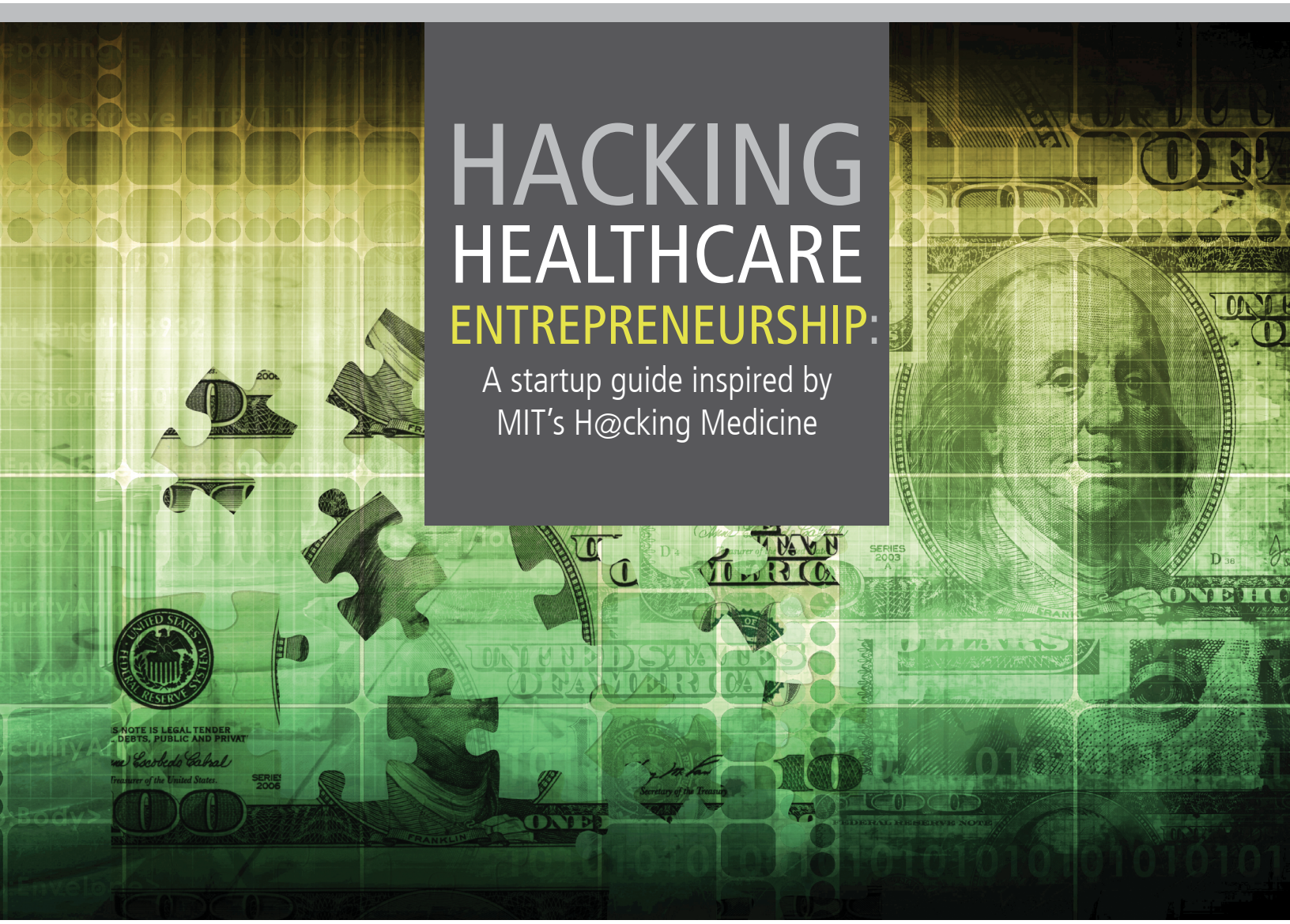
A series of ebooks
featuring practical advice from
healthcare entrepreneurs



HACKING HEALTHCARE ENTREPRENEURSHIP:

A startup guide inspired by MIT's H@cking Medicine

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FROM THE GUEST
EDITOR

Working together to solve healthcare's toughest problems

Zen Chu

Now is the best time in the history of the world to be a healthcare entrepreneur, and those with fresh eyes on healthcare problems – young health professionals along with patients, engineers, designers, and entrepreneurs – are able to make large and rapid clinical impact.

As healthcare reform changes the way we pay for medical products and services, today's clinicians and health professionals are entering the field amid fundamental transformation and new opportunities. Government and the private sector are adopting new models of measuring healthcare value and quality – along with new payment models to bend the cost curve. Hospitals and insurers finally have stronger incentives to invest in new technologies for preventative care and efficiency. Pharma and large med tech firms have pruned their own R&D efforts while partnering with smaller, nimbler companies. These tectonic shifts favor smaller, more agile companies to design new solutions to fill these gaps.

While NIH and government science funding is waning, new funding sources are enabling the testing of new solutions and business models. Funding sources for healthcare startups have expanded beyond traditional venture capital to powerful angel investor networks, venture philanthropy, and crowd-funding by engaged patient communities. Beyond the established healthcare markets, a new global middle class is driving demand for existing healthcare products and new services in emerging economies.

Amid these tectonic shifts in healthcare globally, medical students, young health professionals, engineers, and patients have a unique ability to be healthcare entrepreneurs. They're on the front lines of healthcare delivery – working inside hospitals and healthcare facilities – every day. As new clinicians navigate antiquated workflows, artificially expensive products, and entrenched habits of both clinicians and patients, they're asking an innocent question: Does it really have to be done this way? That simple question opens the door to redesigning products and services that existing hospitals, academic medicine, and industry have failed to address.

Inspired by the rise of Silicon Valley lore and the social impact of new technologies, young health professionals now view startups as a vehicle for meaningful impact. A clinician's impact has traditionally been limited to the patients she can touch with her own two hands. New technologies such as sensors, medical devices, diagnostics, software, mobile applications, and services enabled by these technologies hold the promise of "scalable medicine." New inventions that economically improve diagnostics or simplify treatments result in scaling medicine beyond our doctor shortages and amplify a public health impact.

But clinical insight is insufficient. For a new solution to make a real world impact on patients, it requires proof of clinical efficacy, a sustainable economic model, a willing buyer, and a team that can bring it to market. Most health professionals cannot succeed as healthcare innovators alone. They have been selected and trained in ways that dampen creativity and entrepreneurial muscles. Especially in the USA, most clinicians lack an understanding of payments and costs to drive the business model insight to match the clinical insight of a new invention or process. Hierarchical training, poor hospital management, glacial reimbursement changes, and fear of liability are just a few of the factors that breed a culture where superior solutions can fail to be adopted even when the evidence supports adoption. Often a product that works well in the U.S. or European healthcare system fails when transplanted to a lower income country and needs to be re-engineered for the local clinical context.

Enter the Healthcare Hackathon – a process, tool set, and gathering which accelerates the creation of teams and solutions to tackle the complexity of healthcare's toughest problems. Over the past three years, the H@cking Medicine Initiative at MIT has held more than a dozen events on four continents, in partnership with the Harvard Medical School teaching hospitals and leading healthcare institutions around the world. Hacking culture – meaning clever exploration and engineering – has a long history at MIT and is now being adapted to healthcare challenges.

Through these hackathons, our teams and faculty have honed a process to identify and validate unmet medical needs while assembling diverse teams to tackle solutions with both clinical impact and a sustainable business model. Our health hackathons bring clinicians together with entrepreneurs, engineers, and designers to collaborate openly in events that span a few hours or an entire weekend. Most important, more than 200 teams have formed to taste the entrepreneurial process and tackle a complex health problem, resulting in dozens of teams continuing after the events and a handful of venture-financed startups formed around reinventing solutions to problems such as medication compliance, patient scheduling, and lab report delivery.

In this eBook, with stories written by Christina Hernandez Sherwood and Nicola Parry, you'll read more about our process, get insight from entrepreneurs who got their start at H@cking Medicine hackathons, and go inside our biggest event to date: Healthcare's Grand H@ckfest.

Zen Chu
Entrepreneur in Residence at the Massachusetts Institute of Technology
Managing Director of Accelerated Medical Ventures
Faculty Adviser for H@cking Medicine

H@cking Medicine: Gathering bright minds to create startups

Julien Pham

When Julien Pham, MD, attended his first H@cking Medicine event, the Boston collaborative's second hackathon, he was smitten with the way entrepreneurs, clinicians, and engineers worked in tandem for a common cause. "I fell in love with this mindset of getting people who are completely different in terms of their training to come together to solve a problem," said Pham, a kidney specialist and junior faculty member at Brigham and Women's Hospital.

At the hackathon – a weekend event where participants present healthcare problems and form teams to develop solutions – Pham pitched an idea for a startup that attacked a pain point he observed in medicine: clinical trial data. He quickly teamed up with a business school student, a doctor-programmer, and an entrepreneur in an effort to make clinical trial data more visual and accessible to patients. "It was a neat idea, but we didn't know how to approach it," Pham said. "We failed very fast." The group disbanded.

Undaunted by the failure, which he described as "a great learning experience," Pham continued attending H@cking Medicine events. He became a hackathon adviser on clinical workflow, helping ensure that healthcare products and services created by hackathon teams fit into the culture of medicine. At a spring hackathon, Pham advised a team working on a clinical referral optimization engine. Soon, he became a co-founder of RubiconMD, which uses technology to distribute questions from primary care providers to specialists to reduce avoidable referrals. "What really attracted me to this startup is the large value this can have on healthcare," Pham said.

Based at the Massachusetts Institute of Technology and launched in 2011, H@cking Medicine is an ecosystem bringing together the Boston medical community to teach entrepreneurs, engineers, clinicians, scientists, and designers how to launch disruptive healthcare businesses, said Zen Chu, a serial healthcare entrepreneur and MIT Entrepreneur-in-Residence who started the effort with MIT entrepreneurship faculty member Bill Aulet. H@cking Medicine is about creating "a circle of mentors" to identify new solutions, Chu said. "You need some super-connectors within the ecosystem that can pull in the right expertise," he said, "whether it's patents or regulators or medical devices or reimbursement."

Entrepreneurship is the No. 1 way to solve healthcare quandaries, Chu said. "You need fresh eyes on these problems," he said. "That's how you scale medicine." Along with Pham's company, other H@cking Medicine successes include PillPack, which fills, sorts, and delivers prescriptions in personalized packets to help patients take their medications at the right time, and Careport, a startup run by Harvard Medical School students, that uses software to improve the hospital discharge process.

Set in one of the nation's top medical hubs, H@cking Medicine is led by MIT students from across the university and their Health, Science & Technology joint program with Harvard. MIT as a neutral innovation hub helps to make it easier for competing hospitals and other

organizations to collaborate on healthcare problems, Chu said. "Healthcare is so complex and fragmented by disease and hospital competition that it becomes hyper local," he said. "We're just a bunch of engineers that love solving real problems and healthcare has them in spades. We're not competing for patients the way the hospitals do."

For aspiring healthcare entrepreneurs, H@cking Medicine breaks down the barriers – from handling intellectual property to dealing with HIPAA to gaining access to medical practices – to founding a startup, said Andrea Ippolito, a H@cking Medicine co-leader who met the founding team of her startup Smart Scheduling at a hackathon. The collaborative also fosters a sense of camaraderie among early-stage entrepreneurs, said Ippolito, whose company works to improve access to care through more efficient scheduling. "You know others are out there doing the same thing you are," she said. "You're doing good for healthcare."

Aside from meeting their teams at H@cking Medicine hackathons, Pham and Ippolito found other benefits to participating in the collaborative. For Pham, H@cking Medicine's biggest perk – both for him and the startup community at large – is its accessibility to aspiring entrepreneurs. "It's an organization that doesn't really look to receive equity from the companies that come out of it," he said. "It's more of a social event." Both Pham and Ippolito made important connections through H@cking Medicine, such as Smart Scheduling's hackathon adviser, who is now on the company's board of advisers. Even participants who don't end up working together share tips on lawyers, funders, and other connections, Ippolito said. "We all want to nurture each other along," she said. "We're not just a hackathon… It's a safe space to be launching a company."

Three years into the effort, the H@cking Medicine team has honed a repeatable process for identifying needs in healthcare – and setting out to solve them, Chu said. "It can absolutely be replicated," he said. "It already has been replicated." H@cking Medicine hosted hackathons in India in March, Madrid in June, and Uganda in August, and efforts to launch similar events are under way in China and India. Back in the United States, H@cking Medicine is unveiling a new innovation push with hackathons scheduled through the fall, beginning with Brigham and Women's Hospital in September and Boston Children's Hospital in October, Chu said. "We see this as a bunch of experiments," he said. "We're trying to teach ways of thinking about entrepreneurship as an important force in attacking the enormous challenges facing healthcare in the U.S. and abroad."

Why healthcare entrepreneurs should focus on meaningful metrics

Chris Moses

When patients, doctors, hospital executives, and payers all care about a different metric, finding a measurable return on investment (ROI) can be difficult for healthcare entrepreneurs. For the team at Smart Scheduling, a platform for optimizing appointment scheduling, the first step toward success was finding alignment between these stakeholders, said co-founder and CEO Chris Moses. "We try to identify who cares about operational efficiency and better appointment access and more revenues," he said. "It's such a complex, complicated system."

Part of the process involved determining real, meaningful ROI metrics, Moses said. "A lot of entrepreneurs come up with vanity metrics that may look good," he said, "but no one cares about them." For instance, the number of engaged users on a platform is more meaningful than the number of page views. For Smart Scheduling, he said, important metrics include the accuracy of the system's predictions, how many appointments are booked, and how many patients are seen.

Here are other entrepreneurial insights from Moses:

USE OPEN API TO YOUR ADVANTAGE

There are some 200,000 provider practices in the U.S. on various electronic health systems that aren't interoperable, Moses said. "Even for a hospital system or provider practices using the same software, they can't even easily transfer data among practices with the same software," he said. This presents a unique challenge for healthcare entrepreneurs like Moses who want to develop a tool to work across platforms. The Smart Scheduling team found help in athenahealth, which offers a cloud-based, aggregated open API.

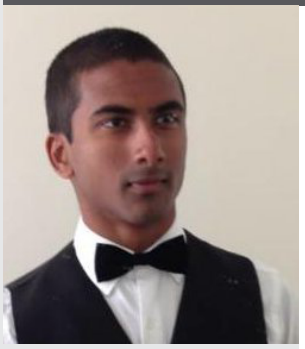
SHOW YOU CAN EXECUTE ON LITTLE CASH

It's getting tougher for healthcare startups to secure funding, Moses said, but for good reason. Because of cloud-based services, he said, companies don't need a big team and significant capital to build a great product or service. For investors, Moses said, ideas are a dime a dozen. Instead, funders want to see that a team understands the problem it's working to solve, has built a prototype and has won awards. "Once you've shown that you can execute on very little money, then it's time to scale and grow," he said.

LET YOUR TEAM LEARN ON THE JOB

With companies like Facebook and Google snapping up young developers and retaining experienced ones, recruiting a technical team member is tough, Moses said. Even more difficult to find is a data scientist with a background in healthcare analytics, he added. Startups might have to instead provide the resources for a developer to learn on the job. "The people you find aren't necessarily experts," he said. "You have to be willing to hire someone who learns on the job."

Why healthcare entrepreneurs shouldn't get caught up in features



Akansh Murthy

Hermes IQ is a healthcare IT company that creates software to manage clinical information, gathering analytics and insights in the process. As with many other healthcare startups, regulatory strategy has been a major issue for the company, said co-founder Akansh Murthy. "When we started, we had many different ideas for where we wanted to go," he said. "We didn't realize what we were getting into."

One way to streamline the process is to focus only on your company's bare concept, Murthy said. While many entrepreneurs get caught up in the features of their product or service, he said, the core product can often be simpler to get through the regulatory process. "Figure out what your core product is," Murthy said, "and figure out if what needs regulatory approval is a feature or the core product."

Here are other entrepreneurial insights from Murthy:

STEEL YOURSELF FOR CO-FOUNDER ISSUES

"If you're getting into a startup, you should be prepared for a tough ride with co-founders," Murthy said. "Use your gut feeling to determine whether it's going to be a good fit." It's imperative to clearly define each co-founder's equity stake, Murthy said, and an equal split isn't always the most equitable. "It can be completely disastrous," he said, if eventually one co-founder decides to go part time, for instance.

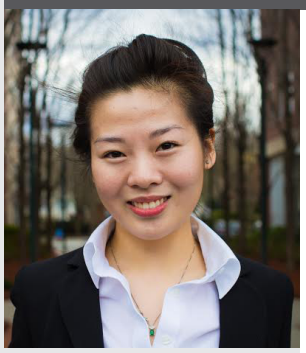
FIND LOCAL CONNECTIONS VIA THE WEB

Boston-based entrepreneurs like Murthy can sign up for newsletters, including Greenhorn Connect and VentureFizz, to find out about local entrepreneurship events. "There are an immense set of free resources for entrepreneurs to get their startups off the ground," he said. "You can find these through newsletters." Entrepreneurs who aren't local to Beantown can use Twitter to find out what's going on across the country. Murthy suggested searching Twitter using hashtags such as #entrepreneurship and #startups, while also following well-known investors and VCs.

DON'T UNDERESTIMATE THE EMOTIONAL

The emotional issues surrounding entrepreneurship aren't well publicized, Murthy said. "There are many times at which things might not seem like they're going anywhere," he said. "That's not something that should stop you or deter you at all." Murthy said he thinks every entrepreneur feels that way sometime or another. "Those feelings are completely normal in the journey of entrepreneurship," he said.

How self-selection can create a successful founding team



Crystal Law

When Crystal Law attended an MIT H@cking Medicine hackathon – where participants present healthcare problems and form teams to develop solutions – she wasn't planning to start a company. But today Law is co-founder and CEO of Twiage, a healthcare startup that works to provide better communication between emergency medical service providers and hospital emergency departments.

Though the hackathon model brings together potential co-founders in a single weekend, Law said the Twiage founding team has evolved over time. While she initially planned to be intentional in building the team, Law said self-selection took over. "Starting a company is not easy," she said. "It sort of [becomes], who is able to make the commitment? Who can get through the difficult times?"

Here are other entrepreneurial insights from Law:

FOCUS ON FUNDRAISING

Start the fundraising process before you think you'll need the money, Law said and raise more than you think you'll need. Law's own mentors gave her that advice and it's proven accurate, she said, especially since many founders spend half their time fundraising. Approaching potential investors as partners is another funding tip, she said. "It's awkward to ask for investments," Law said. "[But] we're able to give our investors an opportunity to be part of this ride... I think that's really exciting for investors who believe in our mission and know we're the team who will be able to pull through. In that way, it's a partnership."

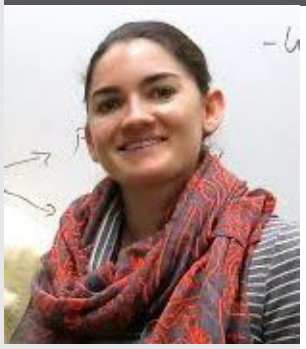
TAKE ADVANTAGE OF THE ENTREPRENEURSHIP ECOSYSTEM

As part of the accelerator Blueprint Health, the Twiage team gained a wealth of mentors and networking opportunities, Law said. "As an entrepreneur in this generation, I feel we're very fortunate," she said. "There's a very helpful and nurturing entrepreneurship ecosystem." And Law still considers the H@cking Medicine team part of her core network. "These are people who I really trust," she said. "Speaking to older entrepreneurs, I know this is a luxury." But even healthcare entrepreneurs who aren't living in Boston or New York can find entrepreneurship networks, Law said, through local meetings and online forums.

ABOVE ALL ELSE, PERSEVERE

"You're starting something completely from scratch," Law said. "You have to remember that and not get bogged down." For a confidence boost, she said, keep in touch with the people who saw value in your startup before it went mainstream. "You get 90 to 99 percent 'nos.' It can be difficult sometimes believing your vision."

Tracking innovative ideas at Healthcare's Grand Hackfest and beyond



Marjory Bravard

Dozens of teams spent the weekend at Healthcare's Grand Hackfest brainstorming on novel ideas to solve problems in healthcare. And at least some of the participants continue to pursue projects that got their start during the Hackfest.

Marjory Bravard, MD, a specialist in internal medicine at Massachusetts General Hospital (MGH) in Boston, and team kicked off the weekend designing a device to record patient-physician conversations to help address the problem of incomplete documentation in medical encounters.

"There's lots of talking in medicine, but not much is transcribed from the actual clinician-patient dialogue," she said. This can have numerous repercussions, from patient dissatisfaction to liability issues.

However, Dr. Bravard discovered that another group had a similar idea, but was using a different approach. "They came in with a technology and were looking for a problem to solve, whereas we came in with a problem and were looking for a technology to solve it," she said. So the team had to decide whether to continue with its design or change track. "I think that's one of the things you're supposed to learn from these hackathons – that pursuing an idea that doesn't turn out to be quite perfect is OK – you can switch to something else," said Dr. Bravard.

Ultimately the team diverted some of its focus to the microbiome. "I think the microbiome space is fascinating, it's really the next big field of medicine – we're really only starting to understand what we don't understand about it," Dr. Bravard said. She emphasized that "… the technology [to sequence the microbiome] exists, so I think the question is how do you set up a business model so that people are interested in paying money to find out about their microbiome. A couple of companies are starting to go that way, but no one has really figured out what people are willing to pay for and why."

Dr. Bravard sees this as a step toward figuring out how the microbiome impacts health and ultimately how it might help address many health issues, including obesity. However, she realizes that one stumbling block is that people would initially be paying for information that isn't yet understood and can't be interpreted. "But I do think a lot of people are interested in what's going on inside their bodies and with their digestion," she said. "So if you're truthful about the limitations, I think there are still people who would be interested."

On the final day of the hack, the team spent time networking with colleagues about both ideas. This included a group from MGH TeleHealth, exploring the potential for a pilot study on recording clinician-patient encounters.

A week later, Dr. Bravard continued to explore both ideas. She remains focused on the team's original recording device, but recognizes that one major hurdle to overcome will be integrating the recording into the electronic medical record. And she has already met up with a team

member to discuss the microbiome project further and they plan to meet again soon. Dr. Bravard's passion for this particular field is obvious. "The microbiome is so fascinating to me, in that we really don't understand it and it has so much potential.… I'm interested in the mystery about it all," she said. "I want something that gets me out of bed in the morning."

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