Alcohol and Traffic Safety in Sweden and the Role of Biologic Markers in Finding Alcohol Dependency.

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INTRODUCTION

In Sweden alcohol abuse is regarded as a dominating public health problem. It has been estimated that about 300 000 Swedes are alcohol abusers or alcohol dependent, corresponding to 4-5% of the male and 1-2% of the female population. As a consequence Sweden has a long tradition of strict DWI legislation which is well internalised in the general sense of justice. Thus, drunken driving is considered a serious crime and most Swedish drivers have a very negative attitude towards such behaviour (Åberg,1993). In the past few years the legislation has become more strict. The legal BAC-limit has been lowered. In 1991 Sweden introduced re-licensing requirements after having been sentenced with more than 0.15% BAC and in 1996 more rigorous regulations of the medical requirements for possession of a driving licence in case of alcohol dependency or abuse (The Swedish National Road Administration,1996).

The number of road traffic injuries has gradually decreased in Sweden for a period of about 20 years. Thus, as compared to 1975 there were 60% less fatal traffic accidents 1995, 16 and 6, respectively, per 100 000 population older than 15 years.

It is of course of great interest to study whether the decreasing number of traffic injuries to some extent is related to the different legal reforms and a consequence of behavioural changes with respect to drunken driving. Some studies which have addressed this question will be referred to. But, firstly let us survey some of that known about alcohol driving in Sweden.
HOW GREAT IS THE PROBLEM OF ALCOHOL IN ROAD TRAFFIC IN SWEDEN?

We have no definite answer to this question and therefore we are forced to present the results of various studies that more or less indirectly illustrate the occurrence of drunken driving.

1 Self reported drunken driving.
According to repeated questionnaire studies about 7% of the drivers report that they had been driving with a BAC over limit during the past three years (Åberg, 1995). This would roughly correspond to 275 000 drivers ignoring the BAC limit. Åberg also calculated the mean number of incidents of drunken driving and 1994 he obtained 0.40 incidents per driver with an illegal BAC, which corresponds to a consumption of three glasses of wine or more.

2 The number of convicted drunken drivers.
During the last 10 years there have been 15 000-20 000 convicted drunken drivers per year. Even though the number has decreased slightly since 1991 it is not a good indicator of the real number of DWI offenders but is a better reflection of police resources and activities. Thus the number of convicted mainly reflects the activity of the police in performing random breath testings. In comparison with 275 000 self-reported drunken drivers these data would indicate that the police identify about one out of twenty of them.

3 The rate of drunken drivers in police reported traffic crashes with personal injury.
During the last 20-years period, without significant changes over time, between 4 and 6% of the drivers in all reported traffic crashes were suspected to be alcohol related.

Regarding merely fatal traffic accidents quite another picture emerges. Among motorists who had been killed immediately from the accident Bonnichsen and Åqvist 1968 found 27 per cent with BAC exceeding 0.05%. In 1993 comparable results are obtained. Öström reports 31 per cent alcohol positive (BAC at least 0.01%) in a postmortem study (regional data). At the national level, 21% of fatally injured car drivers had been drinking (Laurell and Lekander, 1993).

We thus can conclude that alcohol is a considerable problem in road traffic in Sweden.
Therefore it makes sense that the DWI legislation gradually, and in particular the last couple of years, has become more and more strict.

THE LEGISLATION GOVERNING ALCOHOL-IMPAIRED DRIVING IN SWEDEN

The legislative restrictions against drunken driving consist of three different parts; the BAC limit, the medical requirements for possession of a driving licence and the requirements for relicensing after DWI offence. Simply expressed the message of this entire legislation is that alcohol and road traffic do not belong together.

BAC limit:
In 1957 the limit was lowered from 0.08 to 0.05 and in 1990 to 0.02%.
In addition the punishments for drunken driving became more severe in 1994 and drivers with a BAC over 0.1% now run the risk of imprisonment. The duration of suspension of driving licence varies between one month and three years depending on BAC, number and severity of offence.

Medical requirements for possession of a driving licence:
On July 1st, 1996 new provisions were introduced and they included a specific chapter about the use of substances that effect the ability to drive a motor vehicle. Here it is clearly established that dependency on alcohol and psychoactive drugs "constitutes grounds for denial of possession (of a drivers licence) until a long-standing sober lifestyle can be verified and there is a good prognosis for continued sobriety." "Long-standing is understood to mean a minimum of six months and a maximum of up to two years where the dependency is heavy."
The provisions for a verified sobriety are also established and include "a regular contact with a doctor or other means of rehabilitation", "frequent laboratory tests during the entire check-up period" and "a doctor's certificate that indicates and assesses the conditions mentioned".

Of most importance in this context is that dependency on substances is determined on the basis of a diagnosis either "according to conventional medical practice", or on an assessment "that the criteria for such a diagnosis have been fulfilled." The "criteria are those which are specified in a criteria-based system for the classification of diagnosis; e.g., DSM (Diagnostic and Statistical Manual of Mental Disorders) or ICD."
In a similar way the possession of a drivers licence in connection with alcohol abuse (when the criteria for abuse of psychoactive drugs are fulfilled according to DSM) is established.

It is clearly established in these provisions that alcohol dependency is regarded as a medical condition that constitutes an unacceptable risk from a traffic safety point of view. Furthermore that the prerequisites for a diagnosis are specified and that it is up to the applicant to prove his sobriety when once his alcohol dependency has been established. Thus these new provisions considering the medical requirements in cases of alcohol dependence or abuse provide much better opportunities than before to revoke a driving licence or to reject a reaplication.

The relicensing procedure:
In 1991, Sweden introduced requirements for drivers applying for licences after having been sentenced for having driven with more than 0.15% BAC. January 1st, 1997 this BAC limit was lowered to 0.1% (corresponding to 0.5 milligram alcohol per litre in exhaled air). The driver is required to present to the licensing authority a certificate stating that he/she is not dependent upon alcohol or other drugs. This certificate can be obtained from a doctor but only after a minimum of three months observation. A reappraisal shall occur after six months and after an additional twelve months.

The Traffic Medicine Advisory Board and its role:
This Board has the administrative role as adviser to the 23 different County Councils in Sweden. The County Council is the authority handling and deciding the majority of considerations in relation to driving licences and here the clerical officer is assisted by a medically qualified advisor. Cases causing problems in the appraisal at the County Council level are referred to the Advisory Board which in this manner handles about 600 such cases per year.

The Traffic Medicine Advisory Board also has worked out the above mentioned Provisions on the Medical Requirements for Possession of a Driving License.
HAVE THE NEW LEGISLATIVE RESTRICTIONS REDUCED DRUNKEN DRIVING AND/OR ALCOHOL RELATED TRAFFIC CRASHES?

To answer that question we need to focus on the different parts of the legislative procedures:

- The effects of lowering the legal BAC limit from 0.05 to 0.02 have recently been evaluated by Norström (1997).
- The new medical requirements for possession of a drivers licence were introduced too recently (1996) and probably need to be in action for several years until the effects can be evaluated.
- The requirements for relicensing were introduced in 1991, but have not been thoroughly evaluated regarding the possible impact on frequency of drunken driving or alcohol related traffic crashes. Nevertheless, there is a lot of experience from the relicensing procedure worth mentioning.

Impact assessment of the 0.02% BAC limit:

- In a questionnaire study about different aspects of drunken driving Åberg (1993) reported a change of driver behaviour between 1987 and 1991. Probably as a result of the lowered BAC limit in 1990 it was three times as frequent 1991 than 1987 that drivers reported they had cancelled a drive due to a presumption of too much drinking considering the BAC limit.
- Norström has performed an intervention analysis on traffic crashes data covering the period before and after the time of lowering the BAC limit. He analysed three categories of traffic crashes; fatal, single-vehicle and all traffic accidents. The impact of the reform was assessed to have reduced all traffic accidents about 7 per cent, single-vehicle accidents 11 and fatal crashes 10 per cent. The study covered the three years preceding the intervention and the three years following. Norström, however emphasizes that confounding factors cannot be ruled out and therefore suggests that the results should be interpreted with caution.

Granted that the intervention effect was real it seemed to have been materialised by a general reduction of the BAC-level. Thus the average BAC was significantly lower 1991 than 1987 among convicted drunken drivers.
The relicensing. Problems and the procedure in practise:
Relicensing is required after having being sentenced with more than 0.1% BAC. Several studies have pointed out the special problems in DWI offenders, having BAC levels exceeding 0.1%. Some of those problems have to be mentioned as they return as difficulties in the relicensing process.

Some characteristics of the gross drunken drivers at a group level:
• They make up 75% of all DWI offenders in Sweden
• About 40% have no driving licence at the time of their offence
• About 50% are previously convicted for drunken driving
• About 50% also can be found in other social registers about alcohol related problems
• A higher frequency of criminality compared to the offenders with lower BAC-levels
• The BAC value has a strong correlation to the extent of alcohol abuse
• Several data indicate that the gross drunken drivers to a large extent have a mixed pattern of abuse, including legal and illicit drugs

Norström (1996), who has presented most of the mentioned characteristics observed a clear-cut difference between two groups of DWI offenders, those having a BAC below and above 0.1%. Altogether these facts point to specific problems regarding the procedure of relicensing gross drunken drivers.

The certification by the doctor:
A particular form is used for the medical certification. The offender is asked about previous and present alcohol consumption or abuse and efforts of rehabilitation. Questions are also asked about alcohol related diseases. A typical alcohol dependant person with his denying attitude often does not provide very much information about this. Therefore the knowledge and experience of the medical doctor is of great importance in this situation. According to the provisions a certificate shall be issued by a psychiatrist or a medical specialist "highly knowledgeable in the field and experienced in questions involving abuse." These conditions are, however, far from always met.
The physicians try to get the patients into some kind of rehabilitation program when there is need and opportunity.

The certification also includes a physical examination where in particular alcoholic stigmata are looked for. Furthermore there must be at least two sets of laboratory tests during a three months period. The type of laboratory tests to be used is not specially prescribed. Most frequently GGT, ASAT and ALAT are used but also MCV often occurs. During the last couple of years CDT has become gradually more frequently used. Finally the doctor shall appraise the entire information and make a prognosis for continued sobriety.

THE ROLE OF BIOLOGICAL MARKERS IN FINDING ALCOHOL DEPENDENCY AMONG APPLICANTS AND REAPPLICANTS

Firstly, we have to regard that their are two different administrative procedures: One is when the medical requirements for possession of a driving licence are appraised. This is often due to some kind of history of current or recent alcohol abuse. In these cases there is often fairly good medical and social information available. The other procedure is about regranting of licence after a DWI offence. Then generally less information, mainly that presented in the medical certificate besides the BAC value at the current offence and other possible DWI offences, is available.

Secondly, we also have to consider the two different administrative levels where the applications are handled. A majority of the whole number of cases (around 10 000) are handled and decided by the County Councils and about 80% of all DWI offences lead to revocation for a period up to three years. Of these a considerable number never reapply. Each year about 100 of all these cases are referred to the Traffic Medicine Advisory Board. These are cases which cause problems in the appraisal at the County Council level. Here we present the administrative procedure at the Advisory Board and the experience with this selected material of cases. When merely discussing the role of biological markers we have no reason for making a distinction between applicants and reapplicants.
Regarding the regranting of driving licence the information about the licence applicant presented in the medical certificate constitutes the principal basic data for the decision. From experience it could be concluded that in most cases the results of the laboratory tests are determining. Therefore the value of good alcohol specific markers cannot be overestimated. On the other hand this does not exclude, but rather reinforces, the necessity of a much better medical-psychological assessment than generally practised today.

The medical examination including the biological alcohol markers targets individuals with alcohol dependence in order to exclude them for further driving. This means that there is demand for a highly reliable test; expressed both as a high sensitivity (no or few false negatives) and a high specificity (no or few false positives). However both sensitivity and specificity are limited in most known biological markers. CDT is an exception in that it constitutes an outstandingly specific marker for excessive alcohol consumption, but still it is not very sensitive. Hypothetically such a good specificity could be combined with a single biological test of very high sensitivity and a reliable test-system would exist.

For lack of such a highly sensitive biological marker what to do? How to solve the problem of finding, if possible, all applicants with alcohol dependence, i.e. to miss as few as ever possible? At the Advisory Board of Traffic Medicine we tackle this problem by practising a model that could be described as a two-step test. The first step constitutes a sensitive screening system. The next step is a verification test.

A highly sensitive screening system.

This screening system includes DSM as the criteria-based system for the classification of diagnosis, i.e. alcohol dependency or abuse, and GGT, ASAT, ALAT and MCV as biological markers as well as all other possible information indicating alcohol dependence.

- By practising the DSM criteria system approximately more than 50% of the DWI offenders with a BAC value over 0.1% can be classified as alcohol dependent by the available information. According to DSM at least three out of nine possible criteria need to be fulfilled for a diagnosis of alcohol dependency. Normally three or four criteria are easy to identify. Even for those cases where the criteria for a diagnosis of alcohol dependency
previously have been fulfilled the provisions establish that: "If at any time the criteria for dependency have been fulfilled, the provisions on such dependency are to apply."

- The levels of GGT, ASAT, ALAT and MCV are appraised very critically. If there, as in most cases, are other indications of alcohol abuse any raised value further supports the suspicion that this elevation is caused by alcohol. Such a critical appraise of these biological markers is well supported by various studies (for a short review, see Sillanaukee, 1996). Thus 50-72% of all elevated GGT values can be explained by excessive alcohol consumption. The pooled sensitivity of ASAT has been estimated to be 35% as a marker of alcohol abuse, but for ALAT probably poorer. Alcohol abuse has been found to explain increased MCV values in 89% of men and 56% of women in general practice.

- By this very critical examination of any possible sign indicating alcohol abuse we, from experience, find that a majority of those about 100 applicants we meet each year are "caught in this web". At this point of the examination we sometimes have a clear-cut diagnosis and information enough for a rejection of the application. However in many cases we merely reach a high level of suspicion but no evidence. Therefore we need a test providing a very high specificity, i.e. in order to assure that the suspicion was right. This is necessary in order to provide high legal security.

**A highly specific verification system:**

Several studies point at CDT (carbohydrate-deficient transferrin) as a very specific marker of heavy regular alcohol consumption, i.e. an average daily consumption of at least 60g ethanol. Specificities up to 99% and always exceeding 90% have been reported (see for instance Stibler, 1991 and Allen et al., 1994). Most important is that CDT is very well suited for discrimination between alcohol-induced hepathopathy and liver diseases of other origin (Bell et al., 1993). From our experience it is namely common that elevated liver enzyme levels occur among the heavy abusers also due to other factors, for instance current or previous abuse of legal and illicit drugs. Only a few factors are conflicting the high specificity of CDT; mainly a few serious nonalcohol-related liver diseases and rare cases of atypical transferrin variants as well as an inherited disorder (Stibler, 1991, Allen et al., 1994). These factors rarely causes any problem in practice from our experience.
This, consistently shown, high specificity of CDT allows us to use it as a proof of alcohol dependency, when the cut-off levels (20 and 26 u/l for males and females, respectively) are exceeded. As a practice we usually require two raised CDT-values to ensure the diagnosis of alcohol dependency. This is also the case when all other biological markers are normal, which is not an unusual situation. Of course the prerequisite for this is other indications of abuse, for instance according to the DSM criteria system.

In this connection it is important to emphasize that false negative CDT levels occur and therefore normal CDT values can never exclude alcohol abuse (Gilg et al., 1995).

By using this two-step model with screening and verification by CDT a majority (80-90%) of applications for driving licences, appraised by the Traffic Medicine Advisory Board, are rejected. However, it must once more be pointed out that the about 100 applications we handle per year are selected as complicated cases. It still remains to be seen whether our procedure would yield similar results when applied on the total number of reapplicants. The characteristics of the gross drunken drivers, as a group, suggest a very high rate of alcohol or drug dependency and consequently a high rate of rejections. In Great Britain, however, a partly comparable group of "High Risk Offenders" was assessed quite differently. In this high risk group, including individuals with very high BAC values (exceeding 0.2%), only about 4% were denied a licence and as many were granted a one-year licence (Morgan, 1996). Nevertheless we can conclude that our model with screening and, if necessary, verification by CDT offers, according to our legislative restrictions against drunken driving, a system of high legal security, i.e. no one risks being rejected unless he really has a drinking problem.

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