

Episode: *Ethics Talk: What Does Artificial Intelligence Do for Surgeons?*

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[mellow theme music]

TIM HOFF: Welcome to *Ethics Talk*, the *American Medical Association Journal of Ethics* podcast on ethics in health and health care. I'm your host, Tim Hoff. Today, we'll be talking about artificial intelligence in surgery. Now, that could mean any number of things. Artificial intelligence isn't just one type of application or tool, and in fact, it can refer to a wide range of things that might include machine learning models like neural networks that analyze large datasets, natural language processing, computer vision, and many other types of applications. In surgical care, one facial recognition neural network application trained to identify male and female facial features was used to evaluate postoperative success of facial feminization surgeries. A natural language processing model used the massive amounts of data from patients' electronic health records to help surgeons predict potential postsurgical complications like surgical site infections. In another case, AI applications incorporate computer vision to analyze images of patients' bodies to guide a surgeon's movements during a procedure. Now, regardless of which specific tool or model we're referring to when we talk about AI, a key ethical, clinical, and translational challenge common to all AI capabilities is that they develop far more quickly than any clinician can integrate them safely into practice. Clinicians have to use what they know how to use safely and effectively, and they have to rely on tools they know are going to give them the information they need about a patient in order to help that patient.

DR CHAD TEVEN: When you go see your cardiologist—now, there are many, many advanced cardiac imaging tools—but when you go see your cardiologist, almost 100 percent of the time, they're going to take out a stethoscope, and they're going to listen to your heart.

HOFF: That was Dr Chad Teven, a board-certified clinical assistant professor of plastic surgery at the Northwestern University Feinberg School of Medicine in Chicago and contributor to this month's issue. Importantly, clinicians also need to be able to understand and explain to patients what they're using and doing and why. Clinicians do not and cannot say to patients, "Hey, you want to try this cool new thing I just heard about?" Time is needed to test new applications, usually on thousands of patient subjects, and the best clinical and ethical reasons for that fact are that new things that get incorporated into practice, regardless of what kind of technology it is, have to work and have to work safely and effectively.

TEVEN: How do we allocate our limited time to learning the basics and then to also learning this newly implemented or newly evolving technology? And so, at the end of the day, fundamentals come first, principles come first, and we can build upon principles and fundamentals.

HOFF: Dr Teven is with us today to unravel some current and a few hoped for surgical applications of artificial intelligence. And he's here to model for us how he thinks through the ways we should be critically engaging with AI surgical research and scholarship. Dr Teven, thank you so much for being here. [music fades]

TEVEN: Thank you very much for having me, Tim.

HOFF: So, one of the problems that's common to emerging technologies of all kinds is that the quality of information about a technology and its applications can be compromised by market incentives, in this case, specifically, pressure to seize lucrative market share by increasing the pace of research and development. For instance, in the research for this interview, we found that a recent review of articles on AI integration into robot-assisted surgical techniques found many reports to be of low quality. So, what advice do you have for our listeners to keep up to date on realistic surgical applications of AI technologies?

TEVEN: That's a great question. And part of the problem is that many of the reports are on technology implementation that really has a low sort of N. And so, some of the technology that's being implemented isn't utilized clinically, or it's utilized not to a great degree. And so, I think pointing this out is some of the best advice that our listeners and that our providers, that our patients are aware of the fact that despite the fact that technology can be very advanced—and we know that the coding and the software development behind a lot of this is extremely complex—that doesn't mean that the research itself is being done in any type of complex fashion. And in fact, we just have to really carefully look at the studies and ensure that we're collecting data appropriately, we're analyzing it appropriately, there's a control group to the extent that that's possible and feasible and realistic.

And also, we just have to be mindful of the fact that much of the actual technology development from a software standpoint is far outpacing technology implementation at this point in time. While there are goals that the use of this technology is going to help significantly reduce cancer burden and things along those lines, we're not yet at the point where we can say with certainty that, oh, I've got this technology, and this is going to work 100 percent of the time. I'm aware this is important. Also, along those lines, staying up to date with what's out there, with what's being published in the various medical journals, is going to be key to know what's potentially possible, what's not, staying abreast by attending conferences and interfacing with colleagues. And so, if there's a question, really trying to find the answer from colleagues who might be in the space or might have some knowhow about how to get that information.

HOFF: Yeah, that's good advice. Thank you. Before we get too far—and we talked a little bit about this in the introduction to this episode—but artificial intelligence can express in a wide range of technologies: There's machine learning and neural networking and natural language processing, and computer vision, all of these things. So, if we're interested in potential uses of AI in robotic-assisted surgeries, which AI technologies deserve our clinical and ethical attention? Help us narrow our focus a little bit here.

TEVEN: I think we're focusing here on AI in robotic-assisted surgery. And so, robots are utilized in surgery every single day with great success. And more and more, there are ideas as well as implementations of utilizing AI in robotic-assisted surgeries. And so, whether that be with surgical planning, preoperatively or intraoperatively or even just AI assisting the surgeon in making decisions based on where the surgeon is in the operative field and ensuring that all of the relevant anatomy is assessed and examined. And so, these are the key areas clinically. But what's really interesting is ethically, we're not anywhere near a point right now where robots are performing autonomous surgery in the clinical arena, but it is possible that at some point down the line there will be discussion of that as well as potential implementation. And so, ethically, we have to figure out, is that appropriate? Should a robot be performing an operation on a human being without a human being supervising that robot?

And it can be argued from both sides. And just even very simply, on the one hand, we know that even very advanced AI-based technologies can make mistakes. We also know that a lot of the

data that's imputed into these technologies will be reflected in the output. And so, if the data going in isn't so good, the data coming out might not be quite as good as we would hope. And so, that's where having human supervision is key. But at the same time, if we've identified AI-based robots that are actually better than humans at performing a certain task or a certain function or a certain operation, then it might be argued that the robot should be doing that operation. And so, ethically we really have to figure out what the appropriate balance will be there. My own opinion right now is that there should always be human supervision just because we don't know all of the potential consequences of utilizing this technology.

HOFF: Right, right. So, speaking of how sort of readily we accept these kinds of tools and applications into practice, I'd like to turn a little bit to your own field of plastic surgery. So, despite being known as an innovative surgical subspecialty, plastic surgery as a field in general has been a little bit less aggressive about using robotic tools. So, which features of AI in plastic surgery should make us pause and deliberate carefully about their integration? Is there a reason that plastic surgery is being a little bit more cautious about these than one might expect given their history of accepting new technological innovations in the surgical space?

TEVEN: Well, plastic surgery, I think one of the reasons that robotics hasn't been quite as widely adopted in plastic surgery is because much of the operations or many of the operations that are performed in plastic surgery are performed on the skin or relatively superficial or subcutaneous tissues. And robots, as we know, have high utility once we're going deeper within the body, so inside the abdominal cavity, inside the pelvic cavity. And so, just because plastic surgery often isn't performing operations in those areas, there might be less utility with respect to robotic surgery. Now, that's changing, and there've been several use cases within plastic surgery in which robotics have been successfully implemented.

So, for example, using a robot in the case of an APR to help fill a defect in the pelvis, so to harvest some muscle from the abdominal wall to fill a defect, that can be done robotically and has been shown to be successful. There are studies ongoing looking at the use of robot in the field of lymphedema, so vascularized omental lymphatic transplant. We've used both single-port and multiport robots to harvest the omentum, which is then transferred to another area of the body in which there's a deficiency in the lymphatic function or number of structures. It's also been reported in the use of harvest of the latissimus muscle. And so, there are several potential uses for robotics in plastic surgery. Now, moving forward, there probably will be more potential uses even on more superficial structures. And so, if we're able to perform a more precise operation, facelift, for example, with a robot, then there's probably going to find, there's probably going to be utility there as well.

HOFF: Right, right. So, on the flip side of these sort of concrete uses of AI-assisted robotic surgical tools are the maybe pre- and postsurgical tools that might help assess patient outcomes. So, for example, plastic surgery relies heavily on patient satisfaction with aesthetics as one measure of good outcomes. So, how might artificial intelligence improve surgeons' and patients' access to data that could be used to better evaluate aesthetic expectations prior to surgery and then maybe help measure patient outcomes and satisfaction postsurgery?

TEVEN: Yeah, that's a great question. And so, one of the big potential uses of artificial intelligence within medicine and really more broadly is that it allows us to capture a whole lot of data and analyze a whole lot of data much more quickly than can be done with human beings. And so, oftentimes, assuming that the data is collected appropriately and it's representative, then the more data, the more information we have to make appropriate decisions. So, that goes both for providers as well as patients. And so, if we're able to leverage big data, as it were,

which heavily relies upon artificial intelligence, there will be a whole lot more information for providers to make recommendations about specific procedures that a patient would likely benefit from. And also, patients would have more data in which to make their decisions, whether that has to do with making a decision about a specific procedure, about a specific surgeon, about a specific location, so hospital or ambulatory center, things of that sort. And so, AI is going to allow us to collect more data and analyze it to a greater degree than we're able to do without it.

In addition, there are natural language processing programs that allow us to go through free text within Epic, for example, and look for what it is providers are reporting from patients or even potentially what patients are saying in messages. And assuming that this is all appropriately consented, we might be able to leverage this technology to identify specific places where patients tend to report satisfaction or dissatisfaction. And so, again, this allows for the collection of more data.

HOFF: Hmm. Do you know of any projects that do that, that use that natural language processing to analyze patient records?

TEVEN: Yeah, there are a lot of examples, many of which are still in their infancy stage. I recently attended the HLTH conference Health as well as ViiV, and on both of the conference floors there were many companies that were utilizing NLP, or natural language processing, and looking at potentially implementing those technologies into things like Epic or Cerner to be able to look at what patients and providers are saying.

HOFF: Yeah, I think that provides a good overview of how AI might be integrated into kind of medicine as a whole to deal with the increasingly large sets of data that clinicians and even patients have access to. But turning back to plastic surgery a little bit more specifically for a moment, what kinds of tools and applications? We talked a little bit about plastic surgery's, maybe reluctance—I don't know if that's too strong a word—to take on some of these new tools, but what kind of tools are being integrated into practice already at this point, specific to plastic surgery?

TEVEN: So, there are a couple areas within plastic surgery that are already starting to use AI and really thinking about how to use it going forward. One of the areas is with preoperative planning. There are a lot of programs, photography-based programs, that allow providers to show patients photographs of themselves and then manipulate those types of photos. Well, many of these programs are actually moving on to sort of, they're advancing in a way in which the technology learns from previous case examples and gets smarter, so to speak, to allow for more accurate predictions. And so, these are relying upon machine learning-based mechanisms. There are also examples that rely upon computer vision, which basically helps capture images, process them such as the human eye would, and then make predictions. And so, AI, it can mean so many things. And really, its use is still in its infancy within all of medicine, but in particular plastic surgery, though there are a couple of emerging areas that seem to be well on their way to more widespread clinical implementation.

HOFF: Yeah, yeah. It sounds like all of these tools have the potential to be really helpful to both clinicians and patients. But I think it raises the question of how we go about actually integrating them into the workflows for clinicians and hospitals around the country, and then how we actually train clinicians to use them. So, given the rapid speed of development in AI, how should surgical education curricula help students and trainees learn and adapt when the tools that they

use for caregiving today might be obsolete tomorrow, or to stick with the metaphor, might be obsolete later this afternoon?

TEVEN: [laughs] Yeah, right, exactly. No, it's such a good question, too. It's...well, the thing is, is that we don't know. Our ability to forecast which tools today will continue to be used tomorrow and which will not, it's not all that good. And particularly the further along we're trying to forecast, the further into the future, our ability to predict is going to reduce. And so, I think at the end of the day, when you go see your cardiologist—now, there are many, many advanced cardiac imaging tools—but when you go see your cardiologist, almost 100 percent of the time, they're going to take out a stethoscope, and they're going to listen to your heart. And in many ways, that does provide some diagnostic information, but there are other ways to get a lot of that information and potentially even more precisely. But nevertheless, we need to be able to assess patients in a way that doesn't fully rely on automation or technology because technology isn't perfect. It could fail. The power can go out. And so, the tools that we use today are going, unless there's a clear indication that something is going to be obsolete maybe because it's just less safe than sort of an emerging technology, we still need to be able to make assessments of our patients with sort of the non-technologically-based measures, so physical examination, history, those kinds of things. But this does remain a very good question.

So, you've got this new technology, and medical students, residents don't know, particularly as they're more junior, they don't know some of the basic surgical skills that they're going to need. But yet, we've got this new emerging technology. So, how do we allocate our limited time to learning the basics and then to also learning this newly implemented or newly evolving technology? And so, at the end of the day, fundamentals come first, principles come first, and we can build upon principles and fundamentals. [mellow returns] But if we just jump to learning about sort of the new emerging technologies, then we're going to lose out on those fundamental building blocks. And so, I think that's got to be stressed at both the undergraduate and graduate medical levels.

HOFF: Dr Teven, thank you so much for your time on the podcast today.

TEVEN: Thank you for having me.

HOFF: That's all for this episode of *Ethics Talk*. Thanks to Dr Chad Teven for joining us. Music was by the Blue Dot Sessions. To read the full issue on robotic surgery ethics for free, head to our site, journalofethics.org. For all of our latest news and updates, follow us on [Twitter @journalofethics](https://twitter.com/journalofethics). And we'll be back next month with an episode on palliative psychiatry. Talk to you then.