



XENOTECH

A BioIVT Company

XenoTech offers one of the widest portfolios of transporter services and assays available.

It has been formally acknowledged by regulatory and scientific communities that transporters can play a major role in drug safety issues and should be included in new drug candidate preclinical assessment. XenoTech has a multi-pronged study approach to elucidate the drug candidate's interaction with a variety of transporters. Our laboratories in the US and partners in Japan (Sekisui) allow us to offer one of the widest portfolios of drug transporter studies available, including the transporters recommended by the FDA and EMA in the recommended test systems, numerous atypical transporters in stably transfected or transiently transfected cell lines or oocytes and *in vivo* capabilities. We also have the ability to quickly develop assays for new transporters.

Efflux (ABC) Transporters

P-gp (MDR1/ABCB1), BCRP (ABCG2) and BSEP (sPgp/ABCB11) are members of the ATP-binding cassette superfamily, are expressed in the luminal membrane of enterocytes, endothelial cells in the brain, brush border membrane of renal proximal tubules and canalicular membrane of hepatocytes where they limit intestinal absorption limit, blood-brain barrier penetration and facilitate excretion into the bile and urine. BSEP is mainly expressed in the canalicular membrane of hepatocytes where it facilitates excretion into the bile. To evaluate if a test compound is a substrate of P-gp or BCRP, the bidirectional permeability of the test compound across a monolayer of cells (MDCKII-MDR1 or MDCKII-BCRP) in a transwell plate is measured. Inhibition is evaluated by measuring the ability of the test compound to reduce the bidirectional permeability of a probe substrate across Caco-2 (P-gp) or MDCKII-BCRP cells. Accumulation of a test compound in BSEP expressing vesicles is measured to evaluate if the compound is a substrate of BSEP and inhibition is evaluated by measuring the effect of the test compound on the accumulation of a probe substrate.

Hepatic & Renal SLC Transporters

OATP1B1 (OATP-C/OATP2/SLCO1B1), OATP1B3 (OATP-8/SLCO1B3) and OCT1 (SLC22A8) are expressed on the sinusoidal membrane of hepatocytes and facilitate the uptake of endogenous and xenobiotic compounds into hepatocytes followed by metabolism or excretion into the bile. OAT1 (SLC22A6), OAT3 (SLC22A8) and OCT2 (SLC22A2) are expressed on the basolateral membrane of renal proximal tubules and facilitate the uptake of compounds into the proximal tubule which are then excreted in the urine. MATE1 (SLC47A1) and MATE2-K (SLC47A2) are expressed on the brush-border membrane of proximal epithelial cells in the kidney and canalicular membrane of hepatocytes where they efflux organic compounds for further excretion into the urine or bile. Accumulation of a test compound in transporter expressing and control cells (HEK293) is measured to evaluate if the test compound is a substrate of the transporter and inhibition is evaluated by measuring the effect of the test compound on the accumulation of a probe substrate in the transporter expressing and control cells.

Guidance Recommendations

	FDA Guidance 2012 ITC Paper 2010 ¹	EMA Guidance 2013 ²	PMDA Guidance 2014 ³
P-gp / MDR1	✓	✓	✓
BCRP	✓	✓	✓
BSEP	✓*	✓*	
OATP1B1	✓	✓	✓
OATP1B3	✓	✓	✓
OAT1	✓	✓	✓
OAT3	✓	✓	✓
OCT1		✓*	
OCT2	✓	✓	✓
MATE1	✓*	✓*	✓
MATE2-K	✓*	✓*	✓

* Should be considered

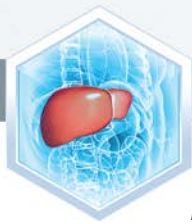
- ¹ [FDA] Food and Drug Administration: Draft Guidance for Industry: Drug Interaction Studies - Study Design, Data Analysis, Implications for Dosing and Labeling Recommendations. Rockville, MD. 2012
International Transporter Consortium, Giacomini et al., Membrane transporters in drug development. *Nat Rev Drug Discov.* 2010 Mar; 9(3):215-36.
- ² [EMA] European Medicines Agency: CPMP/EWP/560/95/Rev. 1 - Corr. Guideline on the Investigation of Drug Interactions. London, England. 2013
- ³ [PMDA] Pharmaceuticals and Medical Devices Agency: Drug Interaction Guideline for Drug Development and Labeling Recommendations (final draft). 2014.

Features of XenoTech Transporter Studies

- GLP and non-GLP services are available
- Multiple test systems for the major transporters, from membranes to *in vivo* models
- One of the most extensive selection of transporters and assays available in the world
- Expert guidance for compound development custom-designed for your needs
- Medium-throughput screening services are available
- Communication and review of all study materials performed by a transporter specialist at XenoTech
- XenoTech's in-house LC-MS/MS (Analytical), quality assurance and knowledge management groups ensure fast, quality data and reporting

Benefits of Having XenoTech As a Partner

- Save time and money with guidance from our experts
- Access to a global team of transporter experts
- Customized studies and reports based on the specific needs for content, turnaround and cost
- Take your program from screening to regulatory submissions
- Full suite of DMPK services including induction, inhibition, metabolism and transporter studies



Kinetic Parameters of Efflux and Uptake Transporter Assays at SEKISUI Medical

Description of construct	Parental Cell line	Gene	Substrates	Kinetic parameters	Kinetic parameters for inhibitors
MDR1	Caco-2	ABCB1	1 µM Digoxin	Km: >100 µM	IC50 Verapamil: 0.594 µM
	LLC-PK1				IC50 Verapamil: 1.6 µM IC50 Cyclosporin A
BCRP	Caco-2	ABCG2	0.1 µM Estrone sulfate	KM: -	IC50 Ko143: 0.0310 µM
	LLC-PK1		10 nM Prazosin	KM: 19.6 µM	IC50 Ko143: 0.0344 µM
	Vesicle		100 µM Methotrexate	KM: -	Benzbromarone: -
BSEP	Vesicle	ABCB11	2 µM Taurocholic acid	KM: 19.9 µM	IC50 Cyclosporin A: -
MRP2	Vesicle	ABCC2	10 µM Estradiol glucuronide	KM: -	IC50 BSP: 11.7 µM
OATP1B1	HEK293	SLCO1B1	50 nM Estradiol glucuronide	KM: 3.94 µM (3.7-8.3)	IC50 Rifampicin: 0.243 µM(0.94) IC50 Cyclosporin A: 0.0602 µM (0.0139)
OATP1B3	HEK	SLCO1B3	50 nM Estradiol glucuronide	KM: 26.5 µM (5-25)	IC50 Rifampicin: 0.388µM (1.5) IC50 Cyclosporin A: 0.0361 µM
			20 nM CCK-8	KM: 18.6 µM	IC50 Rifampicin: 1.06 µM
OATP2B1	HEK	SLCO2B1	50 nM Estrone sulfate	KM: 14.5 µM (7-21)	IC50 Rifampicin: 20.6µM (90)
OAT1	HEK	SLC22A6	1 µM p-Aminohippurate	KM: 11.9 µM (4-22)	IC50 Probenecid: 4.70 µM (6.3-12.5) IC50 Indomethacin: 1.95 µM
	S ₂		1 µM p-Aminohippurate	KM: 24.6 µM (4-22)	IC50 Probenecid: 11.7 µM (6.3-12.5)
OAT2	S ₂	SLC22A7	50 nM PGF2α	KM: 0.137 µM (0.4-0.8)	IC50 Mefenamic acid: 11.7 µM (21.7)
OAT3	HEK	SLC22A8	50 nM Estrone sulfate	KM: 22.8 µM (2-7)	IC50 Probenecid: 2.70 µM (4-30) IC50 Cimetidine: 264 µM
	S ₂		50 nM Estrone sulfate	KM: 1.59 µM (2-7)	IC50 Probenecid: 5.33 µM (4-30)
OAT4	HEK	SLC22A11	50 nM Estrone sulfate	KM: 15.8 µM (1-10)	IC50 BSP: 0.377 µM (<5)
	S ₂		50 nM Estrone sulfate	KM: 7.42 µM (1-10)	IC50 Probenecid: 81.8 µM (25.4)
OAT7	HEK	SLC22A9	50 nM Estrone sulfate	KM: 12.9 µM (8.7-40)	IC50 BSP: 0.121 µM
OCT1	HEK	SLC22A1	5 µM Tetraethylammonium bromide	KM: 576 µM (160-1600)	IC50 Quinidine: 4.57 µM (5.4-23.4) IC50 Verapamil: 0.272 µM
			10 µM Metformin	KM: 899 µM	IC50 Quinidine: 13.8 µM
			5 µM Tetraethylammonium bromide	KM: 453 µM (160-1600)	IC50 Quinidine: 17.9 µM (5.4-23.4)
OCT2	HEK	SLC22A2	10 µM Metformin	KM: 3600 µM (990)	IC50 Quinidine: 88.6 µM (1 mM 5-20%)
			5 µM Tetraethylammonium bromide	KM: 723 µM	IC50 Quinidine: 93.7 µM
			10 µM Metformin	KM: 12500 µM (990)	IC50 Quinidine: 104 µM
			5 µM Tetraethylammonium bromide	KM: 35.1 µM	IC50 Verapamil : 298 µM
OCT3	HEK	SLC22A3	5 µM Tetraethylammonium bromide	KM: 536 µM	IC50 Verapamil: 6.21 µM (24) IC50 Quinidine : 12.7 µM
	S ₂		5 µM Histamine	KM: 261 µM(180-420)	IC50 Verapamil: 11.6 µM (24)
OCTN1	S ₂	SLC22A4	5 µM Tetraethylammonium bromide	KM: 315 µM (199-1280)	IC50 Verapamil: 12.3 µM (8.4)
OCTN2	S ₂	SLC22A5	30 nM Carnitine	KM: 4.73 µM (2-66)	IC50 Verapamil: 5.19 µM (500 µM 2.4%)
NTCP1	HEK	SLC10A1	50 nM Taurocholic acid	KM: 10.2 µM (6.2-10)	IC50 Cyclosporin A: 1.20 µM (1)
NTCP2 (ASBT)	HEK	SLC10A2	200 nM Taurocholic acid	KM: 15.8 µM (9.4-20)	IC50 Chenodeoxycholic acid: 3.48 µM (Ki 3.3)
NPT1	HEK	SLC17A1	50 nM Estradiol glucuronide	KM: 6.68 µM	IC50 Indomethacin: 2.17 µM IC50 Probenecid : 69.1 µM
PEPT1	HEK	SLC15A1	100 nM Glycylsarcosine	KM: 556 µM (290-3130)	IC50 Cephalixin: 1460 µM (5200-13700)
PEPT2	HEK	SLC15A2	100 nM Glycylsarcosine	KM: 59.4 µM (74)	IC50 Cephalixin: 124 µM (10mM 0%)
URAT1	HEK	SLC22A12	50 µM Uric acid	KM: 1050 µM (371)	IC50 Benzbromarone: 0.0334 µM (0.3) IC50 Probenecid : 80.0 µM
MATE1	HEK	SLC47A1	10 µM Metformin	KM: 73.4 µM (220)	IC50 Cimetidine: 1.32 µM (<20)
			5 µM Tetraethylammonium bromide	KM: 29.9 µM	IC50 Cimetidine : 1.10 µM IC50 Quinidine : 1.40 µM
MATE2-K	HEK (Transient)	SLC47A2	10 µM Metformin	KM: 252 µM	IC50 Cimetidine: 4.95 µM
			5 µM Tetraethylammonium bromide	KM: 109 µM	IC50 Cimetidine : 36.6 µM IC50 Quinidine : 16.3 µM
ENT1	MDCKII	SLC29A1	50 nM Uridine	Km: 19.5 µM	IC50 Dilazep: 0.0193 µM
ENT2	MDCKII	SLC29A2	50 nM Adenine	Km: 5.21 µM	IC50 Dipyridamole: 0.347 µM
ENT4	MDCKII	SLC29A4	10 µM Metformin	Km: 3185 µM	IC50 Quinidine: 15.5 µM
CNT1	MDCKII	SLC28A1	1 µM Cytidine	Km: 262 µM	IC50 5-Fluoro-2'-deoxyuridine: 453 µM
CNT2	MDCKII	SLC28A2	50 nM Uridine	Km: 40.7 µM	IC50 Ribavirin: 6.89 µM
CNT3	MDCKII	SLC28A3	50 nM Uridine	Km: 13.1 µM	IC50 Ribavirin: 109 µM
rUrat1	HEK	Slc22a12	50 µM Uric acid	KM: 677 µM	IC50 Benzbromarone : 1.88 µM
OSTα/β	HEK	SLC51A/B	200 nM Taurocholic acid	KM: 7960 µM	IC50 Indomethacin : 262 µM

The values in parentheses show the values from references.

Only the capabilities of SEKISUI Medical's lab in Japan as of June 2022 are listed. Additional options are available through the US lab and may have been added at the Japanese lab.

Contact us to learn more at www.xenotech.com or call 913.438.7450.

	Cell Lines	Vesicle	Double Transfected	Hepatocyte	Animal Model
P-gp (MDR1)	LLC-PK1, MDCKII, Caco-2	✓			
MRP1		✓			
MRP2		✓	OATP1B1		
MRP3		✓			
MRP4		✓			
BCRP	LLC-PK1, MDCKII, Caco-2	✓			
BSEP		✓			
OATP1B1	HEK293		MRP2	✓	
OATP1B3	HEK293			✓	
OATP2B1	HEK293				
OAT1	HEK293, S ₂				
OAT2	S ₂				
OAT3	HEK293, S ₂				
OAT4	HEK293, S ₂				
OAT7	HEK293				
OCT1	HEK293, S ₂				
OCT2	HEK293, S ₂				
OCT3	HEK293, S ₂				
OCTN1	S ₂				
OCTN2	S ₂				
OST α/β	HEK293				
PEPT1	HEK293				
PEPT2	HEK293				
URAT1	HEK293				
NTCP1	HEK293			✓	
NTCP2 (ASBT)	HEK293				
MATE1	HEK293				
MATE2-K	HEK293				
NPT1	HEK293				
ENT1	MDCKII				
ENT2	MDCKII				
ENT4	MDCKII				
CNT1	MDCKII				
CNT2	MDCKII				
CNT3	MDCKII				
Mouse Mdr1a	LLC-PK1				KO animal
Mouse Mdr1b	LLC-PK1				KO animal
Rat Mdr1a	LLC-PK1				KO animal
Rat Mdr1b	LLC-PK1				
Rat Urat1	HEK293				
Dog Mdr1	LLC-PK1				
Cynomolgus Mdr1	LLC-PK1				
Rhesus Mdr1	LLC-PK1				

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