

## Interview with... Ana-Iulia Alexandrescu

*Ana-Iulia Alexandrescu is Professor of Practice and Director of Healthcare Systems Engineering Professional Master's Program, Lehigh University. She focuses on the challenges and opportunities involved in applying the principles of engineering, in a rigorous and systematic way, to streamline healthcare and enhance its safety. Inside Medical Liability wanted to learn more about this exciting, and still developing, field.*



**Inside Medical Liability:** *Do professors in healthcare and engineering speak the same language? Or, does a new, shared vocabulary need to be developed before collaboration can begin?*

**Alexandrescu:** We have been developing a bridge between the very technical vocabulary that systems engineering experts use and the discourse used by people who work in care delivery. These include administrators and public health officials as well as physicians, physician assistants, nurses, and technicians. For our tools to work effectively, we need to understand what those in healthcare do. Often, when we collaborate on projects, we get deeply involved in the details of what healthcare professionals do, so that we can fully understand the processes that they work with, and we can be maximally effective.

**IML:** *Can you provide one or more specific examples where health systems engineering was used to improve care, with tangibly better outcomes?*

**Alexandrescu:** I will give you a simple example. When a patient goes to a physician's office, he checks in; then he has to wait. Then he is taken to the examination room, where a nurse may record his vital signs. Then, the physicians will see him. Then, eventually, he may get some tests, such as blood work, and then return to the examination room and then, finally, check out at the front desk. Frequently, a patient will show up for his appointment perhaps 10 or 15 minutes early, but then may need to wait for a long time. Some patients never do show

up for appointments. Between the date when they made the appointment and the day of the appointment, their symptoms improved, and they decided that they did not want to sit and wait in a physician's office.

On many occasions, if staff notice that there are many people in the waiting area, someone in the office might say, "We need a bigger waiting room." Or, "We need to hire more staff." But we address the problem this way: We follow the various individuals as they progress through the appointment: patients, staff, and physicians. We do this to make sure that we understand how things work, from a system perspective. We usually draw two or more diagrams that we call "flow maps," just to ascertain that we have captured all of the steps that are entailed in the process: what is done, which parties are involved in each step, and how long each of these steps takes.

Then, after that, we may enter all of the information into a simulation model. Once we get data that capture the patterns of various patients' arrivals, we try to simulate the randomness of them. For example, in a doctor's office, there are individuals who are scheduled to arrive at a given time, but they don't all arrive at the office on time. Also, there will be people who arrive without an appointment—people who just walk in. Finally, there will be some people who leave before seeing a healthcare professional, just because they are tired of waiting.

We put all of this information into a simulation model, and, using some powerful statistical tools, we may be able to conclude, that it's not actually a shortage of doctors that is creating problems because, physician utilization at this point is only around 40%. Then we might ask, is it a consequence of having too few rooms? But our analysis might well show that even if we were to add an extra room and an extra doctor, that would fail to solve the problem—because what is actually needed is one extra nurse. Or, we may find that the process includes three redundant steps: a given patient has his vital signs checked three different times, because there isn't well-thought-out coordination in what happens.

But if we introduce a process in which the patient has his vital signs taken only once, and everyone on the staff is informed about that, patients flow through the systems more seamlessly. We have found that we don't actually need to add either doctors or rooms, because we have enough capacity for everything.

This issue can be observed in outpatient settings and in emergency departments as well. The problem of ED crowding is quite significant.

We worked quite recently on a project of this sort. Some people use EDs for care, instead of a primary care doctor or urgent care facility. So, there are emergency physicians who have been trained to care for trauma cases and complex conditions, and instead, are seeing people

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We could redesign the patient flow such that the nosebleed patients see a nurse practitioner initially, so that they don't have to wait as long as they might otherwise in a triage system. The more serious cases would be seen via a different flow.

Well, in theory, that makes sense. Basically, you want to triage the patients right at the beginning, and then take each person down the correct path. However, this scheme may well break down—and you can prove it mathematically—if you try to do this without actually adding any resources. Because what you are doing is splitting the queue in two. Here is an analogy: If you stand in line to buy a bus ticket, you will wait in one long line and then, from that queue, you will be assigned one of several different agents, who will take the next steps, such as checking your ID or selling you a bus ticket. It is more efficient to start with a single queue.

Also when you implement a “fast track” system, but don't actually add more resources, you merely split the queue into two, and so the overall processing time increases, such that at least one of those queues ends up grinding to a halt, eventually.

**IML:** *Does what you, and your students, do increase patient safety?*

**Alexandrescu:** Yes, both directly and indirectly. Most of the projects that we work on are indirect contributors to patient safety. For example, if there is a very crowded ED, that is a very stressful, chaotic work situation. Some patients, stuck in the waiting area, will get tired of

waiting, and leave without being seen. That is not good, because they're not getting care.

Also, from the ED, many patients get discharged or admitted to the facility—as inpatients. If that process isn't flowing properly, there will be backlogs in the ED; people will be waiting in the hallways or are taking up the ED rooms, so people from the waiting area can't be seen. This issue then “trickles down,” and impacts care at every point. Think about what ideal care is, from the patient's point of view, in terms of safety. He wants to be seen by a person who can tell him what medical condition he has and who will be able to direct him to the next step in care, as soon as possible.

So, the more efficient the flow of patients through the ED, the more quickly patients get care, which means that fewer people will leave without getting care. It would also mean that fewer people will be stuck in the in-between status of having been admitted to the hospital but still physically in the ED. In that situation, the ED doctor gets frustrated because he needs the ED room for a new patient, but the patient's inpatient doctor hasn't taken charge of the patient yet. That creates chaos, and a sort of limbo, which is not conducive to good care.

So in an indirect way, if you have efficient care practices, you have a saner, less chaotic work environment that's better for everyone involved. You have fewer patients who are waiting for a protracted period of time to get care, fewer people leaving without being seen, or stuck between the ED and an inpatient room.

There are also factors that we work on that relate to human factors engineering. There are methodologies, in ergonomics, which impact patient safety: for example, having everything correctly labeled, and put in the right place.

**IML:** *Do you see any limits on the application of engineering in medicine?*

**Alexandrescu:** I do have to walk a fine line with this, because I'm not a clinician. I would never be comfortable making a clinical judgment, or some kind of a clinical process improvement, myself. I just don't have that kind of expertise. When I work with my students on projects, we always partner with a member of the institution. And depending on what area the person is in, that member has to have the relevant expertise.

So if we're working on a project in an ED, then we better have some emergency medicine clinical staff who are on board with our project. Because we could optimize the heck out of it—but it might not make any clinical sense or help anyone. In the end, the winning team will be the multi-talented team. There will be systems engineers, but they work alongside clinicians and public health officials, because the problems are multi-dimensional.