

# Science AMA Series: We're scientists and doctors researching nano medicine, Ask Us Anything!

nanomedicines <sup>1</sup> and r/Science AMAs<sup>1</sup>

<sup>1</sup>Affiliation not available

April 17, 2023

## Abstract

Hi Reddit we are scientists from Toronto/Boston working on improving the use of nanomedicine in the clinic. If you're curious about our list of credentials: Shawn Stapleton PhD, Research Fellow at Harvard Medical School/Massachusetts General Hospital, who's currently looking to transition into faculty. [https://www.researchgate.net/profile/Shawn\\_Stapleton](https://www.researchgate.net/profile/Shawn_Stapleton) <https://www.linkedin.com/in/staplet> David Jaffray PhD, Senior Scientist and Director of the TECHNA Institute, University Health Network and University of Toronto. <https://www.uhnresearch.ca/researcher/david-jaffray> <http://technainstitute.com/people/david-jaffray/> Michael Milosevic MD, Clinician and Scientist, University of Toronto and Princess Margaret Cancer Center. <https://www.uhnresearch.ca/res-f-milosevic> <http://www.radonc.utoronto.ca/content/michael-milosevic> Our collaborative research focuses on using imaging, mathematical modeling and physiological/molecular measurements of the tumor microenvironment to understand where nanomedicines end up in a tumour. We are using this knowledge to (1) develop strategies to improve nanomedicine drug delivery to tumours; and (2) develop new clinically relevant imaging methods to help guide drug delivery in patients. Ultimately we'd like to be able to use imaging methods like CT, MRI, or PET to bring drug delivery to the same level of precision achieved with radiation therapy and surgery. We've recently published a review describing how radiation can be used to improve nanomedicine drug delivery to tumors, leading to improved tumor response. The manuscript, titled "Radiation effects on the tumor microenvironment: Implications for nanomedicine delivery. ", can be found in *Advanced Drug Delivery Reviews* . Check it out! <http://www.sciencedirect.com/science/article/pii/S0169409X16301818> This is exciting area of research that will allow us to use clinical methods, such as radiotherapy, to guide where nanoparticles go in the tumor AND increase local drug concentrations without increasing toxicity. We are here to answer your questions about drug delivery, nanomedicine, imaging, radiotherapy, oncology, the pains/pleasures of research, transitioning to/making it in academia, why Toronto is an exciting for biomedical research, and more! Ask US Anything!

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NANOMEDICINES [R/SCIENCE](#)

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Shawn Stapleton PhD, Research Fellow at Harvard Medical School/Massachusetts General Hospital, who's currently looking to transition into faculty. [https://www.researchgate.net/profile/Shawn\\_Stapleton](https://www.researchgate.net/profile/Shawn_Stapleton) <https://www.linkedin.com/in/staplet>

David Jaffray PhD, Senior Scientist and Director of the TECHNA Institute, University Health Network and University of Toronto. <https://www.uhnresearch.ca/researcher/david-jaffray> <http://technainstitute.com/people/david-jaffray/>

Michael Milosevic MD, Clinician and Scientist, University of Toronto and Princess Margaret Cancer Center.

<https://www.uhnresearch.ca/researcher/michael-f-milosevic> <http://www.radonc.utoronto.ca/content/michael-milosevic>

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Ask Us Anything!, *The*

Hey guys, thanks for doing this AMA.

I'm curious if any of you are interested in potential applications this might have for neuroscience. I know there had been some difficulty in the past with treatment of glioblastomas. I guess I'm specifically interested in what this methodology could bring to the table with regards to this problem, and if any of you think it has the potential to impact treatment of brain cancer in the future.

I would also be really interested in hearing any advice you have for someone looking to do a career in neuroscience and neuroimaging. I'm currently working in a neuroimaging lab and am really interested in pursuing this as a career path. Is Toronto somewhere I should look into? Thanks!

[Austion66](#)

Shawn here...

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Short answer, there are huge opportunities in neuroscience/neuroimaging at the cross-section of nanotechnology. The efficacious treatment of glioblastoma is a significant unmet need and nanotechnology can be quite helpful.

For those who don't know, the current standard of care for GBM is surgical resection followed by radiation and Temozolomide. I believe that roughly 15% of patients survive past 3 years...

Here are some research opportunities: Nano-sized contrast agents that can be detected using CT, MRI or optical imaging are being investigated to help better define surgical margins (a huge unmet need). Additionally, the work described in our review (link at the top) suggests that large doses of radiation can help improve drug delivery to tumors through effects on blood vessel permeability. This could be a useful strategy for delivering large drugs like anti-bodies and nanotherapeutics to GBMs by opening up the blood-brain-barrier (\*explanation below) using stereotactic radiotherapy.

If you're interested in coming to Toronto then check out Drs. Jaffray/ Jinzi Zheng/Gelareh Zadeh at UHN and Dr. Kullervo Hynynen at Sunnybrook Hospital. They've all got strong research programs in this area.

The blood-brain-barrier (BBB) is a virtually impenetrable wall formed by the blood vessels of the brain to limit the transport of molecules from blood vessels into the brain tissue. It a safeguard against toxins that could wreak havoc in the tissue.

One criticism that I have heard leveled against the field of nanomedicine is that much of the research depends on the EPR effect (For non-nano people: Enhanced Permeability and Retention, or basically the effect where nano particles accumulate in tumors). Do you think that relying heavily on the EPR effect for nanomedicine targeting is the correct strategy, or do you think that there are other avenues that should be pursued?

[kerovon](#)

Shawn here....

Yes, this is a common criticism that the nanomedicine community has been aware of for quite some time. Nanotherapies work well in mouse models of human cancers but this has not translated to the clinic, leaving some to believe that 'EPR' doesn't exist in human cancers.

First I want to say that EPR is a bit of a misnomer, and we like to approach the problem from more of a systems approach. As we describe in our review, getting nano sized therapeutics to tumors depends on more than just permeable blood vessels. Fluid dynamics, the density of blood vessels, presence of immune cells, etc work in unison to mediate the transport, accumulation, and retention of nanoparticles to tumors.

What we discuss in our review is that radiation improves the delivery of nanotherapy to tumors (loosely put, overcomes EPR limitations) and improves their effectiveness in treating tumors (albeit mouse tumors). What's remarkable is that it seems to work in a variety of tumors and with different types of nanoparticles. We attempt to identify the mechanisms that mediate the improved delivery of nanotherapeutics following radiation. What's exciting is that both radiation and nanotherapeutics (e.g. Doxil) are approved for clinical use. This means we have the ability to translate the pre-clinical findings and see if it's a real effect that has a real impact on patient care.

What has your research determined about using light activated nanoparticles versus other activation methods?

[winstoncurlyfries](#)

Shawn here...

We aren't using light activated nanoparticles, but our colleagues are with success. Check out Dr. Gang Zheng's recent Science AMA on the topic:

[https://www.reddit.com/r/science/comments/4i4lp1/science\\_ama\\_series\\_im\\_gang\\_zheng\\_senior\\_scientist/](https://www.reddit.com/r/science/comments/4i4lp1/science_ama_series_im_gang_zheng_senior_scientist/)

What is your favourite nano material and why is it [Copper Nanotubes](#)?

[Andyryhw](#)

Shawn here...

Our favorite nano materials are those that have benefit in the clinic. This isn't as easy as it seems and many seemingly exciting nano-size therapeutics have not translated from the lab to the clinic...

How long before the healing nano bots depicted in Transcendence are a reality?

[RemoteViewingTrainee](#)

Shawn here... I vaguely remember the nanobots from Transcendence, and did a quick refresher via youtube...not quite our area of expertise, but there has been some interesting 'nanobot' research done at the Wyss Institute here in Boston. They've developed programmable nano-scaled biomaterials that can replicated the same type of gate logic used in computer,s but in vivo (i.e. in people). Check it out:

<http://wyss.harvard.edu/viewpressrelease/183/injectable-3d-vaccines-could-fight-cancer-and-infectious-diseases;jsessionid=472757A40D211A20B4A3F8B6E4399484.wyss2>