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Discussion

Perspective: Transforming medical education through informatics

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ABSTRACT

In the United States and around the world there have been massive changes in the way that health care is evolving – the way that we deliver care, the models of care, the concept of the interprofessional team, the system of care as a network that extends increasingly outside of the hospital much more than in, population and global care, and evidence-based medicine. We are challenged to keep up with our education system's "adaptivity" in this dynamic environment.

At the same time the disruptive effects of technological advances are dramatically accelerating and will challenge the way that healthcare providers, schools teaching young doctors, and patients themselves will experience and understand clinical data. There are emerging technologies that will be implemented around the world, almost instantly; whereas, these analogs in the past took decades to spread globally.

Keywords: Medical education, Educational technology, Educational innovation

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WHY CHANGE?

Important clinical trends are driving schools to transform their educational and delivery models. Medical care that was once based on episodic interactions with individual patients is now intended to be population-based and continuous. From healthcare being provided solely by the physician, we now function in inter-professional teams, with many representatives of different disciplines being integral to the patient's well being. We have moved from focusing on the needs of the provider to being guided by the needs of the patient, and our medicine is more evidence-based than anecdotal. And one of the biggest changes to occur in the last part of the twentieth century is that care once seen as most importantly given in an in-patient setting has become largely ambulatory.

TECHNOLOGY IS ACCELERATING

There are numerous examples of technology already in play in medicine, being replicated in medical schools and used in training. The term "connected health" has evolved to encompass the use of technology, often inexpensive and readily available to consumers, to deliver patient care and collect clinical data remotely.[1] For example, an iPad-based electronic medical record can be quickly and easily implemented in any setting. Mobile connected health devices (Table 1), are good exemplars of infrastructure being adopted globally at a much faster pace than traditional clinic- and hospital-based solutions. An iPhone 5 case can now function as an EKG machine and be carried in a pocket. There are even handheld ultrasound machines that can deliver high fidelity ultrasonography anywhere. These technological advances are going to change the way that we collect data from patients and dramatically change the way our patients will collect data about themselves.

MASSIVE OPEN ONLINE COURSES

At the same time that healthcare is being transformed by technology, there have been similar disruptive changes across higher education. These changes are not limited to the United States and are a fundamental shift to new models of Massive Open Online Courses (MOOCs), a prominent feature of educational delivery at every level.

In the span of a few years, there has been tremendous growth in online learning resources, including OpenPediatrics, MedEd Portal, Khan Academy (Table 2), and many others that are changing the way that we think of education. These systems do not care about the location of the learner, in either time or place, and they are increasingly agnostic as to the location of the teachers, as well. If you were to ask our students across the world what tools they require in order to learn, communicate, and collaborate as they learn medicine, their list of resources would be a global one, not just the schools they attend.

Recent evaluations of the use of MOOCs show that technology is transforming global education. It is no longer just a concept. It is really happening; the transition has been made. Data from an MIT course on "Circuits and Electronics" found that an incredible 155,000 students enrolled. This group of learners came from almost every country in the world.[2]

TECHNOLOGY AND GLOBAL MEDICAL EDUCATION

At NYU School of Medicine, we created an infrastructure to begin what was tantamount to a software start-up within our school of medicine. We did this to have the capability to create new resources

Table 1. Examples of connected health devices.

Description	Vendor	Availability
Portable EKG in an iPhone case	AliveCor http://www.alivecor.com	Over the counter and available to consumers
iPhone-connected glucometer	IBGSTAR http://www.ibgstar.us/	Over the counter and available to consumers
Activity and sleep tracker	Fitbit http://www.fitbit.com/	Over the counter and available to consumers
Pocket ultrasound machine	GE / Vscan www.gehealthcare.com	Available to licensed providers only
Mobile vital sign monitor: temperature, ECG, BP, Oxymetry	Scanadu Scout https://www.indiegogo.com/projects/scanadu-scout	Pre-release, under FDA review
Wireless blood pressure monitor	Withings http://www.withings.com/	Over the counter and available to consumers

Table 2. Examples of open education resources in health professions education.

Provider	URL
Coursera: MOOC Provider	https://www.coursera.org/
edX: MOOC Provider	https://www.edx.org/
MedEdPortal: Free medical education resources from the AAMC	https://www.mededportal.org/
Khan Academy: Free online library of educational content and assessments	https://www.khanacademy.org/
OPENPediatrics: global e-learning resources for critical care pediatric medicine	http://openpediatrics.org/

and invent new technologies that embrace and acknowledge the fact that informatics and educational informatics can transform the way we teach.

The Division of Education Informatics at New York University (NYU) was founded in 1987 as the Hippocrates Project.[3] It is one of the largest and oldest Medical Education IT units in the country and has successfully developed projects in the research and international realms. One of the first things we realized was that our medical students were often choosing to consume their medical education resources. Students were sometimes choosing to view the recorded lecture over attending in person; they use online collaboration tools to work in small groups; and they increasingly use e-learning materials over printed books and syllabi.[4] The local use and consumption of education and the concept of distance and global education are increasingly converging and becoming one.

Educational informatics tools at NYU School of Medicine – screencasting lectures, using tools to allow students to collaborate online asynchronously, empowering faculty to interact with students and have electronic office hours, offering class bulletin boards, the ubiquitous use of computer-based assessment and e-Portfolios to allow students and mentors to measure competency-based performance over time – are all tools that we use locally. They are largely the same tools used by MOOCs and could easily and effectively deliver the same educational content to a global audience.

We also have tackled some of the classic, non-scaleable, non-distance elements in the teaching and learning of medicine. For example, for 175 years the microscope has been used to teach histology and pathology and is a core part of medical school. We saw that our students were not collaborating when it came to using microscopes in the same way that they were collaborating in other team-based learning activities. Our faculty recognized that the competency they wanted to teach was not how to use the microscope, but how to understand what they were seeing and how to correlate that with clinical information and communicate among each other.

We thought there must be a better way. We asked ourselves, what is a great way to look at large sets of images and navigate them? The answer for us was to leverage the Google Maps engine, which is open and free, with digitally scanned versions of our entire microscope slide collection. This created a system by which our students could explore and collaborate on all of their histopathology content. Google Maps had the added benefit of having been used for years by students and faculty for directions on how to get around town.[4] In our system, students can zoom in and out, navigate, and see down to the cellular level. We now have about 1300 slides online.[5]

Perhaps most importantly, beyond setting aside physical microscopes in this system, we have empowered the students to begin contributing some of the content. In Figure 1, the red markers are faculty authored and the black markers are student authored. If you look across the system, 86 percent of the content in the system is authored by medical students and not by faculty. That is not a measure of quality. The students can provide peer review and vote up or down on the markers that other students create, so that they can maintain and curate content.

This has had a significant impact on our teaching and learning. After only six weeks, our faculty decided to stop using physical microscopes in the medical school, profoundly altering the way we teach histopathology and moving to this entirely virtual platform. It is no longer a course solely anchored to a lab that takes place on specific afternoons in the first year of medical school. It is becoming a continuum of learning with ubiquitous available content that now is spread throughout the four years of medical school. This is a powerful example of how disruptive technology can not only change the way we teach, but also the way we could approach global collaborations.

Another example of classic-to-medical school education is the teaching of human anatomy using cadavers. Cadavers are an important part of our medical education and we are committed to maintaining that experience because it is a crucial part of becoming a physician. We sought novel ways

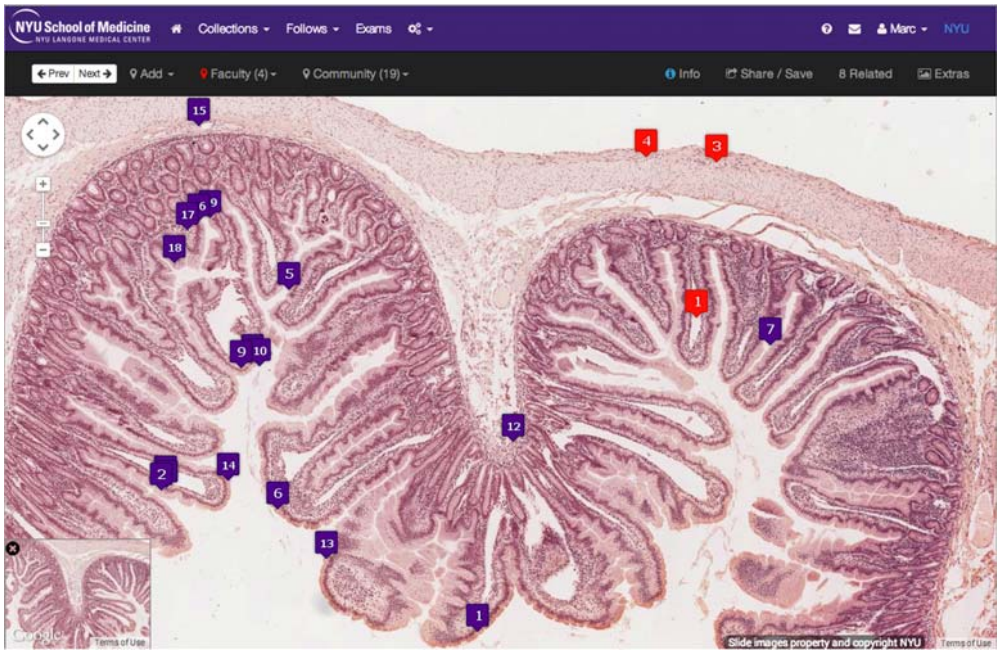

Figure 1. NYU virtual microscope with student (purple) and faculty (red) markers.

to use educational informatics solutions to extend the teaching of anatomy outside of the lab and across our learning continuum.

We partnered with a company in New York City to create "The Biodigital Human."[6] It is completely web-based, and the user does not need any special software (Figure 2). It is a virtual reality, interactive human, used in our anatomy lab as an adjunct to the cadaver. Students can manipulate this body, visualizing the human anatomy in ways that are physically impossible in the human cadaver. Students can link out to individual educational resources and link on campus to their lab manual.

The cadaver is the anchor upon which our students learn anatomy and this technology can extend it. In our anatomy lab, students use 3D, stereoscopic versions of a microscope, wearing 3D glasses while

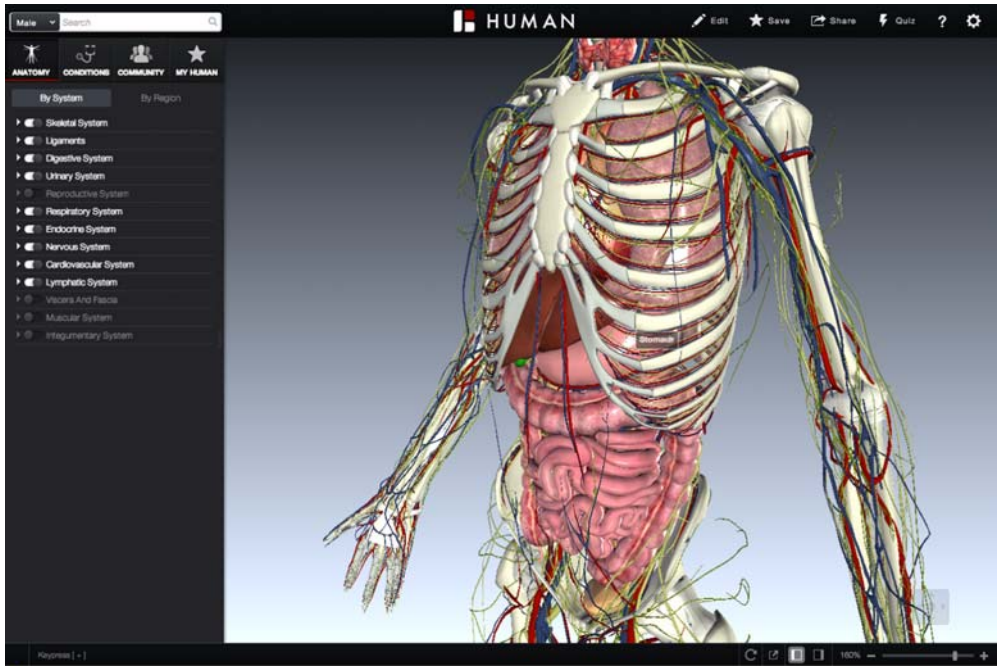

Figure 2. Biodigital Human.

Figure 3. New York University Virtual Anatomy Lab.

dissecting a human cadaver (Figure 3). Projected on the wall next to their cadaver is a virtual reality immersive human that they can manipulate.

We had an unplanned event that showed us the global nature of this technology, when Hurricane Sandy impacted our medical school.[7] We were able to use the biodigital human, along with iPad based textbooks, to have our medical school back up and running within a week of our teaching labs being unavailable due to flooding. We created adhoc learning spaces throughout our campuses, in places that were not designed for that kind of use. We became "global" within a few city blocks and rapidly formed a whole new learning infrastructure.

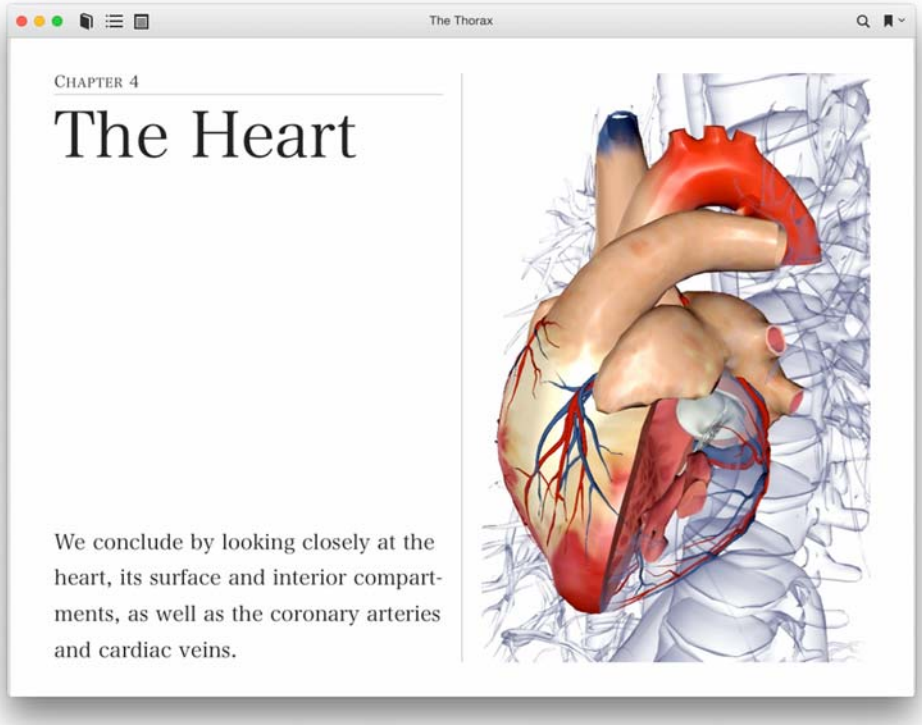

Figure 4. Example chapter from the NYU Anatomy e-Book, incorporating 3D visualizations.

Once one begins to generate electronic learning resources, it opens the door to thinking about mobility and the newly decentralized nature of education. We are translating materials to a mobile infrastructure, including the biodigital human, as a core part of a new anatomy textbook for our students, a neurology exam, virtual microscopy, and online learning (Figure 4).

CONCLUSION

Students are now a part of a global ecosystem of learning resources, which gives educators tremendous opportunities to use these emerging technologies, making us more effective as teachers and mentors. As we integrate data from our electronic medical records, which is difficult to do globally and challenging to do locally, we will have tools that can guide us in giving feedback and assessment to our students, providing them a clear picture of their performance and areas for improvement.

We have the opportunity to expand the horizons of a whole world of potential learners. When we use electronic learning resources, we can move away from the anecdotal nature of text feedback to more quantitative measures that allow us to do evidence-based quality improvement. We will not exclude qualitative measures but begin to make careful decisions about what does and does not work for a heterogeneous group of learners. In this new day, there are great new opportunities for educational scholarship and publication.

Technology infrastructure offers another opportunity for educators because these platforms and approaches support learners across the continuum and not in silos. The boundaries between pre-medical school, medical school, residency training, and practice often have caused fierce separations within a single institution, a state, a country, or a continent. These artificial borders are now beginning to be breached, which will cause a powerful and transformative change in medical education. We are beginning to see true integration of, not only educational outcomes, but also of important clinical outcomes for patients. We will get to measure whether what we are doing matters to our patients, an extremely important bridge to cross. Students want to learn; teachers want to teach; patients want to attain health, no matter where the life-saving materials originate or are learned.

REFERENCES

[1] Wikipedia contributors. Connected health. Wikipedia, The Free Encyclopedia. June 9, 2013, 08:55 UTC. Available at: http://en.wikipedia.org/w/index.php?title=Connected_health&oldid=559033411. Accessed July 22, 2014.
[2] Breslow L, Pritchard DE, DeBoer J, Stump GS, Ho AD, Seaton D. Studying learning in the worldwide classroom: Research into edx's first mooc. *Res Pract Assess*. 2013;8:13–25.
[3] NYU School of Medicine. Division of Educational Informatics. Available at: http://dei.med.nyu.edu. Accessed July 22, 2014.
[4] Triola MM, Holloway W. Enhanced virtual microscopy for collaborative education. *BMC Med Educ*. 2011;11:4. doi:10.1186/1472-6920-11-4
[5] NYU School of Medicine. NYU Virtual Microscope. Available at: http://education.med.nyu.edu/virtualmicroscope. Accessed July 22, 2014.
[6] Biodigital Systems. The Biodigital Human. Available at: https://www.biodigital.com/. Accessed July 22, 2014.
[7] NYU School of Medicine. Powered By Our People: The Story of Hurricane Sandy, NYU Langone, and New York. Available at: http://www.med.nyu.edu/about-us/powered-our-people. Accessed July 22, 2014.