8%	99.5%
> 0.350	1	0.5%	100%
Total	187	100%	

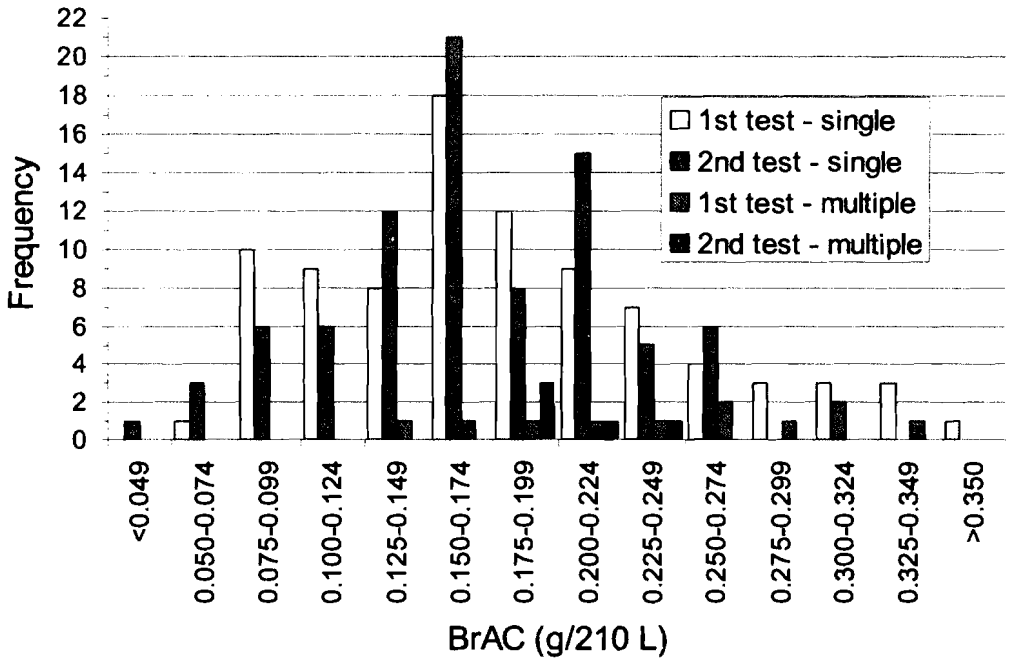

Figure 1. Breath alcohol concentrations (BrACs) obtained subsequent to an INVALID SAMPLE.

of 0.169 and 0.162 g/210 L, respectively. Untruncated BrACs ranged from 0.149 to 0.328 g/210L with a mean and median of 0.232 and 0.239 g/210L, respectively, for the nine MIS messages that occurred prior to the first test. The five MIS messages that occurred prior to the second test had untruncated BrACs ranging from 0.180 to 0.244 g/210L with a mean and median of 0.202 and 0.191 g/210L, respectively. The distribution of BrACs is shown in Figure 1. This figure shows that an IS screen message can occur across a wide range of BrACs, however the majority of BrACs (n = 117, 68%) for single messages are at 0.150 g/210 L or greater. The multiple messages data (n = 13/14, 93%) shows the same trend. These data are in agreement with the observations of Pon *et al.* (6) regarding IS messages with the BAC Datamaster C™. Table 4 shows the frequency distribution data for both SIS and MIS screen messages versus BrAC. There is a tripling of the relative incidence from 11.2 to 34.2% for the first three consecutive BrAC ranges up to 0.150 g/210L. The cumulative % shows that the majority of IS screen messages occur at BrACs above 0.150 g/210L. The occurrence of IS messages at high BrACs is somewhat contrary to their sole causation through mouth alcohol, since, as Gullberg (11) has shown, both the intensity and duration of mouth alcohol effects are reduced as BAC increases. Instead, the correlation of IS with high BACs may indicate that this message is more likely due to other explanations such as variations in breath samples provided, since the variation required to produce an IS would decrease with increasing BrAC. For example, a decrease of 0.001 g/210 L for a BrAC of 0.200 g/210 L would involve only a 0.5% decrease in breath sampling variation, whereas at 0.080 g/210 L, the percent decrease required is 1.3%.

Another indication that an IS message may not be due to mouth alcohol but to a variation in the breath sampling pattern is the time spent in custody from arrest of the suspected drinking driver to the time of the IS message. Figure 2 shows the distribution of the time drivers were in custody prior to an IS message being generated. The times ranged from 27 to 145 minutes (mean time 78 minutes) for a SIS message occurring prior to the

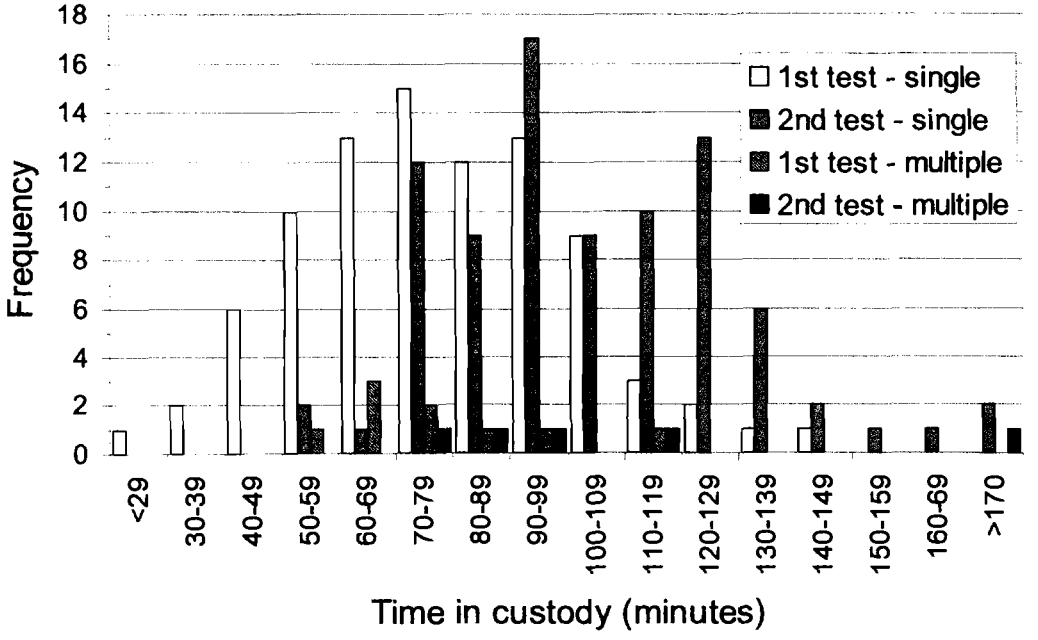

Figure 2. Time in custody until an INVALID SAMPLE was obtained.

first breath test. The mean time in custody for the incidents in which an IS occurred prior to the second test was 105 minutes and ranged from 53 to 223 minutes. For cases involving MIS messages, time in custody ranged from 59 to 115 minutes (mean time 77 minutes) for the cases (n = 9) with messages prior to the first breath test and for 78 to 199 minutes (mean 114 minutes) for the cases (n = 5) when messages occurred prior to the second test.

In forensically relevant situations, the duration of the mouth alcohol effect from exogenous sources is usually less than ten minutes (12–15). The shortest time interval between arrest and the first IS was 27 minutes. All other cases in this study had longer times in custody. As a result of the routine policing procedure of removing all personal items from an individual upon arrest, an IS screen message in this study due to exogenous sources such as the recent consumption or use of alcohol-containing products such as mouthwashes, asthma inhalers, cough syrup, or breath sprays is unlikely as any exogenous mouth alcohol would have dissipated long before any of the breath tests were conducted (16–19). This is of particular interest for those cases where the IS message occurred prior to the second breath test as all these times exceeded 53 minutes.

Another potential source of mouth alcohol that could cause an IS message is that from endogenous sources such as blood in the mouth, belching or regurgitation. The presence of blood containing alcohol in the mouth resulting either from injuries sustained in a motor vehicle collision, or bleeding due to prior dental work would not result in an overestimation of the BrAC of a drinking driver. In a study (20) on the simulation of the effect of blood in the mouth on BrAC in twenty-six male drinking subjects, BrACs tended to decrease slightly and the magnitude of this decrease would have no practical significance on breath alcohol testing when the results are truncated and reported to two decimal places. Similarly, the belching of volatiles from the stomach immediately prior to exhalation of a breath sample into the Intoxilyzer® 5000C would have no significant effect on the final BrAC reading, as any alcohol vapour present in the stomach would be exhaled into and

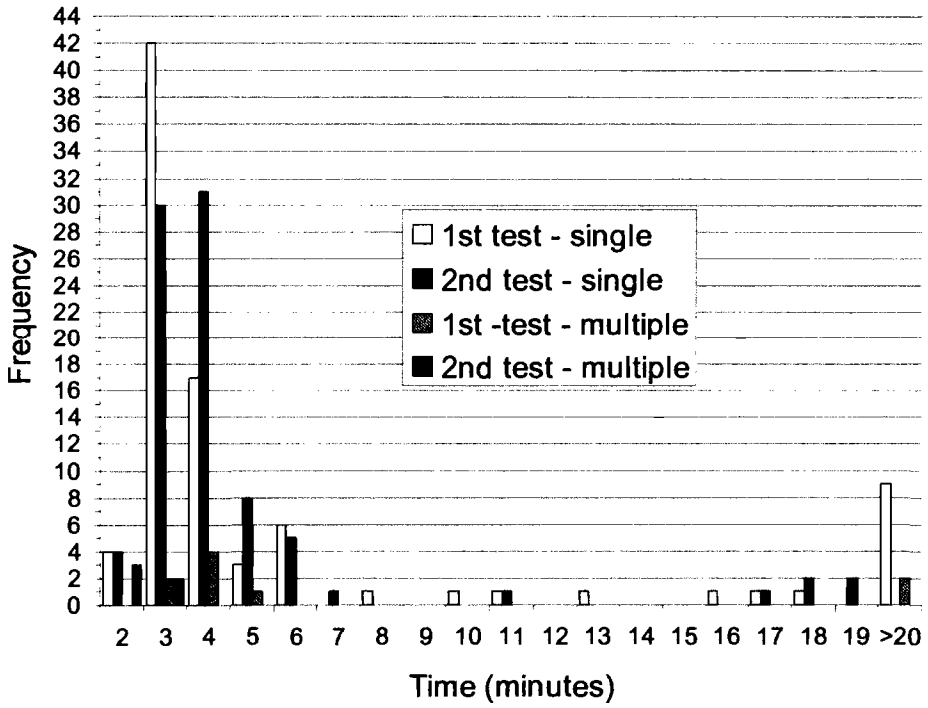

Figure 3. Time between the INVALID SAMPLE and the subsequent retest.

out of the sample chamber and would be replaced with a more accurate end-expiratory sample of breath (21). As it is not possible to breathe out and belch or burp at the same time, subjects cannot belch or burp directly into the instrument when providing a breath sample. However, the potential alcohol vapour during a belch may activate the slope detector resulting in an IS message. Likewise, regurgitation of stomach contents into the oral cavity from a hiatus hernia or gastroesophageal reflux disease (GERD) may temporarily cause a potential mouth alcohol effect, but it is of limited duration and magnitude (21, 22) due in part to the rapid absorption of alcohol from the stomach resulting in a low amount of alcohol remaining in the stomach (23). In addition, acidic stomach contents in the oral cavity will cause a hyper-salivation or waterbrush (24) that results in increased salivary flow rates that have been found to substantially decrease the mouth alcohol effect (25). From our retrospective investigation we cannot exclude burping or regurgitation, resulting in highly transient mouth alcohol as the cause of some of these IS messages. Previous studies attempting to reproduce mouth alcohol effects due to burping, regurgitation or GERD have failed to identify such effects, likely due to the low amount of alcohol that remains in the stomach (20, 21). Nevertheless, if present, such mouth alcohol would have to be highly transient in order to activate the slope detector during the first test and dissipate within the 2 to 3 minutes before the next breath test was conducted. Moreover, qualified breath technicians are trained to be vigilant of the accused during the breath testing procedure for evidence or indication of burping or regurgitation in order to reduce their impact on the breath testing procedure.

Figure 3 shows the distribution of elapsed time following an IS message prior to the subsequent breath test. For cases where a SIS message occurred prior to the first breath sample, the times ranged between 2 to 61 minutes (mean = 6 minutes; median = 3 minutes) and ranged from 2 to 19 minutes (mean & median was 4 minutes) for messages

occurring prior to the second breath test. For the eleven cases of MIS screen messages the mean time between the message and the next test was similarly short on average (mean = 6 minutes, median = 3 minutes for MIS prior to the 1st test and mean = 7 minutes, median = 4 minutes for MIS prior to the 2nd test) while the range of times between MIS and the next test was 3 to 21 minutes.

There were 11 (6%, n = 9 single messages, n = 2 multiple messages) out of 184 cases where the subsequent breath tests were conducted 20 minutes or more after the IS screen message as recommended in the 1996 CMI Inc. Operator's Manual (4) and 19 cases (10%, n = 17 single messages, n = 2 multiple messages) out of 184 cases where the subsequent breath tests were conducted 15 minutes or more after the IS screen message as recommended by CMI in 2000 (7), ATC (5) and CFS.

If significant undetected mouth alcohol was still present after an IS message had occurred, the next successful breath sample taken immediately afterward should have a difference (> 0.02 g/210 L truncated) which would require a third breath test. No third breath tests were required for any of the 184 cases in this study. If an IS message had been due to mouth alcohol, then the shorter time intervals (< 15 minutes) between the message and the subsequent breath test observed in this study should have resulted in a skewed distribution of apparent BrACs between the two completed breath tests. Thus, if any undetected mouth alcohol had occurred prior to the first sample, the retest breath sample taken almost immediately afterward should be greater in concentration than the second sample collected at least 15 minutes later. Likewise, for cases where the IS message occurred prior to the second successful breath sample, this breath result should be greater than the first breath test result collected at least 15 minutes earlier. This pattern would be visually evident if the data for the distribution of differences (test 1 – test 2) was presented in graphical form with mouth alcohol prior to the first test skewing the data in a more positive direction and mouth alcohol prior to the second test skewing the data in a more negative direction. Figure 4 shows the distribution of differences between the results of each pair of subject tests where there was an SIS screen message prior to the first or second tests. The distribution for both sets of data follows a mainly Gaussian or normal distribution and ranges from –0.017 to 0.025 g/210L. The mean and median absolute difference between the results of each pair of untruncated BrAC test results was 0.007 and 0.007 g/210 L when the IS message occurred before the first test and 0.007 and 0.008 g/210 L when it occurred between the two tests.

MIS messages also resulted in no significant differences between the recorded breath tests that would have required a third test. For the three cases of MIS screen messages that occurred prior to both the first and second breath tests, the absolute difference between the first and second untruncated breath test were 0.001, 0.003 and 0.020 g/210L. For the other incidents of multiple messages, the absolute difference between the first and second untruncated breath tests ranged from 0.000 to 0.006 g/210L (median and mean = 0.002 g/210 L) for multiple messages prior to the first test. For the cases of two and three MIS messages prior to the second test, the absolute difference between the two breath tests was 0.018 and 0.016 g/210L, respectively. The means and medians for all tests are very similar regardless of being SIS or MIS messages, and thus, breath tests taken shortly after these IS messages did not result in a high false result.

As stated previously, any retests performed earlier than 15 minutes after an IS message are of special interest (Table 5 and Figure 4). Considering only this subset of the tests, the mean wait time after SIS messages occurred prior to the first breath test (n = 76/88, 86%) was 3.89 minutes (range 2 to 13 minutes; median 3 minutes) and for the second breath test (n = 80/85, 94%) was 3.87 minutes (range 2 to 11 minutes; median 4 minutes). Yet, the

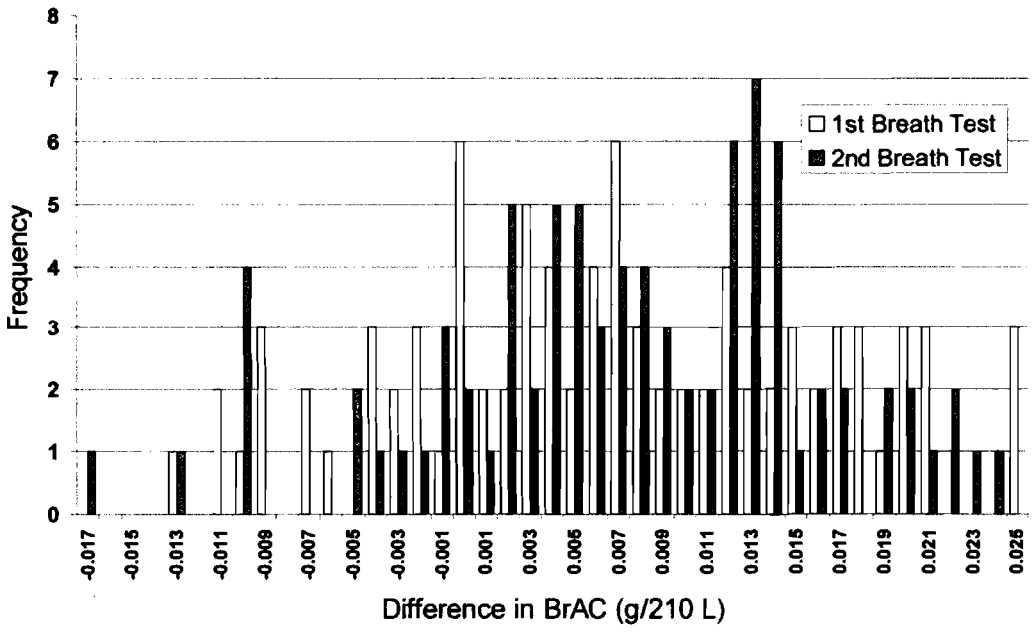

Figure 4. Differences between untruncated paired breath sample results where a single INVALID SAMPLE message occurred prior to the first or second breath test.

breath test results differed on average by only 0.007 g/210 L (range -0.017 – 0.025 g/210 L) for messages occurring both before first or second test. The mean values of the differences between the two subject tests indicate that they are in good agreement. For MIS messages the majority of breath retests (n = 9, 82%) were performed prior to the recommended 15 minute wait period with the mean wait time prior to the first test being 2.5 minutes. The differences between the two subject tests for MIS messages where retests were performed within 15 minutes of the message ranged from – 0.003 to 0.006 g/210 L with the mean and median being 0.001 g/210L. This data is not significantly different from that obtained for single messages, however, there were no instances of untruncated BrAC results being greater than 0.020 g/210 L for any of the MIS messages case.

Table 5 shows the eleven cases extracted from Figure 4 in which the untruncated differences between the two subject BrAC results differed by more than 0.020 g/210 L; all cases involving SIS messages. Six of the results had an IS message prior to the first test and five prior to the second test. In all eleven of the cases, the second breath test was lower than the first test. Interestingly, in all of the instances where SIS occurred in between the first and second test, that second test was performed within 4 minutes of the IS message. As previously stated, if significant mouth alcohol had been present, one would have expected to see an increase the results of the second test, yet in all of the cases the BAC of the second test was lower than the first test suggesting the IS was not due to mouth alcohol. Again, none of the cases in this study required a third breath sample because the truncated BrAC results were greater than 0.02 g/210 L. The differences in the results are likely due to breath sampling variations, analytical variability and the time elapsed between the two breath tests (26–30). Column eight of Table 5 shows the second breath sample corrected for elimination of alcohol in each case using the mean rate of elimination (0.019 g/210 L/h) found

TABLE 5

Intoxilyzer® 5000C tests in which the untruncated difference between tests were more than 0.020 g/210 L

No.	BrAC 1 (g/210 L)	BrAC 2 (g/210 L)	Absolute Difference between tests (g/210 L)	INVALID SAMPLE prior to: 1st test	2nd test	Time from INVALID SAMPLE (Minutes)	Time between tests (minutes)	BrAC 2 corrected to 0.019 g/210 L/h	Absolute corrected difference (g/210 L)
1	0.225	0.204	0.021		*	3	28	0.213	0.012
2	0.177	0.156	0.021	*		3	26	0.164	0.013
3	0.179	0.158	0.021	*		3	24	0.166	0.013
4	0.193	0.172	0.021	*		3	22	0.179	0.014
5	0.196	0.174	0.022		*	4	54	0.191	0.005
6	0.263	0.241	0.022		*	4	26	0.249	0.014
7	0.099	0.076	0.023		*	3	24	0.084	0.015
8	0.168	0.144	0.024		*	2	25	0.152	0.016
9	0.328	0.303	0.025	*		11	19	0.309	0.019
10	0.246	0.221	0.025	*		10	20	0.227	0.019
11	0.295	0.270	0.025	*		3	24	0.278	0.017

in arrested drinking drivers (29, 30). Column nine of Table 5 shows the absolute corrected difference between the first and second breath tests and all the results are less than 0.020 g/210 L.

Figure 4 shows that there is no correlation between the differences in paired breath samples due to the subjects' BrAC, yet it does clearly indicate that the data is skewed such that the second result is lower than the first in a majority of instances. When all 173 SIS messages are examined, 132 (76 %) of the cases had the second test results lower than the first. This is typical of breath tests where no IS was detected and may be due to the elimination of alcohol during the minimum 15 minute time interval between the two tests currently required under the *Criminal Code* (31). When MIS messages data are included, 138 (75 %) of 184 cases had the second test results lower than the first.

Of the 173 incidents of SIS screen messages, eight cases (4.6 %) had results where test 1 and 2 were equal and thirty-three (19 %) cases where the first result was lower than the second. For the eleven cases of MIS screen messages, two cases had results where test 1 and 2 were equal and four cases where the first result was lower than the second.

For the 38 cases of SIS and MIS messages where the first result was lower than the second, 16 had an IS prior to the first test. Again, any hypothetical mouth alcohol, if present in these cases, should have resulted in a higher first test. For the remaining 22 tests, the IS message was preceded by a higher first test followed by a lower second test, the breath tests did not differ by more than 0.013 g/210 L for SIS and 0.016 g/210L for MIS, which confirms that they were in good agreement and not influenced by any significant mouth alcohol effect.

CONCLUSIONS

This five-year retrospective study has shown that IS screen messages obtained in the field could be due to variations in the breath exhalation pattern of the sample provided into the instrument and not exogenous mouth alcohol. However, highly transient endogenous mouth alcohol could potentially still cause an IS message but this effect would be of limited magnitude and short duration. A 15 to 20 minute wait period does not appear to be routinely required after an IS message occurs. Similarly, MIS messages do not appear to be more likely the result of mouth alcohol. If a breath technician observes an arrested

drinking driver varying their breath exhalation pattern, e.g., huffing and puffing, or sucking back a breath sample, into the Intoxilyzer® 5000C resulting in an IS screen message and there is no suspicion of mouth alcohol, then a 15 to 20 minute wait until a subsequent breath test can be conducted is not required. The 15 to 20 minute wait protocol is a tool put in place to prevent potential mouth alcohol from adversely affecting the breath readings. However, based on our data in cases where the wait protocol was not followed, such a change in the protocol does not, in and of itself in anyway discredit the result or affect the accuracy or validity of the result. For breath tests that were conducted less than 20 minutes from the time of the IS screen message, no evidence of a mouth alcohol effect resulting in the next breath test being significantly higher due to mouth alcohol was observed. Also, the duplicate breath test results for all cases (single and multiple messages) were within 0.02 g/210L (truncated) and no third breath test was required. While some instances of consecutive MIS screen messages may be the result of reducing the wait time to only that needed to re-start the test sequence (2–3 minutes), these messages represent only a small percentage (4.5%; n = 8) of the total occurrences (n = 184) of IS screen messages. Other components of the breath testing protocol, especially the fifteen-minute deprivation period prior to testing, the removal of items that may contain alcohol from the accused and any areas they may come into contact with, and vigilance by the breath technician for indications of burping or regurgitation, are sufficient to eliminate the possibility of mouth alcohol.

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