Use of Gold Nanoparticles in Photodynamic Therapy for the Treatment of Cancer
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BACKGROUND
- Cancer is the second leading cause of death worldwide and accounts for approximately 600,000 in the United States alone.
- Cytotoxic agents have been able to treat some cancers effectively, however many can lead to adverse side effects including hair loss, nausea, vomiting, and overall fatigue, which can be prevented with photodynamic therapy (PDT).
- PDT is the process of applying light to a photosensitizer (PS) and through a cascade of energy transfers produces reactive oxygen species (ROS). PDT is able to thus induce cancer cell death through; (1) ROS mediated killing, (2) vasculature damage, and (3) induced immunogenic defense.3
- Typically the PS is directly injected into a tumor leading to more localized effects. Without being exposed to light the PS remains through; (1) ROS mediated killing, (2) vasculature damage, and (3) induced immunogenic defense.3
- Some of the advantages of using PDT are that it is less painful, minimally invasive, and shows low cancer recurrence rates.2,3
- Some of the disadvantages of PDT include prolonged photosensitivity of the skin, expensive procedure, and the variation in blood supply based on the light’s ability to penetrate deep within tumors.2,4
- PDT is currently being used to treat breast, brain, intracranial, esophageal, gastric, head, neck, and colorectal cancer as well as non-cancerous conditions such as attherosclerosis, rheumatoid arthritis, and macular degeneration.5,6

INTRODUCTION
- Nanoparticles delivery systems are great for use in PDT due to their low cost and easy synthesis.
- Metallic nanocarriers are of interest because their size can be customized therefore can be loaded with drugs, DNA, RNA, or biomolecules, in order to pass the blood brain barrier.7
- Smart nanocarriers must be able to avoid the immune system, accumulate at the tumor site, and only release cargo at the site of interest. Nanocarriers can be modified with ligands matching overexpressed proteins unique to cancer cells.
- Tumor cells as they grow and proliferate become dependent on blood supply for nutrients. Eventually, they grow their own vessels to derive their nutrients from, these vessels have increased permeability compared to normal tissue. According to the enhanced permeability and retention (EPR) effect, nano-based drug carriers are able to take advantage of being able to penetrate abnormal, newly formed blood vessels.
- Some of the nanocarriers that are able to take advantage of this phenomenon are liposomes, dendrimers, micelles, and gold nanoparticles.
- Gold nanoparticles are also chemically inert and have minimal cytotoxicity.8 Gold nanoparticles also demonstrate the plasma surface plasmon resonance phenomenon. Therefore when GNPs are irradiated with light the light can be converted into heat and is scattered to induce cell death in cancer cells.9

OBJECTIVES
- This poster will focus on recent developments in photodynamic therapy, and the utility of gold nanoparticles.

METHODS
- Keywrods were entered into PubMed and google scholar to find studies. MeSH terms such as photodynamic therapy, cancer, and gold nanoparticles were utilized.

RESULTS
- Essentially, gold nanoparticles generate singlet oxygen alone which is called photothermal therapy and the photosensitizer is a component of photodynamic therapy.
- The photosensitizer encapsulation in gold nanoparticles creates synergetic PTT and PDT effects.
- The synergetic effect of photodynamic therapy and photothermal therapy in the presence of gold-gold sulfide nanoshells conjugated indocyanine green on HeLa cells. In one study gold-gold sulfide nanoshells were conjugated to indocyanine green and their effects were tested on HeLa cells derived from cervix cancers.
- The compound exhibited a stronger photodynamic and photothermal effect on the cells, exhibiting the synergy between these therapies.10

REFERENCES