

Several risk factors contribute to the development of Psychiatric Side Effects (PSEs) following medication usage. These factors stem from the medication's chemical composition, pharmacological actions, treatment approach employed, or specific patient traits.

<b>Factors Predisposing</b>	<b>Example</b>
<b>Drug-related</b>	
Pharmacokinetics	Variations in absorption, distribution, metabolism, and excretion (ADME) of drugs.
Pharmacodynamics	Differences in drug interactions with specific receptors or neurotransmitter systems.
Dosage	Higher doses increasing the likelihood and severity of psychiatric side effects.
Therapeutic Index	Narrow therapeutic index increasing the risk of adverse psychiatric reactions.
<b>Treatment-related</b>	
Route of Administration	Different routes influencing onset, duration, and intensity of side effects.
Polypharmacy	Concurrent use of multiple medications exacerbating psychiatric side effects.
Duration of Treatment	Prolonged exposure increasing the risk of developing psychiatric side effects.
<b>Patient-related</b>	
Age, Gender	Age-related physiological changes and gender differences impacting susceptibility.
Comorbidities	Pre-existing medical conditions interacting with medication effects.
Genetic Predisposition	Individual genetic variations influencing drug metabolism and receptor sensitivity.

Here is a general overview of potential PSEs. This will be further broken down by classes and disorder/disease implications.

<b>Drug</b>	<b>Psychotic Symptoms</b>	<b>Depression</b>	<b>Mania</b>	<b>Anxiety</b>
<b>Amantadine</b>	+	+	+	+
<b>Aminoglycosides</b>	+			
<b>Amphetamines</b>	+	+	+	+
<b>Anabolic Steroids</b>	+	+	+	+
<b>Anesthetics</b>				+
<b>Anticholinergics</b>	+	+		+
<b>Antihistamines</b>		+		+
<b>Antitubercular Agents</b>	+	+		
<b>Antivirals</b>	+	+		
<b>Baclofen</b>	+	+	+	+
<b>Barbiturates</b>	+	+	+	+
<b>Benzodiazepines</b>	+		+	
<b>β-blockers</b>	+	+	+	+
<b>Bromocriptine</b>	+		+	
<b>Cephalosporin</b>	+		+	
<b>Chloroquine</b>	+	+	+	+
<b>Clonidine</b>	+	+	+	+
<b>Corticosteroids</b>	+	+	+	+
<b>Digoxin</b>	+	+	+	
<b>Disulfiram</b>	+	+	+	+
<b>Interferon-α</b>	+	+	+	+
<b>Isotretinoin</b>	+	+		
<b>L-DOPA</b>	+	+	+	+
<b>Lidocaine</b>	+	+	+	+
<b>Mefloquine</b>	+	+	+	+

<b>Methyldopa</b>	+	+		
<b>Methylphenidate</b>		+	+	+
<b>Metoclopramide</b>		+	+	
<b>Metronidazole</b>	+			
<b>Opioids</b>	+	+	+	+
<b>Oral Contraceptives</b>		+		
<b>Procainamide</b>	+	+	+	+
<b>Pseudoephedrine</b>	+			+
<b>Quinidine</b>	+			
<b>Quinolones</b>	+	+		
<b>Thiazide Diuretics</b>		+		

<b>Symptom</b>	<b>Drugs Implicated</b>
<b>Anxiety</b>	Steroids (e.g., corticosteroids), antivirals (e.g., oseltamivir), clonidine, nitrates, penicillin
<b>Depression</b>	Steroids (e.g., corticosteroids), $\beta$ blockers (e.g., propranolol), clonidine, antiretrovirals (e.g., efavirenz), GnRH agonists, H2 blockers (e.g., ranitidine), IFNs (e.g., interferon-alpha)
<b>Delirium</b>	ACE inhibitors (e.g., lisinopril), steroids (e.g., corticosteroids), antibiotics (e.g., ciprofloxacin), anticholinergics (e.g., diphenhydramine), $\beta$ blockers (e.g., metoprolol), H2 blockers (e.g., famotidine)
<b>Insomnia</b>	Steroids (e.g., corticosteroids), clonidine, salbutamol, proton pump inhibitors (e.g., omeprazole), skeletal muscle relaxants (e.g., baclofen), quinolones (e.g., ciprofloxacin)
<b>Psychosis/hallucination/delusion</b>	Steroids (e.g., corticosteroids), clonidine, proton pump inhibitors (e.g., omeprazole), quinolones (e.g., ciprofloxacin), Salbutamol, H2 blockers (e.g., ranitidine)
<b>Manic reaction</b>	Dopamine agonists (e.g., pramipexole), antidepressants (e.g., selective serotonin reuptake inhibitors), steroids (e.g., corticosteroids), sympathomimetics (e.g., pseudoephedrine), H2 blockers (e.g., ranitidine), thyroxine (e.g., levothyroxine), chloroquine, baclofen
<b>Sexual side effects</b>	Diuretics (e.g., hydrochlorothiazide), anticonvulsants (e.g., carbamazepine), antihistamines (e.g., diphenhydramine), muscle relaxants (e.g., cyclobenzaprine)

<b>Seizures</b>	Antimalarials (e.g., chloroquine), fluoroquinolones (e.g., ciprofloxacin), systemic steroids (e.g., corticosteroids), CNS stimulants (e.g., methylphenidate), cyclosporine, tricyclic antidepressants (e.g., amitriptyline)
<b>Suicidal ideation</b>	Nitrates (e.g., isosorbide mononitrate), antiretrovirals (e.g., efavirenz), antifungals (e.g., fluconazole), cycloserine, fluoroquinolones (e.g., ciprofloxacin), IFN (e.g., interferon-alpha)
<b>Substance addiction</b>	Cough syrups containing opioids (e.g., codeine), steroids (e.g., corticosteroids), ketamine, loperamide, dextromethorphan
<b>Cognitive dysfunction</b>	H2 blockers (e.g., ranitidine), corticosteroids (e.g., prednisone), NSAIDs (e.g., ibuprofen), anticonvulsants (e.g., phenytoin), antidepressants (e.g., tricyclic antidepressants), anticholinergics (e.g., diphenhydramine)

<b>Parkinson</b>	<b>Generic Name</b>	<b>Brand Name(s)</b>	<b>Neuropsychiatric Side Effects</b>
L-DOPA	Levodopa	Sinemet, Madopar	Insomnia, cognitive impairment, psychosis, depression, hypomania, visual hallucinations, agitation, altered mental status
Dopamine Agonists	Pramipexole	Mirapex	Psychomotor agitation, akathisia, insomnia, sedation, hallucinations, psychosis, cognitive impairment, delirium
	Ropinirole	Requip	
	Rotigotine	Neupro	
Amantadine	Amantadine		Visual hallucinations, mood changes, fatigue, euphoria, decreased concentration, sleep disturbances, psychosis, delirium
Selegiline	Selegiline	Eldepryl, Zelapar	Agitation, insomnia, psychosis
COMT Inhibitors	Entacapone	Comtan	Hallucinations, insomnia, delirium
	Tolcapone	Tasmar	
Anticholinergics	Benzotropine	Cogentin	Sedation, psychosis, delirium, abuse potential
	Biperiden	Akineton	Sedation, psychosis, delirium
	Procyclidine	Kemadrin	Anxiety, psychomotor agitation, delirium
	Trihexyphenidyl	Artane	Sedation, psychosis, delirium, abuse potential

<b>Cardiovascular</b>	<b>Generic Name</b>	<b>Brand Name(s)</b>	<b>Side Effects</b>
$\beta$ -blockers	Metoprolol	Lopressor, Toprol XL	Sedation, sleep impairment, psychosis, depression, dysphoria, delirium
	Atenolol	Tenormin	
	Propranolol	Inderal	
ACE inhibitors	Lisinopril	Zestril, Prinivil	Altered mood, anxiety, fatigue, parasomnias, sedation, delirium
	Enalapril	Vasotec	
Alpha adrenergic agonists	Clonidine	Catapres	Lethargy, depression, agitation, anxiety, confusion, delirium, psychosis
	Methyldopa	Aldomet	

Digoxin	Digoxin	Lanoxin	Delirium, fatigue, depression, psychosis
Diuretics	Furosemide	Lasix	Fatigue, lethargy, malaise, anorexia, mania, depression, rarely delirium
	Hydro-chlorothiazide	Microzide	
Calcium channel blockers	Amlodipine	Norvasc	Fatigue, sedation, confusion, delirium
	Diltiazem	Cardizem	
Statins	Atorvastatin	Lipitor	Depression, fatigue, anxiety, occasional sleep disturbances
	Simvastatin	Zocor	
Nitrates	Nitroglycerin	Nitrostat	Hallucinations, acute confusion, delirium, rarely suicidal ideation
Vasodilators	Hydralazine	Apresoline	Fatigue, depression, mild anxiety, psychosis, delirium

<b>Dermatological</b>	<b>Generic Name</b>	<b>Brand Name(s)</b>	<b>Side Effects</b>
Cyclosporine	Cyclosporine	Neoral, Sandimmune	Headaches, tremors, paresthesia, overt psychosis, mania, seizures
Methotrexate	Methotrexate	Rheumatrex, Trexall	Psychosis, mania
Ipilimumab	Ipilimumab	Yervoy	Headaches, dizziness, lethargy, weakness, transient sensory and motor peripheral neuropathies, MERS
IFN – 2αb	Interferon alfa-2b	Intron A	Depression, suicidal ideation
Tetracyclines, isotretinoin, acitretin	Tetracycline, Isotretinoin, Acitretin	Tetracycline (Sumycin), Isotretinoin (Accutane, Claravis), Acitretin (Soriatane)	Headache, fatigue

Antibiotic	Generic Name	Brand Name(s)	Neuropsychiatric Adverse Effects
$\beta$ -lactams	Penicillins, Cephalosporins	Amoxicillin (Amoxil), Cephalexin (Keflex)	Epilepsy (rarely reported)
Macrolides	Erythromycin, Azithromycin, Clarithromycin	Erythromycin (Erythrocin), Zithromax, Biaxin	Tinnitus, anxiety, dizziness, vertigo, mania, disorientation, psychosis, hallucinations, delirium, major depression
Fluoroquinolones	Ciprofloxacin, Levofloxacin, Moxifloxacin	Cipro (Ciprofloxacin), Levaquin (Levofloxacin), Avelox (Moxifloxacin)	Headache, dizziness, somnolence and insomnia, psychosis, delirium, seizures, peripheral neuropathy, suicidal ideation/behavior
Aminoglycosides	Gentamicin, Tobramycin, Amikacin	Garamycin (Gentamicin), Tobrex (Tobramycin), Amikin (Amikacin)	Peripheral neuropathy, delirium, encephalopathy, neuromuscular impulse inhibition
Polymyxins	Colistin, Polymyxin B	Coly-Mycin S, Polytrim	Headache, dizziness, paresthesia, ataxia, convulsions, apnea
Glycylcycline	Tigecycline	Tygaril	Headache, dizziness, insomnia
Sulfonamides	Sulfamethoxazole, Sulfadiazine	Bactrim (Sulfamethoxazole/ Trimethoprim), Silvadene (Sulfadiazine)	Headache, drowsiness, tremor, aseptic meningitis, delirium, psychosis
Nitrofurantoin	Nitrofurantoin	Macrobid, Macrochantin	Headache, peripheral neuropathy, dizziness, drowsiness
Lipoglycopeptides	Telavancin, Oritavancin	Vibativ, Orbactiv	Aggressiveness, agitation, restlessness, visual and auditory hallucinations, psychosis, delirium

Antifungal	Generic Name	Brand Name(s)	Neuropsychiatric Adverse Effects
$\beta$ -lactams	Penicillins, Cephalosporins	Amoxicillin (Amoxil), Cephalexin (Keflex)	Epilepsy (rarely reported)

Antiparasitic	Generic Name	Brand Name(s)	Neuropsychiatric Adverse Effects
Albendazole	Albendazole	Albenza	Headache, dizziness, fatigue, convulsions, visual hallucinations, rarely delirium
Praziquantel	Praziquantel	Biltricide	
Ivermectin	Ivermectin	Stromectol	
Pyrantel	Pyrantel	Pin-X, Reese's Pinworm Medicine	
Nitazoxanide	Nitazoxanide	Alinia	

Antimalarial	Generic Name	Brand Name(s)	Neuropsychiatric Adverse Effects
Mefloquine	Mefloquine	Lariam	Depression, anxiety, paranoia, confusion, memory difficulties, impaired attention, hallucinations, headache, tinnitus, lightheadedness, dizziness; Postmalaria Syndrome (convulsions, tremor, confusion)
Quinine	Quinine	Qualaquin	Few neuropsychiatric adverse events
Chloroquine	Chloroquine	Aralen	Few neuropsychiatric adverse events

Antivirals	Generic Name	Brand Name(s)	Neuropsychiatric Adverse Effects
Acyclovir	Acyclovir	Zovirax	Hallucinations, anxiety, lethargy, delirium (at high doses)
Ganciclovir	Ganciclovir	Cytovene	Hallucinations, anxiety, lethargy, delirium (at high doses)
Foscarnet	Foscarnet	Foscavir	Depression, anxiety, hallucinations, aggressive irritability
Didanosine	Didanosine	Videx	Lethargy, depression, anxiety, emotional liability, delirium, insomnia, psychosis
Efavirenz	Efavirenz	Sustiva	Severe suicidal ideation

Antituberculosis	Generic Name	Brand Name(s)	Adverse Effect
Cycloserine	Cycloserine	Seromycin	(Common) psychosis; (Occasional) anxiety, seizures, headaches; (Rare) dizziness, tremor, insomnia, suicide,

			slurred speech, agitation, bipolar exacerbations
Isoniazid	Isoniazid	Nydrazid	(Common) headaches, seizures with overdosage; (Occasional) peripheral neuropathy; (Rare) ataxia, dizziness, agitation, insomnia, altered mental status, psychosis
Linezolid	Linezolid	Zyvox	(Common) headaches; (Occasional) insomnia, serotonin syndrome
Meropenem	Meropenem	Merrem	(Common) headaches; (Rare – with clavulanate) agitation, confusion, delirium, seizures, somnolence
Ethionamide	Ethionamide	Trecator-SC	(Common) peripheral neuropathy; (Occasional) dizziness, headaches; (Rare) behavioral problems
Aminoglycosides	Various (e.g., amikacin, kanamycin)	Amikacin, Kanamycin	(Common) hearing loss; (Occasional) vestibular dysfunction
Quinolones	Various (e.g., ciprofloxacin, levofloxacin)	Cipro, Levaquin	(Occasional) headaches, insomnia, dizziness, somnolence; (Rare) Tourette-like syndrome, altered mental status, agitation, myoclonus, seizures, muscle jerks, psychosis
Ethambutol	Ethambutol	Myambutol	(Occasional) retrobulbar optic neuropathy; (Rare) headaches, confusion, peripheral neuropathy, dizziness
Thioacetazone	Thioacetazone		(Common) tinnitus, giddiness
Rifampicin	Rifampicin	Rifadin	(Rare) ataxia, headaches, dizziness

Anticancer	Generic Name	Brand Name(s)	Neuropsychiatric Adverse Effects
Ifosfamide	Ifosfamide	Ifex	Frightening, vivid visual hallucinations at toxic doses Psychosis characterized by terrifying hallucinations, delusions of persecution, fear, depressive mood, anxiety, insomnia, and disorganized speech; hypoactivity and negative symptoms alternating with hypomaniacal behavior

Procarbazine	Procarbazine	Matulane	Manic psychosis
Immunomodulatory Drugs	Interferon $\alpha$ -2b, $\alpha$ -2c, $\beta$		Associated with psychosis, depression, and suicidal ideations; increased risk in patients with preexisting psychiatric illness
	Interleukin-2		Associated with neuropsychiatric symptoms such as hallucinations
	Interleukin-1 and Rituximab		Associated with recurrent psychotic episodes

Antiepileptic Drug	Generic Name	Brand Name(s)	Psychiatric Side Effects
Benzodiazepines	Benzodiazepines	Valium, Xanax, Klonopin, Ativan	Cognitive impairment, delirium, agitation, sedation, psychosis, hallucinations, withdrawal syndrome
Phenobarbital	Phenobarbital	Luminal	Cognitive impairment, sedation, insomnia, psychosis, depression, paradoxical agitation, delirium
Phenytoin	Phenytoin	Dilantin	Agitation, insomnia, delirium
Sodium valproate	Sodium valproate	Depakote	Sedation, hallucinations, depression, delirium
Ethosuximide	Ethosuximide	Zarontin	Irritability, insomnia, psychosis, mood changes, delirium
Carbamazepine	Carbamazepine	Tegretol, Carbatrol, Eptol	Depression, psychosis, agitation, sedation, cognitive impairment, delirium
Vigabatrin	Vigabatrin	Sabril	Lethargy, irritability, agitation, major depression, psychosis, cognitive impairment
Topiramate	Topiramate	Topamax	Depression, emotional liability, psychosis, cognitive impairment
Tiagabine	Tiagabine	Gabitril	Psychosis, depressive symptoms, sedation
Gabapentin	Gabapentin	Neurontin	Agitation, sedation, fatigue
Levetiracetam	Levetiracetam	Keppra	Irritability, sedation, psychosis
Brivaracetam	Brivaracetam	Briviact	Not significant
Lamotrigine	Lamotrigine	Lamictal	Agitation, depression, sedation, psychosis

Hormone	Generic Name	Brand Name(s)	Side Effect
Progestins	Progestins	Provera, Mirena, Depo-Provera	Anxiety, irritability, depression
Estrogens	Estrogens	Premarin, Estrace, Climara	Euphoria, manic reaction
GnRH agonists	GnRH agonists	Lupron, Zoladex	Depression
Levothyroxine	Levothyroxine	Synthroid, Levoxyl, Euthyrox	Anxiety, tremulousness, hyperactivity

Immunomodulators	Generic Name	Brand Name(s)	Psychiatric Side Effect
NSAIDs	NSAIDs	Advil, Motrin, Aleve, Celebrex, etc.	Insomnia, mood disorders, psychosis, fatigue, lethargy, agitation, anxiety, delirium
Corticosteroids	Corticosteroids	Prednisone, Dexamethasone, Medrol, etc.	Lethargy, anxiety, agitation, mood disturbances, personality changes, psychological dependence, sleep disturbances, psychosis, delirium
Cyclosporine A	Cyclosporine	Sandimmune, Neoral, Gengraf	Cognitive impairment, depression, anxiety, psychosis, delirium
Tacrolimus	Tacrolimus	Prograf	Depression, psychosis, anxiety, delirium
Sulfasalazine	Sulfasalazine	Azulfidine, Sulfazine	Delirium, sleep disturbances
H1 receptor antagonists	H1 receptor antagonists	Diphenhydramine (Benadryl), Loratadine (Claritin), Cetirizine (Zyrtec)	Sedation, agitation, psychosis, delirium
H2 receptor antagonists	H2 receptor antagonists	Ranitidine (Zantac), Famotidine (Pepcid), Cimetidine (Tagamet)	Insomnia, depression, suicidal ideation, cognitive impairment, agitation, lethargy, anxiety, hallucinations, delirium
Methotrexate	Methotrexate	Rheumatrex, Trexall	Personality changes, irritability, delirium

Various	Generic Name	Brand Name(s)	Psychiatric Side Effects
Steroids	Corticosteroids	Prednisone, Dexamethasone, Medrol, etc.	Insomnia, euphoria, depression, mood changes, delirium, lethargy, personality changes, anxiety, psychosis, agitation; short-term use may lead to euphoria and hypomania, long-term use may lead to depression
	Anabolic Androgenic Steroids	Various	Homicidal rage, aggression, acute psychosis, mood liability, delirium, increased libido, anger
Anesthetics	Ketamine	Ketalar, Ketaset	Perceptual distortions, hallucinations, dissociation, referential ideas, schizophrenia-like psychosis
	Propofol	Diprivan, Propoven	Dizziness, agitation, chills, somnolence, delirium
Decongestants	Ephedrine	Various	Restlessness, dysphoria, irritability, anxiety, insomnia
Reflux Medications	Proton Pump Inhibitors	Nexium, Prilosec, Prevacid	Altered mental status, agitation, depression, psychosis
	H2 Receptor Antagonists	Zantac, Pepcid, Tagamet	Altered mental status, agitation, depression, psychosis, anxiety, insomnia, sexual dysfunction; withdrawal syndrome (insomnia, anxiety, irritability)
Vitamins	Folate	Folate Supplements	Depression
	Vitamin B1 (Thiamine)	Various	Amnesia, anxiety, irritability, depression, insomnia
	Vitamin B12	Various	Mood disorders, psychosis, irritability, confusion, dementia
	Vitamin D	Various	Acute mood disorders, psychosis, depression
Other Drugs	Ondansetron	Zofran	Anxiety
	Metformin	Glucophage, Fortamet	Anxiety, depression, confusion
	Salbutamol	Ventolin, Proventil, etc.	Insomnia, agitation, euphoria, delirium
	Aminophylline	Various	Insomnia, agitation, euphoria, delirium

## References

Charts adapted from:

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