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# BIOIMAGING AND NANOMEDICINE FOR CANCER THERANOSTICS

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**Two fundamental and unsolved problems facing bioimaging and nanomedicine are nonspecific uptake of intravenously administered diagnostic and/or therapeutic agents by normal tissues and organs, and incomplete elimination of unbound targeted agents from the body. To solve these problems, we have synthesized a series of indocyanine near-infrared (NIR) fluorophores that varied systematically in net charge, conformational shape, hydrophilicity/lipophilicity, and charge distribution. Using 3D molecular modelling and optical fluorescence imaging, we have defined the relationship among the key independent variables that dictate biodistribution and tissue-specific targeting such as lung and sentinel lymph nodes, human prostate cancers and human melanomas. Recently, we have developed new pharmacophore design strategy structure-inherent targeting, where tissue- and/or organ-specific targeting is engineered directly into the non-resonant structure of a NIR fluorophore, thus creating the most compact possible optical contrast agent for bioimaging and nanomedicine. The biodistribution and targeting of these compounds vary with dependence on their unique physicochemical descriptors and cellular receptors, which permit 1) selective binding to the target tissue/organ, 2) visualization of the target specifically and selectively, and 3) provide curing options such as image-guided surgery or photo dynamic therapy. Our study solves two fundamental problems associated with fluorescence image-guided surgery and lays the foundation for additional targeted agents with optimal optical and *in vivo* performance.**

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