Global Council on Alzheimer's Disease™

Disrupting Alzheimer's

The Opportunities for Technology in Alzheimer's Disease

Disrupting Alzheimer's

Over the past three years, Otsuka America Pharmaceutical, Inc. has been convening the Global Council on Alzheimer's Disease (GCAD), a cross-sector group of Alzheimer's experts. GCAD brings together leaders from caregiving, finance, medicine, policy, science, technology, and other domains to create practical, on-the-ground solutions for those affected by Alzheimer's disease.

At the inaugural GCAD meeting in October 2014, one conclusion stood out: as the medicine and science for Alzheimer's disease progress, technologies could potentially solve some of the daily problems faced by those affected by Alzheimer's. Yet this potential has not been realized.

The GCAD Advisors concurred that many of the technologies marketed as Alzheimer's solutions failed to solve the real, complex problems that people face. The bulk of technologies, it was hypothesized, was first built and then tweaked to be sold to the Alzheimer's community.

This is a missed opportunity, and the widespread day-to-day usage of helpful technologies remains a dream.

It is imperative to note that even as we call for better technologies, we believe firmly that "low tech" and "no-tech" solutions have a vital role to play in solving all sorts of problems, including mood, diet, toileting, personal hygiene, and more. We want to be crystal clear on this point: there is immense potential for technological innovation in Alzheimer's, but it is not a magic bullet.

In this paper, we focus only on technological solutions, because we believe that technology's unbound potential for Alzheimer's is vastly unrealized. It is our goal to analyze the current state of Alzheimer's and technology in order to provide a framework for innovation for those who are interested in "disrupting Alzheimer's."

In this paper, we survey the academic literature and the technologies on market, and we provide an overview of the strengths, weaknesses, opportunities, and barriers in this field.

We do not want to suggest that this paper is fully comprehensive or that it accounts for all the dynamics in this very large, fragmented field. Instead, we hope to help fill a void by providing an overview of what the landscape looks like in this critical, but underdeveloped area of innovation.

With one new case of dementia every three seconds,[1] it is time for technologists and innovators to do what they do best: be disruptive.

Otsuka America Pharmaceutical, Inc. and the Global Council for Alzheimer's Disease are working with innovators and technologists to create better solutions for those affected by Alzheimer's disease. Writing this paper provided us with essential background. We hope that reading it will do the same for you.

Signed,

Alex Mihailidis, PhD, P.Eng.
University of Toronto, AGE-WELL NCE Canada

Lisa Winstel
Caregiver Action Network

Mary Michael
Otsuka America Pharmaceutical, Inc.

David Digby
Otsuka America Pharmaceutical, Inc.

WHERE ARE WE NOW?

The desire is unequivocal: the Alzheimer's community is yearning for technologies to help those affected by the disease.[2] Yet there is also frustration: technologies haven't done enough. The massive opportunities for technologies to intervene in and improve the lives of those affected by Alzheimer's are still wide open. Alzheimer's remains un-disrupted.

Why?

After extensive research, product analysis, and conversations with experts from Alzheimer's, technology, and innovation, we have come to conclude that the problem is simple. It is not that technologies can't help, or that Alzheimer's disease (AD) is too complex. Instead, we believe that—at the foundation—the issue is one of miscommunication and misunderstanding.

"How many companies actually have someone with dementia? They make these things and we have to adapt to them and not the other way around."

PERSON WITH ALZHEIMER'S

The technology community confronts in Alzheimer's disease a series of "wicked" problems—problems that require complex, evolving solutions.

Most in the technology community do not fully understand Alzheimer's disease—especially the journey undergone by those with AD, caregivers, and families.[3] At the same time, the Alzheimer's community has not sufficiently articulated what those affected by AD need.[4] There are certainly a handful of noteworthy exceptions, but—on the whole—these gaps remain.

This problem of insufficient communication goes further. There is a breakdown in communication between technology developers and end-users. Generally speaking, once a technology for AD is developed and introduced to the Alzheimer's community, the feedback loop closes.[5] A better alternative would be a continuous feedback loop between developers and end-users, one that would allow developers to troubleshoot and continuously improve their products. With little substantive communication or research on a technology's actual effects and "real world" applications, innovative technologies can't reach their potential.

These problems can be solved. In this paper, we hope to begin to bridge this communications gap by reviewing, from a specific Alzheimer's perspective, the technology landscape and offering a framework for successful innovation.

In the section below, we provide a brief overview of the opportunities for development in this field.

One Size Does Not Fit All

It is easy to imagine why technologists and innovators do not understand the scope of Alzheimer's—or why the Alzheimer's community faces such difficulties in explaining the full scope of the disease. Not only is Alzheimer's dramatically progressive, but every person affected embarks on a unique journey.

For technologists, this makes it extremely difficult to develop a solution that can be useful for multiple end-users over any sustained amount of time.[6] Issues with sleep patterns, dietary habits, behaviors, and emotions are in flux.[7] The technology community often refers to these as "wicked" problems, because they require complex, evolving solutions.[8] When new technologies for Alzheimer's cannot address these wicked problems, they are of limited value. Unfortunately, when on-market technologies do not solve real problems, many in the Alzheimer's community start to conclude that technology cannot be an effective solution.

It also seems that a number of existing technologies start on the wrong path. From the very beginning of design and development,

AN ALZHEIMER'S STORY

Steve was diagnosed with Alzheimer's disease nine months ago, just a few weeks after his 69th birthday. He's divorced, lives alone. Since his diagnosis, he's lost over 50 pounds. He forgets to eat. His weight loss startled his daughter, so she set up a system of calendar reminders for his iPhone. They worked for a little while, but not anymore. Now it seems to him that his phone just beeps at him all the time for no reason – and it's annoying, not helpful. Steve's doctor tells him it's vital for him to eat a balanced diet – but he can't do it. His daughter made him a bunch of meals, and delivered them every Sunday, but they just sat in his refrigerator, going to waste. Or he'd stick them in the microwave, then forget about them. If he can't eat more nutritiously, he could decline far faster than he otherwise would.

"I rarely recommend technologies to my patients and their families. I'd like to very much. But I don't feel confident recommending what's out there."

PHYSICIAN

an effective technology solution must be designed specifically for Alzheimer's. Yet many, it seems, begin as broad solutions for age-related conditions, or perhaps they are initially designed specifically for other diseases and then tweaked and re-packaged as Alzheimer's solutions.[9] This won't do.

Other technologies appear to be originally developed for younger users with non-progressive impairments, not the declining mental and physical function of older people with Alzheimer's.[10] This approach will also not work.

Technologies must, from the very beginning, understand the unique complexities of AD—and they must be designed accordingly.

Alzheimer's Disease: A Unique Set of Challenges

Many technology products on market today make a backwards assumption: they presume that those affected by Alzheimer's will learn and adapt to the technology, not vice versa.[11] For a tech solution to be broadly and enduringly effective, it must adapt to the users.

Those with Alzheimer's suffer from declines not just in their memory, but also in judgment, language skills, sensory abilities, executive function, visuospatial reasoning, and more.[12] Their caregivers also operate under extreme stress, and learning new technological functions can be extremely challenging, especially for older family caregivers who are not "digital natives."[13]

Furthermore, the cognitive deficits of those with Alzheimer's are not stable; they become more complex over time.[14] This deterioration demands that solutions for Alzheimer's be adaptive.

For example, some with Alzheimer's may respond better to voice prompts, while others require text; some may be able to interact with an application, while others need an entirely independent device.[15] Further, the typical declines of old age, including deteriorating eyesight, hearing, and finger dexterity, can impede the use of technology.[16]

Even against the "wicked" problems, we remain optimistic, and we believe that technology has the potential to disrupt Alzheimer's. To offer a framework for innovation, in the section below we outline six pillars for effective solutions.

A CAREGIVER'S STORY

Sarah's mom, Florence, has Alzheimer's disease. Florence is 71, and her Alzheimer's is still mild, but it's getting worse—quickly. Florence lives alone, and Sarah worries about her. Her driving is a major source of anxiety. They tried a GPS system, but it did more harm than good. They've agreed that Florence should only drive to a few important places: the grocery store, the bank, the doctor. One day, as Sarah's driving home from work, she gets a call. It's Florence. She's out, driving, and she's lost. She's confused and upset. Sarah wants to call the police for help, but she doesn't know her mom's license plate number. She's not even 100% sure what kind of car she drives. She wants to call 911, but she's in D.C., and her mom lives over the river in Virginia, so she won't get the right dispatch office. She's panicking, and has no idea what to do.

FRAMEWORK FOR INNOVATION: SIX PILLARS FOR EFFECTIVE SOLUTIONS

What would a breakthrough technology do for those affected by AD? How would it help people manage the day-to-day challenges brought by Alzheimer's? Below, we sketch out six pillars upon which effective technologies could build. We do not want to suggest that this is an exhaustive list. Rather, we propose that this framework provides a useful way to think about technological solutions.

1 An Improved Feedback Loop

One of the barriers to creating effective technologies for Alzheimer's is the lack of a feedback loop between end-users and developers.[17] In order to produce technologies that will be adopted, developers must prioritize the needs of those with Alzheimer's and caregivers from the first moment of the design process. This will require not only outreach to the Alzheimer's community and consultations with experts, but also an ongoing dialogue and a "continuous improvement" mindset.

2 Integrated Smart Systems

The rise of connected devices and advanced analytics provides a promising future for Alzheimer's care. Some of the most useful solutions for those with Alzheimer's will not be standalone products, but integrated systems of devices that track condition, behavior, needs, and more.[18] These systems will, and must, know more about a person's condition and environment than he or she does. Such "smart" products would not perform a single use, but play the role of a trusted partner in providing care and enabling independence. If developed and used properly, these smart devices can collect data from multiple domains and then report out in a way that is useful for caregivers, physicians, and others.

3 A Broader Set of Solutions

Technologies for Alzheimer's—and most diseases, for that matter—tend to focus on the same things: medication adherence, vital signs monitoring, transportation, communications, and tracking.[19] A broader set of solutions is needed in Alzheimer's. For example, one of the most substantial sources of stress for families is financial planning. The costs of Alzheimer's caregiving can be staggering, with an average total cost of $58,000 per year for each person with the disease.[20] But it's not only the costs: it is extremely difficult for families to explore and weigh their decisions. We propose that there is a major opportunity for technologies to fill this non-traditional need, as well as others like insurance, legal questions, estate planning, and more.

4 Solving the "Wicked" Problems

Until technologies solve for the wicked problems of Alzheimer's, they will remain of limited use. Yet these wicked problems are, by definition, difficult to solve, because they demand a solution that changes and adapts with the person's needs. The wicked problems that need solving most urgently are the daily tasks of life—eating, drinking, changing clothes, toileting. It is these problems—and the individual's inability to manage them—that often serve as the final trigger for placing someone with Alzheimer's into formal care.[21]

5 Focusing on the Caregiver

Caregivers are critical end-users for technology innovations, especially as the disease progresses. They stand at the center of an overall community of care, and they will be pivotal in determining if a technology is adopted and used.

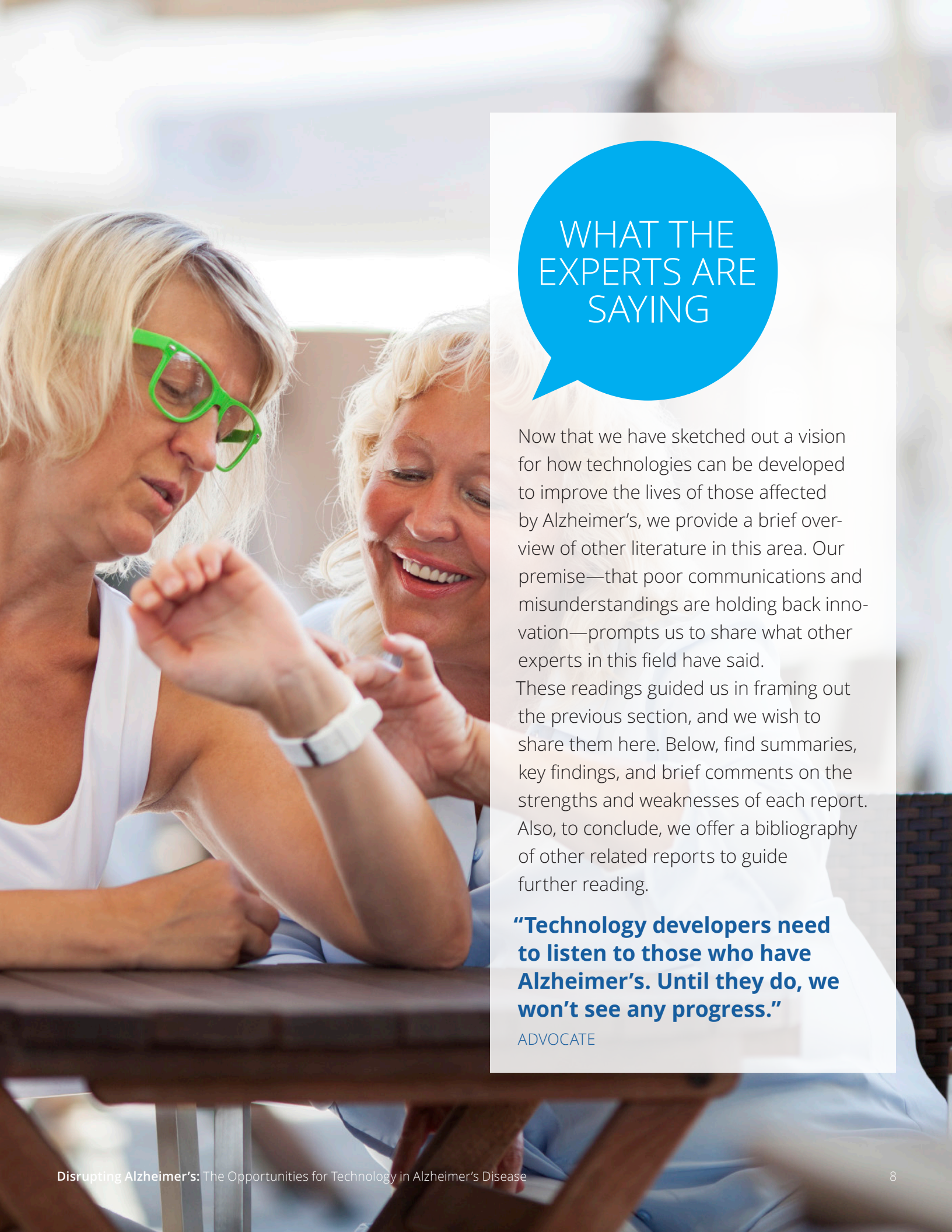
Moreover, caregivers themselves need help. They tend to suffer substantial health burdens as a result of their support role, commonly suffering from stress, chronic pain, sleep deprivation, and an overall reduction in wellness.[22] Technologies for Alzheimer's should strive to reduce the physical and mental stresses of caregiving.

6 Playing the Connecting Role

Technologies for Alzheimer's can provide substantial support by connecting and communicating between those with the disease, caregivers, family members, physicians, in-home care professionals, and more. Each of these stakeholders plays an integral role in the care and treatment of Alzheimer's, but the flow of communication between them is limited.[23] One potential solution for a technology would be to gradually shift control to these third parties, eventually reaching a point where a device or application operates independently of a person with Alzheimer's.

Conclusion

As we have attempted to suggest, the potential for technology is immense—but unrealized. We advocate an approach that considers, from the first steps, the unique nature of Alzheimer's and those it affects.



WHAT THE EXPERTS ARE SAYING

Now that we have sketched out a vision for how technologies can be developed to improve the lives of those affected by Alzheimer's, we provide a brief overview of other literature in this area. Our premise—that poor communications and misunderstandings are holding back innovation—prompts us to share what other experts in this field have said.

These readings guided us in framing out the previous section, and we wish to share them here. Below, find summaries, key findings, and brief comments on the strengths and weaknesses of each report. Also, to conclude, we offer a bibliography of other related reports to guide further reading.

"Technology developers need to listen to those who have Alzheimer's. Until they do, we won't see any progress."

ADVOCATE

RTI International

"Assistive Technology for People with Dementia and Their Caregivers at Home: What Might Help."

September 2010

Summary

According to the authors, technology solutions for those with Alzheimer's and their caregivers have suffered from a one-size-fits-all approach that neglects both context-specific factors and the unique progression of the disease. The article also suggests that caregivers may struggle to understand what products are on market and how to use them.

Key Findings

- **Only customizable technologies can address Alzheimer's.** The technologies for Alzheimer's that are currently on market may be ineffective or even useless, because they cannot adapt to context-specific factors, including declining cognitive and functional abilities, attitudes towards technology, and living environment. An effective solution must adapt to a wide range of circumstances.
- **Not just memory loss.** Most technology solutions currently available focus on memory issues, thereby failing to account for the complexity of the disease.
- **Few resources to navigate the marketplace.** Researchers and manufacturers have not given clear evidence on how their technology products can benefit those affected by Alzheimer's. This hinders caregivers from choosing the right solutions, and it delays technology adoption in the crucial early stages of the disease.

Our Take

The authors draw from a wide variety of academic and industry publications, conferences, and interviews to create a comprehensive, qualitative analysis of the current landscape. These findings create an imperative for the technology community to collaborate with other

"The demand for Alzheimer's caregiving is skyrocketing. The supply of caregivers may not be able to keep up. Technology should be able to fill that gap. But it hasn't."

CARE PROFESSIONAL

stakeholders in the space—including researchers and the Alzheimer's community—to test existing products, develop clear criteria for effective solutions, and define common needs. However, the report could offer more detailed descriptions both of what would characterize effective technologies for AD and possible channels for future collaboration.

The Alzheimer's Society (UK)

"Assistive Technology – Devices to Help with Everyday Living"

April 2015

Summary

The Alzheimer's Society contends that technologists, physicians, and caregivers may be able to adapt mainstream technologies to the specific needs of those with Alzheimer's and their wider support network. In particular, they see the most potential in mobile devices and telehealth applications. They also argue that, at the moment, technologies expect for users to adapt to these products, instead of the reverse. For technology to combat Alzheimer's, solutions will need to interact with those users and engage in an ongoing process of assessment and adjustment.

Key Findings

- **Possibilities of mainstream technology.** General technology applications can be—and are being—adapted to solve the needs of Alzheimer's care and disease management. However, for these conversions to work, the technologies must be set up to respond to the unique needs of those with Alzheimer's.

- **Telehealth: greatest potential, largest hurdles.** Telehealth applications could be particularly useful for the most critical areas of Alzheimer's care. To date, however, telehealth solutions have not been designed to manage the disease's unique limitations.
- **An iterative, community process.** The selection, adoption, and modification of technologies for Alzheimer's disease should not be a one-off event undertaken by a single stakeholder. Instead, effective technology adoption will be an ongoing, collaborative process between caregivers, those with the disease, and care professionals, each of whom can speak to the solution's effect on their area of engagement.

Our Take

This report highlights a critical point: that existing solutions may be applicable to Alzheimer's, but both these technologies and new innovations will need to: 1) understand the unique needs of AD; and 2) engage in an iterative feedback loop. These two points are critical. That said, the analysis could more deeply examine the specifics of particular devices and projected trends. Without this, the article is more useful as a general guide to broad categories of technology for Alzheimer's than as an in-depth examination of existing capabilities and their bearing on the needs of the Alzheimer's community.

Center for Technology and Aging

"Technologies to Help Older Adults Maintain Independence: Advancing Technology Adoption"

July 2009

Summary

The Center for Technology and Aging contends that the technologies with the greatest potential value are those that provide medical adherence and remote patient monitoring solutions. Yet even for these technologies to succeed, they must account for population applicability, health outcomes, cost savings, technological viability, and stakeholder readiness. Overall, this report concludes that technologists, government officials, and payers must commit to rapidly ramping up the development and accessibility of technologies for older adults, in order to meet the immense need of an aging population.

"More and more, people with Alzheimer's do not have families to care for them or caregivers to provide continuous support. That opens an entirely new source of demand for technologies that enable greater, prolonged independence."

ADVOCATE

Key Findings

- **Best technologies: medical adherence and remote patient monitoring.** These are the two technology areas with the greatest potential to both improve health outcomes for older adults and reduce costs. The devices that serve these functions have been shown to optimize medications' effects and improve care management. Both of these outcomes are vital for helping those with AD and caregivers.
- **Integrated health devices are the future.** Standalone devices, while widely available and easy to use, do not offer a complete picture of a person's health. This can only be done by "smart" and integrated devices. The data provided by these types of devices could revolutionize care management once we are able to gather, analyze, and act upon the data they collect.
- **Tech-based cognitive assessments.** These tests could show exactly where and how mental decline is occurring. As a result, they could guide decisions about care and other assistive technologies. In Alzheimer's, these capabilities are particularly critical, but stakeholders will have to overcome a lack of research showing improved health outcomes.

Our Take

The report takes a systematic approach to the topic, using well-defined criteria to assess seven distinct technology domains and reach decisive conclusions.

This evidence-based approach provides a valuable counterpart to the more speculative research on the future of technologies for Alzheimer's. Further, this report clearly identifies the current obstacles and deficits in the field, and it highlights what is necessary to drive market uptake. However, since the report is a review of technology for older adults generally, some sections are not useful for the management of Alzheimer's disease.

Bharucha, Ashok, M.D.; Vivek Anand; and Jodi Forlizzi, Ph.D.; et al.

"Intelligent Assistive Technology Applications to Dementia Care: Current Capabilities, Limitations, and Future Challenges."

February 2009

Summary

To produce technologies for Alzheimer's, the majority of developers have been focused on tweaking products that were originally designed for non-progressive impairments into Alzheimer's solutions. According to Bharucha et al., the success has been minimal. The authors argue that the technology community needs to revamp its design approach by putting those with Alzheimer's and their caregivers at the center from the very beginning.

Key Findings

- **Tweaked for Alzheimer's.** Instead of building solutions from scratch, the focus of research and industry has been on slightly changing assistive technologies designed for younger individuals to help those with AD. As such, these technologies are of limited usefulness, and they are not improved through an iterative feedback process.
- **Context-aware prototypes for cognition are promising.** Some research prototypes have used integrated sensors, artificial intelligence, and customizable prompts to provide a solution even as a user's cognition declines. However, only a very few of these products are commercially available, and some question their viability.
- **Needed: a continuous feedback loop.** Instead of tweaking existing technologies, developers should begin with an initial, thorough assessment of individual needs, and then they should continuously improve their products based on the feedback they receive.

Our Take

The report's survey of academic literature, research projects, and commercial products provides a nuanced picture of the current state of technologies for those with Alzheimer's and caregivers. It also reveals the urgency for developing viable, useful solutions for an aging population. The authors avoid speculating about general trends in computing, and instead they examine specific research prototypes to point the way forward for innovation with technologies for AD. It would have been welcome, however, had the report detailed how this approach might be encouraged or implemented.

Further Readings

- The future of assistive technologies for dementia. By Carrie Beth Peterson, Neeli Prasad and Ramjee Prasad. Gerotechnology. 2012.
- Report to Congress: Aging Services Technology Study. By the National Opinion Research Center. 2012.
- Advancing the Aging and Technology Agenda in Gerontology. By Schulz et al. The Gerontologist. 2014.
- Catalyzing Technology to Support Family Caregiving. By Richard Adler and Rajiv Mehta for the National Alliance for Caregiving. 2010.
- Perspective on everyday technologies for Alzheimer's care: Research findings, directions, and challenges. By Eric Dishman and Maria Carrillo. Alzheimer's & Dementia. 2007.
- The New Era of Connected Aging: A Framework for Understanding Technologies that Support Older Adults in Aging in Place. By the Center for Technology and Aging. 2014.
- Supporting People with Dementia Using Pervasive Healthcare Technologies. By Mulvenna et al. 2010.
- Review of ICT-based services for identified unmet needs in people with dementia. By van der Roest et al. Ageing Research Reviews. 2007.

TECHNOLOGY CATALOG

To conclude this report, we offer a catalogue that profiles current, on-market technologies that are aimed to assist those affected by Alzheimer's. This catalogue is not comprehensive, and numerous technologies are on market—and in homes—that are not profiled below. The intent here is not to offer an exhaustive litany of the many technology applications for Alzheimer's, but to create a representative sampling that suggests the strengths, weaknesses, and general landscape of the overall field.

Below, we group the technologies into three categories:

- **Tracking and Monitoring.** Technologies that communicate information about a person with Alzheimer's to caregivers and care professionals, including their location, activity levels, and the performance of activities of daily living.
- **Wellness.** Technologies that help people with Alzheimer's, caregivers, and care professionals to manage and track various elements of overall well-being, including emotional and financial wellness.
- **In-Home Assistance.** Technologies that help people with Alzheimer's, caregivers, and care professionals with activities of daily living, such as eating and taking medicine.

A CAREGIVER'S STORY

About a year ago, Jennifer had to quit her job to take care of her mother. Her husband still works, her kids are in high school, so it's been tough – financially. But Jennifer is certain that she's doing the right thing. She does not want to put her mom in long-term care. But her mom needs a lot of help. In addition to Alzheimer's, she has diabetes, high blood pressure, vision issues, and a skin condition. Each day, she takes more than eleven medications. And they're not all pills. Some are liquids, others are dissolvable powders, and one is a patch. Two need to be kept refrigerated. She also needs a self-injectable shot once every two weeks. Jennifer can't keep track of it all. She's looked for solutions, but the pill-boxes – the ones with a little compartment for each day of the week – simply don't work for the range of medications her mom takes.

TRACKING AND MONITORING

Personal GPS Safety Device

A GPS tracking device and related software that allow a caregiver to monitor an individual's location and receive alerts when they leave a defined area.

Manufacturer: SafeLink
Cost: $169 + $18/month
Function:
Wandering safety

THE PRODUCT

- Caregivers can view location of tracking device online.
- Alerts caregivers if a person with Alzheimer's leaves a pre-defined area.
- Includes emergency button if a person with AD feels unsafe or becomes lost.
- A "tailing mode" provides real-time tracking to allow for easier response in emergency.[24]

THE NEED IT IS DESIGNED TO MEET

60% of those with Alzheimer's wander, walking aimlessly into unfamiliar areas, which creates distress and endangers their safety.[25] However, walking helps maintain an individual's sense of freedom, keeps them engaged in daily life and provides physical benefits, if caregivers ensure their safety.

THE STATE OF THE INDUSTRY

Tracking devices and support services vary widely in the degree of involvement by the person with AD, and the sophistication of supporting services.[26] Some devices, such as simplified cellphones, require a person with Alzheimer's to call for help. Passive devices, such as electric wrist monitors and GPS tracking cards, allow a caregiver to monitor walking independently of an individual with AD.

LIMITATIONS

- Will not work if a person with AD does not carry the tracking device.
- GPS and cellular signals may not be available or accurate in some areas.
- A person with AD may unintentionally or intentionally leave behind GPS tracker.

The products featured are included only as examples of currently available technology.
The summaries are intended to be illustrative and are not product reviews based on actual product use.

TRACKING AND MONITORING

Lively

A suite of activity sensors, a smart watch and online portal that track if and when an individual with AD performs key activities such as leaving the home, eating and taking medicine.

Manufacturer: Lively
Cost: $50 + $35/month
Function: Remote patient monitoring, medical adherence

THE PRODUCT

- Motion sensors placed at key locations such as the front door, the refrigerator, and the shower can detect when a person with AD is performing certain activities.
- A connected pillbox tracks when individuals take their medication, and notifies caregivers if a dose is missed.
- Smart watch allows a person with AD to call for help in case of an emergency, and tracks their steps to monitor activity levels.
- Online portal combines this information on a convenient dashboard summarizing a person with AD's daily activities.[27]

THE NEED IT IS DESIGNED TO MEET

A failure to perform the most important activities of daily living can be a sign of AD's onset and progression, and a safety risk.[28] By monitoring set categories of activity, the Lively system allows caregivers and medical professionals to respond to AD's progression and its specific impacts on quality of life.

THE STATE OF THE INDUSTRY

Few products monitor multiple activities of daily living to create a single, easily reviewed report, although many devices perform one of these functions.[29] While a simpler PERS device, medication reminder system or motion sensor could target individual needs early in the disease, an integrated set of products like the Lively will likely be more useful as the disease progresses.

LIMITATIONS

- Sensors can only approximately determine whether a certain activity has occurred. For example, a person with Alzheimer's who opens the fridge may not actually ingest food.
- The sudden introduction of the sensors may distress those with AD.

The products featured are included only as examples of currently available technology.
The summaries are intended to be illustrative and are not product reviews based on actual product use.

TRACKING AND MONITORING

Withings Home

A connected camera and motion sensor offering alerts of movement and sound, live footage, 2-way communication and time-lapse recordings of in-home activity.

Manufacturer: Withings
Cost: $200 + $0-20/month
Function: Remote patient monitoring

THE PRODUCT

- Allows caregivers to monitor a person with AD's activity in real-time, and communicate with them via a 2-way sound feed.
- Replays time-lapse footage, so caregivers can view an individual's activity for a given day.
- Monitors air quality.
- Customizable alerts for certain kinds of movement and sound, improving security.[30]

THE NEED IT IS DESIGNED TO MEET

Many people with Alzheimer's live alone, creating safety risks and significant stress for caregivers.[31] Emergencies such as falls require immediate responses, while altered behavior or inactivity can signal a change in condition

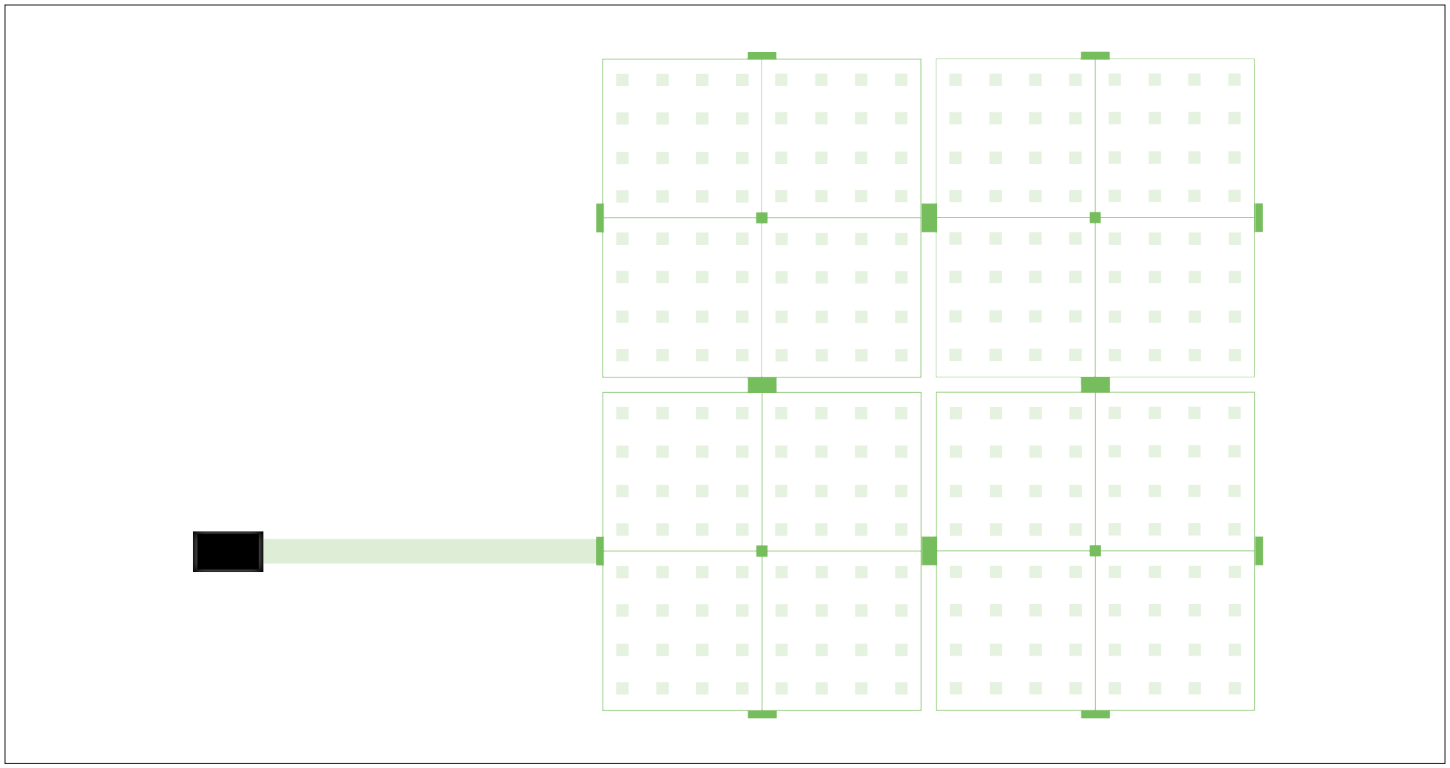
THE STATE OF THE INDUSTRY

Basic cameras or home security systems facilitate patient monitoring, but most do not pair these capabilities with alerts based on customizable levels of motion.[32] Further, few devices allow caregivers to review time lapse videos to identify changes in the behavior of an individual with Alzheimer's.

LIMITATIONS

- Although they track movement, it's unclear whether the Withings Home's sensors can detect falls.
- A person with AD may not respond to the caregiver's voice relayed through the Withings Home, or may become disoriented.
- The Withings Home will not be useful if a person with AD leaves rooms monitored by the device.

The products featured are included only as examples of currently available technology.
The summaries are intended to be illustrative and are not product reviews based on actual product use.



TRACKING AND MONITORING

Scanalytics SoleSensors

Pressure sensors and analytics that track levels of activity throughout the home.

Manufacturer: Scanalytics

Cost: $185/month

Function: Remote patient monitoring

THE PRODUCT

- Tracks movement throughout the home, and presents the information in easy to understand charts and graphs.
- Allows caregivers to review activity levels and movement patterns, which can lead to insights about the effects of AD.
- Certain movements can trigger set actions, such as playing a reminder to wash hands when a person with AD stands in the bathroom.
- A simple dashboard provides real-time and historical data on movement.[33]

THE NEED IT IS DESIGNED TO MEET

Physical activity can significantly impact quality of life for those with Alzheimer's, so tracking levels of daily movement should be a priority for caregivers.[34] Additionally, standing in one area may be a signal that a person with Alzheimer's has become disoriented, and needs a reminder of what they may be doing.

THE STATE OF THE INDUSTRY

Floor pressure sensors are widely available, but few connect to an analytics system that detects when an individual may have become disoriented or compares their activity to historical patterns.[35] Other products also offer reminders of when and how to perform common tasks when an individual with AD enters a given area.

LIMITATIONS

- Prompts to perform activities may be confusing or distressing.
- Not specifically designed for fall detection.
- Adapted from commercial use, so its applications for AD are largely untested.

The products featured are included only as examples of currently available technology.
The summaries are intended to be illustrative and are not product reviews based on actual product use.

WELLNESS

PARO Therapeutic Robot

A seal-shaped robot that uses sensors and programming to respond to a user's actions, creating an emotionally beneficial sense of connection.

Manufacturer: AIST
Cost: $5000
Function: Emotional wellness

THE PRODUCT

- Recognizes an environment and user with its sensors, responding with nurturing actions.
- Shown to reduce anxiety and improve health.
- Provides sense of emotional connection similar to that of a live animal.
- Learns to respond in the ways its users enjoy.[36]

THE NEED IT IS DESIGNED TO MEET

Roughly 90% of those with dementia experience negative emotional symptoms, such as agitation, aggression and loneliness.[37] Technologies such as the PARO Robot can improve these conditions and general emotional wellness by providing a sense of companionship and connection. More broadly, any technology solution that helps an individual with AD engage with their surroundings is a useful tool for stimulating their mind and improving mental states.

THE STATE OF THE INDUSTRY

There are many technology-supported ways to engage those with Alzheimer's and provide a sense of comfort, though few mimic an animal.[38] Mainstream technologies such as Facebook can help those with mild AD remain connected with family members and friends, while those in the later stages of the disease benefit from recorded messages left by their caregiver.

LIMITATIONS

- Robots can and should not serve as a substitute for human contact.
- Significant expense

The products featured are included only as examples of currently available technology.
The summaries are intended to be illustrative and are not product reviews based on actual product use.

WELLNESS

Joy for All Companion Pet

A lifelike robot that responds to touch and motion with actions that mimic a pet, generating an interactive experience that can comfort the user.

Manufacturer: Hasbro
Cost: $99
Function: Emotional wellness

THE PRODUCT

- Sensors generate responses to user's touch or motion.
- Offers competitive, scalable cost for individuals, families, and group facilities.
- Mimics a real cat, promoting the emotional wellness of interacting with a pet.
- Creates a sense of connection by varying its responses as user interaction continues or changes.
- Can provide ongoing, easily available feelings of companionship.[39]

THE NEED IT IS DESIGNED TO MEET

It is becoming increasingly recognized that animals can provide comfort to people with Alzheimer's, creating a friendly and comforting source of interaction.[40] Technologies that mimic animals can provide similar benefits, while avoiding the costs and responsibilities of pet care. Such technologies can help those with Alzheimer's to interact with their environment in a positive way.

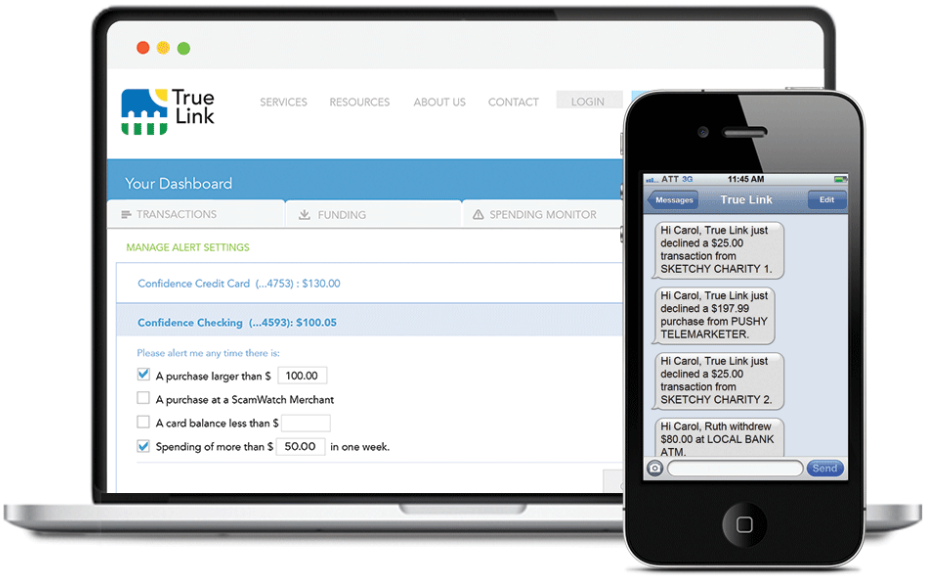
THE STATE OF THE INDUSTRY

There is a growing field of technologies to boost emotional wellness, including devices, software, and social media platforms. Most interactive technologies carry high price points, and require high levels of user sophistication.[41]

LIMITATIONS

- Cannot fully substitute for interactions with humans.

The products featured are included only as examples of currently available technology.
The summaries are intended to be illustrative and are not product reviews based on actual product use.



WELLNESS

True Link

Financial management and monitoring services that allow a caregiver to protect their loved one from fraudulent activity and mistaken spending.

Manufacturer: True Link Financial
Cost: $10/month
Function: Financial security

THE PRODUCT

- Allows caregivers to prevent transactions with certain businesses, categories of spending, or geographic areas.
- Learns a user's spending habits and sends alerts when card activity deviates from normal patterns.
- Prepaid debit card that maintains seniors' independence while limiting the damage of fraud.
- Notifies caregivers when their family member is attempting a transaction with a known fraudulent entity.[42]

THE NEED IT IS DESIGNED TO MEET

70% of those with dementia have been targeted by fraudulent individuals, and 15% have been victims of financial abuse such as cold calling, scam mail, and misleading sales.[43] These fraudulent transactions can drain older adults' savings, but families often feel that more closely controlling their finances would be embarrassing and rob their loved one of independence.

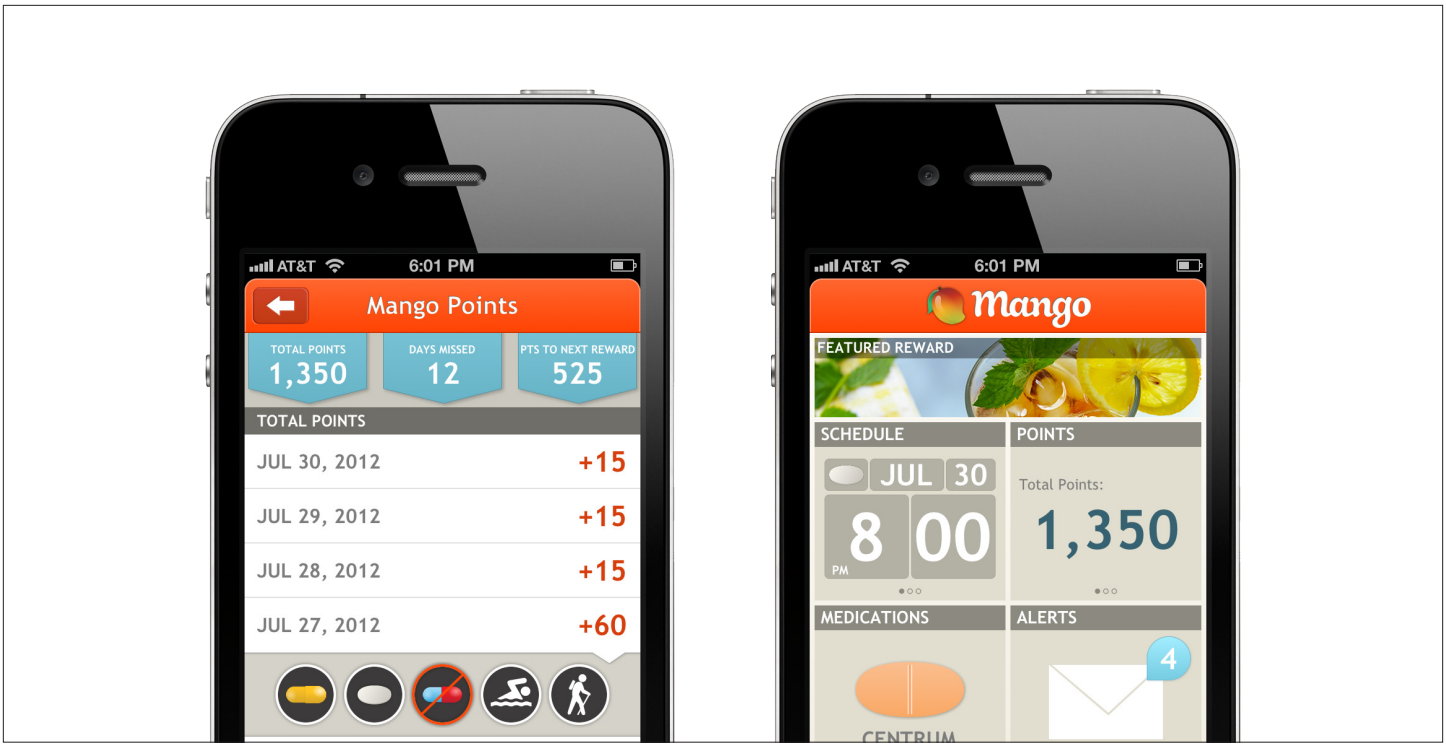
THE STATE OF THE INDUSTRY

Traditional financial arrangements assume a full mental capacity, which makes those with dementia vulnerable to fraud. While many institutions' conventional channels may provide some protection if modified correctly, there is a current lack of tools for caregivers who want more visibility and control in their loved one's finances.[44]

LIMITATIONS

- Those with Alzheimer's must consent to sharing high-level financial information with their caregivers.
- In the later stages of the disease, individuals may not be able to manage their finances at all, which creates the need for greater control by a caregiver or trusted advisor.

The products featured are included only as examples of currently available technology.
The summaries are intended to be illustrative and are not product reviews based on actual product use.



WELLNESS

Mango Health

A smartphone app that reminds users to perform healthy activities, and rewards them with messages, points, and raffle prizes.

Manufacturer: Mango Health
Cost: Free
Function: Medical adherence

THE PRODUCT

- Users set reminders to perform health activities such as taking medication, going on walks and speaking with their doctor.
- Tracks users' performance of healthy activities.
- Gives users access to drug information, such as possible interactions with other medications and food.
- Reminds users to reward themselves for healthy activities, awarding them points and entering them to win gift card raffles.[45]

THE NEED IT IS DESIGNED TO MEET

Simple daily activities can lower the risk of Alzheimer's, so an app that prompts regular exercise, mental stimulation, and dietary changes could play an important role in prevention.[46] Additionally, older adults may need help tracking information about their medication's dosage, side effects, and interactions.

THE STATE OF THE INDUSTRY

There is a crowded market of fitness trackers and medication reminders, but this app offers a few extra capabilities to guide everyday wellness activities.[47] Like most of these products, it is not specifically designed for use by those with Alzheimer's, and could be ineffective after the disease's onset.

LIMITATIONS

- Proper use of the app requires a fairly high-level of forethought and interaction from the user. Those with AD may forget about the app or not respond to its prompts.
- The app does not send alerts about missed activities or medication doses to a third-party, which precludes oversight from caregivers.

The products featured are included only as examples of currently available technology.
The summaries are intended to be illustrative and are not product reviews based on actual product use.

IN-HOME ASSISTANCE

Jon: Automatic Pill Dispenser

A connected pill dispenser that reminds individuals of their medication, alerts caregivers of missed doses, prevents overdosing and generates reports on adherence.

Manufacturer: MedMinder
Cost: $59/month
Function: Medical adherence

THE PRODUCT

- Uses visual cues and recorded messages to prompt medical adherence, as programed by caregivers.
- Alerts caregivers if a person with Alzheimer's does not take medication in set time limit.
- Locks unused pill boxes to prevent overdosing.
- Paired with web portal and app that allow caregivers to view refill needs, medical adherence and reminder settings.[48]

THE NEED IT IS DESIGNED TO MEET

41-74% of all adults aged 65+ do not adhere to their medication regimen,[49] and the rates are likely much higher in those with declining cognitive function. A potentially life-threatening situation can arise if those with Alzheimer's forget to take their medication or accidentally take an overdose.

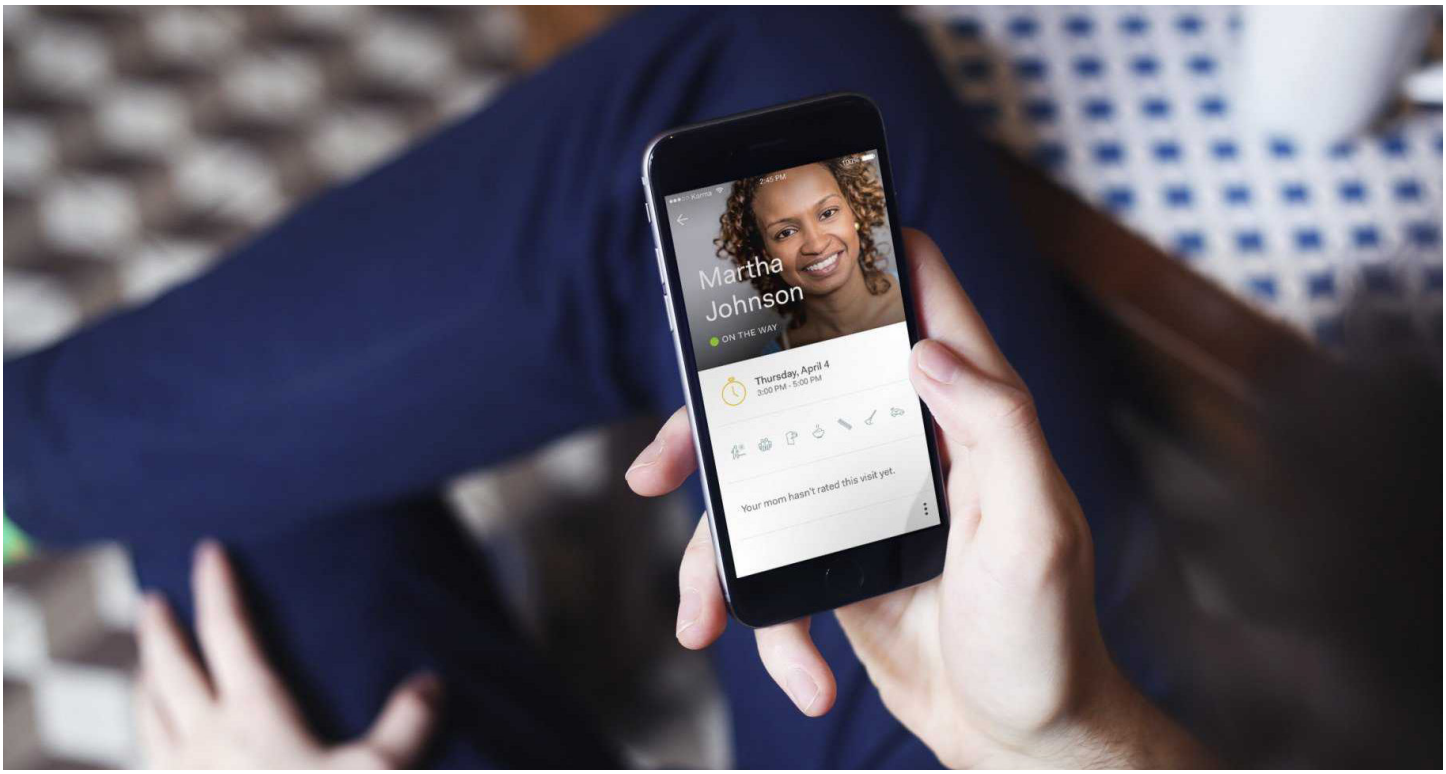
THE STATE OF THE INDUSTRY

From simple watch alarms to comprehensive monitoring services, there are a range of products to improve medical adherence.[50] For someone with mild Alzheimer's, a standalone device like a talking pill bottle or watch alarm may be enough to prompt compliance. However, more advanced AD may prevent an individual from understanding reminders, which creates the need for monitoring.

LIMITATIONS

- Does not ensure ingestion of medication after removal from pill box.
- Those with AD may forget that they have an automated pill dispenser and become disoriented.
- Can only manage pills, not medications in other forms.

The products featured are included only as examples of currently available technology.
The summaries are intended to be illustrative and are not product reviews based on actual product use.



IN-HOME ASSISTANCE

Honor

An online marketplace where family members can find, interview, and hire professional caregivers.

Company: Honor
Cost: $25/hour
Function: Caregiving

THE PRODUCT

- Based on a family's description of a loved one's needs, Honor matches them with a pre-vetted care professional.
- App allows family members to leave instructions and communicate with a care professional directly.
- Provides continuous updates on a care professional's activities.
- Families can save on care services, while care professionals make significantly higher wages.
- Flexible pricing to meet families' changing needs.[51]

THE NEED IT IS DESIGNED TO MEET

Basic services in an assisted living facility cost an average of $43,200 per year, and home health aides are often far beyond the means of most families.[52] However, Honor provides care for $25/hour, offering savings to caregivers and families.

THE STATE OF THE INDUSTRY

Home care agencies and non-professional help dominate the caregiving market, but agencies can be expensive, while informal caregivers can provide a sub-standard level of service.[53] By connecting families with independent contractors, Honor achieves savings and offers access to a wide variety of services.

LIMITATIONS

- The caregiving needs of those with Alzheimer's may eventually exceed the capabilities of some of the contractors listed on Honor.
- Care professionals may not be available in some areas.

The products featured are included only as examples of currently available technology.
The summaries are intended to be illustrative and are not product reviews based on actual product use.

Endnotes

1. Alzheimer's Disease International. "Dementia statistics." 2015. (link)
2. Throughout this paper, we use the term "those affected by Alzheimer's" to refer to patients, caregivers, and families. We avoid the term "patient" because, like many, we agree that people with Alzheimer's disease should not be defined by their disease. We also find the broad scope of the phrase "those affected by Alzheimer's" to be useful, both conceptually and linguistically.
3. RTI International. "Assistive Technology for People with Dementia and Their Caregivers at Home: What Might Help." Page vi. September 2010. (link)
4. Bharucha, Ashok, M.D.; Vivek Anand; and Jodi Forlizzi, Ph.D.; et al. "Intelligent Assistive Technology Applications to Dementia Care: Current Capabilities, Limitations, and Future Challenges." February 2009. (link)
5. Bharucha et al.
6. RTI International. Page vi.
7. Alzheimer's Association. "Stages of Alzheimer's." 2015. (link)
8. Rittel, Horst and Melvin Webber. "Dilemmas in a General Theory of Planning." 1973. (link)
9. Bharucha et al.
10. Bharucha et al.
11. The Alzheimer's Society (UK). "Assistive Technology – Devices to Help with Everyday Living." Page 4. April 2015. (link)
12. RTI International. Page 3.
13. RTI International. Page 20.
14. Bharucha et al.
15. The Alzheimer's Society (UK). Page 13.
16. Wittch, Walter, Kenneth Southall, and Aaron Johnson. "How low vision in older adults interferes with the use of assistive hearing devices." May 2015. (link)
17. Bharucha et al.
18. Bharucha et al.
19. Center for Technology and Aging. "Technologies to Help Older Adults Maintain Independence: Advancing Technology Adoption." Page 5-6. July 2009. (link)
20. Alzheimer's Association. "2015 Alzheimer's Disease Facts and Figures." 2015. Page 45. (link)
21. "2015 Alzheimer's Disease Facts and Figures." Page 38.
22. "2015 Alzheimer's Disease Facts and Figures." Pages 38-39.
23. Center for Technology and Aging. Pages 17-18.
24. SafeLink. "How Does It Work?" 2015. (link)
25. Alzheimer's Association. "Wandering and Getting Lost." 2016. (link)
26. The Alzheimer's Society (UK). Page 6,8.
27. Lively. "How It Works." 2015. (link)
28. Barberger-Gateau et al. "Instrumental Activities of Daily Living as a Screening Tool for Cognitive Impairment and Dementia in Elderly Community Dwellers." Journal of the American Geriatrics Society. April 2015. (link)
29. The Alzheimer's Society (UK). Page 5-6.
30. Withings. "Withings Home." 2015. (link)
31. Alzheimer's Association. "2015 Alzheimer's Disease Facts and Figures." 2015. Page 51. (link)
32. The Alzheimer's Society (UK). Page 11.
33. Scanalytics. "Universal Resources." 2015. (link)
34. Alzheimer's Society (UK). "Exercise and physical activity." 2015. (link)
35. The Alzheimer's Society (UK). Page 10.
36. PARO. "PARO Therapeutic Robot." 2015. (link)
37. Alzheimer's Society (UK). "Treating behavioural and psychological symptoms of dementia." 2016. (link)
38. The Alzheimer's Society (UK). Page 11.
39. Hasbro. "Joy for All Companion Pets." 2016. (link)
40. Smith, James. "Pets and Dementia." Alzheimer's Project. 2016. (link)
41. The Alzheimer's Society (UK). Page 11.
42. True Link. "Services for Older Adults." 2015. (link)
43. Alzheimer's Society (UK). "Shortchanged: Protecting people with dementia from financial abuse." 2015. (link)
44. RTI International. Page 13.
45. Mango Health. "Home." 2015. (link)
46. National Institute on Aging. "Preventing Alzheimer's Disease: What Do We Know?" 2015. (link)
47. The Alzheimer's Society (UK). Page 5.
48. MedMinder. "Jon – Locked Pill Dispenser." 2015. (link)
49. U.S. Department of Health and Human Services and the National Opinion Research Center. "Report to Congress: Aging Services Technology Study." June 2012. (link)
50. The Alzheimer's Society (UK). Page 6.
51. Honor Referral Agency California, Inc. "Services." 2015. (link)
52. Alzheimer's Association. "Planning for Care Costs." 2015. (link)
53. Alzheimer's Association. "2015 Alzheimer's Disease Facts and Figures." 2015. Page 33, 42. (link)

MAY 2016 01US16EUC0021