World Economic Forum
Digital Transformation Initiative:
In collaboration with Accenture

Building the healthcare system of the future

June 2016

The views expressed in this summary of a White Paper are those of the author(s) and do not necessarily represent the views of the World Economic Forum or its Members and Partners. White Papers are submitted to the World Economic Forum as contributions to its insight areas and interactions, and the Forum makes the final decision on the publication of the White Paper. White Papers describe research in progress by the author(s) and are published to elicit comments and further debate.
Building the healthcare system of the future

Today’s model of healthcare provision is increasingly unsustainable. To deliver continued improvements to the world’s health, it will need to be transformed, with digital playing a central role.

Few industries have the potential to be changed so profoundly by digital technology as healthcare, but the challenges facing innovators – from regulatory barriers to difficulties in digitalizing patient data – should not be underestimated.

By almost any measure, global health has improved dramatically in recent decades. However, the current model for providing healthcare is being slowly torn apart by the opposing forces of an ageing population and greater restraints on government spending.

Future of health scenario

- **Continuous Monitoring**: Continuous monitoring of health vital data with intelligent analytics to notify a member of LifeCare network when needed.
- **Retail Clinics**: Provide people with convenient access to routine care with information connected and synchronized across the ecosystem.
- **Connected Home**: Access to my health information enriched with insights to help simplify decisions and actions.
- **Auto Patient Access**: Intelligent personal devices become an extension of the patient facilitating automated access and information sharing.
- **Virtual Care Circles**: People receive real-time information and notifications that allow for more meaningful and productive interactions with doctors.
- **Omni-Channel Experience**: Personalized digital health hub supports people in improvement and maintenance of health seamlessly across interactions to make healthcare simple.
- **Intelligent Treatments**: Treatment plans are customized based on people's personas and continuously learn based on individual actions.
- **Me, My Data & I**: Intelligent personal devices become the center to help people improve and maintain their health throughout their life.

Global annual spending on healthcare in 2013


Average annual rate of increase in global healthcare spending, 1995 to 2013

Source: World Economic Forum / Accenture analysis

$7.5 trillion

6%

To find out more about the DTI project, visit reports.weforum.org/digital-transformation
Building the healthcare system of the future (continued)

The healthcare system of the future will need to look very different. It will be more ‘consumer-centric’ – allowing citizens and their families to have much more responsibility for managing their healthcare.

We expect the two biggest disruptions to healthcare to be:

- Shifting the location of care, out of the hospital and closer to home
- Transforming the type of care, from ‘diagnose and treat’ to ‘prevent and manage’

The outpatient setting – especially the home – will be the optimal medium of care. Virtual care will broaden access to healthcare in rural areas, especially in emerging economies. There will be less focus on adding new beds and more on developing services to provide improved access and quality of care at lower cost.

The Digital Transformation Initiative

The Digital Transformation Initiative (DTI) is a project launched by the World Economic Forum in 2015 as part of the Future of the Internet Global Challenge Initiative. It is an ongoing initiative that serves as the focal point for new opportunities and themes arising from the latest developments and trends from the digitalization of business and society. It supports the Forum’s broader activity around the theme of the Fourth Industrial Revolution.
Eight trends that are changing the face of healthcare

A combination of demographic, market and technology trends is making digital transformation increasingly critical to the future of healthcare.

1. A healthier world
Modern medicine has been spectacularly successful in improving the world’s health and quality of life. This progress has come at a significant cost, however, with global health expenditure growing faster than global GDP.

71 years
Global average life expectancy at birth in 2013

64 years
Global average life expectancy at birth in 1990


2. Economic cost burden
Health spending is consuming an ever-increasing share of global resources, growing faster than global GDP.

Healthcare spending by geographical region (% of GDP, 2015)

<table>
<thead>
<tr>
<th>Region</th>
<th>% of GDP</th>
</tr>
</thead>
<tbody>
<tr>
<td>North America</td>
<td>17.5%</td>
</tr>
<tr>
<td>Western Europe</td>
<td>12.5%</td>
</tr>
<tr>
<td>Latin America</td>
<td>10%</td>
</tr>
<tr>
<td>Asia and Australasia</td>
<td>7.5%</td>
</tr>
<tr>
<td>Middle East and Africa</td>
<td>5%</td>
</tr>
<tr>
<td>Eastern Europe</td>
<td>2.5%</td>
</tr>
</tbody>
</table>

Source: The Economist Intelligence Unit

3. Ageing populations
Populations around the world are ageing due to lower birth rates and rising life expectancy. This trend has been seen in richer countries for many years, but is now also visible in emerging economies.

12% Percentage of China’s population aged 60 or over in 2010

28% Projected percentage of China’s population aged 60 or over in 2040

Eight trends that are changing the face of healthcare  (continued)

4. Increased incidence of chronic disease
Unhealthy diets and sedentary lifestyles are driving a rapid increase in the prevalence and coincidence of chronic diseases. Around the world, there are 382 million people with diabetes and 600 million who are obese.

5. The unsustainable cost of care
Chronic diseases accounted for 86% of all US health spending in 2010 and are becoming an increasing burden in other countries. In the United Kingdom, the National Health Service is expected to need an extra £30 billion over the next five years to continue its current level of activity.

6. Government policy, regulation and mandates
Concerns about costs, quality and access are prompting major reforms to national health systems. Some countries are introducing regulations to push technology such as electronic medical records. Countries are also looking to reform healthcare payments, signalling a shift from fee-for-service to paying for value or outcomes.

7. Empowered consumers
Shifting costs and the liberation of healthcare data have made the empowered healthcare consumer a reality. These people expect a healthcare experience that is simple, personalized, seamlessly coordinated and treats their personal data securely.

8. Scientific triumphs
A number of previously fatal diseases can now be managed or treated. Amazing improvements have also been made in genetic sequencing, genomics, gene-editing techniques, the application of proteomics to gene therapies and the development of personalized treatments.

Challenges to adoption of digital technology
Citizens’ desire for digital healthcare services has not always been matched by action from the industry, with two-thirds of physicians in the United States reluctant to allow patients to access their own health records.

There are a number of reasons why healthcare has not benefitted from digitalization as fully as many other industries. It has been challenging to standardize data and promote interoperability. Privacy regulations and the sensitivity of the data make access and sharing a challenge. The delivery of care is also still critically dependent on the expert labour of highly skilled healthcare professionals. Therefore, the industry’s culture and tradition have made automation more difficult.
1. Smart care

Precision medicine, robotics and medical printing are making healthcare smarter and more personalized.

Recent technological and scientific breakthroughs have propelled medicine into a new era of smart care. Advances in genomics sequencing, coupled with improvements in cloud and analytics capabilities, have hastened the emergence of precision medicine. Cheaper, more capable robots have opened up a wider range of medical applications. The manufacture of individually customized medical devices and implants is now possible thanks to 3D printing.

**Smart care: digital initiatives**

- **Precision medicine**
  Taking into account a person’s lifestyle, genes and environment can improve disease prevention, diagnosis, treatment and management.

  The ability to sequence genes quickly and cheaply and to analyse vast volumes of data is enabling targeted treatments to be devised. Big data analytics, personal health devices and an understanding of sometimes subtle environmental signals are all required, in addition to genomics information, to develop personalized care plans for individuals. Precision medicine will make healthcare more cost-effective by reducing the frequency of inappropriate interventions.

  **Cost of sequencing a human genome**
  - $100 million in 2001
  - ~$1,000 in 2015

  Source: National Human Genome Research Institute, “DNA Sequencing Costs: Data”, 2016

- **Robotics**
  Precise robot movements make minimally invasive procedures possible.

  Patients undergoing robot-assisted surgery benefit from a lower chance of infection, less pain, reduced blood loss and a quicker recovery with fewer complications. Robot-assisted surgery could also allow a surgeon to connect with a patient in a remote area, thus broadening access. The proliferation of robots (there are now estimated to be around 1.5 million worldwide) and their falling cost suggest that they will become increasingly common in healthcare settings.

- **Medical printing**
  Through 3D printing, medical devices and implants can be personalized to individual anatomies.

  While 3D printing has been embraced in fields such as hearing aids, facial reconstruction, personal prosthetics, dental crowns and surgical implants, new technology and regulatory approvals are also advancing in other areas such as drug production. By enabling manufacturing within the hospital or operating theatre, 3D-printing solutions threaten to significantly disrupt the existing healthcare value chain.

  **Revenue from sales of 3D-printed body parts**
  - $537 million in 2014, an increase of 30% on the previous year


  **2015**
  - $3 billion
  - $6 billion

  Source: RNCOS

**Case study: Foundation Medicine (Precision medicine)**

Foundation Medicine uses precision medicine techniques to fight cancer. Through two comprehensive genomic-profiling tests, it provides oncologists with information to identify the best targeted treatments for their patients. So far, 35,000 patients have taken the tests. In January 2015, the world’s biggest maker of cancer drugs, Roche, bought a majority stake in Foundation Medicine for $1 billion.

Sources: [www.foundationmedicine.com](http://www.foundationmedicine.com) and Roche, “Roche enters a broad strategic collaboration with Foundation Medicine in the field of molecular information in oncology”.

The value of the global medical robotics market is forecast to grow...
2. Care anywhere

Shifting care closer to home can broaden access to healthcare and reduce the strain on overstretched health systems.

The technology that has enabled the Internet of Things to proliferate will open up the possibility of care anywhere, through virtual care and connected home initiatives.

Care anywhere will improve the lives of citizens, but the full force of its transformational power will be seen in its impact on health systems. Care anywhere initiatives will allow capacity-constrained healthcare systems to steer patients away from hospitals and shift more medical treatment closer to the home. The 'care anywhere' concept of being able to achieve more from less suggests it could alleviate the forecasted shortage in clinician labour.

Care anywhere has the potential to be one of the most important strategies to reduce the burden faced by overstretched health services and to help set healthcare provision back on a sustainable footing.

Care anywhere: digital initiatives

• Virtual care

Virtual care connects clinicians, patients, family members and health professionals in real time to provide a variety of health services.

By its very nature, virtual care (including telehealth and telemedicine) broadens access to healthcare services, especially in rural areas and some emerging countries. Its usage continues to accelerate, but obstacles (e.g. continued reimbursement challenges, data interoperability and security, and physician adoption) still need to be overcome before virtual care can achieve a truly transformational impact.

• Connected home

Connected homes have smart appliances and devices that can communicate with one another and operate independently when instructed to do so.

With an ageing population and an increasing prevalence of chronic conditions, there will be a sizeable market for healthcare applications that use connected homes to help users ‘age in place’.

Value of the global connected home market in 2015

$33 billion

Estimated value of the global connected home market in 2018

$71 billion

Case study: The TEKI project (Connected home)

Developed by Accenture with its partner Microsoft, the TEKI project in Spain’s Basque Country keeps patients connected to their care team via an internet-linked Microsoft Kinect unit. Patients communicate regularly with their physician using video, voice or text messages via an interface on their TV screen. They can also complete symptom-related questionnaires by gesture control, perform prescribed rehabilitative exercises and check vitals. The control study saved $55 million.

Sources: Telehealth & Telecare Aware, “Telehealth saves $55 million in the Basque Country”, 2013

Number of patients worldwide using telehealth services is forecast to grow strongly

Source: IHS Technology

To find out more about the DTI project, visit reports.weforum.org/digital-transformation
3. Empowered care

New digital offerings give citizens powerful tools to play an active role in managing their well-being and healthcare.

The digital economy can now deliver a wide range of ‘living services’ – intelligent digital services that respond contextually to the user’s needs. These can empower citizens to manage their own healthcare and prevent the onset of chronic conditions such as diabetes.

Empowered care: digital initiative

- Patient engagement at scale

Healthcare providers can benefit from remotely monitoring a patient’s health.

The healthcare industry is fertile ground for innovation, with smart sensors and devices, cloud applications and maturing analytics for providing living services. All of these could help identify early signs of health degradation and prevent adverse events such as readmission to a hospital.

Living services help prevent chronic diseases by encouraging people to live healthily and make the right lifestyle decisions. Some digital offerings are already being aimed at specific therapeutic areas, including chronic obstructive pulmonary disease (COPD), diabetes, hypertension, atrial fibrillation or heart failure.

Around the world, a further 200 million people are expected to be diagnosed with diabetes by 2035, suggesting a substantial market exists for innovations that help people manage their condition.

Case study: Livongo Health

California-based Livongo Health helps users manage diabetes. A two-way smart glucose meter communicates members’ readings in real time to Livongo’s smart cloud. Livongo’s analytics provide personalized insights based on the glucose reading and the user’s personal history. Livongo’s diabetes ‘educators’ can then offer advice to the user. Free for users, the start-up charges its employers or insurers a per-member-per-month fee, on the basis that they will benefit from healthier employees or policyholders.

Sources: www.livongo.com

Percentage of healthcare costs in the United States driven by just 5% of patients

49%


Use of apps to manage diabetes is expected to increase

2013 2018

1.2% 7.8%

Source: Research2Guidance
4. Intelligent health enterprises

Data-driven healthcare has the potential to save lives and billions of dollars but challenges relating to the use of medical data need to be overcome first.

Data-driven healthcare is an idea whose time has come. Advances in data collection, storage and analytics have been accompanied by the proliferation of data – for example, from sensors and devices, clinical information systems and electronic health records. At the same time, more widespread data standards and interoperability are allowing developers to find more applications for health data.

This use of data will underpin smart services that further empower citizens to engage in their own healthcare, allow health professionals to operate at the top of their licence and improve the productivity of healthcare workers.

However, major barriers need to be overcome relating to the collection, sharing and interoperability of medical data before intelligent healthcare enterprises can succeed at scale.

Intelligent health enterprises: digital initiatives

• Accessible intelligence

As data volumes rise, analytics technologies can deliver myriad benefits.

A huge increase in the volume of healthcare data is feeding next-generation analytics technologies such as big data, cognitive computing and machine learning. These technologies are improving the delivery of cancer treatments, personalizing medical interventions, predicting chronic diseases, driving behavioural change and more.

20%

Forecasted annual growth rate of global predictive analytics market to 2019, when the market will be worth an estimated $6.5 billion

Source: Predictive Analytics Times, "Machine Learning and Predictive Analytics Foster Growth", 2014

Progress is however being held back by difficulties in using medical data. Hospitals and insurers often believe that a citizen’s health data belongs to them. In fact, it should belong to the citizen and be available when the citizen demands it.

• Connected worker

Digital technologies, workflow automation and clinical decision support can boost the efficient use of resources.

Physicians are increasingly using digital technologies but there is still plenty of potential for further adoption in healthcare.

Rate of uptake of digital functions by acute physicians around the world

Source: Accenture research (based on a survey of physicians in Australia, Canada, England, France, Germany, Singapore, Spain and the United States).
4. Intelligent health enterprises (continued)

Intelligent health enterprises: digital initiatives (continued)

• Connected worker (continued)

In the hospital environment, connected worker technologies benefit nurses, physicians and surgeons. A connected nurse could make use of mobile, safety tracking, collaboration and analytics so that they could complete their work more effectively and increase patient quality of care and experience. A connected physician could work across various departments from cardiology, labour and delivery, to gynaecology, radiology and nephrology, while a connected surgeon could deliver better care through greater precision in the operating room and better coordination with the care team.

• Intelligent devices

Intelligent devices offer a tremendous opportunity for traditional healthcare companies and new medical device manufacturers.

The smart contact lens developed by Novartis and Google, which monitors glucose levels in people with diabetes, is just one example of an intelligent device. Sensors and connected devices that capture all manner of data are becoming ubiquitous. In the healthcare and fitness sector, the worldwide market for wearable devices is expected to soar from 45 million units shipped in 2015 to more than 125 million by 2019.

Case study: Ayasdi (Accessible intelligence)

A big-data spinoff from Stanford University, Ayasdi uses topological data analysis to visualize extremely complex data sets as shapes. It works with Mercy Hospitals to analyse electronic medical records, generating customized care plans for patients, which can be accessed by physicians and nurses on iPads. Mercy Hospitals estimates this system will save it $100 million over the next three years.


Source: Qmed, “Nurses Want Medical Devices to be More Connected”, 2015

$30 billion

Potential annual savings to the US healthcare system from an effective system of connected devices

$50 billion

Estimated savings to the US healthcare system by 2018 from the wider availability of intelligent devices

400,000

Number of individuals who could be saved from harm annually in the US healthcare system through an effective system of connected devices

Source: Accenture estimate
What healthcare companies and policy-makers must do to survive digital disruption

*Today, delivering consumer health outcomes offers a distinct competitive advantage; soon it will become a catalyst for transformation. Beyond that, it will be nothing less than a strategy for survival.*

The biggest winners will be those that create an enduring customer experience and find ways to be relevant across the value chain. To deliver this next-generation experience, organizations must focus on services that provide a seamless experience, simplicity, coordination of care and trust. To this end, organizations will need the right infrastructure and organizational capability.

**Recommendations for businesses and other stakeholders**

- **Formulate an outside-in strategy**
  The shift from managing inputs as a medical business to delivering outputs as a health business requires a new mindset and strategy.

- **Perform a holistic scan of talent and capabilities**
  Determine the capabilities needed to win in future profit pools. An objective view of existing internal resources (and the gaps therein) will also be needed.

- **Create a culture of iterative innovation**
  Leaders must learn how to fail quickly and cheaply. New market principles will require an iterative approach to innovation.

- **Refocus your portfolio**
  Shift emphasis to the customers or segments that will benefit from disruption and de-emphasize the business areas that are most vulnerable.

- **Explore new business models**
  Some healthcare payers already use a ‘do-it-yourself’ model, teaming up with physicians and building new care-management capabilities.

- **Establish a new business**
  Pioneering organizations establish new businesses that isolate assets from the existing corporate governance structure.

To find out more about the DTI project, visit reports.weforum.org/digital-transformation
What healthcare companies and policy-makers must do to survive digital disruption (continued)

Recommendations for businesses and other stakeholders (continued)

**Invest in resources for the digital era**
Stakeholders need to make bold actions and investments, rather than incremental performance improvements, to build a digital strategy.

**Champion the customer experience**
It’s time to put the patient at the heart of healthcare. Pioneering organizations will put the patient first, competing on price, quality, loyalty and satisfaction.

**Build an insight-driven enterprise**
Use a holistic and pragmatic analytics strategy to deliver business outcomes such as improved revenue generation, customer experience and enterprise-wide performance.

**Become a destination partner and camp**
Creating ecosystems of partners will be critical. Define your business and partner in a way that creates a differentiated service that can be delivered quickly and cheaply.

Recommendations for governments and policy leaders

**Liberate data sources**
Governments should recognize citizens as the ultimate owners of their clinical data and respect their wishes to transfer this data between providers and networks.

**Invest in data standards and infrastructure**
To overcome fatigue in the global IT infrastructure, governments should consider accelerating data governance mandates and data standards.

**Establish interoperability requirements**
Address interoperability first at local, regional and national levels. International organizations should prioritize the creation of a single data-exchange protocol and cross-border clinical data interoperability standards.

**Cultivate the workforce of the future**
Governments will have to cultivate the workforce of the future to meet healthcare demand. Encouraging top-of-licensure activity and the maturation of new education mediums will be important.

**Foster an innovation haven**
Tax benefits for start-ups, urban development and job creation initiatives can help attract and retain talented citizens.

For our full recommendations, please read our in-depth report on digital transformation in the healthcare industry, available at digital.weforum.org.
Acknowledgements

The World Economic Forum would like to acknowledge and extend its sincere gratitude to a broad community of contributors across the private, government, civil society and academic sectors for their participation in the project core team, working group, workshop, survey and interviews.

Working Group
- Javier Lozano, Founder, Clinicas del Azucar
- Hu Bo, Chairman, Ciming Medical Examination and Health Management Group
- Jesus Arenas Wiedfeldt, Co-Founder and Vice Chairman, Grupo Arfeldt
- Yesh Subramanian, Senior Vice-President, Digital Business Strategy & Solutions, Persistent Systems
- Shan Padda, Chairman and Chief Executive Officer, Health Integrated
- Andre Goy, Chairman and Director, John Theurer Cancer Centre
- Greg Anthony, Administrator, Connected Care, Mayo Clinic
- Ramon Felciano, Vice-President, Technology & Strategy, QIAGEN
- John R. Lumpkin, Senior Vice-President, Robert Wood Johnson Foundation
- Sumeet Aggarwal, General Manager; Head, Business Development and Strategic Alliances, Fortis Healthcare
- Bryan Oshiro, Chief Medical Officer, Health Catalyst
- Jessica Beagle, Global Leader, Healthcare and Life Sciences, Amazon Web Services
- Girish KrishnaMurthy, Head, Healthcare Product and Platform, Tata Consultancy Services
- Anya Eremenko, Head, Global Partnerships for Health Search, Google
- Susan Arthur, Vice-President and General Manager, US Health & Life Sciences Industry, HP
- Jianying Hu, Senior Manager, IBM Thomas J. Watson Research Centre
- James R. Mault, Vice-President and Chief Medical Officer, Qualcomm
- Rick Valencia, Vice-President and General Manager, Qualcomm Life
- Andrea Nobili, Corporate Development, Technogym
- Nicole De Cesare, Business Development, Wellness Holdings SRL
- Riccardo Butta, Vice-President, Business Development, Healthcare, Flextrons International
- Eyal Gura, Co-Founder and Chairman, Zebra Medical Vision
- Andrew Thompson, Chief Executive Officer, Proteus
- Ron Gutman, Chief Executive Officer, HealthTap
- Taha Kass-Hout, Chief Health Informatics Officer, FDA
- Tan Yinglan, Adjunct Associate Professor, National University of Singapore
- Jessica Sullivan, Assistant Director of Research at Harvard T.H. Chan School of Public Health
- Michael Hermann, Executive Director, United Nations Population Fund (UNFPA)

World Economic Forum
- Mark Spelman, Head of Future of the Internet
- Bruce Weinelt, Head of Digital Transformation
- Arnaud Bernaert, Head of Healthcare Industries
- Dessislava Dimitrova, Associate Director Healthcare Industries

Accenture
- Anand Shah, Digital Transformation Engagement Lead
- Antti Karjaluoto, Accenture Research and World Economic Forum Secondee
- Anubhav Jha, Accenture Strategy
- Richard Ratliff, Digital Healthcare
- Matthew Collier, Accenture Strategy Healthcare
- Drew Boston, Accenture Strategy Healthcare
- Matthew Robinson, Accenture Institute for High Performance
- Shahir Shroff, Accenture Strategy Value Expert
- Mark McDonald, North America Digital Strategy
- Brian Katz, Accenture Strategy Healthcare
- David Campleux, Accenture Strategy Healthcare
- Mikael Stenstrand, Accenture Research Healthcare
- Phil J. Davis, Accenture Research Healthcare

References
For a full list of sources and references, please refer to our in-depth report on the healthcare industry, available at digital.weforum.org.