Assistive Technology for Healthcare

2.0 Contact Hours

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Assistive Technology for Healthcare

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Objectives:

At the conclusion of this course, the learner will be able to . . .

1. Define assistive technology
2. Identify three basic categories of low-tech assistive technology options
3. Identify three basic categories of high-tech assistive technology options
4. List at least three "pros" and at least three "cons" of assistive technology

Technology wakes us every morning and carries us through the day. It enables our communication, recreation and transportation. In essence, technology fuels and facilitates our very lives. As our technological capabilities expand exponentially each year, so do the applications of technology, especially in the field of healthcare. Out of this broadening arena of healthcare technology has come the assistive technology concept, a concept redefining the future of rehabilitative healthcare.

Webster's Dictionary (1993) defines "assist" as "to give support, to aid, to give help." It defines "technology" as "application of scientific knowledge to serve man in industry, commerce, medicine and other fields." By definition, then, the term "assistive technology" describes the application of scientific knowledge to give support, aid and help to those who need it. Although simplistic, this working definition embodies much of what assistive technology is all about.

A more complex and detailed definition of assistive technology is found in the *Technology-Related Assistance for Individuals with Disabilities Act of 1988* (P.L. 100-407) – one of only three major pieces of assistive technology legislation passed in the past two decades. This Act defines assistive technology as "any item, piece of equipment or product system, whether acquired commercially or off the shelf, modified or

customized, that is used to increase, maintain or improve functional capabilities of individuals with disabilities." This definition is considered the standard in the field, as it comes directly from groundbreaking assistive technology legislation.

The *Technology-Related Assistance for Individuals with Disabilities Act of 1988* (P.L. 100-407) was the first legislation of its kind, recognizing disability as a normal element of human existence and pinpointing technology as a potential avenue to a fulfilling life. This Act was amended in 1994 (P.L. 103-218) and new legislation – the *Assistive Technology Act of 1998* (P.L. 105-394) – just four years later. Together, these acts dictate many of our current assistive technology policies.

Assistive technology policies have established grants, subsidies, loans and reimbursement for those who use assistive technology and those who design, develop, produce, sell and educate others about assistive technology products. Most assistive technology policies are focused on distribution of federal funds and support and education for assistive technology users, their families and care professionals.

Assistive technology often requires extensive support and education, as its implements are so broad and varied. These technologies range from simple tools – such as grab bars and non-slip rugs – to highly complex and elaborate sensor networks and "smart" technologies. With literally thousands of options, assistive technology can and should be highly personalized for individual situations.

Low-tech assistive technology options are generally best for those who need mild to moderate amounts of assistance. These tools are not on the cutting edge of development; in many cases, they have been around for years, or even decades. Despite their lack of complexity, low-tech assistive technologies can be the perfect solution for mildly impaired individuals.

Low-tech assistive technology tools generally fall into three basic categories:

- **Mobility Aids** – Devices that help an individual move within a fixed environment or between two or more environments.

- **Sensory Aids** – Devices that establish or enhance capabilities related to the five basic senses or cognitive ability.

- **Communication Aids** – Devices that assist in communication, whether local or long distance.

Mobility aids come with a variety of forms and functions. Many low-tech mobility aids are in fixed positions and are very simplistic. These aids include grab bars in bathrooms and other settings, hand rails on staircases and ramps, non-slip mats on floors, and chairs and beds that help elevate a user to a sitting or standing position.

Fixed mobility aids are often especially helpful for patients who can do many things for themselves but need extra stability. These aids are generally not helpful for patients with severe physical impairments or those who need extensive help with mobility. Fixed mobility aids are widely available and are among the least expensive assistive technology tools.

Another group of mobility aids includes portable aids, many of which are very common. Canes and crutches, wheelchairs, walkers and motorized scooters all fall into this category. Motorized scooters may seem more like high-tech tools, but they are still very basic when compared with recent high-tech advances in assistive technology.

Portable mobility aids are useful for patients with a strong sense of independence and a need or desire for greater mobility than they can achieve on their own. Patients often need some level of training on these tools, but the required training is generally simple

and well-received. And like fixed mobility tools, portable mobility devices are easy to procure and relatively affordable.

In addition to mobility tools, low-tech assistive technologies also include a number of sensory aids. Most of these sensory aids are familiar and designed to increase the abilities of the five senses – sight, hearing, taste, touch and smell. Common tools such as glasses and hearing aids fall into this category.

In addition to these basic aids, there are also more complex options, such as sophisticated reading machines that scan and magnify documents or even read written information out loud. While few of us will ever use these more complex sensory aids, many of us currently use – or will someday use – some sort of basic sensory aid, making this category among the most widely used of all assistive technologies.

Sensory aids are often highly personalized and can assist even those with severe sensory impairments. They range widely in price and availability, depending on individual needs. Additionally, many sensory aids require consultation with a physician or therapist for proper customization.

Another class of sensory aids goes beyond the five senses and tackles mild cognitive impairments, such as those found in head injuries and early stage dementia. Loss of cognitive ability is among the most frustrating and demoralizing disabilities for patients, families and care professionals. Simple, low-tech assistive technology tools can assist in these situations, especially when cognitive impairment is slight and more complex cognition aids are not yet needed.

Low-tech cognitive aids include simple devices like portable voice recorders, pill organizers and electronic data organizers with calendar and list functions. These basic devices are easy to acquire and fairly inexpensive. They are ideal for patients who are able to live independently but need some assistance with memory and other simple cognitive functions.

The final category of low-tech assistive technologies includes tools designed to improve a patient's ability to communicate with others. Many of these tools – phones, cell phones, computers – are familiar devices that we rarely think of as assistive technology. But these devices may assist with local communication (within a room, building or complex) or distance communication. And in improving and enhancing communication, these tools make patients' lives more complete and fulfilling.

Local communication aids assist patients with communication in a small area, usually within a single building or group of buildings. These are tools that we often use every day without really thinking about it. They include intercom systems and call buttons, among other devices. These tools are particularly valuable for moderately to severely impaired patients who need assistance with basic tasks and activities of daily living.

Distance communication tools, like local communication devices, are especially helpful for those who have high levels of impairment. Something as simple as a telephone designed to meet a person's individual needs (sensory impairments, cognitive disorders, etc.) can add an important social dimension to an otherwise lonely life. And more high-tech options, such as simplified cell phones or computers can further assist with distance communication. Communication tools often uniquely blend low-tech and high-tech elements to create necessary devices.

While low-tech devices are beneficial, it is the high-tech assistive technologies that have recently shown the greatest development and future potential. The simple advantages of low-tech devices have been expanded into elaborate tools with multiple applications. Extensive sensor networks, intelligent monitoring options and other technologies prove useful to a wide variety of patient populations.

High-tech assistive technology tools generally fall into three basic categories:

- **Sensor Technologies –** Devices that use various types of sensors to track physical and/or physiological data.

- **Monitoring Technologies –** Devices that use one or more types of monitors to track behavior and/or other data.

- **"Smart" Technologies –** Devices that use a form of artificial intelligence to learn, predict and direct behaviors.

Sensor technologies have become increasingly sophisticated over the past few decades. Many sensors are now so small that they are virtually invisible, and many use radio frequency identification (RFID) technology to increase their effectiveness. Most modern sensors can transmit data wirelessly, making them convenient and efficient. This new breed of sensors comes in two forms: fixed sensors and portable/wearable sensors.

Fixed sensors are often used to monitor activities or alert care professionals in the event or unusual or dangerous behaviors, such as a fall. Bed sensors are popular for tracking vital signs and important sleep data. Other popular fixed sensors include light sensors, which can automatically adjust the light level in a room when someone enters or exits; chair pad sensors, which can sense when a person rises from a chair unattended; and appliance sensors, which can sense when a stovetop or coffee pot is left on unintentionally and can turn the appliance off.

Many fixed sensor technologies are still being developed by both corporations and university research centers. One of the most promising technologies for the future includes networks of sensors embedded in frequently-traveled floor areas. These sensors are designed to sense gait patterns and to help prevent falls in mobility-impaired patients, especially those who are elderly. Gait sensors – as well as other sensors in development – show great promise as assistive technologies of the future.

Similar to fixed sensors, portable and wearable sensors are used to help identify and prevent problem behaviors. They are also used to track activity patterns and health data. One of the most innovative and important devices in this field is the portable pillbox sensor. Pillbox sensors can be attached to or come built into a standard compartment-type pillbox. These sensors will issue an alert to a patient or designated care professional when a medication dose is missed or taken at the wrong time. As medication adherence is one of the biggest challenges for most patients, these pillbox sensors can be invaluable. Pillbox-type sensors, with all the same functionality, are also available in wristwatch and pendant-type necklace models.

Another type of portable sensor includes clothing and accessory sensors. These wearable sensors are mostly still in development, but one major company is in the final stages of testing for shirts with embedded fiber optic sensors that can monitor vital signs and wirelessly notify a doctor of potential health issues. Such a shirt could be lifesaving for patients with heart or respiratory disorders. Wearable accessory sensors are also in the works, with several universities working on ring sensors. These rings are fashioned like costume jewelry, but with integrated sensors that can track and communicate vital health data without inconveniencing the wearer.

Like sensors, monitors are generally used to track behaviors and health data. While sensors are fairly well accepted, however, and considered compatible with personal privacy, many patients feel that monitors are more intrusive and violate their privacy. This belief is partially grounded in the fact that many monitors use real-time or delayed feeds of video or audio. Most patients and care professionals feel that these "big brother" monitoring systems invade their privacy in an unacceptable way.

Perpetuating this feeling is the fact that many monitors have continuous feeds, meaning that data is sent continuously to a base station or outside computer. As a consequence of perceived privacy violations, these continuous-feed monitors are gradually losing popularity in favor of user-controlled models that are less intrusive. Many patients and

care professionals feel more comfortable with the concept of monitoring when they can exercise a measure of control over when and where the monitoring occurs.

New user-controlled monitors allow patients and/or care professionals to decide when data will be transmitted. This is a very personal decision that should be made in conjunction with the monitoring physician or care service. User-controlled monitors are especially useful for patients whose vital signs or other health functions need to be checked regularly. Popular monitors and monitoring systems currently on the market can monitor basic vital signs, social interactions, medication adherence and cognitive function. One foreign company has even designed a toilet that can automatically perform a urinalysis and monitor and report any abnormal results.

When monitors, sensors and artificial intelligence elements come together, the result is "smart" technology, a relatively new field of assistive technology devices. While it could be argued that all high-tech devices exhibit a degree of "smartness," true "smart" technologies have a remarkable ability to "learn" and adapt to the specific needs and abilities of an individual patient. While many of these "smart" technologies are still in development, they promise to essentially define assistive technology for the future.

Basic "smart" technologies are becoming available for purchase, including "smart" wandering sensors that use RFID technology to allow certain patients more freedom to roam than others, and behavior pattern tracking systems that can identify normal behavior patterns for an individual patient and report any abnormalities. These simple tools demonstrate just a fraction of the potential applications of "smart" technology. Future innovations that are currently in development include appliances that talk a user through a cooking process, walkers that alert a patient when a curb or step is coming up, phones that identify a caller and recount topics of previous conversations, and many other upcoming innovations.

With so many options and potential applications, assistive technology seems like an incredible asset for healthcare environments – and in many ways, it is. Like any

beneficial tool or system, however, assistive technology has both pros and cons associated with it. Before using assistive technology or implementing an assistive technology program, it is important to educate yourself on both the benefits and drawbacks of these technologies.

Assistive technology has undeniable benefits for patients who use the technology. One recent study showed that the use of monitoring and sensor technologies increased perceived quality of life almost universally among patients and their families (Alwan, et. al., 2006). The same study demonstrated that assistive technology also increased patient satisfaction with quality of care.

In addition to improved quality of care, assistive technology has been shown to generally improve levels of patient function. Assistive technology – whether high-tech or low-tech – is designed to make life safer, easier and more comfortable for those with disabilities or impairments of any type. In fact, recent research has shown that assistive technology – more than any other type of intervention – helps maintain patient independence and function (Baker and Bass, 2003).

In addition to patient benefits, assistive technology is also an asset to care professionals. Recent studies have demonstrated that assistive technology reduces stress and increases the efficiency of care professionals (Consolvo, et. al., 2004). The same study also proved that assistive technology improves and increases the quality and consistency of patient care.

Despite these proven benefits, however, assistive technology does have some potential drawbacks. Some patients exhibit a definite resistance to assistive technology, fearing that it will make them seem old or infirm. To many patients, assistive technology seems like medical equipment, rather than a tool to make them feel more alive and capable (MacMillan, 2006).

There is also the challenge of the learning process for both patients and care professionals. While some assistive technologies are basic and simple to use, many are highly complex and require formal training. To learn the proper use of these sophisticated devices, patients and care professionals must commit to the training process and must learn the proper use of each assistive technology device being used.

Care professionals and facilities must also face the drawback of maintaining and upgrading assistive technologies. Because technology and medical knowledge are both expanding at a breathtakingly rapid pace, assistive technology devices often have to be upgraded or, at the very least, routinely maintained to keep them functioning at an optimum level. This can be both costly and time consuming.

If the benefits of assistive technology outweigh the drawbacks in your situation – as they do for many care professionals and patients – your next step is finding the right tools for your needs. Assistive technology is highly individualistic, and mismatches between patients and technologies are the most common cause of assistive technology failure. The best way to prevent such mismatches is through complete and frequent needs assessments.

The needs assessment process has four basic elements. The first step is to realistically evaluate the needs of the patient who will be using the technology. The second step is to identify challenges to the patient's functioning and quality of life. The third step is to find technology that can assist the patient in achieving a higher level of functioning and improved quality of life. The final step in the needs assessment process is actually a periodic reassessment, evaluating the continuing effectiveness of the technology match. Reassessment should be thorough and should take place at least twice each year, as well as whenever a major change in function or ability occurs.

The right assistive technology, matched with the right patient, can be a great asset to everyone involved. Whether low-tech or high-tech, assistive technology is the wave of the future, particularly in the field of rehabilitative health care. With so many options to

choose from – and with technology advancing almost daily – finding the right tool is a matter of careful needs assessment and assistive technology research. You may wonder if the benefits of assistive technology are worth the effort required, but for many patients and care professionals, assistive technology is the difference between mere existence and true living.

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