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 formulary

#	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 (Nitrofuran)**	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	**Antihelminthic**	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** **Nitrofuran** **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
		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	***H2 receptor antagonists*** ***Proton pump inhibitors*** ***Anti-diarrheal*** ***Laxatives – Osmotic*** ***Laxatives - Stimulant*** ***H Pylori protocol*** ***Prokinetic - D2-antagonists*** ***Anti-inflammatory (GI)*** ***TNF-inhibitors*** ***Calcineurin inhibitors*** ***Immune Anti-metabolite*** ***Anti-nauseants***	***GERD*** ***Ulcer*** ***Constipation*** ***IBD***	12
		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©
		Total classes covered at this point:	**111**

Endocrine	**Insulin** **Biguanides** **Sulfonylureas** **Thiazolidinediones** **SGLT-2 inhibitors** **GLP-1 analogues** **DPP-4 inhibitors** **Alpha glucosidase inhibitors** ***Iodine*** ***Thionamides*** ***Thyroid hormone*** ***Growth hormone***	**Pharm – Anti-diabetic agents** ***Thyroid***	12
Reproduction	**Oral Contraceptives** **Progesterone** **Hormone therapy – Estrogen** ***Oxytocic agent*** ***Estrogen Antagonists*** ***Aromatase inhibitor*** ***Hormone therapy - Androgen*** ***PGE1 analogues***	**Contraception** ***Infertility*** ***Breast disease***	8
Mental health	**Antidepressant - SSRI** **Antidepressant - SNRI** **Antidepressant - NDRI** **Antidepressant - TCA** **Antidepressant - NaSSA** **Lithium** **Benzodiazepines** **Non-Benzodiazepines** **Benzodiazepine antagonists** **Antipsychotics -1st generation** **Antipsychotics -2nd generation** **Antipsychotics -3rd generation** ***Stimulant*** ***Nicotine*** ***Aldehyde dehydrogenase inhibitor Opioid antagonist²*** ***Opioid withdrawal²***	**Pharm - Psychopharm I/II** ***Adolescent psych*** ***Substance use***	15 + 2©
Dermatology	**Retinoids** **Topical corticosteroids** **Anti-histamines** **Antimetabolite²** **Antifungal²** **Antifungal - azole²** **Antifungal - polyene²**	**Pharm – Dermatology**	3 + 4©
		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