The digital revolution in healthcare
How big data and artificial intelligence help patients
The world is going digital. It’s happening everywhere, and we can see it all around us. In fact, we all are living it. We use digital technologies to monitor our fitness levels, track shipments in real time and video-chat with family and friends around the globe. Just like digital technologies enrich our personal lives and interactions, they also revolutionize whole industries and shape the way we see our future – both as individuals and as societies.

Undoubtedly, the future is digital, and for many, it is already a reality. I’ve discussed with my colleagues what the expression “going digital” means in healthcare, as it often means different things to different people. Quite some time ago, I read an interesting post on LinkedIn, which I found helpful. It separates the elements of digitization (making information accessible in digital format), digitalization (using digital technologies in the management of that digital information) and digital transformation – which is to devise completely new business models that serve patients by integrating digital data, processes and technologies.

But for me there is a fourth element that is required and sits behind the success of each of these three ideas: It’s mindset. Mindset is the essential element to make “going digital” revolutionize healthcare. It helps unleash the innovation power that comes with these new technologies. And it helps us embrace the possibilities digital can present with curiosity, courage and appetite for change.

When it comes to digital innovation, generics companies might not immediately come to mind. But in fact, at Sandoz, we nurture an entrepreneurial culture and actively drive the digital transformation of our business to help increase access in many markets – and all this with the goal to find new ways to support growing healthcare needs. For example, just recently, we announced a partnership to launch and commercialize digital therapeutics; we support key stakeholders in using digital capabilities to better serve patients and customers; and we apply advanced analytics to improve our ability to serve certain markets with our products.

We are also supporting people with ideas to improve healthcare access in their local communities through the Sandoz Healthcare Access Challenge, or “HACk.” Last year, HACk generated over 150 ideas from over 30 countries, and we are helping three winners from Ghana, the Maldives and the Philippines to bring their digital ideas to life. Whilst we don’t always have all of the answers, HACk finds people with new and novel ways to improve people’s lives, and I’m looking forward to seeing the next generation of digital solutions when we launch this year.

The world is going digital, and the digital transformation in healthcare is already in full swing. Let’s embrace it, drive it and make it a revolution to the benefit of patients and customers around the world.
The big picture

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Quick view by Dr. David Langer

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Dr. David Langer and his team view a magnified image during brain surgery at Lenox Hill Hospital in New York.
Brain surgery with 3D glasses

“Here, my team at Lenox Hill Hospital and I performed brain surgery using an innovative video exoscope called the Orbeye – a new alternative to the standard operating room (OR) microscope. This new technology offers extraordinarily high resolution in 4K and 3D images of the surgical field, making complex and delicate procedures easier to see – for the surgeon and the entire surgical OR team, and for teaching purposes. Neurosurgery in particular tends to require operations lasting many hours in which surgeons are looking down, necks bent. Now surgeons can sit comfortably and look at a 3D monitor in front of them, and the OR staff is able to view the same surgical view as the surgeon. Although everyone has to wear 3D glasses, this is relatively easy to get used to. What requires practice is watching the screen, rather than your own hands, while you work.”

Dr. David Langer is Chair of Neurosurgery at New York City’s Lenox Hill Hospital, where he specializes in complex cerebral and spine surgery.
One-third of the world's population cook and heat their homes using solid fuels in open fires or with traditional stoves.
“Information about household air pollution can empower families to improve their health and lead longer, more productive lives.”

Kip Patrick, Senior Director at the Global Alliance for Clean Cookstoves
Every day, billions of people put their lives at risk simply by cooking meals. Access to information about smoke-related health hazards and ways to avoid them could change this.

Extinguishing the health risks of open-flame stoves
A woman in rural India cooks on her wood-fired stove, called a *chulha*. Being exposed to household smoke causes serious illnesses.
A black fog hovers over the villages of Odisha, India. The sun all but disappears. These dark skies are thicker at certain times of the day. They are, in fact, precisely when women, with small children sitting nearby, are leaning over a traditional, indoor wood-fire stove, called a *chulha*, to cook food.

For twelve years, this has been how Vandana prepared meals for her family every day. “Everything was black,” she says. “The pots were black. The air was black. It was so smoky that my children couldn’t do homework inside the house,” she adds. “And I used to get sick and cough all the time.” For years, she did not know, or fully understand, that chemical pollutants from this smoke were actually attacking her entire body.

In many regions of India, as well Asia, Africa and the Americas, people cook using open flames inside their homes, or they prepare their meals over low quality kitchen equipment. To create fire, they may use anything from wood, coal, agricultural residue or even cow manure gathered from around their homes. These methods result in an estimated three billion people – one-third of the world population – being exposed to household air pollution (HAP) and put them at risk of serious illnesses. Fumes from substandard cooking are the fourth leading risk factor for all diseases in developing countries, according to the World Health Organization (WHO). A 2014 report from the Lancet Respiratory Medical Commission puts it succinctly: Air pollution is the biggest environmental cause of death worldwide.

The silent, steady danger
People cook this way for a number of reasons. For some, it is because of poverty. Some because they have no access to electricity or cooking gas. And some, as importantly, because they lack information about the dangers of cooking this way. This was the case for Dr. Sola Olopade, who was raised in Nigeria and is now Professor of Medicine at the University of Chicago and a leading pulmonary disease physician. “Growing up, I was aware that people used firewood to cook, but usually it was done in open spaces outside. It was a normal part of the culture. I really had no idea of the ill effects. Now, as a pulmonologist, I’m sensitized to lung problems.”

As the Clinical Director of the Center for Global Health at the University of Chicago, Olopade has been leading research projects about household air pollution in the US and Africa. Originally, he intended to investigate allergies and asthma in rural Nigeria. Once there, he was shocked to find that about 70% of the women were cooking with firewood inside their homes. “For these women, this is normal. Preparing meals this way is expected of them, as it is for many women around the world. Even worse, many of these women were carrying their babies on their backs while cooking.” Newborns and infants are particularly vulnerable to lung disease, Olopade notes, due to their immature lungs and immune systems.

Olopade’s realizations led him to refocus his research. He confirmed an alarming result: Women who are exposed to household air pollution tend to have preterm babies with low birth weight. In comparison, a control group of pregnant women who prepared meals using ethanol stoves, which burn much more cleanly than traditional cookstoves, was more likely to carry their babies to term. “Regarding the maturation of babies, two weeks can make a big deal,” Olopade states. The health risks are also considerable for children. Exposure to household air pollution almost doubles the risk of childhood pneumonia. And among

“Being exposed to household air pollution is worse than smoking 400 packs of cigarettes per year.”

Dr. Sola Olopade, physician at the University of Chicago
children under age five, over half of deaths from acute lower respiratory infections are due to indoor air pollution from household solid fuels.

What Olopade learned affected him so much that he began dedicating a major part of his research to the threat from household air pollution – globally and in his home country. In Nigeria, for example, about 128 million people were still using biomass, coal or kerosene for their cooking needs in 2017. This is the largest region in the world with the population relying on biomass for cooking, and its persistence is deeply worrisome for Olopade. “This type of cooking is killing more people, overall, than HIV, tuberculosis and malaria combined, and these deaths are totally preventable,” he says. “And it’s women and children that have the highest risk.”

One major reason that HAP causes disease is that incomplete fuel combustion contains a mass of dangerous particles and chemicals including black carbon, heavy metals and carbon monoxide. When inhaled, they travel from the lungs into the blood, which leads to diseases. According to WHO, the three main diseases that result from exposure to HAP contaminants are stroke (34%), ischemic heart disease (26%) and chronic obstructive pulmonary disease (COPD, 22%). Combined, these diseases lead to four million premature deaths annually.

“When ultrafine particulate matter from household air pollution enters the body, it causes inflammatory reactions in the airways. The body becomes a war...
As the antioxidant defense system is activated. For a short amount of time, the body can win, but overwhelming exposure leads to generalized inflammation and chronic diseases,” explains Olopade. “The impact of being exposed to this high level of pollutants is worse than smoking 400 packs of cigarettes per year.” Women who cook under these conditions are very likely to develop emphysema, a form of COPD. Among other conditions, emphysema leads to breathlessness and respiratory problems – conditions that are usually found in long-term smokers who are over the age of 50.

Experts agree that people need access to information about dangerous cooking methods. “For many families, this knowledge can help empower them to make better cooking decisions and ultimately, to improve health and lead longer, more productive lives,” says Kip Patrick, Senior Director at the Global Alliance for Clean Cookstoves, a public-private partnership hosted by the UN Foundation. The Global Alliance works to raise awareness about clean cooking and to increase access to cleaner stoves and fuels in places like Odisha, India, and elsewhere around the world.

Preparing medical professionals
To reach people in both rural and urban Africa, for example, the Alliance helps educate doctors about symptoms that result from indoor cooking. “If a woman is coughing and her child suffers from eye issues, the physician needs to be able to recognize that this combination of symptoms is potentially caused by household air pollution,” says Patrick. The physician is then ready to identify if the health issues and the patients’ cooking methods are connected.

Dr. Spencer Jones, Head of Medical Affairs at Sandoz, echoes the importance of providing medical professionals with further education. Jones is a member of the Sandoz Breathe Africa program, which created educational programs for medical professionals in Zambia, Ethiopia and Kenya. For many developing nations, says Jones, the problem is not obtaining medicine. Instead, the challenge is providing medical professionals with the most current and effective treatment strategies. “We spoke to a lot of doctors and nurses. And everyone said, ‘It’s education and access to information we need.’”

Jones says one of the challenges is updating physicians’ medical education. “Doctors may only know the treatments from the time of their studies, but over time, the medical community learns how to manage diseases differently. This is why access to medical information needs to be continuous.” As an example, Jones says, patients may be given oral tablets for asthma, which was the common treatment for acute conditions decades ago. “That patient takes his tablets at a clinic, completes the course of treatment and eventually stops taking the tablets,” Jones continues. “The chronic inflammation underlying the respiratory disease isn’t treated.” With every exacerbation, the patient has an increased risk of mortality. The new standard against chronic asthma is a relatively modern treatment via inhaled corticosteroids, which shows proven clinical evidence in reducing mortality. “So this is the situation we’re in,” he explains. “We have to provide continuous education for local healthcare professionals, according to local and international guidelines.”

Cleaner air via television and technology
The Global Alliance for Clean Cookstoves is also informing the public directly, including through a behavior change campaign and reality television programming in Kenya. “Based on our research, we knew that over 80% of the targeted population regularly watch television and listen to the radio,” says Kip Patrick. To reach families with messages about clean cooking, the Alliance recently launched a TV and radio show called “Shamba Chef,” hosted by Janet Kirina and Melvin Alusa,
Every day, millions of people, including these women in Odisha, India, use firewood to cook, which leads to health problems.
Smoke that kills – Global exposure to household air pollution

All over the world, people cook over open fires and burn solid fossil fuels while doing so. Being exposed to household air pollution (HAP), which is the result of incomplete combustion of these fuels, negatively impacts health.

7.7% of global mortality is due to household air pollution.

4.3 million People per year die worldwide from exposure to cookstove smoke.*

500,000 Deaths per year are due to ambient air pollution caused by traditional cooking.

4th HAP is the fourth biggest health risk in the developing world.

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Sources
http://gameserver.who.int/gho/interactive_charts/profile_exp/exposure/sites.html
http://cleancooking.org

who are well-known national presenters in Kenya. In the show, the hosts travel to different communities to help people renovate their kitchens. “Shamba Chef includes educational information about cooking, nutrition, and household air pollution, as well as the messages needed to motivate households to purchase and adopt cleaner cooking solutions.” Other direct approaches include radio and TV advertising, as well as door-to-door-campaigns and community outreach. “In Ghana, we’ve also created a girls empowerment program with the ‘Ghana Girl Guides’,” explains Patrick. “Young women learn about the dangers of household air pollution and the benefits of clean cooking, and they’re then encouraged to talk to their fellow students and families about it. This way, the Girl Guides can bring information back to their villages, becoming clean cooking ambassadors.”
Cloud-based cooking

Project Surya focuses on financing improved stoves – meaning any stove designed to displace a traditional method of cooking with fire – using wireless monitoring in Odisha, India. Clean stoves are equipped with sensors that measure how long and how often they are used. The data is uploaded to a cloud in real time, so clean stove usage can be analyzed in these homes and communities.

Besides reducing household air pollution, the technique has another long-term, positive effect: “Women receive a small loan to procure a clean cookstove. When using the stoves regularly, they receive usage-based payments from a climate fund for the carbon emissions they mitigate,” says Erin Ross from Nexleaf Analytics based in Los Angeles, California. This enables even extremely low-income women to afford clean cookstoves. “As a result, women who change their cooking behaviors experience financial inclusion.”

Much has already been achieved in Odisha. “Some of the women in Odisha have stopped using their traditional stoves,” says Ross. “One woman dismantled the old cookstove completely.”

The work to be done

Like other experts, Dr. Spencer Jones from Sandoz says the global situation is changing, if slowly. “Access to medical information and building capacity locally is crucial. In Ethiopia, we collaborated with the Minister of Health.” The program was a success, and during this process his team raised the level of attention to respiratory health within the Ministry. “If we speed up access to medical information globally, that’s the thing I would like to encourage everyone to do.”

Kip Patrick agrees. For all of the progress that has been made, black cooking smog continues hovering over areas of Odisha and thousands of communities around the world. Increasing access to information – whether how to cook safely, how to access cleaner cooking solutions or how to treat those who are already ill – must continue. “Residents inside homes, and entire communities, are still inhaling toxic cooking smoke,” Patrick notes. “It’s happening, even now, right as we speak. And we have to work together to stop it and to ensure cooking no longer kills.”

Household fuels in India (2013)

Some 166 million households in India still use traditional fuels for cooking, primarily in rural areas.

By 2020, medical data is expected to double every 73 days. Using such data will increase access to healthcare in many ways.
“We are on the verge of a digital revolution across every aspect of the healthcare sector, from the lab bench to the patient’s bedside.”

Vas Narasimhan, CEO Novartis
How digital tools are improving access to healthcare

Through interdisciplinary partnerships, digital technologies such as artificial intelligence affect every aspect of how people access medical services and treatment – and they’ve already begun helping patients worldwide.

Heat kills. In one of the deadliest weather events in Europe in the past century, a heat wave in August 2003 killed nearly 15,000 residents of Paris – in less than two weeks. Thousands of patients with heat-related conditions crowded emergency
From diagnosis to treatment, digital tools have already changed the way healthcare professionals work.
rooms and strained hospital admission capacities. This also happened during a summer vacation month, when fewer staff members were available. The physicians, nurses and other healthcare workers on duty were pushed to their limits. Despite emergency mobilization of healthcare resources, 42% of the city’s heat victims died in hospitals. Better hot-weather preparedness by hospitals might have saved lives.

To better anticipate emergency peaks, as well as to more effectively manage daily hospital operations, the question arises: Is it possible to forecast the number of patients coming to a clinic on a given day – or even in a specific hour – the way meteorologists forecast the weather? This is what four clinics in the Assistance Publique-Hôpitaux de Paris, Europe’s largest university hospital, are testing right now. The clinics wanted to improve access to medical care for patients by reducing waiting times and making optimal use of their existing staff. So technology company Intel helped them develop an analysis system that predicts emergency visits and hospital admissions for the coming 15 days each month. The project is based on a massive, anonymized data base of 470,000 patients that has been collected for more than a decade. Then data scientists combined this information with external factors like flu rates, seasonality and temperatures in Paris. Should all of the tests be successful, a computer will help keep emergency room staff optimally ready and patients better cared for.

Digital technologies and big data offer holistic solutions for patients that lead the way to personalized medicine.

“A big data revolution is under way in healthcare.”


Potential
Increasing every aspect of patient access

When talking about the digital future of healthcare, some patients think of sci-fi scenarios such as robotic nurses. But as with computer models that predict emergency admissions, the biggest changes are already taking place.

“We are on the verge of a digital revolution across every aspect of the healthcare sector, from the lab bench to the patient’s bedside,” says Vas Narasimhan, CEO of Novartis, of which Sandoz is a division. He sees opportunities to provide patients with new, improved and more holistic solutions that lead to better outcomes and also help reduce the burden of illness. “Digital technologies and big data are changing every aspect of how companies operate, across myriad industries,” adds Narasimhan.
Interdisciplinary partnerships with tech giants such as IBM, Apple and Google make big sets of health data accessible in real time. What might sound like sci-fi scenarios hold huge potential for all aspects of medicine.

Physicians, researchers and a plethora of business leaders echo this sentiment. “A big data revolution is under way in health care” is the key sentence in a report by global consulting firm McKinsey. Bringing big data to healthcare is a combined effort that includes interdisciplinary partnerships with tech giants such as IBM, Apple and Google. Such companies work with healthcare organizations so that patients benefit directly from computing power. Put simply, when big data – huge amounts of data – is processed using artificial intelligence and software that “learns” how to apply the data, medical care takes a quantum leap forward. Reducing waiting time in the hospital is just the beginning of how patients experience these systems. Perhaps paradoxically, the more data systems collect from people, the better they can tailor individual diagnosis, drug development and choice of treatment. And the applications reach into patients’ everyday lives when they use digital devices to monitor their own conditions: They can actively contribute to their care or help prevent diseases in the first place.
Artificial intelligence (AI)
In 1966, scientist Marvin Minsky defined AI as “the science of making machines do things that would require intelligence if done by men.” AI is applied colloquially when a machine mimics “cognitive” functions that humans associate with natural intelligence, such as learning and problem solving.

Cognitive computing
Cognitive computing is technology platforms that encompass machine learning, reasoning, natural language processing, speech and object recognition and human-computer interaction via dialogue. The goal of these platforms is to simulate human thought processes in a computerized model.

Big data
Big data is data sets that are so voluminous and complex that traditional data processing application software is inadequate to deal with them. This is where Machine Learning is applied. Data sets grow rapidly – in part because they are increasingly gathered by inexpensive and numerous information-sensing Internet of Things devices.

Personalized medicine (or precision medicine)
Personalized medicine is a medical procedure that tailors medical decisions, practices, interventions and treatment to individual patients based on their predicted response or risk of disease.

Diagnosis
Intelligent systems save lives
When a patient displays a combination of symptoms, physicians rely on their training, experience and usually also on medical equipment to diagnose the condition. For diagnosing heart diseases, for example, cardiologists have relied primarily on echocardiograms. As the diagnosis is based on a limited range of factors, they are only correct in 80% of cases, according to researchers at John Radcliffe Hospital in Oxford, UK. This means a diagnosis may miss imminent heart attacks, or it may lead to an unnecessary operation.

The Oxford researchers aim to reduce some of the uncertainty of diagnosing heart disease. Their system, Ultromics, whose solution is based on artificial intelligence, analyzes 80,000 data points from every image and increases the diagnosis accuracy to 90%. These machine learning models are fed with information from one of the largest heart imaging databases in the world, which is stored at Oxford University. The system, which is planned to start in 2018, could save the UK’s National Health System GBP 300 million a year by making the diagnosis of heart diseases more reliable.

When making a diagnosis using digital data, artificial intelligence systems might have access to millions of patient cases. This can save an individual patient’s life, as in the case of a 60-year-old woman in Japan. At the University of Tokyo in Japan, IBM’s computer system Watson helped physicians to compare the gene sequence of this woman with 20 million clinical oncology studies from a database. As a result, the doctors diagnosed a rare form of leukemia in the woman, and they were able to provide her with a successful therapy. Before this, the woman hadn’t responded to treatments based on conventional diagnosis. Reportedly, Watson needed just 10 minutes to analyze the woman’s form of leukemia. Success stories like this raise hope in researchers and patients all over the world that digital healthcare will help to find a cause – and cure – for their conditions.

Treatment
Cognitive computing improves care
For some patients, for example, following a cancer diagnosis, a long, hard treatment road lies ahead of them. Here, the right combination of therapy approaches can go a long way. This is why Novartis started an initiative to optimize cancer care. The company has joined with IBM Watson Health to explore development of a cognitive solution that uses real-world data and machine learning (see interview, page 26). The common aim is to provide better insights on the expected outcomes of breast cancer treatment options.
Through this collaboration with IBM Watson Health, Novartis will use real-world breast cancer data and cognitive computing to identify solutions that may help physicians better understand which therapy may be best for which patients, and what information is useful for establishing clinical practice guidelines. The goal is to improve patient outcomes and experiences. This collaboration might also uncover care efficiencies that can be applied beyond breast cancer.

R&D
Increasing access to new and better medicines
In many therapies, to relieve symptoms, manage conditions or fight the underlying causes of various diseases, patients rely on medications. And it is in pharmaceutical development where the potential of big data and artificial intelligence really unfolds. Digital technologies, says Novartis CEO Narasimhan, has tremendous undiscovered potential to transform the research and development of medicines. Because databases store extensive data on chemical substances, these can be analyzed to suggest novel therapies, such as for rare diseases. His vision: “Digital solutions can democratize the research process for new medicines by helping us reach previously underserved and understudied groups of people. Ultimately, we can bring new and better medicines to patients who need them.”

The key to developing the next-generation oncology medicine for patients with cancer, for example, may be found by gaining better understanding of the molecular interaction of peptides and proteins. In one project, researchers at Novartis are using different methods of machine learning to predict the docking of compounds with protein targets. And thanks to virtual reality, scientists can even explore the interplay between compound and target in vivid detail. In another project, a Novartis partnership with the University of Vienna, cognitive computing plays a role in trying to help patients with diabetes- or age-related diseases of the retina. This has led to the discovery of two novel biomarkers. When these are present, physicians will be able to predict retinal conditions one year before a noticeable onset of disease. This ability will allow healthcare professionals to intervene earlier with therapy or medication to reduce acute-care episodes.

Stringent clinical trials accompany the development of pharmaceuticals. Here, too, digital solutions help to democratize the research process. In 2015, hardware giant Apple demonstrated to the public that smartphones have become a serious measuring instrument for medical studies. The company revealed a new software platform called ResearchKit that helps researchers enroll an unprecedented number of participants in their studies. The platform collects medical data on conditions including rheumatoid arthritis and concussions. ResearchKit also allows scientists to program apps that take surveys, give patients tasks and use smartphone sensors that track users’ wellbeing.
Prevention
On the way to personalized healthcare

Smartphones also host a range of apps that allow patients to collect and monitor their own health data. Yet collection is nothing without collaboration. “All the progress we see in multiple therapeutic areas is only possible with the data that is accessible,” says Dr. Spencer Jones, Head of Medical Affairs at Sandoz. “If we stop sharing health data, we stop innovation.” Jones is an ambassador for digitalization in healthcare because of the potential that technology and computing models offer. “AI solutions rely on huge data sets – imagine if we could monitor and collect all data relevant for our health,” Jones adds.

And this volume is enormous, indeed. Today, each person will generate enough health data in their lifetime to fill 300 million books. More data has been created in the past two years than in the entirety of human history – and by 2020, IBM expects medical data to double every 73 days. Now, for the first time, humans have the technical possibilities to process all of this data.

What are the possibilities for the future of medicine when researchers have access to more health data? This vision is currently being followed by a large-scale and first-of-its-kind study named Baseline. With the goal “to map human health,” Google and the health tech division of its parent company Alphabet, Verily, have teamed up with Duke and Stanford Universities to monitor around 10,000 volunteers (currently in the US) of different ages, backgrounds and medical histories for a four-year study that started last year. All participants wear a fitness tracker that transmits their heart rates, movements and other information to a central database. A sensor below people’s mattresses monitors their sleep patterns. In addition, Verily also collects genomic data, as well as information on participants’ feelings, health records, family histories and the results of periodic lab tests on
Cloud-based cognitive systems compare the patient's data with ...

Billions of DNA samples
Drug databases

Millions of pages of medical publications, studies and clinical records

Saving lives by predicting malaria outbreaks

With help from the latest data tools, scientists pinpoint the location of potential malaria incidence.

Data from the World Health Organization shows general sensitivity to outbreaks.

The addition of population models (including humans and mosquitoes) narrows down risk areas.

The integration of climate data for temperature and precipitation can more accurately pinpoint potential outbreaks.

These model results make it possible to predict where disease incidence is most likely to increase or decrease.

Public health organizations can then be informed, and specific intervention strategies can be developed in locations where they can have the greatest impact.

urine, saliva and blood. And monitoring environmental clues, such as home temperatures during heat waves, could save lives, too.

Whether predicting hospital admissions peaks in Paris, making genome-based diagnoses in Tokyo or discovering biomarkers in Vienna, digital solutions have the potential to change every aspect of medical service. Jones goes one step further: “If we can predict diseases and severe conditions, we can prevent them before they happen.” In the history of medicine, he explains, the order always used to be disease, medicine and then patient. “Digital tools turn this order on its head.” Dr. Jones and other experts believe that the digital healthcare revolution will affect how people access – or even define – healthcare. From the lab bench to the bedside, the patient will come first and remain solidly at the center of medical care.

Assisting doctors to make the right decisions

IBM Watson Health makes use of cognitive computing for various medical areas. Dr. Eva Deutsch explains how this works.

How is artificial intelligence changing healthcare?

At IBM, we prefer to say ‘augmented intelligence’ and not ‘artificial intelligence.’ This is because cognitive systems like IBM Watson support people, but they are not intended to replace them. In medical contexts, Watson sifts through billions of pieces of unstructured information and finds patient-relevant information, distills and summarizes this information and makes it available to the physician. Significantly, it makes connections that are not retrospective, but future-oriented. This predictive modeling gives us a completely new way to analyze large data sets, such as those typically found in medicine.

How is cognitive computing useful?

What is useful for the healthcare industry is that this system can understand medical terminology and scientific language, such as chemical compound structures. Add to this millions of studies, clinical guidelines, disease patterns, patient cases and treatment options. Watson evaluates all of this information to produce a hypothesis. Here, the IT system is more objective than humans. When people come up with a hypothesis, they try to prove that their idea is correct. When Watson draws a logical conclusion – a diagnosis or treatment method – it nonetheless reasons through other options. And it keeps
on learning from any mistakes as well as successes, and becomes a specialist in a range of disciplines.

**How does Watson get patients' details?**
Using natural language is key. Watson can communicate with patients, even with children. We have taught Watson nine languages (English, Spanish, Brazilian Portuguese, Japanese, Arabic, Korean, Italian, French and German), and it can now speak with a billion people in their native languages. Watson can also read or listen to patient stories. Additionally, it can search patients' social media entries, as well as audio recordings and videos. IBM is working on teaching Watson to integrate patient images, such as mammograms, CT scans and MRIs.

**Do computers diagnose better than physicians?**
Even cognitive systems only deliver computer science. IBM Watson for Oncology, for example, does not diagnose cancer. Watson does not actually diagnose anything. Instead, it analyzes large amounts of existing data to help doctors make informed treatment decisions. And physicians can interact directly with the system through dialogue. In one application, IBM Watson for Oncology discusses various proposals with doctors – so it is basically offering a second opinion. Watson and other cognitive systems are only assistants that support human experts. Doctors and nurses make decisions that are best for their patients, and they always have the last word. Computers cannot replace the emotional and social side of people.

**Are patients now just ‘data sets’?**
On the contrary. Having a condensed, comprehensible version of disease patterns, patient details and potential treatments available quickly relieves doctors and nursing staff, and gives them more time for conversations with patients, and for patient care. And as we move toward "precision medicine," we will need to detect even more exactly the specific parameters and properties of each patient, including genome, environmental and lifestyle data. The emphasis of cognitive systems lays not in searching, but rather, in finding. Search engines uncover resources, such as studies and potential treatment options, yet cognitive software goes further, by processing relevant information and recognizing connections. Only in this way will access to better patient care and higher therapeutic success be possible in the future.

**Will cognitive computing decrease physician-patient interactions?**
Not decrease, but optimize. Studies show that patients today go to the doctor more often, and they also tend to consult several doctors, such as medical specialists. So doctors need to care for a larger number of patients. Reading up about each affliction and treatment is simply impossible in the short amount of time available. A computer does not have such time limitations. More importantly, it never forgets. Information that a computer has read once remains stored and can be called up again at any time. The IT system can quickly identify symptoms or disease patterns that otherwise only top specialists, who have accumulated years of experience, might recognize.
Perspective

A digital disruption in pharma

How advances in technology are improving access to healthcare.

Digital technologies and data science have incredible potential to unlock the next chapter of medical innovation. The companies that will be most successful are those that view this transformation as an opportunity rather than a challenge; and the leaders will be those who fully embrace the power of data and emerging digital technologies.

In the long run, artificial intelligence (AI) is set to transform the way the pharmaceutical industry operates. As part of the overall data analytics revolution, it could change the way we do business – including R&D, evaluating drug trials and generating real world evidence.

I believe that robotic surgery, fully personalized medicine and tailored disease management will one day be commonplace. There is still a way to go before we get there. Soon, however, we will see the full power of data analytics in action, particularly in clinical trials and healthcare delivery.

When looking at the healthcare sector overall, we see potential across the board.

From a patient perspective, I think the biggest and most exciting opportunity is for individuals to finally take control of their own health in a meaningful way. Digital technologies will offer them better access to their own medical data and the ability to share it easily with those they trust. And new applications will enable them to measure key healthcare indicators in real time, to better manage their conditions. As the healthcare industry adopts data analytics, I think pharmaceutical companies will be among the key players. We are already seeing new entrants including tech giants Apple and Google, who are evaluating healthcare-related opportunities, while Amazon is considering entering the pharmacy distribution chain.

Within the pharmaceutical sector, using and digitizing existing data can make drug trials faster, more accurate and more efficient.
At Sandoz, we see two main applications for digital. We are looking at ‘digital transformation’ of the way we work. And we are investigating in ‘digital enablement,’ using existing technologies for incremental improvements in areas such as e-commerce. Specifically, Sandoz is embarking on three cross-divisional “digital lighthouse projects.” Most immediately, in a recently-announced collaboration with Pear Therapeutics, Sandoz will commercialize two prescription software applications, the first of several planned projects in the field of digital therapeutics. In a second project, Sandoz is developing a holistic service offering including a technology platform. This will help Sandoz become a strategic partner for key stakeholders, supporting them on their journey to improve their digital competency. A third project involves using AI to improve commercial efficiency in key markets.

All this is part of a broader digital revolution being undertaken by our parent company Novartis, which it believes could increase engagement with patients, accelerate drug development and improve access to treatment. Although the pharmaceutical industry has not always been the fastest mover in the digital field, the potential for rapid progress now – potentially even ‘skipping a generation’ in technology terms – is enormous.

Along the way, the healthcare industry will have to clear a row of hurdles to achieve a faster uptake of disruptive technologies.

The first obstacles are the technologies themselves. Other obstacles include legal and ethical issues – for instance, around the appropriate use of patient-related data – and these should not be underestimated. Some people are afraid of their health data being misused, and we cannot ignore these worries. However, there are good, practical solutions to such concerns. For example, we believe block chain technologies will play a key role. They offer an inherently secure way to ensure that large amounts of data can be shared without risk of unauthorized modification or alteration.

More generally, we should not neglect the human factor – it is one thing to roll out smart new apps to drive compliance, but it’s something else to make sure the majority of people keep using them once the initial ‘thrill’ has worn off. This ranges from improved diagnostic equipment (at the macro level) to smaller innovations that are already driving access to healthcare at the local (micro) level, particularly those based on mobile technologies. They are making a real difference.

When looking at the big picture, we should not underestimate small, local, technology-driven solutions.

One of my favorite examples comes from the co-winners of our Sandoz HACk competition 2017. They are linking islanders in the Maldives with a database of local hospitals, using geolocation alerts to promote blood donations that can save the lives of children with the blood condition thalassemia. For the pharmaceutical industry, we see great potential in the long run for such technology-based solutions that go ‘beyond the pill.’

Moving ‘beyond the pill’ means embracing innovative developments that improve access and actually change patient outcomes.

Sandoz will continue to develop and sell medical products and services. Yet digital technologies can significantly change the nature of the products and services we offer. New digital therapies also have the potential to fundamentally change the way patients interact with their therapies and, thus, improve patient outcomes. For me, within the overall framework of the data analytics revolution, artificial intelligence clearly has the largest potential for improving access to healthcare in the future."
Anti-smoking campaigns, such as this one at a primary school in the city of Handan, aim to reduce cases of lung cancer in China.
“There must be a global willingness to think out of the box, so we can tackle the NCD epidemic.”

Sania Nishtar, M.D., former Federal Minister, Government of Pakistan, and Co-Chair of the WHO Independent Global High-level Commission on NCDs
Education and access to medical information are important strategies for preventing NCDs such as cardiovascular and respiratory illnesses.
Fighting the world’s biggest killer

Noncommunicable diseases such as diabetes, cancer, cardiovascular and respiratory diseases cause tens of millions of deaths annually. To stop this global pandemic, all societies must develop a range of strategies. Among these, access to generic medicine plays a key role.
In 1990, to begin tackling a growing global health burden, researchers made a significant decision: They gave the problem a name. The group of maladies covered by their new term, first mentioned in the premier “Global Burden of Disease” study, are difficult to define. They include diabetes mellitus type 2, back pain, cancer, genetic disorders like Down syndrome, cardiovascular disease and a number of other illnesses. For this wide range of afflictions, the authors used the term “noncommunicable diseases” (NCDs) – which is, for UK doctor Luke Allen, part of the problem today: “The name is a long-winded non-definition. It only tells us what this group of diseases is not. It is not befitting of a group of diseases that now constitute the world’s largest killer,” says the general physician and WHO advisor, based at the University of Oxford. Allen wants to raise awareness about the significance of NCDs, which is why he published a highly regarded commentary in the renowned journal The Lancet last year. His aim: to see the name of this disease group changed – and it’s not to be fussy about language. Allen wants to foster a “debate around interventions that stand the best chance of stemming the pandemic.”

Main types of NCDs

The group of noncommunicable diseases includes various conditions, but four main types account for more than 80% of all deaths from NCDs worldwide.

<table>
<thead>
<tr>
<th>Type</th>
<th>Number of Deaths Annually in Millions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cardiovascular</td>
<td>17.5</td>
</tr>
<tr>
<td>Cancers</td>
<td>8.2</td>
</tr>
<tr>
<td>Respiratory diseases</td>
<td>4.0</td>
</tr>
<tr>
<td>Diabetes</td>
<td>1.5</td>
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</tbody>
</table>

High blood pressure is the leading risk factor for cardiovascular disease. Worldwide, the number of adults with high blood pressure increased from 594 million in 1975 to 1.13 billion in 2015.
more funding than chronic conditions – although 30 times more people suffer and die from NCDs than from HIV, as Allen notes, adding: “We need to make the public more aware of NCDs.”

**Globalization of Western lifestyles favors NCDs**

Experts know ways to improve the situation. One approach is to give more people access to affordable medicines for these chronic conditions. Another is to provide access to information and medical consultation, so people can focus more on prevention. This is particularly important because 80% of deaths from NCDs are caused by four disease clusters: cardiovascular diseases, cancers, chronic pulmonary diseases and diabetes. All of these diseases are linked to four behavioral risk factors: tobacco use, excess alcohol consumption, poor diet and lack of physical activity.

A central problem is that ‘Western lifestyle behaviors’ have become commonplace almost everywhere in the world, carrying with them a related increase in NCDs. However, focusing on personal choices will have little effect if society and policy do not change in parallel, says Allen. “In many low-income countries, risk factors have increased. Cities are crowded and polluted. Many workplaces require people to sit all day. At the same time, the availability and acceptance of unhealthy foods, tobacco and alcohol rises.”

Allen believes that NCDs are, in fact, partly or wholly communicable, with socioeconomic factors including urbanization, industrialization and poverty...
among the key determinants. Poverty, for example, restricts access to healthy foods. Allen has based his career on making societies healthier, and points to governments’ role in reducing NCDs. Mandating smoke-free workplaces, or regulating sugar, salt and trans fats in processed foods, are possible interventions at this level. Changes to societies, he says, could prevent chronic diseases and save lives.

Since many Global South countries have focused on countering infectious diseases rather than NCDs in recent decades, they often have little experience in preventative measures and limited access to the specificities of medical care for fighting non-infectious, chronic diseases. And there is another factor: Modern medicine has helped lengthen average human life expectancy. In less than three decades, it increased by six years, globally, to 73 years. Because people everywhere are getting older, they are living long enough to develop chronic conditions. Consequently, the number of NCD cases globally has risen rapidly.

Today, almost 75% of all NCD deaths occur in lower-income countries. India, for example, reported over 72 million cases of diabetes in 2017. It is also the country with the highest diabetes rate worldwide. Back in 1990, 15 out of every 100,000 Indian citizens died of diabetes. Today, this number has increased to 26 out of every 100,000 citizens. In comparison, Japan – a high-income country – has had a decrease in the number of its population dying from diabetes, with a reduction of 8 to 7 per 100,000 citizens during the same period.

In countries without primary healthcare, chronic diseases can lead to a vicious cycle: People become ill and spend money on expensive treatments. As a result, they also become poorer, with less money for further treatments and then become even sicker. This cycle pushes millions further into poverty. Widespread access to affordable medicines can help tackle this problem.

The key to saving millions of people
“Promote procurement and use of safe, quality, efficacious and affordable medicines, including generics...” is one measure that WHO proposes in its “Global Action Plan for the Prevention of NCDs 2013–2020.” Generic medicines contain the same active ingredients as a brand product whose patent protections have expired, but they typically are much more affordable. Sandoz aims to help people around the world access high-quality medicine in different therapeutic areas – such as in oncology. “The worldwide demand for oncology treatments is increasing,” states Peter Stenico, Head of Sandoz Oncology. “We provide basic cancer medicines to nearly every country of the world. We have a comprehensive portfolio that supports us as the market leader in this global undertaking. And we are aware of the responsibility that this position brings with it.” Not only is Sandoz the global leader in generic oncology medicines; the portfolio covers more than 70% of WHO’s Model List of Essential Medicines for cancer.

“The name is a long-winded non-definition. It only tells us what this group of diseases is not. It is not befitting of a group of diseases that now constitute the world’s largest killer.”

Dr. Luke Allen, WHO advisor
“Our program provides 15 medicines – mainly from Sandoz – against key chronic diseases. Capacity-building also serves to strengthen healthcare systems in these lower- and middle-income countries.”

Dr. Harald Nusser, Head of Novartis Social Business

offer reliably high-quality medicines, manufactured according to the highest quality standards,” says Stenico. Furthermore, Sandoz has been participating in global partnerships to make its medicines accessible even in developing nations.

**Encourage individuals to make healthier choices**

To tackle the further prevalence of NCDs, many countries have established strategies against the main risk factors in the last ten years. Stricter laws at a national level, like alcohol control measures, smoking bans and increases in tobacco tax have been key strategies in countries around the world to raise public awareness and promote societal changes. Such measures, says WHO, are meant to encourage individuals to make healthier choices and reduce the risk of developing NCDs in the first place. Nevertheless, notes Stenico, once a person develops a chronic disease, it is seldom completely curable – but, generally, it is treatable. “Here, the right – and early – diagnosis and affordable medication is key,” he adds, “which is why capacity building is crucial in low-income countries.”

To support lower- and middle-income countries (LMICs) in their fight against chronic diseases, Novartis launched Novartis Access, a program run by the company’s Sandoz division. “Our program provides a portfolio of fifteen medicines against key chronic diseases, mainly from Sandoz, and capacity-building activities to strengthen healthcare systems in LMICs,” explains Dr. Harald Nusser, Head of Novartis Social Business. These medicines address cardiovascular diseases, type 2 diabetes, respiratory diseases and breast cancer and are offered at a cost of USD 1 per treatment, per month, to governments and NGOs. The first country to launch the program was Kenya in 2015, and today, the program is being rolled out in six countries. “In just two years, we have delivered 800,000 treatments to approximately 400,000 patients. We plan to roll out Novartis Access to 30 low- and lower middle-income countries over the coming years,” adds Nusser.

The battle against the world’s largest killer goes on – and its name remains the same until further notice. When WHO advisor Allen called publicly for alternatives to the term “noncommunicable diseases,” he received dozens of suggestions. “These responses demonstrated that no one has a very good grasp of what NCDs actually are in the first place,” he says. Overall, Allen sees his call as a success. “By proposing a coherent and internationally significant narrative, we hope to stimulate greater action on the major drivers of the world’s most important conditions.”

This outcome could not be more crucial. No matter its name, the group of illnesses currently known as noncommunicable diseases are continuing to kill more than 75 people every minute. Raising awareness is one part of the multilevel approach in fighting this global burden – building system capacity and access to effective, affordable medicines are the other elements needed to fight the world’s biggest killer.
“We have the knowledge to reverse the NCD epidemic”

To defeat noncommunicable diseases, interventions must change behavior, says Dr. Sania Nishtar.

Are noncommunicable diseases more dangerous than infectious diseases?
The NCD epidemic has spread silently, which makes it especially dangerous. But this is not a question of either-or. Infectious disease threats are equally pressing. I would say infectious outbreaks and emergencies with health consequences, along with NCDs, are the biggest immediate threats to the collective health of people worldwide.

How important is access to information and medicines?
Educating people about how best to prevent, screen and treat NCDs is key to halting the epidemic. Here, we need to draw on behavioral science. Billions of people are connected with mobile devices, so processing power, knowledge access and data portability all converge. This could transform individual behaviors and disease management.

Yet access to medicines remains crucial. There are many national and global responsibilities. Countries can increase access through NCD-appropriate Universal Health Coverage policies; the inclusion of NCD-related medicines in the National Essential Drug lists is the bare minimum that can be done.

What role do pharmaceutical companies play?
They are very important. The achievements made through infectious disease partnerships of the 1990s is evidence of what is possible.

What measures can prevent or control NCDs?
There must be a willingness to think out of the box. We need interventions that have transformative potential. For example, if the borrowing costs of countries depended on their human development rankings, ministers of finance and heads of states would pay attention to NCDs. A shift in country planning could ensue.

What will the global situation for NCDs be like in 20 years?
Never in the history of public health has there been a wider chasm between knowledge of burden of disease and how to address it versus lack of appropriate action. We have the knowledge to reverse the NCD epidemic. The global situation in 20 years depends not just on our commitment to tackle it, but also the willingness of public and private groups to work together.
In Ghana, a child has a 10%–20% survival rate, whereas in developed countries the odds of surviving are 80%, according to World Child Cancer.
“We can make an impact for children with cancer. If we can help them and we know how, we have a moral imperative to do so.”

Jon Rosser, Chief Executive, World Child Cancer
Pediatric oncologist Dr. Cathy Segbefia treats children with cancer at Korle Bu Children's Hospital in Accra, Ghana's capital.
Making a difference for children with cancer

As countries develop, access to healthcare may not improve evenly. In the West African nation of Ghana, gaps in access have left children with cancer and their families vulnerable. World Child Cancer is using a multi-level approach to change this.

In a large, open room at Korle Bu Children’s Hospital in Accra, Ghana, a mother sits on one of the cots; her daughter, Rebecca, leans against her. “For months, Rebecca had been weak,” the mother, Charlotte, explains. In their village, they treated Rebecca for malaria; when that didn’t work, they tried treating her for dengue. “Rebecca only got worse,” Charlotte says. As time passed, Rebecca could not eat nor walk. After advice from a regional nurse, Charlotte borrowed money to pay for a hired car to bring them to the city of Accra, specifically to Korle Bu, which is a teaching hospital. They wanted an answer. They got one they did not fully understand, yet feared: cancer. With the diagnosis came new worries, her mother explains: “Will Rebecca’s treatment even work?” And how to pay for it, find a place to stay, make up for missing time from work? After the diagnosis, Rebecca’s father disappeared; her brothers and sisters had stayed behind in their village, and they, too, needed care.

As her mother speaks, Rebecca continues leaning against her. She knows the story, of course. But neither she nor her mother know how the story will end. This is a situation no parent wants to be in, no child should be
aware of. Charlotte pauses. Despite everything, she says firmly, they are still here at Korle Bu, and “there is hope.”

Five among millions
There have been significant odds against a Ghanaian parent or child patient feeling hope. While the nation’s healthcare system, including in pediatric oncology, has made progress, much more needs to be done. One clear example where more work is needed is the lack of medical capacity: In Ghana’s current population of over 27 million, there are only five children’s oncologists in total.

Dr. Cathy Segbefia, a pediatric oncologist at Korle Bu, is one of them. She explains that Rebecca’s situation is common, and so are her mother’s fears. Alongside her colleagues, Segbefia’s responsibilities are not only medical: “A lot of the work we do is education – with patients as well as with caregivers and other healthcare professionals.” Many families don’t know what to do after their child’s cancer diagnosis, and they need basic information about the disease. “We are trying to educate them and provide information, so patients come back and remain with their treatment.”

She, alone, may see up to 50 patients a day, and sometimes more due to emergencies. “I’m thankful to meet the patients and families,” she says. “They give me purpose. I know they can be helped, and I know I am able to give that help.”

Her work remains difficult, however, not the least because of outcomes. “In developed countries, 80% of children now survive a cancer diagnosis, but in developing countries like Ghana, it’s still only about 10%,” explains Jon Rosser, the Chief Executive of World Child Cancer, a London-based non-profit that supports Korle Bu and hospitals in other developing countries by improving access to quality treatment and support for children with cancer and their families. “In our programs, we can already raise that survival rate to around 60%.”

The geography of cancer
Rosser and his colleagues face a complex task in improving outcomes in Ghana. Compared to some West African neighbors, the nation is prosperous: It is lauded for rising annual GDP, a stable democracy, increased educational opportunities as well as lucrative natural resources. The nation’s overall development has been so strong that by 2012, a Guardian article was titled “In Ten Years’ Time, Ghana May Not Require Any Aid at All.”

Six years on, the title does not seem as realistic. “Much more needs to be done in Ghana,” says Peter Stenico, Global Head of Oncology at Sandoz, “but this nation is not at the top of the list regarding international aid.” According to 2016 OECD data, Ghana received only about 2.8% of international aid for Africa. Ghana’s 2017 international aid – USD 1.662 billion – is almost equal to its ten-year average amount (USD 1.621 billion), despite a population increase of six million people during this time.

Ghana’s rising GDP does not cover the gaps in international aid – and this underfunding is worsening the healthcare access situation in the country. Perhaps the most visible and dramatic consequence of this uneven access is a lack of proper diagnosis and treatment of cancers among children.

In 2003, Ghana created the National Health Insurance Scheme (NHIS), which covers approximately 10 million people. Almost 70% of the members pay no premiums, including the elderly and children under 18. The rest cover for the rising healthcare costs in the country. However, children’s cancer treatments are not covered by the National Health Insurance. An official at the NHIA, the insurance program’s governing agency, cited the reason as the “high cost of treatment” which could lead to the “collapse of the
Dr. Lorna Renner (right) was the first pediatric oncologist in Ghana. She has dedicated her life to helping children with cancer and their families.
Where funds or facilities may be lacking, dedication is all the more visible in Ghana. Here, a caregiver attends to a child with cancer in the hospital ward.

Dr. Tim Eden, a patron and founder of World Child Cancer. Along with partners, this organization has helped save the lives of dozens of children in Ghana. But survival rates can still be increased.
whole (health insurance) system.” The estimate for treating a common childhood cancer like lymphoma is about USD 400; a kidney or eye cancer treatment is estimated at about USD 910. For many Ghanaians, where the per capita income is USD 4,600, these out-of-pocket costs are already steep. And for many Ghanaian families, the total treatment costs – which means medicine as well as travel expenses, temporary lodging, time-off from work and childcare for other family members – makes treatment prohibitive.

Professor Tim Eden, a patron and founder of World Child Cancer, notes, “Even today, we still only see about one-third of the children we expect to.”

Finding solutions – and then finding more of them
Jon Rosser, Tim Eden and the World Child Cancer team have been working to make immediate changes to the low survival rate in Ghana and other developing countries. To accomplish this, World Child Cancer works in two ways. First, the organization creates and maintains twinning partnerships between cancer wards in hospitals of developed and developing nations. World Child Cancer also provides direct support for medical facilities in Ghana. This means funding access to essential medicines and services which would otherwise not be available – from chemotherapy supplies to nutritional supplements, as well as transportation costs, community awareness initiatives, medical equipment and even essential staff roles. “And to reduce the most common cause of initial treatment refusal or failure to complete treatment, namely lack of family finances, we have provided subsidies for some medicines,” Tim Eden adds.

In 2016, Sandoz began funding a pilot program to support World Child Cancer’s efforts in the Philippines; the program expanded in 2017 to additional nations, including Ghana. “In a country like Ghana, the whole access issue is more than medicines. It’s about creating awareness, then building capacity and then only comes medicines,” adds Sandoz’s Peter Stenico.

Improving all areas of access
The first area of access that must be developed is creating awareness. This includes being able to recognize the signs of cancer – and even giving the condition a name. According to the *Lancet Oncology*, “Most indigeneous African languages do not even have a word for cancer.” While English is the official language of Ghana, there are more than 250 languages and dialects spoken in the nation, which further complicates understanding between the public and medical professionals.

Tim Eden explains how World Child Cancer is addressing this. “We must concentrate even more on educating health professionals and the public about the signs and symptoms of childhood cancers, in order to speed up diagnoses and ensure that all children get a chance of treatment and potential cure.”

A second area of access to improve is capacity building, meaning to increase the number of facilities and staff members specializing in oncology. About 45% of the nation’s population still lives in rural areas, making access to fully trained physicians more difficult. But should these children and their families come to a major medical center, as mentioned, there currently remains a lack of physicians: Overall, in Ghana, and Africa, medical school graduates have historically left to practice medicine in wealthier nations, at an estimate of 15% per year.

Yet physicians who remain in the country are eager to bring about change, and they are taking up work to improve access to healthcare for the next generation. And since Ghanaian healthcare professionals have been receiving more education about cancer, says Lorna Renner, “We have quite a number of junior doctors who now want to become pediatric oncologists.” Renner also sees longer-term capacity planning in the works. “We now hope to open more pediatric centers in all regional hospitals.”

World Child Cancer’s Jon Rosser points to the third access factor – improving the safety and efficacy of medicines generally, and particularly for children’s cancer. “If we can get patients into the medical facilities, counterfeit and contaminated medicines lead to poor outcomes and even public distrust of the medical community.”

Solutions that bring greater access to medicines will require joint efforts. In treating cancer, the matter of using uncontaminated, authentic drugs is particularly crucial, Eden confirms. “Pediatricians are worried in
general about whether the drugs they receive are authentic. We need to focus on making medications available in the right quantities, accessible, affordable and of certified quality,” says Eden. He says that World Child Cancer’s collaboration with Sandoz is particularly important to improving this.

Rosser is convinced that positive change can continue with ongoing, and increasing, access to education, to medical professionals and to medicine. “We’ve seen in Ghana that the right team of trained medical professionals, using the right resources – which are minimal compared to what is used in developed countries – can save up to 60% of the children we treat. So our next goal has to be saving 61%, and then 62% and onward.”

The path forward
“This work would be really demoralizing if we didn’t see progress,” continues Rosser. “But those days are behind us. We can make an impact now. And if we know we can help children and we know how, then we have a moral imperative to do so.”

In the long-term, more systematic change is needed to stabilize the treatment of children’s cancer, he adds: “We need to work hard with partners to raise the profile of children’s cancer and advocating for governments to give more priority to childhood cancer.”

Sandoz’s Peter Stenico agrees. “We are supporting discussions with governments, health departments and other companies to make access happen. In Ghana, we’ve been attending meetings with the government, the health department and regional groups. We’re all bringing in factors that must be considered to make pediatric oncology, and healthcare overall, available and affordable. More of us need to share resources and information, to establish a lasting solution.”

In the family room of Korle Bu Hospital, Rebecca and her mother Charlotte remain sitting on a cot. “Treating Rebecca will be a long process,” her mother explains, as Cathy Segbefia arrives to check on Rebecca and other patients in the room. For the first time, Rebecca and Charlotte smile. “There is help,” Charlotte adds, as though she is reminding herself. “And I am hopeful,” she repeats, keeping her daughter close.
Mother and child getting treatment at Korle Bu hospital. Together with partners, World Child Cancer has started income-generating activities for parents and provides support for food and treatment costs.
How does your work help improve access?

I have two main focuses in my job, and these are offering access to information and providing alternatives. Because there are so many antibiotics, physicians can’t possibly know everything about every single one. I counsel doctors on optimizing the treatment for each patient and on finding the right combination of medicines to help them recover while avoiding antibiotic resistance. Additionally, I help put together a list of medicines that the hospital should purchase. The savings thus created for the clinic and for the Russian healthcare system also increase access.

What problem needed to be solved?

When I started working in the hospital, four broad-spectrum antibiotics were commonly used. I called them the ‘Four Horsemen of the Apocalypse.’ Although the hospital flora was resistant to them, our doctors kept prescribing these four antibiotics for hospital-acquired infections. They even increased the doses when treatment showed no effect. Ultimately, this could endanger our patients. So we replaced the inefficient medicines. This resulted in better patient outcomes at a lower cost because we required fewer and lower doses of antibiotics.

What motivates you in your job?

Fighting infections and infectious diseases is my passion. When I was young, the book *Microbe Hunters* by Paul de Kruif – about Dutch microscopy pioneer Antonie van Leeuwenhoek – really caught my attention. It even inspired me to specialize in clinical pharmacology. De Kruif described the microscopic world as “peopled with thousand different kinds of tiny beings, some ferocious and deadly, others friendly and useful.” I’m an antibiotic therapist, and I’ve been working with antibiotics all my life. Still today, I see myself as a ‘microbe hunter.’

Sergey Dmitriyevich Mitrokhin

... is a clinical pharmacologist at the Clinical Hospital No. 67 in Moscow. He fights antibiotic resistance by educating staff and suggesting alternatives – and has cut the hospital’s antibiotics expenses in half.

“My passion is to study, understand and fight dangerous microbes.”
The access factor

Water and health

Globally

- **2 billion** people use a drinking water source contaminated with feces.
- **844 million** people lack access to basic drinking water services.
- **263 million** people spend over 30 minutes per round trip to collect water from an improved source.

Water-transmitted diseases

Contaminated water can transmit illnesses and diseases such as cholera, diarrhea, dysentry, hepatitis A, typhoid and polio. WHO counts **26 water-related diseases**. More than **half a million people die each year from diarrhea** as a result of unsafe drinking water. Yet diarrhea is largely preventable, and 361,000 children under age five could be saved each year through access to safe drinking water.

- **26 water-related diseases**
- **361,000** deaths of children under age five could be avoided each year.

History

Since the 1950s, **water fluoridation** has been implemented in at least 24 countries after studies showed its positive effect on reducing tooth decay.

In 1854, physician **John Snow**’s research showed that sewage-polluted water in the Thames led to increased cases of cholera in London. During three outbreaks within a few years, more than 30,000 people died. By removing the handle of a polluted well in Soho, he helped to **end the last cholera outbreak** and saved countless lives.

Access to water

UN Sustainable Development Goal 6.1 calls for universal and equitable access to safe and affordable drinking water.

- By 2025, **half of the world’s population** will be living in water-stressed areas.
- Since 1990, **2.6 billion** people have gained access to improved drinking water sources.


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