



# Effective Health Care Program

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Technical Brief  
Number 9

## **Wheeled Mobility (Wheelchair) Service Delivery**



Agency for Healthcare Research and Quality  
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## **Wheeled Mobility (Wheelchair) Service Delivery**

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## Preface

The Agency for Healthcare Research and Quality (AHRQ), through its Evidence-based Practice Centers (EPCs), sponsors the development of evidence reports and technology assessments to assist public- and private-sector organizations in their efforts to improve the quality of health care in the United States. The reports and assessments provide organizations with comprehensive, science-based information on common, costly medical conditions and new health care technologies and strategies. The EPCs systematically review the relevant scientific literature on topics assigned to them by AHRQ and conduct additional analyses when appropriate prior to developing their reports and assessments.

This EPC evidence report is a Technical Brief. A Technical Brief is a rapid report, typically on an emerging medical technology, strategy or intervention. It provides an overview of key issues related to the intervention—for example, current indications, relevant patient populations and subgroups of interest, outcomes measured, and contextual factors that may affect decisions regarding the intervention. Although Technical Briefs generally focus on interventions for which there are limited published data and too few completed protocol-driven studies to support definitive conclusions, the decision to request a Technical Brief is not solely based on the availability of clinical studies. The goals of the Technical Brief are to provide an early objective description of the state of the science, a potential framework for assessing the applications and implications of the intervention, a summary of ongoing research, and information on future research needs. In particular, through the Technical Brief, AHRQ hopes to gain insight on the appropriate conceptual framework and critical issues that will inform future comparative effectiveness research.

AHRQ expects that the EPC evidence reports and technology assessments will inform individual health plans, providers, and purchasers as well as the health care system as a whole by providing important information to help improve health care quality.

We welcome comments on this Technical Brief. They may be sent by mail to the Task Order Officer named below at: Agency for Healthcare Research and Quality, 540 Gaither Road, Rockville, MD 20850, or by email to [epc@ahrq.hhs.gov](mailto:epc@ahrq.hhs.gov).

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# Wheeled Mobility (Wheelchair) Service Delivery

## Structured Abstract

**Background.** Wheeled mobility service delivery is the process by which mobility impaired individuals are matched to wheeled mobility devices and provided service. Matching patients with mobility limitations with the most appropriate wheeled mobility device, avoiding under- and over-prescribing, is important for functional ability and quality of life, especially for patients with complex rehabilitation needs (i.e., long-term wheelchair users with complex medical conditions).

**Purpose.** To describe the wheeled mobility service delivery process for patients with complex rehabilitation needs, survey the available literature on service delivery, and identify issues and areas for future research.

**Methods.** A search of published, peer-reviewed and grey literature and interviews with selected Key Informants. An evidence map was developed with characteristics of studies pertaining to the wheeled mobility service process identified in the bibliographic databases through March 2011.

**Findings.** Based on textbooks, guidelines, and published literature, the recommended service delivery process typically includes patient evaluation, equipment selection and delivery, and postdelivery training and followup. However, there is a lack of research on the effectiveness of the recommended approaches. Existing studies are primarily observational, exploratory studies designed to determine consumer use of and satisfaction with the wheeled mobility service delivery process. Additional research is needed on the topic of wheeled mobility service delivery to establish an evidence base that will allow for the development of standards and guidelines necessary for evidence-based service delivery.

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## **Executive Summary**

Wheeled mobility service delivery is the process by which an individual obtains a wheeled mobility device. The process typically includes patient evaluation, equipment selection and delivery, and postdelivery training and followup. The purpose of this Technical Brief is to describe the wheeled mobility service delivery process, outline the criteria used by stakeholders in decisionmaking, survey the evidence on service delivery, and identify issues and areas for future research. The focus is on service delivery for long-term wheelchair users with complex rehabilitation needs. Information was gathered from discussions with key informants and searches of the grey and the published literature.

Recommended steps in the service delivery process were identified in textbooks, guidelines, and published literature. Overall, many elements common to all processes were identified. Recommendations to include equipment trials, formal followup, and outcome assessment were less uniform. Twenty-one studies pertaining to wheeled mobility service delivery were identified in the published literature. The majority were observational, exploratory studies designed to determine consumer use of and satisfaction with the wheeled mobility service delivery process. The major finding of this work is the limited number of studies designed to evaluate the effectiveness of the recommended practices. Additional research is needed to develop an evidence base on the topic of wheeled mobility service delivery. Researchers in this field should focus on provider types and process steps necessary to match patients with optimal wheeled mobility devices for their needs. Studies should incorporate the highest quality study designs feasible for this population. This evidence, once available, will be useful in the development of standards and guidelines necessary for evidence-based service delivery. Other issues with respect to wheeled mobility service delivery are identified and discussed.



## Background

Wheeled mobility or wheelchair use in the United States is at an all-time high and growing. A 2005 survey of noninstitutionalized Americans estimated that approximately 3.3 million people (1.4 percent of the population) 15 years of age and older used a wheelchair or similar device. Of those 3.3 million, approximately 1.8 million were 65 years and older (5.2 percent of that population). Among children under 15 years of age, an estimated 83,000 used a wheelchair or similar device (0.2 percent of that population).<sup>1</sup> A similar survey conducted in 2002 estimated use at 1.2 percent of the population 15 years and older, 4.5 percent of the population 65 years and older, and 0.2 percent of the population under 15 years of age.<sup>2</sup> An earlier survey (1994–1995 data) of noninstitutionalized individuals in the United States estimated that there were 1.6 million (0.6 percent) wheelchair users of all ages including 88,000 under age 18 years (0.12 percent) and 897,000 (2.87 percent) 65 years of age and older. Of the total group of wheelchair users, 1.5 million used manual wheelchairs and 155,000 used electric wheelchairs. The leading conditions associated with wheelchair use included stroke, osteoarthritis, multiple sclerosis, absence or loss of lower extremity, paraplegia, orthopedic impairment of lower extremity, heart disease, cerebral palsy, rheumatoid arthritis, and diabetes.<sup>3</sup>

At the same time that the population of mobility-impaired individuals is growing, advances have been made in mobility device and component technology.<sup>4,5</sup> Although difficult to quantify, there appears to be increased use of power mobility devices, including power wheelchairs and scooters or power-operated vehicles.<sup>4,6,7</sup> Advances in wheeled mobility offer enhanced functionality. Mobility devices have been shown to increase the activity, participation, and quality of life of individuals with mobility limitations.<sup>8</sup> The degree to which these wheeled mobility devices and components (notably postural seating and positioning systems) contribute to quality of life depends on the appropriateness of the wheeled mobility device selected for the patient and their utilization of the device. However, inappropriate mobility devices may result in harms (including overuse or repetitive strain injuries, pressure sores, falls, and accidents), equipment abandonment, and underutilization.<sup>9-13</sup>

Wheeled mobility service delivery is the process by which mobility impaired individuals are matched to wheeled mobility devices and provided service. The process has been described by providers, patient organizations, and others. The World Health Organization (WHO) identified the following steps: (a) referral and appointment, (b) assessment, (c) prescription (selection), (d) funding and ordering, (e) product preparation, (f) fitting, (g) user training, and (h) followup, maintenance, and repairs.<sup>14</sup> To maximize the benefit of scarce resources, matching patients with mobility limitations with the most appropriate wheeled mobility device, therefore avoiding under- and overprescribing, is paramount. However, many patients, providers, and payers may not be aware of or fully understand the aspects of wheeled mobility service delivery that likely contribute to attaining the most appropriate match between individual and equipment, features, and services.

Interest in identifying an evidence-based wheeled mobility service delivery process that could guide decisionmaking regarding coverage for individually configured mobility equipment and associated services, often referred to as Complex Rehab Technology (CRT),<sup>15</sup> prompted the nomination of this topic. Evidence based guidelines for best practice might address areas such as critical components of the assessment and followup, selection of appropriate equipment based on patient needs, essential members of the service delivery team, provider qualifications, and frequency of reassessment.

To address this need, we prepared a Technical Brief to identify and describe the literature and expert opinion regarding the process of wheelchair service delivery for long-term wheelchair users with complex rehabilitation needs (i.e., individuals with a primary diagnosis resulting from a congenital disorder, progressive or degenerative neuromuscular disease, or from certain types of injury or trauma who will require a wheelchair for mobility beyond a period of rehabilitation).<sup>15</sup> The Brief provides background information on the wheeled mobility service delivery process for stakeholders interested in wheelchair service delivery, including researchers, patients, providers, suppliers, and payers of wheeled mobility. It also identifies patient, provider, supplier, and payer issues that may impact the service delivery process. We recognize that consumers may obtain wheeled mobility devices from a variety of sources. We have focused on service delivery for individuals whose complex rehabilitation needs most likely will require contributions from physicians, therapists, suppliers, and technicians.

Technical Briefs are products of the Effective Health Care Program on topics which have been determined to be underdeveloped in terms of the availability of high-quality studies, typically topics that represent new technologies or concepts. Their purpose is much different than the purpose of more thorough and comprehensive effectiveness or comparative effectiveness review. The key difference is that while Technical Briefs do search for evidence on the topic and report that the evidence exists, because the evidence is predetermined to be insufficient to draw conclusions regarding the effectiveness of the relevant intervention, synthesis of the evidence is not conducted. Therefore, the contribution of a Technical Brief is to describe what evidence exists and identify topics where research in this field may enhance the quality of the evidence in the future and not to provide synthesized evidence regarding a particular technology or concept. A second purpose of the Technical Brief is to provide an overview of key issues related to a clinical intervention or health care service. Data presented in a Technical Brief cannot be used to develop standards or guidelines, to endorse one practice over another, or to inform policy or payment decisions, but are useful in providing direction on next steps necessary to move the topic in the direction of the development of an evidence base from which to accomplish these goals.

There exists unique terminology and prevalent diseases and conditions related to this topic. A listing of key terms and abbreviations can be found in Appendix A.

# Guiding Questions

Consistent with the Technical Brief format and based on input from nominators of the topic, we developed guiding questions pertaining to the four Technical Brief areas (technology, context, evidence, and issues). We used these questions to guide our literature searches and our discussions with Key Informants.

**Guiding Question 1. Technology.** What criteria (i.e., medical conditions, physical characteristics, functional and/or vocational needs, environmental factors, etc.) do assessors and payers (including Medicare, Medicaid, Veterans Affairs (VA), and others) take into consideration when determining the appropriateness and medical necessity of a wheelchair type (i.e., manual, power scooter, power chair) and features (i.e., seating, tilt, etc.) for an individual patient?

- a. What formal criteria exist?
- b. How do the criteria differ across assessors?
- c. How do the criteria differ across payers?
- d. How do the criteria differ for patients of different ages (i.e., 21 years old and younger versus older than 21 years)?

**Guiding Question 2. Context.** Which of the following elements have been studied with regard to facilitating or hindering achievement of an appropriate patient/wheelchair match?

- a. Provider type (i.e., occupational therapy, physical therapy, primary care provider, psychiatrist).
- b. Provider qualifications (i.e., certification, experience performing wheelchair assessments).
- c. Setting (i.e., primary care clinic, specialty clinic, school, retail store).
- d. Payer (i.e., Medicare, Medicaid, VA, Vocational Rehabilitation, private insurance).
- e. Components of patient assessment (i.e., diagnosis versus functional abilities, cognitive abilities, physical abilities).
- f. Assessment, prescription, and delivery steps (i.e., access, number of visits covered by insurance, trials and simulations with wheelchair, education and/or training provided to the patient, followup, etc.).

**Guiding Question 3. Evidence.** What studies have reported on wheeled mobility service delivery? Specifically, describe the following elements of the studies:

- a. Indication/patient inclusion criteria.
- b. Study design/size.
- c. Elements of service delivery (i.e., patient physical characteristics, environmental factors, needs [functional, vocational], cognitive ability, provider, payer, fitting process [trials], counseling/training/education, followup).
- d. Outcomes assessed (i.e., functional ability, utilization of chair, patient satisfaction, quality of life).
- e. Adverse events/harms/safety issues (i.e., pressure sores, injuries, need for repairs, need for replacement).

**Guiding Question 4. Issues.** What are the important issues surrounding wheeled mobility service delivery? What are the topic areas, research designs, populations, interventions, comparators, outcome measures, and settings for future research into the most effective and efficient approach to matching patients with appropriate wheeled mobility devices?

## Methods

The objectives of this report are to describe the wheeled mobility service delivery process from various perspectives, to survey the evidence pertaining to the process of wheeled mobility service delivery, and to identify issues and areas for future research.

### Data Collection

We identified and utilized a variety of information sources, including key informants, published, peer-reviewed literature, and grey literature. These resources informed the descriptions of the Technology and the Context questions and provided guidance in the development of the Issues question. For the Evidence question, we conducted a systematic search of the peer-reviewed published literature.

**Discussions with key informants.** We identified wheeled mobility service delivery providers, third-party payers, consumers, suppliers, and researchers to serve as key informants to provide expertise from various perspectives. Key informants initially participated in discussions aimed at developing the guiding questions for the Technical Brief and provided leads to resources in the peer-reviewed and grey literature. These individuals, their perspectives, and affiliations are listed in Appendix B (Table B1). Every attempt was made to include a wide and comprehensive group of knowledgeable individuals who represented a broad range of relevant occupations and organizations and were able to provide input from several perspectives. Individual interviews were then conducted via telephone or in person, if logistically feasible, during June and July 2010. The interviews were designed and conducted to gather information pertaining to the guiding questions. Information requested from each key informant varied based upon their area or expertise and/or perspective with regard to wheeled mobility service delivery. Structured discussion questions were developed in advance of interviews to ensure that necessary information was solicited in a timely manner. A listing of these questions appears in Appendix B (Table B2).

**Grey Literature Search.** Grey literature on this topic was important to provide background and context to the topic. It also provided insight into current issues regarding wheeled mobility service delivery. A targeted approach to searching the grey literature was conducted and included bibliographic databases such as ProQuest Digital Dissertations and topic specific databases such as those maintained by the National Rehabilitation Information Center (NARIC) [REHABDATA, National Institute on Disability and Rehabilitation Research (NIDRR) Project Database, and the NARIC Knowledgebase]. Grey literature searching also included searches of related conference abstracts (i.e., International Seating Symposium, Rehabilitation Engineering and Assistive Technology Society of North America (RESNA) Annual Conference). Payment policies were obtained by searching relevant online databases, such as the Medicare Coverage database, and through targeted requests for information. Web sites of relevant not-for-profit organizations and government agencies were searched for information and publications. Relevant Web sites included those published by the RESNA, the Christopher and Dana Reeve Foundation, Paralyzed Veterans of America, the National Coalition of Assistive and Rehabilitation Technology, and others. Quality of Web site information was evaluated to ensure that the information provided was authoritative, up to date, had minimal ties to for-profit

interests as appropriate, utilized references to scientific information, and provided names and credentials of Web site contributors. Grey literature was utilized primarily in addressing the descriptive guiding questions (Questions 1, 2, and 4).

**Published Literature Search.** We conducted literature searches in MEDLINE, the Cumulative Index to Nursing and Allied Health Literature (CINAHL), and the Education Resources Information Center (ERIC) from the earliest time permitted electronically until March 14, 2011. Searches were limited to studies relevant to humans and published in English. Restricting the research to English language materials was not expected to result in a language bias for this topic and stakeholders.<sup>16</sup> Due to the limitations of the Medical Subject Headings (MeSH terms) and the relatively inconsistent use of terminology in this field, a search strategy with maximum recall potential was used. The purpose of the published literature search was to identify studies that addressed some component of the wheeled mobility service delivery process and its relationship with a wheeled mobility outcome such as use or satisfaction with the device or service. We also conducted a manual search of references from reports of relevant studies or review articles. The search strategy used with Ovid MEDLINE and guiding searches of CINAHL and ERIC, including a concept analysis and proposed search terms, is described in Appendix C.

Results from the bibliographic database searches were screened for inclusion based on title and abstract, if available. Full text articles were retrieved when warranted by the title and/or abstract. All publication types were included if they related to the guiding questions. Only information related to wheeled mobility service delivery elements and outcomes was abstracted for studies that included more than one intervention. The exclusion criteria below were applied to studies resulting from the bibliographic database searches:

1. Does not address components of the wheeled mobility service delivery process and their relationship to wheeled mobility user outcomes (i.e., studies of individuals using wheelchairs and their quality of life without addressing aspects of the service delivery process).
2. Addresses aspect of wheeled mobility not relevant to guiding questions:
  - a. Wheeled mobility used outside of routine activities around home and community (i.e., sports chairs, standing chairs, etc.)
  - b. Very specific aspect of seating and mobility (i.e., types of seat cushions, joysticks, specific brands of chairs or seating materials, etc.)
  - c. Outdated technology
  - d. Research and development on equipment not currently widely available
3. Addresses creation, validation, or research on particular outcome measurement instruments.

# Findings

## Description and Context of Wheeled Mobility Service Delivery

Wheeled mobility service delivery is the process by which mobility impaired individuals are matched to wheeled mobility devices and provided services. This process has been described by a number of experts from the point of identification of a need for wheeled mobility to the point of replacement. These sources provide background, education, and guidance to the topic of wheeled mobility service delivery.

Our guiding questions were developed to direct our search of the literature and to focus our discussions with our key informants. Based on the information we gathered about the wheeled mobility service delivery process and how it occurs in practice, our findings for Guiding Question 1 (Technology) are presented under the heading (below) “Available guidance for the service delivery process.” Our findings for Guiding Question 2 (Context) are presented under the headings “Description of third party payers and current policies,” “Current practice of wheeled mobility service delivery,” and “Wheeled mobility service delivery elements.”

**Available guidance for the service delivery process.** The “Technology” (Guiding Question 1) being reviewed in this Technical Brief is the wheeled mobility service delivery process. The process has been outlined, in various levels of detail, by providers, organizations representing patients, payers, suppliers, researchers, and health care agencies. Some of the models presented are from the broader area of Assistive Technology (AT) while others are specific to wheeled mobility service delivery. While there are many common elements among these descriptions or models, there are also differences. The service delivery process for individuals with complex rehabilitation needs will differ from the process for an individual needing a wheeled mobility device for short-term use. How the wheeled mobility device will be paid for (Medicare, private insurance, out-of-pocket, etc.) may also influence the service delivery process as different payers have different requirements. With the exception of adherence to the steps required to obtain reimbursement, no service delivery process is mandated. Furthermore, no evidence exists to say that one source of guidance is superior to another or which steps are essential in obtaining an appropriate match between an individual and wheeled mobility system. The guidance described below represents individual or consensus expert opinion. Table 1 provides an overview of these sources. More detail is presented in Appendix D.

Once a patient is referred, the patient evaluation takes place. There is overall agreement that identifying the individual’s goals and needs, assessing various aspects of their ability (including physical, cognitive, and functional), and assessing the environment in which they will use the wheeled mobility device are important elements of the patient evaluation. With regard to equipment selection and delivery, equipment trials, offering users the opportunity to try out the proposed equipment assembled to meet their needs, are not consistently recommended. This may be, in part, because in some settings the equipment is not available, and in some reimbursement systems equipment trials are not covered. Furthermore, an equipment trial may be difficult due to the high degree of customization that is often required in complex rehabilitation cases. After the equipment is delivered, there is agreement on the need to train the individual and, if necessary, family members or caregivers, on the use of the equipment. A formal followup phase was recommended by many but, perhaps because followup is not reimbursed separately from the overall pricing of the product, it was not included in all of the delivery systems. Outcome

assessment, one approach to determining the appropriateness of the equipment (e.g., usage, user satisfaction), was less frequently recommended.

The American Medical Association's 1996 "Guidelines for the Use of Assistive Technology: Evaluation, Referral, Prescription" described the role of the primary care physician in meeting the needs of individuals with disabilities.<sup>17</sup> These guidelines were developed by the Assistive Technology Advisory Panel with input from focus groups of consumers and allied health professionals. The primary care provider may be the person who initially identifies the individual's need for assistive technology. An interdisciplinary team of physicians, therapists, rehabilitation engineers/technologists, durable medical equipment (DME) suppliers, social workers, vocational counselors, and caregivers/family members will likely be needed for more in-depth assessment, prescription, and training. Respect for the individual and caregiver goals, needs, and preferences, continual assessment of the status and goals, monitoring to ensure that the AT prescribed matches what was delivered, and documentation of goals, intervention provided, and outcomes achieved are elements of the rehabilitation processes that also pertain to service delivery.

The Paralyzed Veterans of America prepared a guide to eligibility for wheelchairs within the Veterans Affairs system.<sup>18</sup> The steps to obtaining a wheelchair were also presented (Table 1). Clinical practice recommendations for patient evaluation included consideration of medical diagnoses, prognosis, functional abilities, limitations, goals, and ambitions.<sup>19</sup>

Cooper described an iterative process<sup>20</sup> (Table 1) for AT service delivery in which outcomes are assessed and compared to goals. He suggested that the individuals' perspective, objectives, and goals will evolve and should be regularly assessed. Given that inadequate training is a potential factor in predicting equipment abandonment, training for individuals prior to or at delivery and for rehabilitation professionals to keep abreast of new products was also recommended.

In a series of online lectures developed to provide an overview of the wheelchair mobility and seating evaluation process, Schmeler and Buning described a nine-step process for service delivery<sup>21</sup> (Table 1). The screening step should focus on the needs and goals of the individual. Fitting, delivery, and training often involve the supplier, so selection of the right supplier is critical. Followup is especially important for individuals with progressive conditions.

Minkel outlined five steps for AT service (Table 1).<sup>22</sup> A team approach was recommended with the individual AT user, payer, practitioner (physician, therapist, teacher, and counselor), supplier, and rehabilitation engineer included in the decisionmaking process.

In 2004 the Clinician Task Force of the Coalition to Modernize Medicare Coverage of Mobility Products<sup>23</sup> developed recommendations for wheeled mobility device coverage and presented the recommendations to the Centers for Medicare and Medicaid Services (CMS) Interagency Work Group. The goal was to "provide CMS with an objective and consistent process by which medical necessity may be determined and documented." The Task Force addressed all steps in the service delivery process (Table 1) with particular emphasis on patient evaluation. They identified three levels of patient complexity—basic (requiring basic manual mobility devices with limited adjustability and simple seating support; typically recovering from a temporary medical condition or recuperating after a surgical intervention), intermediate (requiring a mobility device to meet typical daily functions or for independent mobility but with intact or good sitting balance and therefore simple or no seating and positioning needs), and complex (requiring extensive seating and positioning needs in addition to mobility assistance



often as a result of neurological disease)—with a more in-depth evaluation required as complexity increased.

Cook and Polgar addressed AT delivery in their guide for clinicians and individuals. They described six steps<sup>24</sup> (Table 1) and emphasized a collaborative and consumer-centered approach. Identifying needs and goals during the initial evaluation was believed critical as it would provide the basis for assessing the effectiveness of the final outcome, justifying the purchase to payers, and guiding the rest of the evaluation.

Guidelines from the WHO outlined eight steps in wheelchair service delivery (Table 1). The overall focus of the guidelines was on provision of manual wheelchairs in “less resourced settings.” The individual’s physical, environmental, and lifestyle needs should be considered. The guidelines further described “good practice” for each of the service delivery steps.

The perspective of the clinician was described by Taylor and Furumasu in the Industry Profile on Wheeled Mobility.<sup>25</sup> Their focus was on the seating and mobility evaluation, but they outlined the overall process, as well (Table 1). They emphasized the need to evaluate seating first because postural stability, upper extremity function, and head control are factors in controlling and/or propelling a mobility device. They identified the primary individual needs as comfort, independence, and the ability to be mobile. The role of the supplier was also addressed. The supplier, ideally credentialed by RESNA and certified by the National Registry of Rehabilitation Technology Suppliers (NRRTS), is involved in equipment trials and selection of devices and features. They may also follow up with the individual in their home.

Batavia presented a nine-step approach to wheeled mobility service delivery<sup>26</sup> (Table 1). Key steps included early identification of the funding source, as this might limit equipment options, selection of a knowledgeable, reputable supplier (certified, Medicare enrolled, experienced, available in emergency situations, convenient location for service, carry wide variety of products), and training (for individual and family/caregiver).

In addition to the overall process descriptions, providers have contributed suggestions for service delivery focused on specific populations. These include children,<sup>25,27,28</sup> bariatric patients,<sup>29</sup> patients with neurological or musculoskeletal conditions,<sup>30-33</sup> and older adults.<sup>34,35</sup>

Descriptions of the AT or, more specifically, wheeled mobility, service delivery process have also been presented in the published literature. Di Marco et al.<sup>36</sup> reported that, after a literature review identified no published standards of practice for wheelchair prescription, staff occupational therapists developed clinical guidelines for wheelchair selection, a maintenance education package, and a followup plan. Their focus was on three outcomes: abandonment of the wheelchair, satisfaction, and posture and comfort. They identified factors that influenced these outcomes and that should be addressed in the delivery process based on their experience with 128 patients over a 2-year period of implementing the guidelines. These factors included lack of active involvement of the individual in the prescription process, lack of training of professionals involved in the process, changes in the needs of the individual between prescription and delivery, poor device performance, and unsatisfactory design features and poor fit. Measurement tools, while not validated, were identified for assessment of service delivery from user (satisfaction, comfort, posture, management skills, maintenance knowledge), technology (stability, durability, need for repair/modification), and process (provision of education, followup, waiting time between prescription and delivery) perspectives.

Ripat and Booth interviewed six providers, seven funders, and five individual users to identify the components of ideal AT service delivery.<sup>37</sup> Three themes emerged. First, the user of AT is a unique individual within his or her environment. The user must be the focus of all

decisionmaking, and individuals should not be classified on the basis of their diagnosis, age, or the type of equipment they require. As part of the service delivery, it is important to identify the individual's priorities, current and future abilities and needs, and the resources available to the individual (financial, human, and environmental). The second theme related to allocation of equipment in a fair and equitable manner. The individuals' "needs" should be identified and their "wants" should be considered. It is important to match the AT to the individual within their context. Finally, given the complexity and rapid development of AT devices and services, AT should be considered to be broader than just a device with a single purpose. The device impacts the individual's safety, health, comfort, socialization, quality of life, and self-esteem. Beyond the cost of the equipment, costs of training and maintaining equipment in the individual's environment should be considered.

The most comprehensive process description was presented by Eggers et al.<sup>38</sup> The focus of the work was on individuals with spinal cord injury being evaluated for a primary replacement chair. In addition to the seven-component model for overall service delivery (Table 1), sub-models were developed for each component. Service delivery may be influenced by individual user factors, provider factors, supplier factors, payer factors, and system factors.

Numerous authoritative and comprehensive descriptions of the wheeled mobility service delivery process exist. These sources can offer education or guidance to providers and other stakeholders. However, conversations with key informants provided little assurance that these models are fully utilized in actual practice.

**Description of third-party payers and current policies.** For all wheeled mobility users, an important element of the "Context" (Guiding Question 2d) in which wheeled mobility service delivery occurs relates to the payer. There are a variety of funding sources for wheeled mobility devices (including Medicare, Medicaid, Veterans Affairs, worker's compensation, vocational rehabilitation, and private insurance), each with different service delivery processes. Although payers do not specify the steps in the delivery process, third-party payer coverage policies determine the equipment, features, and services that are reimbursed for enrollees.

Medicare is a major source of reimbursement for wheeled mobility. CMS last modified the Medicare National Coverage Determinations Manual in 2005.<sup>39</sup> The current coverage is based on mobility-related activities of daily living—activities such as toileting, feeding, dressing, grooming, and bathing.

Mobility assistive equipment (MAE) is one aspect of the DME benefit category. DME is defined as equipment that (1) can withstand repeated use, (2) is primarily and customarily used to serve a medical purpose, (3) generally is not useful to an individual in the absence of an illness or injury, and (4) is appropriate for use in the home.<sup>40</sup>

Prescription guidelines were included in the CMS 2005 Decision Memo for Mobility Assistive Equipment.<sup>40</sup> The guidelines were derived, in part, from the work of the Interagency Wheelchair Work Group, physicians, therapists, researchers, and policy specialists with practical experience with mobility device utilization issues.<sup>41</sup> The CMS guideline development group also reviewed the evidence presented in an unpublished technology assessment on the topic. The resulting guidelines identify assessment of the individual's physical, cognitive, and emotional limitations and abilities, their willingness to use MAE on a regular basis, and their typical home environment as important for appropriate prescription. A series of questions, in the form of an algorithm, direct the clinician in identifying the appropriate MAE.

A second element of the review of policies related to MAE was the 2006 final rule on power mobility device regulation and payment.<sup>42</sup> This document specified the responsibilities of physicians and other treating practitioners as well as suppliers. Specifically, the physicians' or other treating practitioners' responsibilities include (1) a face-to-face examination of the individual, (2) a written prescription submitted to a supplier within 45 days of the examination, (3) supporting documentation outlining the need for the power mobility device in the home, submitted to the supplier within 45 days of the examination, and (4) billing and payment for the face-to-face examination and for the work and resources required to compile the supporting documentation. The supplier, having received the prescription and supporting documentation, must identify the specific type of power mobility device to fill the prescription.

A third phase of the CMS initiative is development and implementation of quality standards for suppliers of DME.<sup>43</sup> The standards pertain to Business Service and General Product-Specific Service and specify supplier qualifications and specific responsibilities related to intake, record keeping, product trials, delivery and set up, and training and instruction.

Another major payer is Medicaid. Each state establishes its own coverage policies but many follow the CMS policy. As with CMS, the focus is not on the wheeled mobility service delivery steps but rather on the qualifications of the prescriber and the documentation of need for a particular device.

A third major payer for wheeled mobility is the VA. Information from the Paralyzed Veterans of America and the Veterans Benefit Department outlines the VA policies.<sup>18</sup> Veterans who meet eligibility for prosthetic service and have a disability that requires the use of a wheelchair may receive a wheelchair and a backup chair. Power mobility devices may be used to access medical care and for tasks of daily living in the home and community.<sup>19</sup> Repairs and replacement chairs (based on whether the chair meets the patient's requirements or the estimated costs of repairing the chair) are also provided.

Other elements of the "Context" (Guiding Question 2 a, b, c, e, and f) are addressed in the "Current practice of wheeled mobility service delivery" and "Wheeled mobility service delivery elements" sections below.

**Current practice of wheeled mobility service delivery.** The actual practice of wheeled mobility service delivery was a topic of discussion with a number of our key informants. In practice, the process of wheeled mobility service delivery begins with the recognition of mobility limitations and action taken to address these limitations. At their own recognition or that of a provider or family member, an individual enters the wheeled mobility service delivery process. Entry to the process may be via a rehabilitation department after an injury or stroke, through a provider referral based on a progressive condition, through a supplier storefront, or through an advertisement. We have focused this report on individuals who have complex needs and who will therefore likely work with a team of specialists to obtain appropriate wheeled mobility equipment. We further describe the process for an individual working with a third party payer. For these individuals, a physician referral is required by many payers. We recognize that individuals may obtain wheeled mobility devices in other ways (e.g., out-of-pocket/retail, VA, vocational rehabilitation).

As summarized from input from providers, suppliers, consumers, and payers on our key informant panel, once the need for wheeled mobility is recognized (potentially by a physician, therapist, family member, or other) and the individual finds his or her way into the process, an assessment is conducted. Ideally, a physical therapist (PT) or an occupational therapist (OT)

specializing in seating and mobility performs the assessment. A physician may also be involved. Both current and future needs and abilities should be considered. The assessment process can vary in intensity based upon the complexity of the individual's medical condition and functional needs. A rehabilitation technology supplier is typically involved in the assessment to assist the therapist in identifying the appropriate equipment. While the individuals and their care teams are knowledgeable about the individuals' goals and their physical condition and functional needs, the supplier has the expertise in selecting the technology that can match the identified physical and functional needs. Although ideally the assessors are unaware of the patient's funding source and are focused on maximizing the patient's functional ability, consideration must be given to what will be reimbursed. Equipment options (given funding limitations) and potential sources of additional funding should be reviewed with the patient. Once the assessment is complete, a prescription and a seating and mobility system recommendation in the form of a letter of medical necessity is written by the physician and forwarded by the supplier to the third party payer.

Occasionally, the supplier will provide trial equipment so the patient has a chance to try it out before committing to the purchase. Ideally, a home assessment or a home trial will be included in the service delivery process in an effort to design a system that will work well in the individuals' home. Work environments (as appropriate) and transportation needs should also be addressed.

Once the third-party payer authorizes payment, the supplier can order the equipment. Seating and mobility systems for complex needs often require parts from several manufacturers. The supplier assembles the system that he/she designed and ordered and delivers the system to the patient. Ideally, with the therapist present, a fitting and any necessary adjustments or programming are completed at delivery. Based on our conversations with key informants, there is little followup after the delivery. Although many outcome assessment tools have been developed to assess patient satisfaction and functional ability when using a wheeled mobility device, our key informants reported that outcomes were rarely formally assessed.

**Wheeled mobility service delivery elements.** Theoretically, many elements of the wheeled mobility service delivery process can affect the quality of the match between the individual and the wheeled mobility device.

*Access to high quality providers.* Identifying high-quality providers and suppliers and having access to those providers and suppliers is an important component in achieving appropriate wheeled mobility service delivery. Certification for providers and suppliers is an objective way to identify those with more training in seating and mobility. Asking providers and suppliers about their years of experience, in particular, experience with the condition of interest to the individual, is another approach, although more subjective, recommended by key informants and others.<sup>26,36,44</sup> In rural areas there are likely fewer certified and experienced providers and suppliers. Little is known about other factors that might limit access to high-quality providers.

*Provider type and qualifications.* The provider is another element that clearly influences wheeled mobility service delivery. Ideally, there would be a team of trained professionals involved in service delivery, including a physician, a PT or an OT, a certified rehabilitation technology supplier, and a rehabilitation technician. It is generally accepted that that PTs and OTs have the training necessary to perform seating and mobility evaluations. However, from conversations with key informants we have learned that most PT and OT education and licensure programs spend little time providing training on these skills. The providers that we talked to emphasized

that their seating and mobility skills were learned and enhanced through continuing education opportunities (e.g., seating workshops, product in-services) and through their work experience. Professional certification is offered through RESNA. Their Assistive Technology Professional (ATP) certification is focused on broad-based knowledge of assistive technology. RESNA has also developed a specialty certification, Seating and Mobility Specialist (SMS), focused on seating and mobility assessment, funding resources, implementation of the intervention, outcome assessment and followup.<sup>45</sup> Suppliers are credentialed through the NRRTS. The Certified Rehabilitation Technology Supplier (CRTS) is a Registered Rehabilitation Technology Supplier (RRTS) with at least 4 years of full-time experience in seating and wheeled mobility provision.<sup>46</sup>

*Setting.* Key informants recommended that patients be seen in a hospital seating clinic. The clinic will likely be staffed with PTs, OTs, rehabilitation engineers or technicians, and others.

*Steps in the service delivery process.* Many of the commonly performed or recommended steps in the service delivery process have obvious links to the quality of matching individual and device and the resulting outcome. Training and patient education have been identified as important factors in reducing accidents,<sup>47</sup> preserving limb function,<sup>48</sup> and increasing use of the wheeled mobility device.<sup>49,50</sup> Involving the individual in the prescription process may reduce the risk that the device will be abandoned.<sup>12,13,36</sup> Active followup has been found to reduce accidents<sup>51</sup> and allow for adjustments to improve fit.<sup>36</sup>

The ultimate goal of the process is to obtain a good match between the individual and the device. A good match will reduce nonuse or inappropriate use of seating and mobility equipment and features.<sup>49</sup> As described above, several factors can be expected to influence how well this process works. The next section of this report, Evidence Map of Wheeled Mobility Service Delivery, describes available evidence applicable to support these expectations.

**Table 1. Recommended elements of wheeled mobility service delivery**

Resource Type	Source	Patient Evaluation			Equipment Selection and Delivery			Postdelivery		
		Goals	Physical, Cognitive, Functional Ability	Environment	Product Selection	Trial	Delivery and Fitting	Training	Followup	Outcome Assessment
Provider and Patient Resources	Paralyzed Veterans of America, 1997 <sup>18</sup> Wheeled Mobility	√	√	√	√		√	√		
	Cooper, 1998 <sup>20</sup> AT	√	√	√	√		√	√		√
	Schmeler & Buning, 2003 <sup>21</sup> Wheeled Mobility	√	√	√	√	√	√	√	√	
	Minkel, 2002 <sup>22</sup> AT	√	√	√	√	√	√	√		√
	Clinician Task Force, 2004 <sup>23</sup> Wheeled Mobility	√	√	√	√	√	√	√	√	√
	Cook & Polgar, 2008 <sup>24</sup> AT	√	√		√		√	√	√	√
	World Health Organization, 2008 Wheeled Mobility	√	√	√	√		√	√	√	
	Taylor & Furumasu, 2009 <sup>25</sup> Wheeled Mobility	√	√	√	√	√	√	√	√	
	Batavia, 2010 <sup>26</sup> Wheeled Mobility	√	√	√	√	√	√	√	√	
Peer Reviewed Resource	Eggers et al., 2009 <sup>38</sup> Wheeled Mobility	√	√	√	√	√	√	√	√	√

AT = assistive technology in general

## Evidence Map of Wheeled Mobility Service Delivery

**Evidence.** Searching the bibliographic databases for studies about the process of wheeled mobility service delivery yielded 2,106 titles (1,761 from MEDLINE, 303 from CINAHL, and 42 from ERIC). Of these, 18 primary studies qualified for inclusion. Hand searching yielded another 6 studies for inclusion, for a total of 24 studies. A reference flow diagram appears in Figure 1. An evidence map is presented in Table 2. As previously mentioned, evidence for Technical Briefs is not synthesized because their purpose is to describe the populations, interventions, comparators, and outcomes that have been studied and because of the relatively low quality of the available evidence on these emerging topics.

**Study design/size.** Included studies were published from 1986 to March 2011, with the majority of the studies published during the last 3 years. We read each study, and highlights are discussed in this text. Study designs for this limited body of research varied widely and included 1 randomized controlled trial, 1 quasi-randomized controlled trial, 1 controlled trial, 1 case-control study, 3 retrospective cohort studies, 16 cross-sectional studies, and 1 case series. More recent publications used higher quality study designs with a quasi-randomized trial published in 2005, a randomized controlled trial published in 2007, and a controlled trial published in 2010.

Sample sizes ranged from three to 318 and included individuals of all ages, with most studies focused on adults. Four studies included children; two focused exclusively on children.

**Indication/patient inclusion criteria.** Many types of consumers were represented in these studies, including individuals with spinal cord injuries, multiple sclerosis, spina bifida, cerebral palsy, rheumatoid arthritis, osteoarthritis, and stroke. Ten of these studies included a consumer population with similar diagnoses; three studies addressed individuals with spinal cord injuries, and one study each addressed individuals with spina bifida, rheumatoid arthritis or osteoarthritis of the knee, stroke, muscular dystrophy, amyotrophic lateral sclerosis, cerebral palsy, and neuromuscular disorders (broadly classified). Often the group of individuals in a particular study experienced mobility limitations related to the same condition, such as spinal cord injuries. However, wheeled mobility service delivery studies also occasionally addressed groups of individuals as wheelchair users from a particular service delivery clinic or geographic area. These studies provided a broader representation of individuals in terms of disease and conditions as may be the case in practice. Most of the included research was conducted on localized practices of wheeled mobility service delivery and took place in the United States, the United Kingdom, Canada, Sweden, Holland, the Netherlands, and Australia.

**Elements of service delivery.** The study purposes of these studies were primarily exploratory. Batavia and Hammer<sup>52</sup> and Ward et al.<sup>53</sup> set out to identify factors important to individuals when considering wheeled mobility options. McDonald<sup>54</sup> and Telfer et al.<sup>55</sup> assessed children's caregivers' and parents' opinions about the wheeled mobility used by their child. Beaumont-White and Ham,<sup>56</sup> Karmarker et al.,<sup>57</sup> Pimentel,<sup>58</sup> and Wressle and Samuelsson<sup>59</sup> sought to understand user satisfaction with wheeled mobility device and service delivery. Their studies addressed service delivery within a particular service or regional area to describe user satisfaction and/or identify opportunities for improvement. White and Lemmer<sup>60</sup> address similar questions with a more comprehensive data collection strategy.

**Outcomes assessed.** Most of these studies addressed consumer satisfaction with wheeled mobility and related services in some way. Seventeen addressed satisfaction with the equipment and ten addressed satisfaction with aspects of wheeled mobility service delivery.

Five of the studies we identified involved comparisons of one approach to wheeled mobility service delivery to another. Barlow et al.<sup>61</sup> and Schein et al.<sup>62</sup> compared in-person assessments with those done via telerehabilitation. These studies were both completed relatively recently, possibly indicating a trend towards more research on this topic. The other three comparison studies compared different treatment approaches, either different types of treatment or different approaches to assessment. Hoenig et al.<sup>63</sup> compared an intervention including a multifactorial team approach to service delivery to usual care where a physical or occupational therapy assistant, PT, or OT provided a standard wheelchair at discharge. In a second study, Hoenig et al.<sup>64</sup> compared the provision of a motorized scooter to adults with osteoarthritis or rheumatoid arthritis of the knee to usual care. While the primary purpose of the study was not to make a comparison, Dicianno, et al.<sup>65</sup> compared outcomes between patients having assessments performed at specialized AT clinics to those that did not.

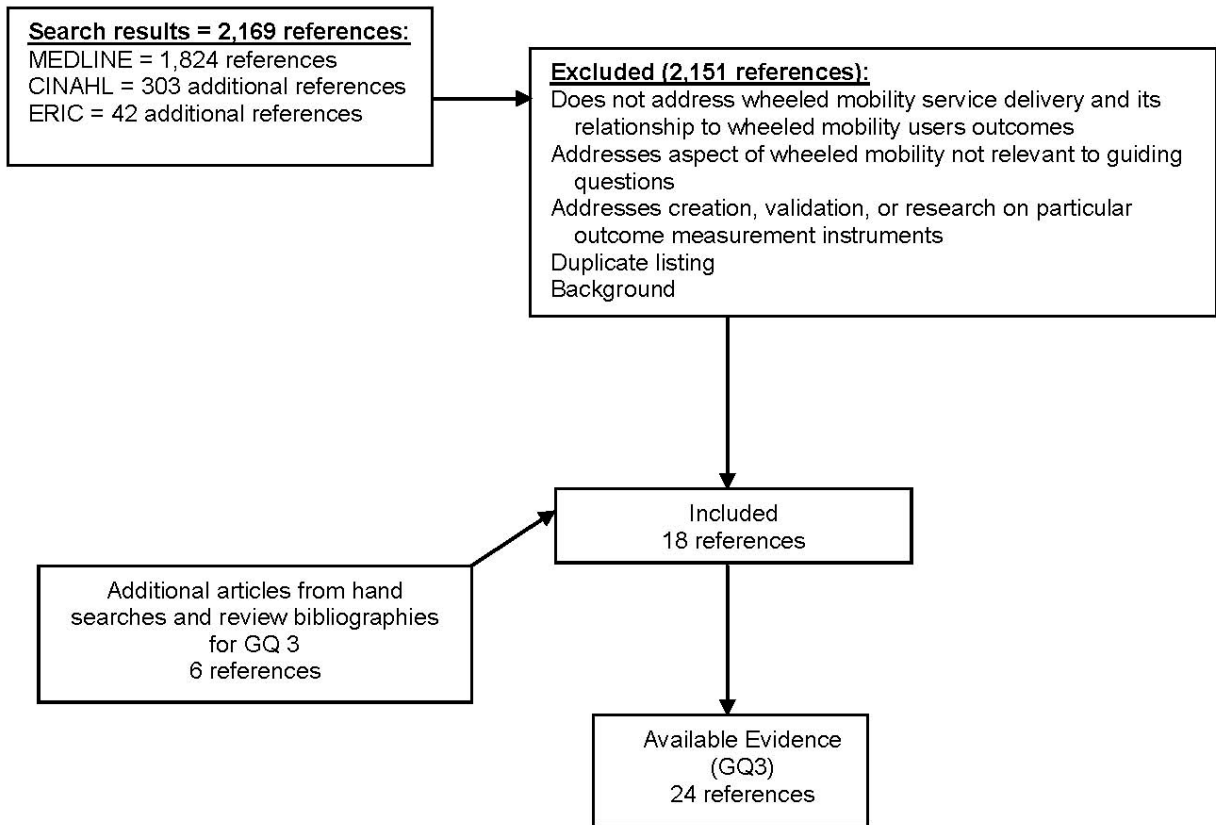
Samuelsson et al.<sup>66</sup> analyzed outcomes in response to a seating clinic visit concerning a particular problem the individual was experiencing related to their wheelchair. Kittel et al.<sup>13</sup> explored individuals' reasons for abandoning their equipment.

Table 2 summarizes the elements of wheeled mobility service delivery and the outcomes addressed in the included studies. While 14 studies examined some aspect of the wheeled mobility service delivery process overall, other studies addressed particular elements of the process. Several authors explored opinions and views of consumers, and others aimed to identify aspects of service delivery important to outcomes. Elements of service delivery studied included access, setting, provider, patient education, device selection, device delivery, wheelchair user training followup, and maintenance and repairs. The outcomes analyzed in these studies included mobility, device usage, goal achievement, and satisfaction with the device and service provided.

**Issues related to service delivery.** Five studies reported patient dissatisfaction with various aspects of service delivery. Included were issues with wait times for appointments and equipment, provider training, patient involvement in the process, and equipment repair.



**Figure 1. Reference flow diagram**



**Table 2. Summary of studies on wheeled mobility service delivery**

Outcomes Assessed	Elements of Wheeled Mobility Service Delivery									
	Access	Setting	Provider	Patient Evaluation	Device Selection	Device Delivery	WC User Training	Followup	Maintenance and Repairs	Overall Process
Mobility	Schein, 2010 <sup>62</sup>	Dicianno, 2009 <sup>65</sup> Schein, 2010 <sup>62</sup>			Hoenig, 2007 <sup>64</sup>	White, 1998 <sup>60</sup>			Dicianno, 2009 <sup>65</sup>	Evans, 2007 <sup>67</sup>
Use			Hoenig, 2005 <sup>63</sup>	Hoenig, 2005 <sup>63</sup>	Samuelsson, 2008 <sup>68</sup>	Evans, 2007 <sup>69</sup>	Evans, 2007 <sup>69</sup> , Garber, 2002 <sup>70</sup>	Hoenig, 2005 <sup>63</sup>	Evans, 2007 <sup>69</sup>	Evans, 2007 <sup>67</sup> Hoenig, 2005 <sup>63</sup>
Goal Achievement	Barlow, 2009 <sup>61</sup>	Barlow, 2009 <sup>61</sup>	White, 1998 <sup>60</sup>							Pimentel, 2008 <sup>58</sup> Ward, 2010 <sup>53</sup>
Satisfaction with Device	Barlow, 2009 <sup>61</sup> White, 1998 <sup>60</sup>	Barlow, 2009 <sup>61</sup> Dicianno, 2009 <sup>65</sup> White, 1998 <sup>60</sup>	Hoenig, 2005 <sup>63</sup>	Hoenig, 2005 <sup>63</sup>	Hoenig, 2007 <sup>64</sup> McDonald, 2007 <sup>54</sup> Samuelsson, 2008 <sup>68</sup>	Evans, 2007 <sup>69</sup>	Evans, 2007a <sup>69</sup> Garber, 2002 <sup>70</sup>	Bergstrom, 2006 <sup>71</sup> Hoenig, 2005 <sup>63</sup> Wressle, 2004 <sup>59</sup> Karmarkar, 2009 <sup>57</sup>	Bergstrom, 2006 <sup>71</sup> Dicianno, 2009 <sup>65</sup> Evans, 2007 <sup>69</sup> Wressle, 2004 <sup>59</sup> Karmarkar, 2009 <sup>57</sup>	Beaumont-White, 1997 <sup>56</sup> Bergstrom, 2006 <sup>71</sup> Suzuki, 2000 <sup>72</sup> Ward, 2010 <sup>53</sup> Batavia, 1990 <sup>52</sup> Hoenig, 2005 <sup>63</sup> Samuelsson, 2008 <sup>68</sup> Wressle, 2004 <sup>59</sup> Karmarkar, 2009 <sup>57</sup>
Satisfaction with Service	Post, 1997 <sup>73</sup> White, 1998 <sup>60</sup>	Barlow, 2009 <sup>61</sup>	White, 1998 <sup>60</sup>	White, 1998 <sup>60</sup>	Samuelsson, 2008 <sup>68</sup> White, 1998 <sup>60</sup>	White, 1998 <sup>60</sup>		Bergstrom, 2006 <sup>71</sup> White, 1998 <sup>60</sup> Wressle, 2004 <sup>59</sup> Karmarkar, 2009 <sup>57</sup>	Bergstrom, 2006 <sup>71</sup> Telfer, 2010 <sup>55</sup> White, 1998 <sup>60</sup> Wressle, 2004 <sup>59</sup> Karmarkar, 2009 <sup>57</sup>	Beaumont-White, 1997 <sup>56</sup> Bergstrom, 2006 <sup>71</sup> Evans, 2007 <sup>67</sup> Suzuki, 2000 <sup>72</sup> Samuelsson, 2008 <sup>68</sup> Wressle, 2004 <sup>59</sup> Karmarkar, 2009 <sup>57</sup>
Medical/Health Issues					Hoenig, 2007 <sup>64</sup>					Richardson, 2009 <sup>74</sup>
Abandonment										Kittel, 2002 <sup>13</sup>

## Summary and Implications

Wheeled mobility service delivery is not a new concept or technology, but elements related to the process (including funding, provider qualifications, and advances in technology) have undergone dramatic changes over the past few decades. These changes make it more difficult for providers, payers, and consumers to gain the appropriate knowledge and awareness necessary to ensure that all individuals with complex rehabilitation needs get the seating and mobility services and equipment most appropriate to their needs. The major finding of this work is the limited number of studies designed to evaluate the effectiveness of the recommended practices.

Guiding Question 4 includes the identification of issues and implications arising from the evidence reviewed in this report. The implications of the lack of sufficient evidence are far and wide. While there is general agreement among seating and mobility experts about how wheeled mobility service delivery should work in practice, without evidence of effectiveness, health care systems may not feel obligated to offer specialty clinics and ongoing services, and third party payers have no rationale for funding the recommended steps. Without adequate funding, providers and suppliers may need to limit the equipment and services they provide, and manufacturers may be reluctant to develop high quality products that may not reach consumers. A first step towards addressing these issues is the funding of high-quality research related to the wheeled mobility service delivery process. Once an evidence base is established, evidence reviews can be performed and evidence-based guidelines can be developed and validated.

To address Guiding Question 4, “Issues,” we focused on our review of the grey literature and our discussions with key informants. We also received suggestions from the public and peer review. We recognize the great potential for bias in the grey literature and in expert opinion. Given that limitation, we identified issues under the general categories of payer issues, provider issues, consumer issues, supplier issues, service delivery process issues, and research issues that may impact the ability of patients to obtain wheeled mobility equipment and services that match their needs.

### Payer and Reimbursement Issues

- a. Payers have expressed concern about the increasing number of requests for power mobility devices. The lack of authoritative, easy to understand guidance supported by evidence to assist them in determining the most effective equipment for an individual may have resulted in the creation of more restrictive reimbursement policies.
- b. Payers are unsure about the role of health insurers in the acquisition of equipment that addresses non-health-related needs (i.e., school and/or work needs).
- c. Medicare covers seating and mobility services and equipment necessary for performance of mobility-related activities of daily living in the home. It is not realistic to assume that individuals will remain confined to their homes when one of the advantages of wheeled mobility is the greater capacity and endurance for community activities.
- d. The type of chair for which an individual qualifies is determined by diagnosis as opposed to functional status. For many complex diseases and injuries that result in mobility limitation, the diagnosis may be the same but the functional abilities vary widely.
- e. Under Medicare, individuals who rent wheeled mobility equipment for 13 months effectively own the device. This often catches individuals by surprise and, more importantly, makes them ineligible to be fitted for a more appropriate device until they reach the requisite replacement time.

- f. Payers typically specify an amount of time (often 5 years) before a replacement chair will be approved regardless of the degree to which the equipment is used or whether the user's health status has changed. This limitation may also apply if the initial equipment was inappropriate.
- g. While payers struggle with questions regarding which individuals need which chairs, a more practical approach may be for them to trust the professionals trained to evaluate the patient and to select the ideal wheeled mobility equipment necessary for that patient. Current practice involves review by staff who have not evaluated the patient and who may not have sufficient knowledge of the patient's need to evaluate the appropriateness of the recommended equipment. A peer review process might be an option. However, to trust the providers would require evidence relating provider types and process components to patient outcomes, an evidence base that does not yet exist. Once such evidence is available and synthesized, payers may be more willing to review issues such as whether the appropriate process was in place or the appropriate team of professionals was involved when determining the appropriateness of the equipment for the patient.

## **Consumer Issues**

- a. Many individuals are ill-equipped to appropriately advocate for seating and mobility equipment and services they need because they lack necessary knowledge and awareness about the wheeled mobility delivery process and/or resources available to them to assist in advocating for their needs.
- b. Access to providers who specialize in seating and mobility and to experienced, dependable suppliers may be a major obstacle in achieving an appropriate match between individuals and seating and mobility equipment and services, especially in rural areas.
- c. Third-party payer networks may limit patient options by specifying the providers and vendors who will be reimbursed, by insufficient reimbursement, by annual caps on DME expenses, and by restricting use of private funds to upgrade equipment.

## **Provider Issues**

- a. In recommending wheeled mobility equipment and services, providers must consider not only what they believe is right for the individual but also what will get reimbursed.
- b. The medical model, with the physician responsible for the prescription and the letter of medical necessity, may not be the most appropriate model for all patients or all situations. Providers may lack the formal education and expertise needed.
- c. Standard academic PT and OT professional education programs may not provide adequate education and training related to evaluation and technological assessment of wheeled mobility and seating devices.

## **Supplier and Reimbursement Issues**

- a. Current Procedural Terminology (CPT) codes may not adequately reimburse providers for their services in assessing patients (especially individuals with complex medical or functional needs) and their environment (i.e., performing home, school, and/or workplace assessments), selecting the equipment (i.e., equipment trials), and delivering the equipment (i.e., fitting, training). Other limitations of the CPT coding system may result in inconveniences for patients and delays in delivery of equipment.

- b. The Healthcare Common Procedure Coding System defines the reimbursement for categories of equipment but may not adequately distinguish between levels of complexity or quality within those categories. With decreasing reimbursements, there is concern that lower quality products are being offered and innovative designs are not reaching consumers. Additionally, the supplier is reimbursed for the equipment. Time spent training the user and/or adjusting the equipment is not directly reimbursed.
- c. Recent Federal payment policy issues include reducing payments for DME by 9 percent and a proposed move towards requiring competitive bidding for DME.

## **Service Delivery Issues**

- a. Underprescription of technology due to provider or supplier inexperience or concerns about reimbursement could result in a lower quality of life than could be realized with the provision of equipment with greater functional capabilities and services that enable users to benefit from the equipment. Overprescription or inappropriate prescription could result in wasted resources and/or harms to the user.
- b. Few studies address outcomes when individuals obtain equipment from a vendor storefront or Web site or as a result of direct-to-consumer advertising.
- c. The service delivery process differs for patients with short-term or minimal-use needs (such as after an injury) versus patients with complex medical rehabilitation needs (such as individuals with multiple sclerosis, cerebral palsy, spinal cord injury, or other disabling and potentially progressive mobility impairments). Stakeholders advocate for restructuring benefits for complex patients to address the delivery process differences.
- d. Assessments of and recommendations for wheeled mobility equipment for individuals who may experience major changes over a short period (e.g., children, patients with progressive disease conditions) must take into consideration restrictions on the frequency of equipment replacement.
- e. The presence of a supplier at a seating and mobility assessment is considered essential due to rapid changes in the technology and the need for experience with a broad array of products. However, there are potential economic incentives for the supplier and therefore selection of a reputable supplier is important. Certification of suppliers is a recent development.
- f. Home (and school or workplace, if appropriate) assessments and equipment trials are important so that the needs and goals of the individual are assessed in the environments in which they function.
- g. Outcomes assessment should focus on how the equipment provided meets the individual's needs and goals.

## **Research Issues**

- a. There is a need for research to enable the development of an evidence base for wheeled mobility service delivery. Using the patient, interventions, comparisons, and outcomes (PICO) approach, future research could address the effectiveness of the service delivery process for patients with different physical and cognitive limitations, funding sources, needs/goals (i.e., home, vocational), and support systems. Interventions could include different models of specialty seating and mobility clinics, telerehabilitation for patients without access to specialty clinics with comparisons to usual care, effectiveness of wheeled mobility device between and among types of professionals performing

evaluations, and comparisons between provider teams with different members and provider qualifications. Outcomes to be studied could include functional abilities, comfort, and use, with the prescribed equipment, patient adverse events, and equipment breakdowns. Consistent use of standard validated outcome measures would enhance the quality of this body of research.

- b. Research in this area is challenging due to issues related to study design, population, environments, and equipment variations.<sup>64</sup> While conducting randomized controlled trials is extremely difficult in the rehabilitation field, progress on study design quality in this field could focus on conducting high quality, well-controlled prospective studies.
- c. Funding agencies need to be willing to allocate resources for research in this area. The current focus is on new technologies.

## Next Steps

The issues identified and compiled in this Technical Brief deserve further attention. Research is needed to investigate and identify factors that contribute to effective wheeled mobility service delivery. The importance of funding this type of research needs to be recognized and reliable, and valid outcome measures need to be developed.

The resulting evidence will guide providers, payers, and consumers. Intriguing concepts (such as seating and mobility specialist certification, added emphasis on seating and mobility assessment in the normative model for PT and OT education, supplier accreditation, specialized seating clinics, and multifactorial seating interventions) need evidence to demonstrate whether they will lead to more effective wheeled mobility provision, thereby justifying the additional resources. Components of service delivery (such as consumer-focused evaluations, consumer training, and followup) need more rigorous evaluation to demonstrate their relationship to effectiveness so that a case can be made to initialize reimbursement-related incentives for their provision. Further exploration and diffusion of telerehabilitation to alleviate access issues to individuals in geographically isolated areas is another high-priority research topic. Research findings should be incorporated into best practice guidelines for providers and educational materials for consumers and caregivers.

This Technical Brief focuses on the process of wheeled mobility service delivery and aspects of that process that may affect the quality of the match between an individual and their wheeled mobility device. There are many existing studies that address a device or a specific feature of the device and the relationship to outcomes. Those studies were beyond the scope of this study. However, a comprehensive review of this body of research would be a valuable contribution to clinical decisionmaking in this field.

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# Appendix A. Terminology and Abbreviations

## Terminology

**Complex Rehabilitation Technology**—“Individually configured manual wheelchair systems, power wheelchair systems, adaptive seating systems, alternative positioning systems, and other mobility devices.<sup>15</sup>”

**Manual Wheelchair**—self-propelled chairs for disabled individuals with the upper body movement and strength sufficient to propel the chair by pushing the rims of the chair. These chairs come in a variety of sizes, materials, and designs and can offer a wide array of features.<sup>75,76</sup>

**Lightweight manual wheelchairs**—weigh less than 34 pounds without footrests or armrests. These chairs can be sized to the user, but often do not offer features that allow for substantial adjustability.<sup>76</sup>

**Ultralight manual wheelchairs**—weigh less than 30 pounds without foot or arm supports. These chairs are the highest-quality chairs designed specifically as an active mobility device. They are highly adjustable and offer features that improve ease of use and comfort.<sup>76</sup>

**Mobility Assistive Equipment (MAE)**—Manual wheelchairs, power wheelchairs, scooters; also includes canes and walkers.

**Power Wheelchair**—chairs that use a battery-powered motor that propels wheels; used by people with little to no movement in the upper body and limbs. These chairs come in a variety of configurations. Components of power wheelchairs include a power base which contains the wheels and electronics. The base provides for a variety of seating systems and seat functions to be attached.<sup>75,76</sup>

## Acronyms and Abbreviations

ADL	activities of daily living
AT	assistive technology
ATP	assistive technology professional
CF	cystic fibrosis
CMS	Centers for Medicare & Medicaid Services
CP	cerebral palsy
CPT	current procedural terminology
DME	durable medical equipment
EPIOC	electronically powered indoor/outdoor wheelchair
MAE	mobility assistive equipment
MD	muscular dystrophy
MS	multiple sclerosis
NARIC	National Rehabilitation Information Center
NRRTS	National Registry of Rehabilitation Technology Suppliers
OT	occupational therapy
PAPAW	push rim activated power assist wheelchair
PMD	power mobility device
PT	physical therapy
RA	rheumatoid arthritis
SB	spina bifida
SCI	spinal cord injury
SMS	seating and mobility specialist
VA	Veterans Administration
WHO	World Health Organization

## Appendix B. Key Informants and Potential Questions

**Table B1. Key informants**

<b>Name</b>	<b>Affiliation</b>	<b>Recommendation and Topic Area</b>
Edward Amaya, M.B.A., RT (R), CPM	Ohio Department of Job and Family Services	Recommended by topic nominator, Mary Applegate Payer representative
Kory Badertscher, OT, ATP	Veterans Health Administration Minneapolis, MN	Recommended by EPC team member contact Local practitioner
Tim Caruso, PT, M.B.A., M.S., Cert. MDT, CEAS	Shriners Hospital for Children Chicago, IL	Recommended by EPC team Pediatric wheeled mobility expert
Donald E. Clayback	Executive Director N.C.A.R.T	Recommended by another key informant Wheelchair benefits expert; supplier and manufacturer representative
Laura Cohen, PT, Ph.D., ATP	Rehabilitation & Technology Consultants, LLC Atlanta, GA	Recommended by topic expert Rory Cooper, Ph.D. National content expert, researcher
Elizabeth Leef	Administration on Aging	Recommended by another key informant Consumer representative
Alison Little, M.D., M.P.H.	Center for Evidence-based Policy Oregon Health and Sciences University	Recommended by SRC Medicaid perspective
Colleen Michals, PT, ATP	Courage Center Golden Valley, MN	Recommended by EPC team member contact Local practitioner
Jeanne Olson	Courage Center Golden Valley, MN	Recommended by EPC team member contact Local content expert
Stephen Sprigle, Ph.D., PT	Professor of Applied Physiology, Bioengineering & Industrial Design Georgia Institute of Technology	Recommended by another key informant Researcher
David Williams	Chairman, Ohio Rehabilitation Services Commission	Recommended by another key informant Consumer representative
Becky Wittig, PT, ATP	Veterans Health Administration Minneapolis, MN	Recommended by EPC team member contact Local practitioner

**Table B2. Structured discussion questions for key informant interviews**

<b>Key Informant Perspective</b>	<b>Potential Questions</b>
Payers	<ol style="list-style-type: none"><li>1. Do you have any guidelines/checklists that you use?</li><li>2. Do you perceive any barriers in service delivery?</li><li>3. Are there ways to make the process better?</li><li>4. What impact does the provider and/or setting have on the process?</li><li>5. What research would you like to see completed?</li></ol>
Providers/Assessors	<ol style="list-style-type: none"><li>1. What guidelines/checklists do you use (or are you aware of)?</li><li>2. Describe the delivery process (from initial contact to final delivery).</li><li>3. What are the barriers to achieving a successful match of patient and wheelchair?</li><li>4. How can the process be improved?</li><li>5. How could future research help you in your practice?</li></ol>
Equipment Suppliers	<ol style="list-style-type: none"><li>1. How do you perceive your role in the service delivery process?</li><li>2. What prevents the ideal patient/wheelchair match?</li><li>3. Is there technology that is not getting to the patients? If so, why?</li><li>4. How does product research and development interface with the delivery process?</li></ol>
Researchers	<ol style="list-style-type: none"><li>1. Are you aware of any research on the delivery process (or aspects of it)?</li><li>2. What are the barriers to research on the delivery process?</li><li>3. What are the key areas for future research?</li></ol>
Patients/Patient Advocates	<ol style="list-style-type: none"><li>1. What has your experience been with different types of payers?</li><li>2. What has your experience been with different types of providers?</li><li>3. What has your experience been in different settings?</li><li>4. What barriers do patients face in the typical wheelchair delivery process?</li><li>5. What prevents patients from getting the "ideal" wheelchair for their needs?</li></ol>



# Appendix C. Search Strategy

## Concept Analysis

Two concepts related to all key questions addressed in this Technical Brief; therefore, one search strategy was used in multiple bibliographic databases. The concepts included wheeled mobility and patient assessment. Table C1 explains the concept analysis and terminology that was used in searching Ovid MEDLINE. MeSH terms (or other terms relevant to the specific bibliographic database as determined by database thesaurus) and text words (with truncation used as necessary) relating to each concept were aggregated. Concepts were combined together to compile a set of literature inclusive of both concepts for screening. Limitations imposed on the Ovid MEDLINE search (and other databases if available) included human studies published in English. The search process was an iterative process with updates to restrict or expand the search as new terms were identified and the search process and resulting sets of literature were analyzed.

**Table C1. Identification of search terms for relevant concepts**

	Concept	
	Wheeled Mobility	Service Delivery
Search terms [MeSH] and text words	Wheelchairs [MeSH] wheelchair\$.tw. scooter\$.tw. "power mobility device\$" "wheel chair\$".tw. "wheeled mobility".tw. powerchair\$.tw. "power chair\$".tw. ("assistive technolog\$" and "mobility").mp. [mp=abstract, heading words, title] "seating clinic".tw.	assess\$.tw. evalu\$.tw. select\$.tw. prescri\$.tw. match\$.tw. "service delivery".tw. provi\$.tw. acquir\$.tw. procur\$.tw. fit\$.tw. recommend\$.tw. purchas\$.tw. refer\$.tw.
	(seating and mobility).mp. [mp=abstract, heading words, title]	

## MEDLINE Search Strategy

- 1 \*Wheelchairs
- 2 wheelchair\$.tw.
- 3 scooter\$.tw.
- 4 “power mobility device\$”.
- 5 “wheel chair\$”.tw.
- 6 “wheeled mobility”.tw.
- 7 powerchair\$.tw.
- 8 “power chair\$”.tw.
- 9 (“assistive technolog\$” and “mobility”).mp. [mp=abstract, heading words, title]
- 10 “seating clinic”.tw.
- 11 1 or 2 or 3 or 4 or 5 or 6 or 7 or 8 or 9 or 10
- 12 assess\$.tw.
- 13 evalu\$.tw.
- 14 select\$.tw.
- 15 prescri\$.tw.
- 16 match\$.tw.
- 17 “service delivery”.tw.
- 18 provi\$.tw.
- 19 acquir\$.tw.
- 20 procur\$.tw.
- 21 fit\$.tw.
- 22 recommend\$.tw.
- 23 purchas\$.tw.
- 24 refer\$.tw.
- 25 12 or 13 or 14 or 15 or 16 or 17 or 18 or 19 or 20 or 21 or 22 or 23 or 24
- 26 11 and 25
- 27 (seating and mobility).mp. [mp=abstract, heading words, title]
- 28 26 or 27
- 29 limit 28 to (english language and humans)
- 30 limit 29 to (addresses or biography or case reports or dictionary or directory or in vitro or legal cases or news or newspaper article or portraits)
- 31 29 not 30

## Appendix D. Evidence Tables

**Table D1. Models and descriptions of wheeled mobility service delivery**

**A. Provider and Individual Resources**

Cooper, 1998 <sup>20</sup> AT	Minkel, 2002 <sup>22</sup> AT	Cook, 2008 <sup>24</sup> AT	Batavia, 2010 <sup>26</sup> Wheeled Mobility	Paralyzed Veterans of America, 1997 <sup>18</sup> Wheeled Mobility
Establish goals/expectations	Need assessment/establish goals	Referral and intake	Evaluate patient	Referral
Assess functional abilities	Assessment of functional capacity and environments	Initial evaluation	Hypothesize (best-suited equipment)	Prescription
Assess ability of technology to augment	Development of intervention strategy	Recommendations and report	Trial/simulation	Evaluation and fitting
Integrate person and AT	Implementation of intervention	Implementation	Recommendation and documentation	Verify eligibility and order
Identify appropriate AT	Determination of outcomes	Followup	Identify funding	Delivery and setup
Train person to use AT		Follow along	Order	Training
Compare outcomes to goals			Fitting Dispensing Followup	
Clinician Task Force, 2004 <sup>23</sup> Wheeled Mobility	Schmeler, 1999 <sup>21</sup> Wheeled Mobility	World Health Organization, 2008 <sup>14,77</sup> Wheeled Mobility	Taylor, 2009 <sup>25</sup> Wheeled Mobility	
History and interview	Client screening	Referral and appointment	Evaluation	
Goal setting and device feature determination	In-depth evaluation	Assessment	Trial of equipment	
Feature and product matching	Final specifications	Prescription	Specific recommendations	
Fitting and delivery	Documentation	Funding and ordering	Funding	
Training	Funding approval	Product preparation	Fitting	
Determination of outcomes	Fittings	Fitting	Training	
Followup program	Delivery Training	User training Followup, maintenance, and repairs		
	Followup			

**Table D1. Models and descriptions of wheeled mobility service delivery (continued)**

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**B. Published Resources**

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Eggers, 2009<sup>38</sup>  
Wheeled Mobility  
Referral/clinic selection  
Needs assessment  
Device selection  
Device evaluation  
Device justification  
Device provision and fitting  
Education, counseling,  
followup

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**Table D2. Studies of wheeled mobility service delivery**

Reference Study Purpose	Population Included	Study Design Sample Size	Elements of Service Delivery Studied	Primary Outcomes Assessed (Assessment Tool)	Dissatisfaction with Service Delivery
Barlow, 2009 <sup>61</sup>  To compare the effectiveness, client satisfaction, cost, and timeliness of wheelchair seating and positioning interventions provided by telerehabilitation and face-to-face.	Cases included clients assessed by telerehabilitation by the GlenRose Seating Service based in Edmonton. Two comparison groups (one urban and one rural) were assessed face-to-face. Comparisons matched by age, diagnosis, and type of seating components received.  Age range: 3-87 Conditions included: progressive neurological diagnosis, Acquired neurological diagnosis: 56%	Case-control  N=30 (10 per group)	Setting (telerehabilitation vs. face-to-face) Travel costs Service provision time Wait times Completion times	Satisfaction (QUEST 2.0 <sup>a</sup> ), achievement of seating intervention goals	Not reported
Batavia, 1990 <sup>52</sup>  To identify and prioritize factors used by long-term users of assistive technology in assessing their devices.	A panel of consumer experts with mobility impairments.  Age range: 31-51 Conditions included: MS, SCI, polio, MD, and CP	Cross-sectional/Qualitative  N=6	Identification of assistive technology factors important to consumers.	Consumer defined satisfaction	Not reported

**Table D2. Studies of wheeled mobility service delivery**

Reference Study Purpose	Population Included	Study Design Sample Size	Elements of Service Delivery Studied	Primary Outcomes Assessed (Assessment Tool)	Dissatisfaction with Service Delivery
Beaumont-White, 1997 <sup>56</sup>  To identify problems with issue and possible areas for improvements to the practice of wheelchair issuance in a London wheelchair service.	Experienced wheelchair users of a London wheelchair service.  Age: Not reported Conditions included: Not reported	Cross-sectional  N=27	Issue detail, therapy input before supply, general maintenance, written information offered and issued, use of the approved repairer service, wheelchair service support, and additional needs unmet by the wheelchair service and ideas for improvement.	Current level of usage, Problems with wheelchair issue	Not reported
Bergstrom, 2006 <sup>71</sup>  To investigate how adults with SCI assess their satisfaction regarding several aspects of their manual wheelchair.	Individuals with SCIs using manual wheelchairs.  Mean age: 49.7 Conditions included: SCI	Cross-sectional  N=124	Service delivery Repair service Professional service Followup	User satisfaction with various aspects of the wheelchair as well as the service.  (QUEST 2.0 <sup>a</sup> )	Not reported
Dicianno, 2009 <sup>65</sup>  To evaluate the association between the use of mobility devices and socialization.	Adults with SB attending University of Pittsburgh-based clinic.  Mean age: 34 Conditions included: SB	Retrospective Cohort  N=208	Setting (attainment of wheelchair at specialized AT clinic or not)	Physical and Cognitive independence, Mobility, Occupation, Social Integration, Economic , Satisfaction, WC repairs  (CHART-SF <sup>b</sup> )	Not reported

**Table D2. Studies of wheeled mobility service delivery (continued)**

<b>Reference Study Purpose</b>	<b>Population Included</b>	<b>Study Design Sample Size</b>	<b>Elements of Service Delivery Studied</b>	<b>Primary Outcomes Assessed (Assessment Tool)</b>	<b>Dissatisfaction with Service Delivery</b>
Evans, 2007 <sup>69</sup>  To qualitatively examine the older EPIOC users' satisfaction with the chair and service providers.	Older adult EPIOC users with severe mobility disabilities recruited through a specialist wheelchair service database.  Mean age: 69 Conditions included: SCI, MS, Stroke, RA, Multiple disabilities, and RA	Cross-sectional/Qualitative  N=15	Provision of safety training; waiting times for assessments and delivery; repair services	Frequency and quality of chair activity; safety and satisfaction with their EPIOC-related services provided, feelings of insecurity in the chair	Wait times for appointments and chairs, disease progression while waiting for delivery of wheelchair, adjustments and repairs.
Evans, 2007 <sup>67</sup>  To qualitatively examine young EPIOC users' satisfaction with the chair and service providers.	Young EPIOC Users recruited through a specialist wheelchair service database.  Mean age: 14.5 Conditions included: MD, CP, and other	Cross-sectional/Qualitative  N=18	Provision of safety training; waiting times for assessments and delivery; repair services	Functioning with the EPIOC, safety of EPIOC, Pain/discomfort, satisfaction with service and support (EQ-5D <sup>6</sup> )	Wait times for initial assessment and delivery, patient involvement in choice products

**Table D2. Studies of wheeled mobility service delivery (continued)**

Reference Study Purpose	Population Included	Study Design Sample Size	Elements of Service Delivery Studied	Primary Outcomes Assessed (Assessment Tool)	Dissatisfaction with Service Delivery
<p>Garber, 2002<sup>70</sup></p> <p>To determine the extent to which wheelchairs prescribed during rehabilitation after cerebral vascular incident are used and perceived as satisfactorily meeting individual mobility, functional, psychological, and social needs of veterans who have had a stroke.</p>	<p>Veterans currently on the patient roster of the Rehabilitation Service at the Houston Veterans Affairs Medical Center (VAMC), discharged with a primary diagnosis of stroke between 1989 and 1999 and being followed for medical, mobility, or functional problems or stroke recurrence, living in Houston metropolitan area, not deceased, not currently hospitalized, and provided wheelchair upon discharge.</p> <p>Mean age=65 Conditions included: previous stroke</p>	<p>Cross-sectional/Qualitative</p> <p>N=49.</p>	<p>Receipt of written information about wheelchair, receipt of verbal instructions about use or maintenance of the wheelchair, informed who to contact if they had problems with wheelchair, receipt of verbal safety information.</p>	<p>Use and satisfaction with wheelchair</p>	<p>Wait time for equipment, equipment prescribed</p>



**Table D2. Studies of wheeled mobility service delivery (continued)**

Reference Study Purpose	Population Included	Study Design Sample Size	Elements of Service Delivery Studied	Primary Outcomes Assessed (Assessment Tool)	Dissatisfaction with Service Delivery
Hoenig, 2005 <sup>63</sup>  To determine the effect of differing methods of dispensing wheelchairs.	Community-dwelling, cognitively intact patients prescribed a standard manual wheelchair.  Mean age: 65 Conditions included: symptoms of weakness, poor balance/dizziness, fear of falling, shortness of breath, and other	Quasi-randomized trial  N=84	Multifactorial intervention consisting of an expert physical/occupational therapist who used a scripted evaluation that included an evaluation based on medical record review and self-reported and physical performance measure; individualization of the wheelchair and initiation or orders for additional occupational/physical therapy, equipment, or home modifications as needed; multimodal patient education; and telephone followup at 3 and 6 weeks vs. usual care.	Amount of wheelchair use. Secondary outcomes of shoulder pain, wheelchair comfort or confidence, or home modifications.	Not reported
Hoenig, 2007 <sup>64</sup>  To investigate the effects of providing a motorized scooter on physical performance and mobility.	Ambulatory community-dwelling adults without cardiac disease and stable rheumatic disease.  Mean age=63 White: 60% Male: 79% Conditions included: RA or OA of the knee	Randomized Controlled Trial  N=43	Provision of motorized scooter and lift vs. usual care.	Six-minute walk distance, Mobility, Scooter accidents, Satisfaction	Not reported

**Table D2. Studies of wheeled mobility service delivery (continued)**

Reference Study Purpose	Population Included	Study Design Sample Size	Elements of Service Delivery Studied	Primary Outcomes Assessed (Assessment Tool)	Dissatisfaction with Service Delivery
Karmarker, 2009 <sup>57</sup>  To describe older adults opinions regarding satisfaction with wheelchair and service delivery.	Convenience sample of 132 individuals participating in the National Veterans Wheelchair Games in Omaha, Nebraska. Participants from VA affiliated nursing homes, private nursing homes, and community dwelling.	Cross-sectional  N=132	Service delivery Repair service Professional service Followup	User satisfaction with various aspects of the wheelchair as well as the service.  (QUEST 2.0 <sup>a</sup> )	Not reported
Kittel, 2002 <sup>13</sup>  To identify factors which influence individuals with a spinal cord injury to abandon their first wheelchair before 5 years of use.	Individuals who abandoned first manual wheelchair before five years of use.  Ages: 26, 33, 37 Conditions included: SCI	Case series/Qualitative  N=3	Reflections on wheelchair prescription experience	Abandonment	Patient knowledge of and involvement in process
McDonald, 2007 <sup>54</sup>  To investigate and compare opinions of parents and therapists of children using adaptive seating systems.	Parents and local therapists matched and assessed regarding child.  Age: Not reported Conditions included: severe CP	Cross-sectional/Qualitative N=30 matched parent-therapist pairs	Level of agreement about between parent therapist pair on opinions regarding child's seating and mobility needs, abilities, preferences.	Use, comfort, satisfaction	Not reported
Pimentel, 2008 <sup>58</sup>  To explore assessment practices for clients requiring standard wheelchairs in one wheelchair service in the UK.	Individuals assessed for wheelchair during 4-month timeframe once new assessment practices were put in place.  Mean age: 73 Age range: 12-102 conditions included: Not reported	Cross-sectional/Qualitative  N=35	Evaluation of new assessment practices focusing on soliciting goals from clients and using these as a framework for the prescription process.	Achievement of goals	Not reported

**Table D2. Studies of wheeled mobility service delivery (continued)**

Reference Study Purpose	Population Included	Study Design Sample Size	Elements of Service Delivery Studied	Primary Outcomes Assessed (Assessment Tool)	Dissatisfaction with Service Delivery
Post, 1997 <sup>73</sup>  To examine individuals with SCI satisfaction with available services and service delivery procedures.	Adults previously rehabilitated in a specialized rehab center between 1986 and 1992 currently living in the community.  Mean age: 39.4 Conditions included: SCI	Cross-sectional/Qualitative  N=318	Availability of services	Functional health status, life satisfaction, satisfaction with available services, satisfaction with service delivery procedures	Not reported
Richardson, 2009 <sup>74</sup>  To identify areas of difficulty encountered by a regional wheelchair service in providing EPIOCs to those with MD in the early years of their provision.	EPIOC users at the EPIOC clinic in Stanmore, UK departmental database seen between April 1997 and March 2000.  Mean age: 25 Conditions included: MD	Retrospective cohort  N=29	Medical chart documentation of outcomes 1) at initial assessment, 2) within the first 12 months and 3) between 13 and 24 months following the delivery of the chair.	Weakness Pain or discomfort Deformities Other medical issues Weight change Functional issues Posture Wheelchair driving skills Other issues	Not reported
Samuelsson, 2001 <sup>66</sup>  To analyze the effects of an intervention to address wheelchair problems improves effectiveness from the consumer perspective.	Active wheelchair users consecutively visiting the wheelchair seating department due to problems with seating at the University Hospital in Linköping, Sweden.  Mean age: 43 Conditions included: SCI, MS, Stroke, CP, SB, Mental disability	Retrospective cohort  N=38	Visits to wheelchair seating department for problems with wheelchair	Wheelchair functionality, seating comfort, pain, occupational performance, pressure distribution	Not reported

**Table D2. Studies of wheeled mobility service delivery (continued)**

Reference Study Purpose	Population Included	Study Design Sample Size	Elements of Service Delivery Studied	Primary Outcomes Assessed (Assessment Tool)	Dissatisfaction with Service Delivery
Samuelsson, 2008 <sup>68</sup>  To evaluate user satisfaction with, use and usefulness of, and make comparison between two types of mobility devices.	Random sample of mobility assistive device users (rollators and manual wheelchairs) in Sweden.  Mean age: 69.8 Conditions included: Not reported	Cross-sectional  N= 262 (175 rollator users, 87 wheelchair users)	Device type prescribed (Rollator or manual wheelchair provision); Service delivery, repairs and services, professional service, and followup.	Use, satisfaction with device and services (QUEST 2.0)	Not reported
Schein, 2010 <sup>62</sup>  To evaluate the equivalency of wheeled mobility and seating assessments delivered in-person (IP) vs. Telerehabilitation (TR) at remotely located clinics.	Adults in need of new wheeled mobility in Western Pennsylvania. Mean age: 54.9 (TR), 50.3 (IP) Conditions included: Progressive, SCI, Orthopedic, Cardiovascular, CNS	Controlled trial  N=98	Setting: In-person vs. telerehabilitation	Functioning (FEW)	Not reported
Suzuki, 2000 <sup>72</sup>  To explore client satisfaction and identify program areas needing improvement at the Rehabilitation Hospital of the Pacific's Wheelchair Seating Clinic in Honolulu, Hawaii.	Adults serviced by the formal seating clinic who had completed the initial interview and received their equipment by April 1999.  Age: Not reported Conditions included: Not reported	Cross-sectional  N=26	Assessment process and followup	Satisfaction	Not reported

**Table D2. Studies of wheeled mobility service delivery (continued)**

Reference Study Purpose	Population Included	Study Design Sample Size	Elements of Service Delivery Studied	Primary Outcomes Assessed (Assessment Tool)	Dissatisfaction with Service Delivery
Telfer, 2010 <sup>55</sup>  To investigate the views of teaching staff members at special needs schools and of the parents of children who attended these schools on the provision and current technology of seating systems.	Teaching staff and parents of children in special needs schools in central Scotland. Teachers that had worked with the children for at least 6 months and parents whose children had used a piece of adaptive seating equipment for at least 6 months. Parents were encouraged to discuss the survey with their child.  Age: Not reported Conditions included: neuromuscular disorder.	Cross sectional/Qualitative  N= 33 teaching staff, 17 parents	Importance of different functions of seating system, satisfaction with speed at which new or replacement models are issued, descriptions of completed repairs or adjustments.	Time spent transferring child between and to and from seating systems on an average day, satisfaction with how seating system accommodated growth, and other additional comments from participants.	Not reported
Ward, 2010 <sup>53</sup>  To determine the features most frequently selected in a PWC, level of satisfaction with the selections, and how often the PWC features are used by patients diagnosed with ALS/MND.	Convenience sample of current patients of ALS/Muscular Dystrophy Association center in Charlotte, NC.  Mean age: 57.9 Conditions included: ALS	Cross-sectional  N=32	Patterns of wheelchair selection and other aspects of decision-making processes that patients experience before, during, and after acquiring a PWC.	Initial and current satisfaction and use of chair and specific features (cushion, headrest, armrests, joystick, backrest, leg rests, overall comfort, ease of use)	Not reported

**Table D2. Studies of wheeled mobility service delivery (continued)**

Reference Study Purpose	Population Included	Study Design Sample Size	Elements of Service Delivery Studied	Primary Outcomes Assessed (Assessment Tool)	Dissatisfaction with Service Delivery
White, 1998	<p>A four stage data collection method was used to collect information from wheelchair service providers, manual wheelchair users, power wheelchair users, and specialty seating evaluations in England.</p> <p>Age: 80% of manual chair users over 60; 55% of power chair users over 60. Conditions: main conditions among manual chair users included aging, arthritis, and cardiovascular disease; main condition in power chair users was neurological disorder.</p>	<p>Cross-sectional/Qualitative</p> <p>N= 125 wheelchair therapists; 84 manual chair users; 27 power chair users, and 19 special seating users.</p>	<p>Wheelchair therapists: referral procedures, assessment approaches, qualifications, training needs, Wheelchair users: assessment approach,</p>	<p>Use, delivery times, knowledge of wheelchair service and repairs, satisfaction with service, level of need fulfillment, chair preferences.</p>	<p>Accuracy of information on referral form, training of wheelchair therapists, adequacy of assessment, service delays</p>
Wressle, 2004 <sup>59</sup>	<p>Adult users of mobility devices in Sweden</p> <p>Mean age: 68</p>	<p>Cross-sectional</p> <p>N=209</p>	<p>Service delivery Repair service Professional service Followup</p>	<p>User satisfaction with various aspects of the wheelchair as well as the service.</p> <p>(QUEST 2.0<sup>a</sup>)</p>	<p>Not reported</p>

**Note:** Reference listing appears in References.

<sup>a</sup> QUEST–Quebec User Evaluation Satisfaction with Assistive Technology

<sup>b</sup> CHART-SF–Craig Handicap Assessment Reporting Technique-Short Form

<sup>c</sup> EU-5D–EuroQoL

<sup>d</sup> FEW–Functioning Everyday with Wheelchair