Pharmacotherapy for ADHD Management

ADHD pharmacotherapy should be considered for individuals with moderate to severe symptoms that significantly impair daily functioning and quality of life, particularly when non-pharmacological interventions, such as behavioural or psychological therapies are ineffective, insufficient or declined.

Medication is an integral part of a multimodal treatment approach and is especially appropriate in cases where symptoms persist despite other interventions or when the impact on academic, occupational or social functioning is substantial. Treatment should always be tailored to the individual's specific needs, carefully considering the risks, benefits and overall treatment goals.^{3,4,11}

Stimulants (Methylphenidate- and Amphetamine-based medications)



CNS: headache, nervousness, irritability, anxiety, insomnia, dizziness, tics GI: nausea, vomiting, diarrhea, loss of appetite, weight loss CV: ↑ HR and BP at initiation, tachycardia, palpitations, hypertension Anticholinergic: Dry mouth, blurred vision, diplopia, mydriasis

Contraindications:

- Untreated hyperthyroidism
- Advanced arteriosclerosis
- Symptomatic cardiovascular disease
- Moderate to severe hypertension
- Glaucoma
- Agitated states (e.g., history of mania or psychosis)
- Pheochromocytoma
- Use of MAOIs during treatment or ≤ 14 days after discontinuation
- Known hypersensitivity to sympathomimetic amines
- History of substance abuse/misuse (precaution)
- Tic disorders (precaution)

★Interactions:

- MAOIs → Hypertensive crisis could occur
- Serotonergic drugs → Risk of serotonin syndrome
- Antihypertensives → May ↓ efficacy of antihypertensives
- Vasopressors → ↑ HR and BP
- Drugs affecting DA/NE pathways → ↑ Extrapyramidal symptom risk
- May reduce, delay or enhance the action of anticoagulants, anticonvulsants, and antidepressants
- Alcohol → Enhanced adverse effects
- Cannabis → Reduced efficacy of stimulants^{26,27}
- Acidifying or alkalizing agents → ↓ or ↑ amphetamine blood levels respectively
- PPIs → ↓ absorption time of amphetamine (Tmax), except Vyvanse®

AWarnings:

- Potential for abuse, misuse and dependence
- Cardiovascular risks, including sudden death, stroke, myocardial infarction, and hypertension
- Psychiatric risks, such as psychosis, aggression, anxiety, and mania
- Raynaud's phenomenon, monitor for signs of digit changes
- Risk of lowering the seizure threshold
- Risk of serotonin syndrome when used with serotonergic drugs
- Risk of priapism
- Potential for gastrointestinal obstruction in patients with pre-existing gastrointestinal narrowing (Concerta®)



Medication	Features	Dosing (Adults)	Cost and coverage (1-month supply)
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Thus, a trial of both classes of long-acting stimulants should be considered before second-line treatments. $^{\eta}$

Amphetamine-based medications (ages ≥ 6 years)

Amphetamines act as substrates for dopamine and norepinephrine transporters, facilitating their release into the synaptic cleft. They also inhibit monoamine oxidase and reverse the DA and NE transporters, further increasing synaptic levels of dopamine and norepinephrine. This leads to enhanced neurotransmission and improves coanitive control.

Mixed salts	Release Ratio (IR%/ER%): 50/50	Initial: 5-10mg daily in the morning	Brand: \$91-145
amphetamine extended-release	Onset: 0.5-1h	Titration: ↑ by 5-10mg at weekly intervals	Generic: \$31-43
exterided-release	Onset: 0.5-III	Itration: 1 by 5-10 mg at weekly intervals	Generic: \$51-45
Adderall XR	TmaxIR: 5-8h Food can delay Tmax by 2.5h; no effect on extent of	Max: 20-30mg	ODB: √
5, 10, 15, 20, 25, 30mg	absorption)		
ER capsules	TmaxER: not reported	Inadequate evidence of additional efficacy at doses > 20mg/day in adolescents and adults.	NIHB: X
3:1	Duration of Action: 12h		
dextroamphetamine		Administration: With or without food (maintain consistency)	
to levoamphetamine	Delivery Mechanism:		
	Immediate and delayed-release beads allow for biphasic release.	Renal:	
	Formulation:	Severe impairment:	
	Can be sprinkled onto applesauce and consumed immediately; do not	\downarrow if eGFR < 30mL/min to max of 20mg/day with further	
	crush or chew.	reductions if on dialysis	
		■ Hepatic: Impairment may alter elimination resulting in	
		prolonged exposure.	
		prolonged exposure.	
Lisdexamfetamine	Release Ratio (IR%/ER%): N/A, prodrug	Initial: 20-30mg daily in the morning	Brand:
(Vyvanse®)			Cap: \$88-205
	Onset: 1-2h	Titration: ↑ by 10-20mg/day at weekly intervals	
10, 20, 30, 40, 50, 60,			Tab: \$88-254
70mg capsules	Tmax: 3.5-4.5h (with food: 4.5-5.5h)	Max: 70mg	C
10, 20, 30, 40, 50,	(Food can delay Tmax by 1h)	Administration: With or without food (maintain consistency)	Generic: Cap: \$51-168
60mg chewable	Duration of Action: 13-14h	Administration: With or Without 1000 (maintain consistency)	Cap. \$51-166
tablets	Duration of Action, 15 1411	Switch: Start with Vyvanse® 20 to 30mg	Tab: \$54-146
10.0.00	Delivery Mechanism: Inactive when ingested and converted to	State With Vyvanses 25 to 55 mg	1 4 5 1 1 1 5
Also indicated for	dextroamphetamine in the body via enzymes in the small intestine	Renal:	ODB: √ (except 70mg
binge-eating	and bloodstream that slowly cleave off the lysine amino acid, ensuring	Severe impairment:	cap)
disorder (BED)	gradual release and tamper resistance.	↓ if eGFR < 30mL/min to max of 50mg/day	
	Farmed Mark Consular control of the district of the state		NIHB: √ (except
	Formulation: Capsules can be opened and diluted in water, orange juice or yogurt and consumed immediately.	ESRD: max of 30mg/day	70mg cap)
	Juice or yogurt and consumed immediately.		
	Do not split chewable tablets; chew thoroughly before swallowing.	PHepatic : No studies have been conducted.	
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Medication	Features	Dosing (Adults)	Cost and cover (1-month supp
1ethylphenidate blo	ased Medications (ages ≥ 6 years unless noted otherwise) cks the reuptake of dopamine and norepinephrine into the presynaptic ne se neurotransmitters in the prefrontal cortex, enhancing attention and rea		he extracellular
Methylphenidate controlled-release	Release Ratio (IR%/ER%): 40/60	Initial: 10-20mg daily in the morning	Brand: \$45-208
Biphentin®)	Onset: 1h	Titration: ↑ by 10mg weekly	Generic: \$30-115
0, 15, 20, 30, 40, 50, 50, 80mg	Tmax _{IR} : 1-3h Tmax _{ER} : 6-7h	Max: 80 mg	ODB: √
CR capsules	Duration of Action: 10-12h	Administration: With or without food	NIHB: √
	Delivery Mechanism : Multi-layer delivery system allows for a controlled biphasic release of methylphenidate from beads with an immediate-release layer followed by a controlled-release layer (mimics	Switch: The starting dose of Biphentin® should be the next lower available strength relative to the patient's total daily methylphenidate dose.	
	delivery of three separate IR doses).	Renal: No dose adjustment	
	Formulation : Granules can be sprinkled onto applesauce or yogurt. Do not sprinkle into liquids or crush/chew.	₹ Hepatic : No studies have been conducted.	
Methylphenidate extended-release	Release Ratio (IR%/ER%): 22/78	Initial: 18mg daily in the morning	Brand: \$119-185
Concerta®)	Onset: 1h	Titration: ↑ by 18mg weekly	Generic: \$48-69
8, 27, 36, 54 mg ER tablets	TmaxIR: 1h TmaxER: 6-10h	Max: 72mg	ODB: √
	Duration of Action: 12h	Administration: With or without food	NIHB: √
	Delivery Mechanism: Osmotic Controlled-Release Oral Delivery System (OROS®)	Switch: Previous daily total methylphenidate dose: 10-15mg IR or 20mg SR = 18mg Concerta® 20-30mg IR or 40mg SR = 36mg Concerta®	
	The OROS® delivery system combines an immediate release of methylphenidate from its outer coating upon ingestion with a controlled, delayed release of the remaining through an osmotic	30-45mg IR or 60mg SR = 54mg Concerta® 40-60mg IR = 72mg Concerta ®	
	pressure-driven mechanism leading to a biphasic release (mimics delivery of three separate IR doses).	Renal: No dose adjustment	
	Formulation: Tablets should be swallowed whole.	Hepatic: No studies have been conducted.	



adults is not available.

Medication	Features	Dosing (Adults)	Cost and coverage (1-month supply)
Methylphenidate bloc	sed Medications (ages ≥6 years unless noted otherwise) less the reuptake of dopamine and norepinephrine into the presynaptic ne e neurotransmitters in the prefrontal cortex, enhancing attention and rec		
Methylphenidate controlled-release (Foquest®) 25, 35, 45, 55, 70, 85, 100mg CR capsules	Release Ratio (IR%/ER%): 20/80 Onset: 1h TmaxIR: 1-2.5h TmaxER: 8.5-16h Duration of Action: 13-16h Delivery Mechanism: Multi-layer delivery system allows for a controlled biphasic release of methylphenidate from beads with an immediate-release layer followed by a controlled-release layer (mimics delivery of three separate IR doses). Formulation: Granules can be sprinkled onto applesauce or yogurt. Do not sprinkle into liquids or crush/chew.	Initial: 25mg daily in the morning Titration: ↑ by 10-15mg after at least 5-day intervals Max: Adult = 100mg Administration: With or without food Switch: Starting dose of Foquest® is the next lower strength based on the total methylphenidate daily dose. Renal: No dose adjustment Hepatic: No studies have been conducted.	Brand: \$109-179 Generic: N/A ODB: √ NIHB: √
Methylphenidate extended-release (Quillivant® ER) 20, 30, 40mg ER chewable tablets Powder for oral suspension: 300, 500, 750, 900mg/bottle (5mg/mL oral suspension) Indication: ages 6-12y ER chew tablets and ER oral suspension ARE NOT INTERCHANGEABLE	Release Ratio (IR%/ER%): Chew: 30/70 Susp: 20/80 Onset: 0.75h – 1hr TmaxTab: 5h TmaxSusp: 5h (high-fat meal: 4h) Duration of Action: Chew = 8-12h Susp = 12h Delivery Mechanism: A biphasic release mechanism, where an immediate-release dose is delivered upon chewing (chewable tablet) or ingestion (suspension), followed by a controlled extended-release through a matrix (chewable) or coated particles (suspension) for sustained effect. Formulation: 20mg and 30mg tablets are scored and can be split; chew thoroughly before swallowing. Reconstituted suspension should be shaken for 10 seconds before withdrawing the dose for administration.	Initial: Chew/Susp: 20mg daily in the morning Titration: ↑ or ↓ by 10, 15, or 20mg at weekly intervals Max: 60mg Administration: With or without food Renal: No dose adjustment Hepatic: No studies have been conducted.	Brand: Tab: \$107-215 Suspension: \$83-431 Generic: N/A ODB: X NIHB: X



Medication	Features	Dosing (Adults)	Cost and coverage (1-month supply)
Methylphenidate bloc	sed Medications (ages ≥ 6 years unless noted otherwise) ks the reuptake of dopamine and norepinephrine into the presynaptic ne e neurotransmitters in the prefrontal cortex, enhancing attention and red		ne extracellular
Methyphenidate delayed-release and extended-release (JORNAY PM®) 20, 40, 60, 80, 100mg ER capsules Indication: ages 6-12y *Approved, but not currently marketed in Canada	Release Ratio (IR%/ER%): 0/100 Onset: 8-10h delay before onset Tmax: 14h Duration of Action: 12 hours Delivery Mechanism: Dual-coating system with an outer delayed-release and inner extended release leading to an 8–10-hour delay once administered before onset. Formulation: Granules can be sprinkled	Initial: 20mg daily in the evening at 8pm (between 6:30pm-9:30pm based on tolerability and efficacy) Titration: ↑ by 20mg at weekly intervals Max: 100mg Administration: With or without food Renal: No dose adjustment Hepatic: No studies have been conducted.	Brand: N/A ODB: N/A NIHB: N/A
	re ineffective, poorly tolerated, or inaccessible, and are suitable in cases we atments for suboptimal responders 3,11 d Medications Release Ratio (IR%/ER%): IR: 100/0 SR: 50/50	vhere stimulants are contraindicated due to misuse risks. Non-st Initial: IR: 2.5-5mg daily or BID (morning and noon)	_
5mg IR tablet			Brand: IR: \$27-247
Dextroamphetamine sustained-release	Onset: IR: 0.5-1h SR: 1h	SR: 10mg in the morning (Spansule® used for once-daily dosing) Titration: ↑ by 2.5-5mg/day at weekly intervals	
		SR: 10mg in the morning (Spansule® used for once-daily dosing)	IR: \$27-247 SR: \$54-155 Generic: IR: \$21-147



Medication	Features	Dosing (Adults)	Cost and coverage (1-month supply)		
Methylphenidate -Bo	Methylphenidate -Based Medications				
Methylphenidate (RITALIN®) 5, 10, 20mg IR tablet Methylphenidate extended-release (RITALIN® SR) 20mg SR tablet Also indicated for narcolepsy	Release Ratio (IR%/ER%): 100/0 Onset: IR: 0.5h	Initial: IR: 5-10mg BID or TID SR: 20mg daily in the morning (Used in place of IR when doses align in an 8-hour interval) Titration: IR: ↑ by 5-10mg at weekly intervals SR: May add daily 2 PM dose. Max: 60mg Administration: With or without food Switch: Replace 8-hour dosage of methylphenidate IR with Ritalin® SR at the same total dose. Penal: No studies have been conducted. Hepatic: No studies have been conducted.	Brand: D/C Generic: IR: \$16-48 SR: \$35-80 ODB: √ (10mg IR and 20mg SR only) NIHB: √		



Non-Stimulant Medications

Selective Norepinephrine Reuptake Inhibitors (ages ≥ 6 years)

Selectively inhibits the norepinephrine transporter, increasing norepinephrine levels in the synaptic cleft, particularly in the prefrontal cortex. This enhances attention and reduces impulsivity and hyperactivity. It has minimal direct action on dopamine or serotonin.

? Side effects (most common):

Insomnia, decreased appetite, dry mouth, nausea, dizziness, constipation, erectile dysfunction, urinary hesitation, and urinary retention.



- Increased risk of serotonin syndrome with serotonergic drugs
- Interaction with CYP2D6 inhibitors (e.g., fluoxetine, paroxetine), leading to increased atomoxetine plasma levels
- Potential interactions with drugs that prolong QT interval or disturb electrolyte balance
- Additive effects on blood pressure with antihypertensive drugs and pressor agents.

Contraindications:

- Hypersensitivity to atomoxetine or any formulation components.
- Use of MAOIs during treatment or ≤ 14 days of discontinuation
- Narrow-angle glaucoma
- Pheochromocytoma or history of pheochromocytoma
- Severe cardiovascular disorders
- Moderate to severe hypertension.

Warnings:

- Potential for severe liver injury, including rare cases of acute liver failure
- Risk of cardiovascular effects, such as increased heart rate and blood pressure
- Potential for orthostatic hypotension and syncope
- Risk of priapism
- Psychiatric risks, including agitation, mood swings, and aggression
- Risk of exacerbating pre-existing psychiatric or cardiovascular conditions QT interval prolongation and associated risks for torsades de pointes.
- Aggression and hostility monitoring in pediatric patients.
- Suicidal behavior and ideation monitoring during treatment.
- Potential withdrawal hypertension if abruptly discontinued.
- Risk of liver dysfunction in patients with hepatic impairment.

Medication	Features	Dosing (Adults)	Cost and coverage (1-month supply)
Atomoxetine (Strattera®) 10, 18, 25, 40, 60, 80, 100mg capsules	Release Ratio (IR%/ER%): N/A Onset: 1-2 weeks Full efficacy could take 4-6 weeks. Tmax: 1h High-fat meal in adults did not affect the extent of oral absorption but did decrease the rate of absorption, resulting in a 37% lower Cmax and delayed Tmax by 3 hours. Duration of Action: Up to 24h Formulation: Do not open capsules as it can cause nausea and upset stomach.	Initial: Adults 25-40mg once daily for 7 to 14 days Titration: ↑ by 20mg/day at 1-2-week intervals Max: Lesser of 1.4mg/kg or 100mg Administration: With or without food Renal: No dose adjustment Hepatic: Moderate impairment (Child-Pugh B): ↓ dose to 50% of the usual dose Severe impairment (Child-Pugh C): ↓ dose to 25% of the usual dose	Brand: D/C Generic: \$29-157 ODB: \(\) (except 80mg and 100mg) NIHB: \(\)



Selective Alpha-2a adrenergic receptor agonist: selectively stimulates alpha-2a adrenergic receptors in the prefrontal cortex, enhancing postsynaptic receptor function. This action strengthens prefrontal cortical network activity, improving attention, working memory, and impulse control by reducing hyperactivity of the sympathetic nervous system.

? Side effects (most common):

Fatigue, headache, somnolence/sedation, dizziness, decreased appetite, and abdominal pain.



- † guanfacine exposure with CYP3A4 inhibitors (e.g., ketoconazole)
- Additive effects with CNS depressants (e.g., alcohol, benzodiazepines)
- Potential interactions with antihypertensive drugs, leading to additive hypotension and, if stopped abruptly, may lead to rebound ↑ BP
- Avoidance of concurrent use with QT-prolonging drugs
- Increased valproic acid levels when co-administered

Contraindications:

- Hypersensitivity to guanfacine or any formulation component

Marnings:

- Risk of somnolence and sedation, particularly at treatment initiation or dose increases
- Cardiovascular risks, including hypotension, bradycardia, and syncope
- THR and BP upon discontinuation (rebound hypertension)
- QT interval prolongation and associated risks for torsades de pointes
- Aggression and hostility -> Monitor during treatment
- Suicidal behavior and ideation → Monitor during treatment
- Risk of liver dysfunction in patients with hepatic impairment

- increased valproic ac	cid levels when co-administered		
Medication	Features	Dosing (Adults)	Cost and coverage (1-month supply)
Guanfacine extended-release	Release Ratio (IR%/ER%): N/A	Initial: 1mg in the morning or evening with a small amount of liquid	Brand: \$114-180
(Intuniv® XR)	Onset: 1-2 weeks		Generic: \$64-97
1, 2, 3, 4mg ER tablets	Full efficacy could take 4 weeks	Titration: ↑ by no more than 1mg/day at weekly intervals	ODB: √ (<u>LU 540</u>)
	Tmax: 5 h	Monitor blood pressure and heart rate for sedation.	(<u>LO 3+0</u>)
Do not substitute immediate-release	Duration of Action:	Max:	NIHB: √
formulations in a 1:1	Up to 24h	As monotherapy:	
ratio	Formulation:	Children (6-12y): 4mg	
Indication: ages 6-17y	Swallow whole to keep delivery mechanism intact (do not crush, chevor break).	Adolescent (12-17y): Target Lesser of 7mg or 0.12 mg/kg/day	
J V	,	As adjunct:	
Safety and efficacy not established in		Children/Adolescent (6-17y): 4mg	
< 25kg		↓ dose if significant renal and/or hepatic impairment	
		↓ dose if concomitant use of moderate/strong CYP3A4/3A5 inhibitor (50% dose reduction)	
		† dose if concomitant use of strong CYP3A4 inducer (up to a max of 7mg)	
		Administration: With or without food. Do not take with high-fat meal or grapefruit.	
		Renal: Severe impairment: Use with caution due to potential for hypotension and bradycardia	
		■ Hepatic: Severe impairment: Use with caution and monitor for exaggerated hypotensive effects.	



Third-line: Bupropion, clonidine, imipramine, and modafinil are third-line options for the treatment of ADHD, often used in treatment-resistant cases. These medications are off-label. carry higher risks or side effects, and may require specialized care, including for comorbidities.

Legend

ADHD = Attention Deficit Hyperactivity Disorder; BID = twice a day; BP = Blood Pressure; CNS = Central Nervous System; CR = Controlled-release; CV = Cardiovascular; CVD = Cardiovascular Disease; DA = Dopamine; D/C = Discontinued; ER = Extended-release; GI = Gastrointestinal; HR = Heart Rate; IR: Instant-release; MAOI = Monoamine oxidase inhibitor; NE = Norepinephrine; N/A = Not Applicable: **PPI** = Proton-pump Inhibitor: **SR** = Sustained-release: **TID** = three times a day

Cost: an approximate range for a 1-month supply using the initial and max dose (includes a markup of 10% and a dispensing fee of \$12.99)

Tmax: Time to max blood plasma concentrations

Titration: Dose escalations can be completed at a slower pace than outlined above based on clinician discretion and patient satisfaction.

Dosing: Dosing should be individualized based on response to careful titration to identify the optimal dose, not on the severity of presentation or solely on the person's age or size. Close monitoring is essential until medication effectiveness and tolerability have been optimized.³

Switching: Specific to switching from another stimulant (methylphenidate to amphetamine or vice versa). Methylphenidate 1 mg is approximately 0.5 mg Adderall® XR or 0.4 mg of dextroamphetamine. If converting patients, monitor closely for clinical efficacy and adverse effects.

Follow-up: May be more frequent during the titration phase to monitor the efficacy and safety of the chosen treatment. Once a patient is stabilized, follow-up appointments can occur at regular points up to the provider's discretion.²

Monitoring: Look for new or worsening mood, anxiety, psychotic, manic, or substance use symptoms. Additionally, consider changes in suicidal ideation or behaviour (e.g., aggressive), as well as sleep, appetite, and mood stability (including irritability and mood swings).11

