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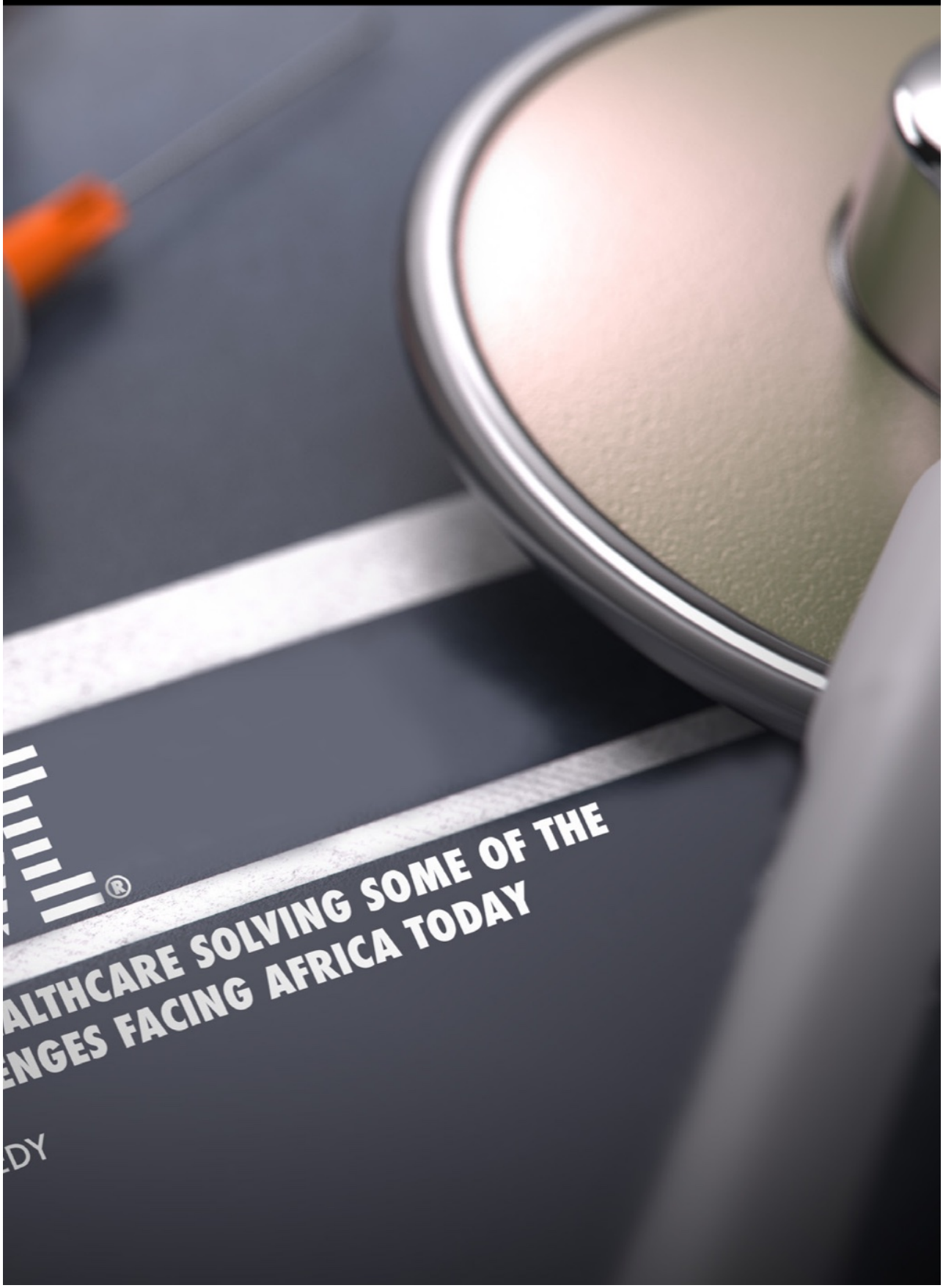
ALTHCARE SOLVING SOME OF THE
ENGES FACING AFRICA TODAY
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IBM has been at the heart of some of the biggest technological leaps forward mankind has made. From playing an integral part in building the computer systems that were required to put the first man on the moon to its latest ground-breaking venture of developing intelligent computers that respond to humans as we enter an era of cognitive technology. IBM is now applying its colossal technologic expertise to provide solutions to some of the biggest healthcare challenges facing Africa today.

IBM has 12 research laboratories across the world dedicated to finding new solutions in topics from fundamental sciences to new computing systems for the modern world. IBM Research Africa has just launched a new state-of-the-art research laboratory in Johannesburg to add to the existing lab in Kenya. The new lab was established to conduct research across three primary areas: digital urban ecosystems, exploring the universe and data-driven healthcare.

The science of urban ecosystems is becoming fundamental to the way the modern world operates. One of the world's major challenges is the growth of cities, urbanisation and how it can be managed as it continues to grow. IBM is researching new ways to manage challenges like traffic congestion and increased air pollution.

IBM has a long history in the area of astronomy, through its role in taking the first man to the moon, and the South African team is continuing this tradition in building systems that can generate new knowledge about the origins of the universe and to finally answer questions including, 'Why are we here?' and 'Are we alone?'. The answers to these questions lie in the data being collected by the soon to be built, Square Kilometer Array (SKA), which will be located in South Africa. The SKA will collect faint radio waves from deep space, which when stored, will be the equivalent of more than 35,000 DVDs every second – it's the ultimate Big Data challenge.

The third research area data-driven healthcare is led by Dr. Geoffrey Siwo, an IBM scientist based in South Africa with a degree in biological sciences. His team is tackling one of Africa's primary challenges in healthcare. Infectious diseases remain one of the biggest killers in Africa with malaria, tuberculosis and HIV being the three leading fatal diseases. However, there is also a rise in non-communicable diseases such as cancer.

"Africa is at a strenuous point in its history. There are a large number of infectious diseases accompanied with a rising burden of non-communicable diseases of which many are chronic," says Siwo.

"It means many patients may have a double burden of diseases. They can have an infectious and non-communicable disease at the same time and this can influence how each disease presents itself."

Molecular maps

Siwo and his team are working on developing new models of understanding the biological basis of disease and a transformative idea they are applying to the area is to view biological entities as systems. Siwo is digitalising a disease such as cancer and then using that data to identify possible solutions.

"The notion of a system is powerful because

Geoffrey Siwo meeting IBM CEO Ginni Rommety

it is like having a map. When you think of cancer think of it as being made up of complex maps of different biological entities like genes or proteins interacting with each other to mediate the disease. Having a map can help you identify the areas of weakness in the disease."

In cancer specifically, Siwo's team are developing a new method for interrogating the molecular maps to solve metastasis, one of the most important problems in cancer. Metastasis is the process of cancer cells spreading from one part of the body to another and once this has occurred the disease is far more difficult to cure - 90% of cancer deaths are caused by metastasis.

Through the use of algorithms to interrogate the molecular maps, Siwo made a discovery showing that cancer initiating genes have very close links to the genes that eventually make cancer spread.

"We were surprised that one of the genes in this process is a gene that has distinct forms in African populations versus Caucasian populations; it is also an important gene for mediating resistance to malaria," explains Siwo.

This is a crucial finding because the same gene has been previously associated with the resistance of African populations to a form of malaria caused by plasmodium vivax.

Siwo says the findings showed that Africans express a distinct form of the gene that while associated with low incidence of plasmodium vivax malaria in Africa, may enhance metastasis. Similar observations have been made by other studies validating predictions made by IBM researchers. The IBM Research algorithm has identified a specific effect of the gene variant that varies by breast cancer subtypes.

"It is a natural resistance, the bug is an arms race between how fast the malaria parasite can develop resistance to medicines and humans develop resistance to the bug."

It is thought that historically there was high selective pressure that made those who expressed the form of the gene that is resistant to malaria survive longer and therefore that gene became the predominant type in Africa.

"By interrogating the molecular maps using this algorithm we were able to find the association that links the gene that gives you resistance to malaria on the one hand but might promote metastasis on the other."

Because IBM has identified this association specifically in certain breast cancer subtypes,

it will help the medical industry to potentially develop treatments and cures for cancer in the future.

"If you know there are population-specific associations between cancer genes and those that drive metastasis then, depending on the genetics of the individual, we could personalise the strategy in targeting the cancer.

"In some patients with cancer metastasis of the brain you might find the cells are migrating using a different molecular route compared to a different population.

"It goes back to the idea of viewing biological problems, such as diseases, as systems and developing the molecular maps because on top of them we can develop powerful algorithms to mine the maps."

The lab is also working on tuberculosis and is mapping how people come into contact with each other on a routine basis and therefore the potential infectious area of the disease. It is a map similar to the cancer work but on a different scale.

"Whether it is at the molecular level of the cancer cell or whether it is looking at how tuberculosis spreads in populations, through digitalising these issues we can develop better strategies."

Digitalising healthcare

Siwo explains that the digitalisation of medical problems will play a key role in the medical profession's ability to develop solutions in the future. The two key factors that digitalising a problems affects are cost and scalability.

Scientific history has been dominated by highly intelligent individuals like Albert Einstein or Alexander Fleming who made major contributions to the world, but it took many years before their contributions were translated into solutions. Now IBM Research Africa is trying to make scalable discoveries that can be brought into the market much faster. Currently, it is on average 15 years for a basic science discovery to be translated into a clinical intervention.

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Solomon Assefa and Zeblon Vilakazi

"Medicine is changing rapidly, the reason behind that is digital technologies and now you can have multiple people working on a problem at the same time," says Siwo. "There is also the cost element, once you digitalise a problem you can work on it from anywhere around the world, you can share it with others and it is much cheaper to produce and test multiple ideas."

Hacking healthcare

The team at the Johannesburg research lab are focused on making progress in two fundamental areas. They are working on data-driven healthcare to make contributions to the understanding of diseases such as cancer as a basic science. Siwo firmly believes that basic science will be at the core of transforming healthcare in Africa. Secondly, the team are dedicated to developing new technologies that can transform the way infectious diseases impact Africa. This is coming through projects such as the wearable device for tuberculosis which tracks infectious disease and could be used for mitigating outbreaks like Ebola.

The lab is also creating a space for open innovation. Earlier this year IBM Research Africa held a 'hackathon' where a group of 25 researchers from eight countries, in collaboration with the University of Notre Dame and pan-Africa organisation H3ABionet, came together to work on the understanding of malaria drug resistance using genomic data.

Siwo says it is for reasons like this that

he works for IBM. He says people think of the company as computing firm but it is now leading the cognitive era and will be fundamental in demonstrating how important technology is in solving some of the world's biggest challenges.

"The reason I work for IBM is that I have seen the power of technology to potentially empower anyone in the world to make key contributions.

"This goes back 14 years to when I started. I was just starting out as a biologist and wanted to test specific ideas but had no lab. However, being able to begin testing my ideas on a computer, within a few months I was able to become an expert in an area of understanding how specific DNA sequences in the human genome might affect diseases like HIV.

"if you look at human history, some of the greatest aspects of progress can be linked to technology, even rudimentary technology like fire, writing, language, communication – bringing this into the digital age makes it even faster. What would have taken hundreds of years will take decades when you bring it into the digital realm. This is the exciting thing about cognitive computing and the cloud."

CONTACT

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