# LEO Foundation Center for Cutaneous Drug Delivery (LFCCDD)

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UNIVERSITY OF COPENHAGEN

# Skin – a formidable challenge for drug delivery



Very tight barrier Challenges for: -transdermal delivery -larger drugs (biologics) -low potency drugs

Large progress in device area But,

-Some require healthcare professionals -Skin surface and area limitations

=> Still a need for new delivery systems Requires new approaches to achieve real progress. Fortunately, recent progress regarding (i) (nano)materials, and (ii) methods for investigating these

LFCCDD established in 2017

## **LEO Foundation Center for Cutaneous Drug Delivery**

## **Scientific platform**

Built on integrative **physicochemical** approaches, including pharmaceutics, as well as novel opportunities in nanotechnology, advanced analytical methodologies, and biological models.

### Realization

Built on a 10-year funding base (LEO Foundation and University of Copenhagen (UCPH)).





# Strategies

- Will be built continuously, starting from existing infrastructure at the Department of Pharmacy (UCPH) and surrounding research facilities.

- Embracing developments in (i) novel delivery systems, (ii) novel analytical tools, and (iii) novel biological models.

- Linking resources at both sides of Øresund, notably pharma at UCPH with MAX IV/ESS, and physical chemistry at LU/MaU.

- Preclinical and clinical research collaborations supporting translation towards rational dermal/transdermal drug development.

- Basic research focus – but interactions with industry through collaboration projects





# Laboratory facilities and related

#### **Physical chemistry**

- -Strong laboratory facilities for colloid and interface science
- -BioSAXS core facility (+ access to UCPH core facilities)
- -Frequent users at ISIS/ILL for neutron experiments

#### **Pharmaceutical**

- -Preparative HPLC for skin lipid purification
- -Co-axial electrospinning
- -Wide arsenal for pharmaceutical characterization (Dept. Pharmacy)

#### **Biological**

- -GMO1 bacterial lab
- -Cell lab (Dept. Pharmacy)
- (-GMO2 bacterial lab underway)
- -Ethical permission for mice models of infection/inflammation.







# **LEO Foundation Center for Cutaneous Drug Delivery**





Martin Malmsten, Research **Director & PI** 

Hanne Mørck Nielsen, PI - Novel Biological Models



Jesper Østergaard, PI -Novel Analytical Technologies



Thomas Rades, PI-Novel Drug Delivery **Systems** 



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Master, bachelor, and project students

**Farshid Vihjeh Ibrahim Al-Gallab Amalie Moesgaard** 

**Rebecka Heinbäck** Minshu Li **Katrine Sørensen** 



**Technical and** administrative support

# Output since inauguration 3.5 years ago

- Recruitment and laboratory set-up



- Securing additional funding (DKK25 million) for projects and instruments.
- Establishing LFCCDD as a key user of international large-scale infrastructures.
- >40 publications from our research.

- Supervising 15 Master's, project, and Bachelor's students, and performing more than 1,700 hours of teaching per year.



# Student exposure and interest

- Aspects of cutaneous delivery covered in various courses, from basic chemistry and pharmaceutics to entrepreneurship in pharmaceutics.
- Strong interest from students to do Master, Indivudual study unit, and Guest projects with us.





## Research – so far...

#### Models for healthy and diseased skin

-Methods for preparing and assembling key skin lipids

-Neutron methods for investigating stratum corneum models -Lipid peroxidation and membrane integrity

#### Colloidal delivery systems for small molecule drugs and antimicrobial peptides -Microgels for responsive delivery -Cubosomes for improved skin permeation

-Inorganic nanomaterials for added functionality

# Designed scaffolds for skin and wound healing

-Electrospinning for multi-compartment delivery systems -Fibers containing peptides or photocatalytic nanoparticles

# Understanding challenging skin/wound infections

-Interplay bacteria, host defence cells, and antimicrobial peptides

-Wound biomarkers for improved precision of therapeutics



# New focus area: Overcoming the skin barrier through delivery system design

#### Permeation through increased driving force

-Multiple prodrugs for maximized chemical potential -Stabilization of supersaturated states

#### Permeation through facilitated exchange

-Deep eutectic solvents -Microemulsions

Permeation through maximized occlusion and surface area Defect-free film formation

#### Permeation through designed responsiveness

Infection- and inflammation triggered systems



# Scientific collaborations

- Complementary groups at Dept. Pharmacy and SUND
- Selected grups/(nano)materials/methods
- Selected groups/skin pharmacokinetics
- Selected groups skin/wound biology in infection/inflammation

#### **Purpose:**

- Access to complementary expertise
- A means to allow our own focus



Interested to hear more? Welcome to contact us!

https://pharmacy.ku.dk/research/lfccdd/

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