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# Connected Care

*Technology-enabled  
Care at Home*

Produced by the  
Deloitte Center  
for Health Solutions

Audit • Tax • Consulting • Financial Advisory

A collection of medical devices including a glucometer, insulin pen, and insulin pump, arranged on a white surface. The glucometer is in the foreground, showing a test strip. The insulin pen is in the middle ground, and the insulin pump is in the background. The devices are arranged in a way that suggests a focus on home care and technology-enabled health solutions.



# Foreword

As stakeholders in the U.S. health care system struggle to increase access to health care services for the under-insured, reduce cost escalation and improve quality, there is widespread consensus that any transformative solution requires the inclusion of disruptive innovations that leverage technology.

Using in-home monitoring devices in tandem with care management programs to enhance self-care for chronic disease management and post-acute discharge monitoring is one such disruptive innovation. The technologies to support this capability are readily available; however, the policies, programs, payments and protections necessary to integrate these technologies and devices appropriately in care management programs are woefully inadequate.

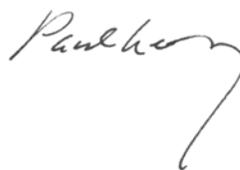
Intel coined the phrase “Shift Left, World Ahead.” “Shift Left” connotes a refocusing of efforts away from acute and office-based health care services to consumer-focused, personalized technologies accessible to individuals and families at home. “World Ahead” connotes the ubiquitous potential of information super-highways to facilitate care in the home or through personal health record (PHR) platforms in cell phones and personal computers.

We believe the home is an important place to start. The effective application of in-home technologies leads to increased medication adherence, reduced avoidable post-acute complications, and improved self-care management of chronic conditions. The net result is a potential annual savings of 20 percent or more – a \$400 billion savings to the U.S. health care system – if chronic conditions and post-hospitalization care is managed by involved consumers in their homes.

Technology alone is not the key: It must be incorporated into a care management program personalized to an individual’s needs and under the oversight of a care team. In-home technologies enable frequent, effective and personalized patient interactions to equip them to care for themselves.

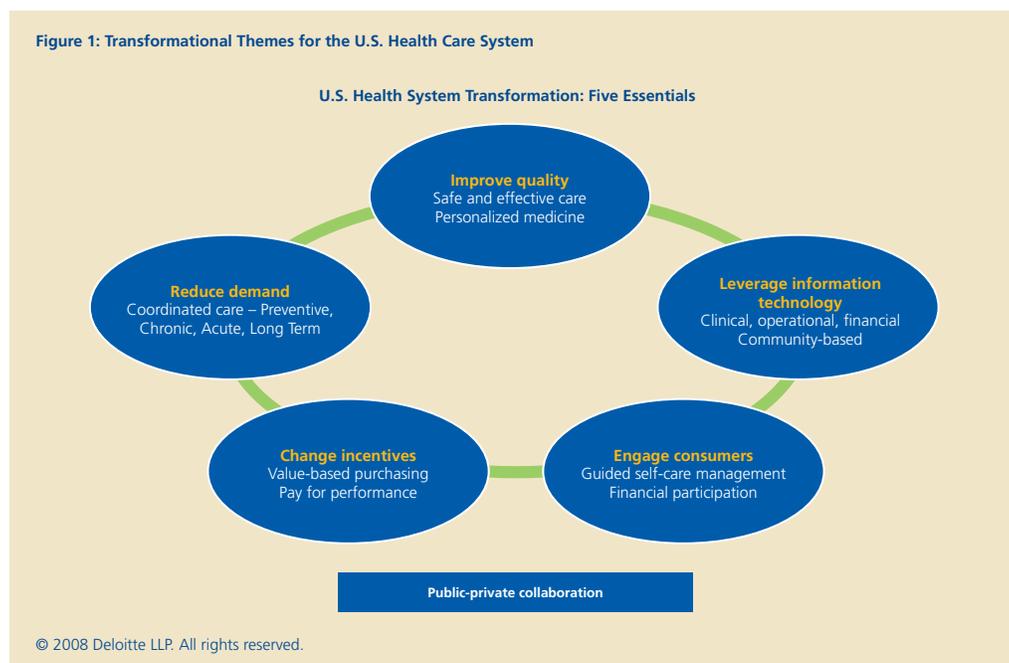
The Deloitte Center for Health Solutions’ framework for health system transformation (Figure 1) illustrates the role that technology-enabled connected care can play. It engages consumers in self-care management, leverages technology, reduces demand on the system, and employs evidence-based clinical knowledge management tools to prompt, alert and facilitate safe and effective care.

This paper offers a strategic perspective about technology-enabled connected care. We believe it is a concept whose time is now. We subscribe to Intel’s notion of Shift Left, World Ahead, believing that it describes the future of the U.S. health care system and a potential solution for the good of global health.



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Figure 1: Transformational Themes for the U.S. Health Care System



# Introduction

The U.S. health care system is prohibitively expensive – its cost has outstripped the growth of the economy since 1980<sup>1</sup> and threatens to continue doing so for the foreseeable future. Contributing to this cost spiral are discouraging, widely acknowledged demographic and lifestyle issues: an aging population and the tendency of individuals to live unhealthy lifestyles. As a result:

- Over 100 million people in the U.S. are living with chronic diseases, and spending on hospitalizations and chronic care management now exceeds up to \$500 billion per year. This represents over 75 percent of all health care costs. More than 50 percent of Medicaid and Medicare beneficiaries are now living with a chronic disease or disabling condition.<sup>2</sup>
- 133 million American adults, or 66 percent of the adult population, are either overweight or obese. The prevalence of obesity has doubled since the 1960s, to an all-time high of 30 percent, and the rate of increase continues to trend up.<sup>3</sup>
- With average life expectancy at an all-time high of 78 years, the nation's elderly population is drastically increasing. Globally, the number of persons 60 and older was 600 million in 2000. It is expected to double to 1.2 billion by 2025. Medicare spending is 12 percent of the entire U.S. Federal Government budget and is expected to increase by nearly eight percent every year between 2007 and 2016.<sup>4</sup>

The U.S. health care system is facing a perfect storm: Increased demand for health care services to support an aging, unhealthy population will require additional investments in acute hospitals and specialty care, spur the need for post-acute patient monitoring to avoid complications and readmissions, and exacerbate primary care (nurse and physician) labor shortages. Left unchecked, the health care system's current consumption rate of 16 percent of the Gross Domestic Product (GDP) is expected to increase to 20 percent by 2013 – threatening the viability of the nation's entire economy.

Hospitals already feel the pressure. The nation's supply of hospital beds is shrinking as demand grows. Left unattended, the nation's hospital beds will be full with patients too old and fragile to care for themselves and conditions that otherwise could have been managed.

<sup>1</sup> Kaiser/HRET Survey of Employer Sponsored Health Benefits

<sup>2</sup> *Health Affairs*, 10.1377/hlthaff.w4.437

<sup>3</sup> National Health and Nutrition Examination Survey (NHANES), Center for Disease Control: <http://www.cdc.gov/nccdphp/dnpa/obesity/faq.htm>

<sup>4</sup> Kaiser Family Foundation, Medicare Spending and Financing, June 2007

Innovations such as technology-enabled connected care (Figure 2) can stem the tide of rising health care costs and demand by using in-home monitoring devices in tandem with care management programs to enhance self-care of chronic disease management and post-acute discharge monitoring. This paper by Deloitte<sup>5</sup> explores why technology-enabled connected care is an idea whose time is now.

### Figure 2: Defining Technology-enabled Connected Care

The technology-enabled connected care model has three key features: (1) a patient in a residential setting (home), (2) a provider relationship augmented by members of the coordination team, and (3) an Electronic Medical Record linked to a patient's Personal Health Record. Other elements:

- **Care is patient-centric.** Providers are patient advocates, providing and coordinating care to avert unnecessary tests and facilitate patient adherence to a prescribed self-care regimen. (Note: The technology-enabled connected care platform differs from the Medical Home model in one key aspect: The medical home is a primary care-focused model where coordination of care is under the oversight of a primary care physician. By contrast, the technology-enabled connected care model may be used by specialists overseeing patients recently discharged from a hospital. For additional information, see the Deloitte Center for Health Solutions' January 2008 publication, *The Medical Home: Disruptive Innovation for a New Primary Care Model*.<sup>6</sup>)
- **The home is the focus.** Technology-enabled connected care is centered at an individual's personal residence. Technology applications are embedded in the day-to-day flow of the person's life. They are designed to be unobtrusive and easy to use.
- **Technology is key.** Data is collected on an ongoing, synchronous basis by smart devices and sent to a knowledge management center led by the clinician, while interactions between the "coach" and "patient" are ongoing. These technologies feature sophisticated algorithms to monitor signals that might warrant a change of treatment or prompt a visit or test.

### Consumers like the Concept of Technology-enabled Connected Care

The Deloitte Center for Health Solutions' *2008 Survey of Health Care Consumers* provides a clear indication that consumers see the value of technology-enabled connected care. Key findings from the online survey of 3,000 adults include:

- Consumers, especially females, Baby Boomers, and seniors, like the potential for better care and lower costs by using in-home monitoring devices.
- Three out of four consumers want expanded use of in-home monitoring devices and Internet-based methods that would reduce the need for provider visits.
- Consumers report that these technologies would help them to be more engaged in their care while providing a continuous stream of information to their physician.
- Consumers want their physician to use information technologies to enhance access to information about prices, test results, scheduling and treatments. In addition to quality and cost information, consumers are interested in value-added services from doctors, hospitals and health plans, including online access to medical records, test results and physicians (via e-mail) and appointment scheduling. Same-day appointments generate the strongest interest of all the value-added service options presented. There is significantly stronger interest in these services among females, Gen X, Hispanics, and commercially insured consumers. Seniors are least interested.
- Twenty-five percent of consumers say they would pay more to physicians for online access to records, e-mail access, and same-day appointments. Against the entire base of respondents, 21 percent are willing to pay for same-day appointments, 19 percent for online access to records and tests, and 19 percent for online access to integrated medical records. Higher percentages of Gen Y, males, and Asians are willing to pay for same-day appointments, as compared to others.
- Consumer willingness to pay more to hospitals for value-added services is slightly less than their willingness to pay physicians, but is still significant. As many as one-fourth of health care consumers expressing interest in online access to medical records and test results are willing to pay a fee. Same-day appointments also seem worth paying for to almost one-fourth of interested consumers (23 percent). Against the total base of consumers, 17 percent are willing to pay for online access to an integrated medical record, 16 percent for online access to records and test results, and 15 percent for same-day appointments. Willingness to pay hospitals for online access to integrated medical records is higher among Gen Y, seniors, and Asians.
- Thirteen percent of consumers report using a medical monitoring device, with mechanical or electronic monitoring devices being the most common. This usage tracks closely with age and health condition. Boomers, seniors, Medicare and Medicaid enrollees, and consumers who rate their health below average are more likely to use electronic or mechanical monitoring devices.
- Interest in using self-monitoring devices in the home is high. 72 percent of consumers report being very interested in using a self-monitoring device at home, and 33 percent are extremely interested. Interest in using self-monitoring devices at home is generally strong across all groups, with the highest percentages among Medicare enrollees, seniors, Boomers and females.
- Convenience in handling medications and test results and better coordination of care with physicians are perceived benefits of home monitoring technologies. 75 percent report being interested if a monitoring device could eliminate trips to the physician's office to be tested; 69 percent report they would use a device if their doctor recommended it; 69 percent report interest if it would relay results back to their physician electronically via the Internet or a cell phone connection; 67 percent are interested if a home monitoring device would help them in adjusting their medications; and 62 percent report being interested if it would offer a continuous stream of information to their doctors by wireless connection. These reasons for interest in a home monitoring device relate to convenience and avoiding trips to the doctor's office. Other functional attributes and benefits also generate positives, but at a lower level of enthusiasm. Interest in avoiding trips to the doctor by using home monitors is highest among Boomers, seniors, females, and Caucasians.

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<sup>5</sup> As used in this document, "Deloitte" means Deloitte LLP and its subsidiaries. Please see [www.deloitte.com/us/about](http://www.deloitte.com/us/about) for a detailed description of the legal structure of Deloitte LLP and its subsidiaries.

<sup>6</sup> [http://deloitte.com/dtt/cda/doc/content/us\\_chs\\_MedicalHome\\_w.pdf](http://deloitte.com/dtt/cda/doc/content/us_chs_MedicalHome_w.pdf)

## Two Applications: Tools for Better Chronic Care Management and Post-Acute Discharge Monitoring

There are two patient populations for whom technology-enabled connected care has particular value: those recently discharged from hospitals with a diagnosis requiring follow-up self-care, and those with a lifestyle-impacting chronic condition intensely related to self-care. These are two of the more costly populations in the health care system; technology-enabled connected care provides a meaningful solution.

For patients recently discharged from hospitals, avoiding complications and readmissions, and improving quality of life, satisfaction, and outcomes are primary goals. For these patients, a monitoring program might require 90 days to five years of coordination, depending on the condition at discharge and various risk factors. (See Figure 3 for conditions that could be addressed by technology-enabled connected care.) For chronic patients, the goals are similar, although the time horizon is likely lifelong.

**Figure 3: Diagnoses for Technology-enabled Connected Care for Patients Recently Discharged from Hospitals**

Condition
• Acute Myocardial Infarction (“Heart Attack”) – (post-acute discharge monitoring)
• Hip Replacement – (post-acute discharge monitoring)
• Cancer (becoming more of a chronic condition which could be managed by technology-enabled connected care)
• Traditional disease management (Congestive Heart Failure, Diabetes, Asthma, Coronary Artery Disease, Chronic Renal Failure, Hypertension, COPD, etc.)
• Neurologic – Parkinson’s, Alzheimer’s, etc. (in-home chronic disease management)
• Preterm labor – (post-acute discharge monitoring)
• Cerebrovascular Accident (“Stroke”) – (post-acute discharge monitoring)
• Hormone Replacement Therapy (thyroid disease, Addison’s, hypoparathyroidism, hypogonadism, infertility, Kallman’s Syndrome, etc.) – (in-home chronic disease management)
• Deep Venous Thrombosis and Other Coagulopathies Managed with Antithrombotics – (post-acute discharge monitoring)
• Post Surgical Wound Monitoring, Decubitus Ulcers, Etc.- (post-acute discharge monitoring)
• Non-surgical Management of Ectopic Pregnancy – (post-acute discharge monitoring)
• Anemias – (in-home chronic disease management)
• Neonatal Apnea – (post-acute discharge monitoring)
• Dehydration and Urosepsis – (post-acute discharge monitoring)
• Autoimmune Disorders – (in-home chronic disease management)

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## Existing Clinical Technology Could be Used in Homes

Technology exists today in clinical settings that could also be used in the home to better monitor health status, improve clinical outcomes and coordinate care. Figure 4 shows devices that provide real-time, clinical feedback and are ready for home use.

**Figure 4: Technologies for General Health Behavior Monitoring**

Sensor	Description
Weight Scale	Electronic scale that measures body weight. Tracks excess fluid retention in patients with chronic heart failure or pregnancies at risk for eclampsia after hospital discharge or clinic visit.
Body Fat Analyzer	Device that estimates the fraction of the total body mass that is adipose tissue (fat) to counter the deficiencies of BMI (Body Mass Index) for being overweight or obese. Used to monitor diet progress or as a measure of physical fitness.
Pedometer	Portable device that counts each step a person takes. Used as an exercise measurer and motivator. Active exercisers should target 10,000+ steps daily.
Physical Activity Accelerometers	Devices that can measure both the intensity and duration of physical activity to track effectiveness of an exercise program.
Digital Health Assistant	A two-way communication device that allows a health care professional to communicate with a patient; typically used to ask health questions on a regular basis. Artificial intelligence could be incorporated in the device to push warnings and alerts between the patient and provider as a sentinel monitor to identify care opportunities.
Air Quality Monitoring	A device to monitor and improve indoor air quality and thermal comfort, and to lower the levels of pollutants within the house. Examples include carbon monoxide and smoke detectors.
Sleep Monitoring	Heart rate, temperature, sound, respiratory and movement monitors to track sleep apnea.
Medication Tracking and Reminders	Electronic device to remind a patient to take medication and/or to determine whether medications have been taken according to prescription or have achieved therapeutic effectiveness.
Sphygmomanometer	Device used to measure blood pressure. Uses range from the medically curious to hypertensive patients to assure effectiveness of high blood pressure treatment.
Glucometer	A medical device for determining the concentration of glucose in the blood to monitor the effectiveness of diabetic treatment.
Insulin Pump	A medical device worn to administer insulin in diabetic patients.
Thermometer	Device used to measure body temperature to determine whether a fever is present. Critical tool for parents and cancer patients undergoing chemotherapy to detect systemic infection.
Electrocardiograph (Holter Monitor)	Device that records the electrical activity of the heart over time to detect life-threatening cardiac arrhythmias.
Intelligent Toilet	Toilet that monitors body composition and waste for sugar levels in urine, dietary fiber, blood pressure, body fat and weight.
Fetal Monitor	Devices that measure fetal heart rate, fetal position, and/or uterine activity to monitor fetal health and detect preterm labor.

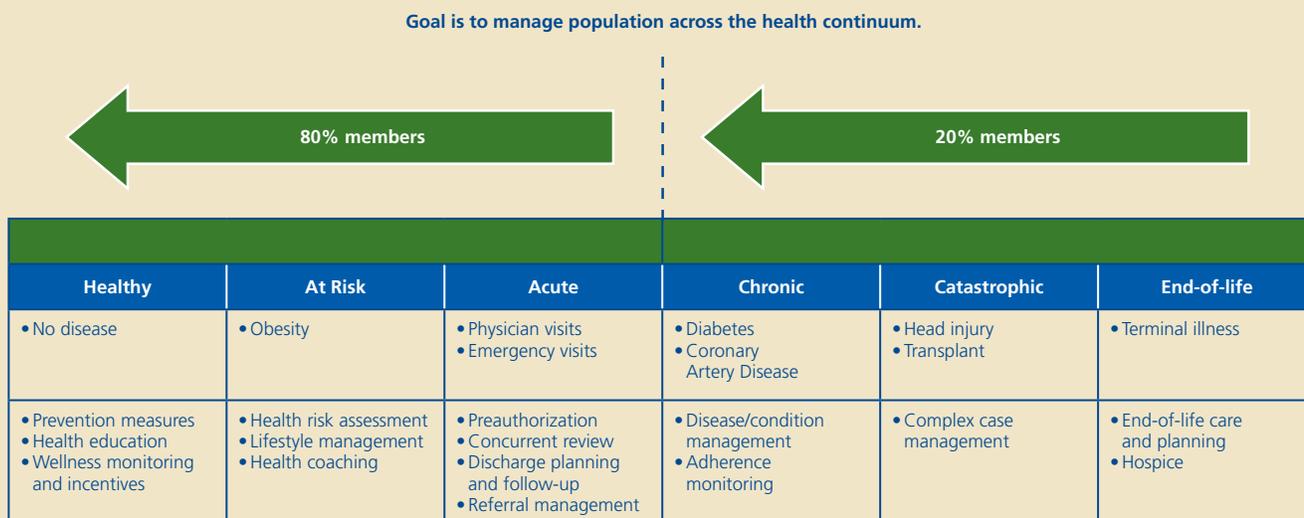
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With the diffusion of these connected devices into the home, the availability of more robust information systems able to capture and manipulate complex clinical data, and an increased focus on integrated population health management, an opportunity exists to converge care management with these technologies to augment the live patient-physician relationship with more virtual interactions to better coordinate care.

According to the Disease Management Association of America (DMAA: The Care Continuum Alliance), the highest achievable health status is attained through the promotion and alignment of overall population health improvement (Figure 5). Effective

population health management depends upon data to stratify patients for a system of coordinated health care interventions for those populations with conditions in which patient self-care efforts are significant.<sup>7</sup> Self-care management of chronic diseases and other acute conditions requires specialized devices and sensors to monitor and track applicable vital signs. Technology-enabled connected care supports patient self-management, process and outcome measurement, as well as improved patient satisfaction and increased job satisfaction among health professionals, who remain deficient in effectively using technology to deliver personalized, evidence-based care coordination.

Figure 5: Components of Population Health Management

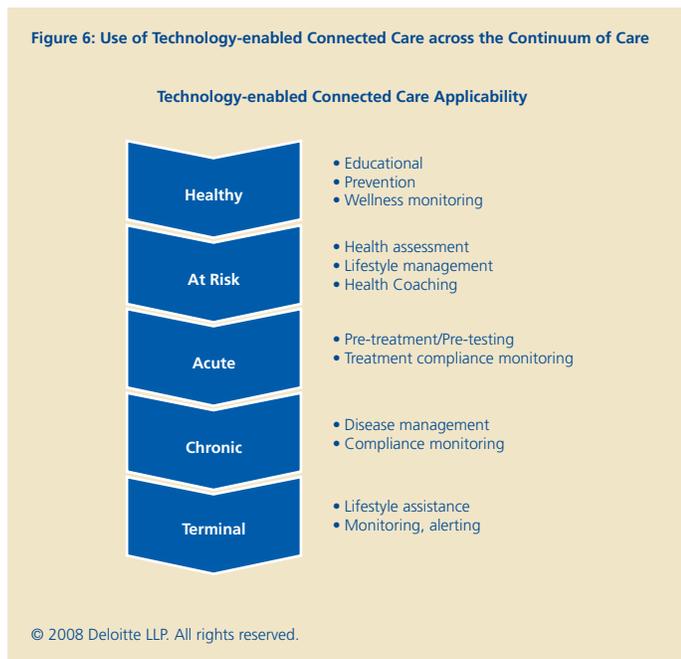


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<sup>7</sup> <http://www.lifemasters.com/corporate/aboutdm/dmdefined.asp>

## Trends Support Technology-enabled Connected Care

Technologies that facilitate coordination of care across the health continuum are readily available (Figure 6). Widespread adoption of these technologies for care coordination in the home is influenced by many factors, including their perceived benefits, quality, suitability, and integration with the physician's clinical oversight. Simply stated, technology is a means to an end: Its use by individuals at home in conjunction with the efforts of a clinical coordination team are keys to its return on investment. It's not about the technology; it's about the "use" of the technology to solve problems.



There are a number of favorable trends that suggest technology-enabled connected care is within grasp as a major feature of the U.S. health system:

### 1. Technology Costs are Declining

The explosive growth of the Internet, personal computers and other digital devices, cellular phones and associated technology continues unabated. An important component of this growth has been downward pressure on the cost to adopt these technologies: Hardware and computer processing power, network bandwidth, Internet access and software costs have all decreased as new technologies become commodities. Since these technologies are all critical components of technology-enabled connected care, the overall value proposition becomes even more compelling as costs continue to decrease.

### 2. Advancements in Device Processing Power are Facilitating the Value Proposition for Technology-assisted Care Management

In addition to declining technology costs, advancements in medical device technology are spurring acceptance for technology-enabled connected care. In general, processing power has tended to follow Moore's Law; i.e., the capabilities of electronic devices, such as processing speed, will tend to double every two years. Such exponential advancements not only force the decline in cost of older technology, but significantly improve the productivity of what medical devices can accomplish. This trickle-down effect occurs in a number of ways: Not only are devices becoming more powerful, their increased capabilities give scientists and engineers the tools they need to create better, more portable testing equipment. In short, they provide better care at lower costs.

### 3. Consumers are Receptive to the Use of Connected Care Technologies

The Internet has created a new paradigm in which users are constantly connected to each other, whether by cell phone, computer, or other personal electronic devices. This connectivity is quickly extending to the health care arena. In fact, in Deloitte's *2008 Survey of Health Care Consumers*, respondents support the use of personal health devices and other IT-enabled tools:

- Twenty-five percent of respondents report using a Personal Health Record.
- Twenty-two percent of consumers are using health plan tools to compare provider costs.
- Consumers want their physicians to use information technologies to enhance access to prices, test results, scheduling, and treatment, with ~10 percent of consumers currently using physician, hospital and health plan web sites to compare quality of care.
- Consumers, especially the elderly, like the potential for better care and lower costs via in-home monitoring devices. 75 percent want expanded use of in-home monitoring devices and Internet tools that would reduce the need for visits, permitting patients to be more active in their care. Interest is highest among Boomers, seniors, females, and Medicare enrollees.
- Twenty-five percent of consumers report that they would pay more to physicians and hospitals for online access to records, e-mail access, and same-day appointments.

### 4. Applied Research about Technology-enabled Connected Care is Increasing

A trend becomes notable when health services researchers focus attention on its application and investors pay attention to a sustainable innovation. Government organizations, universities, industry trade groups, businesses and other organizations are now conducting this research on technology-enabled connected care. Figure 7 (next page) lists organizations making significant contributions to the process:

**Figure 7: Organizations Advancing Technology-enabled Connected Care**

Organization	Relevance to the Connected Home
Continua Alliance	An alliance of technology providers to establish a system of interoperable personal telehealth solutions applicable to the Connected Home.
University of Rochester – Center for Future Health	A research lab that is working toward a proactive health system that puts health care technologies into everyday lives and offloads formal institutions, when appropriate. The lab tests concepts, pilots and prototypes for future products.
Massachusetts Institute of Technology	A research group at the Massachusetts Institute of Technology focused on how the design of the home and its related technologies, products and services should evolve to better meet future opportunities and challenges.
The American Society on Aging	An association to support the commitment and enhance the knowledge and skills of those who seek to improve the quality of life of older adults and their families. The society facilitates a conference to discuss topics such as how a variety of technologies can be used to promote independence, maximize functional abilities and facilitate caregiving.
The Aware Home Research Institute (AHRI) at Georgia Tech	An interdisciplinary research endeavor at the Georgia Institute of Technology that addresses challenges facing the future of domestic technologies. A unique and critical resource in this activity is the Georgia Tech Broadband Institute Residential Laboratory, a three-story, 5,040-square-foot home that functions as a living laboratory for interdisciplinary design, development and evaluation.
Duke SmartHome	A research laboratory operated by Duke's Pratt School of Engineering. The program creates a "living laboratory" environment that contributes to the innovation and demonstration of residential building technology, including home health.
American TeleMedicine Association (ATA)	A leading resource and advocate promoting access to medical care for consumers and health professionals via telecommunications technology.
Aetna, CIGNA, and other payors	Provide reimbursement for online physician consultations.
Disease Management Association of America (DMAA)	The DMAA Care Continuum Alliance represents the disease management and care coordination community as well as all stakeholders in chronic disease care.
Congress	Robust legislative activity promoting self-care management is under way. Examples include the Tax Relief and Health Care Act of 2006, which included a provision for a medical residence demonstration project; the Remote Monitoring Access Act of 2007 (S. 631), which would amend Title LVII of the Social Security Act to provide coverage for remote patient management services for chronic care conditions in Medicare; and H.R. 2043, which would provide for a Medicaid demonstration project in chronic disease management.

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Government support is embedded in recent pilot programs funded by Medicare via the Tax Relief and Health Reform Act of 2006, which instituted a mechanism for testing the concept via the Medicare Medical Home Demonstration Project. Results of this program will be available to policymakers in 2009, just as a new administration takes charge in Washington, DC. Of importance to this pilot, physicians will be required to use health information technology, offering the option of including remote monitoring and patient registries to monitor and track health status and to provide patients with enhanced and convenient access to health care services.

### 5. The Aging Population Stimulates Interest in a Solution

With some 76 million Americans born between 1946 and 1964 now heading toward retirement, self-care technologies and programs will be increasingly needed to meet the needs of this nation's aging Baby Boomer population – especially in light of a continuing health care labor shortage.

### Barriers Remain

Technology-enabled connected care adoption is not without its share of challenges. According to the Medical Records Institute's Ninth Annual Survey of Electronic Health Record Trends and Usage 2007, the challenges are akin to those associated with mobile health devices (Figure 8).

**Figure 8: Major Concerns in Adopting Mobile Health Care Devices and Applications\***

Major Concerns/Problems	2002	2003	2004	2005	2006
Lack of security of confidential information when sending/receiving	52.1%	51.2%	47.6%	43.5%	39.3%
Inconsistent connectivity when roaming within the health care facility	n/a	n/a	36.6%	34.8%	36.4%
Concern about unauthorized use of mobile/wireless devices that have been lost or stolen	39.5%	44.6%	42.8%	40.4%	32.1%
Slow data transfer rates to/from the host system	38.7%	35.4%	35.6%	37.8%	29.3%
Lack of a strategy or implementation plan for adoption	n/a	n/a	29.5%	27.0%	23.8%
Delays in data synchronization with host systems or applications	38.7%	31.9%	26.4%	25.2%	22.3%
Lack of interoperability with other device or systems	34.6%	31.5%	24.0%	28.3%	19.6%
Interference with medical devices	20.8%	24.2%	27.1%	17.8%	17.7%
Inability to achieve workflow integration	n/a	28.0%	20.2%	23.9%	16.7%
Difficult to use	31.2%	31.2%	13.7%	13.9%	12.6%
Other	10.0%	13.0%	7.5%	8.7%	10.4%
Total Respondents	491	596	292	230	588
Margin of Error	+/-4.5%	+/-4.1%	+/-5.7%	+/-6.4%	+/-4.0%

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\* Medical Records Institute's Ninth Annual Survey of Electronic Health Record Trends and Usage for 2007

### 1. Privacy Concerns are Strong among Consumers

A major barrier to widespread adoption of technology-enabled connected care is consumer concern about the privacy and security of their health information.

The financial services sector earned consumer trust to grow its online banking services successfully; similarly, technology-enabled connected care must adapt lessons learned from other industries where web-based and self-management technologies have been successfully deployed, such as:

- Clear Statements – Most online shopping web sites include easy-to-find, simple and concise explanations of why the financial transaction can be trusted.
- Visible Indicators – By placing large icons on a web site that indicate secure transactions, consumers are aware that their transactions are protected from interlopers.
- Trusted Authorities – Many organizations are members of industry associations that strive to protect consumers, and state so on their web sites. By being part of the Better Business Bureau (BBB), consumer privacy protection groups, or other associations, consumers generally assume that the trust they extend to these organizations will also apply to their member sites.
- Anonymity – Many web sites allow users to share information anonymously with virtual communities. Users create pseudonyms and post personal information, such as their financial condition, difficulties at work, x-rays or other medical records, in public forums for others to review and provide feedback. Being able to do so anonymously allows these users to request advice they might otherwise hesitate to seek.

By adopting some or all of the above techniques, technology-enabled connected care stakeholders may be able to build and solidify consumers' trust.

### 2. Payment and Reimbursement Issues Remain a Concern for Providers and Plans

Health care providers operate in an environment of diminishing profit margins and increasing dissatisfaction among health professionals. They complain that lower payments and intrusive tactics by payors infringe on their relationships with patients. Technology-enabled connected care has the potential to shift costs from unnecessary acute interventions to self-care prevention, but it will be a long, protracted process.<sup>9</sup>

Payors are generally receptive to the concept of technology-enabled connected care. These devices fall under health plans' existing durable medical equipment provisions and are covered services if proven to be safe and effective.

There is also considerable policy and regulatory ambiguity about technology-enabled connected care. Currently, of Medicare's \$400 billion budget, less than one percent is spent on pilot programs for testing in-home technologies. Policymakers are apparently slow to embrace the concept and its potential.

### 3. Technologies Used for Connected Care in the Home are in the "Trough of Disillusionment".

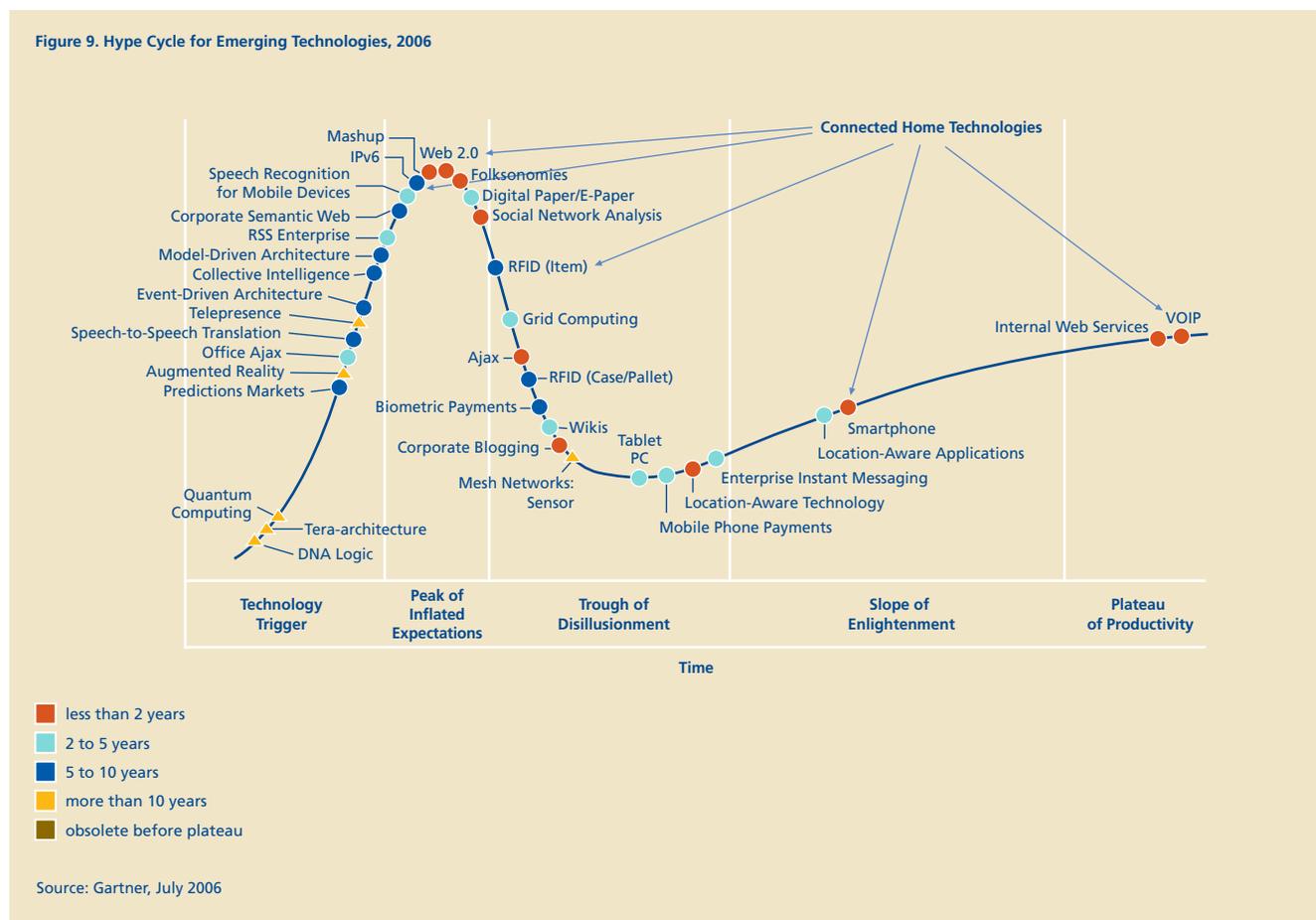
All emerging technologies go through an adoption life cycle: technology-enabled connected care devices are no exception. Unfortunately, the benefits of these new technologies can sometimes get mired in introductory hype and overinflated expectations, leading to consumer disillusionment.

A mechanism sometimes used to assess technology adoption cycles is Gartner's Hype Cycle, a model that describes technology maturity, adoption and application. Gartner's Hype Cycle model is comprised of five stages:

- "Technology Trigger" – The first phase of a hype cycle is the "technology trigger" or breakthrough, product launch or other event that generates significant media coverage and interest.
- "Peak of Inflated Expectations" – In the next phase, a frenzy of publicity typically generates over-enthusiasm and unrealistic expectations. There may be some successful applications of a technology, but there are typically more failures.
- "Trough of Disillusionment" – Technologies enter the "trough of disillusionment" because they fail to meet expectations and quickly become unfashionable. Consequently, the media usually abandons the topic and the technology.
- "Slope of Enlightenment" – Although the media may have stopped covering the technology, some businesses continue through the "slope of enlightenment" and experiment to understand the benefits and practical application of the technology.
- "Plateau of Productivity" – A technology reaches the "plateau of productivity" as its benefits become widely demonstrated and accepted. The technology becomes increasingly stable and evolves in second and third generations. The final height of the plateau varies according to whether the technology is broadly applicable or benefits only a niche market.

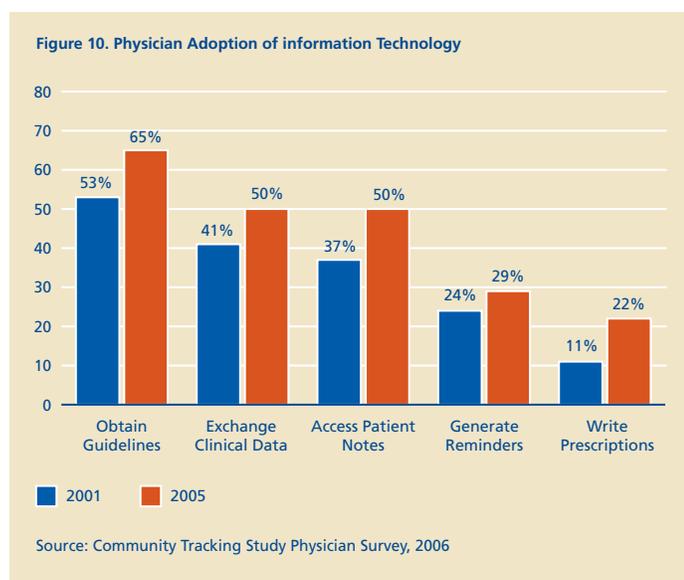
<sup>9</sup> *The Medical Home*, Deloitte Center for Health Solutions, 2007

As depicted in Figure 9, technology-enabled connected care technologies are entering the trough of disillusionment phase. Additionally, several disruptive technologies (e.g., IPv6, RFID) could take many years to attain mainstream adoption.



#### 4. Physicians are Resistant

Physician adoption of practice-based clinical information technology has increased significantly over the last decade (Figure 10). According to a study comparing adoption rates from 2001 to 2005, significant gains have been seen in physicians using IT to obtain guidelines, exchange clinical data, access patient notes, generate reminders and write prescriptions.<sup>10</sup> However, while physicians have been increasing their use of IT and integrating it into their workflows, they have been slow to embrace electronic communication with patients.



Reasons for slow clinician adoption of electronic patient communication include the potential for patient confidentiality breaches, physicians' fear of being overwhelmed by patient e-mails (as well as the associated liability of these e-mails), and a strong financial disincentive to electronically communicate with patients. The Kaiser Permanente Center for Health Research concluded that patients who use e-mail to communicate with their medical providers are apt to phone and/or visit the doctor's office less. Kaiser found a decline of between seven percent and ten percent in primary care office visits for patients who e-mail their physicians and a fourteen percent decrease in patient phone calls to doctors' offices,<sup>11</sup> a disincentive in a reimbursement system that is dependent on procedures and provider visits for physician payment.

#### 5. Seniors Remain Fearful of Technology

The Internet is an integral part of many Americans' lives and has proven to be an effective tool to gather and share information. Currently, however, less than a third of all seniors over 65 are online. This is a generational challenge for proponents of technology-enabled connected care: Over 70 percent of Americans aged 50-64 have gone online and 64 percent have Internet access at home, so Baby Boomers appear more inclined toward using technology at home than seniors.<sup>12</sup> Deloitte's 2008 Survey of Health Care Consumers reported that:

- Respondents aged 50 and older are very interested in home self-monitoring devices. Younger respondents are either somewhat interested or have no interest at all in this technology. Women are more likely to be very interested in self-monitoring devices, while men are more likely to be somewhat or not interested.
- Whites and Asians are more likely to be very interested in home self-monitoring than Blacks/African Americans; however, both Blacks/African Americans and Whites are more likely to not use personal health records. Asians and Other are more likely.
- Respondents in the \$50,000 to \$100,000 income stratum are more likely to be very interested in home self-monitoring, while respondents earning less than \$30,000 are more likely to be not interested.
- Users of personal health records tend to be aged 50 and older at ~50 percent. ~41 percent of non-users are aged 30-49 years.
- Education level also appears to be a significant variable. Those with a bachelor's degree or higher post-secondary education are more likely to be users of personal health records.
- Health status is not statistically significant at the five percent level, but it is statistically significant at the 10 percent level as far as health status having an effect on the use of personal health records.

#### 6. Regulatory and Oversight Issues Remain Unsolved

Similar to other innovations in health care, technology-enabled connected care raises issues around liability, cross-border (state and national) clinician licensing, cultural sensitivities and medical education.

When consumers self-manage their care, who gets blamed for errors and gaps in care attributable to technology misuse? Tort law hasn't determined who this would be. Patients could claim it was the provider's fault because they misunderstood the provider's direction. This, in turn, could further increase providers' resistance to the concept of technology-enabled connected care because they would not want to be held accountable for situations outside of their direct control.

<sup>10</sup> Growing Availability of Clinical Information Technology in Physician Practices Data Bulletin No. 31, June 2006, Marie C. Reed, Joy M. Grossman

<sup>11</sup> "Patient-Doctor E-mail Could Cut Income for Physician Practices," iHealthBeat, July 2007

<sup>12</sup> "e-Health and the Elderly: How Seniors Use the Internet for Health Information," Kaiser Family Foundation, January 2005

Another issue is provider licensing. Which jurisdiction would apply for licensing: the state/country where the underlying care algorithms were developed, the jurisdiction of the device's manufacturer, the jurisdiction where the tools are sold, or the jurisdiction where the patient resides ("place of service")? To date, U.S. regulators have designated the jurisdiction of place of service for offshore radiology and pathology services, with the offshore physicians needing to be licensed where the patient receives their care, but this may not extend to technology-enabled connected care technologies.

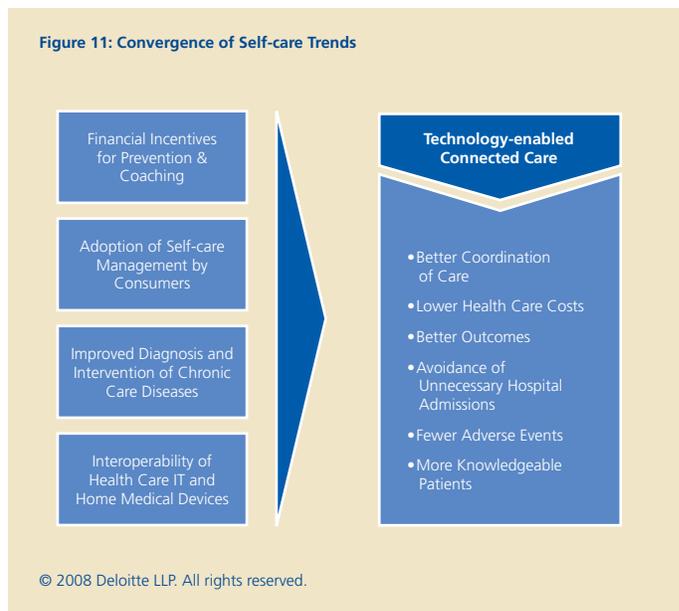
Patients' ability to operate a medical device is influenced by their level of medical training and experience, language barriers, literacy, and racial and ethnic disparities. Additionally, difficulties using certain devices can arise due to advanced age, physical and mental dexterity, medications, or the complexity of the patient's medical condition. The focus of most of FDA guidance will be on ensuring that users are able to safely operate and maintain an in-home device;<sup>13</sup> however, cultural sensitivities should also be considered to mitigate such issues.

## The Future of Technology-enabled Connected Care

Will chronically ill, co-morbid patients proactively manage their care? Will the elderly be able to use sophisticated medical devices and Internet technologies? Will they even want to, as visiting a physician is frequently viewed as a welcome social outing? Will privacy, security and financing concerns prevent mainstream adoption of home self-care devices? What is the potential return on investment of self-care management solutions? Are providers, health plans and government payors ready to support a health care model that encourages prevention and coaching in an episodic, procedural-driven reimbursement environment? These are key questions that could determine whether self-care management and personal health technologies can help to modernize the U.S. health care system.

While these questions are indeed significant, Deloitte believes that technology-enabled connected care is a viable model because it represents the beginning of a disruptive innovation in the management of chronic and post-acute care. Technology-enabled connected care represents the convergence of four important trends (Figure 11):

- New incentives for primary care clinicians and care teams that reward coaching of patients with chronic conditions
- New methods based on adult learning and behavioral readiness to change for coaching patients to improve adherence to self-care
- New scientific discoveries around early diagnosis and interventions to arrest the progression of chronic conditions before they become acute
- New technologies that allow clinicians and care teams to work with individuals in their homes to monitor vital signs, manage conditions and engage appropriately in guided self-care to manage chronic and post-acute care.



Implementing technology-enabled connected care will require new operational models, expanded use of technologies by providers and consumers, and new models for paying for self-care services. Despite these challenges, the net result should be better care and lower costs for individuals with chronic conditions.

<sup>13</sup> Guidance for Industry and FDA Premarket and Design Control Reviewers - Medical Device Use-Safety: Incorporating Human Factors Engineering into Risk Management, FDA, 2000.

## Stakeholder Implications

Technology-enabled connected care represents a strategic opportunity for health care industry stakeholders to better connect with consumers and grow their business. Consider the following ways that stakeholders can promote adoption (Figure 12):

**Figure 12: Stakeholder Roles in Promoting Adoption of Technology-enabled Connected Care**

Stakeholder	Technology-enabled Connected Care Scenario
Employers	<ul style="list-style-type: none"> <li>Employers can structure benefits to encourage use of technology-enabled connected care for post-acute and chronic care management, rewarding enrollees and providers via gain-sharing formulas for increased adherence, cost avoidance not associated with delayed necessary care, and participation. This could be especially helpful in controlling costs and improving care for retirees, for whom many companies bear financial responsibility.</li> </ul>
Health Plans and Government Payors	<ul style="list-style-type: none"> <li>Like employers, payors can leverage their care coordination role to (1) reimburse primary care physicians for coordinating care and coaching using the technology-enabled connected care model; (2) structure benefit design, enrollee premiums and co-payments to encourage use of technology-enabled connected care where appropriate; (3) conduct pilot programs to quantify the efficacy of technology-enabled connected care chronic and post-acute management programs; and (4) collaborate with device makers and information technology companies to advance the safety, effectiveness and value proposition of technology-enabled connected care.</li> </ul>
Technology and Medical Device Companies	<ul style="list-style-type: none"> <li>Technology-enabled connected care opens a lucrative market for personal health technology and self-care device companies that capably navigate the changing landscape of payments and clinical self-care treatment programs.</li> </ul>
Health Care Providers	<ul style="list-style-type: none"> <li>In the provider community, primary care practitioners and hospital discharge planning operations likely will be the major beneficiaries of technology-enabled connected care. In addition, nursing homes and long-term care facilities, home health agencies, and clinic operations in retail, school and prison settings can benefit from these technology innovations. However, providers historically have been reluctant to embrace disruptive innovations wherein liability issues are not resolved appropriately, patient privacy and information security are not protected, and payments/incentives for providers are not adequate to justify necessary investments.</li> </ul>

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## Closing Thought: Shift Left

Andy Grove, co-founder of Intel, promotes the adoption of disruptive, “Shift Left” solutions to address systemic problems in health care. To explain “Shift Left,” Mr. Grove describes a scale where products and services grow more full-featured, complicated and expensive as you move to the right. To “Shift Left” on this scale is to keep things simple. Just like the early personal computer, early technology-enabled connected care technologies will be far from ideal, but they will be a start, and can get better over time. The alternative, Mr. Grove says, is to wait endlessly for a perfect technology.<sup>14</sup>

We agree with Mr. Grove. As cost and technological features increase, so does complexity. Also, the resulting benefits tend to level off when the law of diminishing returns sets in. There are a number of “Shift Left” solutions related to technology-enabled connected care that could have impactful and measurable results. These solutions likely will be centered on specific chronic diseases, patient demographics, and readily accessible technologies.

Technology and self-care management are expected to be an integral part of improving general health and fitness, lowering costs associated with chronic care management, and supporting the elderly who are living independently. However, the convergence of home-based medical devices, Internet technologies, and health coaching won’t realize its full potential until solutions are targeted to match patients’ specific diseases, conditions, and lifestyles. The technologies and services that ultimately will prevail as part of technology-enabled connected care will depend, in part, on the collaborative efforts of health plans, providers, employers, policy-makers and patients.

<sup>14</sup> “Andy Grove Enters New Post-Intel Role As Activist Capitalist,” Lee Gomes, *The Wall Street Journal Online*, <http://online.wsj.com/article/SB116234162751309543-search.html>

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