

Supplementary Table 1: Ion Channel Drugs

	Medicine	Modality	Indication	Route of adm.	Target/Mechanism	Approval/Withdrawal	Company	Essential Medicine (WHO)
	Ziconotide	Peptide	Chronic pain	Intrathecal	Ca _v 2.2 inhibitor	2004	Elan Corporation	
	XEP-018	Peptide	Periocular wrinkles (cosmetic)	Topical	Nav1.4 inhibitor		Activen SA	
Dihydro-pyridines	Nifedipine	Small molecule	Hypertension	PO	Ca _v 1.x inhibitor	1981	Bayer	Yes
	Amlodipine	Small molecule	Hypertension	PO	Ca _v 1.x inhibitor	1990	Pfizer	Yes
	Cilnidipine	Small molecule	Hypertension	PO	Ca _v 1.x (Ca _v 2.2) inhibitor	1995	Fuji Viscera Pharmaceutical Company/Ajinomoto	
	Clevidipine	Small molecule	Acute hypertension	IV	Ca _v 1.x inhibitor	2008	The Medicines Company	
	Efonidipine	Small molecule	Hypertension	PO	Ca _v 1.x (Ca _v 3.x) inhibitor	1995	Shionogi & Co	
	Felodipine	Small molecule	Hypertension	PO	Ca _v 1.x inhibitor	1991	Hässle (AstraZeneca)	
	Isradipine	Small molecule	Hypertension	PO	Ca _v 1.x inhibitor	1990	Sandoz Pharmaceuticals (Novartis)	
	Lercanidipine	Small molecule	Hypertension	PO	Ca _v 1.x inhibitor	1997	Recordati S.p.A.	
	Nicardipine	Small molecule	Hypertension, Angina	PO	Ca _v 1.x inhibitor	1988		
	Nimodipine	Small molecule	Hypertension, vasospasm	PO/IV	Ca _v 1.x inhibitor		Bayer	
	Verapamil	Small molecule	Hypertension, angina	PO/IV	Ca _v 1.x inhibitor	1981		Yes
	Diltiazem	Small molecule	Hypertension, angina	PO	Ca _v 1.x inhibitor			

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	Gabapentin	Small molecule	Pain, Epilepsy	PO	Ca _v inhibitor (α ₂ ,δ)	1993	Parke-Davies (Pfizer)	
	Pregabalin	Small molecule	Pain, Epilepsy	PO	Ca _v inhibitor (α ₂ ,δ)	2004	Parke-Davies (Pfizer)	
	Flunarizine	Small molecule	Migraine	PO	Ca _v inhibitor	1968	Jansen Pharmaceutica (J&J)	
	Cinnarizine	Small molecule	Vertigo, motion sickness, sea sickness	IM	Ca _v inhibitor	1955	Jansen Pharmaceutica (J&J)	
	Fluspirilene	Small molecule	Schizophrenia	PO	Ca _v inhibitor (unselective)		Jansen Pharmaceutica (J&J)	
	Pinaverium bromide	Small molecule	IBS	PO	Ca _v inhibitor	1975	Solvay (Abbvie)	
	Mibefradil	Small molecule	Hypertension, angina	PO	Ca _v 3.x inhibitor	1997/1998	Roche	
	Dantrolene	Small molecule	Malignant hyperthermia	IV	RyR inhibitor	1974		
	Capsaicin	Small molecule	Muscle pain (topical)	Topical	TRPV1 activator	2009 FDA		
	Repaglinide	Small molecule	Type II diabetes	PO	Direct K _{ir} 6.2 inhibitor	1997	Novo Nordisk	
	Nateglinide	Small molecule	Type II diabetes	PO	Direct K _{ir} 6.2 inhibitor	2001	Novartis	
	Riluzole	Small molecule	ALS	PO	K _{Ca} activator Na _v inhibitor	1995	Rhone Poulenc Rorer (Sanofi)	
	Chlorzoxazone	Small molecule	Spasm	PO	K _{Ca} activator	1958	McNeilab Inc (Johnson & Johnson)	Yes
	Zoxazolamine	Small molecule	Spasm	PO	K _{Ca} activator	1955/1961	McNeilab Inc (Johnson & Johnson)	
	Ivabradine	Small molecule	Heart failure	PO	I _f (HCN) inhibitor	2005 EMA 2015 FDA	Servier Amgen	

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	Ivacaftor	Small molecule	CFTR	PO	CFTR potentiator	2012	Vertex; Cystic Fibrosis Foundation	
	Lumacaftor/ivacaftor	Small molecule	CFTR	PO	CFTR chaperone plus potentiator	2015	Vertex	
Sulfonyl-ureas	Glibenclamide	Small molecule	Type II diabetes	PO	K _{Ir} 6.x inhibitor (SUR)	1966	Boehringer Mannheim/Hoechst (Novartis, Sanofi)	
	Tolbutamide	Small molecule	Type II diabetes	PO	K _{Ir} 6.x inhibitor (SUR)	1956	Upjohn Company (Pfizer)	
	Acetohexamide	Small molecule	Type II diabetes	PO	K _{Ir} 6.x inhibitor (SUR)			
	Carbutamide	Small molecule	Type II diabetes	PO	K _{Ir} 6.x inhibitor (SUR)		Servier	
	Chlorpropamide	Small molecule	Type II diabetes	PO	K _{Ir} 6.x inhibitor (SUR)	196?	Pfizer	
	Tolhexamide	Small molecule	Type II diabetes	PO	K _{Ir} 6.x inhibitor (SUR)			
	Metahexamide	Small molecule	Type II diabetes	PO	K _{Ir} 6.x inhibitor (SUR)			
	Tolazamide	Small molecule	Type II diabetes	PO	K _{Ir} 6.x inhibitor (SUR)	196?	Pfizer	
	Glibornuride	Small molecule	Type II diabetes	PO	K _{Ir} 6.x inhibitor (SUR)		Meda Pharma	
	Gliclaside	Small molecule	Type II diabetes	PO	K _{Ir} 6.x inhibitor (SUR)	1972		Yes
	Glipizide	Small molecule	Type II diabetes	PO	K _{Ir} 6.x inhibitor (SUR)	1984	Pfizer	
	Glisoxepide	Small molecule	Type II diabetes	PO	K _{Ir} 6.x inhibitor (SUR)			
	Glycopyramide	Small molecule	Type II diabetes	PO	K _{Ir} 6.x inhibitor (SUR)			
	Glimepiride	Small molecule	Type II diabetes	PO	K _{Ir} 6.x inhibitor (SUR)	1995	Hoechst Marion Roussel	
	Diazoxide	Small molecule	Acute hypertension	PO	K _{Ir} 6.x activator			

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	Pinacedil	Small molecule	Hypertension	PO	K _{IR} 6.x activator	1989	Leo Pharma	
	Minoxidil	Small molecule	Hypertension, hair loss	PO, topical	K _{IR} 6.x activator	1979	Upjohn Company (Pfizer)	
	Nicorandil	Small molecule	Hypertension, angina	PO	K _{IR} 6.x activator		Upjohn Company (Pfizer)	
	Retigabine	Small molecule	Epilepsy	PO	K _V 7.2-K _V 7.5 activator	2011/2017	GSK	
	Flupirtine	Small molecule	Pain	PO	K _V 7.2-K _V 7.5 activator	1984	Asta-Medica	
	Fampridine	Small molecule	Multiple sclerosis	PO	K _V inhibitor	2010	Acorda Therapeutics	
	Amifampridine	Small molecule	Lambert–Eaton myasthenic syndrome	PO	K _V inhibitor	2009	BioMarin Pharmaceutical	
	Amiodarone	Small molecule	Arrhythmia	IV, PO	Multi K channel inhibitor	1961	Labaz company (Sanofi)	Yes
	Dronedarone	Small molecule	Arrhythmia	PO	Multi K channel inhibitor	2009	Sanofi-Aventis (Sanofi)	
	Sotalol	Small molecule	Arrhythmia	PO	Multi K channel inhibitor	1974	Mead-Johnson Pharmaceutica	
	Ibutulide	Small molecule	Arrhythmia	IV	Multi K channel inhibitor	1999	Pfizer	
	Dofetilide	Small molecule	Arrhythmia	PO	K _V 11.1 inhibitor	1999	Pfizer	
Benzo-diazepines	Clorazepate	Small molecule	Anxiety	PO	GABA _A activator	1972		
	Estazolam	Small molecule	Anxiety	PO	GABA _A activator	1990	Upjohn Company (Pfizer)	
	Flurazepam	Small molecule	Anxiety	PO	GABA _A activator	1970		
	Halazepam	Small molecule	Anxiety	PO	GABA _A activator	1981		
	Lorazepam	Small molecule	Anxiety	PO	GABA _A activator	1977	Wyeth Pharmaceuticals (Pfizer)	Yes

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	Midazolam	Small molecule	Anxiety	PO, IV ,IM	GABA _A activator	1985	Hoffman LaRoche (Roche)	Yes
	Nitrazepam	Small molecule	Anxiety	PO	GABA _A activator	1965		
	Oxazepam	Small molecule	Anxiety	PO	GABA _A activator	1965		
	Quazepam	Small molecule	Anxiety	PO	GABA _A activator	1985		
	Temazepam	Small molecule	Anxiety	PO	GABA _A activator	1981		
	Triazolam	Small molecule	Anxiety	PO	GABA _A activator	1982		
	Alprazolam	Small molecule	Anxiety	PO	GABA _A activator	1981	Upjohn Company (Pfizer)	
	Zolpidem	Small molecule	Sleep disorders	PO	GABA _A activator	1992	Synthelabo (Sanofi)	
	Flumazenil	Small molecule	Benzodiazepine antidote	IV	GABA _A binder (neutral)	1987	Hoffman LaRoche (Roche)	
	Diazepam	Small molecule	Anxiety	PO	GABA _A activator	1963	Hoffman LaRoche (Roche)	Yes
	Chlordiapoxide	Small molecule	Anxiety	PO	GABA _A activator	1960		
	Clobazam	Small molecule	Anxiety, epilepsy	PO	GABA _A activator	2011	Maestretti Research Laboratories (Sanofi)	
	Clonazepam	Small molecule	Anxiety	PO	GABA _A activator	1975	Hoffman-la-Roche (Roche)	
	Phenobarbital	Small molecule	Epilepsy	PO, IV, IM	GABA _A opener	1912	Bayer	Yes
	Alpidem	Small molecule	Anxiety	PO	GABA _A activator	1991/1995	Synthelabo (Sanofi)	
	Eszopiclone	Small molecule	Insomnia	PO	GABA _A activator		Sunovion	
	Zopiclone	Small molecule	Insomnia	PO	GABA _A activator	1986	Rhône-Poulenc (Sanofi)	
	Propofol	Small molecule	General anaesthesia	IV	GABA _A activator	1989		Yes

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	Valproate	Small molecule	Epilepsy, bipolar, migraine	PO	GABA _A modulator	1967		Yes
	Ondansetron	Small molecule	Chemotherapy associated nausea	PO	5HT ₃ antagonist	1991	GSK	Yes
	Palonosetron	Small molecule	Chemotherapy associated nausea	IV, PO	5HT _{3A} antagonist	2003 FDA 2009 EMA	Helsinn Healthcare	
	Alosetron	Small molecule	IBS associated diarrhoea	PO	5HT _{3A} antagonist	2000/2000 2002 FDA	GSK	
	Granisetron	Small molecule	Chemotherapy associated nausea	PO, IM and transdermal	5HT _{3A} antagonist	1993 FDA 2012 EMA	Beecham (GSK)	
	Phenytoin	Small molecule	Epilepsy	PO	Na _v inhibitor	1953	Parke-Davies (Pfizer)	Yes
	Phosphenytoin	Small molecule	Epilepsy	IV	Na _v inhibitor (prodrug)	1996	Parke-Davies (Pfizer)	
	Carbamazepine	Small molecule	Epilepsy	PO	Na _v inhibitor	1962	J.R. Geigy AG (Novartis)	Yes
	Eslicarbazepine	Small molecule	Epilepsy	PO	Na _v inhibitor	2009	Bial	
	Oxcarbazepine	Small molecule	Epilepsy	PO	Na _v inhibitor	1990	Geigy (Novartis)	
	Lamotrigine	Small molecule	Epilepsy, bipolar	PO	Na _v inhibitor	1994	GSK	Yes
	Lacosamide	Small molecule	Epilepsy	PO	Na _v inhibitor	2008	UCB	
	Primidone	Small molecule	Epilepsy	PO	Na _v inhibitor GABA _A modulator	1950	Imperial Chemical Industry (Astra Zeneca)	
	Ethosuximide	Small molecule	Epilepsy	PO	Ca _v inhibitor Na _v inhibitor	1960	Parke-Davis (Pfizer)	Yes
	Mesuximide	Small molecule	Epilepsy	PO	Ca _v inhibitor Na _v inhibitor		Pfizer	

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	Phensuximide	Small molecule	Epilepsy	PO	Ca _v inhibitor Na _v inhibitor		Pfizer	
	Amiloride	Small molecule	Diuretic	PO	ENaC inhibitor	1981	MSD (Merck)	Yes
	Triamterene	Small molecule	Diuretic	PO	ENaC inhibitor	1964	Smith Kline & French (GSK)	
	Tetracaine	Small molecule	Local anaesthesia	IM	Na _v inhibitor	1931		
	Procainamide	Small molecule	Arrhythmia	IV, PO, IM	Na _v inhibitor	1951	Bristol-Meyers Squibb	
	Disopyramide	Small molecule	Arrhythmia	PO	Na _v inhibitor	1977		
	Flecainide	Small molecule	Arrhythmia	PO	Na _v inhibitor	1982		
	Propafenone	Small molecule	Arrhythmia	PO	Na _v inhibitor	1994	Knoll Pharmaceuticals (Abbvie)	
	Moracizine	Small molecule	Arrhythmia	PO	Na _v inhibitor	1990/2007	DuPont (Bristol-Myers Squibb)	
	Ranolazine	Small molecule	Chronic angina	PO	Late Na _v inhibitor	2006	Gilead	
	Mexiletine	Small molecule	Arrhythmia	PO	Na _v inhibitor	Still used in US	Boehringer Ingelheim	
	Lidocaine	Small molecule	Local anaesthesia Arrhythmia	IM	Na _v inhibitor	1948		Yes
	Bupivacaine	Small molecule	Spinal anaesthesia	IM	Na _v inhibitor	1963		Yes
	Etidocaine	Small molecule	Local anaesthesia	IM	Na _v inhibitor	1972		
	Levobupivacaine	Small molecule	Local anaesthesia	IM	Na _v inhibitor	1995		
	Mepivacaine	Small molecule	Local anaesthesia	IM	Na _v inhibitor	1957		


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	Prilocaine	Small molecule	Local anaesthesia	IM	Na _v inhibitor	1960		
	Ropivacaine	Small molecule	Local anaesthesia	IM	Na _v inhibitor	1997		
	Cisatracurium	Small molecule	General anaesthesia Neuromuscular block	IV	Chrn $\alpha_1\beta_1\gamma/\epsilon\delta$ inhibitor	1995	Burroughs Wellcome (GSK)	
	Rocuronium	Small molecule	General anaesthesia Neuromuscular block	IV	Chrn $\alpha_1\beta_1\gamma/\epsilon\delta$ inhibitor	1994	Schering-Plough (Merck)	
	Succinylcholine	Small molecule	General anaesthesia Neuromuscular block	IV	Chrn $\alpha_1\beta_1\gamma/\epsilon\delta$ activator	1951		Yes
	Varenicline	Small molecule	Smoking cessation	PO	Chrn $\alpha_4\beta_2$ activator	2006	Pfizer	
	Nicotine	Small molecule	Smoking cessation	Topical (skin)	Chrn activator			
	Perampanel	Small molecule	Epilepsy	PO	GluA1-4 inhibitor	2012	Eisai	
	Felbamate	Small molecule	Severe epilepsy	PO	GluN inhibitor GABA _A modulator	1993	Carter Wallace Laboratories	
	Ketamine	Small molecule	Anaesthesia	IV	GluN inhibitor	1970		Yes
	Memantine	Small molecule	Alzheimer's	PO	GluN inhibitor	1968	Eli Lilly and Company	
	Amantidine	Small molecule	Parkinson's disease (historical for flu)	PO slow release	GluN inhibitor	2017/2018 (formulations)		



 ω-MVIIA CKGKGAKCSRLMYDCCTGSCRSKGC Ziconotide, Prialt[®]


 m-TRTX-Pn3a DCRYMFGDCEKDEDCCCKHLGCKRKMKYCAWDFTF


 α-conotoxin Vc1.1 GCCSDPRCNYDHPEIC


 α-conotoxin RgA GCCSDPRCRYRCR


 α-conotoxin RgIA4 GCCTDP-Cit-CR93-I-Tyr)QCY KCP-400


 Chlorotoxin MCMPCFTTDHQMARKDDCCGGKGRGKCYGQPQLCR Tozuleristide
Tumor Paint

SOR-C27 EGKLSSNDTEGGLCKEFLHPSKVDLPR

SOR-C13 KEFLHPSKVDLPR


 Pi-hexatoxin-H1a NECIRKWLSCVDRKNDCCGLECYKRRHSFEVCVPIPG


 Pi-hexatoxin-H1a FCLVKWKQCDGRERDCCAGLECWKRSGNKSSVCAPIT


 Kappa theraphotoxin Hm1a ECRYLFGGCSSTSDCCKHLSCRSDWKYCAWDGTF

