

The future of medicine and wave theory

Like many other scientific areas, healthcare advances seem to come in waves. In other words, the peak of a wave comes with some era-defining innovation. Then the trough of the wave follows this advancement as it is refined and polished. As this transpires the next peak is forming. If this seems a little nebulous, let me take you back in history about 150 years ago.

The first real major wave in modern history for medicine occurred in the 1870's with the concept of the germ theory leading to the implementation of antiseptic techniques. At the same time, anesthesia launched a critical advancement in surgery. Previously the most notable theory of disease was the miasma theory which held that diseases such as cholera and plague were caused by miasma or



“bad air” coming from rotting material. As such, diseases arose from contaminated locales. Given germ theory, the concept of bacteria and transmission could be understood, and practical applications of aseptic surgical techniques could be implemented. Simultaneously, with the usage of anesthesia, this new discovery changed the nature of surgery forever. For the first time,

surgery was not to be feared or used as a last resort. Rather, surgery became a viable option for treating disease. This was an amazing leap forward as previously fatal diseases could be addressed surgically. Cures for once fatal diseases were now widely available.

The next great wave in medicine occurred in the 1920's when the concept of antibiotics led to the introduction of penicillin - an amazing treatment that could cure many fatal diseases with a simple pill. This also built on the prior wave of germ theory. Suddenly, strep throat no longer led to rheumatic fever or nephritis. Common urinary tract infections no longer led to pyelonephritis and sepsis. A wound on the farm or the battlefield became survivable.



In the 1940's, scientists began to use the concept of controlled trials which allowed decision making to be based less on anecdotes and more on actual reproducible evidence. This allowed physicians to become researchers and to test various treatment and cures on a scientific basis. It allowed understanding of tendencies through populations and with the advancement of statistics allowed more accurate interpretation of data.

In the 1960's and 1970's, we entered an era of electronics and devices. No longer did patients have drop attacks as their heart rates slowed down, pacemakers

were inserted. Individuals who broke their hip could look forward to a new synthetic device rather than hobble for the rest of their lives. Respirators allowed breathing function to be controlled until individuals could resume breathing on their own. Heart rhythms could be monitored moment to moment, IV fluids could be given in a controlled manner. Laboratories could be automated for more rapid results and the array of testing done on a single machine that could be available in a physician's office allowed more accurate diagnosis. CT scanners and MRI scanners showed the interior of the human body to identify specific targets of surgery or autopsy.

I am sure I have missed some amazing waves in this brief medical survey, but the purpose was to launch us into the next wave. We have previously addressed data management, but I wish to make you more aware of artificial intelligence robotics and genetic manipulation, the next great wave of medicine.

Robotics and Artificial Intelligence

Robotics – During the next decade, expect to see a marked increase in the power of robotics. I am speaking of mechanical objects along with the artificial intelligence to support it.

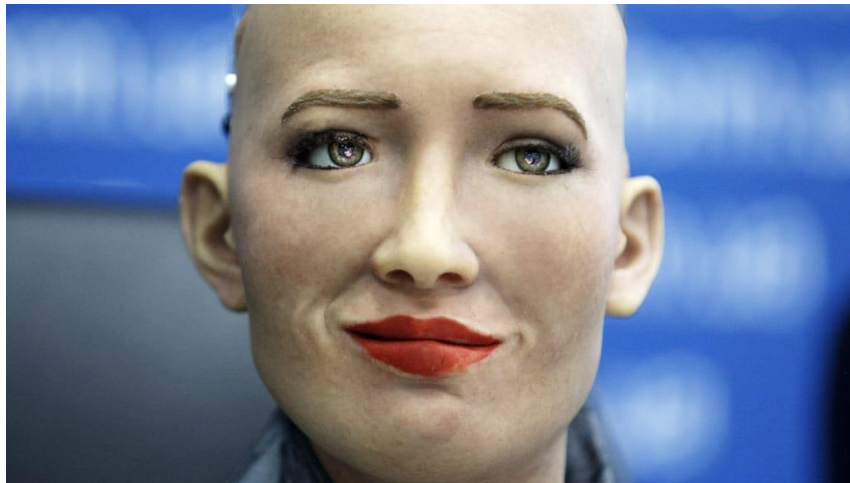
Before I present what an initial visit with your physician in the not too distant future may look like, let me describe your visit today. You go to your physician's office and fill out forms about your demographics. You go to an examining room



and you exchange pleasantries with the physician to break the ice of an initial meeting. He/she quizzes you about your symptoms, medications, allergies, past medical and surgical history and your current complaints. After a perfunctory

exam, he orders certain tests to confirm or rule out various diagnoses and recommends treatment. If you are lucky, you are uninterrupted, and you have your physician's undivided attention.

Now, let's change the scenario. You come to a personal pod in a healthcare complex. You are greeted by a robot shaped like a human (studies have shown we relate better this way). Before you even begin your "session", this AI knows all your past medical history, family history, medications allergies and potential drug interactions. As you sit, various innocuous tests are taking place, such as retinal scanning and other sensors, and your vital signs are added to the data base. Through human interactive research and speech recognition, your robotic physician will be able to "listen" to you and interact with you. Listening to your complaints and considering your history and your current complaints, the AI will be able to drill down through countless algorithms which are constantly updated throughout the country as new medical data becomes available. You will be directed to the appropriate blood tests and or imaging procedures. The AI will be able to interpret this data immediately and place it in your records. You will be then issued the appropriate treatment. An important point should be noted here. Contrary to your human physician, there will be no problem with "remembering"

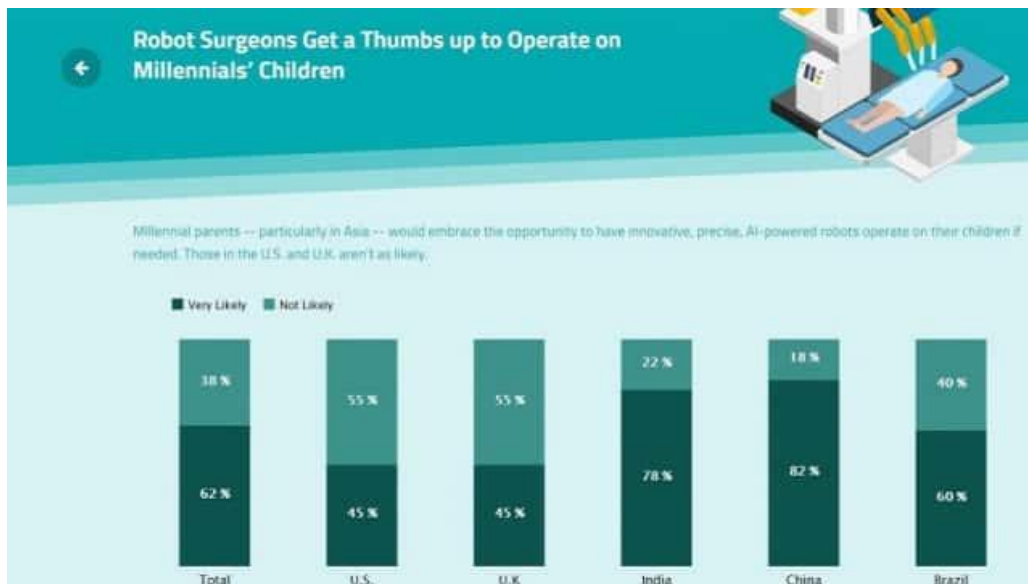


to do a procedure or follow up. There will be no problems with your AI running to another room to see a patient simultaneously. There will be no answering a phone or thinking about personal issues during your interaction. You will be the sole source of input into AI for personal interaction.

If you are not a primary care physician and think this does not apply to your medical practice, think again. The last newsletter outlined that for radiology we are analyzing bits of data or a “film”. Computers are simply outstanding at analyzing bits of data, probably better than humans. If you are a surgeon, you will remember in our last newsletter it was postulated that autonomous surgery will one day be performed with perfect sutures and with 3D printed parts. If you are a pathologist remember that “smart microscopes” are just starting to be used (see below). If you don’t believe we are getting closer day by day to the proposed future above, look at the previous photo. That is Sophia. Below is a YouTube video of her currently. Close your eyes and imagine what she will look like in a decade. <https://www.youtube.com/watch?v=78-1MlkxyqI>

You may say that I am projecting too far into the future. But let me tell you, I may be underestimating the timeline. It is my prediction, that as humans become more and more comfortable with artificial intelligence, barriers to interaction with AI will continue to fall. You see this everyday as younger millennials are much more comfortable relegating personal information on their phones and devices and frequently trust internet searches more than physicians. The next generation will almost totally grow up wedded to their electronic devices and will be very comfortable with the concept of AI in medicine.

Individuals will become even more accepting of AI decision making when they see positive outcomes from AI. These improved AI outcomes are already starting to crop up. Look at the graph below from June of 2018. Respondents were asked



whether they would embrace the opportunity to have innovative, precise AI powered robots operate on their children if needed. Even with the current primitive AI technology, almost half of the millennials in the US said “yes”. In China it’s already 80% yes. Can you imagine what this number will be in a decade? These are not scientists realizing all the new and exciting research, these are regular people.

To update you on the just some of the research that is going on worldwide.

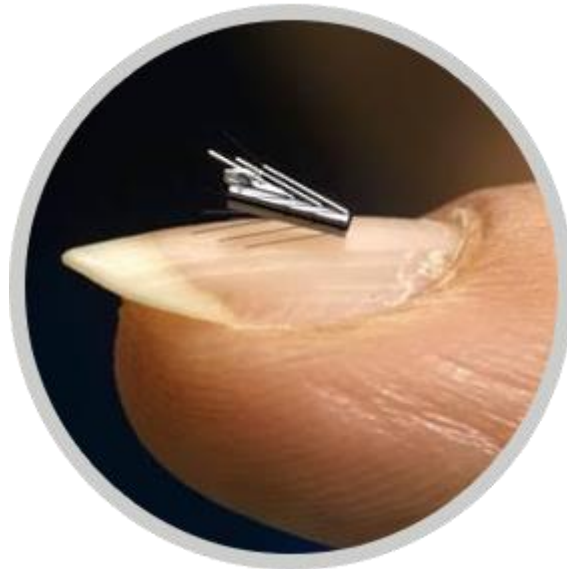
- Researchers in England have developed an AI diagnostic system that is more accurate in diagnosing heart disease at least 80% of the time.
- Harvard has developed a “smart” microscope that can detect blood infections. Not only can the smart microscope detect blood infections, but AI sorted the bacteria with 95% accuracy.
- In Japan, a new computer assisted endoscope system that reveals potentially cancerous growths with 94% sensitivity has been developed.

Most of you know we already have robotic assist type systems in place in the operating room. It is not a large step to total robotic control.

The Da Vinci System is making surgery safer, though it still involves a human operator. With robotic surgery, hospital stays are shorter, and the risk of infection is reduced. Pain and discomfort are reduced, and recovery times are faster. Blood loss and transfusions are lessened.

While the Da Vinci system may be the most well-known, a robot assisted surgery platform for total knee replacement is scheduled to be released this year. The FDA has cleared a system to diagnose and treat lung tumors. New robotic systems have been launched to perform colorectal and gynecological procedures.

Almost all robots are large and macroscopic. Israel is developing a miniature



robot called ViRob that is 1x4 mm. It can crawl through a human and locate a tumor and treat it with drugs. Here is a picture. To see it in action, click on the YouTube link.

<https://www.youtube.com/watch?v=OK3wXfSkhI8>

We are entering an amazing time. Medicine and your practice of medicine will never be the same. How are you planning for this future? What will be your position in this future? Ignore it at your own peril.

Gene Manipulation

You may not realize this but “an influential group of scientists” in England has concluded it could be “morally permissible” to genetically engineer human embryos. I am not making a value judgement, but a group called Nuffield Council on Bioethics made this pronouncement. I am sure they have good intentions, but exactly who are they and who imbued them with the magic power of decision. I reviewed the bios of many of the members. There are a plethora of professors and ethicists but not many clinicians. The chair is David Archard, an Emeritus Professor of Philosophy at Queens University in Belfast. I noted a professor of Political Theory, a Registered Genetic Counsellor, a Professor of Ethics and Care, a program leader in Developmental Genetics, a Professor of Sociology, a Professor

of Old Age Psychiatry, a knighted individual who has an INTEREST in the history of policy and ethics of science and technology plus additional people. I am sure they are simply outstanding individuals, but I don't see a lot of clinicians, you know, the people who take care of people. Which brings up the question, who is to decide what is moral, ethical and legal in this very interesting but dangerous field?

To refresh your memory, there is a gene-editing method called Crispr which is an acronym for Clustered Regularly Interspaced Short Palindromic Repeats. An American team has announced that they have used the technique to change a human genome, where Crispr snipped away a mutated gene for hypertrophic cardiomyopathy.



Obviously, we would all be glad to see certain inherited diseases abolished and to eliminate suffering. After all, as physicians, it is our goal to try to relieve or eliminate suffering. This is the “good side” of such technology. But what if babies could be designed in ways that no longer eliminate disease but enhance what are considered favorable characteristics? This is currently done in a more mendelian way with agriculture, but is this something we wish to do with humanity? If we want a basketball player as a child, do we only select the tall genes, or do we amplify genes that might maximize growth? This may not be possible today but surely will be tomorrow. What if we discover certain genes control IQ, do we maximize these? At what cost?

What about non-Crispr genetic manipulation? As we sequence more of the DNA, what about selecting the embryos with certain characteristics we like. Why don't we in vitro fertilize dozens of eggs and see which one comes out tall with a high potential IQ? What about selecting pleasing characteristics, such as eye color? There was an interview in the Wall Street Journal this year with a married couple; pseudonyms "Blair and James". They were trying to start a family at age 35. Being type A personalities, they researched everything about having a baby and



investigated DNA testing to rule out genetic mutations they might pass on. As a result of their research, they performed this genetic testing. All fine and good you say.

But they also learned about a test that might help predict a future baby's eye color. They want blue. Should they select that embryo and allow it to mature? What happens to the embryos with brown eyes that are not picked? Remember these are not gametes these are embryos. Are they just doomed to medical waste? Only one was going to come to full-term anyway, you could say.

Add to this scenario the fact that IVF is expensive, particularly if done for non-medical reasons. If insurance is not going to pay, will only the wealthiest be able to eventually choose the smartest, "best looking" and fastest human with even more advantages over everyone else?

With the Crispr, will eye color and other desirable features be editable despite whatever embryo is chosen? Will the world's future children be born with a checklist of features and characteristics?

You may consider government regulation to be a way out of this conundrum. But let us say the US government lays out a perfect policy that you can live with. What will other countries do? What will N. Korea or China do? How well will Albania, Zimbabwe, or Paraguay enforce whatever law that is written?

With more knowledge, comes more responsibility. With more knowledge, also comes greater hazards. How we chart this course may very well determine the future of humanity.

Private Practice Doctors

Private Practice Doctors continues to be the premier source of information and savings for private practice physicians. We provide you savings on just about every purchase you make in your office. From banking to test tubes, from insurance to examining tables, from MRI machines to cotton swabs, we save you money. Your expenses represent 50% of your balance sheet and it needs your attention. Don't leave this critical part of your practice only in the hands of your staff. Please let us help.

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