

Tutorial

An intelligent operating room of the future – an interview with the University of California Los Angeles Medical Center

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Abstract

Based on an interview with the University of California Los Angeles (UCLA) Medical Center, which is currently building a new facility to include an intelligent operating room (OR). UCLA's goals for the intelligent operating room are to lead the development of the latest robotic and computer-assisted medical and biomedical devices and technology, to have a flexible broad intelligence of space planning, and to have a paperless yet seamless data exchange of patient and doctor information. UCLA's planning strategy, a multidisciplinary collaborative approach to patient care, is based on a partnership between academic engineers, practicing clinicians, practicing physicians, and manufacturing industry. By creating an intelligent OR, the UCLA Medical Center hopes to improve patient satisfaction, retain and attract the best surgeons, and eventually, through the continued incorporation of image-guided surgery, be able to decrease surgeon variability.

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Introduction

The operating room (OR) of today may soon be replaced by the operating room of the future, an intelligent OR which features computer-enhanced and robotic systems and a network of voice-controlled medical instruments. The intelligent OR will allow for new, minimally invasive surgery procedures currently not possible and will result in faster surgeries and improved productivity as well as reduced patient trauma, recovery time and patient costs. A few pioneering hospitals in the USA utilize an intelligent operating room. One hospital, the University of California Los Angeles (UCLA) Medical Center (Plate 1), is currently building an intelligent OR to house the latest advances in technology to better serve its patients. The following article is based on an interview with UCLA Medical Center's Dr Pete Schulam, an Associate Professor in Urology (Plate 2), and Frances Ridlehoover (Plate 3), Chief Operating Officer, who discussed their goals and strategies for their new intelligent OR with *Industrial Robot* journal.

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The UCLA's Medical Center is building a ten-story, one million square foot, 525-bed facility that is scheduled to open in 2004, and is building an intelligent OR. How would the University of California Los Angeles Medical Center define an intelligent OR?

Frances Ridlehoover

One of the things that we consider to be intelligent about an OR is that it be flexible,

Plate 1 The University of California Los Angeles Medical Center's new hospital will include an intelligent operating room



that there be a broad intelligence of space planning so that its intelligence can change and grow over the life of a building. We have put all of our interventional procedure rooms, whether they are operating rooms, cardiac catheterization labs, or interventional radiology rooms on one floor and designed them all in a standard fashion so that we can move the red line backwards and forwards. We have put a full access mechanical floor immediately above this operating room floor so that we can go in and modify if we need to without disrupting a fully functional sterile environment.

Dr Pete Schulam

I think an intelligent OR is one that is a place to manage information – a place for data transfer of information from the patient to the hospital and physicians, and back and forth; and a place that will allow for rapid development and change in surgical techniques in which innovative surgical

technologies can be implemented easily such that we can maintain our goal of curing the patient, while at the same time subjecting the patient to the least amount of morbidity or pain and discomfort and recovery time possible. In order to do that, what things do we have now that we need to make sure are implemented? Obviously the big thought is laparoscopy, and then eventually robotic surgery, and the potential need or use of telesurgery, such that in an operating room not only do you have a surgeon who is operating but you can get advice or direction from surgeons around the world. That is where we are currently, but all that will change in the next five to ten years.

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Is there a model that your Medical Center is basing the intelligent OR upon, are you just relying on a committee of experts, or do you know of other hospitals and centers that are using these technologies?

Plate 2 Dr Pete Schulam, Associate Professor in Urology, UCLA Medical Center



Dr Schulam

Of course we look at what everyone else has in the community and what is out there currently because that is the way everything evolves. We went around and looked at other centers that we think are doing what they can to push the envelope and then we see what they have, we try to evaluate the pros and cons, and then we try to come up with something better based on their designs. At the same time, however, we are trying to be a little bit different because we want to think outside the box so that we do not make a small incremental step, but perhaps a little bit larger one.

Ms Ridlehoover

Part of what we think is going to drive the ongoing improvement in intelligence in the OR is having intelligent people close by. As part of our development in planning for this, we have designed spaces close to the operating room where engineers can live and be housed and interact on a regular basis with our surgeons and the technical staff in the operating rooms. Therefore, as the technology evolves, we are leading the development of the technology

Plate 3 Frances Riddlehoover, Chief Operating Officer, UCLA Medical Center



rather than having outside companies bring new technology to us. The engineers that are developing technologies at various companies are working hand-in-hand with our physicians and they see what the physicians need in order to improve services in the operating room. Then they go make what we need instead of trying to sell us what they have previously made.

I think one of the keys of our planning strategy has been that what we develop is developed with surgeons from various specialties because in order to take technology that is developed and make it marketable by industry, it has to be useful to as many people as possible to make that a good business endeavor. If we can get neurosurgeons and urological surgeons and cardiothoracic surgeons to reach some sort of agreement over development and define technology that is useful across a specialty, then industry will have a much stronger motivation to develop and market that equipment and we will get better equipment at a lower cost.

I think it is important to note that when we are planning something that is as new and unknown as ORs of the future it has been very

important to us to have strong philanthropic support in developing these programs. Over time they obviously have to become self-supporting, but I think philanthropy is the key to getting started.

Having developed a strong partnership with companies like Computer Motion is what is going to drive the future intelligent operating room. It is a partnership between academic engineers, practicing clinicians, practicing physicians, and manufacturing industry. Computer Motion and UCLA have developed that strong collaboration.

Dr Schulam

In the past, industry has created products and brought them to us and looked for solutions, when in fact we should go to them with the problems and then help them design the product that will meet the solutions. One way of doing that is bringing industry right into the operating room and working with us directly. At the same time who is going to feed industry? How is industry going to continue and who is going to be responsible for going into industry and acting as the liaison between both the industry and the hospital members? I think the best way to do that is to begin now to think about how to integrate engineering programs and engineering schools into the hospital early on. We are fortunate enough that UCLA has a very large engineering school that happens to be on the same campus and within walking distance of the hospital. Not only is the surgeon going to be interacting with industry, but he/she is also going to be interacting with academic engineers in the university and with upcoming students and fellows such that when the students leave here they can then go work with industry and hopefully propagate our little solution for the problem.

We also have a large biomedical engineering program with interest in such areas as Micro Electro Mechanical Systems (MEMS) technology, which will help hopefully downsize things that we currently have, such as surgical robots, so that they are very reasonable in size and in function to incorporate into the operating room.

Basically we are trying to take advantage of what we have here – because we have a large engineering school with very active engineers, we have a bio-medical engineering program,

and we have the areas of interest such as MEMS technology that can be applied to robotics to help make robots that are currently available, but are relatively large and not perfect, more reasonable and hopefully a better product that can then be incorporated into all operating rooms.

Ms Ridlehoover

If through MEMS technology, for example, we could get a biochemical analysis at the cellular level done through an instrument that can be used through minimally invasive surgery, we could do diagnostic testing in surgery that we can only do now after the fact, after removing tissue from the patient.

IR

In what you have existing now, what was the motivation or the justification to go forward to create an intelligent OR?

Dr Schulam

For the whole system, it is realizing that surgery is changing and that we have all witnessed in the last ten years the introduction of laparoscopy. I think the momentum is with us that change will be a little bit more readily accessible or it will be a little more easily applied in the newer operating rooms. The question becomes, "What is the next thing out there?" We all started thinking: "How are we going to affect the future? How best to introduce the next wave of minimally invasive surgery?" It was a university decision that we needed a place (an intelligent OR) to basically think and apply our thoughts and come up with a strategy because in the next five, ten, or 15 years this is something that will always advance and we needed a stage or platform to do this in. It was just a quick decision based on what we have seen in surgery in the last ten years and where we think it is going; and wanting to be a state-of-the-art medical center that will influence how medicine is practiced in the USA and in the rest of the world.

IR

What types of robotic surgery and telesurgery are you utilizing now?

Dr Schulam

Everything is now just being integrated so we have robots that hold cameras that we are slowly implementing in the OR, and we have the robots that are available for suturing, called micromanipulators. They are available for research purposes and they are slowly being FDA approved to be used in the operating room. Telesurgery becomes a legal issue but we have applications or systems that will be made available to us here such that we will be able to observe other people operating and potentially guide them through surgery. The next step obviously would be able to take one of these micromanipulators and not only run it from six feet away from the table but from somewhere else in the hospital or in fact somewhere else in the USA. All these are gradual steps. But what do we have now? We have the surgical robots that are FDA approved currently in the operating rooms: Computer Motion's AESOP[®] and ZEUS[™] the micromanipulator being set up in a cadaver lab here.

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Besides robotic technologies, are there any other automated technologies that are being utilized now or that you expect to be able to utilize through your new intelligent center?

Ms Ridlehoover

We have taken a mantra on building our new hospital that says we are going to make decisions at the last responsible (as opposed to possible) moment. What we have put in is the ability to use wireless communications (we are not doing that in our current facility) and everything we are intending to put in the new hospital we would like to model, if it is practical from a facilities standpoint, in our current operations so that we are fully operational when we open in 2004.

Dr Schulam

One of the other aspects of the intelligent OR in the intelligent hospital is basically to be paperless. That way there is real-time accessibility to patient information to everyone.

Ms Ridlehoover

For example, we intend to have in the new hospital, cameras in the surgical ORs that will link directly to our anatomic pathology physician service area so that we can have a real-time communication between the pathologist and the surgeon in the operating room.

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What other benefits to doctors/surgeons and patients do you see?

Dr Schulam

Having accessibility to data – the patient’s chart essentially – or even what is going on in the operating room. We are going to have everything digitized so that there will be a store of every operation on a bank that the physician can then pull back and edit. And if one thinks about that, what will be amazing is, not only do you learn while you’re in the operating room, but to go back and be able to re-evaluate, or for training purposes to take the information from various cases and then use that information for teaching courses. I think it can greatly benefit not only physicians and patients but also education in general. Without a doubt, the greatest way to learn anything, especially something as mechanical as surgery, is to do it, and if you can in some way, speed someone’s education along in surgery by exposing someone in a very short period of time to as much variability as possible, you can see where they would then gain years of experience. There is currently no way of doing that and this is potentially one way – by going out and harvesting as much data as we can while we are actually performing it, editing it, and then presenting it back to students, residents, and other physicians.

Ms Ridlehoover

The next important step after that is to be able to take dimensional images of patients prior to surgery and have the surgeon and the house staff be able to do a simulated surgery on that particular patient’s anatomy prior to the real surgery. Instead of training after the fact on other cases you could actually train ahead of the fact on the case you are going to do.

IR

What results is the UCLA medical center hoping to achieve by housing an intelligent OR?

Ms Ridlehoover

I think we will be able to retain and attract the best surgeons who will want to work with the best technology and that is clearly important to our clinical mission as well as to our academic mission. I think it will improve patient satisfaction if the outcomes are improved as expected, particularly as it relates to recovery time and pain. While we do not necessarily expect to save any money in the operating room, reduced recovery time could potentially save money on the cost of a patient’s case and their care across the case. Also I think having communications that will cover specialties both in the operating room and outside the operating room will drive a multidisciplinary collaborative approach to patient care which is in the best interest of the outcome for the patient care and very satisfying for the people who work in that environment.

IR

What do you envision the intelligent OR of 2010 to be like?

Dr Schulam

The outcomes will be less dependent on surgeon variability, i.e. there is going to be more incorporation of patient’s pre-imaging, of image-guided surgery, and of computer-assisted and robotic-assisted surgery such that the goal should be the same operation with the same outcome regardless of whether it is performed here, in Boston, or in Houston.