Southern Research
MOVING SCIENCE

Your Drug Development Partner

SPEED, ACCOUNTABILITY & RELIABILITY TO SUPPORT YOUR PATHWAY TO REGULATORY APPROVAL

Southern Research has supported preclinical pharmacological and toxicological studies for government and commercial clients for more than 80 years. These efforts have resulted in the development of a highly talented, experienced, and dedicated staff of scientists with expertise in executing a broad range of studies to support Investigational New Drug (IND)-enabling programs. In addition, we operate in full compliance with U.S. FDA GLP regulations.

To ensure high-quality study execution and client satisfaction, our team of scientists and technical staff work as an extension of your team to provide a level of partnership that is unparalleled among contract research organizations.

$445M in NIH Funding

Awarded $445 Million in NIH funding since 1985

+150 Partners

Serving more than 150 commercial and academic partners

20 Drugs

20 FDA-approved drugs tested

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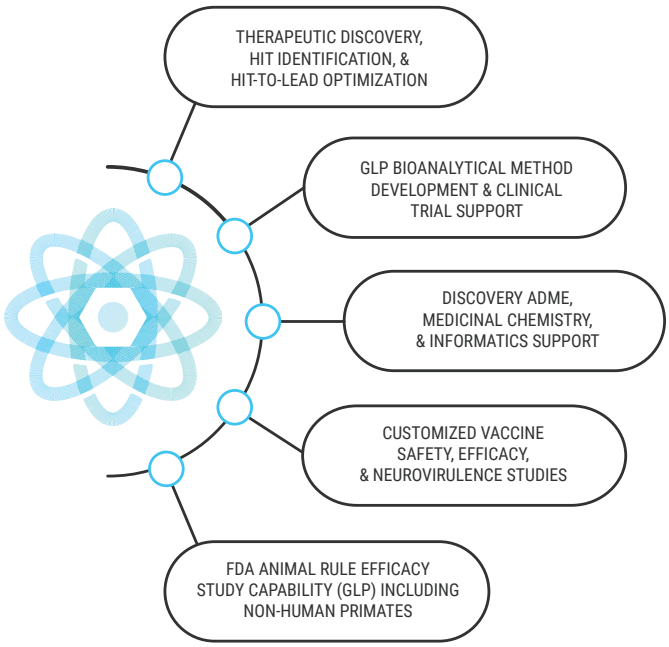
Our integration of world-class resources across these areas within a single service provider is a differentiator not commonly found among our competitors.



HIT-TO-LEAD ASSISTANCE

- Cell-based assays with a variety of read-outs
- *In silico* drug discovery tools and design capabilities
- High-throughput screening and synthesis
- Hit-to-lead optimization and lead development studies
- Synthesis, purification, and characterization across a span of chemical cases

IN-HOUSE SUPPORT SERVICES

- Infectious Diseases
- Bioanalytics
- Toxicology Services
- High-Throughput Screening
- Medicinal, Computational, and Bioanalytical Chemistry
- Oncology and Structural Biology
- Pharmaceutical Consulting Services

CANCER THERAPEUTIC EVALUATION & TESTING SERVICES

A sample of our services

- IND-enabling toxicology studies for small and large molecules, oncolytic viruses, and vaccines
- GLP-compliant qPCR and immunoassays
- Immunogenicity
- *In vivo* efficacy studies of combination studies in developed tumor models or custom models

GLP TOXICOLOGY SERVICES

- Pharmacokinetic/toxicokinetic (PK/TK) analysis
- Maximum tolerated dose and dose range-finding studies
- GLP and non-GLP single dose and repeat dose studies up to 2 years
- Developmental and reproductive toxicology

INFECTIOUS DISEASE VACCINES & THERAPEUTIC TESTING SERVICES

- Expertise in COVID-19, flaviviruses, respiratory viruses, and emerging pathogens
- BSL-3 Select Agent program
- FDA Animal Rule capability
- Animal models for select pathogens
- *In vitro* assays developed for most human repository pathogens

PARTNERING OPPORTUNITIES

- Licensing from our portfolio of 180+ patents
- Co-investing, risk-sharing, and collaborative agreements to drive the creation of new intellectual property

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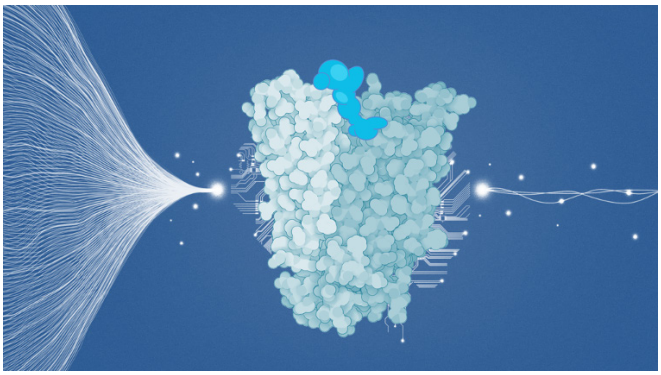
Integrated A.I. Drug Discovery

OUR INTEGRATED DESIGN-MAKE-TEST-ANALYZE PLATFORM LEVERAGES THE LATEST ARTIFICIAL INTELLIGENCE (A.I.) TECHNOLOGY AND NEXT GENERATION MOLECULAR MODELING TO ACCELERATE DRUG DEVELOPMENT FROM THERAPEUTIC TARGET DISCOVERY ALL THE WAY TO CLINICAL CANDIDATES.



SOLVING PAIN POINTS IN DRUG DISCOVERY

- A.I.-accelerated virtual screening for fast exploration of billion-scale chemical space
- Explainable A.I. models for multiparametric lead optimizations
- A.I.-enhanced reverse docking for mechanism-of-action and off-target toxicity predictions
- Deep learning, generative A.I., large language models, and other *in silico* tools for discovery and design of small molecules, biologics, and other novel drug modalities (e.g. PROTACs)
- First-in-class or better-in-class A.I. models trained with in-house experimental data for phenotypic activity, pharmacokinetics, and drug safety predictions

MORE THAN 50 SUCCESSFUL USE CASES IN ONCOLOGY, NEUROLOGY, INFECTIOUS DISEASES, AND OTHER THERAPEUTIC AREAS

- Glucose transporter inhibitors from virtual screening to proof-of-concept in brain tumor mouse model (*AACR Proc. 2018, 78: 1666*)
- Receptor-based design and *in vivo* proof-of concept of subtype-selective opioid receptor ligands as non-addictive analgesic agents (*J. Med. Chem. 2020, 63: 7663*)
- Discovery of sub-micromolar potent flaviviral inhibitors via in-house deep learning A.I. model (ongoing)
- *In silico* designed anti-inflammation agent co-crystalized with target protein (*Bioorg. Med. Chem. Lett. 2022, 64: 128696*)

Learn more about Intergrated A.I. Drug Discovery

southernresearch.org | sales@southernresearch.org

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Your Drug Discovery Partner for Medicinal Chemistry

ACCELERATE YOUR RESEARCH PROGRAM USING OUR COMPREHENSIVE SUITE OF IN SILICO, ARTIFICIAL INTELLIGENCE, AND MEDICINAL CHEMISTRY SERVICES

Southern Research offers all the relevant capabilities required to support drug discovery projects from target identification through to IND submission and beyond.

Southern Research's medicinal and analytical chemists excel in pairing the most cutting-edge *in silico* and bioanalytical technology expertise with extensive drug discovery knowledge across multiple therapeutic areas to enable an informed choice of whether lead compounds can be developed into drugs.

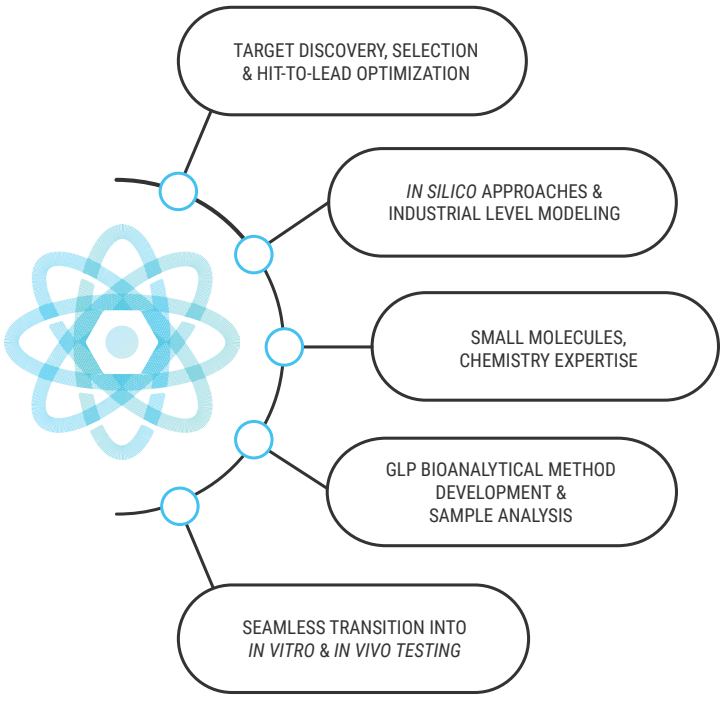
Our scientists provide the personalized attention and flexibility in collaboration that you would expect from a true partner.

OUR DRUG DISCOVERY CHEMISTRY SERVICES INCLUDE:

- Medicinal chemistry for any stage of your project, from hit validation to candidate selection
- Computational chemistry and modeling
- In silico drug discovery programs backed by multiple peer reviewed publications
- Chemistry consulting and proactive problem solving
- One-stop shop CRO for drug discovery chemistry challenges

Discuss your project with an expert
info@southernresearch.org

Our combination of experience, credentials, and direct partnership with senior personnel provides you with a well-established and informed study team that truly acts as an extension of your scientific development program and will guide you through the IND process.



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Experts in Prodrug Discovery & Development

ACCELERATE YOUR RESEARCH PROGRAM USING OUR COMPREHENSIVE SUITE OF TECHNOLOGIES OPTIMIZED FOR PRODRUG-BASED TREATMENTS

For many years, Southern Research has had programs designed to develop nucleoside analogs for cancer and antiviral therapy which led to the discovery of Fludarabine-MP, Clofarabine, Aza-thio-deoxycytidine, Thiarabine and 5-I-4'-thio-deoxyuridine.

Southern Research's medicinal and analytical chemists excel in pairing the most cutting-edge in silico and bioanalytical technology expertise with extensive drug discovery knowledge across multiple therapeutic areas to advance your lead compound to market.

- Application of prodrug approach, a technique that led to several FDA-approved drugs and preclinical candidates as anticancer/antiviral agents
- Extensive experience in carbohydrate and nucleobase synthesis
- Practical milligram to gram scale synthesis of free nucleoside analogs
- Development of new phosphoroamidate and phosphonate pro-moieties
- Considerable expertise in synthesis and optimization of prodrug nucleoside analogs

Discuss your project with an expert
info@southernresearch.org

Southern Research

Jump Start Your Discovery with Insight

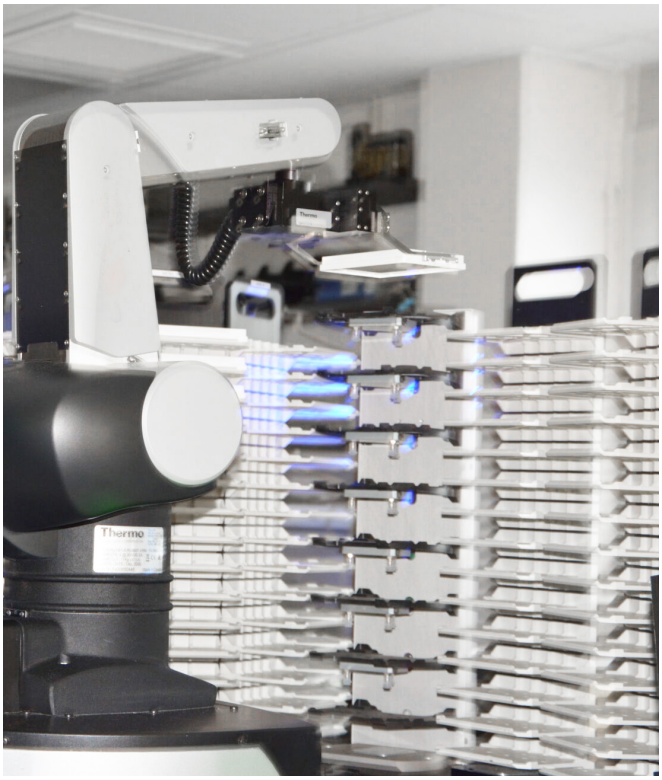
SOUTHERN RESEARCH COMBINES OUR EXPERTISE IN EXPERIMENTAL AND COMPUTATIONAL SCREENING TO EXPAND YOUR HIT DISCOVERY OPTIONS.

Our SR-Insight collection consists of over 700,000 diverse, drug-like small molecules. Also available is a set of 10,000 compounds of known biological activity across 600 targets including FDA-approved drugs and other clinically tested compounds.

1. Screen our SR-Insight collection with a custom-developed or transferred assay. We support multiple biochemical and cell-based assay formats and readouts.

2. Data generated by your project will inform our A.I.- accelerated virtual screening of billion-scale chemical space.

3. We deliver data sets including confirmed hit compound activities to inform your next steps which can include our Medicinal Chemistry services.



MORE ABOUT THE SR-INSIGHT COLLECTION

Discover targets and pathways for corresponding phenotypes

10,000 compounds active across over 600 biological targets including FDA approved drugs. This can be supplemented with all or part of our novel, diverse collection.

De-risk your program with screening to identify back-up chemical matter

We can ensure minimal overlap with your prior screening with a double-blind molecular fingerprint comparison.

Scale to fit your budget and needs

Determine the scale that best fits your needs and budget. We support fee for service and collaborative models, including grant applications.

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High-throughput Antiviral Assays

Southern Research works diligently and quickly to respond to new and emerging needs in antiviral discovery.

Our experts are ready to partner at various stages of the drug development process, from early discovery through clinical studies. Our high-throughput options provide an economical and efficient way to explore a large number of compounds—both small molecule and biologics.

Virus	Containment Level	Virus Strain/ Isolate	Cell Line	Assays available
SARS-CoV	BSL-3	SARS- CoV Toronto 2	Vero E6	CPE
SARS-CoV-2	BSL-3	Delta variant	Vero E6	CPE
SARS-CoV-2	BSL-3	Omicron	Vero E6	CPE
SARS-CoV-2	BSL-3	USA_WA1/2020	Vero E6	CPE
SARS-CoV-2	BSL-3	SARS CoV-2 Nanoluc reporter	A549 (expressing ACE2)	Nanoluc reporter
MERS	BSL-3	Human Beta-Coronavirus LineageC-Novel/2012	Vero-CCL-81	CPE
Human Coronavirus	BSL-2	229E	Huh7	CPE
Influenza	BSL-2	A/California/07/09	MDCK	CPE
Influenza	BSL-2	H1N1 (A/WSN/33)	A549, MDCK	IF, CPE
Influenza	BSL-2	H3N2 (A/Udom/72)	A549, MDCK	IF,CPE
Influenza	BSL-2	H3N2 A/Brisbane/10/07	A549	IF
Influenza	BSL-3	H7N7 A/mallard/Netherlands/12/00	A549	IF
Influenza	BSL-3	H7N9 A/Anhui/1/13	MDCK	CPE
Influenza	BSL-3	H5N1 A/Vietnam/ 1203/2004 (HPAI)	MDCK	CPE
Influenza	BSL-2	B/Florida/4/2006	A549	IF
Influenza	BSL-2	B/Brisbane/60/2008	A549	IF
RSV	BSL-2	Long	HEp-2	CPE
HMPV	BSL-2	GFP reporter virus; parental strain CAN97-83	LLC-MK2	GFP reporter
HIV-1	BSL-2	IIIB-CEM.SS, HIV-1 KER2008, HIV-1 NL4-3	PBMC	AlphaLISA detecting p24; other target based
HSV-1	BSL-2	KOS	Vero CCL-81	CPE
Dengue	BSL-2	Dengue 2 (New Guinea C)	HEK 293	CPE, IF
Zika	BSL-2	Paraiba 2015 isolate	Vero-CCL-81	IF
Chikungunya	BSL-2	vaccine strain 181/25	Vero-CCL-81	CPE
DHODH	BSL-2	biochemical assay (host target)		enzymatic

Panel assays for Coronavirus and Influenza are available; 3D human tissue air-liquid interface model available for respiratory viruses

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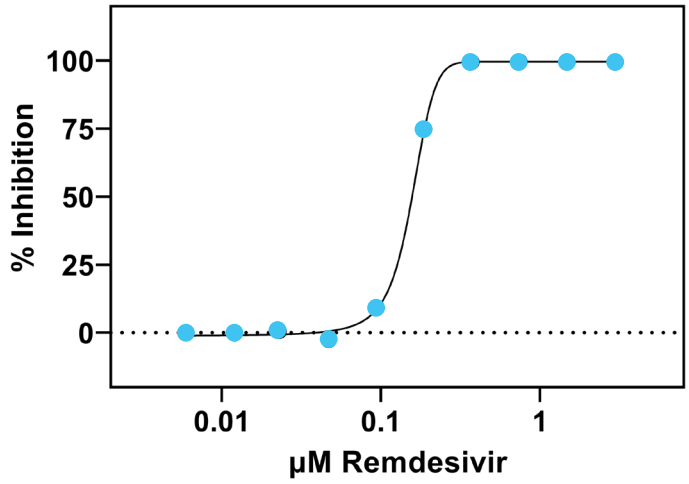
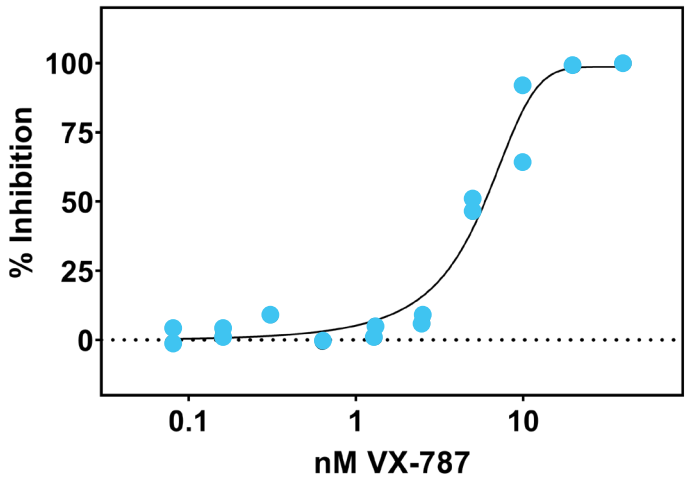
Remdesivir Inhibition of SARS-CoV-2 Nanoluc Reporter Virus in A549 cells



VX-787 Inhibition of Influenza A/WSN/33, H1N1, in A549 cells



Our offerings are constantly being updated.
Additional options are available for alternate *in vitro* formats and *in vivo* studies.

Our range of experience and our capacity to deliver can enhance your antiviral programs.

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GLP Toxicology Services

A COMPLETE SUITE OF PRE-CLINICAL, IND-ENABLING STUDY SERVICES THAT PROVIDE HIGH QUALITY DATA TO SUPPORT REGULATORY SUBMISSIONS

Southern Research offers GLP-compliant toxicology services supporting:

- Nonclinical safety assessments of small molecules and biologics
- Vaccine (mRNA, AAV, DNA, live, attenuated, etc.) safety and biodistribution studies
- Pharmacokinetic/toxicokinetic (PK/TK) studies with analysis
- Maximum tolerated dose and dose range-finding studies
- GLP and non-GLP single dose and repeat dose studies, up to 2 years

Most contract research organizations cannot offer GLP toxicology studies with infectious agents in BSL-2 and BSL-3 facilities. For over 80 years, we have developed the expertise and specialized facilities to support advanced toxicology studies. Our program aims to help clients move vaccines and therapies into the clinic faster.

EXCEPTIONAL, REGULATORY-COMPLIANT STUDIES & SERVICES

» Study Types

- Acute
- Subchronic
- Chronic
- Carcinogenicity/ Oncogenicty
- Immunotoxicology (via Flow Cytometry)
- Vaccine Safety (mRNA, AAV)
- Safety Pharmacology
- ADME/PK

» In-House Support Services

- Bioanalytcal Sciences
- Clinical Pathology
- Anatomic Pathology (histological & pathology evaluation)
- BSL-2 & BSL-3 Containment Facilities
- Quality Assurance
- Clinical Trial Support
- Project Management

» Test Species

- Rodents
  - Cotton Rats
  - Nude Mice
  - Transgenic Mice
  - Tumor-Bearing Mice
- Canines
- Non-Human Primates
- Rabbits
- Guinea Pigs
- Hamsters
- Ferrets

AAALAC Accredited Facility

BSL-2 & BSL-3 containment facilities

Collaborative Partnership

LEARN MORE ABOUT OUR CRO TOXICOLOGY SERVICES:

Southern Research

NHP Safety and ADME Services

A COMPLETE SUITE OF PRE-CLINICAL, IND-ENABLING STUDY SERVICES THAT PROVIDE HIGH QUALITY DATA TO SUPPORT REGULATORY SUBMISSIONS

Currently, Southern Research is one of a handful of contract research organizations ready to begin NHP studies on your timeline—potentially within a matter of weeks. Our exceptional vendor relationships enable us to efficiently source NHPs for your study. Our experts have worked with a variety of NHP species, including African Green Monkeys and Mauritian Cynos, for various preclinical efficacy and safety studies for vaccines and therapeutics. Our experts stand at the ready to help you select, source, and start your next study as soon as possible.

Southern Research offers GLP-compliant toxicology services supporting:

- Nonclinical safety assessments of small molecules and biologics
- Vaccine (mRNA, AAV, DNA, live, attenuated, etc.) safety and biodistribution studies
- Pharmacokinetic/toxicokinetic (PK/TK) studies with analysis
- Maximum tolerated dose and dose range-finding studies
- GLP and non-GLP single dose and repeat dose studies

EXCEPTIONAL, REGULATORY-COMPLIANT STUDIES & SERVICES

Study Types

- Acute
- Subchronic
- Chronic
- Carcinogenicity/Oncogenicty
- Immunotoxicology
- Vaccine Safety (mRNA, AAV)
- Safety Pharmacology
- ADME/PK

In-House Support Services

- Bioanalytcal Sciences
- Clinical Pathology
- Anatomic Pathology (histological & pathology evaluation)
- BSL-2 & BSL-3
- Containment Facilities
- Quality Assurance
- Project Management

aalac INTERNATIONAL

AAALAC Accredited Facility

BSL-2 & BSL-3 containment facilities

Collaborative Partnership

LEARN MORE ABOUT OUR CRO TOXICOLOGY SERVICES

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Influenza Vaccine & Therapeutic Testing

Southern Research's experts can assist with preclinical drug discovery and development of therapeutics and vaccines for influenza—delivering the highest quality, full-service research to support the pharmaceutical and biotechnology sectors. Our scientists are also experienced in GLP-compliant safety and efficacy testing in small and large animal models.

FACILITIES

- A/BSL-2 & A/BSL-3 laboratories
- GLP facility
- NHP housing capacity
  - 332 NHPs in A/BSL-2
  - 48 NHPs in A/BSL-3

PRE-CLINICAL ANIMAL MODELS

- H1N1/H3N2 and HPAI mouse and ferret influenza model
- NanoLuc H1N1 mouse influenza IVIS model (tracking the virus *in vivo*)
- Knockout (KO) mouse influenza models (therapeutics & vaccines with selective sensitivities)
- PK/PD/Efficacy medical countermeasure studies against LPAI and HPAI (A/BSL-3)

ANTIVIRAL ASSAYS

- CPE assays
- Cytotoxicity assays
- Virus load reduction assay
- *In vitro* drug combination assays (synergy/ antagonism with standard drugs)
- *In vitro* virus neutralization assays
- H5N1 (A/BSL-3) in vitro screening &
- virus neutralization

MECHANISM OF ACTION/ MOLECULAR TARGET

- RNA-dependent RNA-polymerase mini-genome transcription inhibition
- Human dihydroorotate dehydrogenase (DHODH) inhibition
- Cellular/biochemical assays for viral and host targets

Learn more about influenza vaccine & therapeutic testing.

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Southern Research Animal Models

Available Models- Small Animals

Pathogen	Animal Species	Route*
Coronavirus (SARS-CoV-2)	hACE2 AC70 Mouse	IN
Coronavirus (SARS-CoV-2)	Syrian hamster	IN
Coronavirus (SARS-CoV-2 MA10)	BALB/c mice	IN
Orthopoxviruses (Vaccinia, Ectromelia)	Mouse	IN
Orthopoxviruses (Rabbitpox)	Rabbit	IN, ID
Coxsackievirus B3 (Nancy)	Mouse	IP, PO
Herpes Simplex Virus (HSV-1 and 2)	Mouse, Guinea Pig, Rabbit	Scar, IN, IVG
Influenza A-H1N1 Mouse adapted	Mouse	IN
Influenza A – HPAI (H5 and H7)	Mouse, Ferret	IN
Influenza A – seasonal	Mouse, Ferret	IN
Pichinde (RVFV model)	Mouse	IP, IC
Respiratory syncytial virus (RSV)	Cotton Rat, Mouse	IN
SARS-CoV-1	Mouse, Ferret	IN
Venezuelan and Western equine encephalitis	Mouse, Guinea Pig	IN, IP
West Nile Virus	Mouse	IP, SC, IC
Zika Virus	AG129 Mouse	SC
Yellow Fever (YF17D)	AG129 Mouse	IP
Chikungunya virus Hepatitis B Virus Dengue virus (DENV-2 and 1)	A129/C57BL6J Mouse Mouse AG129 Mouse	FP IV IV, IP
Human metapneumovirus (HMPV)	Under Development	IN

Available Models- NHP

Pathogen	Animal Species	Route
Coronavirus (SARS-CoV-2)	Rhesus macaque, Cynomolgus macaque, African Green Monkey	IN/IT
Monkeypox (MPXV)	Cynomolgus macaque, Rhesus macaque	IT, IV
Zika Virus	Cynomolgus macaque, Rhesus macaque	SC
Dengue Virus (DENV1-4)	Cynomolgus macaque	SC, IC
Respiratory syncytial virus (RSV)	African Green Monkey	IN
SIV, SHIV	Rhesus macaque	IVG, IV
West Nile Virus	Cynomolgus macaque	IC
Yellow Fever (YF17D)	Cynomolgus macaque	IC, SC
Venezuelan, Western and Eastern equine encephalitis	Cynomolgus macaque	SC

*Acronyms for Routes of Administration

IN = Intranasal
IT = Intratracheal
FP = Foot Pad
IC = Intracranial
PO = Oral gavage
IP = Intraperitoneal
IV = Intravenous
IVG= Intravaginal
SC = Subcutaneous
Scar = Scarification
ID = Intradermal

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Oncology Services

Our mission: To utilize a multi-disciplinary approach in identifying novel targets for new therapeutic entities to advance novel treatment for aggressive and refractory cancers.

Southern Research offers a comprehensive portfolio of services to support oncology research and drug development programs at any phase—from basic research to market launch.

We've developed 7 FDA-approved cancer-fighting drugs to date and are ready to use our experience to help you develop the next one.

DISCOVERY SERVICES

- Medicinal and Computational Chemistry
- Screening Services
  - High-throughput screening
  - Utilizing curated libraries
  - Functional assays
  - Custom assay designs
- Deep learning; Predictive and Generative AI Modeling
- *In Vitro* Efficacy
  - Biochemical assays
  - Cell-Based functional assays
  - MOA (cytotoxicity, apoptosis, cell cycle, invasion/migration, angiogenesis)
  - Custom *in vitro* assay/model development
- *In Vivo* Efficacy
  - Cell and tumor heterogeneity
  - Spatial transcriptomics
  - Biodistribution of systemic delivery of nucleotides
    - State-of-the-art Imaging System for *in vivo* and *ex vivo*
- Proof of Concept
  - Human tumor xenograft models
  - Syngenic tumor models
  - Orthotopic models
  - Custom *in vivo* model development

PRECLINICAL SERVICES

- DMPK/TK
- Biomarkers Identification
- Safety and Biodistribution
- General Toxicology
- GLP IND-enabling Toxicology
- Clinical Pathology
- Immunogenicity

Learn more about our oncology research services.

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