

Technology Trends in Situational Awareness

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By Stephen Popovich and Shelley Symonds, BA, MBA



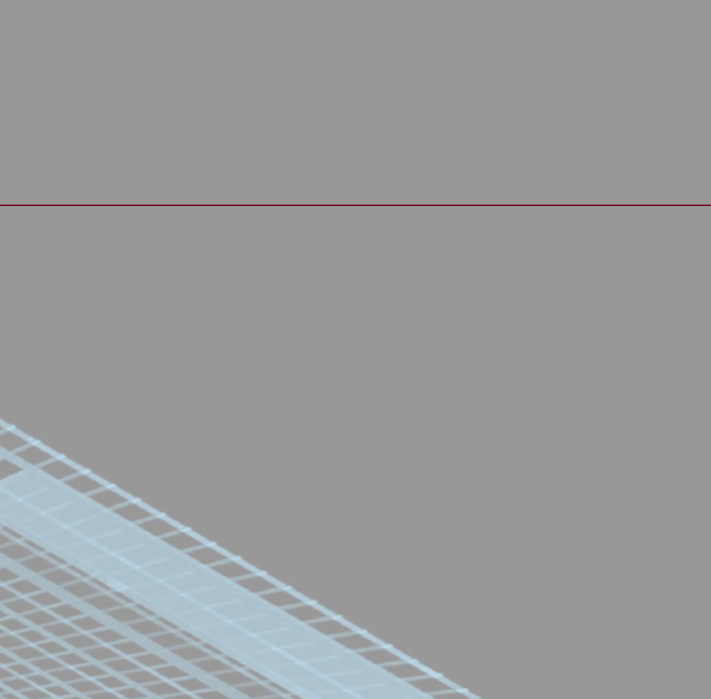
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TECHNOLOGY TRENDS IN

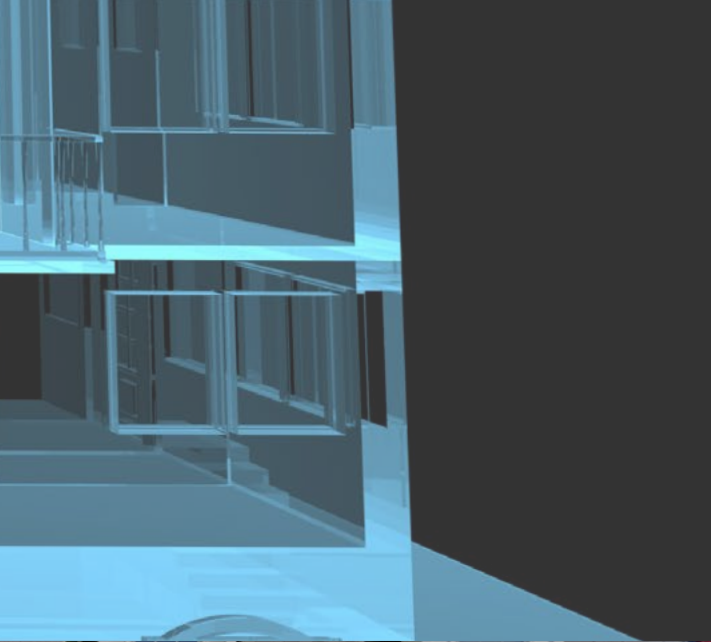
SITUATIONAL AWARENESS



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AND SHELLEY SYMONDS, BA, MBA



What can a caregiver do if a family member who needs assistance lives alone more than a thousand miles away, is having memory issues, and refuses to use a cell phone or move closer? How does the caregiver keep tabs on that person without having to rely on friends, neighbors, or paid caregivers? After all, the caregiver can't likely move a successful business or make a lateral career transfer to the town where the family member lives. This dilemma faces many caregivers who are increasingly turning to technology to help them monitor their loved ones.

Caregiving for older adults is in crisis, but like many industries that have needed to go through massive transformations to survive, technology offers considerable hope. In particular, situational awareness provides caregivers with predictive analytics based on data from sensors and wearables to understand how, when, where, and why an older adult may need attention. As it moves forward, this situational awareness technology promises to upend the entire caregiving industry, from aging in place to high-level nursing facilities.

The caregiving industry has been historically underserved by technology, and much of the current focus has been on back-office solutions for business applications. However, technology at the point of care has not progressed as fast in recent years, especially for people with Alzheimer’s disease or another dementia. While there are many solutions available for common problems, each has benefits, drawbacks, and limitations. The increasing pace of technological advancements at the point of care holds exciting answers to everyday needs.

Demand Outstrips Availability

Much has been written about the perfect storm that is happening in the care of older adults and aging in place. The trifecta of an expanding population of older Americans, their lack of financial capability to successfully age in place, and the shortage of both family and professional caregivers paints a very bleak picture for most baby boomers in their golden years.

Simply put, the current and future demand will not be met by supply, unless we reimagine how we fulfill demand (Redfoot, Feinberg, & Houser, 2013).

Industries in crisis have reinvented themselves with technology before. The last thirty years have seen major technological transformations in manufacturing,

banking, entertainment, retail, publishing, travel, and transportation that have radically changed each industry (Karr, 2015). These changes have improved efficiency while enhancing each industry’s ability to serve its consumers. Transformative technology includes hardware and software systems that can not only create new choices for consumers and businesses, but also serve them better at lower cost.

The care industry can use technology to transform itself to service these exploding demands for limited resources by becoming smarter, more efficient, and more effective while delivering better outcomes for older persons aging in place.

Technology for Older Adult Care

The longevity economy has produced many useful technological innovations, mostly clinical products and those serving hospitals, such as real-time location systems and medical devices for monitoring patient health. These innovations, like many new technologies upon introduction, are expensive and require significant technical expertise to be successful. The question is how fast these technologies can work their way across the continuum of care — from hospitals, to skilled nursing, to assisted living, to home care, and family caregivers — while becoming simpler to use and less expensive.

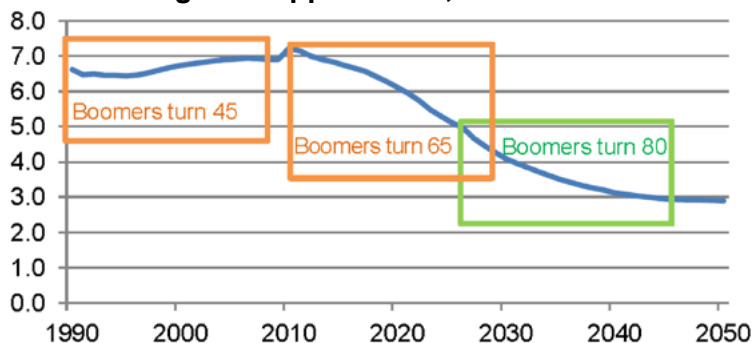
Using the very common scenario of dementia care, it’s possible to examine where the technology is today and where it will be tomorrow. A common thread in caring for a person with Alzheimer’s, the most common cause of dementia, is knowing how, when, where, and why the care recipient may need attention, even when the caregiver is not physically present. This is referred to as **situational awareness**, or the ability to understand the location and condition of the care recipient, recognize the context of an activity or event, and predict an upcoming condition or event.

Global technology analysts such as Barry Runyan and Vi Shaffer (2014) at Gartner Group define situational awareness in a hospital setting as the heart of the healthcare system. With a real-time health system, they note that people “...can see and act in real time to improve care delivery outcomes, patient engagement, and administrative processes.” Additionally, the duo writes that this system is enabled by “advances in mobility, interoperability, location, and condition-sensing services, and real-time analytics.”

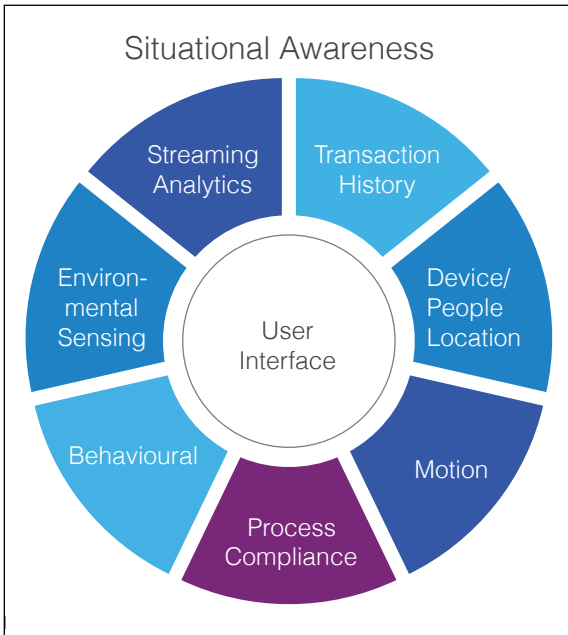
Situational awareness is the ability to:

- **Perceive** — Through the data gathered
- **Understand** — By putting the data in context

Caregiver Support Ratio, United States



Source: AARP Public Policy Institute calculations based on REMI (Regional Economic Models, Inc.) 2013 baseline demographic projections.



- **Think Ahead** — By predicting potential future issues and preventing them

It's possible to use this same framework to explore home technology for dementia care, both what is available today and where it may lead in the future.

Delivering Situational Awareness with Technology

The stages of Alzheimer's are clearly defined by the Alzheimer's Association:

1. Mild Alzheimer's disease (early stage), where a

person may function independently.

2. Moderate Alzheimer's disease (middle stage), where a person needs progressive care.
3. Severe Alzheimer's disease (late stage), where a person needs extensive help with daily activities (Alzheimer's Dementia Stages, n.d.).

The progression of the disease, which may be similar in other dementias, means technology must accommodate the changing needs and requirements of the caregivers and care recipients. Situational awareness is required both inside and outside the home or facility as care recipients move fluidly between indoors and outdoors. The internet of things (IoT), basically a system of interrelated computing devices, is one mechanism commonly used to aggregate and connect data. Using the three stages of Alzheimer's, the following diagram shows the level of activity of the care recipient, the required involvement of the caregiver, what data is needed by caregivers, and the appropriate type of technologies at each stage of the disease.

Early Stage Alzheimer's

In the early stage, people with Alzheimer's are usually out and about, living their normal lives. Caregivers are often family members, and are not needed on a daily basis. What is useful to caregivers at this initial stage is knowing where the care recipient is as the person moves around, and the person's wellbeing. At this stage, the most popular technologies used are wearable devices, which are small enough to be worn on

How Theora Care Works for Alzheimer's

| Early Stages | Middle Stages | Late Stages |
|--|---|--|
| <ul style="list-style-type: none"> Mobile elders Family caregiver monitoring Alerts, communications | <ul style="list-style-type: none"> More assistance needed Family and professional caregivers Situational awareness analytics | <ul style="list-style-type: none"> More care data needed At home or care home Wearable/sensor IoT (UWB) Cloud data and analytics |
| Applications and wearables – shipping today | Applications, wearables and sensors with precision of 10 centimeters | Interoperable with clinical hardware and advanced analytics |

| TECHNOLOGY | PROS | CONS |
|-------------------------------|---|--|
| PERS | -Simple, easy to use | -Low adoption, seniors won't wear stigmatizing devices -Only provides emergency call center monitoring |
| First generation GPS trackers | -Less stigmatizing, look more mainstream -Can set geo-fences and alerts | -Technology shift to 4G / LTE networks will make some devices obsolete -Some devices are large and unwieldy for senior wrists -Accuracy of GPS |
| Next generation wearables | -GPS accuracy improved with WiFi, support for new cellular services -Simple design and user interface for seniors -2 way, hands free communication for caregivers -Family or professional monitoring -Caregiver teams | -Battery life -Standalone solution |
| Smart watches | -Stylish and multi-function | -Not purpose-built for senior market -False positives -Small screen size and too many app icons |

the body. They may include watches, pendants, and other products. Some of the most popular are personal emergency response systems (PERS), global positioning systems (GPS) that use a tracking watch, or even the new Apple iWatch 4. Many families also make sure the care recipient has a smartphone to keep track of their loved one and make contact possible anytime and anywhere.

There was much excitement when Apple launched the iWatch 4 with two features targeting older adults: a heart monitor and fall detection. However, sometimes new technology is just the beginning of a long product evolution to usefulness. While it's positive that Apple and others are looking at health care applications for their wearables, the iWatch 4's initial implementation has some concerns. One of our friends purchased an iWatch 4 immediately after its release. He entered his age (over sixty-five), which automatically set up the fall detection application. According to the Healthcare Information and Management Systems Society website, "When the Watch detects the fall, it will give the user an opportunity to call an emergency contact. But if it detects that the user is immobile for one minute after the fall, it will automatically reach out to authorities using Apple's emergency alert system. It also sends a message to emergency contacts in that situation" (Apple Watch Series 4, 2018). While this sounds like a useful feature, in practicality it has limitations. Our friend is an active soccer player and wore his watch while playing the game. The Apple fall detection app incorrectly detected multiple falls while he

was playing, and because of his age, displayed on the screen shown. If he had not stopped and pushed the "OK" option, the watch would have triggered Apple's emergency alert system, something that Laurie Orlov (2018), a noted technology analyst, is concerned would create unnecessary emergency calls. The iWatch 4 is limited in its efficacy as it is not purpose-built for active older people and the conditions they face.

Often, a family's first response to someone being diagnosed with Alzheimer's or related dementia is to equip them with a smartphone. While this is well-meant, if the older adult is not already comfortable with smartphone technology there may be wide variation in usage. For example, my mother had frontal temporal dementia. In the early stage, she was still active and driving herself to doctor appointments. The family bought her first cell phone and she was very good about always taking it with her when she left home, until the day she brought her phone to the neurologist. Much to our consternation, she had taken the cordless handset from the home phone rather than the cell phone. Of course, she insisted it worked just fine at the doctor's office. Technology for memory care needs to account for the differences in each person's stage of dementia.

First Stage: On the Horizon

Better, more accurate, and more useful wearable IoT technology that is purpose-built for older persons is coming to market. Specific studies will show how well these devices are helping family caregivers and

their care recipients. One interesting upcoming study will be centered around the Theora Connect wearable device and Theora Link smartphone application, purpose-built technology recently made available by Theora® Care. The research is funded by the Texas Alzheimer’s Research and Care Consortium and led by key researcher Dr. Marcia G. Ory. While Steve was speaking to Dr. Ory about her work with new technology for Alzheimer’s and dementia care, she commented, “Achieving the aims of the study will demonstrate feasibility and utility of an intervention that represents a new generation in dementia care. The long-term goal is to advance the current knowledge base regarding outcomes associated when state-of-the-art technology is combined with evidence-informed skill training. Such interventions focus on the dual objective to increase the safety of the care recipient, while reducing the burden of care on the caregiver.”

Middle Stage Dementia

In the middle stage, people with Alzheimer’s are out and about less often, but usually still living in their home. They require in-home assistance from family or professional caregivers on a daily basis. At this stage, the most popular technologies in use are monitoring cameras and a wide variety of sensors, encompassing environmental sensors, motion detectors, pressure and magnetic sensors, and wearable fall detection sensors.

Sensors for the care of older adults have been

studied extensively. The National Institute of Health recently released a document summarizing the best of these studies over the last ten years (Uddon, Khaksar, & Torresen, 2018). In spite of their ubiquitous nature and demonstrated efficacy, sensor technology has not been widely adopted. Typically in the past, a caregiver would add a sensor to the home for each different use case that needed to be covered, such as falling in the bathroom, leaving the stove on, or checking humidity. Unfortunately, these are usually different sensors from different companies and they do not play well together. A family caregiver needs to have a different smartphone app for each one, and cannot integrate the data from each sensor together. Even if, for example, a family caregiver called up an outside service provider such as Best Buy and had a company representative install their Assured Living package, each product is a separate product that does not interoperate with the others (Assured Living, n.d.). When caregivers do not have data in context, they can only react to each event. Predicting troublesome issues, like a potential urinary tract infection based on increased bathroom trips, is not possible. Nor are caregivers able to understand activity and behavior patterns outside the home, leaving a complete picture of the older person out of reach.

Coming Up for Middle Stage Dementia

Sensor technology being developed for assisted living and memory care will provide more complete

| TECHNOLOGY | PROS | CONS |
|------------------------------|---|--|
| Video cameras, sound sensors | -Easy to use | -Privacy concerns for the older person -Limited range of vision -Interpreting video footage or sounds -Only reacting to alerts and events |
| Environmental sensors | -Monitor temperature, humidity, smoke, etc. -Easy to install | -Different sensors required for each aspect monitored -Data in context, reactive not predictive -Interoperability |
| Motion sensors | -Able to monitor activity -Velocity, direction, timing | -Discerning between multiple older persons in a home -Reactive, event-driven -Some predictive monitoring of gait and activity |
| Fall detection sensors | -Wearable or installable -Good accuracy | -Discerning between multiple older persons in a home -Reactive, event-driven -Standalone devices |
| Pressure sensors | -Typically used for beds, chairs -Easy to install | -Only send alerts -Hygiene -Limited to stand-to-sit and sit-to-stand applications |

coverage. This new technology will be equipped with integrated sensors that will not only react to events, but also provide data analytics that predict conditions based on behavior patterns. This technology will be offered not just to elder care businesses, but also to families for use in the home. This next generation of sensors will be easier to install and will provide a much higher level of situational awareness.

Late Stage Alzheimer's

In the late stage, people with Alzheimer's will typically reside in a memory care facility or nursing home. They require assistance around the clock. Consequently, the most popular technologies today are monitoring systems that have been developed for facility use. These sensor-based systems use baseband transmission signals, such as Bluetooth and WiFi, to observe what is happening. On the downside, these current technologies are not very precise because they use triangulation to determine location and movement, and are not able to "see" through walls. Triangulation introduces "jitter" into the systems, rendering them less precise and unreliable for determining, for example, when a person has fallen. In addition, because of the lack of precision, they require the person being monitored to wear a wristband for accurate identification.

What's Ahead for Late Stage Alzheimer's

There is a new generation of sensors coming this year that are based on ultra wide band (UWB). Also known as "indoor radar," this technology is accurate to ten centimeters (about four inches) and can see through walls in both two dimensions (2D) and three dimensions (3D). This level of high-precision data, combined with predictive analytics and low cost, unleashes for the first time extremely precise, private, and unobtrusive monitoring that can be deployed in either the home or a facility. The new technology can reduce the number of different sensors needed for complete monitoring,

while providing a better overall view of how the older person is faring. UWB sensors will be available in 2019 from Theora Care, and perhaps others.

Arriving This Year

Technology for the care of older adults is moving through an innovation curve and quickly on to the next generation of solutions. We foresee solutions coming to market this year that will significantly change how both family and professional caregivers are able to care for older adults. Technology poised for release will provide:

- **Simplicity and ease of use.** Technology for the home will move from multiple, different devices that require professional installation, to devices that are much simpler to install and use, and which provide better information in context to caregivers.
- **Integration.** While this will take some time to achieve, integration between different devices in the home (such as those monitoring health care) and external systems, including electronic health records, will begin to provide a more complete picture and get all members of the care team on the same page.
- **Cost.** Technology that is being tested in hospitals today can be made cost-effective for home use very quickly. Cloud technology also lowers the cost of the data analytics that provide the ability to predict conditions and alert caregivers to those conditions.
- **Greater continuum of care.** Solutions that provide situational awareness during the entire continuum of care, both indoors and outside, will scale as needs increase. A full, 360-degree view of the care recipient will be achieved with more agile technology.

| TECHNOLOGY | PROS | CONS |
|-------------------|---|--|
| Bluetooth sensors | -Monitor temperature, humidity, smoke, etc. -Easy to install | -Different sensors required for each aspect monitored -Data in context, reactive not predictive -Interoperability |
| WiFi sensors | -Able to monitor activity -Velocity, direction, timing | -Discerning between older persons in a home -Use triangulation to locate objects -"Jitter" while triangulating leads to imprecise fall detection |

- **More privacy.** Technology will become more precise and unobtrusive, which reduces objections from older adults to its usage. It is much more comfortable to have a sensor than a video camera deployed in one's home.
- **Better data for better decisions.** Integration of the data from multiple devices that can finally interoperate will deliver larger data sets to algorithms that can then paint a clearer picture of what is really occurring with the care recipient.
- **Prediction, not just reaction.** Understanding the normal pattern, what deviations are occurring, when, where, and why will finally move caregiving into a proactive role. With this new situational awareness provided by predictive analytics to help understand what happened and why during an event, care teams can provide better care at lower cost.

More independence for older adults coupled with peace of mind for caregivers is the mantra of care for this cohort. The investment in technology driving the current revolution will finally bring much-needed relief from the perfect storm swirling around care for older adults. Technology transformation will enable more older Americans to be served, using fewer caregivers, and at a lower cost. Aging in place can extend for a longer time and take place in a more successful way. The next five years will transfigure this industry, and the timing couldn't be better. •CSA



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Shel's expertise also includes family caregiving and the care of older adults.

RESOURCES

Technology changes rapidly. We find these resources to be the most helpful in keeping up with the latest technology on the market:

Aging in Place Technology Watch – leading industry analyst covers technology trends and reviews new products <https://www.ageinplacetech.com/>

Leading Age / CAST – online technology selection tools <http://www.leadingage.org/technology-selection-tools>

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