DriveABLE®

Research-Based Assessments for Medically At-Risk Drivers

Government licensing authorities, physicians, insurance companies, and concerned family members have a critical need for driving evaluation procedures with a strong research base. DriveABLE™ was developed to meet that need.

Background and Overview.

The evaluation procedures were developed in response to a strong appeal by the chief of geriatrics and his team at the Memory Clinic, Glenrose Rehabilitation Hospital, Edmonton, Alberta, Canada. The concern was the lack of scientifically based tools that would enable evidence-based decision making about the continued driving of patients with cognitive decline. The limitations of medical evaluations for fitness-to-drive were apparent. There was a dearth of information that would allow the physician to move from medical-diagnostic information to valid decisions about the patient's competence to drive. The limitations are especially apparent for older patients who typically have multiple medical conditions and medications. The complex interactions of illnesses, medications, and age disallow any easy mapping from medical status to the ability to drive safely.

Despite the lack of effective tools, there is increasing pressure on physicians to make fitness-to drive assessments. In part, this is in recognition of the increasing older population and that older drivers are driving more and driving longer into old age where impairing medical conditions are more likely. In addition, there is recognition of the dramatically increasing casualty crash rates of older drivers.

To address the need, a University and hospital research program was initiated to develop driving assessment for drivers with cognitive impairment that could be delivered at many sites. There was a focus on cognitive impairment because it poses special challenges for physicians and others making licensing decisions, and because of its high prevalence among seniors. The Canadian Study on Health and Aging estimates 8% of the senior population have a dementia and a further 17% have cognitive impairment that is not a dementia but due to an illness such as heart disease, lung disease, kidney disease, diabetes, and/or medications. The prevalence is similar in other industrial countries.

The physicians made their appeal for the development of a scientifically-based driving assessment to Dr. Allen Dobbs, who was a University professor and the Director of the Neurocognitive Research Unit within the Northern Alberta Regional Geriatric Program. Dr. Dobbs had a longstanding interest in cognitive decline associated with aging and age-associated pathologies such as dementia, and the relationship between cognitive decline and the person's ability to accomplish everyday tasks. Driving is an important activity and the challenge to develop a scientifically valid assessment of driving abilities was exciting.

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The Discovery Research. The approach taken was very different from that of others. It was important to first define and describe the driving of normal, healthy drivers in order to have a firm basis for defining a means of identifying medically impaired, unsafe drivers. In the first study, a young group (30-40 years of age) and an older group (65+) were recruited to define the type and severity of driving errors made by normal, healthy drivers. All of those drivers received extensive neuropsychological testing and an assessment by rehabilitation medicine. This testing ensured the young and older volunteer drivers were mentally and physically within the normal range. Each participant also completed a variety of tests that were designed or selected for the research because of their relationship to driving. There was a deliberate focus on complex tasks that were easy to understand but required concurrent use of mental abilities from different domains. This strategy was in recognition of the very poor predictability of neuropsychological and other tests for driving performance. The on-road testing was accomplished on both a closed course and a road course on urban streets. The urban road course emphasized the types of maneuvers and driving conditions that are common in older driver crashes. All drivers drove the same road course.

The discovery research also included a cognitively impaired group (almost exclusively dementia patients) all of whom were currently licensed and driving. This group was designated as the "unsafe driver" group because, as a group, dementia patients are unsafe drivers: 30-50 percent have a crash within a few of years of diagnosis, 80 percent continue to drive and 40 percent of those have at least one more crash before stopping driving. As a group, these drivers allowed us to identify the types of driving errors that are made by unsafe, cognitively impaired drivers. A wide variety of new information was gained from the research. The critical new knowledge for the driving aspect of the research was: (1) the discovery of the driving errors that differentiate cognitively impaired unsafe drivers from healthy normal drivers, (2) the driving situations that are necessary to include in a road test to reveal the driving problems of medically impaired drivers, and (3) an evidence-based pass/fail criterion.

All of the drivers in the discovery research also completed the neuropsychological and rehabilitation medicine testing, as well as completing a variety of tests that were designed or selected for the research because of their presumed relationship to driving and because they required concurrent use of mental abilities. The performance on those tests was compared to driving performance in order to select a small set which were highly predictive of actual driving performance. The goal was to enhance safety by being able to identify at least the most dangerous drivers without the need to test them on public roadways. To maximize accuracy, a high and a low cut-off score were identified which accurately captured those who passed and those who failed the driving test. Those who fell intermediate would need a driving test to resolve fitness-to-drive.

The Validation Research. A second study validated the findings from the initial research and greatly extended the applicability of the assessment procedures in two important ways. First, drivers from across the entire driving age-range were included. Second, a wide variety of medical conditions were included.

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These two extensions expanded the applicability of the assessment procedures beyond older drivers and dementia to drivers of all ages and all illnesses that result in generalized cognitive impairment.

The Tradition of Driver Assessments.

The tradition of driver assessment has been to rely on professional opinion. Individual driving evaluators set up, score, and evaluate the driver's performance on the road test based on their best judgment. They may have extensive experience or training, but the basis for the driver evaluation remains best judgment. The road tests are not based on scientific knowledge about what errors to score, what road conditions are necessary to make the relevant errors occur, and what criterion to use to ensure competent drivers pass and unsafe drivers are identified. Decisions about a person's continued driving are too important to the person and to society to be left to guesses.

A Scientific Approach is Possible. A scientific approach, using extensive research to understand the decline in driver competence and how to measure that decline, is possible. The scientific approach was the one pursued and the discoveries from that research serve as the basis for the DriveABLE™ Road Evaluation.

Development of the DriveABLE™ On-Road Evaluation.

Defining What to Score. A critical aspect of the DriveABLE™ on-road evaluation procedures is that the research identified the driving errors that are made by normal, healthy drivers. These driving errors can not be used to count against a driver in any justifiable assessment of a driver's competence to drive, because that would place healthy normal drivers in jeopardy. Comparisons of the driving errors of the normal, healthy group against those of the cognitively impaired (unsafe driver) group allowed the isolation and definition of the type and severity of errors that cognitively impaired drivers make that are *different* from those of healthy normal drivers. On the basis of this discovery, a scoring system was developed that focuses on the driving errors that signal competence declines. To protect the competent driver, the scoring system explicitly excludes errors that are those made by experienced, healthy drivers and not associated with competence declines.

Defining the Road Course Layout. A second scientific advancement was discovering how to define the rules to lay out a road course that ensures the competence defining errors of medically impaired drivers are revealed. This was accomplished through identifying those attributes of a road course that were necessary and sufficient to reveal errors that signal decline. From this analysis, we developed the rules for laying out a road course that would reliably reveal the competence-defining errors.

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Defining the Unsafe Driver Criterion. Knowing the range and frequency of driving errors made by healthy, normal drivers meant that we could move beyond setting an arbitrary criterion for failing the road test. Instead, we used the scientific data to set our unsafe driver criterion as being "out of the range of normal". This criterion is defensible, based on scientific data, and consistent with known court decisions (e.g., the Supreme Court of Canada ruling regarding criteria for non-discriminatory license removal from drivers with medical disabilities).

Consideration of 'Dangerous' Situations.

During the developmental phase of the research there were two parts to the road assessment. The first part was done on a "closed course". That was an area of the city that had roads, curbs, and stop signs, but land development had not proceeded. The City of Edmonton allowed us to close traffic to that area which made it ideal for assessing 'dangerous' situations in a safe area. In that "closed course" area we had a variety of situations, including:

a)   ***An emergency stop***. For this, the driver's speed and time of arrival at a point was automatically calculated by a computer (speed measured by time taken to traverse the distance between two photo cells). The computer triggered the release of a life sized, two dimensional styrofoam pickup truck from that point. The styrofoam vehicle crossed the path of the examiner's vehicle at a time that necessitated rapid response by the driver to avoid a hit. The driver's response was recorded.

b)   **Anticipate an emergency situation.** In another section of the closed course where the driver had just passed a 'children playing' sign (actual signage from the city), speed and time of arrival were calculated. From behind a parked car, a soccer ball was automatically released at a time where the driver did not have time to avoid it. We looked for two things, did the driver attend to the children playing sign and alter his/her driving behavior, and how did the driver react to the soccer ball.

We also had freeway driving during the developmental research.

Information about the driver's behavior in these kinds of situations is important, but it may not be safe or even practical to test drivers in these situations in everyday driving evaluation situations.

Safety during driving assessments is a critical issue because the driving evaluation is done on public roadways and the driver (client), the assessor, and other road users can be endangered. For safety concerns, one goal was to develop a road course that was safer than one necessitating emergency stops and freeway driving. Never the less, it was important that this safer road course would still identify the drivers who made unsafe actions in the three situations described above.

An evaluation of the driving performance of the drivers who made driving errors in the dangerous driving situations (e.g., emergency stop, freeway driving) revealed that they also made specific types of driving errors in the safer situations. By ensuring that these safer driving situations were included in the road course specifications, and using a criterion

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for the number and frequency of these safer driving errors, we could identify the drivers who made the dangerous driving errors under safer conditions.

Development of the DriveABLE™ DCAT™.

In the research phases, each driver completed a set of cognitive tests selected or developed because of their relationship to driving. On the basis of the research findings, a set of these tests was selected to form a short Cognitive Assessment that was very strongly related to actual on-road performance. The approach was not a 'cognitive domain' approach in which there is an attempt to represent each of the relevant cognitive abilities within the test battery. Instead, the strategy recognized that driving requires concurrent use of mental abilities from different domains and shifting among abilities in sometimes diverse domains. Tasks requiring the concurrent use of different mental abilities that were short, easy to instruct, and amenable to computer presentation were emphasized. Tests were selected from this set to form a battery of tests having high accuracy in predicting actual driving performance. As always, the lowest level of predictive accuracy was for those falling in the mid ranges. Predictions not approaching 100% accuracy were unacceptable to us, because accurate and fair decisions about continued driving are critical to the well-being of the person and to the safety of other road users. To maximize the in-office evaluation's predictive accuracy, high and low criteria

were selected that enabled exceptionally high accuracy in predicting driving performance in the ranges defined by those criteria. We designated those with scores falling between the two criteria as 'in-determinant' and requiring an in-car evaluation to resolve competency (see diagram, Figure 1).
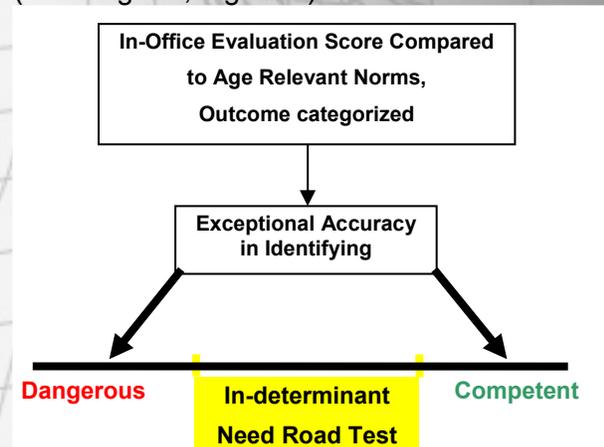

Figure 1. Illustration of testing outcomes for the In-office testing: decision possible or further testing needed.

The DriveABLE™ DCAT™ is computer presented and scored, and the testing procedures are client friendly. A DriveABLE™ trained and certified professional guides the client through the assessment. Although the tests are computer presented, they require only 'touch-the-screen' or button push responses. Computer knowledge, or even familiarity with a computer, is not a determiner of performance. Computer presentation enables precision measurements, unbiased scoring, and immediate results.

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Validation Research.

In the next phase of the research, the DriveABLE™ DCAT™ and the Road Evaluation procedures were validated using a new sample of drivers. In the new sample we extended the testing across the age range and purposefully included patients having a wide variety of medical conditions, all of which had associated, non-specific mental decline (e.g., dementia, pulmonary disease, cardiovascular disease, renal disease, brain trauma).

A new course for the road evaluation was defined using the criteria discovered in the research, which defined the road conditions, maneuvers, visual, and other attributes of driving situations needed to reveal the competence-defining driving errors. The mental ability tests identified as, collectively, providing the best prediction of actual in-car test performance were evaluated as a computerized test battery along with the scoring algorithms and cut-off criteria that maximized the predictive accuracy. The goal of the DCAT™ was to increase the safety of the driver evaluation by identifying the most dangerous drivers without the necessity of on-road testing, and to increase the economy of the assessment by identifying as many as possible of the safe drivers without losing accuracy. If the cut-off scores could be validated as accurately identifying many of the dangerous and competent drivers, this would greatly reduce the number of clients who would need to be tested on public roadways.

The findings showed a remarkable understanding of the attributes of driving situations and environmental conditions that result in the commission of the types of serious driving errors made by medically impaired drivers. The results showed that the rules we had developed for setting up an effective road course were valid. Moreover, the driving error scoring system proved to be appropriate for categorizing all of the driving errors. The research also showed that the cutoff scores defined in Phase I of the research for the In-office Evaluation enabled exceptional (95%) accuracy in identifying the most dangerous drivers and the most competent drivers. This validated the use of the Cognitive Evaluation as an effective and accurate tool for increasing the safety and cost effectiveness of the DriveABLE™ evaluation.

The DriveABLE™ road evaluation is the only in-car testing procedure for which all aspects of the evaluation have a solid scientific grounding. The scoring system, the road course layout, the performance criteria, and the quality assurance measures (see below) for maintaining adherence to the scientific advancements all have extensive scientific support.

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Equal Fairness for Urban and Rural Drivers.

DriveABLE™ has always placed the greatest importance on the fairness and accuracy of our assessment procedures for all clients. From the beginning, we knew it would be important to demonstrate the fairness of the procedures for testing rural drivers because the on-road evaluation is given in urban settings (e.g., Edmonton, Vancouver, Toronto, Montreal, Orlando, New York). To test this, we directly compared the outcome of the assessment for urban and rural drivers sent to DriveABLE™ by physicians who were concerned about their patient's ability to drive safely

- Groups of Rural and Urban drivers were carefully matched on age, sex, diagnosis, and score on a test of mental abilities.

- All were given the DriveABLE™ assessment.

The research showed virtually no difference (2 percent) in the success/fail rates between the urban and rural drivers.

This scientifically confirms the equal fairness and suitability of the DriveABLE™ assessment procedures for both urban and rural drivers.

It is not surprising that the DriveABLE™ procedures were found to be equally fair for urban and rural drivers. Using the DriveABLE™ procedures, the driving evaluator carefully instructs the driver on each turn and other type of driving maneuver. The procedures score only the types of driving errors shown by the research to be associated with medically unsafe drivers, with an emphasis on protecting healthy, competent drivers from misidentification.

Development of DriveABLE Assessment Centres.

At the conclusion of the research (1998), the University recognized the importance of the discoveries and encouraged the development of a University spin-off company to offer the service, and to make the service widely available as an injury-prevention/traffic-safety advancement. With commercialization assistance from the Alberta Heritage Foundation for Medical Research and the National Research Council's Industry Research Assistance Program, DriveABLE Assessment Centres Inc. was founded. The business model of DriveABLE™ is to license the use of the DriveABLE™ assessment procedures to individuals, government, or agencies. DriveABLE™ provides the equipment, software, and training of personnel to administer the assessment. DriveABLE™ personnel also set out the road course to conform to DriveABLE™'s research defined criteria. Each DriveABLE™ Centre conducts the testing and the data are encrypted for confidentiality and sent via the Internet to the DriveABLE™ home office server. The data are scored, weighted, combined using proprietary algorithms, compared to age-relevant norms, and the outcome encrypted and returned to the DriveABLE™ Centre. Software to produce the assessment report is provided by DriveABLE™. Having all of the data at the DriveABLE™ home-office allows for unprecedented standardization and quality assurance.

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Development of Standardization and Quality Assurance for DriveABLE™.

Set up and training.

The delivery of the DCAT™ is computerized as is the scoring. Nevertheless, it is essential for fairness and accuracy that the client understands what it is they are to do for each task. This requires appropriate personnel selection and skill training for DriveABLE™ assessors to instruct and guide the client through the test sequence. All persons administering the DriveABLE™ DCAT™ are certified after receiving explicit personalized training by DriveABLE™ personnel.

The design of the road course is critical. The road course for each DriveABLE™ Centre is set out by DriveABLE™ personnel and is based on attributes (type of roadway, intersections, visual conditions, driving maneuvers, etc) shown by the research to reveal competence defining driving errors. Training the driving evaluators to score the critical driving errors and to appropriately weight the severity of each error is essential to the delivery of the DriveABLE™ evaluation. All persons administering the DriveABLE™ Road Evaluation are certified after receiving explicit personalized on-site training by DriveABLE™ personnel.

Standardization of the Road Evaluation.

Most driving assessors believe that standardization means that all clients are taken on one or another road course, each having the same number of left and right turns, stop signs, traffic signals, one or two lane roads, etc. Standardization across road tests cannot be achieved with this crude

level of matching. Including DriveABLE™'s additional criteria, which attends to visual and environmental attributes, comes much closer, but even that never ensures that any two road courses will be of equal difficulty. The difficulty of each road course needs to be measured and accommodated if drivers are to be fairly and evenly assessed across a jurisdiction.

Licensing authorities need to be assured the evaluation that drivers receive is the same from one testing center to another: To do this, the road testing procedures must ensure that the outcome of the testing would be the same for any driver, no matter which Centre does the testing. DriveABLE™'s standardization procedures which include Road Course Difficulty Calibrations are the only known procedures to achieve this goal with in-car testing.

Difficulty Calibration

Even with careful attention to defining each road course, differences always will remain. No two sites are ever the same. The dozens of sites required to service a state or province exacerbate the challenge of standardization. Ensuring that the road test is equally difficult at each test Centre requires there be an external test against which the road course difficulty can be measured. ***Without an external criterion measure, standardization across sites can never be achieved. DriveABLE™ provides the external criterion to evaluate Road Course difficulty, and adjusts the performance criterion to match the research based standard.***

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DriveABLE™ achieves standardization by careful attention to road course design, examiner training, and final calibration. Calibration is achieved as follows:

- The Computerized Cognitive Assessment is the same at all sites.

- The outcome measures of the Cognitive Assessment are calculated over a set of clients and compared to the road test scores of those drivers. Because the relationship between the Cognitive Assessment and the Road Evaluation is well defined, this comparison allows DriveABLE™ to determine the difficulty of the road course at any particular site. All were given the DriveABLE™ assessment.

- Difficulty is determined by comparing the expected vs. actual fail rates.

- Standardization across sites is accomplished by calibrating the fail criterion to match the difficulty of the road course.

 - If the fail rate is too high, the road course is more difficult than the standard, and the driving error score (driving errors plus severity) needed to fail is adjusted upward to accommodate the higher difficulty.

 - If the fail rate is too low, the road course is less difficult than the standard and the fail criterion is adjusted to accommodate the lower difficulty (fewer driving error points required to fail).

No other driving evaluation can match this level of standardization. Without this level of standardization, licensing jurisdictions and others cannot be assured that the outcome for drivers would be the same across assessment sites.

Quality Assurance.

DCAT™ administrators and Road Evaluation examiners must remain true to the training and administration criteria. The Internet exchange of (encrypted) client test scores provides the home office with all of the data from each Centre. Those data are monitored for Quality Assurance.
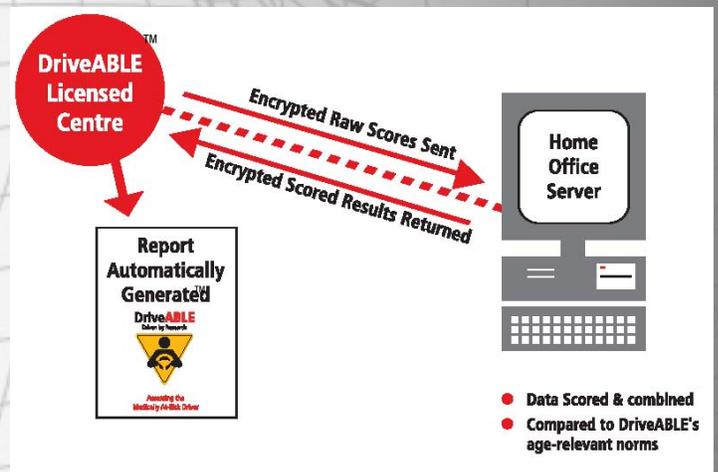
Quality Assurance monitoring includes:

- Confirming that relationships among Cognitive Assessment tasks are preserved at each site over time.

- Periodic re-confirmation of calibration calculations for standardization of the road test.

- Evaluation of road test examiners by confirming that expected errors occur at locations with attributes known to reveal those specific error types.

- Evaluating stability of road test examiner scoring criteria through comparison of his/her ratings of driving attributes of the driver's performance with scores given for driver errors.

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The DriveABLE™ Report.

The DriveABLE™ report provides the physician, licensing authority, insurance industry, client, and family members with a concise, report of the assessment findings. An explicit recommendation is always included and based on the scientific data. The report was originally developed and subsequently revised in consultation with physicians and licensing authorities about the type of information needed and an effective format to present that information. Some information is included to facilitate physician-patient discussions about the outcome of the DriveABLE™ assessment. Information is included based on frequently asked questions from patients or family members that have been reported by physicians individually, or through focus group research.

Physicians appreciate the concise, to-the-point format, both because it reduces their time commitment and because it facilitates the discussion with their patients. The arms-length-assessment allows them to focus on the driving assessment outcome and future needs of their patient.

Licensing authorities appreciate the explicitness and time-saving format of the DriveABLE™ report. The consistency of format from driver to driver and inclusion of required content for decision making are key factors to the time savings. Most of all, both clients and referring sources appreciate the scientific backing and the ability to make evidence-based decisions about the safety of continued driving.

Best practice for driving decisions about medically at-risk drivers has now moved to science-based decisions.

Emphasis on Healthcare.

DriveABLE™ has most recently introduced initiatives which will enable more healthcare professionals access to the assessment. Special pricing incentives such as no up front fees and monthly payments will make the DriveABLE™ System much more accessible to a wide variety of users such as hospitals, rehabilitation centers, memory disorder clinics, and private practices with an emphasis on cognitive impairment.

DriveABLE™ will offer more flexible solutions to the availability of the On-Road portion of the assessment, including setting up licensed DriveABLE™ On-Road Assessment Centers within close proximity to the healthcare facility. For those healthcare groups not wishing to be involved in the On-Road portion of the assessment this new model will be of great benefit.

Please feel free to contact us should you have further questions about these exciting new DriveABLE™ initiatives.

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Summary.

DriveABLE™ is the evaluation for medically at-risk drivers developed through science to provide the strongest foundation for evidence-based decisions about fitness-to-drive. The science focused on discovering the driving errors of medically impaired drivers and how to reveal those in medically unsafe drivers. The standardization procedures offer unprecedented standardization of assessments and outcomes across Centres. The quality assurance procedures ensure that the evaluations remain true to the science and standardization is achieved for fair and accurate assessment across assessment centers and over time. DriveABLE™ is the only evaluation procedure that has been demonstrated to be equally fair for both urban and rural drivers. The reports were developed in collaboration with both physicians and licensing authority officials to be concise and effective.

For more information,
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