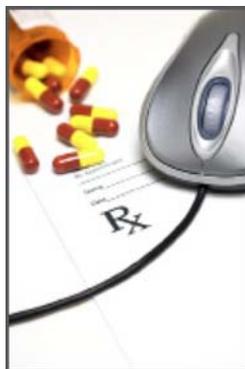


## Technologies for Improving Post-Acute Care Transitions

*Position Paper*  
*September 2010*  
*Discussion Draft*



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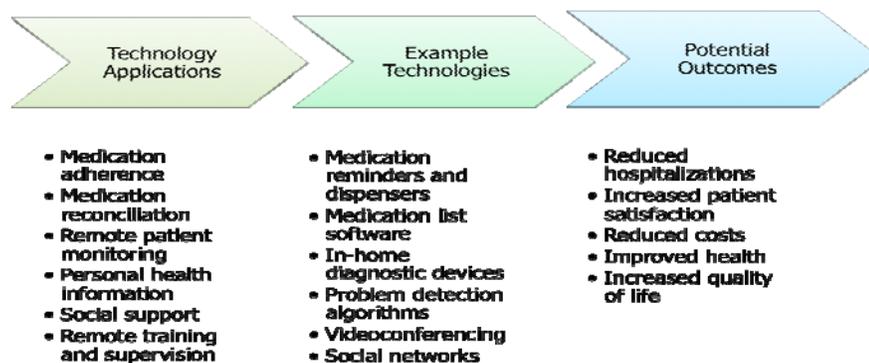
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## Executive Summary

The recent focus on improving post-acute care transitions (the process by which a patient moves from hospital to home or other settings) is being driven by an interest in reducing hospital readmissions. The United States has an 18% rate of hospital readmissions within 30 days of discharge—and as many as 76% of these are preventable. According to Medicare data, over half of readmitted patients received no care or follow-up in the 30 days after hospitalization.<sup>1</sup> Patients that do receive care after a hospital stay often experience care that is fragmented and uncoordinated, which results in duplication of services, inappropriate or conflicting care recommendations, medication errors, patient/caregiver distress, and higher costs of care.

Recent studies by Coleman, Naylor, and others suggest that interventions targeted toward post-acute care transitions can reduce readmission rates by one-third. These interventions focus on improving the care transitions process, providing direct patient support, improving self-management capabilities, and increasing access to needed information and tools. The Care Transitions Intervention and the Transitional Care Model are two commonly used care process improvement interventions that focus on post-acute care transitions. The Guided Care and Geriatric Resources for Assessment and Care of Elders are promising care coordination intervention models that have care transitions elements.

Several types of technologies have potential to support post-acute care transitions interventions and are discussed in this position paper. Technologies that can assist in improving medication adherence, medication reconciliation, patient monitoring, communications between and among clinicians, patients, and informal caregivers, risk assessment, and other important aspects of care transitions are widely available, but often underutilized. Studies suggest that use of such technologies can lead to fewer hospitalizations and emergency room visits, high patient satisfaction and acceptance, and reductions in cost of care.



## Introduction

In June 2010, the Center for Technology and Aging (CTA) announced the release of their **Tech4Impact Diffusion Grants Program** with the aim to help selected states expand the use of **technologies for improving post-acute care transitions** and reduce avoidable re-hospitalizations. CTA's vision for the Tech4Impact Diffusion Grants Program is that state-led aging and disability resource centers (ADRCs) will work with their community partners to expand use of patient-centered technologies that will help recently hospitalized individuals maintain their health and independence and avoid re-hospitalizations. For further information on the Tech4Impact Diffusion Grants Program, refer to Appendix B.

This position paper illustrates some of the technology applications the Tech4Impact grant aims to encourage. Note the paper is a starting point for consideration and is not meant to describe all possible technologies for improving post-acute care transitions ("PACT" technologies).

The paper begins by describing the importance of post-acute care transitions in hospital readmissions. This is followed by a discussion of intervention models that aim to improve care transitions processes. Several example PACT technology focus areas are then reviewed. These include patient-centered medical devices and computer-based technologies that better enable:

- Medication adherence (e.g., devices that remind patients to take the right medication at the right time and alert caregivers when a medication has not been taken).
- Medication reconciliation (e.g., software that stores medication information and detects potential problems, such as duplicate prescriptions).
- Remote patient monitoring, including technologies that help detect early deterioration of a patient's health condition.
- Patient or caregiver access to health records and other important health information.
- Social support and communications between and among patients and caregivers.

## Post-Acute Care Transitions and Hospital Readmissions

The recent focus on improving post-acute care transitions (the process by which a patient moves from hospital to home or other settings) is being driven by an interest in reducing hospital readmissions. The United States has an 18% rate of hospital readmissions within 30 days of discharge—and as many as 76% of these are preventable.<sup>1</sup>

Reducing readmissions rates has become a high priority for policymakers and payers seeking to improve health care quality and contain costs. Researchers estimate that the national fiscal impact to Medicare as a result of unplanned hospital readmissions was \$17.4 billion in 2004.<sup>1</sup> Re-hospitalization also appears to increase the risk of health complications, resulting in greater functional and cognitive impairments for patients.<sup>2</sup>

In 2009, the Medicare Payment Advisory Council (MedPAC) concluded that a large proportion of re-hospitalizations is potentially preventable and recommended improving post-acute care transitions processes. Improvements include better communications and more coordinated care before and after discharge.<sup>3</sup>

Recent research on care transitions activities (or care coordination programs with care transitions elements) has established a strong evidence base for several types of interventions. A randomized controlled evaluation of the Care Transitions Intervention demonstrated that intervention subjects had lower re-hospitalization rates at 30 days and at 90 days compared to control subjects, and that the intervention group had mean hospital costs that were lower than the control group.<sup>4</sup> A separate randomized evaluation of the Transitional Care Model showed that intervention patients had lower re-hospitalization and mean hospital costs than the control participants.<sup>5</sup> Among physician-based care management programs with care transitions elements, a randomized study of the Geriatric Resources for Assessment and Care of Elders (GRACE) Model showed that for participants in a high-risk group, utilization of preventive services increased while the number of hospital admissions declined significantly.<sup>6</sup> Moreover, a randomized study of Guided Care, a nurse-physician care management program, showed fewer hospital and nursing facility days for intervention participants than the control group.<sup>7</sup>

## Evidence-Based Care Transitions Models

Transitional care involves a set of actions, such as coordination among health professionals and education of the patients and caretakers that facilitate the continuity of patients' care as they transfer from one care setting, such as a hospital, to another.<sup>4</sup>

Four models are particularly relevant to this PACT technology review: 1) the Care Transitions Intervention, 2) the Transitional Care Model, 3) Guided Care, and 4) Geriatric Resources for Assessment and Care of Elders. The first two models emphasize hospital-to-home care transitions, while the last two models emphasize practice-based care coordination that includes care transitions elements.

### *The Care Transitions Intervention*

The Care Transitions Intervention (CTI) is a four-week hospital-to-home care transitions model during which patients with complex care needs and family caregivers receive specific tools and work with a "Transitions Coach" to learn self-management skills that will ensure their needs are met during the transition from hospital to home. The intervention includes one hospital visit, one home visit, and three follow up phone calls by the Transitions Coach. The Transitions Coach is a person who has completed the Care Transitions Intervention interactive, face-to-face training with the Care Transitions Program team. This training ensures model fidelity.

- Providing continuity of care across settings, and supporting the patient in developing and maintaining a personal health record.
- Helping the patient and family members to understand when and how to obtain timely follow-up care (including both primary and specialty care).
- Coaching/role playing with patients to ask the right questions to the right health care providers to get their needs met across the various follow-up care settings.
- Helping patients and their families to play a more active role in managing their condition and to develop self-care skills, including medication self-management and increased awareness of symptoms, and recognizing "red flags," and warning signs that trigger the need for care, along with instructions on how to respond to them.

The program has been tested with community dwelling adults that are 65 years or older with at least one of 11 diagnoses. A randomized study of the program showed that the program cost was \$74,310 for 379 patients (\$196/patient) and another study reported that intervention patients saw an estimated annual cost savings, over and above the cost of the intervention, of \$844 per patient.<sup>4, 8</sup>

### ***The Transitional Care Model***

The Transitional Care Model (TCM) provides comprehensive discharge planning and home follow-up by advanced practice nurses (APNs) to older adults at high risk for poor outcomes. The following are core elements of the TCM:

- In-hospital assessment (including detailed assessment of each patient's functional status), collaboration with team members to reduce adverse events and prevent functional decline, and preparation and development of a streamlined, evidenced-based plan of care.
- Regular home visits by the APN with available, ongoing telephone support (seven days per week) through an average of two months post-discharge.
- Continuity of medical care between hospital and primary care providers (facilitated by the APN accompanying patients to the first follow-up visit(s)).
- Comprehensive, holistic focus on each patient's goals and needs, including the reason for the primary hospitalization as well as other complicating or coexisting health problems and risks.
- Active engagement of patients and family caregivers with focus on meeting their goals.
- Emphasis on patients' early identification and response to health care risks and symptoms to achieve longer term positive outcomes and avoid adverse and untoward events that lead to readmissions.
- Multidisciplinary approach that includes the patient, family caregivers, and health care providers as members of a team.
- Physician-nurse collaboration across episodes of acute care; and
- Communication to, between, and among the patient, family caregivers, and health care providers.

The program has been tested with patients that are 65 years or older with poor self-health ratings, multiple chronic conditions, and a history of recent hospitalizations. One randomized study of the program indicated that the annual total intervention cost was \$115,856 (\$982 per patient). The study also concluded that reductions in utilization of health services led to mean annual cost savings, over and above the costs of the intervention, of \$5,000 per patient.<sup>5</sup>

### ***Guided Care***

Guided Care is a physician/nurse care coordination model, usually conducted for a long-term/indefinite amount of time. The model requires a Guided Care Nurse to:

- Conduct a comprehensive home assessment.
- Create an evidence-based care guide for the patient and a patient-friendly action plan for the patient.
- Provide monthly monitoring and self-management coaching.
- Smooth transitions into and out of hospitals and other institutions.
- Coordinate care by all providers.
- Provide family caregiver education/support, and
- Facilitate access to community based services.

To become recognized as a Guided Care Nurse, an individual with a nursing degree and current license must complete an accredited Guided Care nursing course, pass an examination, and be awarded a certificate. The program is being tested for individuals aged 65 years or older who are likely to need many health services in the next year. A randomized evaluation of the program indicated that the total annual intervention cost was \$1,743 per patient, producing a savings, above and beyond the cost of the intervention, of \$1,364 per patient.<sup>7</sup> Guided Care also appears to positively influence patient and physician satisfaction as well as caregiver burden.<sup>9-11</sup>

### ***Geriatric Resources for Assessment and Care of Elders***

Geriatric Resources for Assessment and Care of Elders (GRACE) is a physician/practice-based care coordination model. GRACE is conducted for a long-term/indefinite amount of time and requires a nurse practitioner and social worker.

GRACE has been tested for low-income individuals aged 65 years or older in primary care, including a group at high risk of hospitalization (as determined by the probability of repeated admission risk screen). A randomized study indicated the total annual intervention costs for high-risk patients to be \$315,040 (\$1,432 per patient). The study concluded the intervention to be cost-neutral for high-risk patients due to reductions in hospital costs.<sup>12</sup>

**Figure 1: Hospital-to-Home Care Transitions Models<sup>13</sup>**

Adapted from Tables Produced by the Aging and Disability Resource Center Technical Assistance Exchange

<b>Model</b>	<b>Care Transitions Intervention (CTI) (commonly called the “Coleman Model”)</b>	<b>Transitional Care Model (TCM) (commonly called the “Naylor Model”)</b>
<b>Short description</b>	<p>Transition Coach helps patients and families learn transition-specific self-management skills. The Transition Coach:</p> <ul style="list-style-type: none"> <li>▪ Conducts a hospital visit to introduce the program and tools such as the Personal Health Record (PHR)</li> <li>▪ Conducts one home visit 24-72 hours post-discharge</li> <li>▪ Performs three follow up phone calls to reinforce the coaching offered during the home visit and activation behavior</li> </ul>	<p>In this model, the Transitional Care Nurse:</p> <ul style="list-style-type: none"> <li>▪ Visits patient in the hospital</li> <li>▪ Conducts home visit within 24 hours of discharge</li> <li>▪ Accompanies patient on first visit with the physician post-discharge and subsequent visits if needed</li> <li>▪ Facilitates physician-nurse collaboration across episodes of acute care</li> <li>▪ Conducts weekly home visits for first month</li> <li>▪ Is on call seven days per week</li> <li>▪ Provides active engagement of patients and family caregivers with focus on meeting their goals</li> <li>▪ Provides communication to, between, and among the patient, family caregivers, and health care providers</li> </ul>
<b>Target population</b>	<ul style="list-style-type: none"> <li>▪ Individuals 65 years or older</li> <li>▪ Community-dwelling adults with a working telephone</li> <li>▪ Appropriate for persons with depression or dementia provided they have a willing and able family caregiver</li> </ul>	<p>Evaluation included cognitively intact adults aged 65 or older with two or more risk factors, including:</p> <ul style="list-style-type: none"> <li>▪ Poor self-health ratings</li> <li>▪ Multiple chronic conditions</li> <li>▪ History of recent hospitalizations</li> </ul>
<b>Length of intervention</b>	One month	One to three months
<b>Training</b>	One-day training either onsite or in Colorado	Web-based training modules
<b>Qualification required</b>	Transition Coach needs strong interpersonal and communication skills, the ability to make the shift from doing things for patients to facilitating skill transfer so that patients can do more for themselves.	Transitional Care Nurse in published studies was an advanced practice nurse. Currently evaluating outcomes with bachelors-prepared nurses.
<b>Estimated costs</b>	From research study: \$196 per patient	From research study: \$982 per patient
<b>Website</b>	<a href="http://www.caretransitions.org">http://www.caretransitions.org</a>	<a href="http://www.innovativecaremodels.com/care_models/21/overview">http://www.innovativecaremodels.com/care_models/21/overview</a>

**Figure 2: Practice-based Care Coordination Models  
that include Care Transitions Elements<sup>13</sup>**

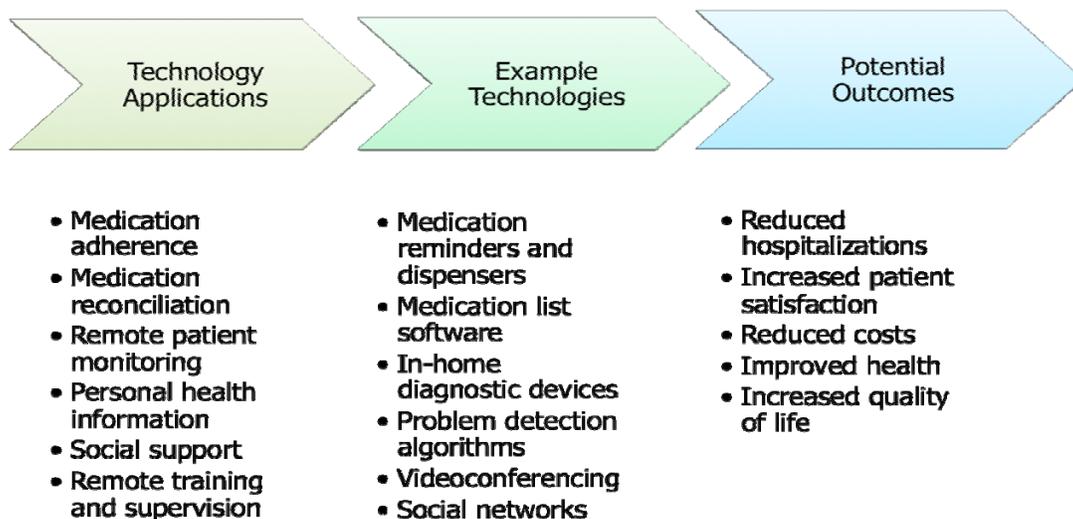
Adapted from Tables Produced by the Aging and Disability Resource Center Technical Assistance Exchange

Model	Guided Care	Geriatric Resources for Assessment and Care of Elders (GRACE)
<b>Short description</b>	Program requires that Guided Care Nurse: <ul style="list-style-type: none"> <li>▪ Conduct a comprehensive home assessment</li> <li>▪ Create a care guide and an action plan for the patient</li> <li>▪ Provide monthly monitoring and self-management coaching</li> <li>▪ Smooth transitions into and out of hospitals and other institutions</li> <li>▪ Coordinate care by all providers</li> <li>▪ Provide family caregiver education/support</li> <li>▪ Facilitate access to community based services</li> </ul>	Program requires that nurse practitioner and social worker: <ul style="list-style-type: none"> <li>▪ Offer in-home assessment and care management</li> <li>▪ Collaborate with and support the primary care physician</li> <li>▪ Meet with the patient's primary care physician to review, modify and prioritize the care plan, then collaborate with the physician on putting it into practice</li> <li>▪ Work weekly with geriatrician-led interdisciplinary team to craft patient care plan</li> <li>▪ Conduct at least one in-home follow-up visit to review care plan, and one telephone or face-to-face contact per month.</li> <li>▪ Coordinate care from all providers</li> <li>▪ Collaborate with hospital discharge planners and make a home visit after any hospitalization</li> </ul>
<b>Target population</b>	Evaluation included individuals aged 65 years or older who were at high risk of using health services heavily during the following year, as estimated by the claims-based Hierarchical Condition Category (HCC) predictive model.	Evaluation included low-income older adults (65 or older) in primary care including a group at high risk of hospitalization as estimated by the probability of repeated admission risk screen.
<b>Length of intervention</b>	Long-term/indefinite; the length of contact with patient is usually for life.	Long-term/indefinite; the length of contact with patient in evaluation was two years.
<b>Training</b>	All candidates must complete the Johns Hopkins 6-week, 40-hour web-based course, pass an online exam, and earn a Certificate in Guided Care Nursing from the ANCC.	Nurse practitioners and social workers each complete a 12-session training program (with meetings held once a week) on implementing the GRACE protocols and working as part of an interdisciplinary team.
<b>Qualification required</b>	Must be a registered nurse, ideally with experience in home care, case management, community health and/or equivalent gerontologic nursing.	Program utilizes nurse practitioner and social worker who work with the primary care physician, geriatrician, and other relevant health professional in a team-based approach.
<b>Estimated costs</b>	From research study: Total annual intervention cost was \$95,900 (\$1,743 per patient).	From research study: Total annual intervention costs for high-risk patients: \$315,040 (\$1,432 per patient).
<b>Website</b>	<a href="http://www.guidedcare.org/">http://www.guidedcare.org/</a>	<a href="http://medicine.iupui.edu/IUCAR/research/grace.asp">http://medicine.iupui.edu/IUCAR/research/grace.asp</a>

## Technologies for Improving Post-Acute Care Transitions

Studies continue to demonstrate the value of health devices and computer-based technologies for enabling care that is more coordinated and informed, and less error prone. Technologies also help engage patients and informal caregivers in the care process, as home-use technologies can promote personal responsibility, and support early patient education and activation on how to better monitor and manage health.

Not all care transitions intervention models encourage the use of technologies for improving post-acute care transitions; and not all patients will be capable or willing to utilize them. But technologies, such as those summarized below and discussed in the following pages, should be considered if they are appropriate and lead to transitions of care that are more efficient, effective, and satisfying for patients and providers. Technologies that can assist in improving medication adherence, medication reconciliation, patient monitoring, communications between and among clinicians, patients, and informal caregivers, risk assessment, and other important aspects of care transitions are widely available, but often underutilized. Based on large-scale studies, such as that of the Veterans Health Administration<sup>14</sup>, care coordination that is supported by medical devices and computer-based technologies can lead to fewer hospitalizations and emergency room visits, high patient satisfaction and acceptance, and reductions in cost of care.



## Medication Adherence Technologies

The World Health Organization defines adherence as “the degree to which the person’s behavior corresponds with the agreed recommendations from a health care provider.”<sup>15</sup> Poor medication adherence can have negative consequences for individuals, families, and society because it significantly increases the cost and burden of illness. Medication non-adherence contributes to 33%-69% of medication-related hospital admissions and 23% of all nursing home admissions.<sup>16</sup> Moreover, the New England Healthcare Institute estimates that \$290 billion of health care expenditures could be avoided each year if medication adherence were improved.<sup>17</sup>

Adherence is influenced by prior experiences, cultural factors, personal beliefs, treatment side effects, patient-provider relationships, and financial constraints. Physical, cognitive, and sensory health challenges also make adherence difficult. Mobility difficulties, forgetfulness, and diminished sight and hearing are deterrents to acquiring medications, understanding instructions, remembering to take medications on time, and reading and hearing medication-taking instructions. Because medication adherence is considered an instrumental activity of daily living, the ability to manage medications successfully is an important factor in maintaining independence among older adults and persons with disabilities.

Because adherence is dependent on many factors, a multi-pronged approach to improving medication adherence is usually most effective. Interventions include:

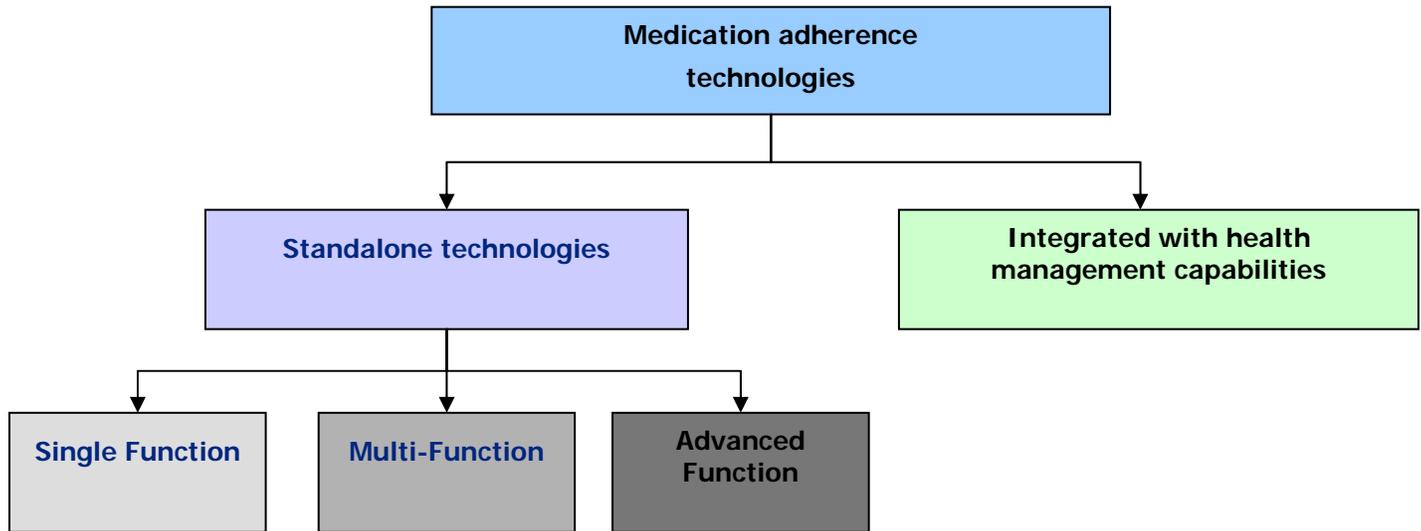
- Simplifying the patient’s medication regimen.
- Identifying if the medication has untoward effects.
- Improving patient self-efficacy and activation.
- Providing cues or reminders to take medications as prescribed.

Cognitive assessments can assist in determining a patient’s capability for medication adherence. Specific cognitive abilities including memory, literacy, executive abilities and general cognitive status all relate to different aspects of medication adherence.<sup>18</sup> Common cognitive assessment tests like the Mini-Mental State Exam (MMSE) have been shown to correlate with medication adherence, especially in older adults.<sup>19</sup> Work is currently underway to computerize cognitive assessment tests for online access by patients in the home, physician’s office, community, or long-term care setting.<sup>20</sup>

Medication adherence technologies have been expanding in both variety and sophistication. Technologies can assist patients and caregivers with obtaining proper medication information, patient education, medication organization, dispensing, and dose reminders, as well as safeguard against an overdose. Such technologies can be classified as standalone or integrated

technologies. Standalone technologies tend to be less complicated and can be single-function, multi-function or have advanced functions. Integrated technologies are more complex and integrate medication management with other health management capabilities such as general health monitoring, sensors, or health information storage.

**Figure 3: Medication Adherence Technology Categories**



A technology can potentially provide one or more functions to an individual patient under a “medication administration continuum,” including<sup>21</sup>:

- *Fill*: provides patient with information and/or instructions about the drug
- *Remind*: reminds patients to take medications – audibly, visually, or both
- *Dispense* (e.g., in the home): automatically dispenses medications, usually at certain times/intervals
- *Ingest*: detects whether or not a patient has ingested his/her medications
- *Metabolize*: detects whether or not a patient has metabolized his/her medication
- *Report*: logs date and time when medication is taken and reports to clinician/caregiver
- *Adjust*: adjusts medication automatically if needed

*Ingest*, *metabolize*, and *adjust* can be considered “advanced functions” because these capabilities are still largely in development. A technology that performs one function currently available within the medication adherence technology spectrum is a single-function technology while a device that performs two or more functions currently available within the spectrum are referred to as multi-function technology. Advanced function technologies perform one or more of the

currently available spectrum functions and can also perform one of the more advanced functions including detection of medication ingestion, metabolism, or adjustment.

Standalone technologies are the simplest and easiest to use; however, they lack the functionality for more comprehensive health management. Examples of standalone technologies include medication information devices, medication reminders, a medication dispenser, or a device that combines informing, reminding, and dispensing. Many standalone technologies are currently available on the market. Additional standalone technologies are being developed, including those with advanced functions. Rex the talking pill bottle is a single-function standalone device that assists visually or cognitively impaired patients with accessing recorded medication information. The pill bottle contains a speaker with recorded information from the pharmacist stating the name of the drug, what it is used for, dose, frequency, duration, side effect warnings, and refill instructions. Kaiser Permanente has implemented this technology in over 140 facilities.

A multi-function standalone technology, The Philips Medication Dispensing System, organizes and dispenses 10-30 days worth of medication (depending on the dose frequency) by individualized doses into plastic cups. Patients are reminded to take their medication based on verbal and auditory reminders. To safeguard against double dosing or missed doses the system will lock away the dispensed medication after 90 minutes if it has not been removed from the device. It will then alert up to four caregivers, including health care professionals, that a dose was missed. Alert and dispensing history are uploaded daily to a web-support system allowing caregiver and clinician review. In a study comparing the Philips Medication Dispensing Service with plastic medication boxes, Philips Medication Dispensing Service was shown to reduce hospitalization rates, emergency room visits, and (where appropriate) decrease the number of medications taken by the patient. Automated medication dispensers seem especially beneficial for patients on warfarin therapy or those with cognitive or mental health impairments.<sup>22</sup>

For the past ten years, Caring Choices and partner Home Health Care Management have successfully used the Philips (previously named the MD.2) medication dispensing device to improve older adult's medication adherence. To encourage diffusion of this promising device, Caring Choices received 2010 funding from the Center for Technology and Aging to share their successful experience with four organizations and to help shepherd the adoption of the device within the organizations. Caring Choices was one of five grantees to receive a Medication Optimization Diffusion Grant from the Center.

**Figure 4: Comparison of Philips Medication Dispensing Service versus Medi-Set Medication Boxes for Patient Outcomes<sup>22</sup>**

	<b>Philips Medication Dispensing Service</b>	<b>Medi-Set Medication Boxes</b>
Hospitalization per patient	0.09	0.42
Emergency Department visits per patient	0.18	0.42
Prescriptions per patient	7.62	8.65

Advanced function standalone medication technologies using direct measures, such as detecting if a patient ingested his/her medication or whether they have metabolized the medication, are mostly in development and not yet available on the market. A few examples include MagneTrace and Xhale's SMART™. The "ideal" technology would continue to improve the patient's medication behavior, and start to integrate monitoring features like automatically adjusting medication doses.

Integrated technologies include medication management devices with add-on health management features and home health devices with add-on medication management features. While these integrated technologies allow for more comprehensive health management, they can be more expensive and complicated than their standalone counterparts. Integrated technologies often use a service-based pricing model (compared to a one-time fee for standalone technologies).

Patients have highly varied needs for medication adherence technologies. Some patients want a simple, inexpensive technology while others may have a condition requiring an expensive, integrated technology as well as a spectrum of technologies in between. There is a need for a large portfolio of technologies, from simple to complex, in order to meet needs for all patient segments in the most appropriate way.

Figure 5: Medication Adherence Technologies

Category	Description	Sample Techs	Pros	Cons	Market Stage	Economics	Categories in Medication Adherence Spectrum
<b>Single-Function</b>	Performs one function currently available within the medication adherence technology spectrum	<ul style="list-style-type: none"> <li>• iGuard</li> <li>• Timex messenger</li> <li>• Rex Pill bottle</li> <li>• Gentle Reminder</li> </ul>	Simplest and easiest to use technologies	<ul style="list-style-type: none"> <li>• Lacks greater functionality for more comprehensive health management</li> </ul>	Many technologies out on the market and currently used	<ul style="list-style-type: none"> <li>• Usually a one-time purchase</li> <li>• Prices can vary widely</li> <li>• Relatively inexpensive</li> </ul>	Fill, Remind or Dispense
<b>Multi-Function</b>	Performs two or more functions currently available within the medication adherence technology spectrum	<ul style="list-style-type: none"> <li>• EMMA</li> <li>• Philips Medication Dispensing System</li> <li>• MedSignals</li> <li>• uBox</li> <li>• Dispense-a-Pill</li> </ul>	<ul style="list-style-type: none"> <li>• Mostly easy to use</li> <li>• Integrates multiple functions for better health management</li> </ul>	<ul style="list-style-type: none"> <li>• May be complex or require greater caregiver involvement</li> <li>• Lacks functionality for more comprehensive management</li> </ul>	Many technologies out on the market and currently used	<ul style="list-style-type: none"> <li>• Usually a one-time purchase</li> <li>• Prices can vary widely (less than \$100 to \$1000+)</li> </ul>	Fill, Remind, Dispense, and Report
<b>Advanced Function</b>	Performs one or more of the currently available spectrum functions and can also perform one of the more advanced functions	<ul style="list-style-type: none"> <li>• MagneTrace</li> <li>• Xhale's SMART</li> </ul>	<ul style="list-style-type: none"> <li>• Advanced technologies allow actual tracking/ adjustment/ ingestion of medication</li> <li>• Integrates multiple functions</li> </ul>	<ul style="list-style-type: none"> <li>• Considerably more complicated than single/ multi function without clear benefit understanding</li> <li>• In some cases, may lack comprehensive management functionality</li> </ul>	Most technologies still in development	<ul style="list-style-type: none"> <li>• Currently unclear - most technologies still in development</li> <li>• May be relatively expensive</li> </ul>	Advanced functions: Ingest, Metabolize, and Adjust
<b>Integrated with Health Management Capabilities</b>	Technologies that integrate medication administration with other health-related management functions (i.e. monitoring, sensors, independent living assistance)	<ul style="list-style-type: none"> <li>• Med-eMonitor</li> <li>• HealthHero</li> <li>• Home HealthPoint</li> <li>• Zume Life</li> <li>• Zuri</li> <li>• Intel HealthGuide</li> </ul>	<ul style="list-style-type: none"> <li>• Combined offering allows for broad patient management</li> <li>• Many devices likely to move towards integration of health tracking/ monitoring</li> </ul>	<ul style="list-style-type: none"> <li>• Relatively complicated, may require caregiver involvement</li> <li>• May require greater tech knowledge</li> </ul>	<ul style="list-style-type: none"> <li>• Some techs currently on market and used</li> <li>• Other techs in development</li> </ul>	<ul style="list-style-type: none"> <li>• Usually upfront cost plus a monthly fee (service-oriented model)</li> <li>• Upfront cost can be relatively high</li> </ul>	Fill, Remind, Dispense, and Report

## Medication Reconciliation Technologies

Medication reconciliation is the process of creating an accurate list of all medications a patient is taking, comparing that list against new physician orders, and checking for discrepancies or other problems. The five main steps of the process are: 1) developing a list of current medications; 2) developing a list of medications to be prescribed; 3) comparing the medications on the two lists; 4) making clinical decisions based on the comparison; and 5) communicating the new list to appropriate caregivers and to the patient.<sup>23</sup>

Since most medication errors are made at the “interfaces of care,” the Joint Commission asserts that medication reconciliation should be done at every transition of care, including changes in setting, service, practitioner, or level of care. A change in a patient’s condition is also a critical point when medication reconciliation is needed.<sup>24</sup>

When care transitions occur, the complete and reconciled list of medications should be communicated to the patient’s known primary care provider, or the original referring provider, or a known next provider of service. When a patient transitions from a service organization to home, a complete and reconciled list of the patient’s medications should be provided directly to the patient (and to the patient’s family as needed). When appropriate, the list should be explained and the communication should be documented.<sup>24</sup>

A primary goal of medication reconciliation is to avoid adverse drug events (ADEs). While not all ADEs are due to medication reconciliation errors, the data below suggest that such errors may play an important role.

- Approximately 20% of patients discharged from the hospital to their home experienced an adverse event in one study. More than 66% of these adverse events were medication related<sup>16</sup>
- Medication discrepancies were the most common drug-related problem at the time of hospital discharge in one study and the cause of half of all preventable adverse drug events 30 days after discharge<sup>25</sup>
- Another study found that half of previously hospitalized patients who were receiving continuing care from their primary care physician experienced at least one medication error within two months of discharge from the hospital<sup>26, 27</sup>

According to the Institute for Health Improvement, a well-designed medication reconciliation process has the following characteristics:

- Uses a patient-centered approach
- Makes it easy to complete the process for all involved
- Helps people understand the benefits of medication reconciliation
- Minimizes the opportunity for drug interactions and therapeutic duplications by making the patient's list of home medications available when physicians prescribe medications
- Provides the patient with an up-to-date list of medications
- Ensures that other providers who need to know have information about changes in a patient's medication plan<sup>28</sup>

The patient is the one constant in the continuum of care. Hence, patients, family members, or other informal caregivers should be encouraged to carry a current medication list to all medical encounters and settings.<sup>27</sup> As electronic health records (EHRs) remain absent in most care settings and systems, patients (and caregivers) should take an active role in the medication reconciliation process. Even if a care provider has an EHR system, patients need to actively check the accuracy of medication data. In a recent study of medication discrepancies, 70% of medications recorded in patients' electronic medical records were no longer being taken.<sup>29</sup>

Patients and caregivers can utilize technologies to improve medication reconciliation problems. Using a variety of online programs and technologies, patients or caregivers can provide complete, up-to-date patient medication histories. There are several models for medication lists. Some online medication lists only allow one-time entry of medication information, while others electronically store information for continuous updates. Most lists require patients to enter drug, dose, and other medication information, which can leave room for error. Electronic lists in this form are often only accessible to patients and caregivers. In order for clinicians to access this medication list, patients must bring a printout of the list with them to the medical exam.

The Care Transitions Intervention program provides a printable medication discrepancy tool at <http://www.caretransitions.org/documents/MDT.pdf>. The tool is "designed to facilitate reconciliation of medication regimen across settings and prescribers" and is to be completed each time a medication discrepancy event occurs.

**Figure 6: Examples of one-time entry medication lists include (see IHI.org for additional examples)**

Name	Organization	Description
<b>My Medication Log</b>	Cardiovascular and Public Health Detailing Programs	A medication log for use in the Cholesterol Action Kit <a href="http://www.ihi.org/IHI/Topics/PatientSafety/MedicationSystems/Tools/MyMedicationLog.htm">http://www.ihi.org/IHI/Topics/PatientSafety/MedicationSystems/Tools/MyMedicationLog.htm</a>
<b>Universal Medication Form</b>	McLeod Health in Florence, SC	A form where patients can enter medications used, allergies, and immunization records
<b>Health and Safety Passport</b>	California Pacific Medical Center, San Francisco, CA	Patients list their medications, health history, and other relevant information
<b>Med List</b>	A statewide, collaborative initiative in Massachusetts	Medication list to keep track of patient medications and supplements. Also offers tips for using medications wisely.
<b>My Medicine List</b>	American Society of Health-System Pharmacists (ASHP)	A tool where patients can develop and manage their own medication list. The tool can be found on the ASHP Foundation website and on <a href="http://www.safemedication.com/meds/medForm.cfm">http://www.safemedication.com/meds/medForm.cfm</a>
<b>Pill Card</b>	Agency for Healthcare Research and Quality (AHRQ)	Information on how to develop an easy-to-use "pill card" for patients, parents, or anyone who has a hard time keeping track of their medicines at <a href="http://www.ahrq.gov/qual/pillcard/pillcard.htm">http://www.ahrq.gov/qual/pillcard/pillcard.htm</a>
<b>My Medicine Record</b>	Food and Drug Administration (FDA)	Patients list prescription medicines, over-the-counter medicines and dietary supplements. <a href="http://www.fda.gov/cder/consumerinfo/my_medicine_record.htm">http://www.fda.gov/cder/consumerinfo/my_medicine_record.htm</a>

Walgreen's currently provides pharmacy patients access to their medication history through online tools. Patient drug and dose information input errors can be reduced as prescription information and filling history is automatically pulled into the list. Like other medication lists, patients often fail to share this information with the clinician. Walgreens has recently partnered with Microsoft® HealthVault™, a web-based PHR platform, giving Walgreens pharmacy patients the ability to upload their medication history into HealthVault and share this information with caregivers, clinicians, and others. Medication information will be automatically updated daily in HealthVault, allowing patients to share their most up-to-date health information while avoiding manual entry of data.<sup>30</sup>

Check-in medication kiosks, piloted at the Veterans Health Administration (VHA), have patients and caregivers review and adjust their medication history, pre-populated from their EHR. The VHA developed the Automated Patient History Intake Device (APHID) for use in the ambulatory setting, where patients review and update their medication histories before their appointments.

APHID pulls medication lists from the VHA's electronic health record and has patients review the name, dose, frequency and pictorial representation of the medications. Patients have the opportunity to input information from non - VHA clinician visits into the kiosk, which can then be used on subsequent visits. Providers then review the updated medication history during the appointment, looking for possible drug interactions and duplicate therapies. During the pilot of APHID, older adults reported that the kiosk was simple to use (75.4%) and navigate (66.7%), and that the medical information was easy to understand (94.2%). APHID's utilization of EHR and patient input on medication history prior to medical appointments also has the potential to reduce clinician reconciliation work and streamline work processes. While the reconciliation process cannot be completely replaced by technology, kiosks reduce the time clinicians spend entering medication information while engaging patients and caregivers in managing the patient's health.<sup>31</sup>

## Remote Patient Monitoring Technologies

Remote patient monitoring (RPM) technologies are used to more closely monitor a patient's health condition in their home. Using a variety of integrated or stand-alone RPM devices, up-to-date information on patients' chronic disease and/or post-acute care status (including vital signs, heart rate, blood glucose levels, medication management, mental health, physical and cognitive fitness) and other data can be transmitted to family caregivers, providers, and other third parties. Clinicians or other properly trained individuals can then intervene by providing coaching or adjusting the course of treatment.

Currently, several different types of integrated RPM devices exist. These devices act as an aggregator of information from multiple peripheral devices (e.g., blood pressure cuff, scale, glucose monitor, pulse oximeter, prothrombin time/international normalized ratio [PT/INR] meter, thermometer, electrocardiogram (ECG), peak flow meter, stethoscope, pedometer) that transmit or plug directly into integrated technologies. Many integrated devices are activated daily by the patient or caregiver. They ask patients to answer a series of questions, collect and report peripheral device data, provide educational information, and even support audio or visual contact with clinicians for real-time intervention or assistance.

Some instruments also can self-activate and alert patients and caregivers that a test or medication must be taken. Data are subsequently transferred to health care professionals, where they are triaged through patient-specific algorithms to categorize risk and alert appropriate caregivers and clinicians when answers and/or data exceed predetermined values. Many of these tools store previous test results through a specific device program or a Web-based program. RPM devices also provide patient education via reading or hearing health tips. Devices can be a conduit of communication between patients and healthcare professionals through audio and/or visual settings, allowing for real-time intervention, coaching, and patient education.

The ability to augment patient self-management tools and skills is critical to the value of integrated RPM devices. This can be accomplished in a variety of ways, as described in Figure 7.

**Figure 7: Self Management Capabilities in RPM Devices<sup>32</sup>**

<b>RPM capabilities</b>	<b>Resultant Support via Technology</b>
Managing therapeutic processes	<ul style="list-style-type: none"> <li>- Disease knowledge</li> <li>- Vital signs and self-reporting</li> <li>- Take medication</li> <li>- Rules of conduct</li> <li>- Physiotherapy</li> </ul>
Managing health and preventive behavior	<ul style="list-style-type: none"> <li>- Nutrition</li> <li>- Physical exercise</li> <li>- Cognitive exercise</li> <li>- Social interaction</li> <li>- Stress reduction</li> </ul>
Managing the role of the chronically ill patient	<ul style="list-style-type: none"> <li>- Dynamics of health status and disease progress</li> <li>- Navigating the health care system</li> <li>- Relationship to health care professionals</li> <li>- "Action plans"</li> </ul>
Managing daily life	<ul style="list-style-type: none"> <li>- Maintain autonomy in daily life</li> <li>- Deal with disease related implications</li> <li>- Support in daily life by friends, family members and informal helpers</li> </ul>
Managing crises	<ul style="list-style-type: none"> <li>- Be prepared for crises</li> <li>- Recognize crises</li> <li>- Call for help</li> </ul>

Numerous health care organizations are now fielding RPM-enabled programs for chronic disease management. Examples for this paper are drawn from Kaiser Permanente, Group Health of Puget Sound, and the Veterans Health Administration (VHA). The VHA has broadly deployed a range of RPM technologies in 50 different health management programs across 18 Veterans Integrated Service Networks and conducted various studies showing improved chronic disease management, cost savings, and reduced hospital admissions and Emergency Department (ED) visits.<sup>14</sup>

Specifically, since 2000, VHA researchers have evaluated the use of one device, the Health Buddy, through a number of studies that vary in study design, patient population, and size. The Health Buddy is a stationary integrated RPM device that utilizes peripheral devices including scale, blood pressure monitor, glucose meter, pulse oximeter, and peak flow meter readings. Additionally, it contains a series of questions and dialogues addressing the patient's mental, physical, and cognitive health. Appropriate risk intervention dialogues can be assigned based on individual patient needs. Health Buddy has received NCOA certification for 10 programs: asthma, cancer, coronary artery disease, CHF, COPD, chronic pain, depression, diabetes, hypertension, and pediatric asthma.

Findings from comparative studies conducted on 17,025 patients enrolled in the VHA Care Coordination/Home Telehealth (CCHT) program in 2006 and 2007 show a 25% reduction in bed

days of care, 20% reduction in numbers of admissions, and mean satisfaction score rating of 86%. Figure 8 shows the percent decrease in healthcare utilization by chronic condition. The cost of the program is \$1,600 per patient per annum. This compares with direct cost of VHA's home-based primary care services of \$13,121 per patient per annum, and market nursing home care rates that average \$77,745 per patient per annum.<sup>14</sup>

**Figure 8: Outcomes: VHA Care Coordination/Home Telehealth 2004-2007<sup>14</sup>**

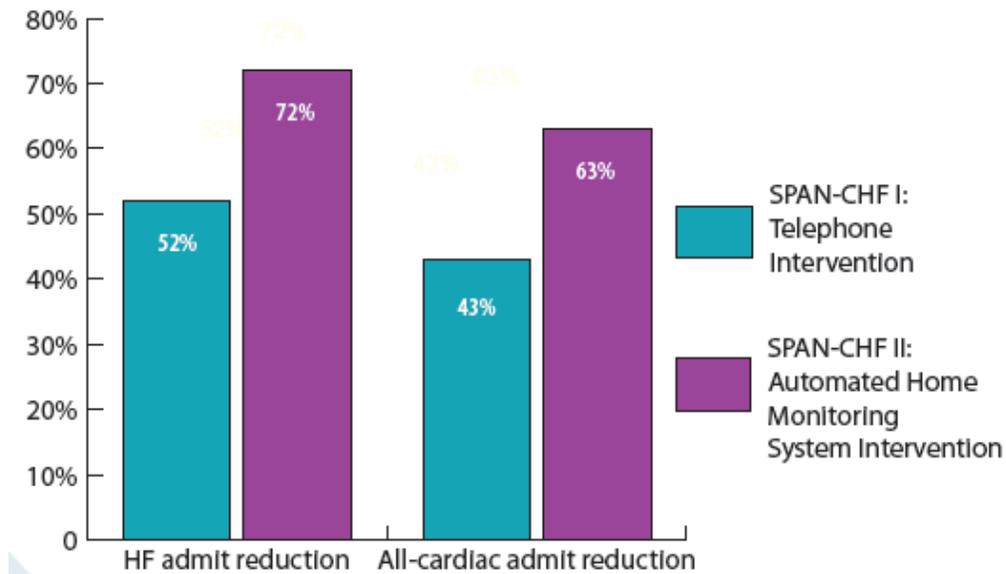
Condition	# of Patients	% Decrease Utilization
Diabetes	8,954	20.4
Hypertension	7,447	30.3
CHF	4,089	25.9
COPD	1,963	20.7
PTSD	129	45.1
Depression	337	56.4
Other Mental Health	653	40.9
Single Condition	10,885	24.8
Multiple Conditions	6,140	26.0

The VHA's underlying health information infrastructure, coupled with a strong commitment to standardized work processes, policies and training, have combined to support an increase in CCHT patients from 2,000 in 2003 to 31,570 in 2007. VHA plans to increase its non-institutional care (NIC) services 100% above 2007 levels to provide care for 110,000 patients by 2011, or 50% of its projected NIC needs. VHA's experience is that an enterprise-wide RPM implementation is an appropriate and cost-effective way to manage chronic care patients in both urban and rural settings.

The use of RPM technologies in reducing hospital readmissions for post-acute patients also has been studied and evaluated. In patients released from the hospital with heart failure, the Specialized Primary and Networked Care in Heart Failure (SPAN-CHF I) disease management program conducted a randomized control trial evaluating a nurse-run disease management (DM) program using weekly telephone calls to prevent readmission of heart failure patients. A follow-up study, SPAN-CHF II, investigated the use of DM along with an automated home monitoring (AHM) system to further evaluate reductions in readmissions. As shown in Figure 9, the study

found that the combination of these two interventions — in-home monitoring and coaching — after hospitalization for congestive heart failure (CHF) reduced rehospitalizations for heart failure by 72 percent, and all cardiac-related hospitalizations by 63 percent.<sup>33, 34</sup>

**Figure 9: Preventing Readmissions: SPAN-CHF I and II Studies<sup>33, 34</sup>**



The AHM utilized an interactive scale, blood pressure cuff, text messaging system, and the Bosch Health Buddy device described above. The Health Buddy is one of several major integrated devices currently on the market, some of which are summarized in Figure 10.

**Figure 10: Examples of Integrated Home Health Monitoring Devices**

(Adapted from the NEHI FAST Detailed Technology Analysis: Home Telehealth Report<sup>35</sup>)

Device	Organization	Description
Health Buddy	Bosch	Over 30 programs where patients answer a series of questions about their health and wellbeing. Data transmitted via telephone line or Ethernet connection to a secure data center. The data are then available for review on the Web-based Health Buddy Desktop. Patient responses are color-coded by risk level as High (red), Moderate (yellow), and Low (green), prompting intervention when needed. Care managers can send texts under 150 characters straight to the device. Peripheral devices include: scale, glucose meter, peak flow meter, blood pressure cuff, pulse oximeter.
Telestation	Philips	Patients answer health assessment survey questions. Data are transmitted from wireless peripheral devices to the telestation. Information is then transmitted through the phone line to health care professionals. Peripheral devices include: scale, blood pressure meter, glucose meter, pulse oximeter, rhythm strip recorder.
Genesis DM	Honeywell	Web-based system with customizable subjective disease-related queries for patients. Two-way audio allows healthcare professionals and patients to communicate. Peripheral devices include: stethoscope, scale, blood pressure meter, glucose meter, pulse oximeter, thermometer, PT/INR meter, peak flow meter.
Intel's Health Guide PHS6000	Intel	Combines in-home patient device with an online interface. Patients and caregivers interact using two-way audio and video. A multimedia education library can be found on the system. Peripheral devices include: blood pressure monitors, glucose meters, pulse oximeters, peak flow meters, weight scales.
LifeView	American TeleCare	Combines patient monitoring and interactive video, allowing healthcare professionals to monitor the status of the patients. Data are collected from peripheral devices and the LifeView Patient Monitors, and are then transmitted through telephone line or broadband connection. Two-way audio/video allow clinicians and patients to communicate. Peripheral devices include: stethoscope, scale, blood pressure meter, glucose meter, pulse oximeter, thermometer, PT/INR meter.
Ideal LIFE Pod	Ideal Life	Data are collected from peripheral devices and the Ideal LIFE Pod, which then transmits data through an analog phone line. Peripheral devices include: blood pressure meter, glucose meter, scale pulse oximeter, peak flow meter, pedometer, chair scale.
Healthanywhere	Healthanywhere Inc.	Platform offered in various devices including a home tablet, kiosk, and smartphone application. Data from peripheral devices are transmitted using bluetooth. Additional features include calendars, reminders, questionnaires, and two-way video through kiosks that link patients with healthcare professionals. Data can be viewed by healthcare professionals and users and is also integrated with Microsoft's HealthVault. Peripheral devices include: blood pressure cuffs, glucose meter, and scales.

Integrated devices are expected to grow in capabilities and scope to include monitoring from sensors and other streams of continuous data. Information regarding environmental safety, such as the temperature of a patient's home, monitoring appliances for activity, and security systems, are beginning to be merged with patient monitoring in integrated devices. Behavioral safety devices, including sensors to monitor falls and location devices to track wandering, can also stream data into integrated devices. These expanded combinations offer patients and caregivers access to a broader array of both patient and environmental data.

While there are an increasing number of integrated devices, many RPM devices effectively function independently. One of the most prevalent forms of standalone RPM devices are physiological cardiac devices, such as Pacemakers, Implantable Cardioverter Defibrillators (ICDs), and Cardiac Resynchronization Therapy devices (CRTs). These devices can provide continuous, real-time tracking and analysis of patients' heart rhythms as well as device components, like battery life and lead function. Physiological cardiac RPM devices have demonstrated many benefits, including reduced in-person clinic visits, early detection of health problems, increased patient satisfaction, and potential cost savings.<sup>36</sup> A comparison of four representative continuous cardiac RPM technologies is presented in Figure 11.

**Figure 11: Comparison of Continuous Cardiac Remote Patient Monitoring Technologies (adapted from Burri and Senouf, 2009<sup>36</sup>)**

	<b>Biotronic Home</b>	<b>Medtronic CareLink</b>	<b>Boston Scientific Latitude</b>	<b>St. Jude Merlin.net</b>
Wireless communication with implanted device	Radiofrequency	Radiofrequency	Radiofrequency	Radiofrequency
Data transmission	GSM network	Analog phone line	Analog phone line	Analog phone line
Transmitter	Mobile	Stationary	Stationary	Stationary
Frequency of transmissions	Daily follow up; Alert events	Scheduled follow up; Alert events	Scheduled follow up; Alert events	Scheduled follow up; Alert events
Physician notification	SMS, e-mail, fax	SMS, e-mail	Fax, phone	Fax, e-mail, SMS
Special features	Alerts fully configurable online; Wireless pacemakers	OptiVol lung fluid status alert; Configurable red and yellow alerts	Optional wireless weight scales and blood pressure cuffs	EHR data export capability Alerts fully configurable online; Possibility of sending automated phone calls to patients

Most large cardiac physiological monitoring device manufacturers use Radio Frequency Identification (RFID) to wirelessly transmit data from the device to a base station, which can be stationary or mobile. Such transmissions are either manually requested by a patient using a wand tool, or automatically uploaded to the base station without patient involvement. Base stations then transmit data via an analog phone line (“landline”) or Global System for Mobile Communications network (GSM, or cellular phone networks) to the clinician. Transmission to the clinician can occur daily or on a scheduled basis. Acute events, like shock administration by the device, trigger an alert to the clinician. Clinicians can receive alerts via SMS text messaging, e-mail, fax or phone. Clinicians can then investigate patient data to decide whether the patient should come into the hospital or stay at home. Some devices have the ability to create specific alerts for individuals, accessing and configuring alerts online, and stratifying risk. Other unique features include measuring lung fluid levels and generating alerts (Medtronic CareLink), using wireless peripheral devices like weight scales and blood pressure cuffs (Boston Scientific Latitude), and exporting data directly into electronic health records (EHRs) (Boston Scientific Latitude, St Jude Merlin.net).

According to the American College of Cardiology (ACC)/American Heart Association (AHA)/Heart Rhythm Society (HRS) guidelines, patients obtain many benefits from the use of standalone cardiac RPM devices.<sup>37, 38</sup> Preliminary results from the TRUST trial, which analyzed remote monitoring of patients using Biotronik ICDs, found that remote monitoring reduced the number of in-person clinic visits by 43%.<sup>39</sup> The trial also demonstrated no significant difference in terms of patient safety between in-person clinic visits and remote monitoring. Reduction of in-person visits depends on the severity of the patient's illness and the implanted device. It should be noted, given the nature of patients' conditions who use CRTs, a reduction of in-person clinic visits may not be appropriate for this population.

Continuous Cardiac RPM technologies will increase automation processes and accessibility of data to patients and clinicians. The Biotronik device is the first to allow for automatic upload of patient data to the clinician. This automation will ensure transmission of data at appropriate intervals and allow for increased frequency of transmission. The portable base station, which can be worn by patients, and the use of GSM networks to transmit data can improve the frequency of transmission as patients are not required to be in the same location as the stationary base station and/or landline ports.

In the future, closed loop systems will permit devices to administer or adjust treatment based on sensor readings. Improved sensor development will create a more robust and accurate data set. Many continuous cardiac devices are capable of becoming closed loop systems. Such systems will emerge as algorithms and alert systems mature, error signals decrease, and remote overview by physicians becomes seamless. As the number of older adults implanted with cardiac devices grows, device communications and capabilities will mature.

## Other Health Information and Communications Technologies

A number of medication management and remote monitoring technologies have just been described. To collect and analyze data, and communicate it to multiple nodes of the healthcare and social services system, many of these technologies have significant computer- and Internet-based capabilities. Many other health information and communications technologies (ICT) exist. Though some have not been studied as closely as Medication Adherence, Medication Reconciliation and RPM technologies have, they do merit brief mention because of their theoretical potential to reduce hospital readmissions.

### *Personal Health Records Technologies*

Personal Health Records (PHRs) refer to a set of technologies that help patients track their health care services, access important health records and manage their own health information. The patient generally controls the PHR and chooses whether to share their health information with family members, caregivers and providers. PHRs enable patients to store and share a narrative of their diagnoses and immunizations, current and past lists of medications, allergies and drug interactions, records of hospitalizations and medical procedures, and health indicators such as blood pressure. A complete summary of a patient's health information fosters self-management and coordination of care. Current applications of PHRs tend to target key functions such as<sup>40</sup>: 1) storage of a patient's medical history, 2) access to vital health records, 3) support for diet changes and wellness activities, 4) assistance with chronic disease management and medication management, and 5) secure forum for patient-clinician communication.

Use of PHRs have potential to reduce hospital readmissions associated with communication breakdowns between health care professionals, insufficient follow-up, and inadequate evaluation and continuity of care procedures.<sup>41, 42</sup> Deficiencies in the transitional care process significantly contribute to the high rates of readmissions.<sup>43</sup> Effective discharge planning engages and prepares the patient to better manage their care. Adoption of PHRs may improve post-discharge care management if they facilitate: 1) development of a care plan to prevent future re-hospitalization, 2) identification of patients' health goals, and 3) active engagement of patients in the management of their care.

The Stepping Stones Project of Whatcom County provides a good example of the use of personal health records technologies to reduce unnecessary readmissions. The Stepping Stones Project aims to decrease communication gaps between healthcare providers and patients and engage formal caregivers to ensure safe transitions from one healthcare setting to another. The project encourages patients to use the Shared Care Plan Personal Health Record, an electronic health

record that lets patients organize and store vital health information.<sup>44</sup> Patients can print and carry a wallet size summary of their key personal information. This is especially useful in emergency situations when patients may be unable to communicate with medical personnel and provide critical health information.<sup>45</sup> The Stepping Stone Project supports the use of The Shared Care Plan because it provides valuable features for patients such as the ability to<sup>45</sup>:

- Follow-up on appointment times and direct health questions to health care professionals
- Identify a Care Team that may include medical providers, pharmacies, family members and social workers. The identification of a Care Team makes it easier to share a patient's preferences and health care information with those involved in the transitional care process
- Utilize the personal planning tools to track health issues, set goals and plan next steps to achieve those goals
- Access detailed health information in Healthwise, an extensive health information database written for patients
- Access and download health care data from participating providers' systems
- Share health information with informal and formal caregivers

### *Social Networking*

Web-based social networking enables communities of patients, caregivers, and clinicians to connect, share knowledge with, and provide support to other older patients and their care providers. Social networking has the potential to reduce hospital readmissions and ease post-acute care transitions by increasing social connectedness, improving communication between formal and informal caregivers, and promoting self management of care. These web-based social networks utilize a variety of means to facilitate communication among patients and care providers including discussion groups, chat, messaging, email, video, and file-sharing.

Web-based social networking emerged as a way to connect peers, independent of geography. Before web-based social networking services existed, in-person peer groups like the Chronic Disease Self-Management Program, developed by Kate Lorig and colleagues, have recognized the effect of sharing experiences, exchanging knowledge, and providing support to improve health outcomes for patients with various chronic conditions. A study examining the two-year outcomes of patients utilizing the Chronic Disease Self-Management Program found that emergency department (ED) and outpatient visits as well as health distress were significantly reduced while patient self-efficacy improved.<sup>46</sup>

Social networks can enhance social ties and contribute to increased social connectedness. A meta-analysis found that social integration leads to reduced mortality risks and an improved mental health state as the quality of existing social ties also influences such health benefits.<sup>47</sup> Some social networks are specifically designed for older adults to exchange their knowledge and experiences of managing their conditions with other older adults. PatientsLikeMe is a social networking website where members share treatment and symptom information in order to track and to learn from real-world outcomes. Currently, PatientsLikeMe has communities for amyotrophic lateral sclerosis (ALS), multiple sclerosis (MS), Parkinson's disease, fibromyalgia, HIV, and mood disorders, as well as the rare conditions such as progressive supranuclear palsy, multiple system atrophy, and Devic's disease (neuromyelitis optica). One study analyzing users' perceptions on PatientsLikeMe found that 57% of users thought the site was helpful for understanding side effects of their treatments while 42% found another user through the site that helped them to understand the impact of a specific treatment for their condition.<sup>48</sup> The study also found that 41% of HIV patients thought they reduced risky behaviors while 22% of patients with mood disorders thought they needed less inpatient care as a result of using the site.<sup>48</sup> Analysis of the Web access logs showed that participants who used more features of the site perceived greater benefit.<sup>48</sup>

Caregivers and clinicians can use social networks to manage and coordinate care for a patient, improving communication between care providers and patients. Some social networks integrate social interaction like sharing experiences with friends and family, while also providing a pathway for formal and informal caregivers to manage and coordinate the care of an individual. Such a network could be used to convey transitions of care protocols and advice for caregivers and patients, who can ask questions to providers when needed. One such organization, Tyze, is utilizing the Internet to foster these connections around the older adult. Tyze is an extension of the PLAN Institute for Caring Citizenship, a national organization based in Vancouver that aims to reduce isolation in people with mental health conditions, older adults, and people struggling with major transitions. Tyze has launched a three-year Canada-wide initiative through the federal government that focuses on care providers and the individuals they assist. With funding from the Robert Wood Johnson Foundation, Tyze is also implementing a 15-month pilot program in Northern California, working with Assisted Living, Independent Living, and Continuing Care Retirement Communities (CCRCs) for older adults. Tyze provides an online network around an older adult where friends, neighbors, caregivers, and care providers join the network and communicate through Tyze tools. Different tools focus around creating tasks and goals for the older adult, sharing health information with set parameters around who can access the documents, and sharing stories about the older adult. As of mid-2009, Tyze was working with 30

organizations, and hosting nearly 2000 individual networks. Each network has between 6 and 30 network members.

Web-based social networks are beginning to incorporate search applications and are integrating with personal health records (PHRs) and remote patient monitoring (RPM) devices. Web-based social networking sites with search applications allow older adults and caregivers to search for health information and connect with others who may be suffering from similar conditions.

Web-based social networking sites that integrate PHRs give the patients the ability to view their medical information data as well as to share it with whom they wish. Integration with RPM devices lets patients share real-time information from these devices with friends and family as well. Data sharing ensures that the older adult is using the device correctly and provides extra oversight should the older adult health condition begin to deteriorate—potentially constituting admission or readmission to the hospital, or transition to a higher acuity care setting.

Furthermore, the overlay of intelligent algorithms to Web-based social networking sites gives patients the ability to see health information that is personalized and tailored to their needs and interests. By seeking patterns, intelligent algorithms help individual patients improve their own health and have the potential to build on the collective wisdom of patients.

### *Remote Training and Supervision Technologies*

Remote Training and Supervision (RTS) technologies are systems that support the training and supervision of health care workers and patients who are not physically collocated with their educator. Training and supervision can occur synchronously in real-time, or asynchronously in the manner of an online education course. Training and supervision are facilitated using Web-based technologies ranging from basic e-learning courses, to collaborative Web conferencing platforms, to immersive virtual environments. Moreover, training and supervision can be accomplished using existing video-conferencing technologies that utilize analog communication systems. In many cases, remote training and supervision technologies can also be used to monitor medication intake, improve medication management, and train and support family caregivers (effectively augmenting the existing workforce).

Rest Assured®, a ResCare company, is an organization that provides remote training and support services to older adults seeking independence and those that are transitioning from one care setting to another. Tele-caregivers monitor the patient in real time through cameras installed in the patient's home. These cameras can be activated as needed and provide two-way communication to support patients including medication instructions and use of monitoring devices. Remote monitoring and support services can be customized based on patient needs.<sup>49</sup>

The Visiting Nurse Service of New York (VNSNY) Center for Home Health Care Policy & Research, is demonstrating how remote training and supervision technologies for nurses can help older adults who rely on complex medication regimens to manage chronic conditions. With support from The Center for Technology and Aging, VNSNY launched the IMPACT-CI program (Improving Medication Management Practices and Care Transitions through Technology -- Focus on the Cognitively Impaired).

In order to address poor medication management and reduce readmissions, the VNSNY professional nursing field staff in the post-acute division use pen-based Lenovo personal computers (tablet computer) that run a secure electronic health record (EHR) called the Patient Care Record System (PCRS). Information on new referrals and continuing patients is regularly updated and wirelessly communicated between the tablet and VNSNY's mainframe. Three key modules in the PCRS inform nurses' clinical practice: 1) the Plan of Care, 2) the Visit Module, and 3) the Medications Module. Before and/or during each patient visit, nurses review and update the patient's medications and Plan of Care while documenting the patient's progress in a specific "Care Plan Problem" in the Visit Module. The VNSNY IT intervention uses these existing modules to identify patients at risk of a potentially serious medication problem, prioritize cases needing immediate attention, and directing nurse care protocols to efficiently focus time and attention.

## Discussion

The Center for Technology and Aging supports more rapid adoption and diffusion of technologies that enhance independence and improve home and community-based care for older adults and persons with disabilities. The Center believes there are significant opportunities to support post-acute care transitions intervention models with home and community-based technologies, and further reengineer the processes of care and the roles people play in those processes.

Several evidence-based care transitions models have been designed to improve readmissions rates, and studies have demonstrated their effectiveness in reducing re-hospitalizations, supporting patients in recovery, encouraging patient and caregiver self-management, and facilitating information exchange and collaboration across care settings and care providers. Information and communications technologies (ICT) can better enable more efficient, effective, and timely access to needed health information. Devices that are used in the home to monitor important health parameters can be coupled with ICTs to provide care and support that is continuous rather than episodic; patient-centered rather than health facility-centered; and available anywhere and anytime, rather than limited to those who are able and willing to drive to a health facility.

Adoption of technologies, such as those described in this paper, has been limited to healthcare niches, such as the Veterans Health Administration and Kaiser Permanente. Several factors and trends will likely encourage more widespread adoption and diffusion of technologies that improve care processes, communications, collaboration, and patient self-management. Government incentives and grant programs can directly influence technology usage, e.g., the HITECH Act and the Center for Technology and Aging's Technology Diffusion Grants Program. Less direct, but equally important, are changing trends in health care financing and delivery, e.g., movement away from fee-for-service health care toward more accountable care will likely favor ICT innovations.

To improve the rate of technology adoption, technology advocates will also need a better understanding of the factors that speed or slow adoption, and plan their educational and marketing campaigns accordingly. Matching individual needs and wants to available technologies is one part of the adoption equation, as is prioritizing diffusion efforts toward early adopters. Not all patients—and caregivers—will be ready and willing to incorporate a technological innovation into their lives. Some individuals are late adopters of technology by nature, and some technologies will appear to have costs that outweigh the benefits. Technology advocates may learn valuable lessons by reviewing diffusion of innovation theories as well as lessons learned from actual cases of technology adoption.

Without fundamental system changes, the US will face unprecedented challenges in meeting the health and social service needs of its citizens. A perfect storm of demographic, epidemiologic, economic, and health services workforce challenges is forming in the US as the US population is growing proportionately older and the number of health and social services workers are decreasing per capita. Because health problems tend to increase with age, demand for and cost of health care and social services will increase dramatically without fundamental and widespread change.

## Appendix A: List of Abbreviations

ACC	American College of Cardiology
ADL	Activities of Daily Living
ADE	Adverse Drug Event
ADRC	Aging and Disability Resource Center
AHA	American Heart Association
AHM	Automated Home Monitoring
ALS	Amyotrophic Lateral Sclerosis
ANCC	American Nurses Credentialing Center
AoA	Administration on Aging
APHID	Automated Patient History Intake Device
APN	Advanced Practice Nurse
CCHT	Care Coordination/Home Telehealth
CCR	Continuity of Care Record
CCRCs	Continuing Care Retirement Communities
CHF	Congestive Heart Failure
COPD	Chronic Obstructive Pulmonary Disease
CMS	Centers for Medicare & Medicaid Services
CTA	Center for Technology and Aging
CTI	Care Transitions Intervention
CRT	Cardiac Resynchronization Therapy
DM	Disease Management
ECG	Electrocardiogram
ED	Emergency Department
EHR	Electronic Health Record
GRACE	Geriatric Resources for Assessment and Care of Elders
GSM	Global System for Mobile Communications
HCC	Hierarchical Condition Category
HRS	Heart Rhythm Society
IADL	Instrumental Activities of Daily Living
ICD	Implantable Cardioverter Defibrillator
ICT	Information and Communication Technologies
IHI	Institute for Healthcare Improvement
IMPACT-CI	Improving Medication Management Practices and Care Transitions through Technology -- Focus on the Cognitively Impaired

INR	International Normalized Ratio
IT	Information Technology
MedPAC	Medicare Payment Advisory Council
MMSE	Mini-Mental State Exam
MS	Multiple Sclerosis
NCQA	National Committee for Quality Assurance
NIC	non-institutional care
PACT	Post-Acute Care Transitions
PCRS	Patient Care Record System
PHR	Personal Health Record
PT	Prothrombin Time
RFID	Radio-frequency Identification
RF	Radio-frequency
RPM	Remote Patient Monitoring
RTS	Remote Training and Supervision
SMS	Short Message Service
SPAN-CHF	Specialized Primary and Networked Care in Heart Failure
TCM	Transitional Care Model
Tech4Impact	Technologies for Improving Post-Acute Care Transitions
VHA	Veterans Health Administration
VNSNY	Visiting Nurse Service of New York

## Appendix B: Description of the Center for Technology and Aging Funding Opportunity

This position paper is targeted toward applicants interested in a special Center for Technology and Aging (CTA) funding opportunity that is being offered in collaboration with the Administration on Aging (AoA) and the Centers for Medicare & Medicaid Services (CMS).<sup>50</sup> The funding opportunity, which is available to state agencies or instruments of a state, is briefly described in this appendix. For further information see: <http://www.aoa.gov/AoARoot/Grants/Funding/index.aspx>

As announced June 3, 2010, AoA and CMS will jointly award up to \$60 million in formula and competitive grants through the Program Announcement entitled: *"Implementing the Affordable Care Act to make it easier for Individuals to Navigate their Health and Long-Term Care through Person-Centered Systems of Information, Counseling and Access."* Within the Program Announcement, CTA, with support from The SCAN Foundation, is offering a complementary award that will support the use of assistive technologies in the Evidence-Based Care Transition Programs funded under "Option D" of this Announcement.

Under Option D, AoA is making funds available for states to significantly strengthen the role of Aging and Disability Resource Centers (ADRCs) in implementing evidence-based care transition models that meaningfully engage older adults and individuals with disabilities (and their informal caregivers). ADRCs work to assist individuals in "critical pathways," which is defined as the times or places when people make important decisions about long-term care. This grant opportunity is designed to promote the further development and enhancement of ADRC participation in evidence-based care transition models. This may include:

- Increasing the capacity of ADRCs' current involvement in evidence-based care transition initiatives by expanding the reach of the ADRC efforts (e.g., adding additional staff, expanding an intervention to serve new populations, or expanding to additional sites).
- Strengthening the extent to which existing transitions programs leverage the assets of the ADRCs (e.g., to streamline access to public benefits, link individuals with community-based services and supports, and counsel individuals and their families on service options) among programs where ADRCs have a limited role currently.
- Informing AoA/CMS, other Federal agencies and Congress on national policy related to care transitions, hospital discharge planning, person-centered planning, and mechanisms to reduce unnecessary hospital re-admissions.

This funding is not intended to support the development of new care transition models, per se, nor is it meant to build new relationships where none already exist. Rather, the focus is to strengthen and expand activities that are already well developed and already have the active involvement of key partners. Applicants are limited to states increasing the capacity and/or geographic reach of ADRCs that already are involved in evidence-based care transition models. For this program announcement, all applicants must – before submitting an application – have established partnerships with one or more hospitals, clinics, or physician practices related to the implementation of evidence-based care transitions activities. Because ADRCs have different funding, capacity, and partners, ADRCs might serve different roles within these partnerships. For this solicitation, applicants must clearly describe the role that ADRCs will play in the care transitions activities.

Funding under this Announcement is only available to support ADRC involvement with *evidence-based* care transition models such as the Care Transitions Intervention, the Transitional Care Model, Guided Care, and the model titled Geriatric Resources for Assessment and Care of Elders (GRACE).

As a complement to the AoA and CMS Program Announcement, CTA has created a separate funding opportunity: the **Tech4Impact Diffusion Grants Program**. Brief information about the program follows. Refer to [www.techandaging.org](http://www.techandaging.org) for further information.

### **What is the Purpose of the Tech4Impact Diffusion Grants Program?**

The purpose of the **Tech4Impact** Diffusion Grants Program is to accelerate adoption and diffusion of technologies that better enable evidence-based care transitions models, and result in a reduction in avoidable hospitalizations, improvements in health outcomes and cost of care, and an increase in the number of people that are able to safely and effectively transition from hospital to home or to long-term care community settings.

### **Who is Eligible to Apply for the Tech4Impact Diffusion Grants Program?**

States that apply for Option D are eligible to apply for CTA's **Tech4Impact** Diffusion Grants Program.

### **Who May Receive Tech4Impact Awards?**

Grant recipients who are approved by AoA/CMS for Option D funding will become eligible to receive **Tech4Impact** awards.

### **What are the allowable activities that can be paid for with Tech4Impact Awards?**

**Tech4Impact** funds may be used to support community-based interventions that align with the goals of the **Tech4Impact** program: to accelerate adoption and diffusion of technologies that better enable evidence-based care transitions models. Example activities or interventions include, but are not limited to, the use of medical devices and computer-based technologies that better enable:

- Medication adherence (e.g., devices that remind patients to take the right medication at the right time and alert caregivers when a medication has not been taken)
- Medication reconciliation (e.g., software that stores medication information and detects potential problems, such as duplicate prescriptions)
- Patient or caregiver access to health records and other important health information
- Home monitoring of a patient's health condition, including technologies that provide an early warning alert when a patient's health condition deteriorates
- Health risk assessments (e.g., to identify pre-discharge patients most at risk of hospital readmission).
- Communications between and among patients and informal caregivers, and formal caregivers

CTA may also consider funding the following technology-enabled activities:

- Training and supervision of personnel implementing one of the care transitions models (e.g., Care Transition Intervention or Transitional Care Model)
- Care transitions program evaluations that will guide and improve program quality

Note that grant funding cannot be used to pay for technology equipment.

**Standards:** State Units on Aging and ADRC grant recipients who are approved by AoA/CMS for Option D funding will become eligible to receive a **Tech4Impact** award. **Tech4Impact** applicants that will be given highest consideration include those that 1) have in place the basic elements of an evidence-based care transitions program and understand how technology can complement the program, 2) have demonstrated ability to work collaboratively with local organizations to implement a care transitions program, and, 3) have developed a plan for long-term sustainability.

### **Target Population:**

**Tech4Impact** funds are intended for older adults or persons with disabilities participating in, or who could benefit from, an Evidence-Based Care Transition program (e.g., Care Transitions

Interventions, Transitional Care Model, Geriatric Resources for Assessment and Care of Elders, or evidence-based models).

**Tech4Impact Award:**

CTA will award up to 6 grants through the **Tech4Impact** Diffusion Grants Program. CTA will consider funding up to \$100,000 for each community-based project. Applicant's eligibility and receipt of an award from the CTA for this option is dependent upon receiving an AoA/CMS Implementing the Affordable Care Act grant award. The **Tech4Impact** awards will be made no later than December 31, 2010.

**Collaboration between U.S. Administration on Aging (AoA), the Centers for Medicare & Medicaid Services (CMS), and the Center for Technology and Aging (CTA)**

CTA supports AoA and CMS's long range vision to have ADRC programs fully operational and available to individuals in every community across the country, serving as highly visible and trusted sources of objective information on the full range of long-term services and support options and help in accessing the services and supports they need. ADRCs are community-wide "programs" or "systems" of information, counseling and access that work in a coordinated manner to provide consumers with a "single point of entry" to all long-term services and supports, including all publicly supported programs, both community based and institutional care. From the perspective of the consumer, ADRCs are intended to provide seamless access to long-term services and supports and be supportive of the care transition process.

CTA ([www.techandaging.org](http://www.techandaging.org)) supports more rapid adoption and diffusion of technologies that enhance independence and improve home and community-based care for older adults and persons with disabilities. Through grants, research, public policy involvement and development of practical tools and best practice guidelines, CTA serves as an independent, non-profit resource for improving the quality and cost-effectiveness of long-term care services.

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## About the Center for Technology and Aging

The Center for Technology and Aging ([www.techandaging.org](http://www.techandaging.org)) supports more rapid adoption and diffusion of technologies that enhance independence and improve home and community-based care for older adults. Through grants, research, public policy involvement and development of practical tools and best practice guidelines, the Center serves as an independent, non-profit resource for improving the quality and cost-effectiveness of long-term care services. The Center was established with funding from The SCAN Foundation ([www.thescanfoundation.org](http://www.thescanfoundation.org)) and is affiliated with the Public Health Institute ([www.phi.org](http://www.phi.org)) in Oakland, CA.



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