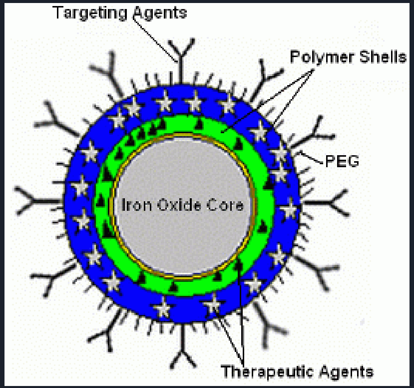
# Applications and Research with Iron Oxide Nanoparticles

Alexa Shikiar

Dr. Miqin Zhang
Dr. Richard Ellenbogen

Department of Materials Science and Engineering
University of Washington

# Background




-Iron Oxide Nanoparticles (IONPs) consist of an $Fe_3O_4$ core, of which biocompatible polymers can be attached

-$Fe_3O_4$ is superparamagnetic at the nanoscale; can be detected under MRI

- $Fe_3O_4$ is biocompatible and biodegradable

- Iron oxide core can be coated in various biocompatible polymers, including polyethylene glycol (PEG), chitosan (shell, protects from body removal)

- To these polymers, we can attach various drugs and cellular targeting agents, for targeted drug delivery

-Therapeutic drugs may include Paclitaxel, Temozolomide, Benzylguanine, or other chemotherapy agents. Main targeting agent is Chlorotoxin (derived from scorpion venom).

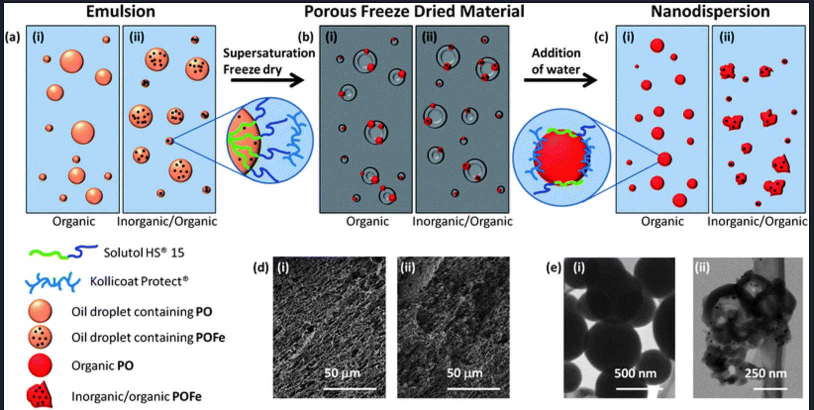
# The Challenge of Storage for Clinical Translation

-in order for a clinical translation of the IONPs, they must be able to retain certain properties and stability during shipping and storage

-current means of storage and transportation is freeze drying/lyophilization, ideally up to several months

-however, current efforts at freeze drying these particles often results in the particles aggregating and their stability being greatly reduced (lyophilization is poorly understood)

- the long term goals are to maintain size, magnetic visibility, targeting ability, and efficacy, while simultaneously minimizing oxidation.



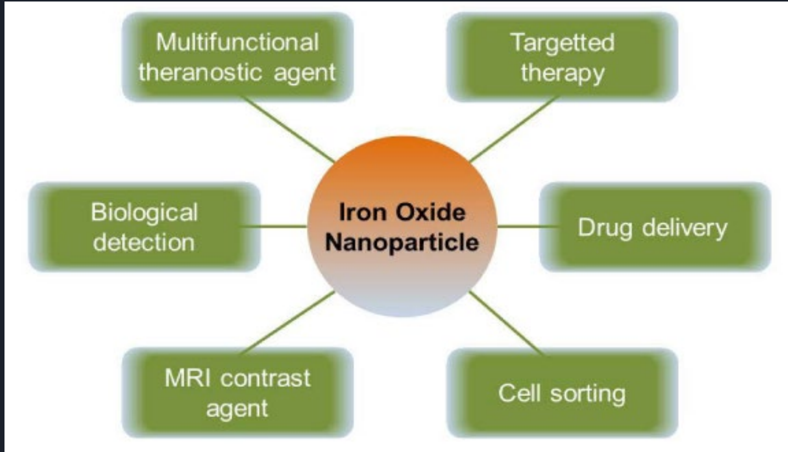
# Applications

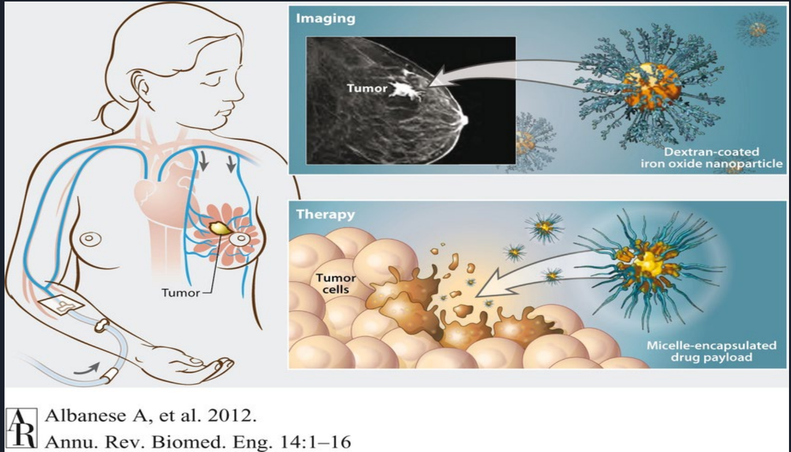
-There are multitudes of applications for IONP  still in development

-Dr. Ellenbogen and Dr. Zhang's lab focuses on targeted drug therapies for cancer treatment

-IONPs are especially effective in  targeting hard-to-reach tumors while minimizing invasive procedures and unwanted chemical exposure to healthy tissue

- Great potential in also using IONPs to image the brain using MRI (targeting areas of the brain DAT, neurological disorder understanding)



# Research and Results

-Size is an important property for in vivo applications; size must be retained after freeze drying and storage

-The ideal size range is between 10-100nm, if  too small (<10nm) will be filtered out by the kidney, if too large (>100 nm) it will be removed via liver/spleen

-wanted to utilize different surfactants previously mentioned in literature. We narrowed our list of surfactants to glucose, dextrose, sucrose, sorbitol, mannitol, PEG 600, and glycerol.

-Made combinations of IONP with various concentrations of the surfactants (0-20% weight by volume); freeze dried, and monitored stability of the particles

-Measured hydrodynamic size in biological media

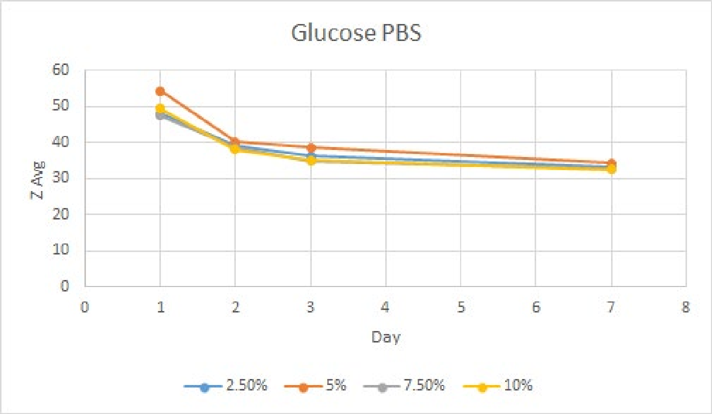
# Research, Results, and Conclusion

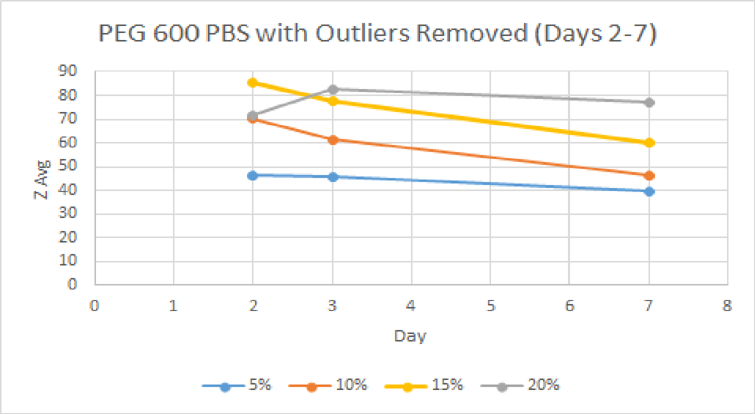
-after the sizes were measured, the results were analyzed and graphed in excel

-we narrowed down the list of viable surfactants to 5, removing PEG 600 and glycerol from further studies

-we want to continue to test different storage conditions:  various temperatures (freezer vs fridge vs room temp), various transporting conditions (dry ice vs. ice pack), etc.

-find ideal condition for long term storage and transportation



# Thank You

Various Donors, Doctors, and Participants in the program

Dr. and Mrs. Ellenbogen

Mr. Pridgeon

Ms. Smith

Zach Stephen

Mike Jeon

NIH NINDS R25NS095377 - Summer Research Experience in Translational Neuroscience and Neurological Surgery