

Deadly & Life-Saving: Printing Our 3D Future

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With the emergence of 3D printers into mainstream markets, what the devices actually do seems to matter less than what they will do, or could be made to do, in the future. Will they create a crisis of unregistered, undetectable firearms? Or will 3D printers become such a life-saving medical necessity that a century from now, consumers will regard the technology as unremarkable as the current practice of casting broken bones?

I don't have the answers. But from a health and safety perspective, I think 3D printing is among the most profound opportunities we as a society have to alter the future. It's hard to believe that it all starts with a single drip of liquid plastic...

How 3D Printing Works

Despite the hype, 3D printing technology isn't new. A 3D printer existed as early as 1984, according to [PC Magazine](#) [1]. At its most simplistic, the technology compares to the process of printing a two-dimensional document from your home or office computer. Instead of flat ink, devices "print" layers of a substance - typically plastic, but alternatively metal or biological materials - to create a three-dimensional shape.

As a whole, 3D printers have become more affordable and less technically demanding so that some businesses and hobbyists can attain and operate the once mysterious and rare devices. Prospective users can purchase 3D printers from mainstream retailers like Staples and Amazon.com, according to science and tech site [Singularity HUB](#) [2] for around \$1,300 or less, and some tech sites report certain models going for as little as \$200 to \$500 - not so different from the cost of early P.C.'s. With companies like [Microsoft](#) [3] jumping onboard the bandwagon by announcing the integration of 3D printing support into upcoming products, it's easy to anticipate a scenario where everyone has access to 3D printing just as they can create documents with little more than a click.

But the question that's got techies deep in thought and media, government officials, and the public on edge is what, exactly, will people use the technology to accomplish?

Ready, Aim, Print

As early as May 2013, the first gun created almost entirely through 3D printing - the "Liberator" - had been not only built, but fired successfully (3D printed guns have since shot as many as 600 rounds in one demonstration). Within just two days of the organization Defense Distributed publishing the 3D printer gun blueprints

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online, 100,000 people downloaded them, according to [Forbes](#) [4]- an astonishing number of downloads for a technology that is only beginning to burst into mainstream consumer use.



In light of recent, devastating episodes of mass violence like the Aurora, Colorado, movie theater shooting and the Sandy Hook Elementary School tragedy, it's become clear that guns in the wrong hands are a major threat to public safety. These homemade guns - which can be manufactured from materials costing as little as \$25 - would not only circumvent any gun control laws, but would also be essentially undetectable by standard methods due to their plastic construction. "These are not manufactured in certified facilities, are not designed to be picked up by metal detectors and are largely untraceable once they hit the streets," wrote [The Montreal Gazette](#) [5]. "There is no way, right now, of regulating this kind of manufacturing. There is no way of learning who is printing weapons."

In other words, 3D printing could be another way to make it easier for criminals to get their hands on lethal weapons, endangering anyone and everyone. Theoretically, the bullets used in these guns also could be manufactured at home someday, possibly in mass quantities. For the casual criminal, the time and expense of buying and learning to use 3D printing technology probably isn't worth it. For the kind of terrorists that already go to great lengths to create homemade, untraceable bombs, a 3D printer could mean access to a host of new weapons in their arsenals - someday.

Defense Distributed has since removed the plans at the request of the U.S. government, which will determine whether or not sharing these files violates trade

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laws. But as a non-profit organization, Defense Distributed's blueprints may fall under public domain, making them publicly accessible, reported tech site [BetaBeat](#) [6]. The loophole could mean the organization will be allowed to share weapons blueprints – at least unless another law is passed regulating or banning 3D printed weapons.

Already, governments are treading water trying to figure out what to do next. In Canada, laws prohibit the use of 3D printers to make guns at home. In the United States, it's not so simple – in fact, the Department of Homeland Security allegedly stated in a memo that “limiting access” to these weapons “may be impossible,” [TechCrunch](#) [7] reported. Current laws require guns to have at least some metal components to make them discoverable by metal detectors, but after all, it's impossible to charge someone for having an undetectable weapon unless that weapon is found *somehow*. Already, lawmakers some regions – like New York City, New York State, California, and Washington, D.C. – have announced plans to introduce bills that will regulate or prohibit the creation, sale, and use of 3D guns and ammunition.

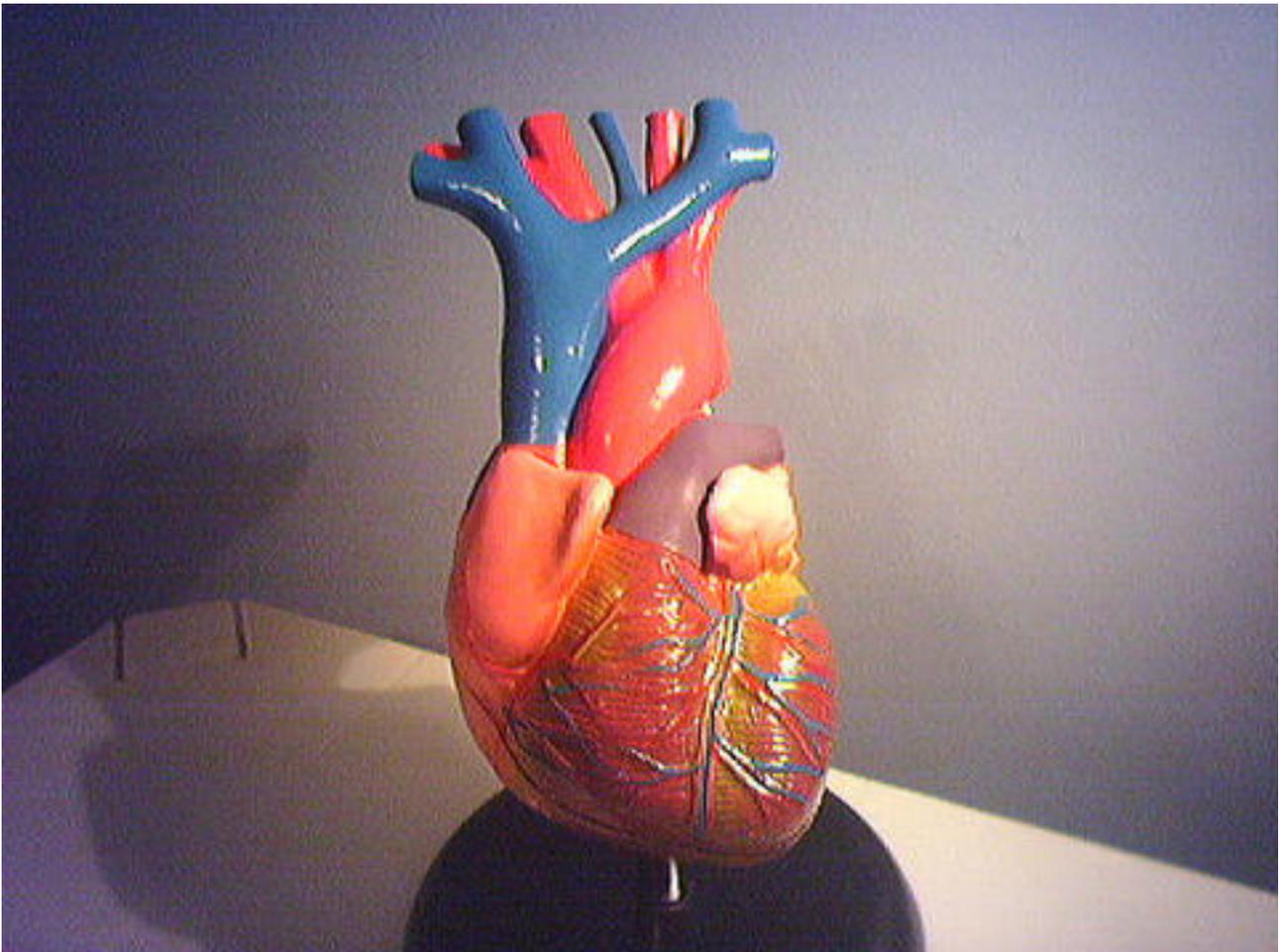
Outside the political sphere, manufacturers are taking action. [Stratasys](#) [8], the company that leased Defense Distributed the 3D printer used to create the gun, cancelled the contract and took back the printer, according to [Wired](#) [9]. Though Denmark-based company Create It REAL has developed software to prevent the creation of 3D printed firearms, according to [NBC News](#) [10], it's hard to assume that prospective gun makers would be incapable of getting around the software by either printing pieces individually or disabling the software in some way.

Printing Medical Miracles, One Tissue at a Time

As startling as the prospect of an influx of cheap, unregistered, undetectable guns may be, 3D printers also have life-saving possibilities. The technology can fulfill an array of medical functions, from training purposes to treating injuries. In the future, doctors intend to create entirely new tissues and even organs with the help of 3D printers. The potential for saving, extending, and improving lives is nothing short of awesome.

“Practicing” Medicine

Doctors study human anatomy and physiology intensely during their training, but no matter how thoroughly they memorize diagrams, they can never become completely familiar with the diseased internal organ of a particular patient. Imaging tests are certainly a help, but when it comes to operating on a real damaged heart, there's more risk than either doctors or patients are comfortable with.



Already, 3D printing has made great strides in changing how surgeons prepare for these high-risk surgeries. Realistic replicas of individual human organs allow doctors to practice difficult techniques on the heart and other vital organs before opening up the patient. This means less risk to patients, as complex surgical techniques will have already been put through a trial run. In Iowa, some doctors working in such specialties as orthopedics, neurology, and cardiac surgery currently are using 3D printed organ prototypes to prepare for the demands of real surgeries, [Digital Journal](#) [11] reported. The prototypes are based on actual CT scans of particular patients. More training equals less likelihood for complications – and in an already risky surgery, that means everything.

Will Signing a Cast Become a Thing of the Past?

As good as modern medicine is, there are a few practices where it seems like there's got to be a better way. As anyone who has ever fractured a bone knows, casting a broken bone is one of those practices. Often, patients with traditional plaster or fiberglass casts complain about the itchy texture, the size of the bandage restricting what clothing they are able to wear, and the challenges of trying to bathe without getting the cast wet.

This bulkiness and inconvenience drove a New Zealand designer to develop a lightweight cast that can be custom 3D printed to fit users' bodies precisely, [Gizmag](#) [12] reported (check out the pictures [here](#) [13]). The cast is made of plastic and has an almost lattice-like appearance, leaving much of the body part exposed

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to reduce itching. Unlike the hefty plaster and fiberglass casts of old, this new design could get wet without complications and would be thin enough to fit inside clothing easily.

Research suggests 3D printing also can help build new bones. By using 3D printers to create biodegradable framework to simulate bones and cartilage and then strategically placing actual human cells capable of regeneration, doctors and researchers could make “fake” body parts that would eventually become a real, permanent part of the patient, [Yahoo! News](#) [14] wrote. Noses, ears, and jawbones are just the beginning. The idea – at least in theory – is better than transplants, which can be rejected, or implantable devices, which can cause any number of adverse effects. While the technology hasn’t reached the stage of human trials just yet, it seems to be on the horizon.

The End of Transplants?

Each day, 18 Americans die while waiting for some type of transplant, [OrganDonor.gov](#) [15] reported. Transplant procedures are difficult, from locating a matching organ to performing the surgery to recovering from the trauma of the operation. Sometimes transplants fail. Sometimes the recipient’s body rejects the foreign organs. The resources are scarce, and because they can only come from deceased humans who have died in ways that did not damage the organs, there has never been an ethical way to increase the number of resources.

Until now.

Scientists have already been able to use 3D printing with biological materials to create synthetic human tissues, some of which can contract like muscles and carry electric signals like those needed to run our bodies, [The Los Angeles Times](#) [16] reported. The hope, throughout the medical community and among patients and family members, is that 3D printing technology could eventually grow entire functioning organs, either synthetic or through real patient cells. Imagine a scenario where there was no waiting list to determine whether or not a patient would survive –in which the rejection of an organ is unheard of. Not only would 3D printed organs save lives, but they could cut huge costs to the healthcare system. Instead of long-term dialysis, kidney failure patients could just get a new kidney. Diabetic patients could get a new, perfectly functioning pancreas. The possibilities seem endless.

I can imagine the implications that medical 3D printing could have for the clients who have turned up at our office, their bodies battered and broken in accidents. A client who lost his lip in a dog bite could have his face made whole again, with a lip grown from his own cells. For a car accident victim whose arm suffered such a forceful impact that the bones broke in half, these new techniques could result in a quicker, less inconvenient recovery. Babies born with birth defects could have replacement body parts made from their own cells that could grow with them. And for those who suffered internal organ damage, or nerve damage, or traumatic brain injuries – will 3D printing finally make us capable of fully healing these injuries that, until now, have been permanent?

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Like nearly all technologies, 3D printing can be used for good or for harm, but that doesn't mean we have to dread it. Rather than living in fear of the dangers that could theoretically happen, let's remember the opportunities that this new technology provides to help literally hundreds of thousands of people – if not more – live longer and fuller lives.

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- [5] <http://www.montrealgazette.com/health/printing+good/8619098/story.html>
- [6] <http://betabeat.com/2013/05/defense-distributed-state-department-cody-wilson-3d-guns/>
- [7] <http://techcrunch.com/2013/05/23/homeland-security-reportedly-warns-3d-printed-guns-are-impossible-to-contain/>
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