

Photodynamics and phospholipids

Controlled drug release and tumor permeation with light

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Institute for Advanced Biosciences

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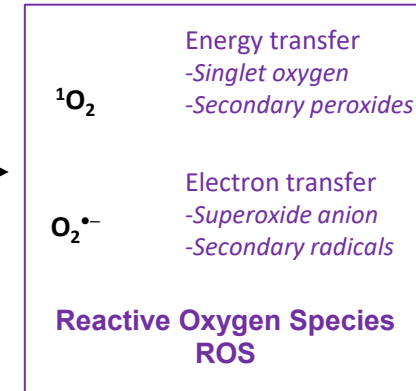
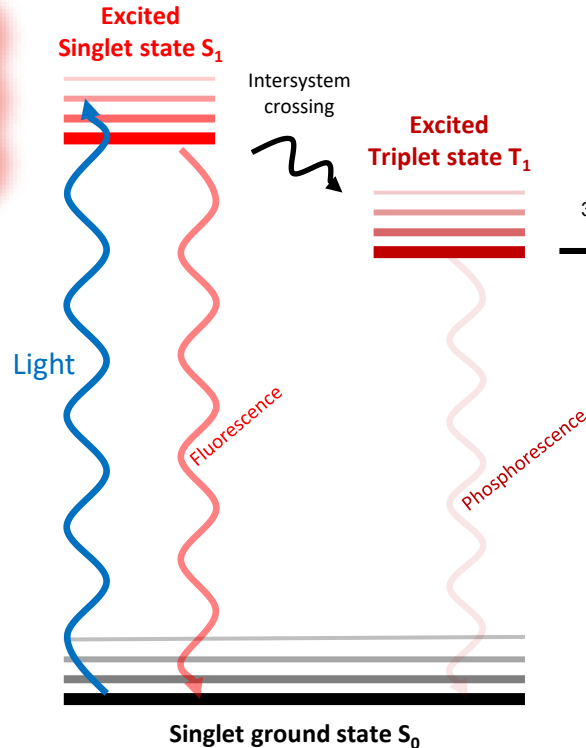
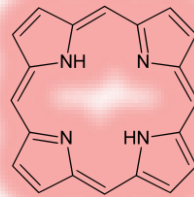
France National Institute of Health and Medical Research (Inserm)



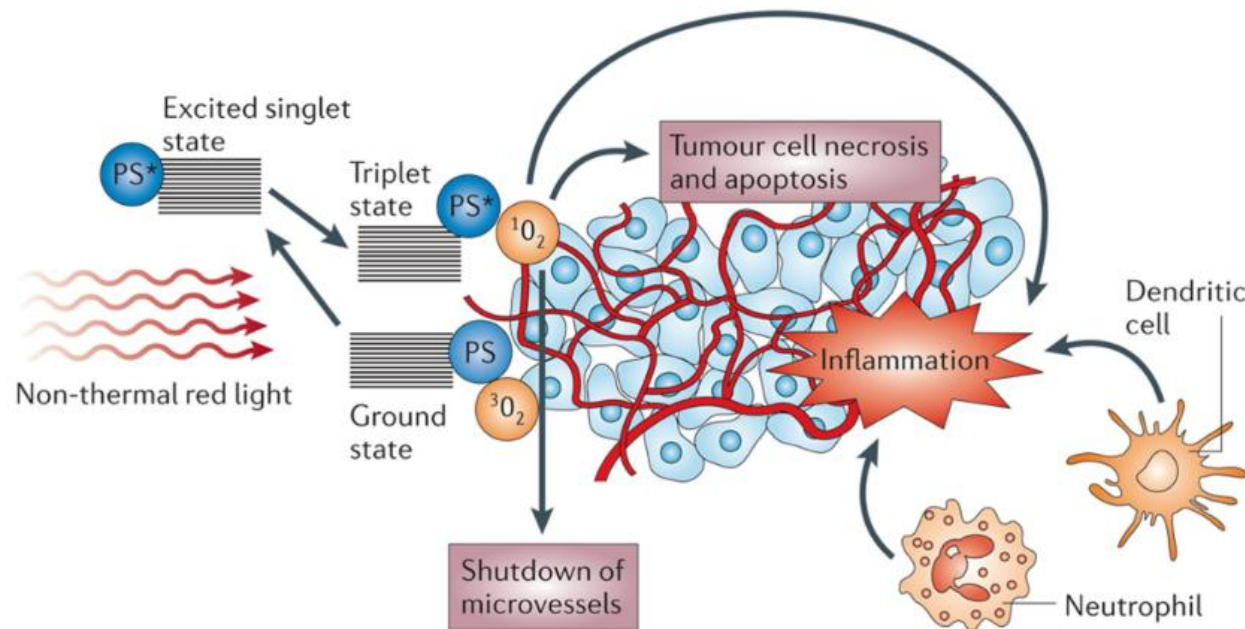
PHILADELPHIA, PA
JULY 13-18, 2025

**NEXT-GENERATION
DELIVERY INNOVATIONS**

Photodynamic therapy (PDT)



Mechanisms of PDT



Photodynamic therapy in the clinic

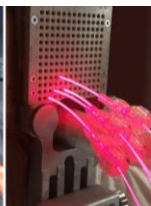
Approved applications



Lung cancer
Photofrin



Prostate cancer
Tookad



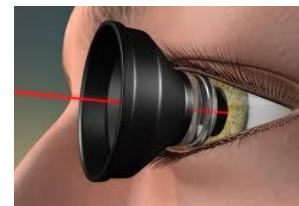
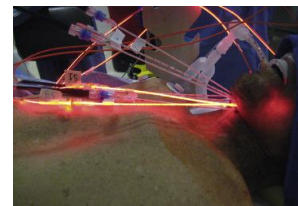
Skin (pre)cancers
5-ALA/PPIX



Esophageal cancer
Photofrin



Head-Neck cancer
Photofrin



AMD
Visudyne

Clinical Trials



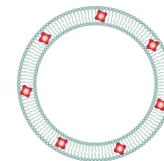
Glioblastoma
5-ALA/PPIX



Biliary tract cancer
Talaporphin



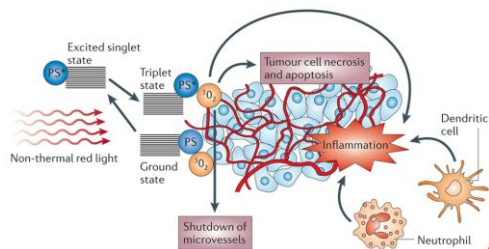
Pancreatic cancer
Visudyne



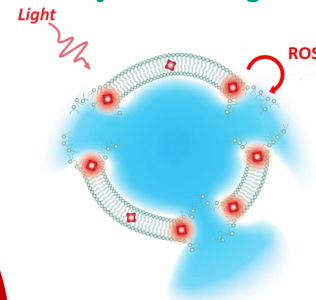
**Liposomal
benzoporphyrin derivative**

Photodynamics & Phospholipids

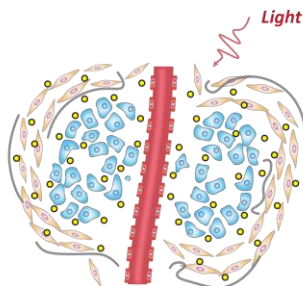
1. Photodynamic therapy



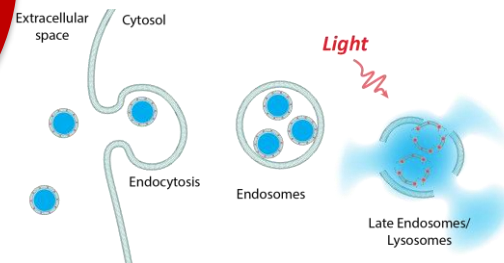
2. Photodynamic drug release



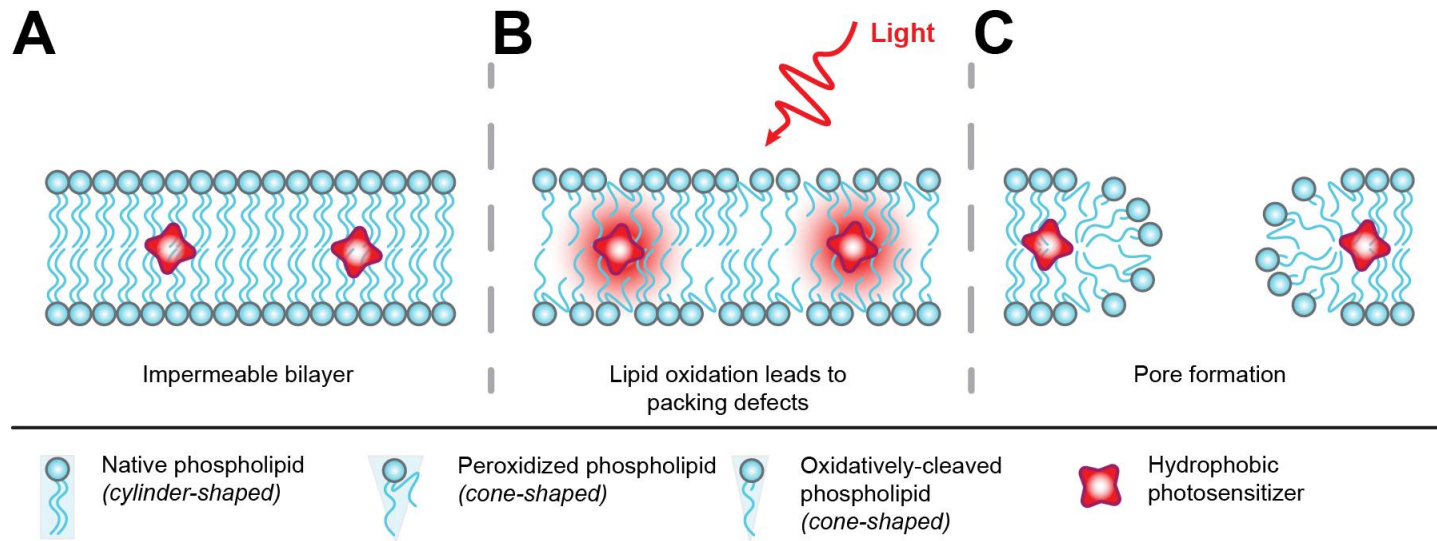
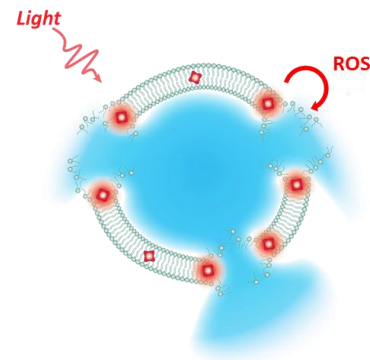
3. Photodynamic priming



4. Photochemical internalization

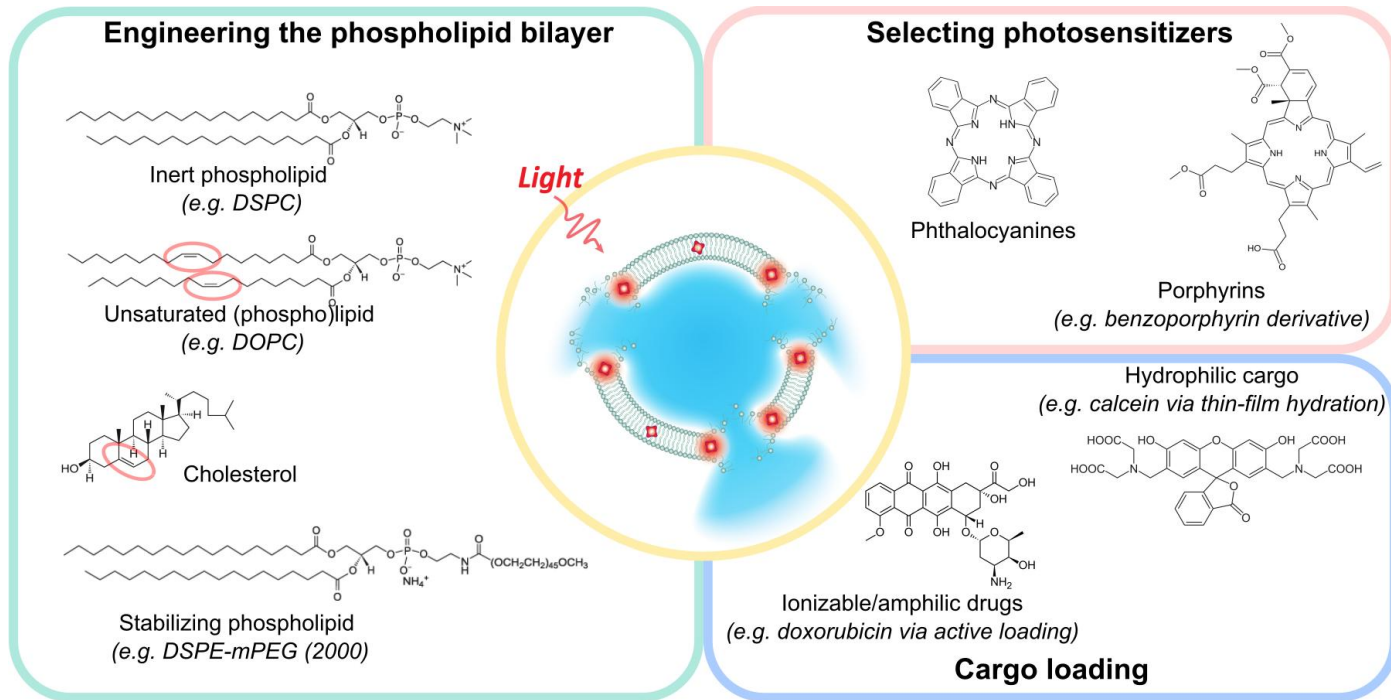


2. Photodynamic drug delivery



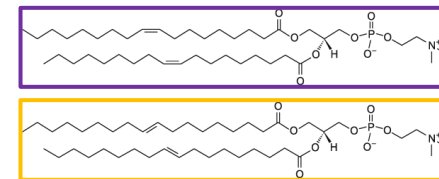
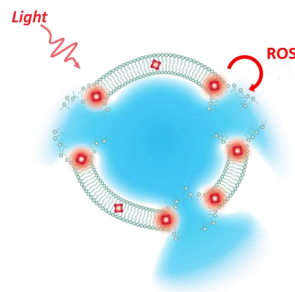
2. Photodynamic drug delivery

Liposome design considerations



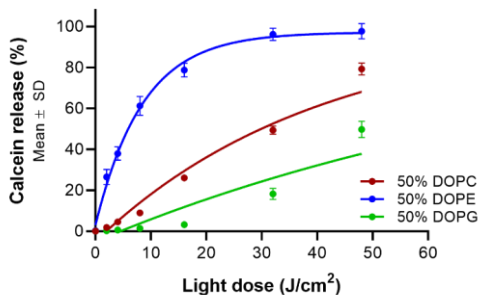
2. Photodynamic drug delivery

Liposome engineering



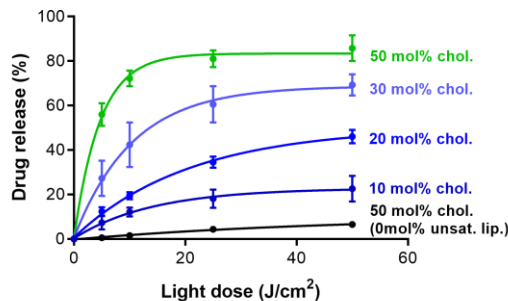
Effect phospholipid headgroup

DSPC:Chol:DSPE-PEG:DOPX (16:30:4:50)

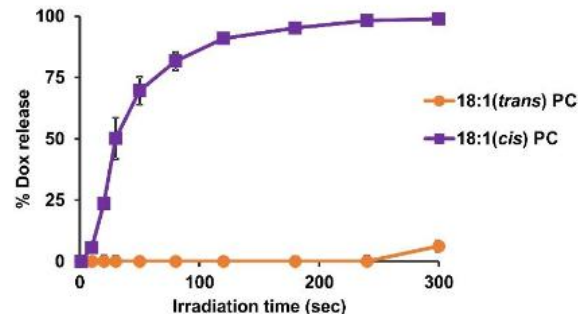


Effect cholesterol

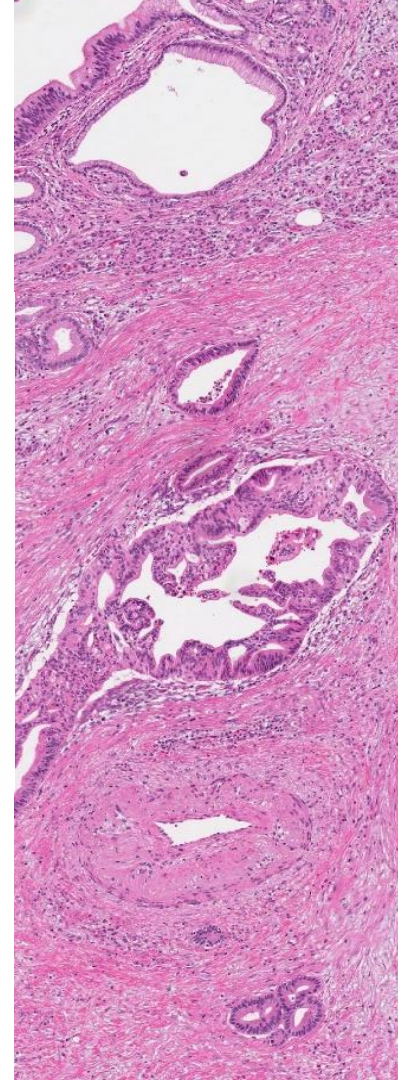
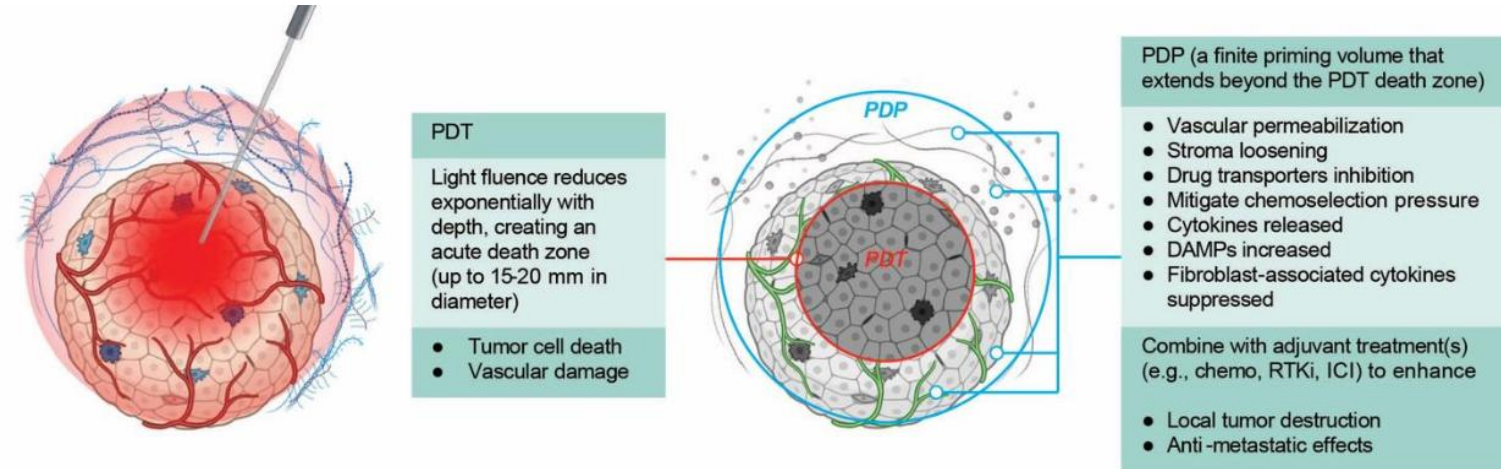
DSPC:DOPE:Chol (45:95:5:0-50)



Effect 18:1 cis vs 18:1 trans PC

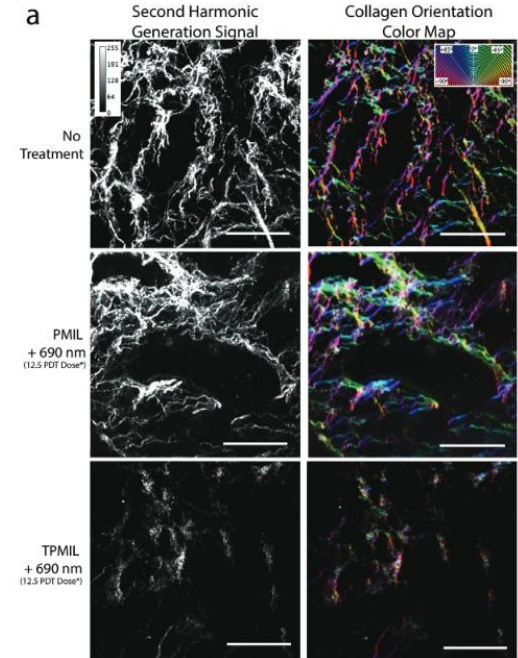
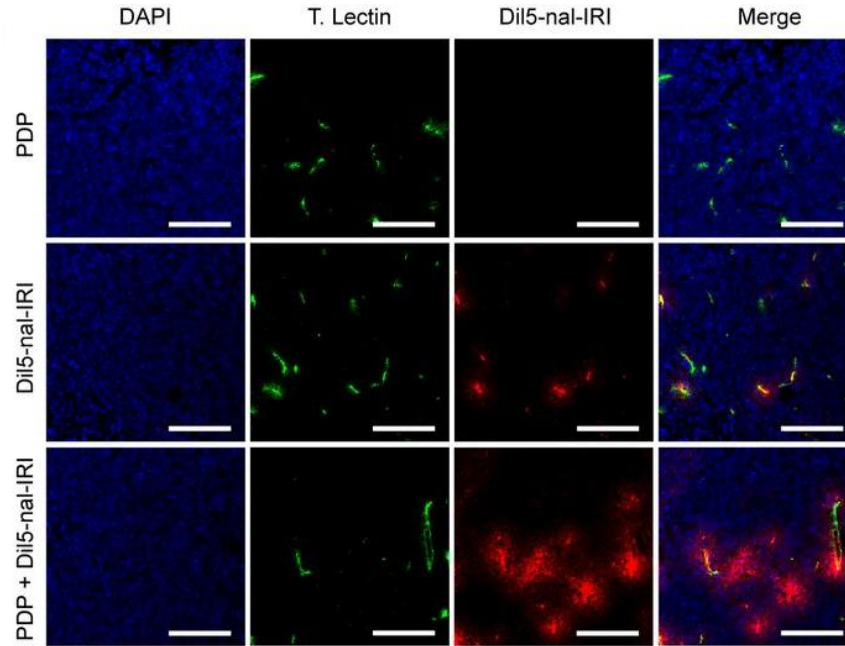
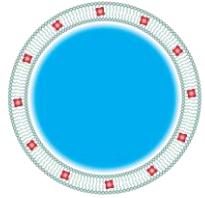


3. Photodynamic priming



3. Photodynamic priming

Effects on cancer microenvironment

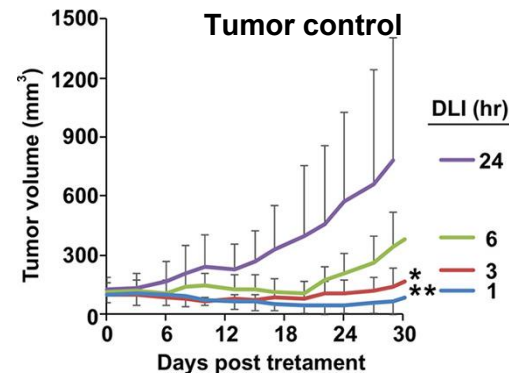
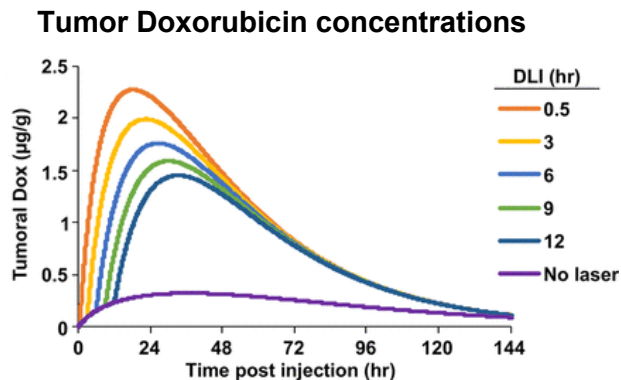
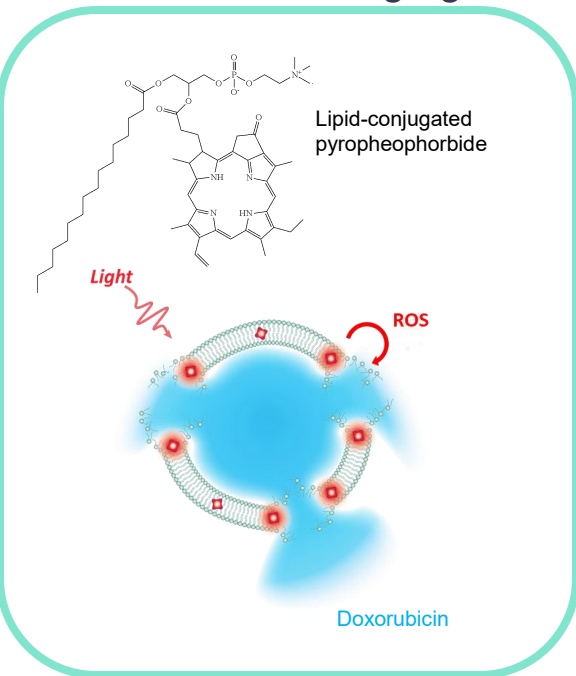


Obaid..Broekgaarden Hasan, **Nano Lett** 2019

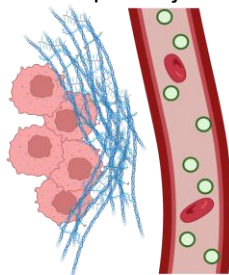
Obaid...Hasan **Adv Science** 2022

3. Photodynamic Priming (PDP)

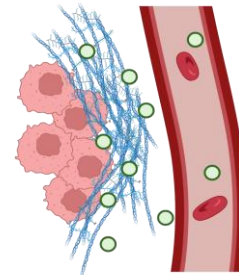
Effect drug-light interval



30min post-injection

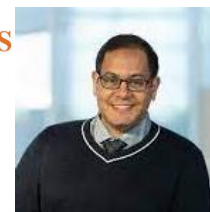


24h post-injection

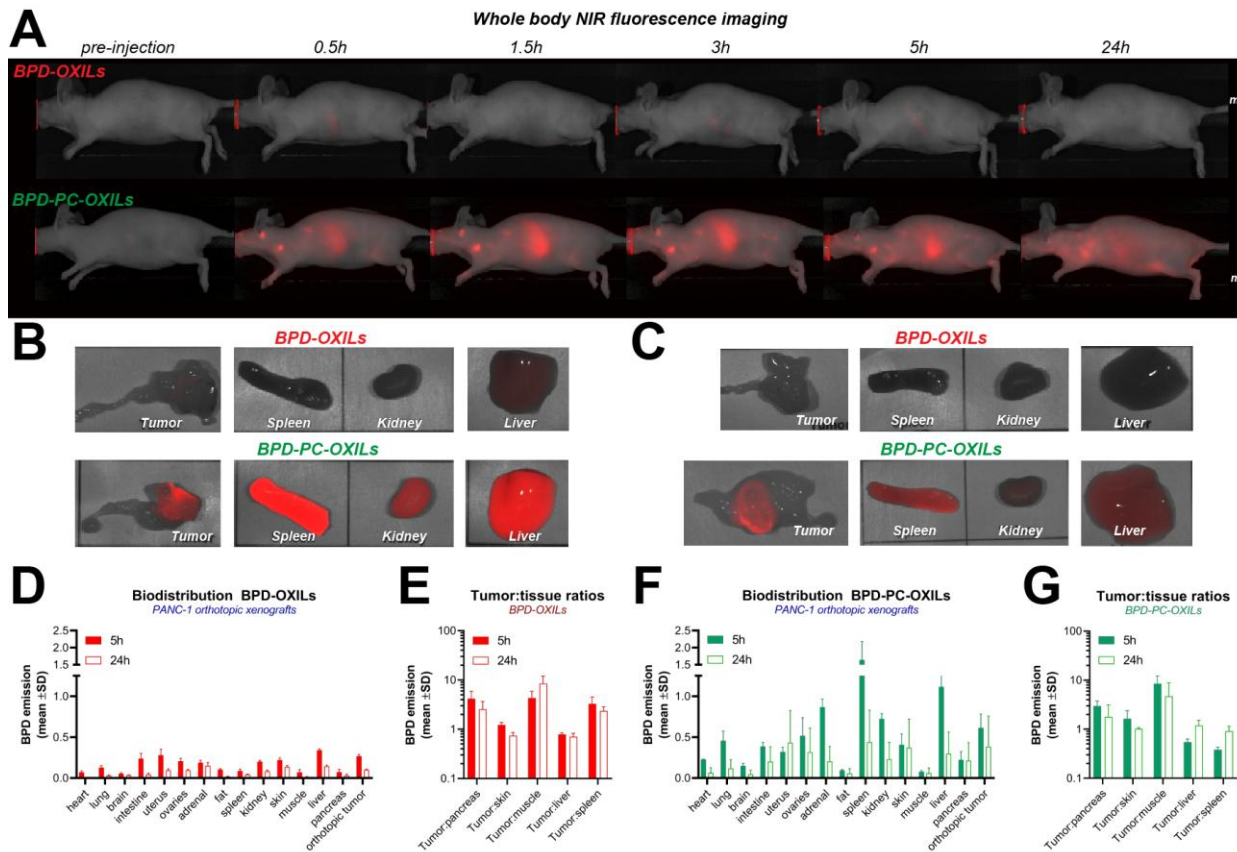
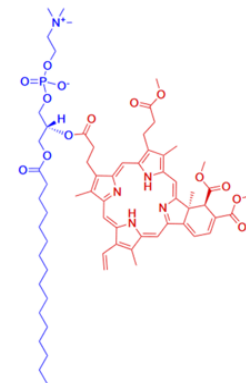
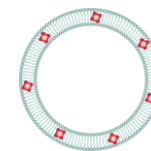
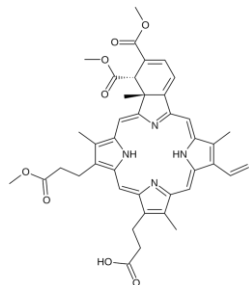
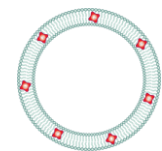


Photodynamic Priming (PDP)

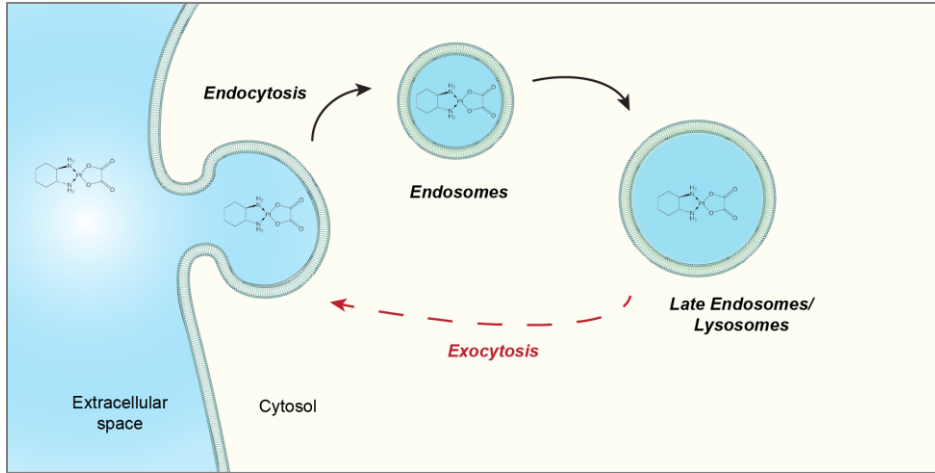
Free vs lipid-conjugated photosensitizer



Collab Dr. Girgis
OBAID



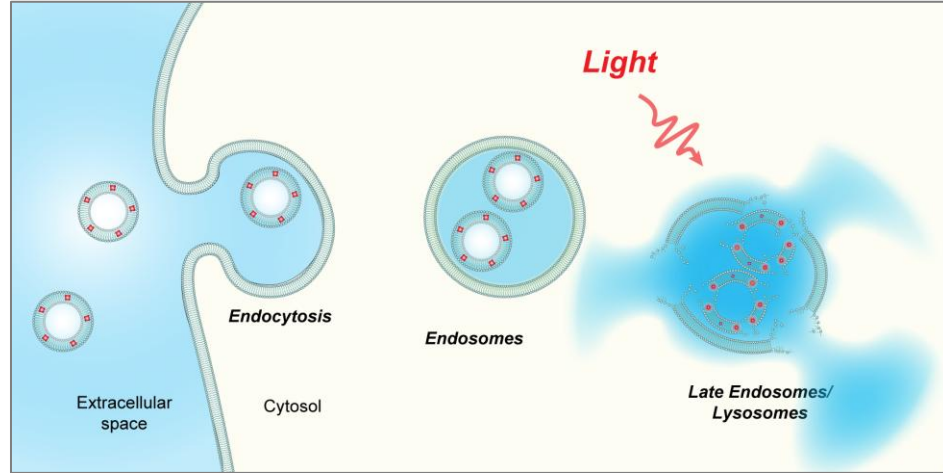
4. Photochemical Internalization (PCI)



Poor diffusion across membranes/ Retention in lysosomes

Mostly developed for Bleomycin $\log P_{o/w}$ -7.5

Also relevant for Oxaliplatin? $\log P_{o/w}$ -1.4 (Platts et al 2006)

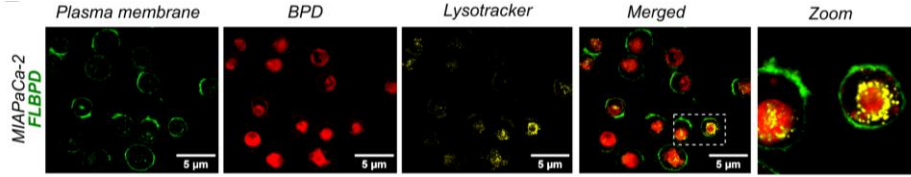


PEGylated liposomes deliver photosensitizers to lysosomes

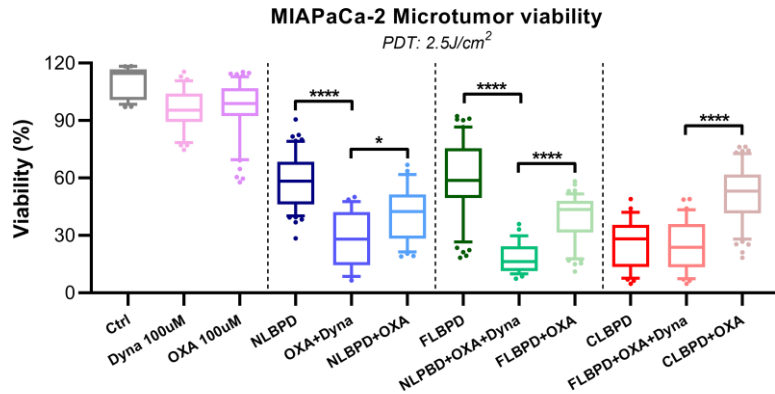
Improved bleomycin efficacy by PCI (Peng et al 2014)

Improved RNA delivery via LNPs (Mo...Cullis & Zheng 2023)

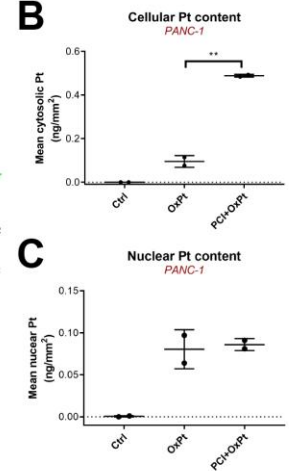
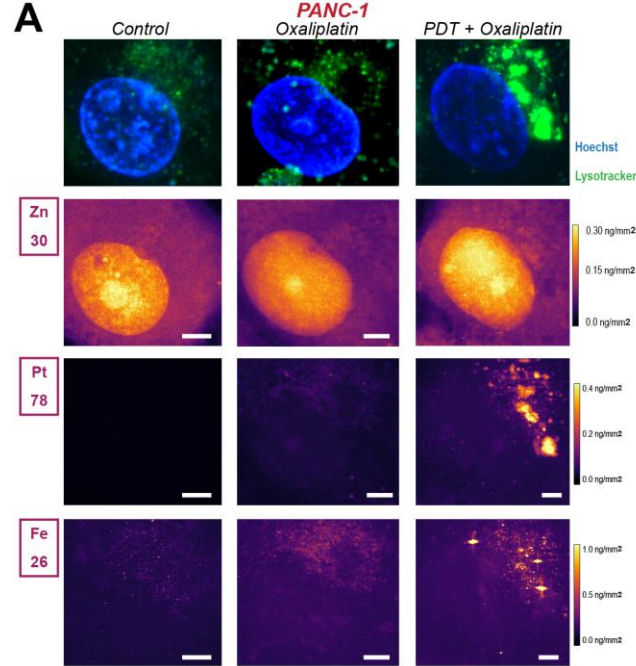
4. Photochemical Internalization (PCI)



- ✓ Liposomal BPD accumulates in lysosomes (not exclusively)



- ✓ PDT + Oxaliplatin: synergistic enhancement
- ✓ Reversed by Dynasore

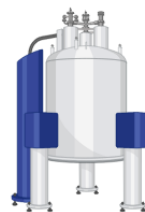


- ✓ PDT improves oxaliplatin retention
- Additional coping mechanisms (ATP7B Cu chelators)

Photodynamics & Phospholipids

Challenges

- Elucidate effects on cancer microenvironment
- Safety (Metastasis in the long term?)
- Detection & quantification of priming



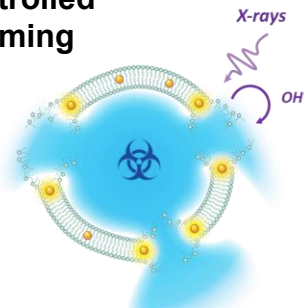
NMR Metabolomics of immediate & prolonged priming effects

Fondation
pour la recherche
sur le cancer

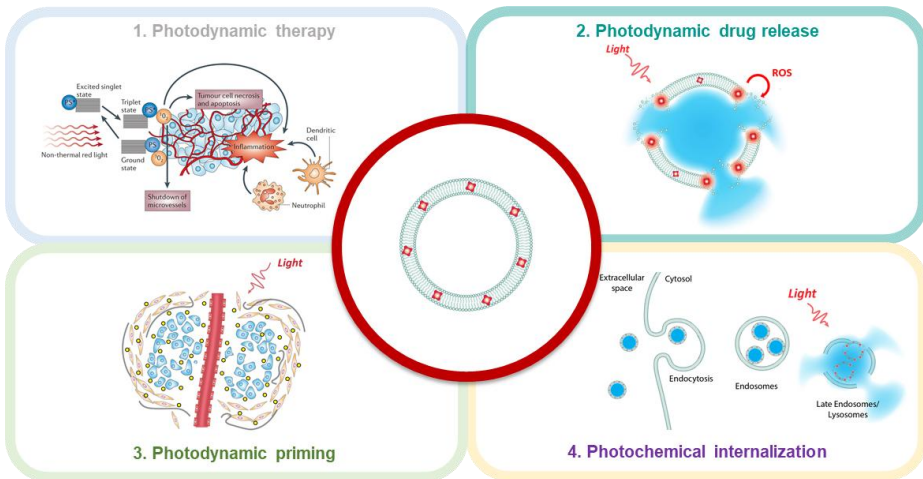


- Overcoming the shallow penetration of light in tissue

**Radiotherapy-controlled
drug release & priming**

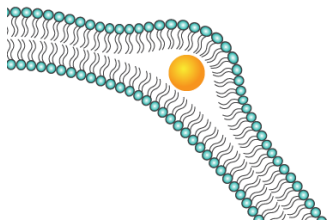


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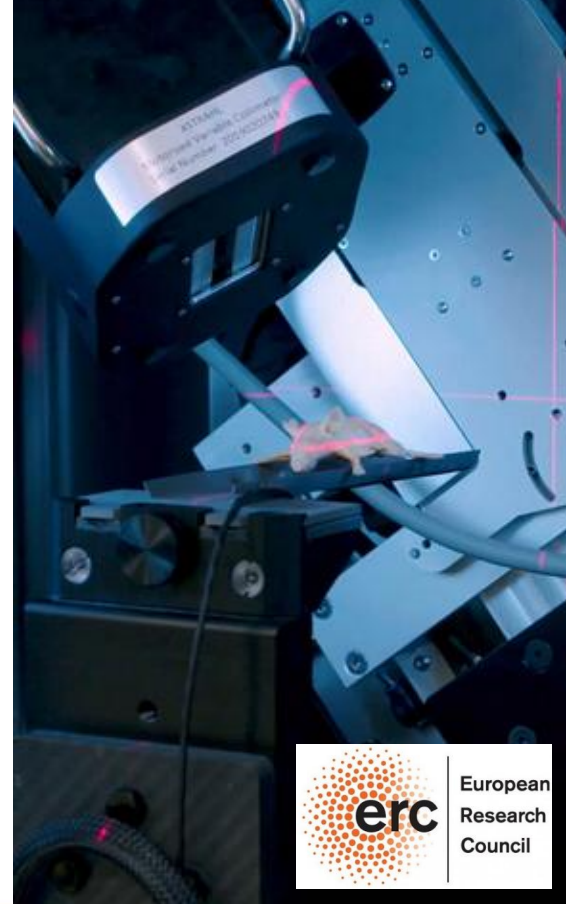
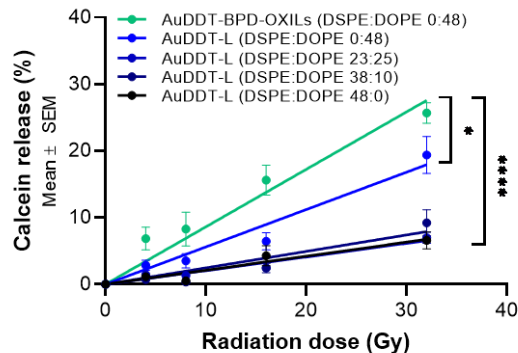
Perspective:

From light to X-rays



X-Ray triggered calcein release

81.7 keV synchrotron irradiation



Carigga-Gutierrez...Broekgaarden, *Adv Mater*, 2024
Leo...Broekgaarden, *Eur J Med Chem* 2025



PHILADELPHIA, PA
JULY 13-18, 2025

**NEXT-GENERATION
DELIVERY INNOVATIONS**

Acknowledgments



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Ahmed Abdelhamid
Estelle Porret
Bénédicte Elena-Herrmann
Amandine Hurbin
Lucie Sancey



Benoit Habermeyer



Fondation
pour la recherche
sur le cancer



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Anne Moore
University College Cork, Ireland



Anuja Lipsa
Luxembourg Institute of Health



Elias Fattal
University of Paris-Saclay, France



October 15-16th, 2025

Scheltema Leiden, Netherlands

Registration fees

Academics: 100 €

Industry: 150 €

Gala dinner (15 october): 40 €

Abstract deadline

July 31th, 2025

Send your abstract to: crsbnlfmeeting2025@gmail.com