Medical Technologies From the Edge of Medicine

Robotic appendages are sensitive enough to maneuver around organ and wheelchairs being directed by the patient's brain waves. These are former science fiction fantasies that are now realities. How are these technologies already changing medicine and should we have any ethical concerns about implementing these and other future medical innovations.

You are listening to ReachMD Radio on XM160, The Channel For Medical Professionals. Welcome to the Clinician's Roundtable. I am you host Dr. Lee Freedman and joining us to discuss his book on emerging medical technologies entitled The Edge Of Medicine is Dr. William Hanson. Dr. Hanson is an anesthesiologist and Chief of Intensive Care at the University of Pennsylvania Medical School as well as an Associated Faculty Member of the Computer Science Department at Princeton University.

DR. LEE FREEDMAN:

Thanks for being with us Dr. Hanson.

DR. WILLIAM HANSON:

Thank you for having me.

DR. LEE FREEDMAN:

You cover a lot of very interesting technologies and future possible developments in your book. There are some in particular that you think are important for us to know about or get exited about.

DR. WILLIAM HANSON:

Well, I divided the book into several chapters and I constructed the book to think in many ways enabling technologies or enabling developments, not so much individual advances, but categories of advances, and the first part of the book speaks in some part to the same sorts of developments we have seen in other industries having anything to do with computer science, things like networks and artificial intelligence and data visualization, which I think are all beginning to enter our world, but there is so much more to be had and so many ways in which these technologies can help us.

DR. LEE FREEDMAN:

Certainly the electronic medical records and when I go to prescribe something there is something that checks for interactions and all. What type of other ways could we have artifical intelligence and computers assisting us?

DR. WILLIAM HANSON:

Well, the checking of prescriptions and making sure that we don't prescribe inappropriate drugs to the patient who has allergies or critical functions, but they are relatively primitive from a computer science standpoint. Most of the audience will be aware of telemedicine and its potential capabilities and in the book I have prescribed a couple of ways or a couple of sorts of categories of telemedicine, one of which is The Store and Forward Approach, which is used by radiologist where images stored somewhere out of the network and then read in a disconnected fashion by radiologist who may be located on the other side of the world. This is the Nighthawk Model that many hospitals use. So there is a belief on the part of some people that the current model of Radiology where you have employed radiologist may eventually give way to something where there is a group of radiologists who are outsourced in large part. This could be good news or bad news for some of the audience.

DR. LEE FREEDMAN:

Right, right, but you get the world's most authorities in particular areas to read a person's x-ray regardless of where that x-ray may be that image may be.

DR. WILLIAM HANSON:

Where it is and when it is. I mean it is very possibly that you will have one of the world's authorities at the other end of a link who can be called upon at need and in fact that is the way in which the nighthawk model is described. There was a need for a radiologist who has been located on the other side of the world and a light bulb button went off in somebody's brain. So, that is Store and Forward model and there are real-time models where the expert clinician is in a real-time link with the patient or with another physician and some other things that fit this category are things like intensive care telemedicine where there is an intensivist who is monitoring in some cases over 100 beds using smart software to guide him or her to patients who are needed at that point. Another real-time link that is actually in use at this point are remote robotic surgeons. So, the surgeon can be located at some distance from the patient that he or she is operating on.

DR. LEE FREEDMAN:

Certainly, a step beyond the Da Vinci Model for prostate another surgeries, actually the surgeon would not physically be at the bedside with the patient.

DR. WILLIAM HANSON:

Right, but there is no reason and you know in fact the Da Vinci Model the surgeon is sitting several feet away from the patient and connected by wired links to the robotic device and there is no reason why the surgeon needs to be in the same room as long as there is a reasonably capable assistant in the room that can help out.

DR. LEE FREEDMAN:

So you can imagine a very skilled surgeon of some discipline who is able to operate from some central location on the patients who are geographically at some distance.

DR. WILLIAM HANSON:

Fascinatingly, the advantages of that certainly could be wonderful.

DR. LEE FREEDMAN:

There is in fact a model where a surgeon who has done some research with NASA has done some surgery on a simulated space environment that is located in a undersea laboratory off of QS called NEEMO and the surgeon has operated on simulated patient using the same kind of link and thus capabilities might be available to astronauts in the space station.

DR. LEE FREEDMAN:

That is fascinating. Are there other things within this computer or telemedicine you would like to mention?

DR. WILLIAM HANSON:

Well, I think the two other categories that I mentioned in the book are artificial intelligence and here there is a broad range of things that fall under that edges, but smart machines that can act as assistants or act under the direction of clinicians are very likely the common in model in the real world for us are things like the autopilot on aeroplane, which are really just 5 or 6 small computers have fail-safe. If one of the computers goes down, the 4 others are there to back it up and those computers control the bladders, thrust and the aeronsin various parts of the plane in much the same way that a similar computer might control the administration of anesthesia, which is field that I work in. In fact there is something that I saw recently called the mix sleepy which is demonstration where a smart computer monitors the degree of paralysis and sedation of a patient using EEG and EMG of a sort and that administers the appropriate drugs more less automatically.

DR. LEE FREEDMAN:

That is fascinating.

DR. WILLIAM HANSON:

And then the third field that I want to mention very quickly is data visualization. I work as an intensivist in the ICU and much of what our

nurses do in many of our ICUs is to transcribe data from what are essentially glorified oscilloscopes on the paper and the paper record then I combine around and I lease my way to that paper record and try to make sense of what happens to the patient over some period of time. There are electronic medical records that do this automatically, but there is essentially glorified spreadsheets and what we really need is visualizations of that data where clinicians who are like humans very good at processing information visually are presented with that information in way that they can sort of understand what's happened to that patient at a glance, so maps of the patient's blood pressure and laboratories in the link.

DR. LEE FREEDMAN:

And this would go beyond grasping. I am trying to visualize what you are referring to that would give a picture of how the patient is doing.

DR. WILLIAM HANSON:

Well, you could imagine 3-dimensional maps that would take a number of different data streams and narrow them into one field that the clinician will then, you know after times becomes familiar with what that 3-dimensional data represents, you know, a picture of a patient in heart failure for example or a patient in sepsis would go for a different if the information represented topographically or 3-dimensionally in some way.

DR. LEE FREEDMAN:

So recognizing new patterns or new ways of presenting data would lead to particular diagnosis or conclusions about the patient.

DR. WILLIAM HANSON:

Yeah. I mean very briefly. As you know that we basically take textual streams of numbers like the creatinine overtime or the blood pressure overtime or the heart rate overtime and then in a sense work with what the trend of that information is and create a visual map of that for our own purposes. So, if somebody did some of that work for us ahead time using, you know, computers and final displays and made pictures that we could process more quickly that would be much more informative than knowing that the blood pressure going from 138/71 to 142/75.

DR. LEE FREEDMAN:

If you are just tuning in, you are listening to the Clinician's Roundtable on ReachMD Radio on XM160, The Channel For Medical Professionals. I am you host Dr. Lee Freedman and with us discussing his book on emerging medical technologies entitled The Edge Of Medicine is Dr. William Hanson. Dr. Hanson is Chief of Intensive Care at the University of Pennsylvania Medical School.

Dr. Hanson, do you see certain fields in medicine where this would be less applicable to think certain primary care or psychiatry may need the person-to-person touch a little more.

DR. WILLIAM HANSON:

Well, yes and no. You mentioned two fields where there is an intuitive application of advance technologies, but you know, primary care clinicians just like intensive care clinicians have to deal with streams of data. So any way in which we can help them with distilling a fixed medical record into a concise presentation using some sort of computerized preprocessing would be of help to that primary care clinician. You know, you think of psychology or psychiatry as being a practice where you have the clinician may be sitting in a chair crossing the couch where the patient is lying, but they are in fact many applications of telepsychology and telepsychiatry where for example clinicians are working with the patients in prisons or patients in locations that are otherwise difficult to reach, so they are able to extend their practice beyond the room in which they would otherwise typically works. So, I think that technology has ways to help almost all of us and we are going to have to move in that direction in the future.

DR. LEE FREEDMAN:

That to me is very, very fascinating and makes great sense. Now, as we look at some of these possible innovations are there are certain things that you are worried about, certain abuses, certain questions we should be asking?

DR. WILLIAM HANSON:

Well, you know, in other parts of the book I have talked for example about neuro interfaces where we have devices that already allow us to take brain waves and translate them into action, so one of my colleagues here at Penn has a sort of the skullcap of electrodes that allows him to control the text on a computer screen for example and right where he is not able to talk because on a ventilator. That is a fabulous advance, but you could imagine that other sort of neural interfaces prosthetic eyes that allow us to see wavelengths that one

might otherwise not be able to see or prosthetic ears that allow us to hear wavelengths. Certain advances that might give us supernormal capabilities could take us to places we don't to be in the future. You know, another example that occurs to me is if there were certain technologies that were potentially advantageous to a patient, but were not what one might consider to be a baseline medical care that there would be patients who are haves because they can afford to buy that extra something a population of have-nots and I think is as you know the current financial environment shows us there are people that can afford health insurance and there are other people who cannot afford to having things like plastic surgery and alike. So, if in fact there were surgical techniques or prosthetics that the havesmight choose to buy that we get into a very uncomfortable situation in the future, and to give a very precise example of that what of they were very expensive life extending pharmaceutical that became available, that to me is a very scariest.

DR. LEE FREEDMAN:

In regard to that do you think it would be important to have somebody some committee, some organization to fight to govern and organize some of these developments.

DR. WILLIAM HANSON:

Well, I think that, you know, we have some significant responsivity to think about these things and by wishing that they want so and believing that they will keep them from happening, and I think that's not the way things work in the real world. Whether a committee or some organization is going to affectively stop that, I have some skepticism that having work with both committees and organizations that work in that field, but we are going to be faced with these issues.

DR. LEE FREEDMAN:

Someone like FDA for genetic research for advances in computer technology that might be helpful, you feel?

DR. WILLIAM HANSON:

Yeah, well, I think that somebody that looks at the advances that are already available and thinks about the ethical implications that very least publishes them in the way that I have sort of tried to highlights these same sort of things in the book is a good thing because there has to be public comment and somewhat public awareness of the authority up on us in some ways.

DR. LEE FREEDMAN:

In terms of cost what you have brought up, is the development for some of these technologies largely coming from private funds from pharmaceutical companies or either some governmental grants that are at work in developing these?

DR. WILLIAM HANSON:

Well, I think there is broad mix. I mean I think some of the companies that I worked with that have new technologies are start ups that have done very well, some of the advances will see in genomics and probably in stem cells are being funded by or will be funded by mix of governmental and pharmaceutical agencies. Some of the advances we will see will come from we don't think of its traditional medical industries like Goggle, Microsoft, and Intel, all of them are entering the market with different medically oriented products.

DR. LEE FREEDMAN:

I would very much like to thank our guest from University of Pennsylvania Medical School Dr. William Hanson. We have been speaking about his very exciting book called "The Edge Of Medicine". This is a book of emerging medical technologies and Dr. Hanson has outlined some broad areas of advances as well as some of the specifics within those areas and we could explain to see that there are some very exiting benefits in terms of improved healthcare that can be gained with these advances and then some cautions we have to be aware of as we go forward the apprehension also outlined for us.

Thank you very much for listening of the Clinician's Roundtable. This is on ReachMD Radio on XM160, The Channel For Medical Professionals.