

Case Study: Innovation Training



A tech innovation incubator inside the radiology department at Massachusetts General Hospital turns physicians into inventors.

By Brooke Bilyj

Key Takeaways:

- A radiology resident at Massachusetts General Hospital led development of an in-house invention incubator to help physicians transform ideas into practical inventions.
- The first innovation incubator known to be integrated into a medical training program, the facility gives physicians access to tools and equipment for validating ideas and prototyping new devices.
- The incubator's comprehensive innovation curriculum equips residents and physicians with hands-on training about the steps involved in translating ideas into clinical applications.

Before Marc D. Succi, MD, joined Massachusetts General Hospital (MGH) as a radiology resident in July of 2015, he had already secured several patents and launched two startup companies, gaining valuable experience as an inventor and CEO. His entrepreneurial background made him the go-to invention expert at MGH, quickly revealing the hospital's need for more robust innovation resources.

"Radiologists and other physicians were coming to me with questions, saying, 'Hey, I have an idea,' or 'I want to start a company; how would you suggest doing this?'" says Succi, who'd taken a research year while at Harvard Medical School to study at Massachusetts Institute of Technology, where his research led him to develop a new device that he patented and licensed to a pharmaceutical company. "I realized a tangible need existed for innovation training, because clinicians want to be innovative, but most don't have the tools to bring their ideas to fruition."

After observing the struggles of creative physicians who didn't know how to approach innovation, Succi developed plans for an in-house prototyping lab and entrepreneurship incubator designed to transform ideas into impactful inventions. He founded The Medically Engineered Solutions in Healthcare (MESH™) Incubator at MGH — the first innovation incubator and accompanying curriculum that is known to be integrated into a medical training program, in any specialty.

Since Succi started the incubator in 2016, MESH has helped several radiology residents and other physicians turn their abstract ideas into detailed concepts ready for market. "In radiology, virtually everyone has good ideas about how to improve some aspect of imaging, but they don't always have the resources, knowledge, or mentors to take their ideas to the next level," says Bill Bradley, MD, a radiology resident who participated in MESH last year. "This incubator is empowering technology innovation by catalyzing our ideas to improve patient care."

Building Buy-in

Before Succi could launch the incubator, he needed support from radiology leaders. So in February of 2016,



Marc D. Succi, MD, executive director of the MESH Incubator, teaches residents how to convert a CTA scan of the head from PACS into a manipulable 3D model.

he met with MGH's radiology residency program directors and then with Radiologist-in-Chief James A. Brink, MD, FACR, to present his vision and business plan.

To outline the opportunity, Succi described how radiologists are well-positioned to drive innovation across the hospital. "Radiologists are at a unique intersection of clinical care and technology," Succi says. "Radiologists interact with every other specialty, and they have more experience with technology than most other specialties, so they really are in a prime position to innovate."

For this reason, Succi proposed building the invention incubator in the radiology department, where he could provide training, resources, and equipment to help radiologists and other physicians innovate. He envisioned a workshop equipped with prototyping tools, like microprocessors and 3-D printers, coupled with a hands-on curriculum and informational lecture series to empower radiologists and other physicians with the skills to turn their ideas into reality.

Succi explained that MESH (so named to reflect the foundational collaboration between medicine and engineering in improving patient care) would mentor physicians through the early stages of innovation. By the end of the training, participants would be ready to leverage their prototypes and early data to seek outside funding to develop their ideas further. With this educational goal, Succi noted that MESH would

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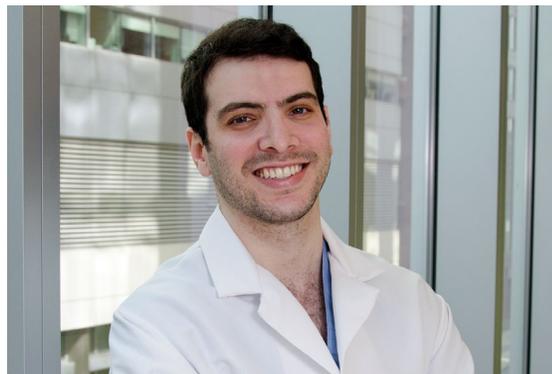
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Succi started the MESH incubator to mentor students through the early stages of innovation.

be a relatively lean start-up. He requested a five-figure investment to open the incubator and outlined a long-term vision that would get inventions to bedsides in five to 10 years.

While MESH's profitability would take time, Succi emphasized that it would bring enduring value to the hospital and the profession. "The goal is not to make money immediately," Succi says. "It's about training the future leaders of medicine to impact patient care and, in the process, branding radiology as the center of innovation, which elevates our value in the healthcare landscape. You can't quantify that impact."

Gaining Support

The idea of a tech-centric incubator resonated with Brink, who earned his bachelor's degree in electrical engineering before pursuing radiology. "The idea of enabling non-engineers to use design principles to prototype potential inventions intrigued me," says Brink, who is also the Juan M. Taveras Professor of Radiology at Harvard Medical School and the ACR Board of Chancellors president. "I'm a big believer in combining engineering with radiology, because at the intersection of different skills is where innovation occurs."

From Brink's perspective, the benefit of fostering a reputation of innovation at the hospital outweighed the nominal startup investment. "Certainly, as patents are commercialized, we will earn future royalty revenue," Brink says, "but we're not looking at ROI from that perspective. It's more important that we provide an outlet for our residents to develop new skills, so they can create tools to improve care."

With Brink's backing, Succi received seed funding from the radiology department in July of 2016 to open the MESH Incubator.

Creating a Creative Space

Although hospital leaders were excited about the incubator's potential, they weren't sure where to house the innovation workshop. Initially, administrators offered Succi space in a building next to the hospital, but that didn't support his vision of making innovation more accessible. "I knew that if it wasn't close or even integrated into the reading room, radiologists and other physicians wouldn't take the time to go there," Succi says. "If you're trying to popularize innovation, the resources must be accessible at the closest possible point-of-care."

In a stroke of serendipity, MGH was relocating some radiology offices just as Succi was searching for a space. The move freed up an area adjacent to the reading room, and Brink agreed when Succi suggested that it would be a good location for the incubator.

From there, Succi made a list of the tools and equipment necessary to build out the workshop — including a 3-D printer, computer-aided design software, micro-processors, electrical components (like resistors and breadboards for building circuits), and other prototyping support tools. He also began developing the incubator curriculum.

To start, Succi surveyed radiology residents to assess their baseline understanding of innovation. He discovered that 82 percent of residents weren't comfortable creating a device prototype, and none of them knew how to write an intellectual property (IP) disclosure.¹ So, he built the program around these topics.

Nurturing Innovative Ideas

In late 2016, Succi launched the first of two incubator courses, the Core Invention Design Curriculum (CIDC). This year-long invention mentorship is open to residents, fellows, and attending radiologists, as well as other physicians who have an idea they want to develop.

During the first six months of the CIDC, participants work one-on-one with Succi and MESH leaders in a mentorship format to validate the clinical need for their ideas. To that end, they gather patient feedback and data to define how their inventions could potentially impact patient care. During the second six months, participants prototype and iterate their inventions in the workshop before drafting and submitting IP disclosures.

Succi stresses that this tiered approach is critical to MESH's care improvement goal. "Innovation starts with talking to patients, observing procedures, understanding what's happening at the patient level, and being

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empathetic to their experiences,” says Succi, who is executive director of the MESH Incubator. “Ultimately, our work is all about developing ideas that positively impact patients.”

Teaching Innovation Basics

While the CIDC is geared toward residents and physicians who just need the right space and skills to execute their ideas, not all residents and physicians have specific ideas to engineer.

Recognizing this, Succi began developing the second incubator course, called the Core Residency Design Curriculum (CRDC), in late 2017. “It’s key to reach people who may not have specific ideas but who may be great innovators and not know it yet,” Succi says. “This course provides the fundamental knowledge they need.”

The CRDC is designed to proactively educate residents and physicians throughout MGH on the basics of 3-D printing, programming, prototyping, entrepreneurship, writing patents and business plans, and other skills. In this weeklong innovation boot camp, participants hear from Succi and other subject matter experts, including the director of the hospital’s Center for Clinical Data Science, who discusses artificial intelligence and machine learning — important aspects to any contemporary innovation program.

“As radiology evolves with AI and quality-based care, it’s going to be important to have a framework to interpret the opportunities for innovation,” says Bradley, a third-year resident who participated in the first CRDC pilot. “It’s empowering to understand how certain innovations could impact your practice.”

Measuring the Impact

Succi launched the CRDC as a pilot project in August of 2018. The pilot involved three classes with four residents in each class, for a total of 12 students, each of whom rated the course as “extremely effective.”

To further gauge the CRDC’s impact, Succi and the other expert presenters developed pre- and post-course assessment exams to rate students’ understanding of innovation. The scores soared from less than 50 percent to approximately 90 percent — spurring Succi to offer the curriculum to all residents, fellows, and attending physicians at MGH.

“Going through the program really demystified the process of innovation,” Bradley says. “A lot of residents, in particular, look at tech startups and think, ‘I could never be involved in that. That happens outside of the hospital. That’s something business people do.’ But this



James A. Brink, MD, FACR, radiologist in chief at MGH, Juan M. Taveras Professor of Radiology at Harvard Medical School, and the ACR Board of Chancellors president, appreciates that MESH brings together radiology and engineering.

course broke down those barriers and familiarized us with the resources and pathways we can access to turn an idea into a design that can improve patient care.”

Fueling the Conversation

To build awareness around the incubator and keep innovation top of mind, Succi introduced the MESH Innovator Lecture Series. Launched in mid-2017, the quarterly program is “a platform for interesting people talking about innovative things,” he says.

These lectures aren’t limited to radiology. Succi invites speakers from various disciplines and draws attendees from across the hospital and beyond. Generally, Succi focuses on topics and speakers that are “relevant to the modern clinician.” For example, he invited his former MIT adviser to speak about the process of translating ideas to the patient’s bedside, and an entrepreneur from MGH to talk about the software company he created and sold.

Each lecture draws an average attendance of between 30 and 40 people — including medical students, residents, staff, and even members of the public. Garnering positive feedback and high audience engagement, the series has been “a valuable vehicle for advertising the incubator,” Succi says. “It’s facilitating a knowledge transfer to open your mind to new ideas you might not be exposed to otherwise.”

Generating Interest

Now, Succi says one of the most common questions that students ask when applying for radiology residency at MGH is: How can I get involved in the incubator?

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MESH has become a strong branding and recruiting tool for the hospital, strengthening its reputation for innovation. Incubator participants have already disclosed five patents, and more applications are pending.

An interventional radiologist (IR) who was having trouble stabilizing the radiofrequency ablation probe in patients' chests developed one of the first patentable devices through the CIDC. After Succi observed several of the clinician's procedures, the two worked together to design and 3-D print a probe stabilization device, which they tested in several simulations before writing the patent disclosure.

Succi and the clinician are now focused on further developing the technology and licensing the device for industry use. "This is just one example of the innovations we're working on that will have a direct impact on the delivery of care," Succi says. "When residents see the technologies that are coming out of the incubator, they want to get involved."

Brink and other leaders are pleased with the program's early results. "There's tremendous enthusiasm and excitement among residents to participate," Brink says. "I think it's because people have creative ideas about how to improve medicine, and MESH is enabling them to create the tools that they imagine and to improve the care they can provide to their patients."

Reinforcing Radiology's Role

Interest in the CRDC has been so high, in fact, that Succi received another radiology department grant in December of 2018 to fund the purchase of additional 3-D printers and other equipment, enabling the CRDC's expansion to other specialties throughout the hospital. By the end of 2019, the program will expand further to include clinicians from other institutions.

"We're even working with other hospitals to help them establish their own incubators, creating a collaborative network for sharing knowledge and resources," Succi says. "Ultimately, we want to popularize innovation across medical disciplines, while elevating radiology's position in a quickly-changing landscape of value-based care."

From Brink's perspective, the MESH Incubator underscores that innovation is no longer optional for radiologists — it's critical. "Radiology has to stay on the cutting edge of technology to remain a viable specialty," Brink says. "It's incumbent upon radiologists to maintain a high level of innovation and to continue to differentiate and reinvent themselves as new opportunities arise. Incubators like MESH can help radiologists continue to demonstrate their value beyond the reading room."



Radiology residents Evan Stone, MD, and RJ Dhami, MD, build and program prototypes based on microprocessors, using their laptops to run the code and off-the-shelf electronics to execute variable functions.

Endnotes

1. Succi MD, Uppot RN, Gee MS, McCloud TC, Brink JA. Medically Engineered Solutions in Health Care: a technology incubator and design-thinking curriculum for radiology trainees. JACR. June 2018;15(6):892-896. doi: <https://doi.org/10.1016/j.jacr.2018.02.017>.

Next Steps:

- Embrace the unique position of radiologists at the intersection of clinical care and technology, in collaboration with other specialties, to identify opportunities for innovation and improvement.
- Encourage new ideas from radiology residents about how to improve training and patient care, and make sure they understand the appropriate next steps for pursuing their ideas.
- Equip physicians with the tools and skills to translate ideas into inventions that can impact patient care. If your institution can't support its own incubator, consider sending your staff to MESH to learn the fundamentals.

Share Your Story

Have a case study idea you'd like to share with the radiology community? To submit your idea please [click here](#).



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