IBM Institute for Business Value

The future of connected health devices

Liberating the Information Seeker

IBM Institute for Business Value

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By Heather Fraser, YangJin Kwon and Margaret Neuer

Health device makers, to date, have primarily targeted consumers who are either fitness focused or chronically ill. But between these two extremes sits a large, fragmented and often overlooked population who seek better information to effectively manage their health. Our research suggests that successful solution providers will approach this market opportunity as an ecosystem of partners – with an integrated solution that extends beyond the device itself. By plugging the information gap for these consumers, solution providers can help fuel healthcare innovation.

Executive summary

For some years now, medical device makers have provided products and services for consumers who are extremely health or fitness conscious as well as those who need to be regularly monitored because of a serious health risk. And they've been quite successful within these consumer segments. At the end of 2009, the size of the global medical device market was US$290 billion.[1]

As impressive as this is, device makers are generally overlooking a far larger consumer segment that we call Information Seekers. These consumers are relatively healthy, but could use some help managing a health-related challenge. They are looking for solutions that can provide missing information to help them gain greater control over their conditions and ultimately lead healthier, more independent lives.

Thanks to recent technological advances and increased willingness to collaborate among industries, it is now feasible to deliver solutions that meet the needs of this consumer segment and help reduce long-term healthcare costs. As our environments at home and on the go grow more instrumented, interconnected and intelligent, health monitoring solutions also can become more intuitive, comprehensive and affordable – all critically important factors in winning over Information Seekers and healthcare payers. Likewise, the analytical insights enabled by this groundswell of information will be invaluable to the healthcare and life sciences communities.

Health device makers now have the means to target Information Seekers, a large but currently underserved market.

Our research – including interviews with medical device makers and consumer electronics companies as well as input from more than 1,300 current device users and caregivers – reveals key insights about targeting Information Seekers. For those aiming to capture this emerging market, four principles will be key:

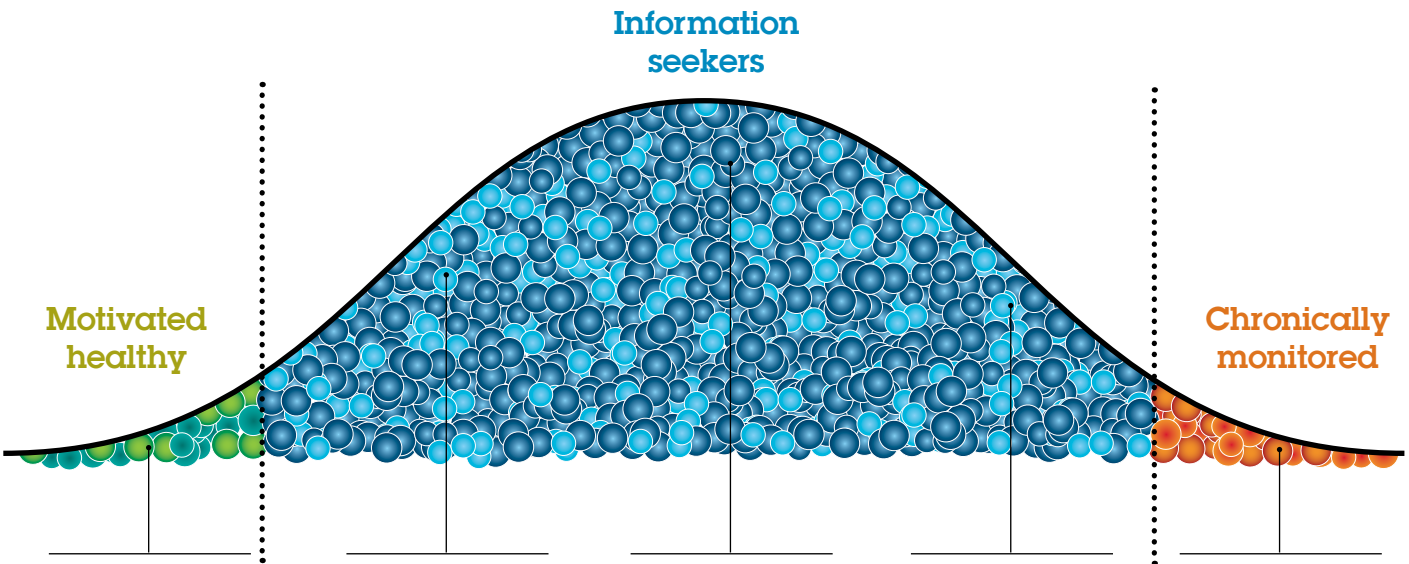
- **Make it easy.** Adoption will depend on making the monitoring process easy for consumers. They need simple, intuitive, yet feature-rich devices and online tools that are designed for their specific needs. Technological advances will continue to fuel a stream of innovation in this space.
- **Design the solution with the end result in mind.** Information Seekers need comprehensive solutions that help them achieve their ultimate objectives. This will involve integration with healthcare providers, payers and even peer support networks. Successful solutions will also leverage the power of data analytics; the real value for consumers and especially healthcare providers is hidden in the data.
- **Pick a position and partner well.** Since it is unlikely any single firm will be able to offer a full solution, each company needs to decide the role it will play in the evolving health device ecosystem. By evaluating competitive strengths and weaknesses, companies can determine what they can profitably do on their own and where they will need partners. Increased levels of partnering may also require companies to strengthen their collaboration skills.
- **Help set the rules.** Consumer – and especially clinician – adoption will hinge not only on ease-of-use, but also industry-wide interoperability. Regulatory hurdles should not be underestimated. To control their own destinies, device makers should get actively involved in establishing standards for connected health devices.

Collectively, our findings emphasize the need for more extensive partnering across the electronics, healthcare and life sciences industries. The building blocks of a health device ecosystem are rapidly emerging, with market adoption and innovative progress ramping up across areas such as mobile devices, home-based devices, web-based resources, electronic health records and personal health records. But the key question remains: which companies will bring them all together to liberate the Information Seeker?

Targeting the Information Seeker

Today, health devices are most commonly used by two segments of consumers – those who are extremely health conscious and fitness focused (the Motivated Healthy) and those who are chronically or terminally ill and require regular monitoring (the Chronically Monitored). The Motivated Healthy voluntarily seek out and pay for monitoring solutions that can help them achieve specific goals. They tend to like gadgets and are willing to invest the time required to set up and learn how to use their selected devices. At the other end of the spectrum, the Chronically Monitored are in poor health and may be dependent on a caregiver. Their devices are typically prescribed by doctors and often covered by insurance. Monitoring helps these consumers remain independent and, in some situations, it can literally save lives.

But in the middle, between these two extremes, another much larger segment exists (see Figure 1). We call these consumers Information Seekers. While their conditions are not currently life-threatening, these individuals are seeking some measure of control over a potentially serious health risk or a condition that is difficult to manage. They represent a willing – but currently underserved – market for health device makers.



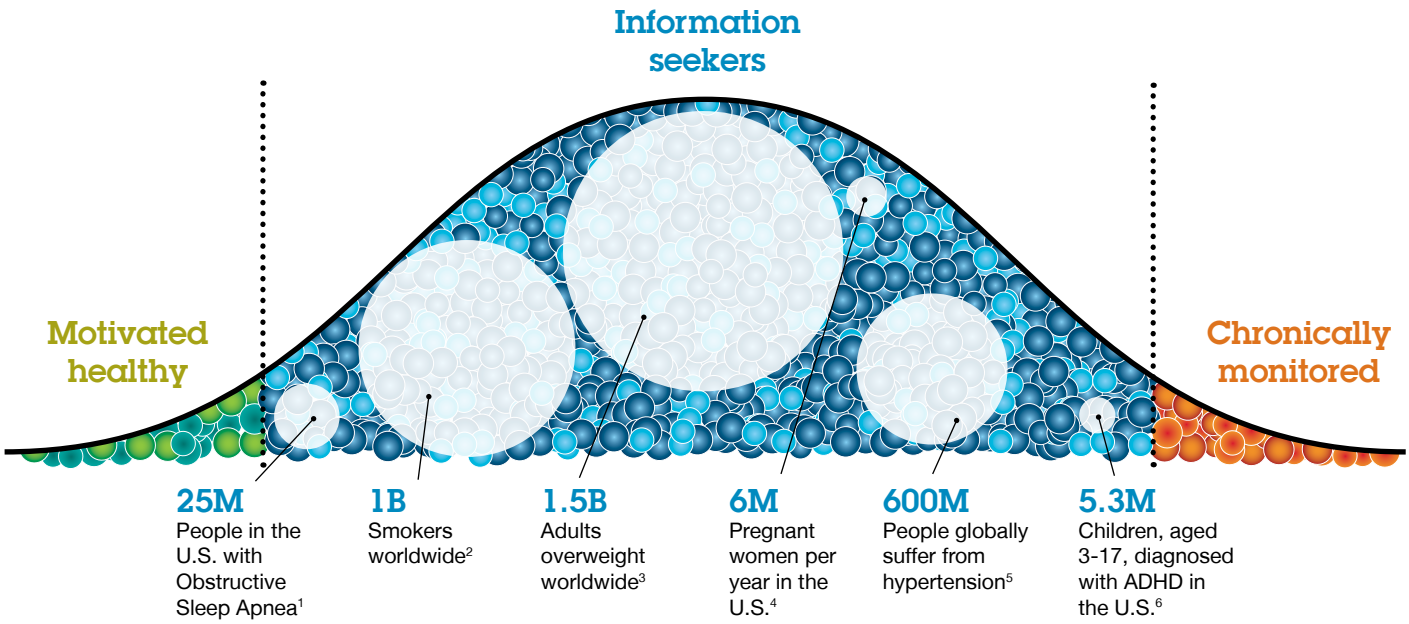
Source: IBM Institute for Business Value.

Figure 1: **Consumers who are not part of the Motivated Healthy or the Chronically Monitored represent an extremely large, but fragmented, target market for device makers.**

This segment is far from homogeneous, including consumers who:

- Want to break destructive habits or addictions (for example, overeating or smoking)
- Are frail or elderly and need assistance to live independently
- Have difficulty complying with prescribed treatment regimens
- Struggle with high blood pressure, migraines, mood swings, asthma, attention deficit hyperactivity disorder (ADHD) and a host of other conditions that require significant trial and error to develop an optimal, individualized treatment approach
- Have children or other dependents who suffer from similarly challenging conditions.

These examples are by no means exhaustive. And the population of this consumer segment is staggering (see Figure 2).



Note: Bubble size is illustrative and not to scale. The conditions included in this figure as examples represent only a subset of the overall size of the Information Seeker segment.
Source: 1 "SLEEP APNEA IN AMERICA: AN EXAMPLE," http://www.stanford.edu/~dement/us.html 2 "Tobacco: Fact sheet N°339," World Health Organization, February 2011, http://www.who.int/mediacentre/factsheets/fs339/en/index.html 3 "Obesity and overweight: Fact sheet N°311," World Health Organization, March 2011, http://www.who.int/mediacentre/factsheets/fs311/en/index.html 4 "Statistics," American Pregnancy Association, http://www.americanpregnancy.org/main/statistics.html 5 "Facts Related to Chronic Diseases," World Health Organization, http://www.who.int/hpr/gs.fs.chronic.disease.shtml 6 "FastStats: Attention Deficit Hyperactivity Disorder (ADHD)," Centers for Disease Control and Prevention, http://www.cdc.gov/nchs/fastats/adhd.htm

Figure 2: **The Information Seeker segment represents a broad spectrum of consumers unified in their need for assistance in managing a health challenge.**

So, why target this segment now?

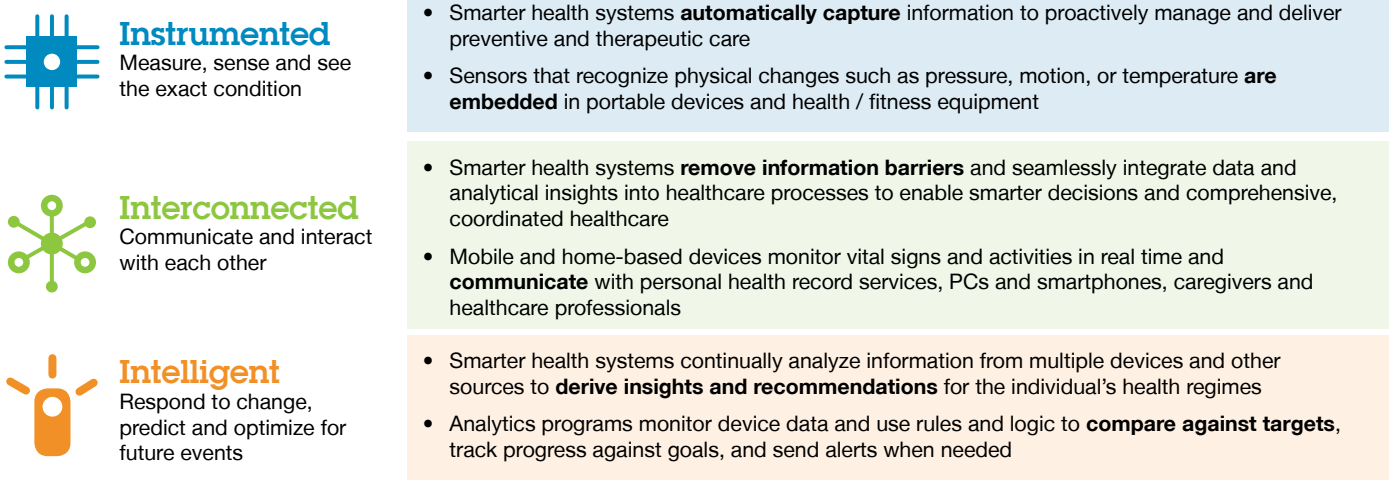
As consumers begin to pay a higher share of their total healthcare costs, we believe the average person may become more motivated to manage his or her health to help contain healthcare expenses and reduce insurance premiums. In addition, major health and demographic shifts are underway, with obesity on the rise and elderly populations in most countries ballooning.

But perhaps the largest reason for targeting this segment now is because it is finally feasible. Recent advances in technology are enabling smarter, connected personal healthcare "systems" that can supply crucial information to significantly improve diagnosis, treatment and condition management (see Figure 3). In terms of Internet connectivity, much of the world now enjoys unprecedented network speed, high penetration of home broadband and availability of various mobile network

options. New and more affordable sensor technologies are introducing entirely new monitoring possibilities. And today's social networking phenomenon presents yet another powerful dimension that can be used to improve health and well-being through peer support. For healthcare solution providers, all these possibilities are rapidly becoming expectations as consumers grow accustomed to them in other industries, such as entertainment and telecommunications.

Usage shifting toward prevention and management

To better understand consumer opinion and gain insights for targeting Information Seekers, the IBM Institute for Business Value surveyed more than 1,300 consumers who are currently using a health device to monitor a particular condition – both individuals living with a chronic condition as well as care-givers.



Sources: IBM Institute for Business Value Analysis; IBM Smarter Planet – Healthcare, Electronics, Life Sciences.

Figure 3: **Through greater levels of instrumentation, interconnectivity and intelligence, smarter health monitoring solutions are possible.**

Study methodology

The IBM Institute for Business Value conducted an online survey of more than 1,300 users of home health electronics. Given that the Information Seeker segment is an emerging market, we opted to survey the broader population of health device users, which is currently dominated by those who are chronically ill. The usage, opinions and future plans of these current users highlight useful trends and insights that can inform strategies for targeting the Information Seeker.

Within our survey population, 80 percent are individuals who are living with a chronic condition, and 20 percent are caregivers. We polled consumers across the United States and the United Kingdom because these two countries represent different healthcare models. In the United Kingdom, healthcare is provided and financed by the government through tax payments. The United States has private care delivery funded by private insurance or through the government for the elderly and poor.

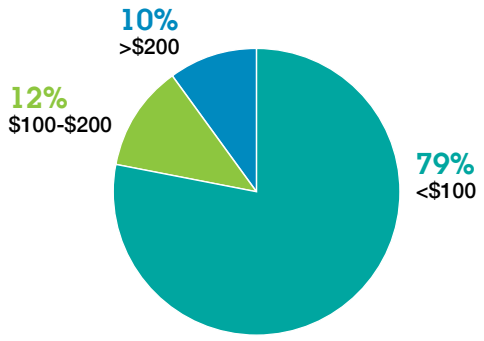
When discussing "health devices" as part of this research, IBM is referring to a software-enabled instrument, apparatus or appliance that senses, monitors or measures a particular condition and is used for wellness, diagnostic or therapeutic purposes. For the purposes of this study, we are excluding devices used in healthcare provider facilities and hospitals as well as those surgically implanted within the body.

Willingness to pay out of pocket is limited

Among those surveyed, nine out of ten (93 percent) are satisfied or very satisfied with the basic functionality of their devices. Although less than 10 percent are paying out-of-pocket charges for their devices today, more than one-third expect to do so within two years. Most users are willing to pay for a device, but will not spend more than US$100 out of pocket (see Figure 4). An increasing number of consumers also anticipate paying monthly fees in the future; while only 5 percent pay a monthly charge today, 35 percent expect to do so in two years.

Preventative uses are gaining importance

Currently, half of those surveyed are using devices to measure and manage a known health problem. However, interest in preventative usage is on the rise. Within two years, 30 percent more respondents expect to be using devices to encourage physical activity, and twice as many will depend on devices to inform others of someone's changing health condition.



Note: n = 715.
Source: IBM Institute for Business Value Connected Health Devices Survey.

Figure 4: Within limits, consumers are open to paying out-of-pocket for health devices.

Everyone is looking for simplicity

Almost unanimously, respondents told us ease-of-use is the top factor in selecting one device over another (96 percent). Price is a clear second (76 percent), well ahead of range of features (54 percent), customer support (42 percent), warranties (23 percent) and stylish design (9 percent).

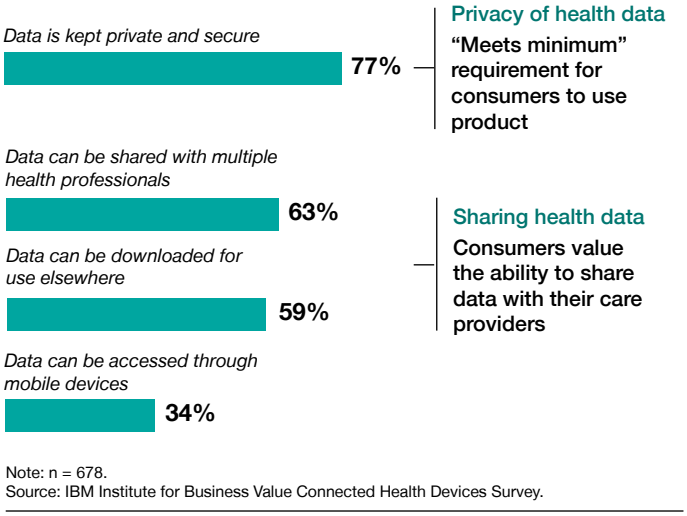
Sharing data and getting feedback are critical

Not surprisingly, the top data requirement is privacy and security, as noted by 77 percent of respondents. However, more interestingly, a high percentage of respondents also want to be able to share and use the data in a variety of ways (see Figure 5). Clearly, they want health professionals to incorporate data from health devices into diagnosis and treatment decisions. Consumers recognize that monitoring data, when combined with a range of other inputs, enables health professionals to see a more complete picture.

In fact, when asked about getting feedback related to health device data, more than three-quarters rate feedback from healthcare professionals – whether online or in a subsequent office visit – as important or very important. Although feedback from the device itself is desirable, it does not replace personalized, synthesized advice and interpretation from healthcare providers.

Consumers buy based on healthcare providers' advice

Even in terms of device purchase, the opinions of their physicians matter. Far more respondents (71 percent) rely on healthcare provider recommendations than on their own familiarity with the brand (52 percent for medical devices and 45 percent for consumer devices). Endorsements from healthcare provider associations (64 percent) carry more weight than those made by insurers (50 percent), regulatory agencies (49 percent) and consumer advocacy groups (43 percent). As these results attest, gaining medical community support – particularly among physician and healthcare provider organizations – will be vital to the market success of any health monitoring solution.



Note: n = 678.
Source: IBM Institute for Business Value Connected Health Devices Survey.

Figure 5: **Privacy and security are top expectations, but consumers are also keenly interested in sharing their health data.**

Perhaps most surprising of all, more than half of all respondents could not recall the brand of their current device – even though many of them use it every day. The fact that consumers have so few preconceived notions about existing brands suggests companies have a clean slate upon which to build their brand presence in this space.

Device makers' battle for mindshare

To reach Information Seekers, device makers will need to develop solutions that meet some important requirements:

- **Enable real-time monitoring, allowing less frequent visits to the doctor** – The conditions Information Seekers struggle with are often complex and require frequent assessment, making monitoring at office visits impractical or ineffective. In addition, measurements taken at home may actually be more accurate than those performed in doctor's offices and hospitals due to "white coat syndrome." For example, many patients today are misdiagnosed with high blood pressure because of the anxiety or stress they experience simply from visiting the doctor.[2]
- **Be cost-effective and simple to use** – Current users rank ease-of-use and price as the top criteria for purchase; these hurdles will be even steeper for information-seeking consumers who lack extreme motivation (such as life-or-death situations or strong fitness commitments).
- **Seamlessly and securely connect to the Internet to upload monitoring data and allow care providers to download** – The majority of the value of these devices comes from the ability to provide data to physicians or other health professionals without necessitating an office visit. And the process of sharing and using this information must be easy for both patient and healthcare provider.
- **Target conditions that both doctors and consumers are hungry for information about** – Devices will be most successful when they provide data that would not otherwise be available because of the measurement frequency required or the need to capture "in the moment." Conditions that would derive the most value are those that involve much trial and error to determine course of treatment, are frustratingly difficult to manage or have high risks associated with noncompliance or side effects.

Although many health devices in use today lack connectivity or other important features, several progressive products foreshadow what lies ahead. For example, the consumer electronics company Fitbit offers a clip-on device that monitors activity levels and sleep quality, uploads data via a wireless base station and provides online data storage and analytical tools.[3] Marketed as a platform for wellness and awareness, it helps people monitor and receive data when and where needed to control their conditions. Medical device maker Medtronic markets a diabetes management solution called CareLink that consolidates and analyzes data from a patient's insulin pump, continuous glucose monitoring device and blood glucose meter and makes it available to the individual's doctor.[4] Having a real-time view of blood sugar and the ability to deliver insulin precisely when needed helps diabetics reduce the risks associated with erratic sugar levels.

More than half of the consumers we surveyed did not recall the brand of their current health device.

Who has the edge?

As the preceding examples show, both medical device makers and consumer electronics companies are active in this space (see Figure 6). But does one type of device maker have a distinct advantage over the other?

Generally speaking, consumer electronics firms tend to be stronger in terms of branding and driving consumer loyalty. They also are in a better position to create new markets for health devices because of their large, existing consumer bases and innovative products that could be adapted to measure health in new ways (for example, Nintendo Wii Fit).

However, consumer electronics companies may struggle with distributing through healthcare professionals because they lack relationships within the healthcare and life sciences communities. They also have little experience working in a purchasing environment dependent on payers and in a product development cycle that involves regulators (such as the U.S. Food and Drug Administration).[5] Compounding these challenges, both regulatory policies and payer systems vary by country.

Medical device companies, on the other hand, have more credibility and experience working with care providers. These close relationships can help them identify additional conditions that are conducive to monitoring with health devices.

But medical device makers may face challenges with the consumer-related aspects of serving this segment – such as understanding consumer needs, behaviors and attitudes and turning these insights into specific product features and functions. They also may be less familiar with consumer-oriented user interface design techniques.

Source: IBM Institute for Business Value.

Figure 6: Consumer electronics companies and medical device makers have their respective strengths and weaknesses – but who will win?

The fact that our consumer research showed no strong bias favoring either type of device maker suggests this emerging market is up for grabs. However, companies cannot afford to ignore inherent strengths and weaknesses as they make go-to-market plans.

Think solutions and ecosystem, not just the device

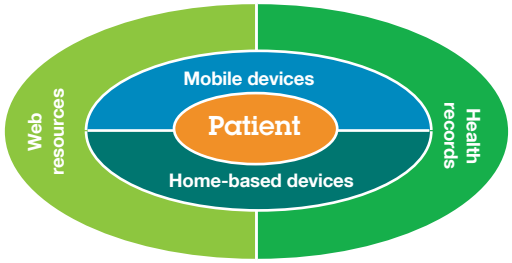
Capturing this market will require more than innovative, easy-to-use devices; success will be determined by the strength of the entire solution. By that, we mean the comprehensive, cohesive experience provided to the consumer – which could include: online and retail purchasing, service, accessories, content, social network support, analytical applications for patients and physicians, physician and hospital education and enablement, and more.

Delivering this type of solution will involve an ecosystem of partners, and adoption will depend on open standards and interoperability. Across the electronics, healthcare and life sciences industries, components of this health device ecosystem are already appearing and evolving (see Figure 7).

Rapid adoption of mobile interactive devices has provided a viable gateway for consumers to transmit health data. Currently, 17 percent of mobile phone owners (29 percent of those ages 18-29) use their phones to look up health or medical information.[6] Nine percent of mobile phone owners (15 percent of those ages 18-29) have smartphone applications that help them track or manage their health.[7] In fact, 10 percent of all apps downloaded from the Apple iTunes store (1.09 billion downloads) are related to healthcare, medical and lifestyle.[8] One example is the Pfizer Mon Krono Santé application,

Mobile devices
Applications that provide monitoring capability when the user is away from home. Should include the ability to store and share collected data with PCs and other elements of the ecosystem.

Web resources
Websites that deliver content such as medical condition descriptions and nutritional details. Includes the variety of interactive tools and data sharing services now available. May be free or subscription based.



Electronic and personal health records
Electronic health records that are shared among different healthcare organizations. May include a patient's entire medical history, test results, and current prescriptions. Web-based personal health records that consumers maintain and selectively share.

Home-based devices
Solutions that monitor condition status outside of a clinical setting. May include the features required for data sharing with PCs and other elements of the ecosystem.

Source: IBM Institute for Business Value analysis.

Figure 7: **Components of a connected health device ecosystem have already appeared, but need to be better integrated.**

which serves as a memory aid and offers a personal health record for chronic disease sufferers.[9] Gaming devices are viable conduits as well. Bayer DIDGET, for example, is a plug-in for the Nintendo DS gaming system targeting children with diabetes.[10]

As home-based gaming and fitness devices become increasingly sophisticated, they are also introducing new methods of monitoring health remotely and automatically. For example, Withings offers an Internet-connected scale that unobtrusively records and transmits body weight and allows subsequent analysis via PC and smartphone applications.[11]

The growing number and increasing maturity of web-based resources are providing more opportunities for consumer self-service and peer support. Bayer, for instance, offers a comprehensive support program called BETAPLUS for multiple sclerosis (MS) patients.[12] In addition to an application for the Apple iPhone mobile device that assists with injection timing and site reminders, Bayer's solution includes a robust website with educational tools, peer support and access to solution-trained nurses.

Providers are beginning to adopt electronic health records that can be shared among healthcare organizations.[13] Consumers also see the value in a consolidated view of their health information and are experimenting with personal health record services offered by IT companies, insurers and employers.[14] The benefits of digital health records are profound; including new types of data and more frequent measurements (enabled by connected health devices) will help close information gaps and create a truly comprehensive digital health record.

Clearly, the building blocks are there and gaining traction; but the greater value comes in bringing the components together to provide a step-change in diagnosis and treatment – both in terms of patient outcomes as well as healthcare system efficiency.

Seizing this market opportunity

For companies across the electronics, healthcare and life sciences industries that choose to target the Information Seeker, our research and analysis suggests keeping four key principles in mind:

Make it easy. Adoption will depend on making the monitoring process easy for everyone involved. Consumers need simple, intuitive, yet feature-rich devices and online tools that are designed for their specific needs. For instance, kids with ADHD may need a very basic user interface that does not distract from schoolwork, while busy executives may prefer a smartphone application that can be used unobtrusively during meetings and while in transit. Solutions should be capable of transmitting data seamlessly and securely using PCs, smartphones and other connected devices and sharing data with a variety of applications and online services. Features should help users manage their health passively by setting rules and alerts to provide specific feedback. Users will also want to configure the solution – for example, tailoring the frequency of measurement and data transmission. In terms of feedback, information should be presented in a clear, easy-to-understand format.

Delivering solutions for the Information Seeker will require an integrated ecosystem.

Advances in interfaces and mobile communications will continue to provide opportunities for ease-of-use breakthroughs. For example, bioacoustic sensing could allow the skin to be used as an input surface, enabling an interface that is literally always at hand. By overlaying information on top of a live view of the real world, augmented reality technologies could help users immediately "see" detected conditions that demand action.

Design the solution with the end result in mind. To manage their health conditions, Information Seekers need a comprehensive solution that helps them achieve their ultimate objectives. This will necessitate an end-to-end view that involves integration with healthcare providers, payers and even peer support networks. Integration into the diagnosis and treatment process will be crucial; the information should come in a format that is easy to interrogate and store (for example, in a patient's electronic health record). Solutions should also leverage the power of data analytics. The real value for consumers and especially healthcare providers is hidden in the data; they need tools to consolidate, interpret and mine it (see sidebar: Getting a handle on health data). Above all, the source data and resulting insights must be indisputably accurate.

For many conditions, peer support will also play a key role in effectively managing health challenges. Incorporating community and social networking tools can help Information Seekers stay motivated and gain insights from others in similar situations. Peer support could be extremely beneficial to caregivers as well. For example, parents of bipolar teens might not know other families within their neighborhoods who are struggling with this condition, but an online caregiver network could provide valuable advice and encouragement.

Getting a handle on health data – The possibilities presented by Watson

By nature and by oath, physicians are compelled to thoroughly assess a patient's condition when diagnosing and determining a course of treatment. But with medical literature doubling every seven years and patient data expanding geometrically with the addition of genomic data, it is no longer humanly possible for physicians or their assistants to consider all relevant data when making decisions.[15] However, advances in DeepQA technology and natural language processing – as demonstrated by the IBM Watson Jeopardy! Challenge – are rising to the challenge.

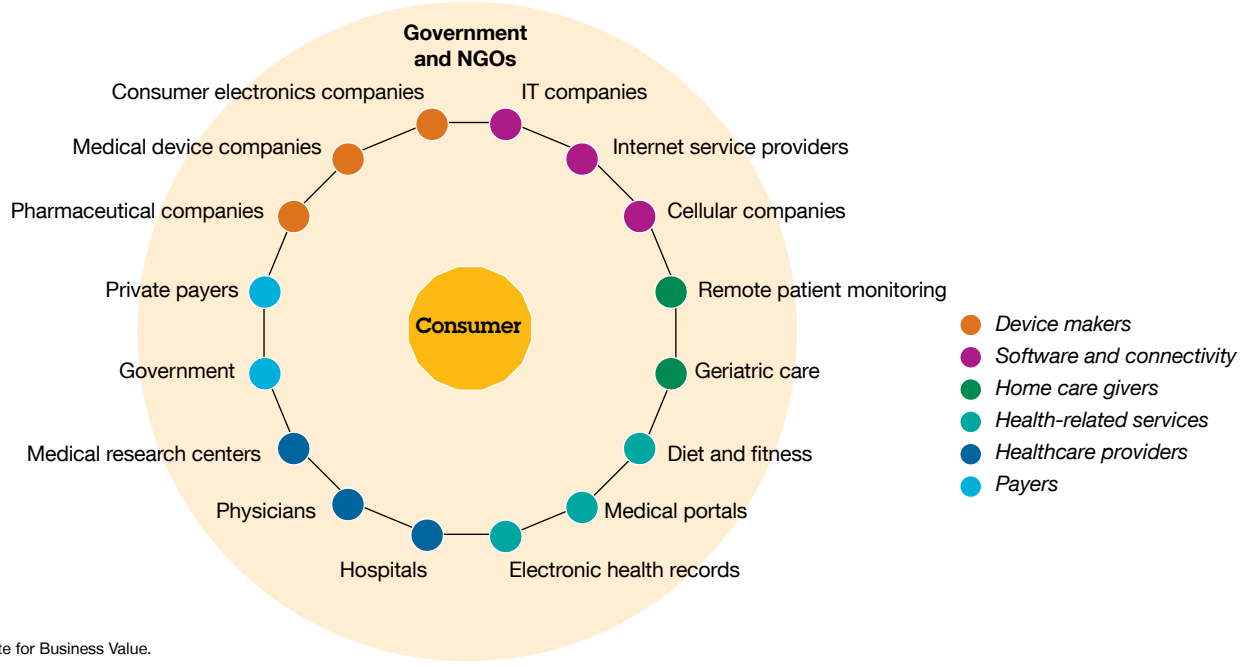
Imagine a physician's tool that could evaluate – in minutes or possibly seconds – a wealth of data from connected health devices plus the complete medical history of a patient and all available medical literature (such as medical records, texts, journals, research documents even ongoing clinical trial results), much of which is unstructured information written in natural language. This application could suggest possible diagnoses – complete with documented "reasoning" and probabilities – or request additional, seemingly unimportant information needed to test hypotheses.

Today, 20 percent of medical errors are caused by diagnostic errors, not always the *wrong* diagnosis, but often *delayed* diagnoses.[16] Connected health devices have the potential to dramatically accelerate the speed with which doctors can arrive at an accurate diagnosis or find effective treatments. Factor in Watson's analytical speed and reach, and doctors could dramatically improve the quality of care they provide to their patients.

Pick a position and partner well. Companies will need to identify an optimal position in this evolving ecosystem by evaluating their strategic objectives and operating strengths. In addition, they will need to strengthen their collaboration and partnering skills since it is unlikely any single firm has all the capabilities required to offer a total solution (see Figure 8). Because its core competency is manufacturing, a device maker may need to collaborate with a software company that develops user interfaces or a publishing company that supplies health-related information and content.

In this market, healthcare provider relationships will be particularly vital – not only because consumers will rely on them for recommendations, but also because the value proposition of connected health device solutions falls apart if they are unwilling to use this new data source. Depending on how a new device for Information Seekers is sold, device makers may need to work with community pharmacists as well as physicians and hospitals. And since making these new devices affordable may require some type of insurance reimbursement or incentive such as premium discounts, they may need to collaborate closely with payers as well.

To help control healthcare costs, insurers may assume an increasingly prominent role in the health device ecosystem. One example is a sleep benefits management program from WM SleepCare, an affiliate of Watermark Medical, Inc.[17] It offers insurers an end-to-end Obstructive Sleep Apnea program for oversight and compliance management that utilizes a cloud-based platform to deliver improved healthcare at a substantially lower cost.



Source: IBM Institute for Business Value.

Figure 8: **Comprehensive solutions will involve a broad ecosystem of participants, including payers, healthcare providers, governments and non-government organizations (NGOs).**

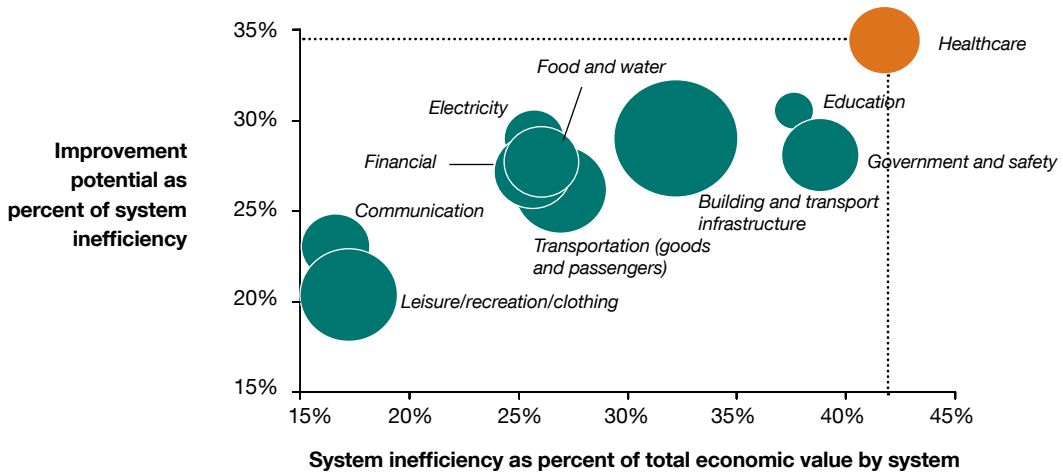
Help set the rules. Consumer – and especially clinician – adoption will hinge not only on ease-of-use, but also on industry-wide interoperability. Therefore, device makers should get involved and participate actively in the dialog on future standards for the connected health device ecosystem. Continua Health Alliance, for instance, is an alliance consisting of more than 230 healthcare organizations, electronics companies, telecom service providers and IT firms that are committed to working together to create common industry standards that enable device manufacturers to rapidly develop and gain regulatory approval for devices and services.[18]

The bigger picture: Why this matters to the world

Today's global healthcare system is plagued by systemic inefficiency, which wastes US$2 trillion each year (see Figure 9).[19] The inability to collect, share and use data from a variety of sources to support diagnosis and treatment decisions is a chief contributor to this inefficiency.

By helping the industry address its underlying information management challenges, connected health device solutions can make a dent in this seemingly intractable problem and pave a path toward improved diagnosis and treatment, making our world a healthier place.

The expansive Information Seeker segment presents electronics, healthcare and life sciences companies with a rare opportunity. In mature industries within developed economies, market saturation has become a constant challenge, but this consumer segment represents a burgeoning opportunity that has barely been tapped. Even more special, this white space provides a chance for solution providers to make money while simultaneously making headway on an issue of great significance to future generations. The question is: which companies will have the vision and collaborative instincts to bring together integrated solutions that capture the hearts and minds of the Information Seeker and the healthcare community at large?



Note: Size of the bubble indicates absolute value of the system (US$ billion).
Sources: "The world's 4 trillion dollar challenge," IBM Institute for Business Value, January 2010.

Figure 9: **Relative to the world's other major systems, the global healthcare system is the least efficient and has the highest potential for improvement.**

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