

Pharmacology Integrated Curriculum:

Goal: Promote the learning of pharmacology in a clinical context

Pharmacology content will focus on that which is clinically relevant. The Pharmacology theme lead is a pharmacologist with a background as a pharmacist, and is therefore able to provide a perspective of both science and clinical pharmacology for the students. The pharmacology faculty lead (Dr. Stan Bardal) was recruited to UofS from the UBC MDUP, and in his career has won six teaching awards, including a national award, authored a textbook, and now has a pharmacology teaching app with thousands of users worldwide.

Pharmacology curriculum plan:

Pharm-150 List

The Pharm-150 is a list of 150 drug classes that are considered to be 'must-see, must-know' for the graduating medical student at the UofS CoM.

Objectives and Milestones

Pharmacology objectives in Years 1 to 4 are spiraled to add complexity as students transition from pre-clinical to clerkship years, with the goal of achieving exit competencies, primarily from the Expert domain, but others as well. These exit competencies are achieved by setting milestones for each year (see next page for Pharmacology Milestones). From these milestones, the course and session-level objectives are derived. With the exception of the PRIN course, pharmacology session objectives in Years 1 and 2 will typically focus on students ability to describe mechanism of a given drug as it relates to its clinical use, as well as key pharmacokinetic issues, and issues related to harms.

PHARMACOLOGY MILESTONES:

Year 1

1. Describe the pharmacokinetic (PK)^a and pharmacodynamic (PD)^b properties of the drugs taught in Year 1, including but not limited to the drugs that appear in the Pharm-150 list.
2. Identify the appropriate medication(s) for the treatment of conditions / clinical presentations in Year 1.
3. Describe the key side effects^c associated with the drugs taught in Year 1.
 - * a: PK properties refer to the drug's absorption, distribution, metabolism and excretion, and appropriate route(s) of administration
 - * b: PD properties includes the drug's mechanism(s) of action
 - * c: this includes common side effects as well as important safety issues that may harm the patient

Year 2

1. Describe the PK and PD properties of the drugs taught in Years 1 and 2, including but not limited to the drugs that appear in the Pharm-150 list.
2. Identify the appropriate medication(s) for the treatment of conditions / clinical presentations in Years 1 and 2.
3. Describe the key side effects associated with the drugs taught in Years 1 and 2.
4. List the methods and resources available to help obtain a patient's medication history.

Year 3

1. Order, under supervision, appropriate medications for patient encounters and justify these therapeutic choices based on an understanding of a given drug's PD and PK.
2. Demonstrate the appropriate use of resources to support pharmacotherapeutic choices.
3. List the factors that contribute to medication compliance and employ strategies to maximize success.
4. Describe how laboratory tests can be used to inform drug dosing and monitor for side effects.

Year 4

1. Prescribe, under supervision, appropriate medications for patient encounters and justify these therapeutic choices based on an understanding of a given drug's PD and PK.
2. Demonstrate the appropriate use of resources to support prescribing decisions.
3. Produce a plan, under supervision, regarding what drugs the patient should be taking, and justify decisions based on efficacy, safety and cost-effectiveness.
4. Review the above plan with the patient, including them in the decision-making process and making sure to use terminology appropriate for that patient.
5. Monitor a patient's progress and propose adjustments to medications accordingly.
6. Access, interpret, evaluate, communicate and apply evidence-based information about complementary and alternative therapies (CAT).

Pharmacology Drug formular

#	DRUG CLASS	PROTOTYPE	#	DRUG CLASS	PROTOTYPE	#	DRUG CLASS	PROTOTYPE
1	Abx (Aminoglycoside)	Gentamicin	51	ACE inhibitor	Ramipril	101	Anesthetic (inhaled)	Sevoflurane
2	Abx (Antitubercular)	Rifampin	52	Antiarrhythmic (Class V)	Adenosine	102	Anesthetic (IV)	Ketamine
3	Abx (Cephalosporin)	Cephalexin	53	Angiotensin receptor blocker	Losartan	103	Anesthetic (local)	Lidocaine
4	Abx (Fluoroquinolone)	Ciprofloxacin	54	Antiarrhythmic (Class III)	Amiodarone	104	Dopamine replacement	L-dopa/Carbidopa
5	Abx (Glycopeptide)	Vancomycin	55	Beta blocker (cardio)	Metoprolol	105	Anticonvulsant	Carbamazepine
6	Abx (Lincosamide)	Clindamycin	56	Beta blocker (alpha/beta)	Carvedilol	106	Anticonvulsant	Lamotrigine
7	Abx (Macrolide)	Azithromycin	57	Beta blocker (non-cardiosel)	Propranolol	107	Anticonvulsant	Levetiracetam
8	Abx (Nitrofurantoin)	Nitrofurantoin	58	Beta blocker (Class III antiarrhyt)	Sotalol	108	Anticonvulsant	Phenytoin
9	Abx (Nitroimidazole)	Metronidazole	59	Ca-channel blocker (DHP)	Amlodipine	109	Anticonvulsant	Topiramate
10	Abx (Penicillin)	Amoxicillin	60	Ca-channel blocker (nonDHP)	Diltiazem	110	Anticonvulsant	Valproic acid
11	Abx (Sulfonamide)	SMX-TMP	61	Digitalis glycoside	Digoxin	111	Barbiturate	Phenobarbital
12	Abx (Tetracycline)	Doxycycline	62	Nitrate	Nitroglycerin	112	Botulinum toxin	Botulinum toxin A
13	Antifungal	Terbinafine	63	HMG-CoA reductase Inhibitor	Atorvastatin	113	Cholinesterase inh	Donepezil
14	Antifungal (azole)	Fluconazole	64	Antiarrhythmics (Class I)	Various	114	Dopamine agonist	Pramipexole
15	Antifungal (polyene)	Nystatin	65	Sympathomimetic	Epinephrine	115	GABA analogue	Gabapentin
16	Anthelmintic	Albendazole	66	Dopamine	Dopamine	116	GABA-b agonists	Baclofen
17	Antiviral (HIV)	HAART	67	Alpha-blocker	Terazosin	117	Neuromuscular block	Rocuronium
18	Antiviral (HSV)	Acyclovir	68	Anticholinergic (LUT)	Tolterodine	118	NMDA antagonist	Memantine
19	Antiviral (Influenza)	Oseltamivir	69	Diuretic (loop)	Furosemide	119	Opioid (natural)	Morphine
20	Antimalarial	Chloroquine	70	Diuretic (thiazide)	Hydrochlorothiazide	120	Opioid (synthetic)	Fentanyl
21	Alkylator	Cyclophosphamide	71	Diuretic (Aldosterone ant)	Spironolactone	121	Opioid (reuptake inh)	Tramadol
22	Anthracycline	Doxorubicin	72	Diuretic (ENac block)	Amiloride	122	Prostaglandin analogue	Latanaprost
23	Antiandrogen	Flutamide	73	ADH analogue	Desmopressin	123	Serotonin agonist	Sumatriptan
24	Antiestrogen	Tamoxifen	74	Alpha blocker - selective	Tamsulosin	124	Thiazolidinediones	Rosiglitazone
25	Antimetabolite	Methotrexate	75	Thienopyridine	Clopidogrel	125	DPP-4 inhibitors	Sitagliptin
26	GnRH agonist	Leuprolide	76	Direct thrombin inhibitor	Dabigatran	126	GLP-1 analogues	Liraglutide
27	Monoclonal antibody	Rituximab	77	Heparins	Enoxaparin, Heparin	127	Biguanides	Metformin
28	Taxane	Paclitaxel	78	Iron salt	Ferrous gluconate	128	Insulin	Insulin NPH
29	Immune modulator	Pembrolizumab	79	Salicylate	ASA	129	SGLT-2 inhibitors	Empagliflozin
30	Tyrosine kinase inhibitor	Osimertinib	80	Thrombolytic	tPA	130	Sulfonylurea	Glyburide
31	Proteasome inhibitor	Carfilzomib	81	Vitamin K antagonist	Warfarin	131	Alpha glucosidase inh	Acarbose
32	Acetaminophen	Acetaminophen	82	Factor Xa inhibitor	Apixaban	132	Growth hormone	Somatropin
33	Bisphosphonate	Alendronate	83	Supplement	Calcium	133	Iodine	I131
34	Anti-inflammatory (gout)	Colchicine	84	Antidepressant (NaSSA)	Mirtazapine	134	Thionamide	Methimazole
35	Cannabinoids	Cannabis	85	Antidepressant (NDRI)	Bupropion	135	Thyroid hormone	Levothyroxine
36	COX-2 inhibitor	Celecoxib	86	Antidepressant (SNRI)	Venlafaxine	136	Androgen	Testosterone
37	NSAID	Ibuprofen	87	Antidepressant (SSRI)	Citalopram	137	Contraceptive (oral)	Various
38	TNF inhibitor	Etanercept	88	Antidepressant (tricyclic)	Amitriptyline	138	Estrogen antagonist	Clomiphene
39	Xanthine oxidase inh	Allopurinol	89	Antipsychotic (1st gen)	Haloperidol	139	Estrogen derivative	Estrogen
40	Antidiarrheal	Loperamide	90	Antipsychotic (2nd gen)	Risperidone	140	Oxytocic agent	Oxytocin
41	Antiinflammatory (GI)	5-ASA	91	Antipsychotic (3rd gen)	Aripiprazole	141	Progestin	Progesterone
42	Antinauseant	Dimenhydrinate	92	Mood stabilizer	Lithium	142	Prostaglandin E1	Alprostadil
43	Antiulcer	H pylori Protocol	93	Benzodiazepine	Lorazepam	143	Anticholinergic (inhale)	Tiotropium
44	H2 antagonist	Ranitidine	94	Hypnotic	Zopiclone	144	Beta-2 agonist	Salbutamol
45	Laxative (stimulant)	Senna	95	Opioid antagonist	Naloxone	145	Corticosteroid (inhaled)	Fluticasone
46	Prokinetic	Metoclopramide	96	Opioid withdrawal	Methadone	146	Corticosteroid (sys)	Prednisone
47	Proton pump inhibitor	Omeprazole	97	Aldehyde dehydrogen inh	Disulfuram	147	Leukotriene antagonist	Montelukast
48	Laxative (osmotic)	PEG	98	Benzodiazepine antagonist	Flumazenil	148	Anti-histamines	Hydroxyzine
49	Calcineurin inhibitor	Cyclosporine	99	Nicotine	Nicotine replace	149	Retinoic acid derivative	Isotretinoin
50	Immune antimetabolite	Azathioprine	100	Stimulant	Methylphenidate	150	Corticosteroid (topical)	Hydrocortisone

ACE: angiotensin converting enzyme; **DHP:** dihydropyridine; **GABA:** gamma-aminobutyric acid; **HAART:** highly active antiretroviral therapy; **HSV:** herpes simplex virus; **NaSSA:** noradrenergic and specific serotonergic antidepressants; **NMDA:** n-methyl d-aspartate; **NDRI:** noradrenaline dopamine reuptake inhibitors; **SMX-TMP:** sulfamethoxazole/trimethoprim; **SNRI:** serotonin noradrenaline reuptake inhibitors; **SSRI:** serotonin selective reuptake inhibitors; **TNF:** tumour necrosis factor

Note that prototypes are not intended to be an endorsement for that specific drug but rather an example of the class

Drug classes are grouped by common therapeutic indication to enhance readability of this list, however many overlap multiple groups (order of groupings: ID, Cancer, MSK, GI, Cardio, KUT, Hematology, Supplements, Psych, Neuro, Endo, Resp, Derm)

Pharmacology Roadmap

Year 1 Term 1	Drug classes	Relevant Sessions	#Drug classes
PD/PK			
Drug interactions			
Variability			
Toxicology			
Analgesics	Salicylates NSAIDs Cannabinoids Acetaminophen Opioids-natural Opioids-synthetic Opioids-reuptake inhibitors Opioids-antagonists Opioids-withdrawal	Pharm - Analgesics	9
Antibiotics and antifungals	Aminoglycosides Antituberculars Cephalosporins Fluoroquinolones Glycopeptides Lincosamides Macrolides Nitrofurantoin Metronidazole Penicillins Sulfonamides Tetracyclines Terbinafine Azole antifungals Polyenes	Pharm- Antimicrobials	15

Anti-viral/Anti-cancer	Antiviral – HSV Antiviral – HIV Antiviral – Influenza Alkylators Anthracyclines Antimetabolites Taxanes Topoisomerase inhibitors Tyrosine kinase inhibitors Vinca alkaloids Monoclonal antibody Antiestrogen Antiandrogen	Pharm - Antivirals/Anticancer	13
Autonomics	Anticholinergics (2) Sympathomimetics Beta2-agonists Beta Blockers(4) Alpha blocker Alpha blocker-selective Acetylcholinesterase inhibitors Dopamine NMJ-Blockers	Pharm - Autonomics	13
Supplements	Supplement Iron salts	Nutrition	2
End of PRIN		Total classes covered at this point:	52

Hematology	Vitamin K antagonists Direct thrombin inhibitors Factor Xa inhibitors Heparin Thrombolytics Thienopyridines Salicylates ²	Pharm - Antithrombotics	6 + 1©
Respiratory	Inhaled corticosteroids Systemic corticosteroids Leukotriene receptor antagonists Beta2-Agonists ² Inhaled anticholinergics ²	Pharm - Respiratory	3 + 2©
Cardiovascular	ACE inhibitors Angiotensin receptor blockers Calcium channel blockers (DHP) Calcium channel blockers (non-DHP) Nitrates Digitalis glycosides Loop diuretics Thiazide diuretics Mineralocorticoid receptor ant ENac-Blockers Anti-arrhythmics (Class I) Anti-arrhythmics (Class III) Anti-arrhythmics (Class V) Statins Alpha blocker ² Alpha blocker-selective ² Beta Blockers (cardioselective) ² Beta Blockers (alpha/beta) ² Beta Blockers (non-cardioselective) ² Beta Blockers (Class III antiarrhythmics) ²	Pharm - Intro/Hypertension Pharm - Coronary artery disease Pharm - Anti-Arrhythmics Pharm - Heart failure	14 + 6©
Gastrointestinal	<i>H2 receptor antagonists</i> <i>Proton pump inhibitors</i> <i>Anti-diarrheal</i> <i>Laxatives – Osmotic</i> <i>Laxatives - Stimulant</i> <i>H Pylori protocol</i> <i>Prokinetic - D2-antagonists</i> <i>Anti-inflammatory (GI)</i> <i>TNF-inhibitors</i> <i>Calcineurin inhibitors</i> <i>Immune Anti-metabolite</i> <i>Anti-nauseants</i>	<i>GERD</i> <i>Ulcer</i> <i>Constipation</i> <i>IBD</i>	12
End		Total classes covered at this point:	87

Neurology	LevoDopa Dopamine agonists Carbamazepine Lamotrigine Levetiracetam Phenytoin Topiramate Valproic acid Gabapentin Barbiturate Anesthetic – Local Anesthetic – Inhaled Anesthetic – Intravenous NMDA-antagonists Botulinum toxin Serotonin agonists (Triptans) PG-analogues GABA-b-agonists Vitamin K antagonists ² Direct thrombin inhibitors ² Factor Xa inhibitors ² Heparin ² Thrombolytics ² Salicylates ³ Thienopyridines ² Statins ² Acetylcholinesterase inhibitors ²	Pharm - Movement disorders Pharm - Seizure disorders Pharm - Anesthesia Dementia Migraine/Vertigo Glaucoma Spinal cord injury Stroke	18 + 9@
Musculoskeletal	Anti-inflammatories(gout) Xanthine oxidase inhibitors Folate analogue Anti-malarials Bisphosphonates TNF inhibitor ² Cannabinoids ² NSAIDs ² Acetaminophen ² Salicylates ⁴ Corticosteroids (systemic) ² Opioids-natural ² Opioids-synthetic ² Opioids-reuptake inhibitors ²	Pharm-Anti-inflam/Immunosuppress Acute and Chronic Pain management Osteoporosis Approach to Monoarthritis	5 + 9@
Kidney/Urinary Tract	ADH Loop diuretics ² Thiazide diuretics ² Mineralocorticoid receptor antagonists ² ENac-Blockers ² Alpha blocker ² Alpha blocker-selective ² Anti-cholinergics (LUT) ²	Pharm-Diuretics Pharm-Diabetes and HTN Pharm-Metabolism and Kidney LUT – Incontinence	1 + 7@
End		Total classes covered at this point:	111

Endocrine	Insulin Biguanides Sulfonylureas Thiazolidinediones SGLT-2 inhibitors GLP-1 analogues DPP-4 inhibitors Alpha glucosidase inhibitors <i>Iodine</i> <i>Thionamides</i> <i>Thyroid hormone</i> <i>Growth hormone</i>	Pharm – Anti-diabetic agents <i>Thyroid</i>	12
Reproduction	Oral Contraceptives Progesterone Hormone therapy – Estrogen <i>Oxytocic agent</i> <i>Estrogen Antagonists</i> <i>Aromatase inhibitor</i> <i>Hormone therapy - Androgen</i> <i>PGE1 analogues</i>	Contraception <i>Infertility</i> <i>Breast disease</i>	8
Mental health	Antidepressant - SSRI Antidepressant - SNRI Antidepressant - NDRI Antidepressant - TCA Antidepressant - NaSSA Lithium Benzodiazepines Non-Benzodiazepines Benzodiazepine antagonists Antipsychotics -1 st generation Antipsychotics -2 nd generation Antipsychotics -3 rd generation <i>Stimulant</i> <i>Nicotine</i> <i>Aldehyde dehydrogenase inhibitor</i> <i>Opioid antagonist²</i> <i>Opioid withdrawal²</i>	Pharm - Psychopharm I/II <i>Adolescent psych</i> <i>Substance use</i>	15 + 2©
Dermatology	Retinoids Topical corticosteroids Anti-histamines Antimetabolite ² Antifungal ² Antifungal - azole ² Antifungal - polyene ²	Pharm – Dermatology	3 + 4©
End Year 2		Total classes covered at this point:	149

Not covered: anti-helminthic (covered in Year 3 – Tropical diseases)

Drug classes in italics are not necessarily covered in lecture

Sessions in italics are not pharm-focused

© and superscripts² indicate drug classes that are being encountered for the 2nd time. Additionally, most antibiotics and most anticancer drugs will be covered again in various clinical lectures throughout Foundations I, II, and III