Assistive Technology for Patients with Cognitive Impairments: Occupational Therapy

Indexing Metadata/Description

› **Procedure:** Assistive Technology for Patients with Cognitive Impairments: Occupational Therapy

› **Synonyms:** Assistive and adaptive technology for patients with cognitive impairments: occupational therapy

› **Area(s) of specialty:** Acute Care, Home Health, Neurological Rehabilitation, Orthopedic Rehabilitation, Pediatric Rehabilitation, Environmental Modification

› **Description/use:** Assistive technology (AT) is classified as any item, piece of equipment or product system, whether acquired commercially off the shelf, modified, or customized, that is used to increase or improve functional capabilities of individuals with disabilities, including cognitive impairments. AT is a multidisciplinary intervention to develop compensatory strategies that will allow patients with cognitive limitations to actively participate in desired roles, occupations, and activities at home, work, school, and in the community. Occupational therapists (OTs) recommend the use of various types of AT based on the patient’s physical and cognitive strengths and limitations, consideration of human occupation (i.e., productive, self-care, leisure, or restorative occupations), kinesiology, and biomechanics. Proper use of AT will complement the patient’s residual abilities. Because AT can improve a patient’s quality of life, increase participation in daily activities and interaction with the physical environment, and increase social interaction, some proponents believe that it fits within the International Classification of Functioning, Disability and Health (ICF) developed by the World Health Organization (WHO). However, authors of a review by the Assistive Technology Outcome Measurement Project reported that “for multiple reasons, the ICF falls short of serving the needs of AT outcomes researchers and clinicians, thereby limiting the effectiveness of the instrument in serving the consumer with assistive technology (AT) needs.” Rehabilitation technology differs from AT in that the rehabilitation technology remains in the clinic when a patient is discharged from therapy, whereas the AT is taken home for use in daily activities.

› **Indications:** Use of AT is appropriate for patients unable to participate in desired activities and roles/occupations due to cognitive impairment(s). AT can help a patient compensate for cognitive impairments as well as immobility; low cardiorespiratory endurance; difficulty with reaching, grasping, or typing; sensory impairments; speech and language disorders; and difficulty with the complex skills required for reading, writing, and learning.

› **CPT codes**
  - 97535 self-care/home management training (e.g., activities of daily living [ADLs] and compensatory training, meal preparation, safety procedures, and instructions in use of assistive technology devices/adaptive equipment) direct one-on-one contact, each 15 minutes
  - 97537 community/work reintegration training (e.g., shopping, transportation, money management, avocational activities and/or work/environment modification analysis,
work task analysis, use of assistive technology device/adaptive equipment), direct one-on-one contact, each 15 minutes

- 97755 assistive technology assessment (e.g., to restore augment, or compensate for existing function, optimize functional tasks and/or maximize environmental accessibility), direct one-on-one contact, with written report, each 15 minutes

G-Codes

- **Self Care G-code set**
  - G8987, Self care functional limitation, current status, at therapy episode outset and at reporting intervals
  - G8988, Self care functional limitation, projected goal status, at therapy episode outset, at reporting intervals, and at discharge or to end reporting
  - G8989, Self care functional limitation, discharge status, at discharge from therapy or to end reporting

- **Other PT/OT Primary G-code set**
  - G8990, Other physical or occupational therapy primary functional limitation, current status, at therapy episode outset and at reporting intervals
  - G8991, Other physical or occupational therapy primary functional limitation, projected goal status, at therapy episode outset, at reporting intervals, and at discharge or to end reporting
  - G8992, Other physical or occupational therapy primary functional limitation, discharge status, at discharge from therapy or to end reporting

- **Other PT/OT Subsequent G-code set**
  - G8993, Other physical or occupational therapy subsequent functional limitation, current status, at therapy episode outset and at reporting intervals
  - G8994, Other physical or occupational therapy subsequent functional limitation, projected goal status, at therapy episode outset, at reporting intervals, and at discharge or to end reporting
  - G8995, Other physical or occupational therapy subsequent functional limitation, discharge status, at discharge from therapy or to end reporting

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Source: [https://www.cms.gov/](https://www.cms.gov/)

**Reimbursement**: In the United States, applications for AT devices can be submitted by the OT or a durable medical equipment provider to Medicare, Medicaid, vocational rehabilitation services, and other funding sources.(8) Third-party payment is vital for most patients, as they often live on limited incomes and typically the AT devices are expensive.(6) Funding for AT is often available; however, the patient, OT, and physician must be thoroughly prepared and persistent with payors.(10) To increase the likelihood that the cost of AT devices will be reimbursed, the OT must document the medical necessity of the devices.(6) Justification should include the context and setting for the use of the equipment, why it is needed to compensate for deficits or to meet functional needs, and why lower-cost alternatives are not appropriate.(33)
Indications for AT for patients with cognitive impairment

- The patient is unable to or is limited in the ability to participate in desired occupations due to cognitive impairments
  - Cognitive impairment is a central feature of many neurological disorders such as dementia, mental illness, acquired and congenital brain injury, intellectual disability, and sometimes stroke

- Typically the evaluation for AT is driven by a patient’s desire to participate in specific activities and/or occupations
  - AT is not only for patients with severe impairments; even those patients with mild deficits can benefit considerably from AT

- In some cases, the evaluation for AT is driven by the need to alleviate caregiver burden; formal and informal caregivers often act as “cognitive assistants” for patients with cognitive impairment

- AT is often introduced to promote independence and autonomy, to delay or defer institutionalization, and to manage potential safety risks of patients with cognitive impairment

Guidelines for the Use of AT for patients with cognitive impairment

- HAAT model
  - The HAAT (Human, Activity, and Assistive Technology) model is a framework for use in evaluation for and service delivery of AT
    - Based on general systems theory; a change in one realm creates consequences in another realm
    - In addition to considering the components of HAAT, the OT must also consider the context in which the AT is going to be used; contextual factors include the physical attributes of the patient’s surroundings (e.g., temperature, moisture) as well as the social and cultural attributes of the patient’s environment (e.g., is the AT to be used in a professional or social setting?)

  - To identify the features needed in a specific AT device for a given patient, the OT must also consider the patient’s physical and cognitive strengths and weaknesses as well as the patient’s goals for AT use
    - AT devices support a patient’s performance in ADLs and IADLs (see Clinical Review… Assistive Technology for Activities of Daily Living: Occupational Therapy; Topic ID Number: T901900); the patient’s areas of strength work in combination with the AT device to accommodate for the areas of weakness (e.g., a word predictor function for patients with poor language formulation/spelling ability but adequate fine motor control for typing)

  - According to the HAAT model, AT has four components
    - Human-technology interface: also called the user interface; the means by which the client interacts with the device to input and/or receive information. Examples are keyboards, dials, computer mice, slider bars, push buttons, toggle switches, voice menus, and touch screens. Some interfaces are “low tech”; for example, a laser pointer attached to glasses utilized for selection on a letter board
    - Processor: the part of the AT that acts on human input and follows the instructions or program to produce activity output (e.g., pushing on the joystick of a motorized wheelchair to turn it right and move down a hallway)
    - Activity output: the desired output of an AT device; ranges from speaking selected words in digitized speech to starting a music CD to moving a motorized wheelchair
- Environmental interface: part of the AT device that detects external information, interprets it, and delivers it to the human user via the human-technology interface; not a part of every AT device
- Examples of environmental interfaces
  - Page scanner that converts written materials into computer text for listening via a speech synthesizer
  - Ultrasonic cane that can detect obstacles for a patient with low or no vision

- Consider the hierarchy of access principle during AT evaluations, which recommends using the least amount of technology required to achieve the desired outcome; seek simple, cost-effective options that still create the desired activity output

- Universal design is a method of creating devices or products that serve the needs of a wide range of individuals, those with and without disabilities. For example, the iPhone is built with a calendar program that provides reminders and can easily be used by a patient with memory deficits as well as his or her spouse who is cognitively intact. For devices with universal design, no adaptations are necessary

Contraindications/Precautions to AT for patients with cognitive impairment
- There is no “onesize fits all” with respect to AT; each device must be customized to meet the specific needs and goals of a given patient
- General precautions should include awareness of cognitively impaired patients’ potential for self-injurious behavior, poor impulse control, poor safety awareness, and communication deficits

Examination
- Contraindications/precautions to examination
  - Occupational therapy evaluations of patients for the use of AT should utilize a client-centered approach to most effectively evaluate deficits and needs
  - A client-centered approach increases the likelihood of success with AT; the patient must invest time and effort to learn to use AT, and this investment is worthwhile only if the patient finds the outcomes meaningful
  - A client-centered approach is based on the following principles
    - The patient is uniquely qualified to make decisions or provide input about his or her occupational functioning
    - The patient should have an active role in determining goals and desired outcomes
    - The patient-therapist relationship should be interdependent
    - Evaluation and treatment should focus on the patient’s culture, roles, and interests
    - When the patient is able to define the problems on which he or she would like to work, the patient also becomes a problem solver
    - The patient should evaluate his or her own performance and set personal goals
  - Depending on severity of the cognitive impairment, many of the above client-centered principles might need to be adapted; for example, input from family and caregivers may be used to establish goals and desired outcomes
- History
  - History of present illness/injury/circumstances for which the AT is needed
    - Mechanism of injury or etiology of impairment: Review medical chart and physician reports to ascertain information about the patient’s medical history, current medical and functional status, and the treatments the patient has received for medical condition(s). What is the current reason for referral? What is the cause of the patient’s cognitive impairment? What has changed for the patient that AT is being considered at this time?
    - Course of treatment
      - Medical management: Document medical and surgical management of the patient’s condition to date; note weight-bearing status, if applicable, as well as whether the patient has been cleared by the physician to participate in therapy
      - Medications for current illness/injury: Determine what medications physician has prescribed; are they being taken?
      - Diagnostic tests completed: Document any diagnostic tests completed and the results, if available
      - Home remedies/alternative therapies: Document any use of home remedies (e.g., use of a journal or calendar for memory) or alternative therapies (e.g., acupuncture) and whether they help
      - Previous therapy: Document whether patient has had occupational or physical therapy for this or other conditions and what specific treatments were helpful or not helpful. Note the use of any AT in prior therapy encounters. Does the
patient currently use AT that was introduced in prior occupational of physical therapy sessions? If so, does the patient feel that the AT is beneficial?

Aggravating/easing factors (and length of time each item is performed before the symptoms come on or are eased)
- Is the patient sensitive to lights or sounds? Is the patient distractible or does he or she have difficulty with concentration?
  - AT such as headphones can help to manage sensitivity to sounds
- Do any activities or positions bring on, aggravate, or ease the patient’s symptoms? For example, does the patient have more difficulty maintaining concentration when new activities are introduced?

Nature of symptoms: Document nature of symptoms or impairments (e.g., memory impairment, executive dysfunction, impaired judgment/problem-solving, poor abstract thinking, wandering, agitation). Functional deficits resulting from cognitive disabilities can impact concentration, ability to react to emotions, problem-solving, generating ideas, and memory

Rating of symptoms: How much do patient’s symptoms impact function?

Pattern of symptoms: Document changes in symptoms throughout the day and night, if any (a.m., mid-day, p.m., night); also document changes in symptoms due to time of day (e.g., worse memory in the evening) or other external variables (e.g., more cognitive difficulty when under stress)

Sleep disturbance: Document number of wakings/night

Other symptoms: Document other symptoms patient might be experiencing that could exacerbate the condition and/or symptoms that could be indicative of a need to refer to physician (e.g., physical impairments, development of new symptoms, change in cognitive abilities)

Respiratory status: Note respiratory status
- Does the patient require supplemental oxygen? Tracheostomy tube, nasal cannula, or breathing mask?
- Does the patient require mechanical ventilation?
- Does the patient become short of breath? If so, when? Standing? Walking? With exercise?

Barriers to learning
- Are there any barriers to learning? Yes__/No__
  - If Yes, describe

Medical history

Past medical history
- Previous history of same/similar diagnosis: Has the patient experienced similar symptoms in the past? Has the patient previously had the same or a similar diagnosis to his or her current diagnosis?
- Comorbid diagnoses: Ask patient or caregiver about other problems, including diabetes, cancer, heart disease, complications of pregnancy, psychiatric disorders, and orthopedic disorders
- Medications previously prescribed: Obtain a comprehensive list of medications prescribed and/or being taken (including OTC drugs)
- Other symptoms: Ask patient about other symptoms he/she is experiencing

Social/occupational history

Patient's goals: Document what the patient and patient’s family/caregiver(s) hope to accomplish with assistive technology and in general

Vocation/avocation and associated repetitive behaviors, if any
- What are the patient’s daily occupations and role(s) within his or her family?
- Is the patient currently employed?
  - Is the patient hoping to return to work?
  - Patients who cannot currently work but wish to return to work might need a full vocational and ergonomic assessment; if possible and with the patient’s permission, contact the patient’s employer and work together to determine possible modifications to both environment and job responsibilities as needed
- What activities and hobbies does the patient enjoy? Is participation in these activities limited at this time?
- A patient/caregiver interview might be helpful to gain insight into the patient’s hobbies, family/community roles, interests, prior work status, and home responsibilities

Functional limitations/assistance with ADLs/adaptive equipment
- Is the patient comfortable with technology? What are the patient’s and caregiver’s attitudes towards computers, the internet, cell phones/smartphones, and personal digital assistants (PDAs)? The type of and features included in the AT device(s) will vary according to both patient and caregiver comfort and acceptance of technology
- What current assistive or adaptive equipment is available to the patient at home? Can it still be used based on patient’s current level of functioning?
- Document both high- and low-tech adaptations and equipment

**Living environment**
- Who is the patient’s primary caregiver?
- If the patient has no caregiver or the patient’s caregiver is not receiving guidance or assistance with the patient’s care, refer to social worker or case management
- With whom does the patient live (e.g., spouse/partner, parents, children, siblings, grandparents, caregivers)? Does the patient live alone? If so, what measures/devices are currently in place to reduce the risks of living alone?
- Are there pets in the home?
- Identify if there are barriers to independence in the home; are any modifications necessary?
- Inquire about the levels of the home, including stairs and number of floors
- A home visit might be beneficial to provide functional and realistic environmental modifications around the house

**Relevant tests and measures** (While tests and measures are listed in alphabetical order, sequencing should be appropriate to patient medical condition, functional status, and setting) The OT’s evaluation for AT focuses on how the human-technology interface and activity output support the patient’s ability to participate in desired occupations. AT is applicable in almost any setting; specific measures will vary according to the setting, which might include inpatient, outpatient, school, home, and work. Although the OT will determine the patient’s areas of deficit and need, it is essential to work in combination with a certified rehabilitation technology supplier (CRTS) who specializes in knowing available products and features so that the most appropriate AT device(s) is/are provided to a specific patient. The American Occupational Therapy Association guideline for occupational therapy evaluations with community-dwelling older adults is to consistently use standardized assessment tools and outcome measures for evaluating occupational functioning, home safety, and IADLs whenever possible to increase the likelihood of reimbursement and improve outcome data collection.

- **Anthropometric characteristics:** Note height, weight, and BMI; note amputations or other anthropometric characteristics that might affect which type of AT device the patient can use successfully
- **Arousal, attention, cognition** (including memory, problem-solving): Note patient’s ability to communicate, level of arousal, memory, attention, problem-solving, and orientation to person, place, time, and situation. Consider cognitive abilities when determining appropriate system input methods, discussed below in Assistive and adaptive devices, for an AT device
  - For patients with significant cognitive impairment, referral to neuropsychology is appropriate for extensive assessment and input regarding cognitive intervention
  - After a thorough examination of cognition by a neuropsychologist, review the report to understand the type of cognitive impairments as well as their extent to determine which type(s) of AT would be most appropriate for the patient given his or her specific strengths and weaknesses, and goals
  - For additional information on how specific disease processes affect cognition, see the series of Clinical Reviews on these topics (e.g., stroke, dementia) as well as Clinical Review...Cognition in Older Adults, Topic ID Number: T903600 for information about cognitive changes resulting from aging
  - Refer to speech-language pathology reports, if available, regarding speech, language, or cognitive-linguistic impairments
  - Augmentative and alternative communication (AAC) devices are prescribed by the speech-languagepathologist (SLP). Contribution from the OT regarding fine or gross motor skills for system input (described below) is necessary for the SLP to prescribe the best type of AAC device. AAC can be high- or low-tech. For additional information on AAC, see the series of Clinical Reviews on this topic
- **Assistive and adaptive devices:** Conduct a thorough assessment of the patient’s physical and cognitive strengths and weaknesses to determine which features should be included in the patient’s AT
  - System input
    - Direct selection: method of system input in which the patient can choose from many options
    - Appropriate for AT users with good motor control, stability, reach, control, and strength of a finger or other body segment (e.g., toe, head)
    - Before determining if the patient is a candidate for direct selection, it is necessary to assess the patient for reliable, low-effort,high-accuracy hand movements, eye movements, communication skills, and hearing abilities
    - The AT user chooses an option from a display of all options possible
- Examples include computer keyboard, phone number pad, and remote control

- Control enhancers: aids that facilitate the use of a body part to enable an AT user to use direct selection

- Control enhancers use low-tech augmentations or positioning changes to extend a patient’s motor control

- Examples
  - Positioning a keyboard on an accessible platform or easel
  - Forearm or mobile arm supports
  - Mouth or stick typing

- Indirect selection: method of system input in which the AT user is provided with the entire selection set grouped by subsets; subsets are presented to the AT user in sequence, and the user must wait to make a selection with a switch until the desired option is presented

- Also referred to as “scanning”

- Used as the last possible option because of its inefficiency and high cognitive load; only appropriate for patients with severe motor limitations and relatively intact cognitive functioning

- The AT user must have at least one body part that can produce reliable and repeatable movement as well as adequate cognitive skills to anticipate items and activate a switch

- Options to activate the switch include hand, arm, chin, foot, knee, and even eye-blink

- Sensitivity of the switch should be adapted to fit the patient’s unique characteristics (e.g., an adult patient with late-stage amyotrophic lateral sclerosis [ALS] might require a very sensitive switch activated by light finger touch, whereas a preschooler with cerebral palsy would benefit from a larger, brighter, and less sensitive switch activated by stronger hand or foot movements

- Examples
  - Repeated presses of a remote control’s “channel up” button until the desired channel is reached on the television
  - Alphabet is presented in subsets of 5–6 letters with sets for punctuation and numbers for the AT user to spell out a message

- Proportional controls: for patients with good motor control; the movement of the human-technology interface is directly proportional to the activity output (e.g., the joystick of a motorized wheelchair responds proportionally with respect to speed and direction; the farther the joystick is moved, the faster the wheelchair moves)

- Digital controls: for patients with less precise motor control; the movement of the human-technology interface is preset so the user has limited options and grading of movement is not necessary

- System output
  - For patients with sensory impairments, it might be necessary to modify the system output

  - Examples
    - Low hearing: vibration or flashing lights can replace sounds of doorbells, alarm clocks, or smoke detectors/fire alarms
    - Low vision: text-to-speech software or refreshable Braille displays can substitute for reading text on a computer display; large print materials or screen enlargements

- Examples of AT according to setting or functional deficits
  - Home: smart homes (homes in which a single network is used to control many devices such as home security, entertainment, and thermostat), stair-lifts, rails, raised toilet seats, fall detector, video doorbell, smoke alarm, electronic reminder system for stove, talking watch/microwave, flashing doorbell, vibrating alarm clock

  - School: computers, AAC device, software for screen magnification, screen access through Braille or speech recognition

  - Work: computers, telephone accessories, voice-controlled computer, ergonomic office space, software for screen magnification, screen access through Braille or speech recognition

  - Leisure/recreation: sports wheelchairs, computer games for patients with vision loss, audiobooks, page turners, electronic aids to daily living (EADLs), adapted sporting equipment

  - Healthcare: telecare/telehealth

- Medication aids (e.g., pill dispensers with electronic reminders)
- Concentration/distraction: Earphones to block ambient noise, shields on unneeded controls, cubicle or enclosed workspace
- Memory: speed dial/voice dial on a phone, autoshutoff for appliances, calendar or written agenda
- Problem-solving: electric eye faucet

**Balance:** Evaluate static and dynamic balance functionally during ADL/IADL tasks involving weight shifting, in sit and stance. It is important to determine in what ways balance affects the patient’s ability to perform ADLs/IADLs to prescribe an effective AT device or devices

- Tinetti Balance Scale
- Berg Balance Scale
- Functional Reach Test

**Cardiorespiratory function and endurance**
- Refer to physician orders regarding cardiac and exercise limitations
- Assess heart rate, blood pressure, and respiratory rate regularly pre/during/post activity; use Borg Rating of Perceived Exertion (RPE) Scale if indicated
- Monitor breathing to assist in determining fatigue and endurance levels

**Circulation:** Assess pulse bilaterally; note any discrepancies or abnormalities as appropriate based on diagnosis

**Cranial/peripheral nerve integrity:** Assess patient for the involvement of cranial and peripheral nerves as appropriate based on diagnosis

**Ergonomics/body mechanics:** Analyze the patient’s activities and work environment to determine if ergonomic seating or positioning interventions are necessary to make it possible for the patient to properly access AT. For additional information on ergonomics, see Clinical Review...Ergonomics Assessment and Intervention; Topic ID Number: T708456

**Functional mobility** (including transfers): Bed mobility and transfers should be assessed to determine the amount of assistance needed for the patient to perform each activity. It is important to determine the ways in which functional mobility is impaired in order to prescribe an appropriate AT device or devices

- Test static and dynamic activities
- Timed Up & Go (TUG) test: a measurement of mobility; includes tasks such as standing from a seating position, walking, turning, stopping, and sitting down, all of which are important for independent mobility
- FIM – an 18-item, 7-level ordinal scale assessing functional mobility, ADLs, language skills, and cognition

**Gait/locomotion:** Observe patient’s gait and ability to climb stairs (assisted or unassisted), if possible
- Note use of braces or aids for walking; AT for ambulation includes crutches and rolling walkers
- Document use of wheelchair or scooter for mobility

- Options for wheelchairs are manual or powered
  - Manual wheelchairs can be maneuvered in tight spaces and pulled into a motor vehicle easily; however, long-term manual propulsion is linked to repetitive strain injuries and rotator cuff tears
  - Powered wheelchairs require accessible environments for use and cannot be transported easily in a motor vehicle; however, the user can focus on activities and interactions rather than propelling because the motorized wheelchair traverses distance and hills with minimal effort from the patient
  - Joysticks are the most common human-technology interface for powered wheelchairs; however, if the patient’s fine motor skills are not strong enough to use a joystick, the OT can collaborate with the CRTS to find an alternative control option. Alternative options include sip-and-puff straws and directional switches
  - Depending on the severity of cognitive impairment and the patient’s safety awareness, judgment, and problem-solving skills, it might not be appropriate to use AT to increase the patient’s independent mobility (e.g., if the patient wanders). Inpatients with cognitive impairment might pose a safety hazard to themselves or other patients with enhanced mobility options. Maximum speed in a power wheelchair might need to be limited and safety barriers imposed (e.g., to prohibit cognitively impaired patients from attempting to drive a power wheelchair down the stairs)
- If the patient presents with impaired gait or mobility needs, referral to physical therapy is appropriate. The physical therapist (PT) and OT determine together which type of AT is the most appropriate for serving a patient’s mobility needs

**Joint integrity and mobility:** Assess joint integrity and mobility
- Assess upper extremity active and passive range of motion (AROM/PROM)
- Note hyper- and hypomobility as well as soft tissue changes such as swelling, inflammation, and restriction at the shoulder, elbow, and wrist
• **Motor function** (motor control/tone/learning): Assess fine and gross motor function of the upper extremities; describe the quality of movement; consider both fine and gross motor control when determining appropriate system input methods, discussed above in *Assistive and adaptive devices*, for an AT device
  – Document the presence of hemiplegia in patients with stroke or TBI
  – Observe manual dexterity; serial opposition or rapidly touching each finger to thumb in succession
    - Patients with decreased dexterity might be more significantly impaired in their ability to complete ADLs
  – Modified Ashworth Scale (mAS)
    - Used to assess tone
  – Motor Assessment Scale
    - Assesses motor function; includes disability and impairment measures; assessments include those of arm and hand movements, tone, and mobility
  – Functional Test for the Hemiparetic Upper Extremity
    - Assesses arm and hand function through 17 hierarchical functional tasks such as folding a sheet, screwing in a light bulb, stabilizing a jar, and zipping a zipper
  – Arm Motor Ability Test (AMAT)
    - Evaluates arm functional ability and quality of movement; 28 tasks, including eating with a spoon, opening a jar, tying a shoelace, and using the telephone
  – Upper Extremity Performance Test for the Elderly (TEPA)
    - Upper extremity assessment composed of 9 standardized tasks; assesses tasks both bilaterally and unilaterally
  – Jebsen Test of Hand Function
    - Composed of 7 activities, including writing, turning over stacked index cards, simulated eating, moving empty and weighted cans, and picking up small objects
  – 9-Hole Peg Test for fine motor control
  – Handwriting assessment
  – Computerized Penmanship Evaluation Tool (ComPET): objective assessment of handwriting

• **Muscle strength:** Assess muscle strength; consider muscle strength when determining appropriate system input methods, discussed above in *Assistive and adaptive devices*, for an AT device
  – Manual muscle testing (MMT) to evaluate strength in both upper extremities, including the shoulder, elbow, forearm, wrist, and fingers; do not perform MMT on muscles with contractures or muscles with abnormal tone
  – Dynamometer to evaluate hand strength bilaterally
  – Assess grip force in functional tasks
  – Assess pinch strength
  – Motricity Index: measures limb strength impairments with weighted ordinal scale

• **Neuromotor development:** Assess with standardized neuromotor development tests, such as:
  – Peabody Developmental Motor Scales, Second Edition (PDMS-2):This standardized assessment measures gross and fine motor skills of children from birth to 6 years of age

• **Observation/inspection/palpation** (including skin assessment): Document presence of any skin breakdown, including decubitus ulcers and open wounds
  – Observe for and document presence of skin breakdown upon initial evaluation and at the start of each treatment session; report new or changing skin breakdown to patient’s nurse and/or physician
  - Pressure ulcers can be caused by ischemia, shear from sliding, heat and moisture, poor nutrition, and age-related soft-tissue changes\(^\text{6}\)
    - Those patients with decreased sensation or inability to independently reposition themselves in a wheelchair are at high risk for pressure ulcers\(^\text{6}\)
    - To reduce the risk of pressure ulcers, fit patients with appropriate pressure-reducing cushions; additionally, adjusting footrests, armrests, and seating angle can redistribute pressure and reduce risk\(^\text{6}\)
  – Ocular motor screening includes tracking through all planes, visual accommodation, and clarity of vision
    - Document complaints of double vision, optic pain, or visual field cuts
    - Document use of eye patching
  – Referral to ophthalmology or neuro-ophthalmology is appropriate if symptoms of visual disturbances are noted during evaluation
• Posture: Poor posture can impact the ability of a patient to complete occupational tasks such as feeding, dressing, oral care, transfers, and meal preparation
  – Document static/dynamic posture in both sitting/standing throughout a variety of tasks
  – Patients in wheelchairs must perform all tasks in sitting positions, and adaptations will be necessary for many ADLs/IADLs. For patients in a wheelchair or other seating system, assess the following with respect to seated posture
    - Ability to transfer sitting balance
    - Bilateral symmetry and ROM through spine and pelvis
    - Fixed asymmetry/deformity should be accommodated for with a custom-molded seating system; flexible asymmetry should be corrected to prevent worsening
    - Signs of pressure/shearing over the bony areas of the pelvis
    - Muscle tone, ROM, and presence of primitive reflexes as they affect sitting
    - Seat-to-back angle is affected by decreased ROM in the hips
    - The angle of the footrest hanger is affected by the presence of shortened hamstrings
  – Note posture with/without the use of AT or adaptive equipment
  – It is important for patients confined to a sitting position that the pelvis is stabilized to increase functioning; a neutral pelvis supports the natural spinal curve and assists with upper extremity function
  – Pelvic stabilization can be achieved with positioning cushions, positioning belts, and tilting seats

• Range of motion: Assess AROM and PROM of both upper extremities, including the shoulder, elbow, forearm, wrist, and fingers
  – Note pain response with any active movement or stretching
  – Document presence of contractures

• Self-care/activities of daily living (objective testing): Assess safety and ability to perform ADLs (see Clinical Review…Assistive Technology for Activities of Daily Living: Occupational Therapy; Topic ID Number: T901900) (e.g., brushing teeth, combing hair, dressing upper and lower extremities, clothing management, using the toilet, applying makeup or shaving the face, bathing, eating)
  – For infants/children, the WeeFIM is appropriate for assessment of ADLs
    - The WeeFIM assesses basic daily living and functional skills in children from birth to 7 years of age
    - The WeeFIM is based on the FIM for adults and includes 18 items in the following areas: self-care, sphincter control, transfers, locomotion, communication, and social cognition
  – For community-dwelling and other high-functioning patients, assess IADLs such as driving (car transfers), meal preparation, shopping, and housework
    - Lawton and Brody Instrumental Activities of Daily Living Scale
      - Includes items related to using the telephone, taking public transportation, shopping, meal preparation, housework, and medication and money management
    - The FIM, the Physical Self-Maintenance Scale (PSMS), the Assessment of Motor and Process Skills (AMPS), the Kohlman Evaluation of Living Skills (KELS), the Frenchay Activities Index, and the Barthel Activities of Daily Living Index are appropriate standardized measures for ADLs
    - There are thousands of low-tech modifications or aids that can be used to improve ADL/IADL performance, including weighted spoons, scoop plates, long-handed hairbrushes and toothbrushes, sock aides, one-handed buttoners, adapted toys for play, and built-up pen, pencil, and crayon grips

• Sensory testing: Briefly assess for sensory impairment: pinprick, temperature changes, pressure, proprioception, vibration. Document known impairments of sensation, vision, or hearing. Consider sensory limitations when determining appropriate system output methods, discussed above in Assistive and adaptive devices, for an AT device

• Special tests specific to diagnosis
  – AT assessment tools
    - The Student, Environment, Tasks, Tools (SETT) model: a general framework, not a formal protocol, for evaluating a student, environment, and individual goals to identify the most appropriate AT
- Matching Person and Technology (MPT): a validated measure that assesses how patients judge their own functional and health status; also measures quality of life and attitude toward AT, and has been found to successfully predict satisfaction with AT 1 month post discharge\(^{16}\)

- Considering AT: a flowchart that guides the clinician through the process of selecting the appropriate AT for a given patient\(^{16}\)

- Assessing students’ needs for AT: a protocol for evaluating a child’s AT needs as they relate to an individual education plan (IEP)\(^{16}\)

- Education Tech Points: assessment forms and a manual detailing components of effective AT service delivery\(^{16}\)

- Quality of life
  - The Short Form Health Survey (SF-36) evaluates overall independence, emotional and mental health, limitations to previous roles, and social status
  - The Canadian Occupational Performance Measure (COPM) evaluates function through evaluation at baseline and status throughout treatment using the patient’s direct input in scale
  - The COPM allows patients to identify goals in therapy that are personally meaningful; useful for a client-centered approach to therapy

### Assessment/Plan of Care

#### Contraindications/precautions

- Only those contraindications/precautions applicable to patients who use AT for cognitive impairments are mentioned below, including with regard to modalities. Rehabilitation professionals should always use their professional judgment

- Patients with a diagnosis for which this procedure is used might be at risk for falls; follow facility protocols for fall prevention and post fall-prevention instructions at bedside, if inpatient. Ensure that patient and family/caregivers are aware of the potential for falls and educated about fall-prevention strategies. Discharge criteria should include independence with fall-prevention strategies
  - AT use is a factor that has been found to be related to increased risk of falling; patients who require AT for either physical or cognitive impairments are at increased risk of falling\(^{12}\) (e.g., a patient with poor safety awareness and judgment who uses a bed alarm to remind him not to get out of bed, but he ignores it because of the severity of cognitive impairment)

- Long-term manual propulsion of a wheelchair is linked to repetitive strain injuries and rotator cuff tears\(^{6}\)

- For additional information on injuries associated with wheelchair use, see *Clinical Review...Shoulder Pain: Wheelchair User;* Topic ID Number: T708462

- It is important that the OT provide the patient and family with realistic information about the amount of training and follow-up visits required to master use of the device(s) during the initial AT evaluation\(^{10}\)

- Clinicians should follow the guidelines of their clinic/hospital and what is ordered by the patient’s physician. The summary below is meant to serve as a guide, not to replace orders from a physician or a clinic’s specific protocols

#### Diagnosis/need for procedure:

- The OT must consider the patient’s risk factors and specific cognitive deficits to determine if the patient is an appropriate candidate for therapy as well as use of AT; the patient must be amenable to the therapeutic process and have the potential to benefit from occupational therapy to increase functional independence by using AT. An OT is a professional uniquely qualified to train patients to use AT to improve functional performance because of the OT’s understanding of the learning process and ability to analyze the interactions between a given patient and an AT device, making changes as necessary.\(^{6}\) The OT has the knowledge to document the need for AT devices by making correlations between cognitive impairments that cause deficits in occupational performance and the specific features of the AT that improve occupational engagement and participation.\(^{6}\) The American Occupational Therapy Association guideline for occupational therapy practice for community-dwelling older adults is to use client-centered treatments “that include a mix of exercise, education, home modifications or assistive technology”\(^{9}\)

#### Prognosis:

- The prognosis for successful use of AT for ADLs varies significantly from patient to patient. Prognosis will depend on factors such as the condition for which the patient is being treated, the patient’s general state of health, the patient’s age, the patient’s familiarity and competency with the AT, and patient-related factors such as motivation and family support. Prior to purchasing one or more AT devices tailored to the individual patient’s needs, the patient should be issued a trial device whenever possible to determine if it will be a good fit for the patient’s lifestyle and needs\(^{10}\)
• On average, the rate of nonuse/abandonment of optional AT is 33% in the first 3 months. Common reasons for abandonment include the following:
  – Changes in functional abilities/needs
  – Lack of motivation to use the device or complete the task
  – Ineffective training or training in the device that was not meaningful for the patient
  – Environmental obstacles to use of the AT
  – Lack of access to or information about repair and maintenance of device
  – Insufficient need for the device or device functions
  – Dissatisfaction with device aesthetics, including weight, size, and appearance
  – Refusal of the insurance company to reimburse the cost of the device

Referral to other disciplines: Successful use of AT requires a multidisciplinary team

• Together with the CTRS, make recommendation/referral to a rehabilitation technology supplier to fabricate AT device(s) appropriate for the patient’s needs
• Referral to physical therapy if the patient has difficulty with gait, balance, mobility, transfers, or has weight-bearing pain
• Referral to speech therapy if the patient presents with speech, language, or swallowing problems
• Referral to neuropsychology for significant cognitive impairment
• Referral to ophthalmology or neuro-ophthalmology for assessment and treatment of visual disturbances
• Referral to dietician if the patient has any feeding or swallowing difficulties and might be at risk for malnutrition; patient might require nutritional supplements or supplemental feedings
• Referral to recreational or vocational therapist for using AT to return to activities of leisure and employment
• Referral to audiology if the patient appears to have a hearing loss
  – AT for hearing impairment includes hearing aids, cochlear implants, and other hearing technology such as closed captioning or FM systems; typically, these AT devices are prescribed by an audiologist
• Referral to psychiatry, psychology, or social work if patient appears depressed or anxious, is having difficulty coping, and/or might benefit from assistance with issues such as facility placement. Social work might also assist in obtaining equipment funding
• Referral to special education teacher for school-aged AT users

Other considerations: AT is a specialized area of occupational therapy intervention; if the evaluating OT does not possess the necessary expertise to recommend suitable AT or train a patient in its use, a referral to an appropriate OT should be made. For patients with severe physical and/or cognitive impairments, it is often necessary to combine multiple AT devices. Because of improved standards in software operating system designs, it has become easier to combine two or more AT devices

Treatment summary

• Traditionally, due to the nature of cognitive disabilities, AT for patients with cognitive disabilities has been simple, with clinicians utilizing colored highlighter tape, pencil grips, reminder lists, and calendars
• High- and low-tech AT options available for patients with reading disabilities include large print, audiobooks, text-to-speech software, and spell check
• Since 2004, there has been a substantial increase in the variety of more complex, high-tech AT options for patients with cognitive limitations
  – The United States Department of Education’s National Institute on Disability Research and Rehabilitation identified a need for additional AT options for patients with cognitive impairments and funded the first Rehabilitation Engineering Research Center for the Advancement of Cognitive Technologies (RERC-ACT) to develop a wider range of new ATs for vocational and literacy development, service provision, and enhanced caregiver supports
  - Developments from RERC-ACT include interactive intelligent agents that assess, instruct, or assist patients with cognitive disabilities in daily tasks and “batteryless” micropower sensors
• The authors of a systematic review of AT for cognition that included 89 papers reporting on 91 studies with AT devices for patients with cognitive impairments discussed the available AT options in ICF
Patients included in the studies reviewed had diagnoses of traumatic brain injury (TBI), acquired brain injury (including TBI and hemorrhagic stroke), dementia, intellectual disability, mental illness, stroke, neurodevelopmental disorder, or mixed diagnoses. According to the systematic review, 67% (61 studies) reported positive treatment effects with AT for cognition. AT for cognition by ICF cognitive functions

Attention functions: according to the ICF, attention is the cognitive ability to focus on either internal or external stimuli for a given period. AT for attentional impairment (including unilateral neglect) was examined in 12 clinical trials. Examples include the following:

- Neglect Alert Alarm: a device that produces auditory tones if the patient hasn’t moved the neglected limb over a predetermined period.
- Content-free cueing devices: devices that provide either an auditory tone or text reminder (e.g., “stop”) to remind the patient to pay attention to or reflect on his or her internal goal status.

Overall, the evidence found in the systematic review for AT for attentional impairments was good, with the best evidence found for the Neglect Alert Alarm.

Calculation functions: ICF divides calculation abilities into simple and complex. The systematic review found no clinical studies that used AT to improve complex calculation ability; however, a single case report found improvement in subtraction ability with AT for dyscalculia.

Emotional functions: ICF describes emotional functions as the specific cognitive ability related to the feeling and affective mechanisms of the mind. Two types of AT for emotional regulation were examined in 6 studies included in the systematic review:

- Personal stereos to manage auditory hallucinations for patients with schizophrenia; evidence for these devices was positive, but the methodological quality was low for these studies.
- Biofeedback devices for patients with anxiety-related disorder; evidence for these devices was good.

Experience of self and time functions: according to the ICF, this category relates to the specific cognitive awareness of time and one’s identity, body, and position in the environment. The only type of AT studied for this ICF category was for navigation (i.e., one’s position in the environment) and involved the use of PDAs and global positioning systems (GPS).

Seven studies with this type of AT were included in the review, and overall the evidence to support their use was limited.

Higher-level cognitive functions: ICF defines higher-level cognitive functions as those dependent on the frontal lobe, or executive functioning.

The ICF further divides higher-level cognitive function into those cognitive abilities that allow for abstraction, organization and planning (as well as carrying out these plans), time management (related to prospective memory), cognitive flexibility, insight, judgment, and problem-solving.

In this systematic review, 25 studies examined AT for organization and planning and 33 assessed AT for time management.

Types of AT in these studies included voice-recorded reminders to perform a task, automatic text messages to cell phones, reminder functions on a smartphone, and scheduling software on a personal computer.

Overall, the studies involving AT for time management found strong evidence of effectiveness; however, because some studies showed mixed or negative results, it is necessary that the technology be appropriately matched to the patient’s specific needs and abilities to promote success.

The 25 studies that examined AT for organization and planning included in the systematic review indicated moderate support for its effectiveness in supporting patients with these areas of deficit.

Memory functions: according to the ICF, memory is the cognitive ability related to registering, storing, and retrieving information. The two main types of AT for supporting memory functioning are cameras and multimedia reminiscence devices. Examples include the following:
- SenseCam: intended to augment long-term memory, the SenseCam is a camera with a sensor attached; it is worn throughout the day and takes still images throughout the day to record the events of the wearer’s day. Images are then downloaded to a computer so the wearer can review them later.
- Multimedia reminiscence tool with touch screen; the user interacts with the system by activating images and sounds to trigger personal memories for the person to discuss.
- The authors of the systematic review found limited support for the use of these types of AT for memory across 7 studies; trials involving patients with dementia indicated that these patients enjoyed the devices, but the devices did not necessarily improve the rate of memory recall or facilitation.

**Authors of a 2010 systematic review of electronic aids for patients with cognitive deficits found 28 papers presenting 25 studies with 423 total participants. Most of the papers were case reports or nonrandomized clinical trials. In the one RCT that was identified, the NeuroPage device (a portable electronic paging system) was found to be effective in supporting participants’ prospective memory. In most studies, various types of AT indicated positive outcomes for supporting retrospective and prospective memory. Although there is not currently enough research, including RCTs, to document the efficiency of AT for patients with cognitive deficits, the research is promising.**

- Authors of a 2010 systematic review of the effect of AT on employment outcomes for patients with cognitive impairments found that AT has a positive impact on job performance.
  - Included 9 studies with 358 total participants, 154 of whom used AT in the study intervention; all of the studies included reported positive effects related to AT intervention, including increased accuracy, independence, and employee/employer satisfaction.
  - The type of technology most helpful for this population was an AT cueing system, which resulted in greater job independence and higher rates of job completion and accuracy.
  - Low- and high-tech AT was used; low-tech cueing systems were typically picture cue books and high-tech devices were handheld PDA-type devices.

**Many mainstream technologies can be modified and used as AT for persons with cognitive impairments, including smartphones, PDAs, pagers, GPS devices, and digital video recorders:**

- Examples include the following:
  - A software program for a PDA can be used to prompt patients with cognitive disabilities through tasks via customization of photos and digitized speech to portray the steps of a specific sequence (e.g., making lunch).
  - Several apps for smartphones are available (for free and for purchase) that can assist patients with memory impairment (e.g., program to remind the patient to take his or her medications).
  - Frequently used numbers can be programmed into a cell phone to make communication easier and more reliable (e.g., “Call Dr. Jones”).

**Using mainstream technologies as cognitive AT is desirable because it provides the patient with a discreet option for AT as well as provides caregivers a means of remote supervision for increased safety.**

- Authors of a literature review on AT used to improve nighttime safety for patients with dementia found that there was good evidence to support its effectiveness.
  - In the evening and nighttime hours, patients with dementia often experience aggression, restlessness, and sundowning (i.e., a state of disorientation and agitation that occurs in patients with dementia in the evening and into the night).
  - Many of the studies included in the review examined the use of AT during the day for mental stimulation or re-orientation; however, improvements in daytime mood can have a positive impact on nighttime behavior as well.
  - Smart homes have been used in many studies for patients with dementia with positive results; sensors and alert systems are installed throughout the home (e.g., on door and window locks, stoves, drawers with knives) to either protect the patient from danger or alert the caregiver of a potential problem. Smart homes are effective during both daytime and nighttime hours.
  - Two studies included simulated presence therapy with verbal instructions (i.e., AT devices that cued patients to perform ADLs such as bathroom routines) and found that these were both effective and affordable solutions for patients with dementia.
  - Other types of AT for patients with dementia that were included in the studies reviewed (with limited evidence to support their effectiveness) were GPS devices for patients who wander, audiovisual devices for reminiscence, music players to provide calming input, devices for mental stimulation/brain training, and caregiver devices.
In a study conducted in Scotland, researchers developed a novel device called “GUIDE” – General User Interface for Disorders of Execution; preliminary studies showed that use of the device showed promise in assisting patients with executive functioning impairments to complete activities of self-care.

GUIDE comprises four components: hardware (laptop), voice recognition software, a protocol/decision tree used to scaffold users’ behavior, and the GUIDE software program.

The protocol/decision tree used to scaffold the users’ behavior is the key component of the GUIDE. It is a meticulously constructed set of steps and checks that helps users complete each task with verbal cues; at the time of publication the researchers had developed protocols for making a smoothie, making tea, donning an artificial limb, and transferring from a wheelchair to bed.

In the first part of the study, with nonimpaired adults, researchers found that GUIDE helped these participants keep focus in order to make a smoothie in the kitchen while having to generate a random number between 34 and 43 every 30 seconds; participants performed better with GUIDE than without GUIDE.

In the second part of the study, a 67-year-old male with bilateral transtibial amputations and visuospatial, attention, and memory impairments used GUIDE to don his prosthesis. Without GUIDE, he donned his prosthesis in 12 minutes; with GUIDE, the time was reduced to 9.25 minutes.

Two years after the original GUIDE study, the same researchers conducted a study using GUIDE with 8 patients with amputations whose baseline performance donning their prostheses was marked by critical safety errors and frequent omissions. Six of the 8 participants performed significantly better with the GUIDE than without.

In a study conducted in Sweden, researchers found that electronic memory aids had good potential for patients with cognitive impairments.

Single-subject study with multiple baseline AB design
Participants in the study (n = 5) had memory impairments resulting from a stroke or TBI at least 1 year before the start of the study and were all motivated to use an EADL to compensate for memory problems.

Each participant received a home-based electronic memory aid that communicated with a wireless network to sensors throughout the home and could be individually adjusted in the participant’s home.

The software program in the electronic memory aid provided a list of actions to remind the user about predetermined items.

For example, if the participant chose to be reminded to take a pill at 5pm and the pill had not been removed, the sensor in the pill box communicated with the electronic memory aid and gave the patient a spoken reminder.

At the conclusion of the 12-week study, 4 of the 5 participants successfully used the memory aid to complete their prioritized, self-selected daily activities and wanted to keep the device at the conclusion of the study; quality of life improved for all participants.

In a study conducted in the United States, researchers examined the effectiveness of a handheld electronic device in providing a virtual support network for caregivers of aging adults and encouraging the division of responsibilities associated with caregiving among family and friends.

Participants included 6 older adult volunteers and 2 spousal caregivers of patients with Alzheimer’s disease (AD).

The AT used in this study was a type of PocketPC technology called the PocketBuddy. The PocketBuddy is a handheld device that was programmed with a “senior-friendly” design and was used by an older adult caregiver to record patient behaviors and the emotional well-being of the caregiver, document daily activities, and schedule appointments. Information was synced to a website (WebBuddy) accessible to selected family and friends.

Participants were trained in the use of the PocketBuddy in a 2-hour session and then used it for 1 to 4 weeks in the home.

At the conclusion of the program, the participants expressed satisfaction with the system, finding that it made them feel more connected to their support network, allowed them to track important information for physicians and therapists, and did not create a significant burden.

In a pilot study conducted in Canada, researchers found that a software program on a PDA, Mobus, had potential for cognitive rehabilitation and increasing social interaction in patients with schizophrenia.

The Mobus software had two connected sub-applications; one application was used by the patient to keep track of the ADLs once each was completed and the other application was used by the caregiver to be alerted when the patient tracked a symptom.

The goal of the study was to have patients track at least one symptom per week and validate 50% of ADLs in their personalized list once they had been realized.

Nine outpatients with schizophrenia used the Mobus program for 6 weeks; on average they tracked 42.61% of ADLs and reported 1.01 symptoms per week; 3 of the patients in the study tracked over 82% of their ADLs in this period.
Researchers found that using the Mobus program helped some of the patients to increase social interaction by planning new activities (e.g., participating in a soccer class).

Although the purpose of the Mobus software is to keep patients connected to their caregivers, some of the patients felt as though they were “being watched,” and researchers noted that this could be prevented by adding a feature in which the patient had control over which information was shared and which was private.

**Intelligent AT:** A field of AT designed for patients with cognitive disabilities (specifically memory and executive functioning deficits) resulting from dementia. Intelligent AT are context-aware devices that receive input from the user via sensors or cameras.

In a study conducted in Canada, researchers distributed an 85-item questionnaire to caregivers of older adults with dementia and found that the 106 respondents reported that they would benefit from intelligent AT that could guide one through personal ADLs that are typically performed in private (e.g., showering, toileting).

Authors of a review of the literature found a range of commercially available and emerging prototype intelligent AT devices for dementia care, including the following:

- Prospective memory aids (e.g., memory glasses; a context-aware memory aid is embedded in the glasses and delivers reminders to the wearer)
- Visuospatial dysfunction aids (e.g., Intelligent Mobility Platform, a walker-based device that uses a laser beam range-finder, a handheld computer with a touch-screen interface, and navigation software to orient the user to the proper direction)
- Fall detectors (e.g., a prototype computer vision-based fall-detection system that uses a ceiling-mounted video camera to detect when a patient has fallen and can alert emergency response teams)

**Computers**

Computers can be used in a variety of ways to achieve goals of patients with cognitive impairments. Examples of computers used as AT include the following:

- A young child with intellectual disability can use early learning software to learn cause and effect and other developmental concepts.
- An adult with cognitive impairment resulting from a TBI can manage his or her schedule and finances with computer software built for these purposes.

Computers can be modified in many ways to meet individual needs, including using inbuilt software programs as well as by using sensors that are triggered by specific events (e.g., a patient who is supposed to take an afternoon rest has a sensor on his or her bed and is reminded by the computer to lie down if he or she is not lying down by a certain time).

Computer input modifications: the computer keyboard and mouse can both be modified to meet individual patient needs.

- A “sticky key” option allows a user who can depress only one key at a time (with one finger or mouth stick) to replace simultaneous keystrokes (e.g., shift+1 for !) with sequential keystrokes to produce the same action.
- Control enhancers such as an easel for keyboard positioning or trackball to increase mouse control are simple ways to allow for direct selection.
- Alternatives to standard keyboards include miniature keyboards requiring less ROM/reach or large keyboards with increased key size, making one-hand typing easier; when keyboard modifications are not effective, speech recognition, pointing a cursor to an on-screen keyboard, or eye gaze can be used for text entry.
- Alternatives to a traditional computer mouse include joysticks and head-controlled technologies.
- Full descriptions of accessibility options for computers are available on company websites (e.g., Apple Computer Inc., Microsoft Corporation).

Activity output for computers: computers can be connected to many commercially available products to support independent living, including kitchen timers, alarm clocks, doorbells, and fire alarms.

- Additionally, closed-circuit television technology can enable an AT user with low vision to enlarge anything placed in front of the camera display (e.g., TV guide, electric bill, needle and thread).

In a qualitative, exploratory study conducted in Sweden of computer-based AT for patients who had a stroke, researchers found that this type of AT was able to improve the lives of these patients.
- The 4 participants in the study were all over age 65 and had a stroke at least 1 year prior to the study; each of the participants completed the study with an informal caregiver (spouse or child)
- The pairs were trained to use a specific computer-based AT system, the Tentaculus System (TS), that has been shown to support memory for self-selected activities and tasks after stroke; the TS was then installed on the home pairs’ home computers
- To be a candidate for this study, the participant must have expressed a desire or need for the specific type of memory support provided by TS
- After 6 months, the following positive outcomes were reported by the patients:
  - Increased security and control during performance of ADLs (e.g., taking medications independently given reminders from TS)
  - Increased control of time and recreated daily structure (e.g., TS reminding the patient to perform his or her exercises)
  - Regained social contact
  - Reduced responsibilities for the caregiver/regained personal responsibilities for the patient

- AT for driving
  - Driving typically is difficult for patients with moderate to severe cognitive deficits due to the combination of high-level cognitive abilities and physical functioning necessary to drive safely
  - Specially trained professionals, sometimes OTs, called driver rehabilitation specialists (DRS) will assess a patient’s ability to drive and determine if the patient is an appropriate candidate for AT to allow him or her to return to driving
  - AT for driving includes intelligent transport systems (ITS) and advanced driving systems (ADS)
  - Even with the use of AT, it still might not be possible for a patient with significant cognitive impairment to drive given the complexity of driving and the potential risks posed to both the patient and other drivers on the road

> See Description, Indications of AT for patients with cognitive impairment, and Guidelines for use of AT for patients with cognitive impairment, above
<table>
<thead>
<tr>
<th>Impairment of ADL/IADL performance related to cognitive impairment</th>
<th>Increased functional independence with ADLs and IADLs</th>
<th>Prescription, application of devices and equipment</th>
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<tbody>
<tr>
<td></td>
<td>Increased functional independence with ADLs and IADLs</td>
<td>Exact progression of therapeutic tasks and inclusion of AT when performing ADLs/IADLs will vary according to patient goals and underlying diagnosis/presentation</td>
</tr>
<tr>
<td></td>
<td>Prescription, application of devices and equipment</td>
<td>Initially, break ADL/IADL tasks down into separate parts and train the patient in how to use the AT to increase ability to perform the tasks; with increased patient tolerance, have the patient perform progressively longer segments of each ADL/IADL task at a time</td>
</tr>
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<td></td>
<td>Computing with modifications to system input as necessary</td>
<td>Caregiver education is important for carryover of ADL/IADL training into environments outside of the therapy room</td>
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<td></td>
<td>Smartphone technology (e.g., set timers for medication management, ADL activity reminders/cues)</td>
<td>The patient should use the AT device, as prescribed, in all home, work, and leisure settings to increase independence with ADLs/IADLs</td>
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<td></td>
<td>AAC device to assist with patient directing care and alerting caregiver to needs</td>
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<td></td>
<td>Digital photo album (e.g., provide pictures/cues for ADLs)</td>
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<td></td>
<td>PDA/daily assistant</td>
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<td>See Treatment summary, above</td>
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<tr>
<td>Reduced functional independence resulting from impaired memory</td>
<td>Increased functional independence</td>
<td><strong>Prescription, application of devices and equipment</strong></td>
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<tr>
<td>Smart home (e.g., alarms to notify caregivers of door/window opening)</td>
<td>Appliance with automatic shut-off capability</td>
<td>PDA/daily assistant</td>
</tr>
<tr>
<td>See Treatment summary, above</td>
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<tr>
<th>Reduced safety or hygiene as a result of dementia or other severe cognitive impairment</th>
<th>Increased safety or hygiene</th>
<th><strong>Prescription, application of devices and equipment</strong></th>
<th>Exact progression of therapeutic tasks and inclusion of AT during functional activities will vary according to patient goals, underlying diagnosis, and presentation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intelligent AT (e.g., memory glasses, fall sensors)</td>
<td>Smart home</td>
<td></td>
<td>Caregiver education is important for AT success for patients with dementia or other severe cognitive impairment outside the therapy room</td>
</tr>
<tr>
<td>See Treatment summary, above</td>
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**Desired Outcomes/Outcome Measures**

› Increased functional independence with ADLs and IADLs with the use of AT

  - AMPS
  - Assessing students’ needs for AT
  - Barthel Activities of Daily Living Index
  - Education Tech Points
  - FIM
  - KELS
  - MPT
  - PSMS
• WeeFIM
  › Increased patient safety\(^{(10)}\)
  › Improved quality of life\(^{(7)}\)
• MPT
• SF-36
• COPM
› Reduced caregiver burden\(^{(2)}\)
  • Decreased caregiver burden is often a desired outcome for AT. The Caregiver Assistive Technology Outcome Measure (CATOM) measures the impact of AT on caregiver burden\(^{(24)}\)
  – 18-item evaluation that includes identification of the activities with which the caregiver(s) assist and for which they would be open to using AT; and caregiver rating of burden experienced with a selected activity and overall
  – Preliminary validation has shown good content validity for the CATOM

**Maintenance or Prevention**
› All high-tech AT devices will require regular maintenance to keep them in good working condition and to promote the best possible functioning; some low-tech devices will also require maintenance as well as cleaning

**Patient Education**
› For information about the Rehabilitation Engineering Research Center for the Advancement of Cognitive Technologies, see [http://www.ucdenver.edu/academics/colleges/Engineering/research/AssistiveTechnologyPartners/research/RERC/Projects/Pages/Projects.aspx](http://www.ucdenver.edu/academics/colleges/Engineering/research/AssistiveTechnologyPartners/research/RERC/Projects/Pages/Projects.aspx)
› The Pass It On Center is a United States nonprofit organization that creates national and state resources to promote the appropriate reuse of AT so that individuals with disabilities can get the affordable AT they need to live, learn, work, and play more independently, [http://www.passitoncenter.org/](http://www.passitoncenter.org/)

**Note**
› Recent review of the literature has found no updated research evidence on this topic since previous publication on November 4, 2016

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**Coding Matrix**

References are rated using the following codes, listed in order of strength:

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
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<tbody>
<tr>
<td>M</td>
<td>Published meta-analysis</td>
</tr>
<tr>
<td>SR</td>
<td>Published systematic or integrative literature review</td>
</tr>
<tr>
<td>RCT</td>
<td>Published research (randomized controlled trial)</td>
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<tr>
<td>R</td>
<td>Published research (not randomized controlled trial)</td>
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<tr>
<td>C</td>
<td>Case histories, case studies</td>
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<tr>
<td>G</td>
<td>Published guidelines</td>
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<tr>
<td>RV</td>
<td>Published review of the literature</td>
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<td>RU</td>
<td>Published research utilization report</td>
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<td>QI</td>
<td>Published quality improvement report</td>
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<td>Legislation</td>
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<tr>
<td>PGR</td>
<td>Published government report</td>
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<tr>
<td>PFR</td>
<td>Published funded report</td>
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<td>PP</td>
<td>Policies, procedures, protocols</td>
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<td>Practice exemplars, stories, opinions</td>
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<td>GI</td>
<td>General or background information/texts/reports</td>
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<td>U</td>
<td>Unpublished research, reviews, poster presentations or other such materials</td>
</tr>
<tr>
<td>CP</td>
<td>Conference proceedings, abstracts, presentation</td>
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**References**


20. Assistive technology can benefit clients in multiple situations. Case Manage Advis. 2010;21(6):61-64. (X)


