Using applied behavior analysis and smart technology for meeting the health needs of individuals with intellectual disabilities

Linda K. Haymes1, Keith Storey1, Ana Maldonado1, Michal Post1, & Joyce Montgomery2

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Abstract

Objective: Individuals with intellectual disabilities often have special healthcare concerns such as diabetes, kidney disease, severe allergies, progressive illnesses, respiratory weaknesses, and obesity. Smart technology can be an asset for individuals with intellectual disabilities for better managing their healthcare needs.

Methods: A critical review of the literature related to applied behavior analysis, smart technology, and health needs of individuals with intellectual disabilities was conducted.

Results: This discussion paper describes factors that contribute to the successful use of smart technology for the health issues of individuals with intellectual disabilities.

Conclusions: We see key components in developing appropriate access and use of smart technology for the health of people with intellectual disabilities being: (a) systematic instructional methods for consistent and accurate use of the technology, (b) modifying the current technology for people with intellectual disabilities, (c) guidelines for implementation, and (d) resources for getting the technology.

Subject Review

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Keywords

Applied behavior analysis, intellectual disabilities, smart technology, telehealth

History

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Poor quality of life outcomes for individuals with intellectual disabilities are evident in the limited progress individuals with intellectual disabilities have experienced in being competitively employed, realizing quality living standards, and for being active participants in community life [1, 2]. Unaddressed healthcare concerns and poor management of health needs contribute to this lack of progress [3].

The National Survey of Children with Special Health Care Needs Survey [4] indicates that individuals with disabilities with special healthcare needs often fail to learn how to manage their health issues and access needed healthcare services which puts them at risk for failure in being able to hold a job, get a higher education degree, and live independently in the community. Findings in a study by Reichard et al. [5] indicate that individuals with disabilities receive fewer preventive disease services and have poorer health than individuals without disabilities who have the same health conditions. Rimmer et al. [6] found that youths with autism and Down syndrome were two to three times more likely to be obese than adolescents in the general population. Additionally, the findings indicated that obesity in the adolescents with intellectual disabilities caused secondary health issues (hypertension, hyperlipidemia, diabetes, liver or gall bladder problems, pressure sores, depression, fatigue, low self-esteem, preoccupation with weight, and precocious maturation).

Individuals with intellectual disabilities who have chronic progressive illnesses such as diabetes, kidney disease, severe allergies, asthma, anemia, and obesity, to name only a few, will need to create a medical plan and be able to understand the implications on their healthcare needs [7–11]. Additionally, due to the progressive nature and increase in the severity of health issues as people age, individuals with intellectual disabilities will often need to learn how to plan for consistent treatment and the necessary skills for self-management throughout their life [12–14].

Knowing ahead of time what anticipated accommodations and support will be needed may avoid disruption to life routines that negatively impact family and community life and avoid loss of job or education pursuits. Learning to assess one’s situation and plan for the future is a key self-determination skill that needs to be learned as early as possible in school, but no later than the high school transition years [15]. Special education teachers, related personnel staff, and rehabilitation service staff need to be aware of the many health-related issues to specific disabilities and the health services available to students so, together with students and parents, a proactive health plan and strategies for support can be developed [3, 16–19]. Additionally, understanding the family culture and perspective on health concerns as it impacts the student’s choices is of critical importance in planning and implementing effective transition [20, 21].
The National Center for Secondary Education and Transition reports that we now have the first generation of students with special healthcare needs who are living beyond their initial expected life span. Nationally, less than half of youth with special healthcare needs successfully transition to adult healthcare systems [22]. Knowing how to manage health issues increases a student’s chances of a successful transition from school to a productive adult life [8, 23]. Students with intellectual disabilities need to understand the relationship between having accurate knowledge about their health needs and making healthy lifestyle choices, such as positive choices for diet, exercise, self-care, seeking care, sharing information with healthcare providers, managing chronic disease, and health-related media [24].

With the advent of smart technology, many individuals with intellectual disabilities can now learn to manage many of these healthcare needs in a format that is easier to access and understand. For example, a review of 15 studies on the use of iPods, iPads, and iPhones in teaching programs for individuals with developmental disabilities in the domains of academics, communication, employment, leisure, and transitions indicates positive results in using smart technology to learn targeted skills in all five areas [25].

Smart technology can be an asset for individuals with intellectual disabilities for better managing their healthcare needs and for accessing healthcare services. The purpose of this paper is to present an overview of and recommendations regarding the uses of smart technology and applied behavior analysis (ABA) to assist and support individuals with intellectual disabilities in managing their own healthcare needs.

What is smart technology?

Smart technology in healthcare broadly refers to the combined use of information and communication technologies and health monitoring devices and covers a wide variety of technologies such as internal (implants for monitoring physiological signals), devices integrated into clothes (wearable technologies), and smart house technologies [26, 27]. Smart technology may involve a variety of systems such as a computer, cell phone, Personal Digital Assistant, voice activation system, touchpad controller, and/or other device such as a remote control that can interact with and manipulate the devices in the environment that the person is functioning in. Control can be through radio frequency, infrared extension units, or sound (such as clapping to turn lights on or off). These may be thought of as networks between systems that are controlled by smart technological devices, which are then controlled by an individual (or individuals). Mann and Milton [28] put smart house functions into eight levels based upon complexity and availability and these apply to functions for health as well. These are:

Level 1: Offers basic communications (e.g. interactive voice and text communication by phone).
Level 2: Responds to simple commands (e.g. open cabinet with medication).
Level 3: Automates household functions (e.g. controlling air temperature).
Level 4: Tracks location, behaviors, and health indicators of the individual (e.g. determining vital signs).
Level 5: Analyzes data, makes decisions, takes actions (e.g. issues alert regarding health problem to supported living coordinator).
Level 6: Provides prompts to the individual (e.g. medication reminder).
Level 7: Answers questions by the individual (e.g. “Did I take my medication today?”).
Level 8: Make household arrangements (order medication).

One increasingly used smart technology is the use of smart phones, as these devices have many capabilities beyond phone calling. Thus, it is important to consider the use of smart phones for both communications (such as contacting a medical provider) as well as for supporting individuals with their medical needs (e.g. interventions for sleep management issues, maintenance of glucose levels with diabetes). For example, an individual can receive communication (regarding time to exercise or remembering schedules or routines) through calls, texts, or tweets as well as by programming the smart phone for prompts (using icons, pictures, text, and/or voice) in these areas.

Technological advances have also made it easier for individuals to operate electronics through the use of electronic control devices (environmental control units (ECUs)) or interface devices. ECUs may be controlled through voice activation systems, remote controls, switches, and/or the use of smart phone applications [26, 29–31]. The ECUs then control the application through the use of infrared or other technology. For example, ECUs can be programmed to control lights, televisions, thermostats, etc., which makes an individual more independent and less dependent upon support providers. It is important to remember that one ECU may be used or multiple ECUs used for different functions (e.g. a computer to preset temperature controls and a remote control for controlling electronic devices such as stereo, television, lights, etc.).

Uses of smart technology in the delivery of medical care

For many years, healthcare systems have used technology for testing, imaging, and the advancement of surgical techniques. In the rapidly developing technological environment of medicine, there are increasingly advanced services and healthcare delivery innovations applied to patient care. Additionally, the development of essential medical devices has enhanced the diagnostic and treatment spectrum for clinicians and patients [32]. Through the use of technology, medical providers have advanced the level of care in screening and prevention as well as in the diagnostic and treatment domains of medical care. The ongoing and critical component of medical intervention lies in the extrapolation of these advances to patients and the caregivers in the home and community. For example, the use of telehealth technologies and smart devices in day-to-day patient care is increasing exponentially as healthcare providers, insurers, and patients experience the benefits and efficiency of these integrated models of care.

A prime example of this approach to community-based, integrated care has been developed by the
Veteran’s Administration (VA) medical services. Currently, the VA cares for thousands of chronically ill patients across the country. Many of these patients have problems obtaining adequate, timely transportation, and other supportive services to access their medical providers. Additionally, many of these patients have complex diseases as well as cognitive disabilities, which compromise their capabilities to maintain their care. Through the use of the telehealth services, patients within the VA system that have been identified by their primary care providers, are those individuals who receive daily one on one medical support from a service staffed by nurses, dieticians, and pharmacists. The telehealth system utilized by the VA functions by instructing the patient and/or their caregiver in inputting the data of the patient’s weight, blood sugars, blood pressures, and other health assessments measures. From this real-time communication, clinician evaluation of data input, transmitted via telehealth hardware installed in the patient’s home, assists the patient in obtaining timely medical recommendations, which then assist them in adjusting their treatment interventions. This ongoing communication facilitates the identification of potential medical abnormalities and addressing them in a timely manner. Subsequently, for the patient and/or their caregiver, this telehealth service functions as an empowering method of collaborative care, which addresses the individual patient’s needs over real-time.

Health issues and intellectual disability

As noted above, individuals with intellectual disabilities often have a variety of health issues secondary to progressive chronic illnesses such as diabetes, obesity, kidney disease, severe allergies, asthma, hemolytic, and pulmonary diseases. Maintaining maximal health is combined with their individual need for accurate knowledge and real-time feedback about their health status and needs. The encouragement and support to make healthy lifestyle choices with the use of smart technology involves matching the technology with the individual and their health needs. Healthcare providers must thus be aware of specific smart technology available to assist the individual with monitoring, evaluating, and reporting recommendations for the management of their chronic health needs. For example, in a diabetic patient, close monitoring of caloric intake and ongoing evaluation of blood sugar content is essential for reducing potential end-organ damage from hyperglycemia. Variations in blood sugar which are directly influenced by total caloric intake and physical activity can be monitored, evaluated, and reported to the patient or their caretaker in real-time through the use of a glucometer and a smart device application. The diabetic individual can then alter their intake as well as their use of insulin to respond to the hyper or hypoglycemic events that can occur throughout the day. This level of real-time control significantly reduces the potential damage to kidney and circulatory function.

Additionally, in a telehealth setting, patients are monitored in their home environments by their primary care providers simply by providing information collected at home and transmitted with smart technology. This health status information, such as blood pressure readings, weight, oxygen level status, blood sugar values can be interpreted by the healthcare team off-site and recommendations for management alterations advised without requiring the burden of an office visit.

ABA and systematic instructional methods

ABA is defined as the science in which the principles of the analysis of behavior are applied systematically to improve socially significant behavior and in which experimentation is used to identify the variables responsible for change in behavior [33, 34]. For individuals with intellectual disabilities, applied behavior analysts use systematic instructional strategies in order to develop skills and support that these individuals need to be successful in the criterion environment (home, work, community, and/or school) in which they must address their health issues [35]. Evidence-based applications of these principles include: building the skills of students in school settings; accessing community supports; initiating doctor visits; following multi-step instructions; and developing communication with significant others. People with intellectual disabilities often are supported in their acquisition of skills with the use of the principles of ABA. These principles include forms of systematic instruction such as task analysis, discrete trials, prompt hierarchies, video modeling, use of reinforcement, general case programming, and self-management.

To facilitate access to healthcare using smart technology, individuals with intellectual disabilities will need systematic teaching on use of the devices. It cannot be assumed that the individuals will successfully learn to use the smart technology without systematic instruction in their use.

Task analysis

When people with intellectual disabilities are introduced to a new piece of equipment or tool they often require systematic instruction to use the tool independently, properly, and consistently. One form of systematic instruction that has been shown to be effective for acquisition of multi-stepped activities is task analysis and chaining. A task analysis is used to teach a complex skill by breaking it down into small teachable units where each step leads to the next step. The small steps are sequentially ordered. Chaining is the process of performing a sequence of functionally related responses in an exact order to complete a more complex task. Each step in this chain becomes a discriminative stimulus for the next response in the chain. Individuals with intellectual disabilities will often learn complex tasks such as making a phone call to a doctor, evaluation of blood sugar content with the Glucose Buddy®, accessing a website, or performing daily chores related to health needs through the use of task analysis with either backward chaining or forward chaining.

For example, Van Laarhoven et al. [36] taught an adolescent with intellectual disabilities to use a video iPod as a prompting device in his employment setting. Prior to using the iPod in the work place, the adolescent was provided with systematic instruction on use of the device, the instruction included a task analysis. Similarly, a task analysis can be used for accessing the photos contacts list on a smart phone for contacting a primary care physician or telehealth system.
Discrete trial teaching

A discrete trial consists of a concise and consistent instruction or question, a response to the instruction, followed by a specific consequence for the response [37, p. 374]. For instance, Van der Meer et al. [38] used a discrete trial format to teach students to use three means of communication, manual signing, picture exchange, and speech-generating device for communicating what their preference (for food or play). All participants learned to make specific requests with one of the communication modes through use of discrete trial teaching (DTT). In the same way, DTT can be used to teach individuals to use the Glucose Buddy. The Glucose Buddy provides a push reminder (the $S^D$ or discriminative stimulus) via the app for smart phones, the person uploads the data directly to the app and receive access to positive reinforcement through social praise or a preferred community activity.

Prompts, corrections, and fading

In addition to using the task analysis and DTT to access the smart technology and use it effectively, it is important to consider how to most effectively use prompts and corrections in instruction. Prompts are an added antecedent stimulus, which increases the probability of a correct response. Prompts include verbal instructions, gestures, models, and physical guidance presented in a hierarchy or with a time delay. Time delay is a prompt fading strategy, where a delay is inserted between the instruction ($S^D$) and the response prompt (e.g. gesture). This is used to minimize errors during the fading process and transfer stimulus control from the prompt to the natural cue or instruction [39]. Common prompts include pictorial or written prompts as well as video-based models. A correction procedure refers to supplementary or corrective information to communicate to a learner that a response already performed is inappropriate or that a different response is needed [35].

Individuals with intellectual disabilities have been taught to successfully and independently use devices which can be used in healthcare such as the iPad, iPod Touch, iPhone, and other tablet-based devices for communication [40, 41] leisure [42, 43] and employment [36, 44]. It is also possible for the smart technology device to deliver prompts and instructions. For example, the Prodigy Voice® Meter has been developed for individuals with visual impairments. The individual simply inserts the glucose test strip and the meter turns on automatically, reads, records, and audibly reports the blood glucose reading. Additional features of the Prodigy Voice® is that it will “talk” the user through all set-ups, step-by-step, including audible test results, audible meter status, audible averages, and memory records with date and time.

Lancioni et al. [45] taught post-coma patients with cognitive impairment to send out and receive (listen to) messages independently using a computer to present information verbally, according to pre-programmed schemes and sentences, respond to micro-switch activations, send out text messages, and read and verbalize incoming messages. This was accomplished through prompts and training sessions (approximately 20–30). Similar systems can be applied for use in communications between patients and caregivers and medical supports to facilitate check-ins and increase opportunities for independent living.

Video modeling and prompting

Video modeling is an instructional strategy where the individual views another person perform a skill from beginning to end in a video format [46]. The viewing is followed by an opportunity to perform the skill either immediately or delayed in time. Similarly video prompting uses video technology but the individual views each step of a task and has an opportunity to perform the step before moving on to view the next step in the task analysis [47]. Video modeling has been shown to be an effective tool for skill acquisition for people with intellectual disabilities [48–50]. Video prompting has been shown to be an effective strategy as an antecedent prompt as well as error correction procedure and can be especially useful for those with intellectual disabilities who have difficulty attending to lengthy videos [51–53]. Video modeling and prompting can be used to teach individuals the steps for use of the device for sending and receiving communications with caregivers and doctors.

Reinforcement

Systematic instruction for individuals with intellectual disabilities also involves the use of consequent strategies such as reinforcement. During the acquisition stage of learning, positive reinforcement is a key component for increasing accurate responses and providing feedback. Once a high rate of accurate responses is established, this subsequently should be faded slowly so that the reinforcement is provided on an intermittent schedule.

Generalization and maintenance

When developing systematic instructional programs, planning must be made for naturally maintaining contingencies as well as general case programming components [54, 55]. Accessing and consistently using smart technology can be a complex task, especially with the technology changing so rapidly that both maintenance and generalization of use will be a critical issue for individuals with intellectual disabilities. Individuals may initially use a smart technology system and then abandon its use for a variety of reasons. One study found one-third of all assistive technology devices being abandoned by users [56]. Pigot et al. [57] recommend that smart technology must not only meet skill levels and support needs but also must meet physical, psychological, social, and economic criteria of individuals in order to increase maintenance of use.

Self-management

One effective method of systematic instruction that often is successful for generalization and maintenance is self-management strategies. This can include the use of picture cues on a computer-aided system, object cues, and verbal cues [58]. Self-management strategies are useful when individuals have become dependent on support providers for prompts, cues, instructions, or reinforcement for completion of healthcare tasks. Self-management procedures in conjunction with the smart technology can provide the individual with a
positive means of transforming the need for external reminders and/or instructions from the support provider to independently using a self-managed prompt delivery process, thus taking control of their own healthcare process.

Implementation of the smart technology

Communication with health providers

One of the technological advances related to communication by smart technology and medicine is the use of telemedicine. Telemedicine (also known as telehealth) is broadly defined as the use of telecommunications technologies to provide medical information and services to the medical provider, patient, and/or caregiver [59]. This telemedicine system includes technologies such as telephone, electronic mail systems, and remote patient monitoring devices, which are used to collect and transmit patient real-time data for monitoring, interpretation, intervention, and care management.

For example, the implementation of smartphone applications and tools has been found to be a viable option for the management of diabetes and may contribute to the reduction of the progression of diabetes and improve the patient’s quality of life. Consistent self-monitoring blood glucose (SMBG) has been shown to be helpful tool for improving glycemic control in type 2 diabetes [60]. Current data have shown that the use of smartphone applications (“apps”) has been shown to be advantageous in a patient accurately logging and managing SMBG results. This collection of real-time data, which is logged on smartphone applications, can be easily electronically transmitted to a patient’s clinician via e-mail, transmitted into the electronic medical record, and reviewed. With these data accessibility the clinician (or their designee) can then make recommendations regarding exercise, diet, and medications [61].

A recent article published by Tran et al. [61] reviews 10 applications provided for a diabetic patient on the iOS platforms of the iPod, iPhone, and iPad. These devices offer a wide variety of functions which include logs for documenting blood sugars and providing an analysis nutritional values and intake recommendations for diet control, insulin administration, and exercise recommendations. One particular application, Glucose Buddy® offers a glucose recording activity guide for patients, assists with monitoring glucose, medications, carbohydrate intake, and hemoglobin A1C documentation. This information can then be synchronized online to the Glucose Buddy website, which can be transmitted to the medical provider for analysis and management. It can also provide reminders for checking blood sugars and designate the specific time intervals for taking medications [61].

Medical needs can be monitored through devices such as the Medtronic (www.medtronic.com), which allows doctors to monitor their patients in their homes. The individual uses a ‘‘Medtronic Monitor’’ that allows the collection of information where the individual holds a small antenna over the implanted device. This information is then sent electronically to the Medtronic CareLink Network and clinicians can then monitor the information and make any necessary medical decisions. It is also possible for family members and other support providers to have access to this information as well.

Emergency response systems can involve a variety of options. For example, devices for getting immediate help (e.g. I have fallen and cannot get up) use a wireless transceiver (worn around neck or wrist) to connect with a monitoring center that then can use speakers in the house to interact with the individual and summon help if necessary. Alarm systems can be used to notify remote monitoring services, which can then contact the individual or notify others regarding fires or medical emergencies.

Adapting technology to provide information to doctors

As mentioned previously, telemedicine Medtronic monitoring and emergency response systems are used to provide critical information to doctors and care providers. Additionally, text messaging via verbally presented programed options provides another means for communicating with medical personnel [45]. Perilli et al. [62] developed a method of communicating by phone with providers and family members for persons with Alzheimer’s disease. Rather than reliance upon text-based contact lists or pre-assigned numbers by name this system used photos of the persons available for phone calls. A micro-switch was used to activate the computer where the photos and names were presented in a pre-programmed sequence. Similar systems can easily be adapted for people with intellectual disabilities to communicate with doctors and care providers.

One health-related communication that appears to often be ignored or misunderstood for people with intellectual disabilities is communication of pain. There is a misbelief that people with intellectual disabilities have a higher pain threshold than people without learning disabilities [63]. Typically, self-report is the ‘‘gold standard’’ of pain determination. Stone-Pearn [64] concluded that people with intellectual disabilities have the concept of pain but lack the language to communicate effectively with their doctors. In a survey of clients in day services and supported living in Surrey, England, Beacroft and Dodd [63] found that 70% stated they would take pain medication if they were in pain, 78% of the participants stated that the staff did not use pictures to help them communicate about pain and 85% of the doctors did not use them either. This really speaks to the need for use of communication devices and photos based technology systems for communication with caregivers and doctors.

Adapting technology for feedback to person with intellectual disabilities

Telcare has an FDA-approved glucose meter that sends information to the cloud where preselected people can read it. Feedback is sent to the patient’s meter from a diabetes educator. This information can also be sent via short message service (SMS) to the iPhone of a family member or care provider [65]. However, the difficulty really lies in the direct communication between the doctor and the person with the disability.
Smart technology for medication reminders and appointments

Individuals with intellectual disabilities often have a need for a reminder system that is flexible and adaptive to individual needs. Several have been developed such as Able Links, Schedule assistant, PEAT, and Auto-minder. For example, Auto-minder provides adaptive, personalized reminders of activities of daily living such as taking medicine correctly, eating, drinking, toileting, performing routine hygiene, socializing, and keeping regular medical appointments [66]. PEAT™ is an Android smartphone application that provides cueing and scheduling assistance for individuals with memory, attention, and cognitive disorders. One of the advantages of the PEAT application is its flexibility with scheduling and that a unique cue card display presents information about only the current activity with pictures that link to contacts, notes, and recordings about the current activity. PEAT can also be customized for individual needs and preferences such as automatic cues to start and stop activities using personalized voice recordings, sounds and pictures, or vibrations for people with hearing impairments. Some of the other features offered on the PEAT system are personalized note sequences with audio recordings. These can be used to break large tasks into smaller steps, and guide users through multi-step procedures. Additionally, a task wizard for adding tasks, contacts, and notes helps users gain independence and confidence is available on the PEAT application [67].

Medical sensors of physiological functions

Using an example of diabetes mellitus, there is a chronic care management plan and clinical focus to prevent the secondary events that can occur from progressively damaging, uncontrolled disease. These include blindness, peripheral artery disease resulting in amputation of gangrenous limbs, coronary artery disease, which may result in myocardial infarction, and cognitive impairment secondary to cerebral vascular accidents stemming from micro-vascular insult from uncontrolled hyperglycemia. Many, if not all of these pathologic events can be reduced significantly with increased ongoing medical management and surveillance of the disease. Breakthroughs in microprocessor technology have allowed the design of small, portable, inexpensive sensors that measure the wide range of objective clinical indicators such as fasting and post-prandial blood sugars and blood pressure measurements. These systems can then provide information of the patient’s current medical status with instantaneous feedback. Additionally, insulin can also be monitored via sensitive devices, some of which are provided with built-in response capabilities to send information directly to a data source and their primary care provider for clinical evaluation. This monitoring can currently be provided via cell phone technology and can serve as an adjunct to the patient’s self-management [68].

Accessing health information via the web

It has become commonplace for individuals to access health information from the web. There are many sites that offer quick diagnosis, dietary guidelines, and preventative strategies. In addition, there are now applications for diet and exercise guides and monitoring created for devices such as the iPhone, iPad, and Android. Despite standards to design websites without barriers, online health information is not available to all users [69]. The Pew Internet & American Life Project on “Chronic disease and the internet” [70] found that persons living with disability were less likely to use the Internet for online health information gathering. Health education specialist can determine the accessibility of a webpage for their clients with ID. The URL can be entered into this free online resource, which can be found at: http://wave.webaim.org/

Guidelines are available for web designers considering accessibility issues. Importantly, it has been determined that navigation menus using hyperlinks with images (Image navigation menu (INM)) are more effective than text navigation menus (TNM) for individuals with ID [71]. In addition, Rocha et al. [71] determined the use of audio help was valuable for participants with ID. The buttons need to be programmed to initiate the audio help when the mouse passes over the buttons.

Accessing and obtaining smart technology

There have been recent developments in the use of smart technology for gaining health information and communicating with health providers (telemedicine and telehealth). However, for people with intellectual disabilities access ranges from limited to nonexistent. This lack of access is unfortunate according to the Pew Internet & American Life Project people living with disabilities were significantly less likely to use the Internet for online health information [70]. The intent of Individuals with Disabilities Education Act (IDEA) and American Disabilities Act (ADA) is to promote full participation by people with disabilities. However, despite these laws people with disabilities have limited access to health information and technology. Obviously, individuals with intellectual disabilities need access to smart technology devices for their healthcare needs. Table I provides information resources available for individuals with intellectual disability to obtain the smart technologies necessary for improving their health. Along with federal and state agencies mandated to provide services and supports for individuals with intellectual disabilities, numerous agencies, foundations, grants, volunteer agencies, and family networks exist to help guide individuals, families, and support providers to find and fund smart technology.

Future research and development

Matching technology with person and their support needs

It can be difficult to match current technology with individual support needs of the person with an intellectual disability. As with all support needs it is important to consider individual preferences, environmental factors, and the ability of the support individuals to understand and deliver the use of the smart technology. The CUSTODIAN system (www.smartthinking.ukideas.com) provides a decision tree for matching smart home technology with the support
Table I. Resources for obtaining smart technology.

<table>
<thead>
<tr>
<th>Funding source</th>
<th>Description</th>
<th>Type of assistive technology</th>
<th>Eligibility for assistive technology</th>
<th>Contact information</th>
</tr>
</thead>
<tbody>
<tr>
<td>School District/ Special Education</td>
<td>Specially designed instruction to meet the unique needs of children with disabilities newborn through 22 years of age</td>
<td>Any item, piece of equipment, or product system that is customized, non-customized or modified and used to increase maintain or improve functional capabilities of a student with a disability</td>
<td>Student must have a need for an assistive device to benefit from his/her educational program. Benefit means making meaningful progress toward IEP goals and objectives. Must be written in the IEP</td>
<td>Local School District/ Special Education Department State Department of Education/ Special Education Division US Department of Education OSERS Office of Special Education and Rehabilitative Services IDEA of 2004</td>
</tr>
<tr>
<td>Department of Developmental Services</td>
<td>Plan, coordinate, and monitor the services and supports that are needed because of a developmental disability</td>
<td>Adaptive Equipment and supplies under the services and supports provisions that will enable persons with developmental disabilities to maintain or maximize their independence</td>
<td>The person’s need must be related to the developmental disability and necessary to maintain or maximize independence. The need must be documented in the Individualized Program Plan (IPP) and other sources for funding must be considered first</td>
<td>State Department of Developmental Services Office of Developmental Services</td>
</tr>
<tr>
<td>Medicaid</td>
<td>Federal Health Insurance program for people who are 65 and older, certain younger people with disabilities and people with end-stage renal disease</td>
<td>Assistive technology is classified as durable medical equipment or medical supplies</td>
<td>Prior authorization must be obtained from primary care physician</td>
<td>Medicaid.gov</td>
</tr>
<tr>
<td>Medicaid</td>
<td>Program that provides health coverage for lower income people, families and children, the elderly and people with disabilities</td>
<td>States must provide mandatory benefits and elect to provide optional benefits. Assistive devices vary from state to state under durable medical equipment</td>
<td>Medicaid.gov</td>
<td></td>
</tr>
<tr>
<td>Children’s Health Insurance Program</td>
<td>Extends the healthcare coverage of Medicaid to families with higher incomes then allowable under Medicaid but not able to purchase healthcare</td>
<td>States must provide mandatory benefits and elect to provide optional benefits. Assistive devices vary from state to state under durable medical equipment</td>
<td>Medicaid.gov CHIP</td>
<td></td>
</tr>
<tr>
<td>Department of Healthcare Services</td>
<td>Agency for protecting the health of all Americans and providing essential human services</td>
<td>Defined as rehabilitative technology, including rehabilitative engineering, assistive technology devices, and assistive technology services</td>
<td>After eligibility is determined an assessment of need to development an Individuated Plan for Employment may include a referral for rehabilitative technology services necessary to obtain and maintain ability to perform work in an employment environment A request for a referral for rehabilitative technology services may also be made in writing by the consumer</td>
<td>US Department of Health and Human Services HHS.gov</td>
</tr>
<tr>
<td>Department of Rehabilitation</td>
<td>State agency responsible for providing vocational rehabilitation services resulting in employment, independent living and quality. Not an entitlement program. Based on impact of disability and ability to obtain and maintain employment, desire to gain employment and ability to benefit from services</td>
<td></td>
<td></td>
<td>Rehabilitative Services Administration State Department of Rehabilitation Services State Department of Vocational Rehabilitation</td>
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<tr>
<td>Employer</td>
<td>Tax credits that allow employers to cover ADA-related eligible access expenditures and reduce the employers cost of doing business encouraging them to hire individuals with disabilities</td>
<td>Small businesses can cover ADA-related eligible access expenditures Employers can apply for a work opportunity tax credit for individuals in the target group of receiving supplemental social security or in a vocational rehabilitation</td>
<td>Employers must apply for tax credits For the work opportunity tax credit, employers apply for and receive a certification from their state workforce agency before they claim the tax incentive</td>
<td>Department of Justice’s ADA Tax Incentives for Businesses ADA Small Business Tax Credit <a href="http://www.ada.gov/archive/tax-pack.html">www.ada.gov/archive/tax-pack.html</a> Work Opportunity Tax Credit <a href="http://www.dotleta.gov/business/Incentives/opptax/">www.dotleta.gov/business/Incentives/opptax/</a> <a href="http://www.doleta.gov/wotc">www.doleta.gov/wotc</a> <a href="http://www.irs.gov/form8850">www.irs.gov/form8850</a> AccessibleTech.org for accessible technology in the workplace Employment Accommodations <a href="http://askjan.org">http://askjan.org</a> Employment <a href="http://www.eecoc.gov">www.eecoc.gov</a> US Social Security ssa.gov disability101.gov World Institute on Disability - wid.org</td>
</tr>
<tr>
<td>Social Security Administration</td>
<td>The program is designed to ensure continuing income to families when a worker retires, dies or becomes disabled</td>
<td>IRWE – Impairment Related Work Expense is an expense for an item or service such as medical equipment or work-related equipment necessary for the individual for employment that can be deducted from work earning and not count toward income calculations for benefits PASS – Plan for Achieving Self-Sufficiency allows an individual to set aside income and resources for a vocational or educational objective and is not counted toward the persons resource limit</td>
<td>SSI – Supplemental Security Income is for children and adults with a qualifying disability SSDI – Social Security Disability Insurance is an earned benefit based on the individual’s own work record SSDAC-Social Security Disabled Adult Children is for an individual with a disability whose parent is retired or deceased and earned enough work credits to qualify</td>
<td></td>
</tr>
<tr>
<td>Private Insurance</td>
<td>Individual insurance plans will indicate amount of coverage for durable medical coverage</td>
<td>Assistive technology is classified as durable medical equipment</td>
<td>Approval is based on medically necessary</td>
<td>Individual or employer paid health insurance Medicare Advantage Plans <a href="http://www.medicare.gov/sign-up-change-plans/medicare-health-plans/medicare-advantage-plans/medicare-advantage-plans.html">http://www.medicare.gov/sign-up-change-plans/medicare-health-plans/medicare-advantage-plans/medicare-advantage-plans.html</a></td>
</tr>
</tbody>
</table>

**Additional government resources**

<table>
<thead>
<tr>
<th>ADA National Network</th>
<th>Provides Information and guidance and training on the ADA</th>
<th>Helpful resource network supporting the mission of the ADA to insure that people with disabilities have an opportunity to live a life of freedom and equality</th>
<th>Adata.org <a href="http://www.ada.gov">www.ada.gov</a></th>
</tr>
</thead>
<tbody>
<tr>
<td>US Access Board</td>
<td>Federal Board devoted to accessibility for people with disabilities</td>
<td></td>
<td><a href="http://www.access-board.gov">www.access-board.gov</a></td>
</tr>
<tr>
<td>US Department of Justice</td>
<td>The Special Litigation Section addresses the rights of individuals with disabilities to receive services in the community</td>
<td></td>
<td><a href="http://www.usdoj.gov/crt/split">www.usdoj.gov/crt/split</a></td>
</tr>
<tr>
<td>Funding source</td>
<td>Description</td>
<td>Type of assistive technology</td>
<td>Eligibility for assistive technology</td>
</tr>
<tr>
<td>----------------------------------------------------</td>
<td>------------------------------------------------------------------------------</td>
<td>----------------------------------------------------------------------------------------------</td>
<td>------------------------------------------------------------------------------------------------------</td>
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<tr>
<td>Fair Housing Act</td>
<td>Federal agency that addresses accessibility in housing</td>
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<td></td>
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</tr>
<tr>
<td>Telecommunications Act</td>
<td>Federal agency to ensure that people with disabilities can access communication technology</td>
<td></td>
<td></td>
</tr>
<tr>
<td>National Public Website on Assistive Technology</td>
<td>Website featuring products and assistive technology</td>
<td></td>
<td></td>
</tr>
<tr>
<td>The Center for Assistive Technology and Environmental Access</td>
<td>Engineering and design research center dedicated to enhancing the lives of people with disabilities through technology</td>
<td>iPod and iPad devises</td>
<td>Anyone that can show benefit can apply</td>
</tr>
<tr>
<td>World Institute on Disability</td>
<td>Public Policy center with the mission of eliminating barriers to full social participation of individuals with disabilities</td>
<td>Assistive technology equipment</td>
<td>Eighteen years old and younger. Have a medical need not covered by insurance</td>
</tr>
<tr>
<td>Grant, scholarship, and foundation opportunities</td>
<td></td>
<td>Periodic grants available for technology</td>
<td>Autism and Parkinson’s Disease</td>
</tr>
<tr>
<td>Conover Mobile Technology Grant</td>
<td>Promoting the use of mobile technology to improve self-sufficiency</td>
<td>iPod and iPad devices</td>
<td>Anyone that can show benefit can apply</td>
</tr>
<tr>
<td>First Hand Foundation Applications</td>
<td>Funding for healthcare for children that would not be covered elsewhere</td>
<td>Speech therapy and assistive technology devices</td>
<td>Medical grants awarded based on need</td>
</tr>
<tr>
<td>Holly Rod Foundation</td>
<td>Foundation to improve the quality of life for children and families with Parkinson’s and Autism</td>
<td>Speech and or language disorders</td>
<td>Medical grants awarded based on need</td>
</tr>
<tr>
<td>Autism Care and Treatment Today!</td>
<td>Non-profit organization to raise awareness and provide treatment support for children with autism</td>
<td>iPod and iPad devices</td>
<td>Anyone that can show benefit can apply</td>
</tr>
<tr>
<td>Small steps in speech</td>
<td>Non-profit organization to help children with Speech and or language disorders</td>
<td>iPod and iPad devices</td>
<td>Anyone that can show benefit can apply</td>
</tr>
<tr>
<td>United Healthcare Children’s Foundation</td>
<td>Non-profit charity for children with medical needs not covered by medical insurance</td>
<td>iPod and iPad devices</td>
<td>Anyone that can show benefit can apply</td>
</tr>
<tr>
<td>Non-profit organizations and volunteer resources</td>
<td></td>
<td>iPod and iPad devices</td>
<td>Anyone that can show benefit can apply</td>
</tr>
<tr>
<td>Danny’s Wish: How to apply for an iPad Grant:</td>
<td>Website with resources to fund technology</td>
<td>iPod and iPad devices</td>
<td>Anyone that can show benefit can apply</td>
</tr>
<tr>
<td>Autism Consortium: Raising A Child with ASD</td>
<td>Researchers and families collaborating to find cures and treatment for Autism</td>
<td>iPod and iPad devices</td>
<td>Anyone that can show benefit can apply</td>
</tr>
<tr>
<td>Generation Rescue Family Grant Program</td>
<td>Non-profit organization with a focus on autism and treatment</td>
<td>iPod and iPad devices</td>
<td>Anyone that can show benefit can apply</td>
</tr>
<tr>
<td>MyGOAL Inc. Enrichment Grant</td>
<td>Family counseling and advocacy for children with Autism</td>
<td>iPod and iPad devices</td>
<td>Anyone that can show benefit can apply</td>
</tr>
<tr>
<td>Disabled Children’s Relief Fund</td>
<td>Non-profit organization that provides children with physical disabilities assistive technology</td>
<td>iPod and iPad devices</td>
<td>Anyone that can show benefit can apply</td>
</tr>
<tr>
<td>Squidalicious: How to Get You Kid with Autism that Wonderful iPad</td>
<td>Parent Blog and information site</td>
<td>iPod and iPad devices</td>
<td>Anyone that can show benefit can apply</td>
</tr>
</tbody>
</table>
needs of an individual. However, research needs to be conducted to guide how the matching can best be implemented.

**Summary of guidelines for appropriate modifications**

As previously stated, some technology is being developed already with access for those with cognitive impairment but most devices and systems need to be modified to accommodate people with ID. The following recommendations are a few of the communication methodologies that could be developed to enhance the exchange of information between provider and patient in real-time:

- **Communicating with healthcare providers.** A few suggested methods of adapting include: (1) pre-programmed scanning of photo contact lists, (2) pre-programmed sentences within schemes, and (3) voice output when mouse is held over the photos.
- **Receiving feedback from healthcare providers.** (1) Receive step-by-step instructions in photographic or icon-based format. (2) Receive instructions sent via SMS to multiple devices, including caregivers.
- **Medication reminders and appointments.** (1) Programmed personalized voice recordings with options for sounds and pictures, (2) pictures that link to contacts, notes, and recordings about the current activity, and (3) vibrations for people with hearing impairments.
- **Accessing healthcare information from the Internet.** (1) Navigation menus using hyperlinks with images (INM) rather than TNM and (2) buttons need to be programmed to initiate the audio help when the mouse passes over the buttons.
