

NUVISAN

Today's Agenda



Drug Discovery
& Development



About
NUVISAN



Drug Discovery
Solutions



Drug Development
Solutions



Integrated
Solutions

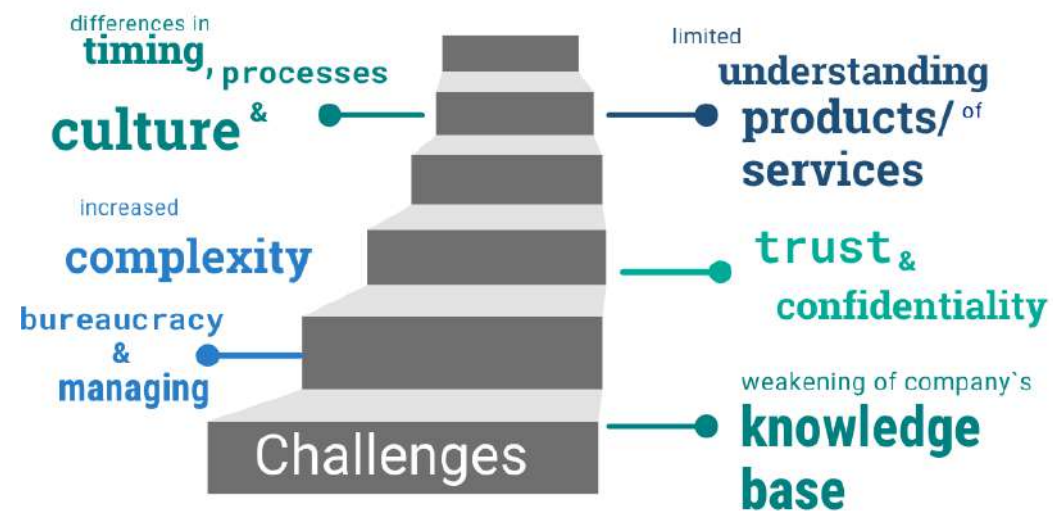
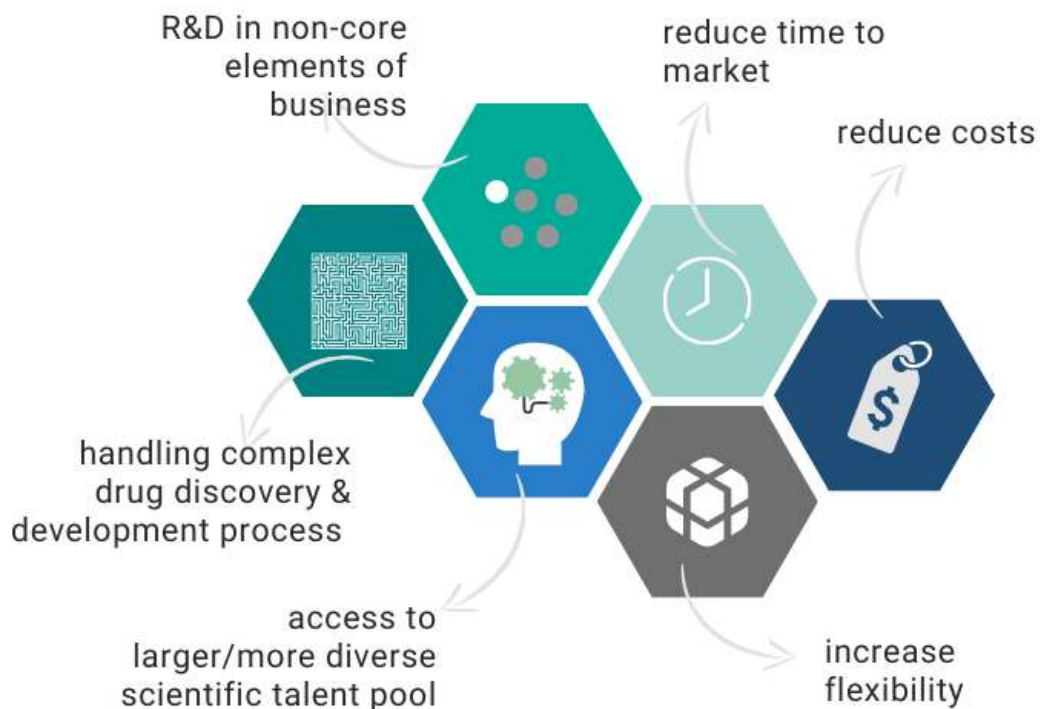


R&D Challenges

How to meet the growing demands
of flexible and integrated drug
discovery & development solutions



Outsourcing of Drug Discovery & Development Opportunities & Challenges





Growing Demands on Outsourcing Settings

Integrated Solutions & One-stop Shop

Encompasses a wide range of services including



Single Master Agreement

keeping minimum contractual burden

Flexibility of research

of outsourcing capabilities

1 project manager

for multidisciplinary operations

Deliverable: biological data

via compound handling & storage capabilities

NUVISAN The Science CRO

Drug Discovery & Development
Meet Scientific Excellence





Focus on Science & Pharma Expertise

- Extensive industry experience (scientists, lab professionals & leadership team) thanks to integration of functional R&D teams from Pharma companies
- “Science first” & customer-centric focus paired with creative, flexible & solution-driven mindset to meet your individual needs
- Audits & inspections (clients & BfArM, EMA, FDA, ANVISA):

38

2017

34

2018

40

2019

29

2020

36

2021



Balanced Client Portfolio

- Clients & partners from Pharma industry, biotech / startup companies, venture capitals & non-profit organizations
- With a focus on transparent discussion, review & revision of project strategies, our industry-experienced scientists
 - Provide consulting - from idea to asset
 - Increase your project value
 - Optimize your portfolio with enabling solutions



Fully Integrated Solutions

From Target to Patient

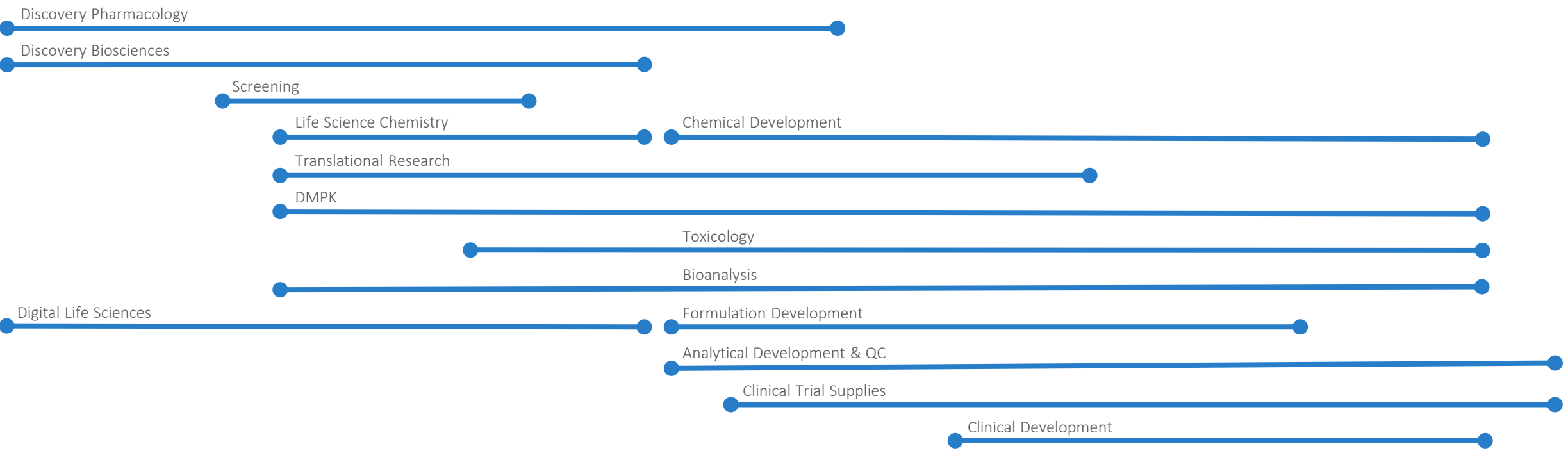
- EU-based company with > 40 years of experience, short communication paths, quick turnaround & unified molecule and data handling standards
- One partner to move your assets with seamless transition of unique, high-quality, & tailored integrated solutions along R&D value chain

DRUG DISCOVERY

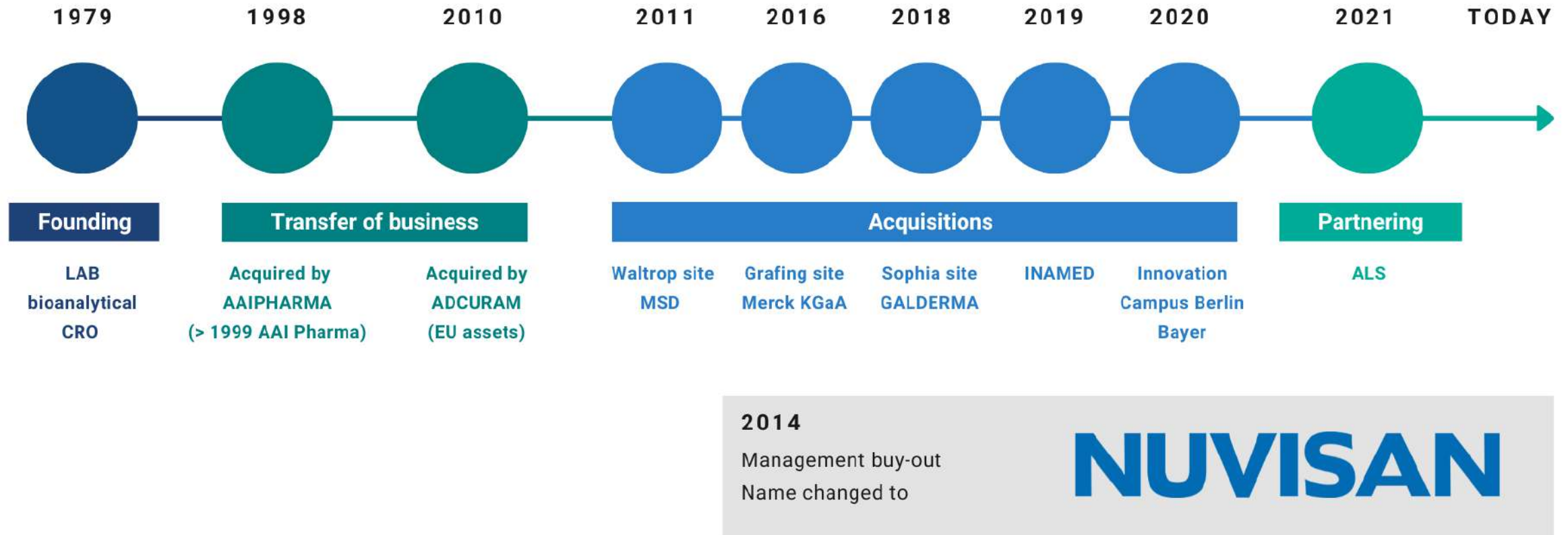
DRUG DEVELOPMENT



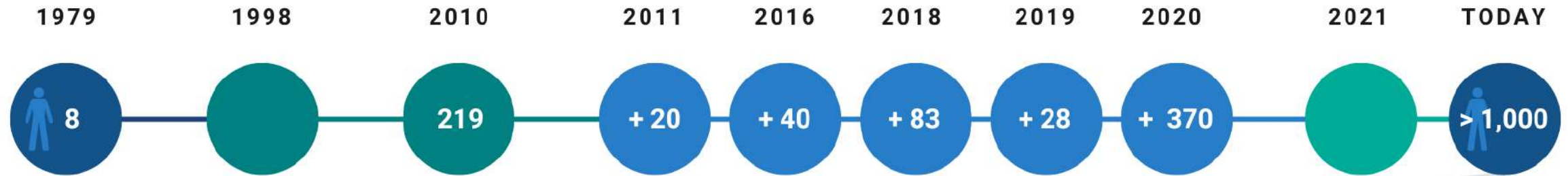
Target identification & validation Target-to-lead Lead-to-candidate Preclinical development Phase I Phase II Phase III



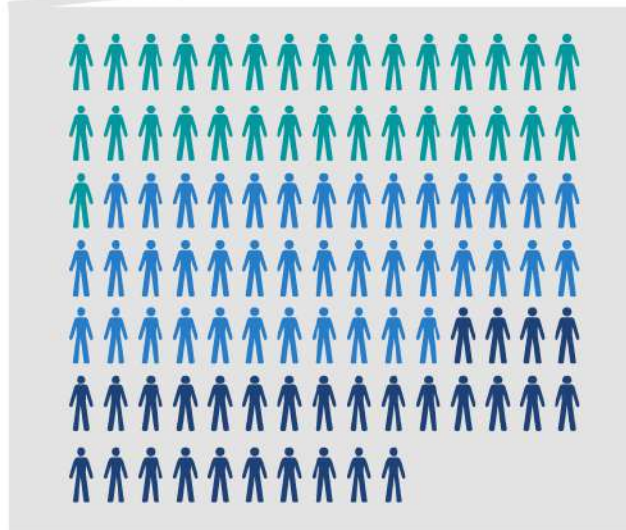
Our History



➤ Our People



~ 31% scientists (69 % *Ph.D.*)
~ 40 % lab professionals
~ 29 % non-scientific staff



➤ Our Sites in Europe & Beyond



Berlin (GER)



Neu-Ulm (GER)



Waltrop (GER)



Grafing (GER)



Gauting (GER)



Sophia (FRA)



- 📍 Lima (PE)
- 📍 Sao Paulo (BRA)
- 📍 Buenos Aires (ARG)

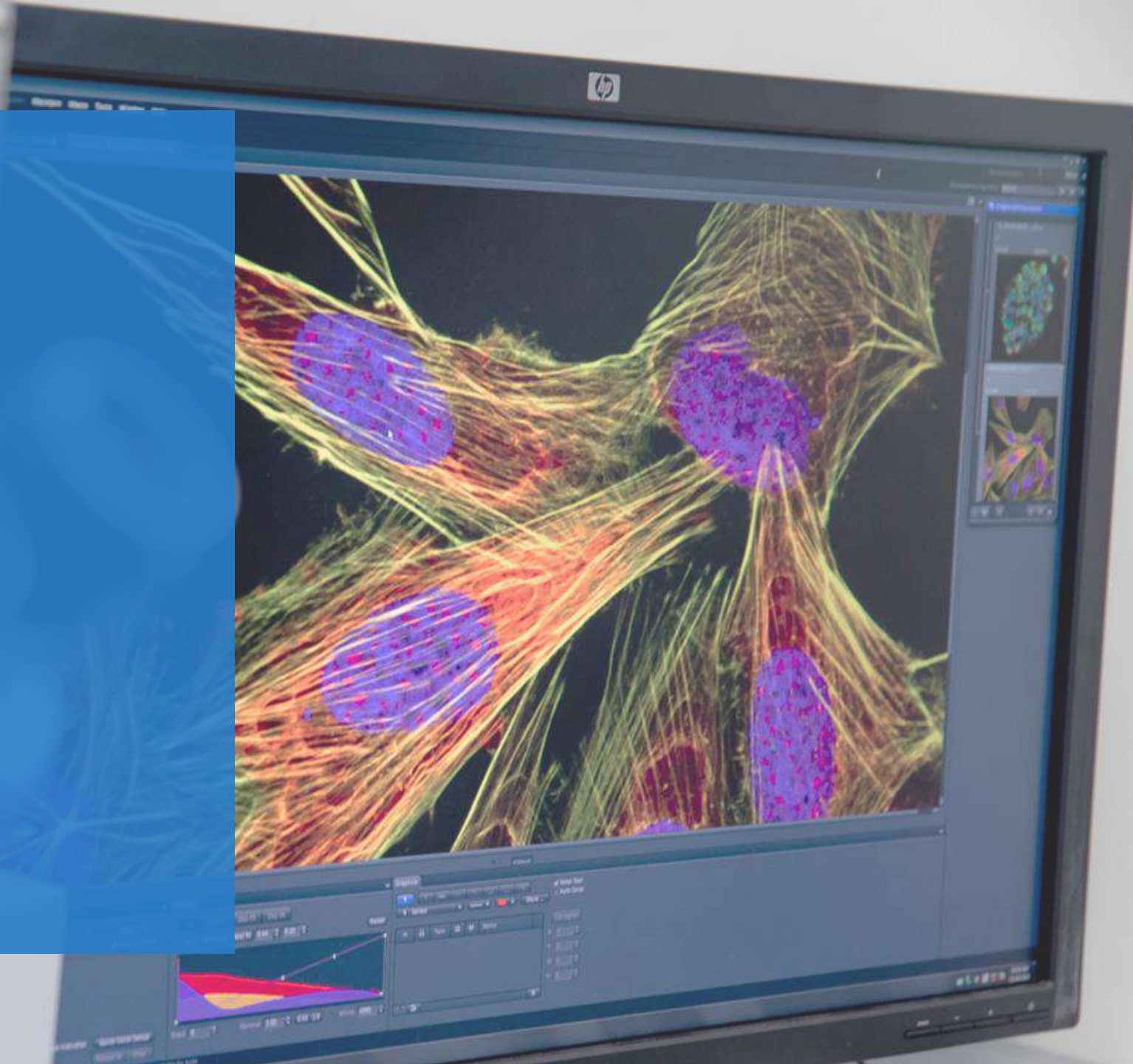
Drug
Discovery
Hub

Drug
Development
Hubs

Local
Experts

Drug Discovery

From Target to Lead



Our Drug Discovery Leadership Team



Charlotte Kopitz
Discovery Pharmacology
& Translational Research



Franz von Nussbaum
Life Science Chemistry
& Digital Life Sciences



Olaf Prien
DMPK
& Toxicology



Holger Steuber
Discovery Biosciences
& Screening

Discovery Pharmacology



Target
Validation



In vitro
Biology



In vivo
Pharmacology



Functional
Genomics



Therapeutic
Areas

Discovery Pharmacology

Target Validation

- Bioinformatics *in silico* target analysis
- Indication space assessment, positioning & expansion
- Cell engineering tools
- CRISPR screening
- Target deconvolution
- Strategy development

Functional Genomics

- Next-generation & single-cell sequencing
- CRISPR / RNAi platform
- Expression analysis
- Bioinformatics services

In Vitro Biology

- Cellular assays & assay development
- Cell line generation
- iPSC platform
- *Ex vivo* assays
- Virus biology
- Flow cytometry, IHC & microscopy units

Therapeutic Areas

- Oncology
- Dermatology
- Inflammatory / autoimmune diseases
- Fibrotic diseases
- Contraception

In Vivo Pharmacology

- Efficacy & PD studies
- Disease models
- *Ex vivo* analysis
- Imaging capabilities
- Model development
- Women's health
- Neurology / pain
- Metabolic diseases / aging
- Cardiology / pulmonary diseases

Translational Research Biomarkers



**Biomarker
Discovery**



**Biomarker Assay
Development**



**Biomarker
Technologies**



**Clinical Translation
of Biomarkers**

Translational Research

Biomarker Discovery

- Target / mode-of-action based or hypothesis free global biomarker discovery approaches
- Proof-of-concept studies *in vitro* & *in vivo*
- Demonstration of target engagement & pharmacodynamic effects
- Correlation of predictive biomarkers & response

Biomarker Technologies

- Next-generation & single-cell sequencing
- Immunohistochemistry
- *In situ* hybridization
- Flow cytometry & cytokine / chemokine platform
- Real-Time PCR / automated Western Blot
- *In vivo* imaging platform

Biomarker Assay Development

- Project tailored *in vitro* & *in vivo* models for PK / PD assessment
- Assays in target & surrogate tissue
- Assay optimization & fit-for-purpose validation
- Analysis of preclinical & clinical samples

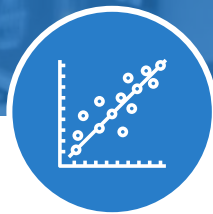
Clinical Translation of Biomarkers

- Human tumor & normal tissue biobank
- Indication profiling to support Ph1 target patient population
- Reverse translation of biomarker read-outs from clinical trials

Discovery Biosciences



Protein
Sciences



Assays



High-Content
Analysis



Biophysics



Mass
Spectrometry



Structural
Biology

Discovery Biosciences

Protein Sciences



- Customized molecular biology service
- Multi-parallel expression optimization (*E.coli*, insect & mammalian cells)
- High quality protein production for assays, structural biology & biophysics
- Protein QC (MS, fSEC, aSEC, nDSF, DLS)
- Membrane protein platform

Biophysics



- Versatile platform: SPR, TSA, nDSF, NMR, ITC, DLS, MST
- Hit characterization, kinetic profiling & SAR support
- Mode-of-action & target engagement
- Biophysical fragment screening (SPR, TSA, NMR)

Assays



- Assay development incl. tool generation (stable cell lines)
- Biochemical, cellular & high content assays
- Binding & enzyme activity assays
- Adaptation to ultra high-throughput

Mass Spectrometry



- High-throughput (HT) MS (RapidFire MS & MALDI-MS)
- Intact mass measurement
- Native mass spectrometry
- Targeted metabolomics
- Proteomics & peptide mapping

High-Content Analysis



- Phenotypic & multiplexed HTS
- SMOL & CRISPR libraries
- Eukaryotic cells (animal, fungi, plant), bacteria & 2D and 3D cell systems
- Single time points & live-cell kinetics

Structural Biology

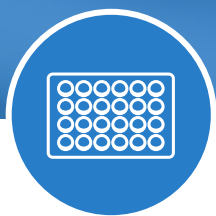


- X-ray determination & analysis
- High-throughput platform for multi-target crystallization
- Cryo-EM, NMR
- HT Crystallography (HTX) for fragment screening
- Small molecule structure determination

Screening



Libraries



**High-Throughput
Screening**



**Fragment
Screening**



**Virtual
Screening**

Screening

Libraries

- 3 million small molecule library (access to Pharma library)
- Different subsets & focused libraries (e.g. 290k / 820k / 2.4 million compounds)
- High chemical diversity, > 70 % proprietary

Fragment Screening

- Biophysical screening (SPR, TSA, NMR) of customized library (~ 2k Ro3 fragments)
- X-ray screening of customized library (~ 900 fragments @500 mM DMSO)
- 1° screen / hit confirmation → hit validation → fragment-to-lead

High-Throughput Screening

- Biochemical, biophysical, cellular with up to 300,000 tests / day
- Mass spectrometry HTS (MALDI-HTOF, RapidFire)
- Best-in-class high content analysis (HCA) screening platform
- > 20 yrs of Pharma HTS experience (> 10 clinical cpds)
- State-of-the-art screening data management

Virtual Screening

- Internal library (3 million small molecules)
- External libraries (100k - > 1b)
- *In silico* virtual screening
- Target / ligand data mining
- Hit expansion

Life Science Chemistry



Design
& Synthesis



Analytics
& Purification



Scale-up
& Special
Technologies



Microbiological
Chemistry



Compound
Logistics



PhysChem

Life Science Chemistry

Design & Synthesis

- Decades of MedChem experience from hit assessment to clinical compound
- ID of new leads for challenging targets
- Multi-parameter optimization of molecules (hit-to-lead, lead-to-candidate)
- SMOLs, probes & new modalities (incl. PROTAC[®]s)

Microbiological Chemistry

- Biotransformation & protein / plasmid production
- Integration in NUVISAN metabolite discovery platform
- Metabolite identification, screening, synthesis & characterization

Purification & Analytics

- Separation technology platform (from < 1 mg up to 1 kg)
- Chiral separation incl. SFC
- NMR, MS & OPT expertise for structure services
- Ligand-protein interaction analysis via NMR & MS

Compound Logistics

- Collection, storage, plating & shipping of compounds
- Building block collection for fast synthetic diversity

Scale Up & Special Technologies

- Large-scale synthesis of API or intermediates incl. route optimization
- High pressure reactions, photochemistry, hydrogenation, carbonylation

PhysChem

- Solubility
- Lipophilicity
- Stability
- Crystallinity (XRPD) & pKa

Digital Life Sciences



Life Science
Datasets



Molecular
Modeling



Cheminformatics
& Machine Learning



Omics Data Analysis
& Bioinformatics

Digital Life Sciences

Life Science Datasets

- ~1b *in vitro* & *in vivo* data points connected to 3 million well-characterized compounds from > 1 decade of research
- HTS, physicochemical, biochemical, pharmacological, pharmacokinetic & toxicological data
- Digital technologies & data mining

Cheminformatics & Machine Learning

- Fingerprint, substructure & similarity search
- ML models for ADME end points
- QSAR predictions
- Clustering & SAR
- Chemical space analysis
- R-group decomposition & visualization, activity cliffs

Molecular Modeling

- Virtual screening
- Structure-based design
- Pharmacophore- & ligand shape-based screen
- Scaffold hopping
- Molecular docking
- Molecular dynamics & free energy calculation

Omics Data Analysis & Bioinformatics

- Interpretation of transcriptomics, genomics, epigenomics (single-cell & bulk next-generation sequencing) / spatial profiling / pooled, arrayed & single-cell CRISPR screens
- Microscopy image analysis at single-cell resolution
- *In silico* target & indication space evaluation
- Literature & database mining

DMPK

Discovery & Development



In Vitro PK
& DDI



In Vivo DMPK



Biotransformation
& MET ID



Consultancy
Services



Isotope
Chemistry

DMPK (Discovery & Development)

In Vitro PK & DDI

- *In vitro* ADMET assay panel for research (HT) & IND-enabling PK characterization
- *In vitro* HT assays with custom protocols
- Investigation of absorption, distribution, metabolism, excretion (ADME) with radio- / non-labeled material
- DDI profiling (victim & perpetrator) & assessment of transporter proteins & metabolizing enzymes

Biotransformation & MetID

- *In vitro* & *in vivo* metabolite profiling, quantification & structure elucidation in various matrices
- Analysis of clinical trial samples (metabolite “scouting”, relative & absolute quantitation, profiling & metabolite ID in hADME)
- Mass spectrometry imaging

In Vivo DMPK


- PK in rodents, dogs & minipigs, single compound & cassette dosing, different admin routes
- Microsurgical rodent models e.g. cannulation of bile duct & portal vein, lymph sampling, femoralis admin
- Absorption, metabolism & excretion (mass balance studies incl. bile excretion & expired air)
- Quantitative tissue distribution incl. placental transfer
- According to GLP upon request

Consultancy Services

- DMPK consultancy through all R&D phases
- Human PK predictions & DDI evaluations
- Project management, DMPK representation
- Scientific writing (IND/IMP, IB, briefing books, reports)

Isotope Chemistry

- ^{14}C radiosynthesis
- Synthesis of stable labeled compounds (^2H , ^{13}C , ^{15}N)
- Manufacturing & QC of radiolabeled APIs according to EU-GMP guidelines
- Reanalysis & repurification of APIs
- Dedicated storage for radioactive APIs (^{14}C & ^3H)



Best Practice in Animal Welfare

(Discovery & Development)

- We believe that humane care & use of animals is a key element of high-quality science
- Our high standards are confirmed by continuous positive feedback from client audits, authorities & full AAALAC accreditation at all sites working with animals
- In addition to complying with legal requirements, we strive to continuously improve our practices & husbandry conditions in the interest of animal welfare

Drug Development

From Preclinical Candidate
to Patient



Our Drug Development Leadership Team



Martina Knoedler
DMPK



Jean-Guy Boiteau
Chemical
Development



Achim Freisleben
Bioanalysis



Gareth Winckle
Formulation
Development



Sandrine Antoniotti
Analytical
Development & QC



Christin Erbach
Clinical Trial
Supplies



Ralf Wulkow
Clinical Development

Toxicology

Discovery & Development



In vitro
Toxicology



In Vivo
Toxicology



Toxicologic
Pathology



Clinical
Pathology



Formulation

Toxicology (Discovery & Development)

In Vitro Toxicology

- Genotoxicity: Bacterial Reverse Mutation & Mammalian Cell / Erythrocyte Micronucleus Test, Mammalian Erythrocyte, Pig-a Gene Mutation & *In Vivo* Mammalian Alkaline Comet Assay
- Skin toxicity: Skin irritation (corrosion & sensitization) assays & NRU 3T3 phototoxicity test
- Cardiac safety (ion channel screenings)

Toxicologic Pathology

- Gross examination, histotechnique & histopathology assessment
- Molecular services incl. development of customized staining / biomarker assays
- Digital pathology platform
- Organ databank
- Peer review for external studies

In Vivo Toxicology

- Single-dose toxicity, dose range finder & toxicokinetics
- Pivotal repeated dose toxicity (4-, 13- & 26-week)
- *In vivo* genotoxicity
- Customized mechanistic toxicity
- Investigations: clinical observations, ophthalmology, sensory reactivity, functional observations & motor activity

Clinical Pathology

- Analysis of clinical chemistry, hemostasis, hematology & urine parameters
- Specific clinical biomarkers services, (e.g. insulin, thyroid hormones) from discovery & validation to robust assay development

Formulation

- Formulation stability, homogeneity & test substance concentration
- Development & validation of analytical methods

Bioanalysis

Discovery & Development



LC-MS
Assays



Ligand-
Binding Assays



Cell-based
Assays

Bioanalysis (Discovery & Development)

LC-MS

- Method development & validation (> 100 assays / yr)
- Dedicated large molecule & new modality assay development team
- > 250 non-proprietary assays
- Experienced in VAMS, peptide analysis, PROTAC[®]s, chiral separations & ion mobility chromatography
- Support from discovery PK throughout non-clinical GLP & clinical development; all biological matrices

Cell-based Assays

- Support of cell-based assays & cell preparations (lysates & cryopreservation)
- Fully equipped cell culture laboratory
- State-of-the-art flow cytometry (BD FACSLytic)

Ligand-binding Assays

- Support of PK & immunogenicity studies (ADA & NAb), biomarkers & biosimilars
- Fully validated systems incl. MSD QuickPlex SQ 120, Gyrolab xPlore & xPand, Tecan M200 ELISA Reader
- Experience with various tissues (using Precellys tissue homogenizer)

- All assays validated according to applicable international guidelines
- Fully validated Watson LIMS incl. immunogenicity module covering validation studies as well
- GLP, ANVISA, S1 license (GMO), BSL2 certification (pathogenic / infectious samples)
- Co-location with Phase I clinic

Chemical Development



Process Research
& Development



GMP Batch
Manufacturing



Solid Phase
Investigations



Impurities ID
& Assessment

Chemical Development

Process Research & Development



- Fast, efficient route evaluation, selection & scale-up
- Co-localized process development & Kg batch manufacturing of preclinical & clinical supplies
- Production of 1 - 10 kg batches (intermediate / API) incl. impurity control for preclinical studies

GMP Batch Manufacturing



- Advancing of candidate from preclinical through phase I / IIa by scale-up in GMP Kilo Lab
- Starting material definition, analytical method validation & PGI assessments, informal & full ICH stability studies & CoA

Solid Phase Investigations



- Selection & control of API solid state
- Identification of new solid forms of small organic molecules (e.g. polymorphs, salts, co-crystals, or amorphous forms)
- Polymorph & salt screening, solubility curves, filtration assessments

Impurities ID & Assessment



- Isolation, identification, synthesis & assessment of unknown impurities (higher than ICH legislation, 0.1 %)
- Analysis of degradation pathways
- Identification of potential ingredient interactions for dossier examination by regulatory agencies

- GMP compliance
- Tox & GMP batches up to 10 kg
- HPAPI up to OEL 0.1 $\mu\text{g}/\text{m}^3$
- Prep-HPLC / SFC, high-res MS, 400 MHz NMR
- State-of-the-art laboratory

Formulation Development

Focus on Semi-Solids & Liquids



Consulting
& Technology
Development



Preformulation



Prototype
Development



Formulation Selection
& Preliminary Process

Formulation Development

Consulting & Technology Development



- Project evaluation, product development planning & troubleshooting
- Technology assessment
- IP creation & patent strategy
- Strategic life-cycle management

Prototype Development



- Target product profile & formulation strategy
- Excipient selection & function justification
- Prototyping for optimized formulation parameters
- Stability / API release & skin delivery / tolerance customized to disease / sensory assessment / microstructure characterization

Preformulation



- Solubility & compatibility profiling (single solvents & solvent blends)
- Assessment of key formulation parameters incl. pH, temperature & oxidation
- Rational residual composition design to optimize solubility & skin delivery

Formulation Selection & Preliminary Process



- Robust & de-risked formulation selection of lead & backup candidates & regulatory compliance, stability
- *In vitro* release & skin permeation testing (IVRT/ IVPT)
- *In vitro* (irritation, inflammation), & *in vivo* models, imaging (AP-MALDI-MS)*
- Preliminary assessment of critical process parameters to support scale up

- R&D of topical formulations for pharmaceutical & OTC dermatological treatments & complementary consumer products
- Conception & creation from TPP, preformulation to formulation selection & transition into scale-up, clinical development & QbD.
- 10 g – 10 kg capacity
- HPAPI up to OEL 0.1 µg/m³ (OEB5)
- Other delivery routes, incl. oral liquids (see slide 44)

*atmospheric pressure-Matrix-assisted laser desorption/ionization-mass spectrometry

Analytical Development & QC



**Full
Service**



**Method Development
& Validation**



**Release
& QC testing**



**Stability
Testing**

Analytical Development & QC

Full Service

- Specifications tailored to project stage
- Small & large molecules
- Dosage forms: solid, semi-solid, liquids
- Highly potent APIs up to HHB5 (OEL > 1 µg/m³)
- GMP certified & FDA inspected

Release & QC Testing

- QC testing of drug substances & products
- Support to preformulation, formulation & scale-up
- Cleaning validation methods
- Non-sterile microbial testing with preservative efficacy & microbial limit tests (USP & Eur Ph)
- In-house QP release

Method Development & Validation

- Analytical continuum DS/DP
- Forced degradation studies
- Container closure integrity testing (blue dye, headspace analysis, high voltage leakage detection)
- Break-loose / glide-force testing
- Rheology platform & *in vitro* release testing

Stability Testing

- Stability chambers, climate cabinets & stand-alone stability storage
- Zone I to IV, ICH compliance
- 320 m³ of storage with rooms from - 70 → + 60 °C
- Temperature, light & humidity controlled
- Cycling, photostability & transportation studies

Clinical Trial Supplies



Manufacturing



**Packaging
& Labeling**



**Logistics &
Depot Solutions**



**Supporting
Services**

Clinical Trial Supplies

Manufacturing

- Solid oral forms, esp.:
 - Automatic capsule filling, incl. over-encapsulation
 - Tablet pressing (matching placebos)
- Creams, lotions, ointments & oral solutions
 - 10 & 50 kg tank with 5 kg / 25 kg melting vessel
- Handling of high potent APIs

Logistics & Depot Solutions

- > 700 m² clean rooms for manufacturing & primary packaging
- 6 walk-in refrigerators & 2 walk-in freezers
- Global distribution
- Worldwide depot network
- Reconciliation & destruction

Packaging & Labeling

- Primary packaging of non-sterile products
- Blistering (PVC / Alu, Alu / Alu, Aclar) & wallet packs
- Secondary packaging & labeling at:
 - Ambient / 2 - 8°C / - 20°C / on dry ice
- Blinding solutions for, e.g., PFS, inhalers, tubes
- Packaging of light-sensitive products

Supporting Services

- Import & QP services (incl. blood products & vaccines)
- Creation of randomization lists & emergency envelopes
- In-house label printing, all types of labels
- Comparator sourcing incl. decommissioning
- Handling of controlled substances

Clinical Development



Early Clinical
Development



Phase II-III,
Clinical Efficacy Trials



Clinical Trial
Services



Clinical & Regulatory
Consulting

Clinical Development

Early Clinical Development



- Clinical trials:
 - First-in-man (SAD/MAD)
 - Pharmacokinetic (incl. PK, BA / BE, DDI)
 - Special safety (e.g. TQT trials)
 - PK / PD
 - Proof-of-concept
 - First-to-patient (Phase Ib)
 - Exploratory in patients with PK / PD endpoints

Clinical Trial Services



- Project management
- Clinical trial supply management
- Data management
- Medical writing
- Biostatistical & bioanalytical evaluation
- Regulatory support
- Clinical monitoring

Phase II-III, Clinical Efficacy Trials



- Phase II clinical trials with complex endpoints at few specialized sites
- Large-scale Phase II or III clinical trials in a multi-center setting
- Special expertise & track record in therapeutic area respiratory

Clinical & Regulatory Consulting

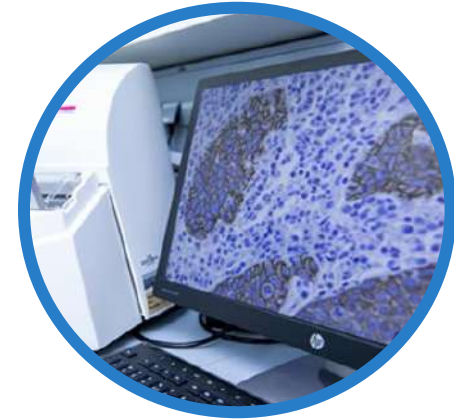
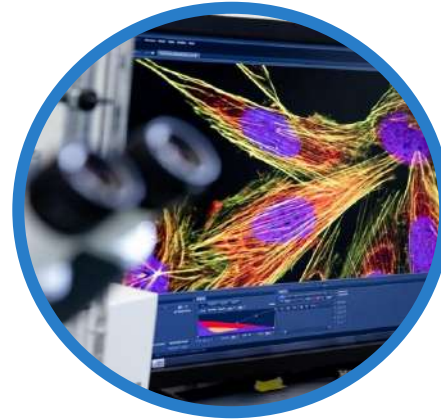
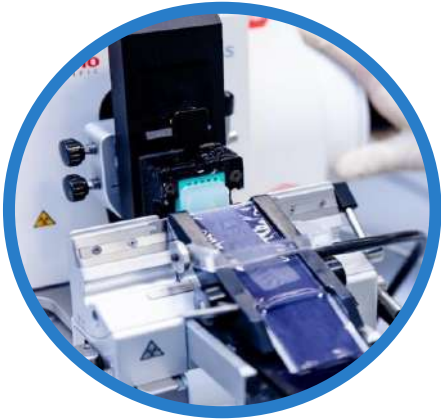


- Setup of clinical trial concepts & development plans
- Regulatory consulting
- Advice on clinical-pharmacological questions

Integrated Drug Discovery & Development Solutions



➤ Integrated Therapeutic Solutions – Oncology



Solutions along the Value Chain

- Target Identification & validation
- *In vitro* biology & *in vivo* pharmacology
- Biomarker discovery
- Bioinformatics platform
- Preclinical & clinical sample analysis
- API manufacturing
- Clinical Phase I studies in healthy volunteers
- Clinical monitoring (Phase II-IV) studies

In Vitro Capabilities

- Functional genomics platform (CRISPR & viral expression systems)
- Gene expression platform (bulk & single-cell next-generation sequencing)
- Flow cytometry, IHC & microscopy units
- Cellular assays
- Mode-of-action exploration

In Vivo Capabilities

- Efficacy, PK/PD & biomarker studies
- *Ex vivo* analysis in tissues & tumors
- >100 xenogeneic & syngeneic tumor models
- Radiation & imaging capabilities
- Model development
- PK/PD modeling & human dose prediction
- Preclinical safety & toxicology
- AAALAC accredited *in vivo* facility

➤ Integrated Therapeutic Solutions – Dermatology



Our Experts

- Multidisciplinary teams combining a unique blend of discovery, research, and development expertise in drug substance & drug product creation
- Decades of experience in identifying, developing & manufacturing drug substances, systemic candidates & topical products

How We can Support You

- Identification of optimal asset indication space
- Preclinical *in vitro* & *in vivo* efficacy models for various skin diseases, safety, PK & toxicology
- PKPD modelling & human dose prediction
- API, finished semi-solid & liquid product development incl. creams, gels, ointments & foams

Facilities & Equipment

- Established on former medium and big Pharma R&D sites incl. one that was the world's largest skin-focused R&D center
- Best-in-class equipment incl. liquid chromatographs (UPLC/HPLC), LC-MS/MS, Q-TOF, qNMR, Biolumix, LUMISizer, RapidOxy, AP/MALDI-MS

➤ Integrated Solutions – Our PROTAC[®]s Platform

Target / POI Identification

Various indications
Unbiased target ID approaches
Target selection
ID of POI binder using uHTS, fragment / MS / biophysical / virtual screens

MedChem Design

Collection of building blocks for rapid PROTACS assembly, with focus on:

- Linkers
- POI & E3 ligase binders
- Property optimization



E3 Ligase Portfolio

Known E3 binders
Novel E3 ligases & binders:

- Focused / rational approach
- Comprehensive bioinformatics analysis / unbiased screen strategy

PROTACs Characterization Platform

Biochemical, biophysical & cellular mechanistic assays
Ubiquitylation assays
Proteomics
DMPK & bioanalysis
In vivo models

Contact Us



Drop Us a Line
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www.nuvisan.com

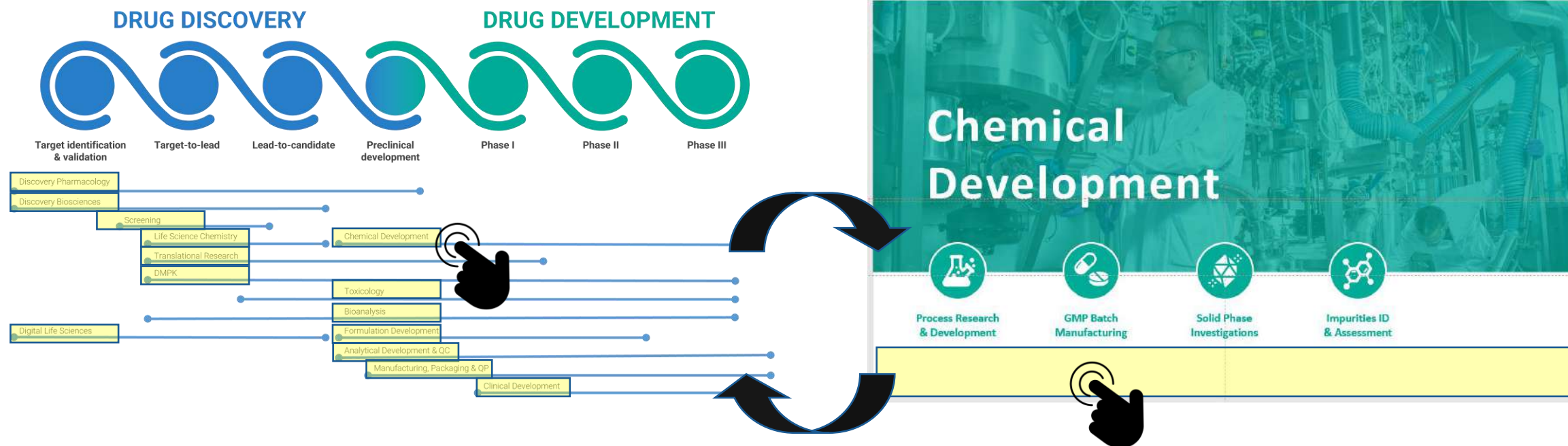


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www.calendly.com/nuvisan

➤ How to Use the Value Chain Hyperlinks



- Hidden behind the respective name of the solution lines in the value chain on slide #10 are invisible hyperlink boxes (exemplary shown in yellow here)
- **When in presentation mode**, you can click on them and you automatically jump to the respective detailed solution line slide
- If you are on the detailed solution line slides and would like to go back to value chain, there is an invisible hyperlink box at the bottom of those slides (exemplary shown as a yellow box here)