Artificial intelligence shall come forth from Zion

New Israeli models allow doctors to gain rapid insight into patients

By Maayan Hoffman

TECHNOLOGY IS transforming the medical field, and artificial intelligence (AI) is enabling medical technology to advance at an increasingly rapid pace. Already, hospitals around the world are benefitting from Israeli medical technology. But when it comes to AI — including deep learning and machine learning — researchers say there is much more ahead from the Start-up Nation.

Take Ra’anana-based MedAware, which utilizes AI and machine learning to significantly reduce medication errors. The technology allows healthcare providers, pharmacies and pharmacy chains to leverage big data to identify and eliminate a wide range of prescription errors and provide better risk management.

MedAware CEO and co-founder Dr. Gidi Stein told “The Jerusalem Report” that medication errors account for a $21 billion drain on the American healthcare system, not including the cost of legal action taken when medication errors occur.

Further, adverse drug events (ADEs) — or injuries resulting from taking a medication — are one of the three most common and harmful categories of medical errors. Each year in the U.S. there are approximately two million ADEs that cause a staggering 100,000 deaths, reports the NGO Patient Safety Movement.

Earlier this year, Sheba Medical Center’s Internal Medicine Department completed a two-year MedAware trial, which found that 61% of prevented errors occurred when a previously safe medication became dangerous to a patient, due to a change in his condition.

Some 39% of errors prevented occurred when physicians entered medication orders, and Sheba physicians changed their prescriptions based on MedAware notifications most of the time — 10 times more frequently than the current standard of other clinical decision support tools.

“There is a large volume of medication errors in hospitalization,” said department head Gadi Segal, who spearheaded the trial. “We don’t really know the extent, but we know that much of it is human error and that medications are potentially dangerous.”

Segal told the Jerusalem Report that MedAware, “could actually save lives.”

In fact, Stein founded MedAware in 2012 after reading about a deadly medication error in Israel, in which a physician prescribed a 9-year-old boy an anticoagulant blood thinner, which killed him one week later. The doctor meant to click the medication above the one he prescribed in the electronic prescription service and did not notice his mistake until it was too late.

“It was not bad judgement,” said Stein. “It was a typo. A doctor can easily make a typo, but typos can kill.”

As a computer scientist and physician, Stein said, “I could not live with myself if anything happened like this. It’s just unthinkable. So, I set forth to try to solve the problem.”

MedAware uses similar AI methods to those used in the finance sector to stop fraud by identifying “outliers” from a trend or practice to recognize suspicious or erroneous transactions. Stein said when a person owns and uses a credit card, the bank begins to track the individual’s personal spending patterns. When an unusual transaction is made, the bank is alerted and can contact the owner or put a hold on the credit card.

“We are trying similar methodologies with healthcare data,” said Stein. “Prescription patterns of thousands of physicians treating millions of patients are used to determine the ‘normal’ treatment spectrum. A prescription largely deviating from this spectrum is likely to be erroneous.”

MedAware is different than other rule-based medication support technologies, which have been developed for a limited range of medication decision support, such as drug-allergy checking, automated dosing guidelines and identifying drug-drug interactions.

In contrast, MedAware’s system is fully personalized in that its responses are based on each patient’s specific data. The system is likewise self-learning with no rule-set that limits the errors it can capture.

Most current systems set off too many false alarms — as many as 95%, Stein said, causing doctors to ignore even relevant alarms. MedAware’s false alert rate is beneath 10%.

“It tells you that it would not be advisable to give a certain medication because it does not suit the patient’s profile,” said Segal. “Only machine learning software that knows the patient’s profile would know to tell me, ‘Hey, doctor, this is a typo, or the wrong medication, or you’re too tired — you cannot give insulin to a patient that doesn’t have diabetes.’”

The wave of the future

While AI is not a new field in general — the first AI program, the Logic Theorist, was developed in 1955 — only in the last decade did its use become mainstream. However, while AI caught on rapid fire in the marketing, automobile and finance industries, for instance, the healthcare arena was slow to adopt this innovation.

Dr. Ahuva Weiss-Meilik told the Report that lack of quantity and quality of data kept AI outside the medical setting. Now, with the growth of clinical data, captured effectively by electronic health records, researchers, doctors and other clinical staff can take advantage of such tools.

Weiss-Meilik heads Tel Aviv Sourasky Medical Center’s new center focused on...
developing models for leveraging AI in the clinical workspace. She said AI models “allow doctors to see patterns or gain insights into a patient’s clinical results” in real or rapid time.

According to Talma Hendler, professor of psychiatry and neuroscience at Tel Aviv University and the founding director of the Sagol Brain Institute at the hospital, with AI, a computation based on clinical data that might have taken a month in the past “can now be computed in an hour.” She said these insights will improve patient care and outcomes.

“A predictive model might tell us that a sick person is likely to be readmitted to the hospital within a week because of this or that,” said Weiss-Meilik. “Or, let’s say a doctor is monitoring a fetus. He can easily see if the unborn baby’s heart rate has accelerated or decelerated, but he might not so readily see other, smaller changes that look normal to a doctor but to a predictive model might be known to be problematic.

“With predictive analytics, the formula can warn us that every time you see this pattern, there will be X or Y medical event,” she said.

Hendler said using increased AI will also allow for more personalized medical treatment and give doctors the ability to look at patients more holistically. If in the past, a patient would have been labeled as diabetic or having heart disease, “machine learning will cluster a patient’s ailments and perhaps help develop new, more nuanced labels.”

Hendler believes that just as today every patient entering an emergency room is automatically given a blood test, in the future some form of AI related testing and consideration will become standard practice.

Humans still required
Yuval Shahar, head of the Medical Informatics Research Center at Ben-Gurion University of the Negev, said that if he had it his way, AI would reduce those going to the ER.

Shahar’s research team developed MobiGuide, a scalable, secure and accessible mobile solution for designing, deploying and maintaining Patient Guidance Systems (PGS) based on clinical guidelines and personal health records. The system provides personalized evidence-based clinical recommendations, increases patients’ compliance to guidelines, and reduces healthcare costs.

Traditional clinical decision-support systems are targeted toward care providers and see their role as providing decision-support at the point of care during patient-physician encounters. In contrast, MobiGuide interacts with both the patient and their care provider, delivering health-related recommendations and enabling access to their health data whenever a need arises, from anywhere, using web and Smartphone interfaces.
The clinical data is acquired using body-wearable and portable monitoring devices, even in patients’ homes.

“If a pregnant woman has high blood pressure, a home test would monitor it,” Shahar explained. “If the machine notices a change in her tests, it might send her a recommendation, such as, ‘Start checking your blood pressure six times per day instead of three,’ or if she has gestational diabetes, it might ask her to take an at-home test to measure ketones in her urine.”

While the patient would get one set of instructions, the physician would be alerted appropriately, too, such as, “You cannot leave her at home on her current medications,” like if cardiac arrhythmia is reported.

Shahar said MobiGuide – coordinated in conjunction with his colleague from Haifa University, Prof. Mor Peleg, and 13 partners from five European Countries – has been running for four years in Italy and Spain as part of a $7 million project funded by the EU.

This is the first AI project to include completely automated, closed-loop monitoring and management of chronic patients, specifically heart patients with arrhythmias in Italy and pregnant women with gestational diabetes or hypertension in Spain.

“The EU, like most of the Western world, is facing a huge crisis with 25% of its population entering retirement age, when most chronic disorders – diabetes, heart disease, cancer – develop,” said Shahar. “This will cost the system billions, and we won’t have enough medical personnel to treat all the patients effectively. The solution is to use a system like MobiGuide to transfer the physicians’ knowledge to computers and provide much cheaper and likely better medicine.”

He continued, “If you need to go to a clinic, the system or your physician would send you there, but in 80 percent of situations, the person does not need a clinic and can handle the situation at home according to some protocol your own physician would have used had you gone to him.”

MobiGuide will also help disseminate best practices by allowing physicians to enter findings that would then be automatically distributed to anyone using the system.

Lior Rokach, chair of the Department of Software & Information Systems Engineering at BGU, is also tackling new AI projects in the medical sphere.

Rokach recently worked with Asaf Achi- ron of Holon’s Wolfson Medical Center to develop a database of nearly 20,000 laser eye surgery patients to build a predictive model that would inform physicians whether such a surgery will ultimately be effective.

“There is a very long list of medical parameters checked on each patient before doing surgery and we know the outcomes,” Rokach explained. “Although the surgery is successful in almost all patients, some two percent fail. The idea was to find out if we can predict if it will fail.”

Rokach aims to make this prediction model available online so physicians could check the likelihood of success for their patients and advise them more effectively.

Rokach told the Report that the biggest upheaval in the AI-medical arena will be in radiology. Right now, ML has vision capabilities that can analyze CT and x-ray scans very efficiently, often better than a human physician. This could enable patients to get their results in minutes.

He cited the Sehfayim-based company Zebra Medical, which works with millions of imaging and correlated clinical records to create high-performance algorithms that automatically detect medical conditions faster and for numerous findings.

Rokach said he expects Zebra and others to release additional automated findings and insights to help radiologists provide more comprehensive, accurate outcomes faster, without compromising quality of care. The technology should allow doctors to identify high risk patients earlier and optimize worklist prioritization for urgent cases.

“Many people ask whether AI will replace physicians,” Shahar said. “Not for at least 50 years.”

He said that while computers are faster and can learn more effectively from the mass amounts of clinical data being collected, there are just as often cases outside of “protocol.” For instance, a computer can inform a physician there might be an adverse reaction between two medications. But what if the patient needs both? A physician must decide.

“I don’t think such value judgments should be left to computers,” he said.