Taxonomy and Terms for Stakeholders of Older Adult Mobility

Second Edition

TRANSPORTATION RESEARCH CIRCULAR E-C289

Taxonomy and Terms for Stakeholders of Older Adult Mobility

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Preface

The taxonomy, terms, and definitions advanced in this publication are intended to facilitate communication and promote best practice among a host of disciplines and professional organizations committed to safe, independent, and dignified options for older adults to remain mobile within their communities. It is anticipated that this resource will be revised and updated as needed to reflect the dynamic and evolving set of issues that confront practitioners in this area.

Important words should convey a consistent message within and among groups invested in the safe mobility of older adults, including but not limited to researchers, gerontologists, geriatricians, occupational therapists, licensing authorities, social workers, and older adults themselves, all of whom ideally communicate effectively by written, oral and other means. Practitioners and older adults need a shared understanding of the complexities of the services provided to determine which mobility options are most appropriate for each individual situation. It is particularly important to use terms based on a common vocabulary to translate research into tools that develop and support evidence-based interventions. While it is hoped and expected that this document can promote evidence-based practice, the circular is not intended to establish a standard of practice.

Broadly speaking, this attempt to harmonize terms within the emerging field of traffic medicine encompasses all the various activities that are conducted to diminish harm from crashes and promote safe mobility. It includes the development of medical standards for driving, functional driving screens and assessments, the determination of fitness to drive by clinicians, and research into how effects of cognitive, sensory and physical limitations that impact driving fitness are measured. It also includes the automotive engineer researching injury mitigation and prevention through improved crashworthiness of vehicles, the civil engineer designing safer roads, and the traffic engineer working on improving traffic control systems. The licensing agency's driver examiner is another vital part of the panoply of activities that comprise traffic medicine. So, too, are researchers working on the epidemiology of traffic crashes, retention systems, and the biomechanics of crash injuries. The educational activities centered on road safety are an important element in the traffic medicine spectrum, as is the training of drivers and the counseling of individuals who need or choose to transition from driving to alternative transportation to maintain their community mobility and social participation.

Thus, while the use of the word "medicine" may lead some to assume a purely clinical orientation, the range of activities undertaken to support personal mobility and public safety are much more expansive, as carried out by practitioners throughout the world today. With such a wide variety of participants and activities, it is essential that everyone involved in traffic medicine, although they may not speak the same language, strive to operationalize the terms they use by applying the same words as much as possible to refer to a specific concept or practice.

ACKNOWLEDGMENTS

Contents

Introduction

The community of stakeholders in safe mobility for older adults use technical terms or expressions that can have very specific meanings across disciplines. The variety of different interpretations often leads to miscommunication. Moreover, the terminology continually changes to keep pace with advances in technology, measurement tools and methods, and transportation options.

With these advances, the terminology has grown and evolved. As new terms come into general use, older terms often must be reevaluated to determine if a revision is needed. This document contains terms of common usage and best practice as identified in the technical and clinical literature and as elaborated through peer review in work undertaken by the Transportation Research Board's (TRB's) former Committee on Safe Mobility of Older Persons and its subcommittee on Driver Medical Review and Driver Licensing, which have been reorganized together as the Subcommittee on Older Drivers under the Committee on Vehicle User Education, Training, and Licensing. This E-Circular was generated by volunteers of these groups.

PURPOSE

The purpose of this E-Circular is to provide a reference document for usage of terminology clarification to be used by stakeholders in older adult mobility. This includes professionals and groups engaged in driver evaluation and rehabilitation services; research and program development; education and training; alternative transportation; and others (e.g., psychologists, social workers) who may encounter older adults with limited mobility and be asked to help identify potential solutions. It is hoped that this publication will foster improved communication among those who are involved in preserving and extending safe, independent community mobility for older persons.

BACKGROUND

First Edition

The genesis of the first version of this E-Circular[1], *Transportation Research Circular E-C211: Taxonomy and Terms for Stakeholders in Senior Mobility* (2016), can be traced to discussions at the 2012 meeting of the former TRB Subcommittee on Driver Medical Review and Driver Licensing. Meeting attendees included occupational therapy authors writing a textbook on driving and community mobility. As the authors attempted to differentiate programs and wording, it became obvious that specific terms were used to describe programs and program components that differed significantly in scope and content yet were labeled using the same words. *Driver evaluation* was one such term. In different articles, descriptions of research

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[1] https://www.trb.org/Publications/Blurbs/174681.aspx

methods used "driver evaluation" to refer to a paper-and-pencil test, a 15-min driver licensing administered road test, or a comprehensive, 2-h evaluation by an expert driver rehabilitation specialist.

Meaningful translation of research to practice requires an accurate understanding of research methods to draw conclusions and generate recommendations. This is particularly important in a field where practice must rapidly evolve to meet increasing and changing demands, as demonstrated by the growing needs of safe mobility for older adults. The implications of mixed meanings for terms were further examined in March 2012, at a meeting of experts funded through a cooperative agreement between the American Occupational Therapy Association (AOTA) and the National Highway Traffic Safety Administration (NHTSA). At this meeting, a growing awareness of the variability in descriptors and practice-specific terms used to communicate between stakeholders was identified as a critical concern.

This concern was brought to the attention of the Standing Committee on Safe Mobility of Older Persons at the 92nd Annual Meeting of the Transportation Research Board in January 2013. The members of the committee subsequently organized a midyear meeting with experts to (1) identify terms needing clarification; (2) develop a taxonomy of senior mobility terminology; and (3) devise a method of communication and continued collaboration.

Outcomes of the 2013 midyear meeting included the generation of a draft list of terms to be elaborated through expert opinion—drawing upon existing technical and clinical literature to the greatest extent possible—by meeting participants, who organized into work groups before the meeting adjourned. A plan to facilitate communications within and between work groups via an online "wiki" was also developed. This wiki was subsequently implemented, with the support of East Carolina University, in time for the 93rd Annual Meeting of TRB in 2014. At this annual meeting, a podium session provided information to a wider audience about the effort to develop a taxonomy and a common terminology with multidisciplinary application. During its 2014 committee meeting, a second midyear meeting was planned to advance this initiative.

Throughout the spring of 2014, the work groups contributed to the wiki, revising the draft definitions developed the previous summer and adding new terms; a lively online debate highlighted differing definitions used by specific professions or associations. In July 2014, attendees at the midyear meeting refined terms compiled through the wiki and developed a template and timeline for the development of this E-Circular, which was finally published in July 2016.

Second Edition

As intended, the taxonomy was the start of a discussion with a shared understanding of word usage for the increased clarity of research and clinical application. This was seen as successful, as more methods sections in research manuscript are improving their specificity with terminology. For example, descriptions of *driving evaluations* are clearly articulated and distinguished between operational, tactical, and strategic levels of driving. However, as expected the changes in the practice and research area of older adult mobility necessitate an update of the taxonomy. In addition, the growing awareness of the importance of Safe System Approach demonstrates the need to communicate effectively and efficiently between the various professionals and organizations involved with the broad area of transportation.

The work plan started at the 98th TRB Annual Meeting in 2019. Using an online survey platform, members and friends of the former TRB Standing Committee on Safe Mobility of Older Persons were invited to access the survey platform to offer input on each term of the 2016 Circular E-C211. Specifically, the stakeholders could vote to keep terms the same or offer minor or major changes. In addition to offering these suggestions, there was amble opportunity to list additional terms with definitions. The results of this survey were shared at the 2020 TRB committee meeting. Next, three committees of experts in the three areas (Driver Evaluation and Rehabilitation, Alternative Transportation Options, and Assistive Technologies in Driving and Community Mobility) were recruited at the 99th TRB Annual Meeting in 2020. They were given the original terms and definitions, the results of the survey, as well as the many suggested ideas for revision. Once the committees completed their work, final editing and revision were completed for the second edition of this E-Circular on taxonomy.

ORGANIZATION

This publication is divided into four parts: an index, a taxonomy and definitions of terms used by stakeholders in older adult mobility; a list of abbreviations and symbols; and references. The major part is the taxonomy and definitions of terms. The terms selected for definition include many terms that frequently are misinterpreted, misunderstood, or generally confusing because the same language can evoke strikingly different meanings within or across different areas of practice.

The definitions provided are sometimes more than basic definitions; they may also attempt to clarify the sources of confusion. This is facilitated by examining specific domains and, within each domain, focusing on groups of related terms to develop a better appreciation and understanding of the uniqueness of each individual term. Thus, the definitions do not appear alphabetically but are organized by domain. Within each domain, identified topics serve as headings for lists of terms that need to be compared to point out their distinctions and these terms are located next to one another. For some definitions, footnotes provide editorial comments, which may be helpful in establishing a better understanding of the term as it is applied in a particular context.

The domains of knowledge and practice of this second edition of the taxonomy are Driver Evaluation and Rehabilitation, Transportation Options (revised from Alternative Transportation Options), and Assistive Technologies in Driving and Community Mobility.

Because definitions of terms are not alphabetical, the user may want to refer to the index to locate a term's definition more easily. The index shows the topic under which the term is grouped as well as the page number where the definition may be found. It also identifies the reference(s) that were used to develop a definition.

NEED FOR UPDATES AND COMMENTS

This publication represents a continued commitment to harmonize terminology used by stakeholders in older adult mobility with planned updates. One aspect of the updating will be simply to improve the quality of the definitions. Such improvements certainly are anticipated once the definitions are used and specific problems, shortcomings, or inconsistencies are

identified by users. This version of the taxonomy demonstrates changes that aim to improve the quality of the definitions. In addition, many new terms have been added to this taxonomy as well as an array of references demonstrating the use of the terms. It is expected that as soon as this version is published, an effort needs to be started on the third version as changes occur in the rapidly changing and dynamic transportation environment. Comments or suggestions, with supporting documentation as appropriate, should be directed to Bernardo Kleiner at bkleiner@nas.edu.

Alphabetical Index of Terms

Term	Page	Topic
Driver Rehabilitation Specialist (DRS)	14	Driver Evaluation and Rehabilitation
Driving Abilities	9	Driver Evaluation and Rehabilitation
Driving Automation	18	Assistive Technologies
Driving Capacity	13	Driver Evaluation and Rehabilitation
Driving Cessation	15	Transportation Options
Driving Competency	13	Driver Evaluation and Rehabilitation
Driving Evaluation	11	Driver Evaluation and Rehabilitation
Driving Rehabilitation (as a process)	14	Driver Evaluation and Rehabilitation
Driving Rehabilitation (as an outcome)	14	Driver Evaluation and Rehabilitation
Driving Retirement	15	Transportation Options
Driving Simulation	10	Driver Evaluation and Rehabilitation
Driving Simulator	10	Driver Evaluation and Rehabilitation
Driving Simulator Assessment	11	Driver Evaluation and Rehabilitation
Driving Skills	9	Driver Evaluation and Rehabilitation
Driving Test	10	Driver Evaluation and Rehabilitation
Drowsy-Driver Warning System	20	Assistive Technologies
Emergency Driver Assist	20	Assistive Technologies
Enhanced Night Vision Display	19	Assistive Technologies
Episodic Impairment	13	Driver Evaluation and Rehabilitation
Evaluation	12	Driver Evaluation and Rehabilitation
Evaluator Screening	12	Driver Evaluation and Rehabilitation
Fitness to Drive	13	Driver Evaluation and Rehabilitation
Fixed-Route Transit	15	Transportation Options
Formal Transportation Support	15	Transportation Options
Forward Collision Warning (FCW)	19	Assistive Technologies
Front Automatic Emergency Braking (AEB)	19	Assistive Technologies
Full Driving Automation	18	Assistive Technologies
High Driving Automation	18	Assistive Technologies
Individualized Transportation Options	15	Transportation Options
Informal Transportation Support	15	Transportation Options
Interactive Driving Simulation	10	Driver Evaluation and Rehabilitation
Lane Departure Warning (LDW)	19	Assistive Technologies
Lane Keeping Assistance/Lane Centering/Lane Departure Prevention/Warning	19	Assistive Technologies
Medical Fitness to Drive	13	Driver Evaluation and Rehabilitation
Medically At-Risk Driver	13	Driver Evaluation and Rehabilitation
Microtransit	15	Transportation Options
Mobility Equipment Dealer	14	Driver Evaluation and Rehabilitation
Mobility Management	16	Transportation Options
Naturalistic Driving	10	Driver Evaluation and Rehabilitation

Term	Page	Topic
Naturalistic Driving Assessment	10	Driver Evaluation and Rehabilitation
Navigator	9	Driver Evaluation and Rehabilitation
No Driving Automation	18	Assistive Technologies
Non-Emergency Medical Transportation (NEMT)	16	Transportation Options
Occupational Therapist, Generalist in Driving and Community Mobility	14	Driver Evaluation and Rehabilitation
Occupational Therapy Practitioner, Specialist in Driver Rehabilitation	14	Driver Evaluation and Rehabilitation
Off Road	9	Driver Evaluation and Rehabilitation
On-Demand Transportation	16	Transportation Options
On Road	9	Driver Evaluation and Rehabilitation
On Road or Behind-the-Wheel Driving Assessment	12	Driver Evaluation and Rehabilitation
Operational Design Domain	18	Assistive Technologies
Operational Level (of driving)	9	Driver Evaluation and Rehabilitation
Paratransit	16	Transportation Options
Partial Driving Automation	18	Assistive Technologies
Permanent Driving Impairment	13	Driver Evaluation and Rehabilitation
Personal Transportation Plan	16	Transportation Options
Physical Driving Limitation	13	Driver Evaluation and Rehabilitation
Physician	14	Driver Evaluation and Rehabilitation
Pre-Driver Licensing	11	Driver Evaluation and Rehabilitation
Pre-Driving Tasks	11	Driver Evaluation and Rehabilitation
Private Transportation Capacity	16	Transportation Options
Proxy Screening	12	Driver Evaluation and Rehabilitation
Public Transportation	16	Transportation Options
Rear Automatic Braking	19	Assistive Technologies
Rear Cross-Traffic Alert/Rear Cross-Traffic Warning	19	Assistive Technologies
Rear Parking Sensor/Backup Warning	19	Assistive Technologies
Rehabilitation Technologies	18	Assistive Technologies
Ride Hailing	16	Transportation Options
Ride Sharing	16	Transportation Options
Road Test	10	Driver Evaluation and Rehabilitation
Screening	12	Driver Evaluation and Rehabilitation
Self-Regulation of Driving Behavior	16	Transportation Options
Self-Screening	12	Driver Evaluation and Rehabilitation
Specialized Transportation	17	Transportation Options
Standardized Road Test	10	Driver Evaluation and Rehabilitation
Strategic level (for driving)	9	Driver Evaluation and Rehabilitation
Supportive, Assistive, or Escorted Transportation	17	Transportation Options

Term	Page	Topic
Surround View Camera	19	Assistive Technologies
Tactical Level (of driving)	9	Driver Evaluation and Rehabilitation
Transient Driving Impairment	13	Driver Evaluation and Rehabilitation
Transition to Non-Driving	17	Transportation Options
Transportation Credit	17	Transportation Options
Transportation Network Companies (TNCs)	17	Transportation Options
Transportation Options	19	Transportation Options
Transportation Plan	11	Driver Evaluation and Rehabilitation
Transportation Planning	11	Driver Evaluation and Rehabilitation
Transportation Referral Service	19	Transportation Options
Volunteer Driver	17	Transportation Options
Volunteer Driver Program	17	Transportation Options
Volunteer Vehicle	17	Transportation Options
Warning Signs	12	Driver Evaluation and Rehabilitation

Taxonomy and Definition of Terms

DRIVER EVALUATION AND REHABILITATION[2]

General Terms

Community Mobility: An individual's ability to move about in their community by walking or using private (e.g., wheelchair, bicycling, driving) or public transportation (e.g., bus, taxi, trains) (Silverstein et al., 2016; Unsworth et al., 2021).

Driving Skills: A driver's demonstration of appropriate vehicle control skills at operational and tactical levels in a range of traffic and environmental conditions using clear knowledge of rules of the road (Bıçaksız et al., 2018).

Driving Abilities: The sensory–perceptual, cognitive, behavioral and psychomotor functions needed to control a motor vehicle in a range of traffic and environmental condition (Huang et al., 2020).

Operational Level (of driving): Controlling the motor vehicle through physical actions (e.g., steering, accelerating, braking, signaling) which uses overlearned skills and habitual in nature so performance is largely automatic (Dickerson and Bédard, 2014).

Tactical Level (of driving): Maneuvering the vehicle in quick response to current or anticipated traffic conditions using behaviors that are typically learned and practiced (e.g., maintaining lane position or speed, obstacle avoidance, gap acceptance, obeying traffic signals, turning, passing other vehicles) (Dickerson and Bédard, 2014).

Strategic Level (for driving): Planning a trip to include goals, route, modal choice and risks. Also includes the ability to adapt plans as necessary, such as changing a route due to a crash or construction, making an unexpected stop, a change in goals, or seeking help if lost (Dickerson and Bédard, 2014).

Copilot: A passenger that assists with driving tasks primarily at the tactical level (Wheatley et al., 2014).

Copiloting: Assisting a driver with driving tasks at the tactical or operational levels (Wheatley et al., 2014).

Navigator: Assisting a driver with driving tasks at the strategic level. These include directions in unfamiliar areas or atypical situations (e.g., crash, detour). A navigator follows maps, technology, alerts driver to landmarks, highway signs, and street names to assist with wayfinding (Kerschner and Silverstein, 2018).

Off Road: Areas or paths that are not traveled as public roads (e.g., dirt roads, fields, private roadways) (Dickerson et al., 2012).

On Road: Driving on roadways, usually public streets or highways (Dickerson et al., 2012).

Closed Course: A driving venue separate from publicly traveled roadways with known and controlled driving parameters (Dickerson et al., 2012). [Note: Typically used for the evaluation of driving skills or abilities, practice of driving maneuvers, or research studies.]

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[2] It is understood that professional organizations (e.g., AOTA, Association for Driver Rehabilitation Specialists, Driving School Association of the Americas) have their own terms of use.

Road Test: An exam of operational and tactical driving maneuvers and knowledge of rules of the road performed in a motor vehicle on a public roadway or closed course (Davis et al., 2012; Feiss et al., 2021). [Note: An example of a road test is the short test used by state licensing agencies for provision of driver's license.]

Standardized Road Test: A road test following a predetermined route with specific, operational and tactical components (e.g., right turns, highway, intersections) used to establish a score that is comparable across individuals (Bhalla et al., 2007). [Note: Standardized road tests are only accurate for a specific city, evaluator, or research study. Standardized road tests are typically used by state licensing agency for provision of driver's license.]

Driving Test: The examination of a driver's performance of operational and tactical driving maneuvers performed in a motor vehicle on public roadways (Feiss et al., 2021). [Note: Driving tests of individuals are typically performed by state licensing agencies or driving instructors.]

Naturalistic Driving: An understanding of an individual's driving pattern and behaviors while in their environment over a period of time (Davis et al., 2020).

Naturalistic Driving Assessment: A methodology to monitor an individual's driving patterns and behaviors with using passive instruments installed in the vehicle to collect objective data over a period of time (Guo, 2019).

Driving Simulation: A computer-controlled environment used for driver assessment or training that is considered to be representational although drivers may not respond the same as during real-world driving (Classen et al., 2017).

Driving Simulator: A generic term that describes that a computer-controlled environment designed to reproduce, with varying degrees of realism, part or all of the experience of driving a motor vehicle in realistic road and traffic environments and allows for objective measurements of users' responses within the programmed driving scenarios. Driving simulators have a wide range of configurations and types of computer hardware, software and real or proxy vehicle components (e.g., controls, instruments, seat, dashboard) with costs that vary according to the quality or fidelity of the realism of the simulation (Classen et al., 2017).

Interactive Driving Simulation: A computer-controlled environment that presents selected aspects of the driving experience considered representational of real-world driving where users' responses influence subsequent events within the limits of the parameters of the simulation program and objectively measures the user's responses to the driving tasks within the designed scenarios (Classen et al., 2017). Considerations should include the following.

- All driving simulators, but particularly interactive driving simulators, can be extremely variable in the amount and fidelity of information (e.g., visual, auditory, tactile–haptic) they present as well as the amount and fidelity of feedback available to the driver based on their vehicle control inputs.

- Simulation biases include (but not limited to) cognitive bias (e.g., responding to simulated driving scenarios as a game, vehicle control decisions and/or actions do not have consequences); perceptual bias (e.g., displays do not offer the resolution needed to make gap judgments or read signs); and psychomotor or proprioceptive bias (e.g.,

distortions in press on pedals translates into speed change, movements of the wheel translate into a lateral position change).

- While performance in a simulator can reliably signify sensory deficits (e.g., hemianopia) or cognitive impairment (e.g., ignoring traffic control information, absence of hazard avoidance behaviors), evaluators must be cautious in applying only simulator data to measure a driver's capacity to respond appropriately under real-world driving conditions.

Behind the Wheel (On Road): Performing driving maneuvers in a motor vehicle for purposes of evaluation or instruction on public roads, off-road settings, or closed courses (Dickerson et al., 2012).

Behind the Wheel (Simulator): Performing driving maneuvers within the driving simulator environment for purposes of evaluation, instruction or training of training skills, abilities and/or knowledge (Classen et al., 2017).

Behind the Wheel (Training): Practicing driving maneuvers in a new, modified or adapted motor vehicle on public roads, off-road settings, or closed courses to gain competence or confidence (Dickerson et al., 2012).

Driving Simulator Assessment: Use of a simulator to measure and characterize driving skills and abilities with the aim of complimenting and corroborating measures from clinical and/or on-road assessments (Classen et al., 2017).

Pre-Driver Licensing: Tests or training completed prior to a driving test that may include vision, knowledge of rules of the road, or driving practice (Glendon et al., 2014).

Pre-Driving Tasks: Preparatory steps in readiness for driving in the domains of knowledge, physical, visual–perceptual, and cognitive abilities. [Note*:* Pre-driving activities for the medically at-risk driver are typically interventions to improve or optimize capacities in the domains of physical (e.g., strength, range of motion, agility), visual–perceptual abilities, and cognition in preparation functional capacity assessment or a comprehensive driving evaluation for the determination of fitness to drive.]

Transportation Plan: A comprehensive design or blueprint for maintaining social participation through diverse means of community mobility, typically instead of independent driving (Babulal and Dickerson, in press).

Transportation Planning: The process of preparing a designed plan or blueprint for using multiple means of community mobility to maintain social participation as an individual gradually or suddenly stops independent driving (Babulal and Dickerson, in press).

Driving Evaluation

Driving Evaluation: An umbrella term that can represent a range of services, such as screening, assessment, or comprehensive driving evaluation. Where possible, more precise language is preferred for detailing the services that are being provided or measured (Dickerson et al., 2018a; Korner-Bitensky et al., 2006).

Evaluation: Obtaining and interpreting data to document results and inform a plan for driving and community mobility (McGuire and Schold Davis, 2012).

Assessment: Use of measurements, tools, or instruments during an evaluation of driving or community mobility (McGuire and Schold Davis, 2012).

Screening: Obtaining and reviewing data to identify if a driver is at-risk and if a formal evaluation of driving and community mobility is needed (McGuire and Schold Davis, 2012).

Self-Screening: An individual obtains and reviews his or her own data to determine the need for an evaluation of driving and community mobility (Molnar et al., 2010).

Proxy Screening: An individual who provides information to determine the need for evaluation of a person's driving risk or community mobility (Stapleton et al., 2012).

Evaluator Screening: A professional skilled in a specific screening tool obtains and reviews data to determine the need for additional evaluation of an individual's driving risk or community mobility (Pomidor, 2019).

Warning Signs: Observable or quantifiable indicators of driving disability. They may include, but are not limited to apparent decline in function or skill level, lapses of control or erratic control of a vehicle, a crash or history of crashes, or indirect evidence (e.g., dents, scratches) (Stern et al., 2008).

Critical Driving Error: A controlled action or failure to act by a driver that results in a crash, near miss, or a high-risk encounter without an adverse outcome (Shechtman et al., 2009).

On Road or Behind-the-Wheel Driving Assessment: Use of an on-road test to measure and quantify driving skills and abilities at the operational, tactical, and strategic level to determine the level of driving risk and/or potential (Dickerson et al., 2009; Dickerson et al., 2018b; Dickerson et al., 2012). [Note: If simulator is used for a behind-the-wheel assessment then should be stated explicitly as a driving simulator assessment.]

Clinical Driving Evaluation: The in-clinic evaluation in which a qualified and experienced professional performs assessments of sensory–perceptual, cognitive, psychomotor and functional abilities and analyzes the data to determine driving risk and potential (Pomidor, 2019).

Comprehensive Driving Evaluation: A thorough evaluation in which a qualified and experienced professional assesses an individual's driving knowledge, skills, and abilities (Classen et al., 2013; Dickerson et al., 2018a). The comprehensive driving evaluation may include:

- Medical and driving history review;
- Clinical evaluation of sensory–perceptual, cognitive and psychomotor functional abilities;
- Behind-the-wheel assessment in a vehicle, as appropriate;
- Adaptive driving equipment evaluation, as appropriate; and
- Provides a report of the results with recommendations for an inclusive mobility plan including transportation options.

Adaptive Driving Equipment Evaluation: Obtaining and interpreting data in determine the need for adaptive equipment or modified vehicle based on an individual's abilities or potential to be an independent driver (Hegberg, 2012; Stressel et al., 2014). This evaluation may include

- Screening or assessment of sensory–perceptual, cognitive, and physical, and psychomotor functioning;
- Wheelchair seating or other mobility equipment as they pertain to the functional skills necessary to safely operate a motor vehicle;
- On-road assessment using recommended or similar equipment similar equipment; and
- A report of the results with recommendations and options.

Driving Capacity: The demonstration of driving skills and abilities required for fitness to drive as evaluated by the medical community.

Driving Competency: The demonstration of driving skills and abilities required for fitness to drive that meets criteria recognized by agencies responsible for driver licensing, with or without restrictions or assistive or adaptive technology.

Fitness to Drive: A description of a driver's skills and abilities that indicates the individual is capable of fully controlling their vehicle, responding to the dynamic driving environment and obeying the rules of the road and traffic laws (Dickerson et al., 2018b; Piersma et al., 2018; Pomidor, 2019; Shen et al., 2020).

Medical Fitness to Drive: When fitness to drive is due to a change or progression in a medical condition that requires consideration or assessment of driving risk (Dickerson et al., 2018a; Molnar et al., 2005).

Notes:
- Medical fitness to drive may change as the medical condition is recovered, remediated, or rehabilitated or the contextual factors change (e.g., type of vehicle, driving environment).
- A driver is considered medically fit to drive when their medical condition has been reviewed by a medical professional and determined to present with low driving risk or that meets licensing standards.
- A driver is considered medically unfit to drive when their medical condition has been reviewed by a medical professional and determined to present with high driving risk or does not meet licensing standards.
- Medical fitness to drive should be determined by physicians (or primary care providers) or medically educated professionals with appropriate experience and training in driving rehabilitation (e.g., occupational therapist or driving rehabilitation specialist).

Medically At-Risk Driver: A person, regardless of age, who has a medical condition(s) that may affect driving performance (Classen, 2014).

Episodic Impairment: A fluctuating impairment that can alter medical fitness to drive, such as a seizure or a loss of consciousness (Pomidor, 2019).

Permanent Driving Impairment: An impairment that will not improve over time and signals the need for driving risk assessment.

Transient Driving Impairment: A limitation of driving ability that is present for a finite time (e.g., hours, days, weeks, months) with an expectation of a return to normal driving functioning.

Physical Driving Limitation: A limitation caused by the loss, abnormality, or decreased functioning (e.g., strength, range of motion, coordination, sensation, vision, hearing) of a joint, limb or other body part involved in the operational actions required for driving (Hegberg, 2012; Stressel et al., 2014).

Cognitive Driving Impairment: A deficit in the executive functions or cognitive processes that affect skills and abilities needed for fitness to drive (Eby and Molnar, 2012). [Note: Cognitive processes collectively include all mental capacities needed for fitness to drive including (but not limited to) executive functions (e.g., judgment, reasoning, insight), memory, attention, divided attention, concentration, speed of processing information, praxis, somatognosia body perception, visual perception, sustained mental effort, and the ability to follow instructions. It is a general rather than a specific definition.]

Cut Point(s): A level or threshold of performance obtained with a valid measurement tool or procedure that is used to differentiate a driver between categories of risk (e.g., no risk, high risk) (Choi et al., 2016).

Driving Rehabilitation (as a process): Implementation of an intervention or course of action that, in the context of driving, facilitates safe mobility and transportation (Betz et al., 2014).

Driving Rehabilitation (as an outcome): An intervention intended to ameliorate impairments or deficits and support the driving task (Cox et al., 2010).

Professionals in Driving/Driver Rehabilitation

In this area of practice, health professional roles are often blurred. Below are distinctions between specific roles. These are not complete definitions of a particular profession and may differ from terms used by the respective professional associations.

Occupational Therapist, Generalist in Driving and Community Mobility: A skilled healthcare professional who uses research and scientific evidence to perform clinical evaluations or interprets assessment results to identify driving and community mobility risk or fitness to drive as an instrumental activity of daily living. Develops interventions to restore driving abilities and community mobility or refers a client to comprehensive driving evaluation at the optimal time when appropriate (McGuire and Schold Davis, 2012; Pomidor, 2019). [Note: Occupational therapy practitioners include occupational therapists and occupational therapy assistants (OTA). OTAs are often limited by state licensure from performing evaluations and interpreting results.]

Occupational Therapy Practitioner, Specialist in Driver Rehabilitation: A skilled healthcare professional with advanced training specific to driver rehabilitation who provides comprehensive driver evaluations which may include: clinical driver assessments, behind the wheel driver assessments, vehicle adaptive equipment evaluations, and interventions to develop or restore driving skills (McGuire and Schold Davis, 2012; Pomidor, 2019).

Driver Rehabilitation Specialist (DRS): A provider of driver rehabilitation services, which may include clinical driver assessments, behind the wheel driving assessments, driving mobility equipment evaluations, or interventions to develop or restore driving skills and abilities (Dickerson et al., 2018b; McGuire and Schold Davis, 2012; Pomidor, 2019). [Note: There are significant differences in professional education (college degrees), credentialing education, experience, and monitoring of DRSs.]

Physician: A healthcare professional with a medical or osteopathic degree who provides a recommendation regarding fitness to drive based on a medical assessment or review of the individual's medical condition(s) and functional status with respect to factors identified as significant predictors of crash risk (Dickerson et al., 2018b). [Note: Primary care providers may also be used as nurse practitioners or physician assistants.]

Driver Instructor: An individual who provides training and instruction for the learning and improvement of driving skills, knowledge of driving laws and the operational and tactical levels of driving (Dickerson et al., 2018b). [Note: Most states have criteria or certification that governs the use of this title.]

Mobility Equipment Dealer: A business which modifies, sells, services, rents, accessible vehicles necessary for community mobility for clients with disabilities (Dickerson and Schold Davis, 2012). [Note: Mobility equipment dealers may participate in national trade

organizations Quality Assurance Programs that operate via industry best practices, most based on applicable Federal Motor Vehicle Safety Standards.]

Transportation Options

Alternative Transportation: Mode of transportation other than driving oneself in a private vehicle (Dickerson et al., 2019).

Bike Share: Refers to a service in which bicycles are made available to individuals for shared use on a short-term basis (timed in minutes) for a cost (Guo et al., 2022).

Car Share: A service that provides members with access to an automobile for short-term use. Types of carsharing include round-trip, one-way, point-to-point, peer- to-peer, and niche (e.g., Flightcar allows travelers to rent out the vehicles left in airport parking lots or closed-network systems, such as universities) (Dong et al., 2020; Hu et al., 2020; Xu et al., 2021).

Community Transportation: Includes a wide range of mobility services, typically small transit service programs that are provided by a public agency, nonprofit, or other community group (e.g., faith-based organization). Conventionally used to describe volunteer driver programs and transportation targeted to serve veterans, older adults, people with disabilities, people in rural or small communities, or individuals needing medical transportation (Dickerson et al., 2019).

Demand Responsive Transportation (DRT): A rider requests a trip at a certain time to a specific place. Unlike city buses or trains, these flexible services do not follow fixed routes or schedules. Examples include dial-a-rides, ride hailing, taxis, ride sharing, car sharing, or bike sharing. Demand responsive transportation is a subset of flexible transportation (Frost et al., 2012).

Deviated Route Transit: Transportation service provided by a high-occupancy vehicle that typically follows a predictable route that may vary based on rides scheduled for individuals who request a stop at a specific house, building, or place.

Dial-a-Ride: A colloquial term for DRT (Luoma-Halkola and Jolanki, 2021).

Driving Cessation: When an individual chooses or is forced to permanently stop driving (Dickerson et al., 2019).

Driving Retirement: The transition from operating an automobile to becoming a passenger in a personal vehicle or using other transportation options. Unlike driving cessation, this occurs differently across individuals (Croston et al., 2009; Dickerson et al., 2019; MacDonald and Hébert, 2010).

Fixed-Route Transit: High-occupancy vehicles, generally publicly funded, that travel an established route and stop at predetermined locations (e.g., trains, subways, bus) (Lim and D'Souza, 2021).

Formal Transportation Support: Public or private transportation service.

Individualized Transportation Options: Transportation choices tailored to a person's needs.

Informal Transportation Support: Rides from family, friends, or one's social network that are outside traditional taxi or other for-hire providers.

Microtransit: Refers to information technology (IT) -enabled private multi-passenger transportation services (e.g., Chariot, Via) that serve passengers using dynamically generated routes on demand. Passengers may be expected to make their way to and from common pick-up or drop-off points. Vehicles can range in size (e.g., SUVs, vans, shuttle

buses) and provide transit-like service on a smaller, more flexible scale. [Note: The dynamic route-generating technology used by these services has tremendous potential for modernizing public transit and paratransit services.]

Mobility Management: From a human services perspective, mobility management is a customer-centered approach to designing and delivering transportation services to individuals with special needs due to age, disability, or income (Kerschner and Silverstein, 2018; Ward et al., 2018). [Note: Mobility managers provide information about community and regional transportation services to help individuals access those services.]

Non-Emergency Medical Transportation (NEMT): Provides transportation services to persons not in an emergency but require medical transportation due to their medical condition (Smith et al., 2017). [Note: It is a core solution to patient care access among populations facing transportation barriers to medical appointments, the pharmacy, urgent care, or the hospital. Medicaid is the largest funder of NEMT, but NEMT may also be covered by Medicare through the Medicare Advantage Program.]

On-Demand Transportation: Refers to a service available immediately (e.g., taxi, Lyft, Uber) (Freund et al., 2020). [Note: Trips that require 24- or 48-h advance reservations are not on demand. However, it may be used synonymously with demand responsive transportation where reservations are required.]

Paratransit: Special transportation services for people with disabilities, often provided as a supplement to fixed-route bus and rail systems by public transit agencies (Sitter and Mitchell, 2020).

Personal Transportation Plan: An individual approach to future mobility options, usually in addition to driving, that may include learning to navigate and use alternative transportation options, as well as setting aside resources in cash, credit or insurance to fund such choices (Kerschner and Silverstein, 2018).

Private Transportation Capacity: The vacant seats in private automobiles available for sharing rides.

Public Transportation: Federal law defines public transportation as regular, continuing, shared-ride, surface transportation service that is open to the general public or open to a segment of the general public defined by age, disability, or income level and includes buses, subways, light rail, commuter rail, monorail, passenger ferry boats, trolleys, inclined railways, and people movers. It can be provided through fixed-route, demand responsive, or on-demand service (Lamanna et al., 2020).

Ride Hailing: Traditionally has been a service provided by a taxicab company whereby a customer hails a ride from the curb. More recently it has come to include services by Transportation Network Companies, reserved through an app (Morrison et al., 2022).

Ride Sharing: Adds additional passengers to a preexisting trip. Such an arrangement provides transportation options for riders while allowing drivers to fill otherwise empty seats in their vehicles (e.g., carpooling, vanpooling) (Storch et al., 2021). [Note: Rideshare drivers are not for hire but may be compensated for their time and/or mileage.]

Self-Regulation of Driving Behavior: Change in the amount, time, location and kind of driving an individual undertakes in an effort to avoid risk and preserve safety (Bergen et al., 2017; Bird et al., 2017; Molnar et al., 2014). [Note: Typically includes avoidance of driving at night, rush hour, highways, or left turns, driving slower, or no passengers.]

Specialized Transportation: Services tailored to meet the needs of older adults and people with disabilities, often through door-to-door or door-through-door paratransit services, provided on request by van, small bus, or taxi (Kerschner and Silverstein, 2018). [Note: Various human services providers arrange this form of transportation for their clients. They are typically demand responsive services and are also known as Human Services Transportation.]

Supportive, Assistive, or Escorted Transportation: Levels of individualized passenger assistance including: curb-to-curb, door-to-door, door-through-door, and stay-at-the-destination assistance (Kerschner and Silverstein, 2018).

Transportation Network Companies (TNCs): Companies that use online platforms to connect passengers with compensated drivers who use personal vehicles (e.g., Lyft, Uber) (Erhardt et al., 2019). [Note: California law codifies these services as TNCs.]

Transportation Referral Service: An organization that charges a fee to request and monitor a ride using a ride-hailing service on behalf of a person without using a smartphone (Freund et al., 2020). [Note: An example is GoGoGrandparent.]

Transition to Non-Driving: The process of shifting from being the driver to being the passenger as well as to other forms of alternative transportation (Dickerson et al., 2019; Dickerson et al., 2007).

Transportation Credit: Equity in a transportation system in lieu of cash reimbursement for driving or trading an automobile (Freund et al., 2020).

Transportation Options: Range of ground conveyance that includes but is not limited to a private motor vehicle, taxi or ride service, walking, bus, train, bicycle, streetcar, or micro mobility devices (Dickerson et al., 2019; Kerschner and Silverstein, 2018).

Volunteer Driver Program: A program designed to assist members with their transportation needs using volunteer drivers and vehicles (Martin et al., 2020).

Volunteer Driver: When a person, on behalf of an organization, transports another person without direct compensation (Martin et al., 2020).

Volunteer Vehicle: When a personal vehicle is used to provide transportation for others without direct compensation to the driver (Freund et al., 2020).

ASSISTIVE TECHNOLOGIES IN DRIVING AND COMMUNITY MOBILITY

Assistive Technology: An item, piece of equipment, or product system available commercially as original equipment, modified or customized equipment that is used to increase, maintain or improve functional driving capabilities (Cook et al., 2019). [Notes: Assistive technologies are no longer exclusively used for individuals with disabilities, but include mainstream devices useful to all individuals both in vehicle or after-market (e.g., GPS units, backup cameras). This includes hard technology, the actual device or piece of equipment (e.g., vehicle hand controls, left-foot accelerator) and soft technology, the human support of training or assessment strategies to use the hard technologies.]

Adaptive Equipment: Any product or device designed to enable the performance of daily activities by an individual (Hegberg, 2012). Adaptive equipment is considered a subset of assistive technology. Note that

- Adaptive equipment is typically used to assist with daily activities such as eating, dressing, and personal hygiene, is typically commercially available and does not require a clinician for procurement.
- Adaptive equipment for vehicles, even if commercially available, should not be installed or used by the consumer without professional input, especially for products that interact with the action of driving (e.g., hand controls, left-foot accelerator, spinner knob). Professional expertise includes recommendations for installation, types and styles of equipment, position of equipment, as well as evaluation and training in the use of the adaptive equipment, particularly with mechanical adaptations. When adaptive equipment requires adaptation to the driver's seat or vehicle electronic systems, it is considered high-tech adaptive equipment and requires specialized installation and expertise of a skilled clinician for evaluation and training.

Rehabilitation Technologies: Devices that are used as part of remediation or rehabilitation and not used as part of daily life (e.g., parallel bars, driving simulation) (Cook et al., 2019).

Operational Design Domain: The specific operating conditions under which a driving automation system is designed to function, which can include environmental (e.g., speed limit, weather), geographical (e.g., specific location, road type), time-of-day, or traffic restrictions. The operational design domain can vary among systems that otherwise have similar functionality (Reddy et al., 2020).

Driving Automation: Technologies that allow a motor vehicle to perform some or all the functions traditionally performed by drivers on a sustained basis. The specific levels of automation are defined by Society of Automatic Engineers (SAE) International and have been adopted by the U.S. government (Committee, 2018).

- **Full Driving Automation** (SAE Level 5): Performs all driving functions under all roadway and environmental conditions.
- **High Driving Automation** (SAE Level 4): Performs all driving functions within the operational design domain without the expectation that the human driver will respond appropriately to a request to intervene.
- **Conditional Driving Automation** (SAE Level 3): Performs all driving functions within the operational design domain, with the expectation that the human driver will respond appropriately to a request to intervene.
- **Partial Driving Automation** (SAE Level 2): Key automated capabilities are standard, such as performing longitudinal (i.e., adaptive cruise control) and lateral (i.e., by centering the vehicle in the lane) control on a sustained basis under specific roadway and environmental conditions, but the human driver is responsible for the safe operation of the vehicle at all times.
- **Driver Assistance** (SAE Level 1): While the vehicle may perform longitudinal (i.e., cruise control) or lateral control on a sustained basis under specific roadway and environmental conditions, the human driver is required for all critical functions and is responsible for the safe operation of the vehicle at all times.
- **No Driving Automation** (SAE Level 0): The driver is in complete and sole control of the primary vehicle controls (e.g., brake, steering, throttle) always, and is solely responsible for monitoring the roadway and for safe operation of all vehicle controls, even when

enhanced by crash avoidance systems (e.g., forward collision warning, lane departure warning).

Connected Vehicle Systems (CVS): Vehicle-to-vehicle (V2V), vehicle-to-infrastructure (V2I), vehicle-to-pedestrian (V2P), or vehicle-to-everything (V2X) communication systems that allow vehicles to communicate location, speed, direction and other data to similarly equipped vehicles, roadway infrastructure, or other equipped road users (Shladover, 2018).

Advanced Driver Assistance Systems (ADAS): Electronic systems that assist drivers in driving and parking functions by using sensors and cameras to detect obstacles or driver errors and respond through automated technology (Davidse, 2006).

Crash Avoidance Systems/Collision Avoidance Systems (CAS): Systems that warn drivers or provide transient assistance to prevent or mitigate the severity of a crash (Godbole et al., 1998).

Following are the most common CAS and ADAS technologies available in U.S. vehicles at the time of publication.

Backup Camera/Rearview Camera: A camera that provides an image of what is immediately behind the vehicle when the vehicle is in reverse (Cicchino, 2017b).

Surround View Camera: A system that displays the immediate surroundings on all sides of the vehicle when the vehicle is travelling at low speeds (Ravi Kumar et al., 2021).

Rear Parking Sensor/Backup Warning: A technology to warn drivers when there are objects behind the vehicle when the vehicle is in reverse (Cicchino, 2017b).

Rear Cross-Traffic Alert/Rear Cross-Traffic Warning: A technology that detects approaching vehicles that may cross the path of a backing vehicle and provides a warning to the driver when the vehicle is in reverse (Cicchino, 2019).

Rear Automatic Braking: A system that automatically applies the brakes when it detects a potential collision when the vehicle is in reverse (Cicchino, 2019).

Curve-Adaptive Headlamps: Headlights that improve visibility through curves during nighttime driving by swiveling the headlamps to the left or right as the driver steers (Reagan and Brumbelow, 2017).

Automatic High Beams/High Beam Assist: A system that automatically switches the headlights between high and low beams depending on the presence of other vehicles (Stam, 2001).

Enhanced Night Vision Display: A technology that affords visibility via an in-vehicle display of pedestrians, cyclists, animals, or objects which otherwise would be difficult or impossible for a driver to detect in the dark (Kovordanyi et al., 2006).

Adaptive Cruise Control: Cruise control that automatically speeds up and slows down the vehicle to maintain a set distance from the vehicle ahead (Vollrath et al., 2011).

Forward Collision Warning (FCW): A system that alerts the driver to the risk of a frontal collision. Some systems can detect pedestrians (Cicchino, 2017a).

Front Automatic Emergency Braking (AEB): A system that attempts to mitigate or prevent frontal crashes by automatically applying the brakes (Cicchino and Zuby, 2019).

Lane Departure Warning (LDW): A system that alerts the driver as the vehicle strays from its lane (Cicchino, 2018a, 2018b).

Lane Keeping Assistance/Lane Centering/Lane Departure Prevention/Warning: A system that assists with steering to keep the vehicle within its lane. Some systems provide

continuous steering support to keep the vehicle centered in the lane. Others provide transient steering or braking assistance to redirect the vehicle toward the lane center when the driver strays from the travel lane (Cicchino, 2018a, 2018b).

Blind Spot Monitor/Blind Spot Detection/Blind Spot Assist: A technology that warns the driver of vehicles present in adjacent lanes (Cicchino, 2018a).

Drowsy-Driver Warning System: A system warns the driver when it detects driver drowsiness (Siddiqui et al., 2021).

Automatic Parking: Depending on the relative cars and obstacles, the vehicle positions itself safely into an available parking spot (Guo and Shi, 2021).

Automatic Head-Up Display: Displays essential system information (e.g., speed, direction) to a driver at a place that does not require the driver to look away from the road (Gregoriades and Sutcliffe, 2018).

Emergency Driver Assist: Activates emergency countermeasures if the driver falls asleep or does not perform any driving action within a designated time (Forghani et al., 2016).

Abbreviations

ABS   antilock braking system
ADAS   Advanced Driver Assistance Systems
ADED   Association for Driver Rehabilitation Specialists
AEB   front automatic emergency braking
AOTA   American Occupational Therapy Association
BA   brake assist
CAS   crash avoidance systems/collision avoidance systems
CDRS   Certified Driver Rehabilitation Specialist
CVS   connected vehicle systems
DI   driving instructor
DRS   driver rehabilitation specialist
DRT   demand responsive transportation
EBA   emergency brake assist
ESC   electronic stability control
FCW   forward collision warning
GPS   global positioning system
IT   information technology
LDW   lane departure warning
NEMT   non-emergency medical transportation
NHTSA   National Highway Traffic Safety Administration
TNC   transportation network companies
TRB   Transportation Research Board
TTC   time-to-collision
V2I   vehicle-to-infrastructure
V2V   vehicle-to-vehicle
V2X   vehicle-to-everything
V2P   vehicle-to-pedestrian

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