

# PRODUCT MONOGRAPH



## **TEVA-METHYLPHENIDATE ER-C** (Methylphenidate Hydrochloride)

Extended-release Tablets 18 mg, 27 mg, 36 mg, and 54 mg

Teva Standard

CNS Stimulant

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**PART I: HEALTH PROFESSIONAL INFORMATION**

**SUMMARY PRODUCT INFORMATION**

<b>Route of Administration</b>	<b>Dosage Form / Strength</b>	<b>All Nonmedicinal Ingredients</b>
Oral	Extended release tablet / 18mg, 27mg, 36mg and 54 mg	hydroxypropyl methylcellulose, lactose monohydrate, microcrystalline cellulose, polyvinyl alcohol- polyethylene glycol copolymer and colloidal silica, simethicone and stearic acid.  Colourants present in the tablets are: 18 mg: D&C Yellow #10 aluminum lake, FD&C Red #40 aluminum lake, iron oxide yellow, polyethylene glycol, polyvinyl alcohol, talc and titanium dioxide.  27 mg: iron oxide black, polyethylene glycol, polyvinyl alcohol, talc and titanium dioxide.  36 mg: polyethylene glycol, polyvinyl alcohol, talc and titanium dioxide.  54 mg: hydroxypropyl methylcellulose, iron oxide yellow, iron oxide red, polyethylene glycol and titanium dioxide.

**INDICATIONS AND CLINICAL USE**

TEVA-METHYLPHENIDATE ER-C (methylphenidate hydrochloride extended-release) is indicated for the treatment of Attention Deficit Hyperactivity Disorder (ADHD) in:

- Children (6 – 12 years of age)
- Adolescents (13 – 18 years of age)

- Adults (> 18 years of age)

**Paediatrics (< 6 years of age):**

TEVA-METHYLPHENIDATE ER-C should not be used in children under six years, since safety and efficacy in this age group have not been established.

**Geriatrics (> 65 years of age):**

No data available.

A diagnosis of ADHD (DSM-IV) implies the presence of hyperactive-impulsive or inattentive symptoms that caused impairment and that were present before age 7 years. The symptoms must be persistent, must be more severe than is typically observed in individuals at a comparable level of development, must cause clinically significant impairment, e.g., in social, academic, or occupational functioning, and must be present in 2 or more settings, e.g., school (or work) and at home. The symptoms must not be better accounted for by another mental disorder. For the Inattentive Type, at least 6 of the following symptoms must have persisted for at least 6 months: lack of attention to details/careless mistakes, lack of sustained attention, poor listener, failure to follow through on tasks, poor organization, avoids tasks requiring sustained mental effort, loses things, easily distracted, forgetful. For the Hyperactive-Impulsive Type, at least 6 of the following symptoms must have persisted for at least 6 months: fidgeting/squirming, leaving seat, inappropriate running/climbing, difficulty with quiet activities, “on the go,” excessive talking, blurting answers, can’t wait turn, intrusive. For a Combined Type diagnosis, both inattentive and hyperactive-impulsive criteria must be met.

**Special Diagnostic Considerations**

The specific etiology of ADHD is unknown, and there is no single diagnostic test. Adequate diagnosis requires the use not only of medical but of special psychological, educational, and social resources. Learning may or may not be impaired. The diagnosis must be based upon a complete history and evaluation of the patient and not solely on the presence of the required number of DSM-IV characteristics.

**Need for Comprehensive Treatment Program**

TEVA-METHYLPHENIDATE ER-C is indicated as an integral part of a total treatment program for ADHD that may include other measures (psychological, educational, social) for patients with this syndrome. Drug treatment may not be indicated for all patients with this syndrome. Drug treatment is not intended for use in the patient who exhibits symptoms secondary to environmental factors and/or other primary psychiatric disorders, including psychosis.

Appropriate educational placement is essential in children and adolescents with this diagnosis and psychosocial intervention is often helpful. When remedial measures alone are insufficient, the decision to prescribe drug treatment medication will depend upon the physician’s assessment of the chronicity and severity of the patient’s symptoms.

**Long-Term Use**

The effectiveness of methylphenidate hydrochloride extended release for long-term use, i.e. for more than 4 weeks in children and adolescents or 7 weeks in adults, has not been systematically evaluated in placebo-controlled trials. Therefore, the physician who elects to use TEVA-

METHYLPHENIDATE ER-C for extended periods should periodically re-evaluate the long-term usefulness of the drug for the individual patient (see **DOSAGE AND ADMINISTRATION**).

## CONTRAINDICATIONS

- Anxiety, tension, agitation, thyrotoxicosis, advanced arteriosclerosis, symptomatic cardiovascular disease, moderate to severe hypertension or glaucoma.
- Patients who are hypersensitive to methylphenidate or to any ingredient in the formulation or component of the container. For a complete listing, see the **DOSAGE FORMS, COMPOSITION AND PACKAGING** section of the Product Monograph.
- During treatment with monoamine oxidase inhibitors, and also within a minimum of 14 days following discontinuation of a monoamine oxidase inhibitor (hypertensive crises may result) (see **DRUG INTERACTIONS; Drug-Drug Interactions**).

## WARNINGS AND PRECAUTIONS

### Serious Warnings and Precautions

- **Drug Dependence** (see **Dependence/Tolerance** section below)

### General

TEVA-METHYLPHENIDATE ER-C is intended for oral use only. In dogs, the intravenous injection of the pulverized methylphenidate hydrochloride extended-release tablets resulted in death (see *Product Monograph Part II: TOXICOLOGY, Acute Toxicity*).

### Sudden Death and Pre-existing Structural Cardiac Abnormalities or Other Serious Heart Problems

#### Children and Adolescents

Sudden death has been reported in association with stimulant drugs used for ADHD treatment at usual doses in children and adolescents with structural cardiac abnormalities or other serious cardiac problems. Although some serious heart problems alone carry an increased risk of sudden death, TEVA-METHYLPHENIDATE ER-C generally should not be used in children, adolescents, or adults with known structural cardiac abnormalities, cardiomyopathy, serious heart rhythm abnormalities, or other serious cardiac problems that may place them at increased vulnerability to the sympathomimetic effects of a stimulant drug.

### Adults

Sudden deaths, stroke, and myocardial infarction have been reported in adults taking stimulant drugs at usual doses for ADHD. Although the role of stimulants in these adult cases is also unknown, adults have a greater likelihood than children of having serious structural cardiac abnormalities, cardiomyopathy, serious heart rhythm abnormalities, coronary artery disease, or other serious cardiac problems. Adults with such abnormalities should also generally not be treated with stimulant drugs (see **CONTRAINDICATIONS**).

### **General**

Children: Theoretically there exists a pharmacological potential for all ADHD drugs to increase the risk of sudden/cardiac death. Although confirmation of an incremental risk for sudden/cardiac death arising from treatment with ADHD medications is lacking, prescribers should consider this potential risk.

All drugs with sympathomimetic effects prescribed in the management of ADHD should be used with caution in patients who: a) are involved in strenuous exercise or activities, b) use other sympathomimetic ADHD drugs or c) have a family history of sudden/cardiac death. Prior to the initiation of treatment with sympathomimetic medications, a personal and family history (including assessment for a family history of sudden death or ventricular arrhythmia) and physical exam should be obtained to assess for the presence of cardiac disease. In patients with relevant risk factors and based on the clinician's judgment, further cardiovascular evaluation may be considered (e.g., electrocardiogram and echocardiogram). Patients who develop symptoms such as exertional chest pain, unexplained syncope, or other symptoms suggestive of cardiac disease during ADHD treatment should undergo a prompt cardiac evaluation.

### Fatigue

TEVA-METHYLPHENIDATE ER-C should not be used for the prevention or treatment of normal fatigue states.

### Information for Patients

Patients should be informed that TEVA-METHYLPHENIDATE ER-C should be swallowed whole with the aid of liquids. Tablets should not be chewed, divided, or crushed. Patient information is provided in **Product Monograph Part III: CONSUMER INFORMATION**. To assure safe and effective use of TEVA-METHYLPHENIDATE ER-C, the information and instructions provided in **Product Monograph Part III: CONSUMER INFORMATION** should be discussed with patients.

### **Carcinogenesis and Mutagenesis**

See **Product Monograph Part II: TOXICOLOGY; Carcinogenicity and Mutagenicity and Reproductive and Developmental Toxicity** for discussion on animal data.

### **Cardiovascular**

**Pre-existing Cardiovascular and Cerebral Vascular Conditions** CNS stimulants should be used with caution in patients with a pre-existing cardiovascular or cerebrovascular condition, taking into account risk predictors for these conditions. Patients should be screened for pre-existing or underlying cardiovascular or cerebrovascular conditions before initiation of treatment with

TEVA-METHYLPHENIDATE ER-C and monitored for new conditions of the heart or brain during the course of treatment.

### Hypertension and Other Cardiovascular Conditions

TEVA-METHYLPHENIDATE ER-C should be used cautiously in patients with mild hypertension and other cardiovascular conditions. Blood pressure should be monitored at appropriate intervals in patients receiving TEVA-METHYLPHENIDATE ER-C, especially in patients with hypertension. In the laboratory classroom clinical trials in children (Studies 1 and 2), both methylphenidate hydrochloride extended release and methylphenidate t.i.d. increased resting pulse by an average of 2-6 beats per minute (bpm) and produced average increases of systolic blood pressure (SBP) and diastolic blood pressure (DBP) of approximately 1-4 mm Hg during the day, relative to placebo. In the double-blind, placebo-controlled study in adults (Study 5), changes in mean DBP and SBP were observed with methylphenidate hydrochloride extended-release doses up to 72 mg. A statistically significant ( $p < 0.05$ ) mean increase in standing DBP and SBP versus baseline was reached at Week 1 in the 72 mg methylphenidate hydrochloride extended-release dose group (mean increase of 2.0 mm Hg for standing DBP and 4.0 mm Hg for standing and supine SBP) but not at later time points. A statistically significant increase in pulse was observed for all methylphenidate hydrochloride extended-release dose groups (18 mg, 36 mg and 72 mg) versus baseline (range of mean increase of 2.0-10.6 bpm). Therefore, caution is advised in treating patients whose underlying medical conditions might be compromised by increases in blood pressure or heart rate, e.g., those with pre-existing hypertension, heart failure or recent myocardial infarction.

### Dependence/Tolerance

#### Drug Dependence

TEVA-METHYLPHENIDATE ER-C should be given cautiously to patients with a history of drug dependence or alcoholism. Chronic abusive use can lead to marked tolerance and psychological dependence with varying degrees of abnormal behaviour. Frank psychotic episodes can occur, especially with parenteral abuse (See **DOSAGE AND ADMINISTRATION, Administration**). Careful supervision is required during withdrawal from abuse since severe depression may occur. Withdrawal following chronic therapeutic use may unmask symptoms of an underlying disorder that may require follow-up.

### Endocrine and Metabolism

#### Long-Term Suppression of Growth

Sufficient data on the safety of long-term use of methylphenidate in children are not yet available. Although a causal relationship has not been established, suppression of growth (i.e. weight gain and/or height) has been reported with the long-term use of stimulants in children. Therefore, patients requiring long-term therapy should be carefully monitored. Patients who are not growing or gaining weight as expected should have their treatment interrupted.

### Gastrointestinal

#### Potential for Gastrointestinal Obstruction

Because the TEVA-METHYLPHENIDATE ER-C tablet does not appreciably change in shape in the gastrointestinal tract, TEVA-METHYLPHENIDATE ER-C should not be administered to patients with pre-existing gastrointestinal narrowing (pathologic or iatrogenic, such as small

bowel inflammatory disease, “short gut” syndrome due to adhesions or decreased transit time, past history of peritonitis, cystic fibrosis, chronic intestinal pseudo-obstruction, or Meckel’s diverticulum). There have been rare reports of obstructive symptoms in patients with known strictures in association with the ingestion of other drugs in nondeformable controlled-release formulations. There have been very rare reports of obstructive symptoms associated with the use of methylphenidate hydrochloride extended release in patients without known gastrointestinal stricture. Due to the controlled-release design, TEVA-METHYLPHENIDATE ER-C tablets should only be used in patients who are able to swallow the tablets whole (see **DOSAGE AND ADMINISTRATION; Administration**).

## **Neurologic**

### **Seizures**

There is some clinical evidence that methylphenidate may lower the convulsive threshold in patients with a prior history of seizures, in patients with prior EEG abnormalities in the absence of seizures, and, very rarely, in the absence of history of seizures and no prior EEG evidence of seizures. In the presence of seizures or suspected seizures, the drug should be discontinued.

### **Motor and Verbal Tics, and Worsening of Tourette’s Syndrome**

Central nervous system (CNS) stimulants, including methylphenidate, have been associated with the onset or exacerbation of motor and verbal tics. Worsening of Tourette’s syndrome has also been reported. It is recommended that the family history be assessed, and that the patient is clinically evaluated for tics or Tourette’s syndrome before initiating methylphenidate. Regular monitoring for the emergence or worsening of tics or Tourette’s syndrome during treatment with methylphenidate is recommended at every dose adjustment and every visit, and treatment discontinued if clinically appropriate (see **ADVERSE REACTIONS, Clinical Trial Adverse Drug Reactions**, Adverse Reactions Occuring in Long-Term Safety Trials).

### **Effects on Ability to Drive and Use Machines**

Stimulants may impair the ability of the patient to operate potentially hazardous machinery or vehicles. Patients should be cautioned accordingly until they are reasonably certain that TEVA-METHYLPHENIDATE-ER-C does not adversely affect their ability to engage in such activities.

## **Ophthalmologic**

### **Visual Disturbance**

Symptoms of visual disturbances have been encountered in rare cases. Difficulties with accommodation and blurring of vision have been reported.

## **Psychiatric**

### **Pre-Existing Psychosis**

Administration of stimulants may exacerbate symptoms of behaviour disturbance and thought disorder in patients with a pre-existing psychotic disorder.

### **Screening Patients for Bipolar Disorder**

Particular care should be taken in using stimulants to treat ADHD in patients with comorbid bipolar disorder because of concern for possible induction of a mixed/manic episode in such patients. Prior to initiating treatment with a stimulant, patients with comorbid depressive symptoms should be adequately screened to determine if they are at risk for bipolar disorder;

such screening should include a detailed psychiatric history, including a family history of suicide, bipolar disorder, and depression.

#### Emergence of New Psychotic or Manic Symptoms

Treatment emergent psychotic or manic symptoms, e.g., hallucinations, delusional thinking, or mania in children and adolescents without a prior history of psychotic illness or mania can be caused by stimulants at usual doses. If such symptoms occur, consideration should be given to a possible causal role of the stimulant, and discontinuation of treatment may be appropriate. In a pooled analysis of multiple short-term, placebo-controlled studies, such symptoms occurred in about 0.1% (4 patients with events out of 3482 exposed to methylphenidate or amphetamine for several weeks at usual doses) of stimulant-treated patients compared to 0 in placebo-treated patients.

#### Aggression

Aggressive behaviour or hostility is often observed in children and adolescents with ADHD, and has been reported in clinical trials and the post-marketing experience of some medications indicated for the treatment of ADHD. Although there is no systematic evidence that stimulants cause aggressive behaviour or hostility, patients beginning treatment for ADHD should be monitored for the appearance of or worsening of aggressive behaviour or hostility.

#### Suicidal Behaviour and Ideation

There have been post-marketing reports of suicide-related events in patients treated with ADHD drugs, including cases of ideation, attempts, and very rarely, completed suicide. The mechanism of this risk is not known. ADHD and its related co-morbidities may be associated with increased risk of suicidal ideation and/or behaviour.

Therefore, it is recommended for patients treated with ADHD drugs that caregivers and physicians monitor for signs of suicide-related behaviour, including at dose initiation/optimization and drug discontinuation. Patients should be encouraged to report any distressing thoughts or feelings at any time to their healthcare professional. Patients with emergent suicidal ideation and behaviour should be evaluated immediately. The physician should initiate appropriate treatment of the underlying psychiatric condition and consider a possible change in the ADHD treatment regimen (see **ADVERSE REACTIONS, Post-Market Adverse Drug Reactions**).

#### Serotonin Syndrome

Serotonin syndrome is a rare but potentially life-threatening condition resulting from concomitant administration of serotonergic drugs. Serotonin syndrome has been reported when methylphenidate was co-administered with serotonergic drugs such as selective serotonin reuptake inhibitors (SSRIs) and serotonin-norepinephrine reuptake inhibitors (SNRIs). Other common serotonergic drugs include: tricyclic antidepressants (TCAs), serotonin 5-HT<sub>1</sub> receptor agonists (triptans), and 5-HT<sub>3</sub> receptor antagonist antiemetics. The symptoms of serotonin syndrome may include mental status changes (e.g., agitation, hallucinations, delirium, and coma), autonomic instability (e.g., tachycardia, labile blood pressure, dizziness, diaphoresis, flushing, hyperthermia), neuromuscular symptoms (e.g., tremor, rigidity, myoclonus, hyperreflexia, incoordination), seizures, and/or gastrointestinal symptoms (e.g., nausea,

vomiting, diarrhea). If concomitant use of TEVA-METHYLPHENIDATE ER-C with a serotonergic drug is warranted, prompt recognition of the symptoms of serotonin syndrome is important so that treatment with methylphenidate and serotonergic drugs can be immediately discontinued and appropriate treatment instituted (see **DRUG INTERACTIONS, Drug-Drug Interactions**).

### **Sexual Function/Reproduction**

#### **Priapism**

Prolonged and painful erections requiring immediate medical attention (sometimes including surgical intervention), have been reported with methylphenidate products, including methylphenidate hydrochloride extended-release in both pediatric and adult patients (see **ADVERSE REACTIONS, Post-Market Adverse Drug Reactions**). Priapism can develop after some time on methylphenidate, often subsequent to an increase in dose. Priapism has also appeared during a period of methylphenidate withdrawal (drug holidays or during discontinuation). Patients who develop abnormally sustained erections or frequent and painful erections should seek immediate medical attention.

#### **Vascular**

##### **Peripheral Vasculopathy, Including Raynaud's Phenomenon**

Stimulants used to treat ADHD, such as methylphenidate hydrochloride extended-release, are associated with peripheral vasculopathy, including Raynaud's phenomenon. Signs and symptoms are usually intermittent and mild; however, very rare sequelae include digital ulceration and/or soft tissue breakdown. Effects of peripheral vasculopathy, including Raynaud's phenomenon, were observed in postmarketing reports at different times and at therapeutic doses in all age groups throughout the course of treatment. Signs and symptoms generally improve after reduction in dose or discontinuation of drug. Careful observation for digital changes is necessary during treatment with ADHD stimulants. Further clinical evaluation (e.g., rheumatology referral) may be appropriate for certain patients.

#### **Special Populations**

**Pregnant Women:** Methylphenidate hydrochloride has been shown to have teratogenic effects in rabbits when given in doses of 200 mg/kg/day, which is approximately 100 times and 40 times the maximum recommended human dose on a mg/kg and mg/m<sup>2</sup> basis, respectively.

A reproduction study in rats revealed no evidence of harm to the fetus at oral doses up to 30 mg/kg/day, approximately 15-fold and 3-fold the maximum recommended human dose of methylphenidate hydrochloride extended release on a mg/kg and mg/m<sup>2</sup> basis, respectively. The approximate plasma exposure to methylphenidate plus its main metabolite alpha-phenyl-2-piperidine acetic acid (PPAA) in pregnant rats was 2 times that seen in trials in volunteers and patients with the maximum recommended dose of methylphenidate hydrochloride extended release based on the AUC.

There are no adequate and well-controlled studies in pregnant women. TEVA-METHYLPHENIDATE ER-C should be used during pregnancy only if the potential benefit justifies the potential risk to the fetus.

**Nursing Women:** A study conducted in rats indicated that the distribution profiles of methylphenidate in milk and plasma are similar. Case reports showed that methylphenidate was distributed into breast milk reaching a milk-to-plasma ratio of up to approximately 2.7 (see **ACTION AND CLINICAL PHARMACOLOGY**)

There is one case report of an infant who experienced an unspecified decrease in weight during the period of exposure but recovered and gained weight after the mother discontinued treatment with methylphenidate. A risk to the suckling child cannot be excluded. A decision should be made whether to abstain from breast-feeding or to abstain from TEVA-METHYLPHENIDATE ER-C therapy, taking into account the benefit of breast-feeding to the child and the benefit of therapy to the mother.

**Pediatrics (< 6 years of age):**

TEVA-METHYLPHENIDATE ER-C should not be used in children under six years, since safety and efficacy in this age group have not been established. Long-term effects of methylphenidate in children have not been well established (see **WARNINGS AND PRECAUTIONS; Endocrine and Metabolism**).

**Monitoring and Laboratory Tests**

Periodic laboratory tests are advised during prolonged therapy. The tests should include, but not be limited to, haematological parameters, including complete blood count, differential and platelet counts, and liver enzymes.

**ADVERSE REACTIONS**

**Clinical Trial Adverse Drug Reactions**

*Because clinical trials are conducted under very specific conditions the adverse reaction rates observed in the clinical trials may not reflect the rates observed in practice and should not be compared to the rates in the clinical trials of another drug. Adverse drug reaction information from clinical trials is useful for identifying drug-related adverse events and for approximating rates.*

The development program for methylphenidate hydrochloride extended release included exposures of 321 pediatric patients, and 305 adult patients to the drug in placebo-controlled, double-blind trials, and 3590 pediatric and adult patients in open-label clinical trials. The patients in these studies received methylphenidate hydrochloride extended release 18, 36, 54 or 72 mg/day. Children, adolescents and adults with ADHD were evaluated in five placebo-controlled clinical studies (Studies 1, 2 and 3 in children; Study 4 in adolescents; Study 5 in adults), three open-label clinical trials and two open-label extensions. A limited number of adolescents and adults received methylphenidate hydrochloride extended release 72 mg/day (n=85) and 90 mg/day (n=41), respectively. Safety was assessed by collecting adverse events, results of physical examinations, vital signs, weights, laboratory analyses, and ECGs.

Adverse events during exposure were obtained primarily by general inquiry and recorded by clinical investigators using terminology of their own choosing. Consequently, it is not possible

to provide a meaningful estimate of the proportion of individuals experiencing adverse events without first grouping similar types of events into a smaller number of standardized event categories. In the tables and listings that follow, COSTART terminology has been used to classify reported adverse events, except for Study 5 in adults, where MedDRA terminology was used.

The stated frequencies of adverse events represent the proportion of individuals who experienced, at least once, a treatment-emergent adverse event of the type listed. An event was considered treatment emergent if it occurred for the first time or worsened while receiving therapy following baseline evaluation.

### Adverse Events Leading to Discontinuation of Treatment

#### *Placebo-controlled Trials*

In a 4-week placebo-controlled, parallel-group trial (Study 3), one patient treated with methylphenidate hydrochloride extended release (0.9%; 1/106), one methylphenidate t.i.d.-treated patient (0.9%; 1/107), and one placebo-treated patient (1.0%; 1/99) discontinued due to an adverse event (sadness, emotional lability, and increase in tics, respectively).

In the 2-week placebo-controlled phase of a trial in adolescents (Study 4), no patients treated with methylphenidate hydrochloride extended release (0%; 0/87) and 1 placebo-treated patient (1.1%; 1/90) discontinued due to an adverse event (increased mood irritability).

In the 5-week placebo-controlled phase of a trial in adults (Study 5), 0% (0/96) of the patients in the placebo group, 1.0% (1/101) of the patients in the methylphenidate hydrochloride extended release 18 mg dose group, 2.9% (3/102) of the patients in the methylphenidate hydrochloride extended release 36 mg dose group and 7.8% (8/102) of the patients in the methylphenidate hydrochloride extended release 72 mg dose group discontinued due to an adverse event.

#### *Open-Label Trials*

In two open-label, long-term safety trials (Studies 6 and 7), one study up to 27 months in children aged 6 to 13 and one study up to 9 months in child, adolescent and adult patients treated with methylphenidate hydrochloride extended release, 6.7% (101/1514) of patients discontinued due to adverse events. Those events leading to discontinuation of methylphenidate hydrochloride extended release, with an incidence of >0.5%, included: insomnia (1.5%), twitching (tics, 1.0%), nervousness (0.7%), emotional lability (0.7%), abdominal pain (0.7%), and anorexia (0.7%).

### Adverse Events Occurring in Patients Treated with Methylphenidate Hydrochloride Extended Release

Table 1.1 enumerates, for the 4-week placebo-controlled, parallel-group trial in children with ADHD at methylphenidate hydrochloride extended release doses of 18, 36, or 54 mg q.d., the incidence of treatment-emergent adverse events. The table includes only those events that occurred in 1% or more of patients treated with methylphenidate hydrochloride extended release, methylphenidate hydrochloride and placebo-treated patients.

**Table 1.1: Incidence (%) of Treatment-Emergent Events<sup>1</sup> in a 4-Week Placebo-Controlled Clinical Trial of Methylphenidate Hydrochloride Extended Release in Children**

Body Systems	Preferred Term <sup>2</sup>	Methylphenidate Hydrochloride Extended Release, q.d. (n = 106)	Methylphenidate hydrochloride t.i.d. (n = 107)	Placebo (n = 99)
<b>General</b>	Headache	14	6	10
	Abdominal pain	7	6	1
	Aggravation reaction	2	2	2
<b>Digestive</b>	Vomiting	4	2	3
	Anorexia	4	0	0
<b>Nervous</b>	Insomnia	4	1	1
	Dizziness	2	0	0
<b>Respiratory</b>	Upper respiratory tract infection	8	7	5
	Cough increased	4	8	2
	Pharyngitis	4	4	3
	Sinusitis	3	1	0

<sup>1</sup>Events, regardless of causality, for which the incidence for patients treated with methylphenidate hydrochloride extended release was at least 1%. Incidence greater than 1% has been rounded to the nearest whole number.

<sup>2</sup> COSTART terms

Table 1.2 lists the incidence of treatment-emergent adverse events for a 2-week placebo-controlled trial (Study 4) in adolescents with ADHD at methylphenidate hydrochloride extended release doses of 18, 36, 54 or 72 mg/day.

**Table 1.2: Incidence (%) of Treatment-Emergent Events<sup>1</sup> in a 2-Week Placebo-Controlled Clinical Trial of Methylphenidate Hydrochloride Extended Release in Adolescents**

Body Systems	Preferred Term <sup>2</sup>	methylphenidate hydrochloride extended release, q.d. (n=87)	Placebo (n=90)
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<b>General</b>	Abdominal Pain	2	2	
	Accidental Injury	6	3	
	Allergic Reaction	1	0	
	Asthenia	2	2	
	Chest Pain	1	0	
	Fever	3	0	
	Flu Syndrome	1	0	
	Headache	9	8	
	Infection	1	6	
	Pain	1	1	
<b>Digestive</b>	Anorexia	2	0	
	Diarrhoea	2	0	
	Dyspepsia	1	0	
	Gastrointestinal Disorder	1	0	
	Increased Appetite	1	0	
	Nausea	1	2	
	Tooth Caries	1	0	
	Vomiting	3	0	
	<b>Musculoskeletal</b>	Myalgia	1	0
		<b>Nervous</b>	Agitation	1
Anxiety	1		0	
Dizziness	1		0	
Insomnia	4		0	
Neurosis	1		1	
Tremor	1		0	
<b>Respiratory</b>	Pharyngitis		2	1
	Rhinitis		3	2
<b>Urogenital</b>	Dysmenorrhoea	2	0	

<sup>1</sup> Events, regardless of causality, for which the incidence for patients treated with methylphenidate hydrochloride extended release was at least 1%. Incidence has been rounded to the nearest whole number.

<sup>2</sup> COSTART terms

Table 1.3 lists the incidence of treatment-emergent adverse events for a 5-week placebo-controlled trial (Study 5) in adults with ADHD at methylphenidate hydrochloride extended release doses of 18, 36, or 72 mg/day.

**Table 1.3: Incidence (%) of Treatment-Emergent Events<sup>1</sup> in a 5-Week Placebo-Controlled Clinical Trial of Methylphenidate Hydrochloride Extended Release in Adults**

Body Systems	Preferred Term <sup>2</sup>	methylphenidate hydrochloride extended release			Placebo q.d. (n=96)
		18 mg q.d. (n=101)	36 mg q.d. (n=102)	72 mg q.d. (n=102)	
<b>Cardiac Disorders</b>	Palpitations	2	5	5	0
	Tachycardia	4	5	8	0
<b>Ear and Labyrinth Disorders</b>	Vertigo	2	3	2	0
<b>Gastrointestinal Disorders</b>	Abdominal Pain Upper	4	2	2	5
	Diarrhea	3	1	4	5
	Dry Mouth	8	7	21	2
	Hemorrhoids	0	0	4	0
	Nausea	8	16	15	4
<b>General Disorders and Administration Site Conditions</b>	Fatigue	4	4	6	6
<b>Infectious and Infestations</b>	Influenza	4	2	2	3

	Nasopharyngitis	7	8	4	9
<b>Investigations</b>	Weight Decreased	3	8	11	5
<b>Metabolism and Nutrition Disorders</b>	Decreased Appetite	20	22	34	7
<b>Nervous System Disorders</b>	Confusional State	0	3	1	0
	Dizziness	6	10	9	7
	Headache	26	21	17	18
	Initial Insomnia	3	2	5	2
	Insomnia	12	12	17	7
	Migraine	0	1	3	3
	Paresthesia	3	1	1	0
	Tremor	1	1	7	1
<b>Psychiatric Disorders</b>	Aggression	2	3	2	1
	Agitation	0	1	3	1
	Anxiety	3	5	8	1
	Attention Deficit/ Hyperactivity Disorder	0	0	4	0
	Depressed Mood	6	3	5	1
	Depression	0	3	4	1
	Irritability	4	4	9	1
	Nervousness	0	3	8	1
	Restlessness	0	2	6	0
	Tension	0	3	0	0
<b>Respiratory, Thoracic and Mediastinal Disorders</b>	Pharyngolaryngeal Pain	2	0	4	1
<b>Skin and Subcutaneous Tissue Disorders</b>	Hyperhidrosis	5	3	8	1
<b>Vascular Disorders</b>	Hypertension	0	1	4	4

<sup>1</sup> Events, regardless of causality, for which the incidence in any methylphenidate hydrochloride extended release dosage group was at least 2%. Incidence has been rounded to the nearest whole number.

<sup>2</sup> MedDRA Terms

### Adverse Events Occurring in Long-Term Safety Trials

Methylphenidate hydrochloride extended release was evaluated in two long-term open-label studies (n = 1514), one study up to 27 months in children aged 6 to 13 and one study up to 9 months in child, adolescent and adult patients. The adverse event profile seen is similar to that observed in shorter term trials. COSTART terminology is used to classify reported adverse experiences. The experiences are classified within body system categories and grouped by frequency.

**Table 1.4: Adverse Events Occurring in Long-Term Safety Trials**

Frequency	Very Frequent	Frequent		Less Frequent
Body System	>10% - <50%	5-10%	<5% and ≥1%	<1%
Body as a Whole	headache	accidental injury, abdominal pain, fever	flu syndrome, allergic reaction, infection, aggravation reaction, pain, extremity pain, back pain	surgery procedure, accidental overdose, chest pain, cyst, infection fungal, photosensitivity reaction, malaise, asthenia, neck pain
Cardiovascular System			hypertension	cardiovascular disorder, tachycardia, migraine
Digestive System		anorexia, vomiting	gastroenteritis, diarrhea, nausea, dyspepsia	rectal disorder, gastritis, increased appetite, nausea and vomiting, periodontal abscess, tongue disorder, tooth disorder, constipation
Endocrine System				diabetes mellitus
Hemic and Lymphatic System				ecchymosis, petechia, lymphadenopathy
Metabolic and Nutritional System			weight loss	dehydration
Musculoskeletal System			myalgia	arthralgia, leg cramps
Nervous System	insomnia		twitching, nervousness, emotional lability, anxiety, depression, somnolence, hostility, dizziness	apathy, neurosis, hallucinations, speech disorder, sleep disorder, tremor, thinking abnormal, abnormal dreams
Respiratory System	upper respiratory tract infection	pharyngitis, cough increased, rhinitis	sinusitis, respiratory disorder, asthma bronchitis, epistaxis	dyspnea, pneumonia, voice alterations, laryngitis
Skin System			rash, contact dermatitis	pustular rash, urticaria, eczema, pruritus, skin benign neoplasm, acne, alopecia, nail disorder, psoriasis, herpes simplex
Special Senses		otitis media	conjunctivitis	ear disorder, diplopia, ear pain
Urogenital System				albuminuria, urinary frequency, urinary tract infection, urinary urgency

### Tics

During two long-term, open-label studies, the overall incidence of tics (twitching) in children was 4.3% (48/1109 subjects). In one study, the incidence of tics rose from 3% at baseline to 5% after one month. The incidence remained the same during the rest of the study. The treatment period was up to 27 months with a mean treatment duration of 10.3 months.

In a long-term study of up to 9 months of treatment, the incidence of tics was 0.4% (1/269) in adolescents and 0.7% (1/136) in adults.

### Open-Label Adult Trials

In addition to the adverse events listed above, the following ADRs were reported in adult patients treated with methylphenidate hydrochloride extended release in open-label clinical trials of up to one year.

**Table 1.5: Adverse Drug Reactions reported by Methylphenidate Hydrochloride Extended Release -Treated Subjects in 5 Open-Label Clinical Trials of Adult Subjects**

Frequency Body System	Very Frequent		Frequent	Less Frequent
	>10% - <50%	5 - 10%	<5% and ≥1%	<1%
Blood and Lymphatic System Disorders				leucopenia
Cardiac Disorders			palpitations	
Eye Disorders			vision blurred	accommodation disorder, dry eye
Gastrointestinal Disorders	dry mouth		abdominal pain upper, abdominal discomfort	
General Disorders and Administration Site Conditions		irritability, fatigue	feeling jittery, pyrexia	thirst
Infections and Infestations		nasopharyngitis		
Investigations		blood pressure increased, heart rate increased		alanine aminotransferase increased
Metabolism and Nutrition Disorders	decreased appetite			
Musculoskeletal and Connective Tissue Disorders			muscle spasms, muscle tightness	
Nervous System Disorder			psychomotor hyperactivity, paraesthesia	tension headache, sedation, lethargy
Psychiatric disorders		restlessness	agitation, depressed mood, initial insomnia, libido decreased	affect lability, aggression, anger, bruxism, hypervigilance, mood altered, mood swings, panic attack, tearfulness, tension, confusional state
Reproductive system and Breast Disorders			erectile dysfunction	
Respiratory, Thoracic and Mediastinal Disorders			oropharyngeal pain	
Skin and Subcutaneous Tissue Disorder			hyperhidrosis	
Vascular Disorders				hot flush

All Clinical Trials (including open-labels trials, adult and pediatric)

Logorrhea was observed as an uncommon adverse reaction.

### **Post-Market Adverse Drug Reactions**

Adverse events identified during post-marketing experience with methylphenidate hydrochloride extended release are included in Table 1.6.

In each table, the frequencies are provided according to the following convention:

Very common	≥1/10
Common	≥1/100 to <1/10
Uncommon	≥1/1,000 to <1/100
Rare	≥1/10,000 to <1/1,000
Very rare	<1/10,000, including isolated reports

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**Table 1.6 Adverse Events Identified During Post-marketing Experience with methylphenidate hydrochloride extended release**

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#### **Blood and Lymphatic System Disorders**

*Very rare* Pancytopenia, Thrombocytopenia, Thrombocytopenic purpura, Aplastic anemia

#### **Cardiac Disorders**

*Very rare* Arrhythmia

#### **Immune System Disorders**

*Rare* Hypersensitivity reactions such as Angioedema, Anaphylactic reactions, Auricular swelling, Bullous conditions, Exfoliative conditions, Urticarias, Pruritus NEC, Rashes, Eruptions and Exanthemas NEC, Serum sickness

#### **Psychiatric Disorders**

*Very rare* Disorientation, Hallucination, Hallucination auditory, Hallucination visual, Mania, Complete Suicide, Suicide ideation, Suicide attempt, Psychotic disorder, Logorrhea, Libido disorder

#### **Nervous System Disorders**

*Very rare* Convulsion, Grand mal convulsion, Dyskinesia

#### **Eye Disorders**

*Very rare* Diplopia, Mydriasis, Visual impairment

#### **Cardiac Disorders**

*Very rare* Angina pectoris, Bradycardia, Extrasystoles, Supraventricular tachycardia, Ventricular extrasystoles

#### **Vascular Disorders**

*Very rare* Raynaud's phenomenon

#### **Hepatobiliary Disorders**

*Very rare* Blood alkaline phosphatase increased, Blood bilirubin increased, Hepatic enzyme increased, Hepatocellular injury, Acute hepatic failure

#### **Skin and Subcutaneous Tissue Disorders**

*Very rare* Alopecia, Erythema, Dermatitis exfoliative, Stevens-Johnson Syndrome

#### **Musculoskeletal and Connective Tissue Disorders**

*Very rare* Arthralgia, Myalgia, Muscle twitching

#### **Reproductive System and Breast Disorders**

*Very Rare* Priapism

#### **General Disorders and Administration Site Conditions**

*Rare* Therapeutic response decreased

*Very rare* Chest pain, Chest discomfort, Drug effect decreased, Hyperpyrexia, Sudden cardiac death

#### **Investigations**

*Very rare* Platelet count decreased, White blood cell count abnormal

#### **Gastrointestinal Disorders**

*Very rare* Pancreatitis

#### **Endocrine Disorders**

*Very rare* Hypoglycemia

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### **Adverse Events with Other Methylphenidate Hydrochloride Products**

Nervousness and insomnia are the most common adverse reactions reported with other methylphenidate products. Other reactions include hypersensitivity (including skin rash, urticaria, fever, arthralgia, exfoliative dermatitis, erythema multiforme with histopathological findings of necrotizing vasculitis, and thrombocytopenic purpura); anorexia; nausea; dizziness; headache; dyskinesia; drowsiness; blood pressure and pulse changes, both up and down; tachycardia; angina; abdominal pain and weight loss during prolonged therapy. There have been rare reports of Tourette's syndrome. Toxic psychosis has been reported. Although a definite causal relationship has not been established, the following have been reported in patients taking this drug: instances of abnormal liver function, e.g., hepatic coma; isolated cases of cerebral arteritis and/or occlusion; leukopenia and/or anemia; transient depressed mood; and a few instances of scalp hair loss. There have been reports of serotonin syndrome following coadministration of methylphenidate with serotonergic drugs. Very rare reports of neuroleptic malignant syndrome (NMS) have been received, and in most of these, patients were concurrently receiving therapies associated with NMS. In a single report, a ten-year-old boy who had been taking methylphenidate for approximately 18 months experienced an NMS-like event within 45 minutes of ingesting his first dose of venlafaxine. It is uncertain whether this case represented a drug-drug interaction, a response to either drug alone, or some other cause.

### **Suicidal Behaviour and Ideation**

There have been post-marketing reports of suicide-related events, including completed suicide, suicide attempt, and suicidal ideation in patients treated with ADHD drugs. In some of these reports, comorbid conditions may have contributed to the event. (see **WARNINGS AND PRECAUTIONS, Suicidal Behaviour and Ideation**)

## **DRUG INTERACTIONS**

### **Overview**

Alcohol may exacerbate the CNS adverse effect of psychoactive drugs. Therefore, patients undergoing TEVA-METHYLPHENIDATE ER-C therapy should be advised to avoid alcohol during treatment.

Because of possible increases in blood pressure and heart rate, TEVA-METHYLPHENIDATE ER-C should be used cautiously with drugs with similar pharmacological actions.

### **Drug-Drug Interactions**

**Inhibition of Drug Metabolism by Methylphenidate** Human pharmacologic studies have shown that methylphenidate may inhibit the metabolism of coumarin anticoagulants (e.g., warfarin), anticonvulsants (e.g., phenobarbital, phenytoin, primidone) and some antidepressants (tricyclics)

and selective serotonin reuptake inhibitors). Downward dose adjustment of these drugs may be required when given concomitantly with methylphenidate. It may be necessary to adjust the dosage and monitor plasma drug concentrations (or, in the case of coumarin, coagulation times) when initiating or discontinuing concomitant methylphenidate.

#### Monoamine Oxidase Inhibitors

Methylphenidate is contraindicated during treatment with monoamine oxidase inhibitors, and also within a minimum of 14 days following discontinuation of a monoamine oxidase inhibitor (hypertensive crises may result). The same precautions apply to TEVA-METHYLPHENIDATE ER-C (see **CONTRAINDICATIONS**).

#### Serotonergic Drugs

There have been reports of serotonin syndrome following coadministration of methylphenidate with serotonergic drugs. If concomitant use of TEVA-METHYLPHENIDATE ER-C with a serotonergic drug is warranted, prompt recognition of the symptoms of serotonin syndrome is important. TEVA-METHYLPHENIDATE ER-C must be discontinued as soon as possible if serotonin syndrome is suspected.

#### Clonidine

Serious adverse events, including sudden death, have been reported in concomitant use with clonidine. In these cases, no causality for the combination could be established because of insufficient data.

#### Drug-Food Interactions

There are no known food interactions with methylphenidate hydrochloride extended release.

#### Drug-Herb Interactions

Interactions with herbal products have not been established.

#### Drug-Laboratory Interactions

Interactions with laboratory tests have not been established.

### **DOSAGE AND ADMINISTRATION**

#### Dosing Considerations

TEVA-METHYLPHENIDATE ER-C should be administered starting at the lowest possible dose. Dosage should then be individually and slowly adjusted, to the lowest effective dosage, since individual patient response to methylphenidate hydrochloride extended release varies widely.

TEVA-METHYLPHENIDATE ER-C should not be used in patients with symptomatic cardiovascular disease and should generally not be used in patients with known structural cardiac abnormalities (see **CONTRAINDICATIONS** and **WARNINGS AND PRECAUTIONS**).

Children: Theoretically there exists a pharmacological potential for all ADHD drugs to increase the risk of sudden/cardiac death. Although confirmation of an incremental risk for sudden/cardiac death arising from treatment with ADHD medications is lacking, prescribers should consider this potential risk.

All drugs with sympathomimetic effects prescribed in the management of ADHD should be used with caution in patients who: a) are involved in strenuous exercise or activities, b) use other sympathomimetic ADHD drugs or c) have a family history of sudden/cardiac death. Prior to the initiation of treatment with sympathomimetic medications, a personal and family history (including assessment for a family history of sudden death or ventricular arrhythmia) and physical exam should be obtained to assess for the presence of cardiac disease. In patients with relevant risk factors and based on the clinician's judgment, further cardiovascular evaluation may be considered (e.g., electrocardiogram and echocardiogram). Patients who develop symptoms such as exertional chest pain, unexplained syncope, or other symptoms suggestive of cardiac disease during ADHD treatment should undergo a prompt cardiac evaluation. Patients who are considered to need extended treatment with TEVA-METHYLPHENIDATE ER-C should undergo periodic evaluation of their cardiovascular status (see **WARNINGS AND PRECAUTIONS**).

### **Recommended Dose and Dosage Adjustment**

#### **General**

TEVA-METHYLPHENIDATE ER-C should be administered orally once daily in the morning, with or without food. For patients new to methylphenidate, the starting dose for TEVA-METHYLPHENIDATE ER-C should be 18 mg daily. For patients currently on a methylphenidate-based product, see the conversion table below.

#### **Dose Selection**

##### **Patients New to Methylphenidate**

The recommended starting dose of TEVA-METHYLPHENIDATE ER-C for patients who are not currently taking methylphenidate, or for patients who are on stimulants other than methylphenidate, is 18 mg once daily for all age groups.

**Table 1.7: Recommended starting dose and maximum dosage of TEVA-METHYLPHENIDATE ER-C for patients new to methylphenidate**

<b>Patient Age</b>	<b>Recommended Starting Dose</b>	<b>Maximum Dosage</b>
Children (6-12 years of age)	18 mg/day	54 mg/day
Adolescents (13-18 years of age)	18 mg/day	54 mg/day
Adults (>18 years of age)	18 mg/day	72 mg/day

A limited number of adolescents have been treated with methylphenidate hydrochloride extended release 72 mg/day in the open-label extension of Study 4 (n = 62). A limited number of adults have been treated with doses above the recommended maximum daily dose, up to 90 mg/day (n=41 in Study 5).

##### **Patients Currently Using Methylphenidate Hydrochloride**

The recommended conversion dose of TEVA-METHYLPHENIDATE ER-C for patients who are currently taking methylphenidate hydrochloride b.i.d., t.i.d., or sustained-release (SR) at doses of 10 to 60 mg/day is provided in Table 1.8. Dosing recommendations are based on current dose regimen and clinical judgment.

**Table 1.8: Recommended Dose Conversion from Methylphenidate Hydrochloride Regimens to TEVA-METHYLPHENIDATE ER-C**

Previous Methylphenidate Hydrochloride Daily Dose	Recommended TEVA-METHYLPHENIDATE ER-C Conversion Dose
5 mg methylphenidate hydrochloride b.i.d./t.i.d. or 20 mg methylphenidate hydrochloride SR	18 mg q. a.m.
10 mg methylphenidate hydrochloride b.i.d./t.i.d. or 40 mg methylphenidate hydrochloride SR	36 mg q. a.m.
15 mg methylphenidate hydrochloride b.i.d./t.i.d. or 60 mg methylphenidate hydrochloride SR	54 mg q. a.m.
20 mg methylphenidate hydrochloride b.i.d./t.i.d.	72 mg q. a.m.

A dosage strength of 27 mg is available for physicians who wish to prescribe between the 18 mg and 36 mg dosages.

#### Dose Titration

Dosage should be individualized according to the needs and responses of the patient. Based on an assessment of clinical benefit and tolerability, doses may be adjusted at weekly intervals for patients who have not achieved an optimal response.

#### Maintenance/Extended Treatment

There is no evidence available from controlled trials to indicate how long the patient with ADHD should be treated with methylphenidate hydrochloride extended release tablets. It is generally agreed that pharmacological treatment of ADHD may be needed for extended periods. The physician who elects to use TEVA-METHYLPHENIDATE ER-C for extended periods in patients with ADHD should periodically re-evaluate the long-term usefulness of the drug for the individual patient with trials off medication to assess the patient's functioning without pharmacotherapy.

#### Dose Reduction and Discontinuation

If paradoxical aggravation of symptoms or other adverse events occur, the dosage should be reduced or, if necessary, the drug should be discontinued.

If improvement is not observed after appropriate dosage adjustment over a one-month period, the drug should be discontinued.

#### Administration

TEVA-METHYLPHENIDATE ER-C tablets must be swallowed whole with liquids, and must not be chewed, divided or crushed. In dogs, the intravenous injection of the pulverized

methylphenidate hydrochloride extended release tablets resulted in death (see **Product Monograph Part II: TOXICOLOGY, Acute Toxicity**).

## OVERDOSAGE

**For management of a suspected drug overdose, contact your regional Poison Control Centre immediately.**

### **Signs and Symptoms**

Signs and symptoms of methylphenidate hydrochloride overdose, resulting principally from overstimulation of the CNS and from excessive sympathomimetic effects, may include the following: vomiting, agitation, muscle twitching, convulsion, grand mal convulsions, confusional state, hallucination (auditory and/or visual), hyperhidrosis, headache, pyrexia, tachycardia, palpitations, heart rate increased, sinus arrhythmia, hypertension, mydriasis and dry mouth.

### **Recommended Treatment**

Treatment consists of appropriate supportive measures. The patient must be protected against self-injury and against external stimuli that would aggravate the overstimulation already present. The efficacy of activated charcoal has not been established. Intensive care must be provided to maintain adequate circulation and respiratory exchange; external cooling procedures may be required for pyrexia.

Efficacy of peritoneal dialysis or extracorporeal hemodialysis for methylphenidate hydrochloride extended release overdose has not been established. The prolonged release of methylphenidate from TEVA-METHYLPHENIDATE ER-C tablets should be considered when treating patients with overdose. Alcohol may induce the production of ethylphenidate. The amount of ethylphenidate production is proportional to the blood alcohol concentration (see **DRUG INTERACTIONS**; Overview). As with the management of all overdose, the possibility of multiple drug ingestion, including alcohol, should be considered.

## ACTION AND CLINICAL PHARMACOLOGY

### **Mechanism of Action**

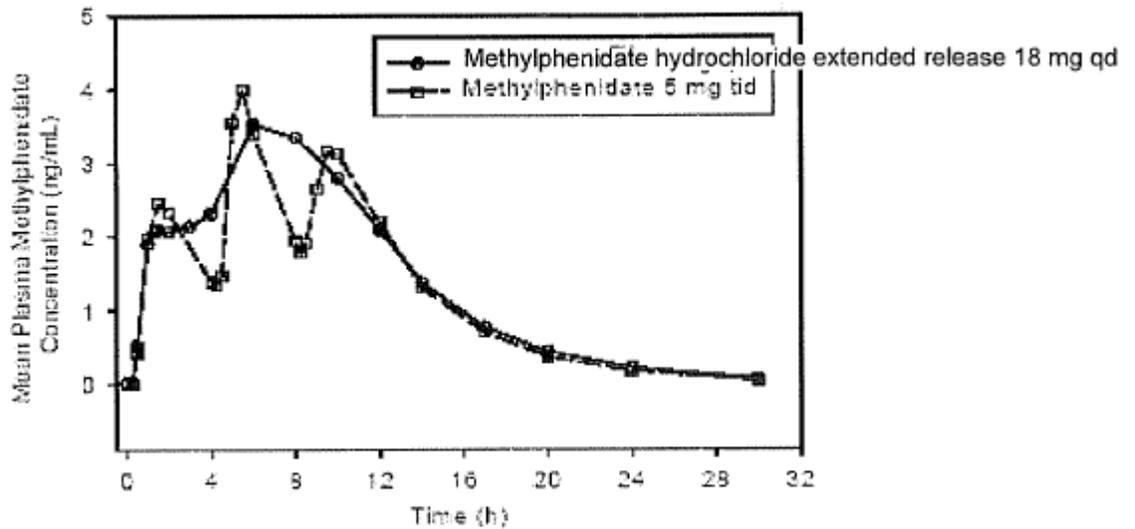
Methylphenidate hydrochloride is a central nervous system (CNS) stimulant. The mechanism of action on the CNS is not completely understood, but methylphenidate is thought to block the reuptake of dopamine and norepinephrine into the presynaptic neuron and increase the release of these monoamines into the extraneuronal space.

### **Pharmacodynamics**

Methylphenidate is a racemic mixture comprised of the *d*- and *l*-isomers. The *d*-isomer is pharmacologically active; the *l*-isomer has little pharmacologic activity. Following administration of methylphenidate hydrochloride extended release, plasma concentrations of the *l*-isomer were approximately 1/40th the plasma concentrations of the *d*-isomer.

## Pharmacokinetics

**Absorption:** Methylphenidate is readily absorbed. Following oral administration of methylphenidate hydrochloride extended release, plasma methylphenidate concentrations reach an initial maximum at about 1 hour followed by gradual ascending concentrations over the next 5 to 9 hours. Mean times to reach peak plasma concentrations across all doses of methylphenidate hydrochloride extended release occurred between 6 to 10 hours. Methylphenidate hydrochloride extended release once daily (q.d.) minimizes the fluctuations between peak and trough concentrations associated with multiple doses of immediate-release methylphenidate treatments (see Figure 1.1). The relative bioavailability of methylphenidate hydrochloride extended release q.d. and methylphenidate three times a day (t.i.d.) in adults is comparable.



**Figure 1.1:** Mean methylphenidate plasma concentrations in 36 fasted adults, following a single dose of methylphenidate hydrochloride extended release 18 mg q.d. and immediate-release methylphenidate hydrochloride 5 mg t.i.d. administered every 4 hours.

### Children (single dose)

The mean pharmacokinetic parameters in 13 children 7 to 12 years of age following administration of methylphenidate hydrochloride extended release 18, 36 or 54 mg are summarized in Table 1.9.

**Table 1.9: Pharmacokinetic Parameters in Children after single dosing (Mean ± SD)**

Parameters	Methylphenidate Hydrochloride Extended Release	Methylphenidate Hydrochloride Extended Release	Methylphenidate Hydrochloride Extended Release
	18 mg (n = 3)	36 mg (n = 7)	54 mg (n = 3)
<b>C<sub>max</sub> (ng/mL)</b>	6.0 ± 1.3	11.3 ± 2.6	15.0 ± 3.8
<b>T<sub>max</sub> (h)</b>	9.4 ± 0.02	8.1 ± 1.1	9.1 ± 2.5
<b>AUC<sub>0-11.5</sub> (ng·h/mL)#</b>	50.4 ± 7.8	87.7 ± 18.2	121.5 ± 37.3

# limited blood sampling

Adolescents (steady-state)

The pharmacokinetics of methylphenidate were evaluated in adolescents 13 to 16 years of age with ADHD following steady-state dosing with methylphenidate hydrochloride extended release 36 mg, 54 mg, or 72 mg. The mean pharmacokinetic parameters are summarized in Table 1.10.

**Table 1.10: Pharmacokinetic Parameters in Adolescents at steady-state (Mean ± SD)**

Parameters	Methylphenidate Hydrochloride Extended Release	Methylphenidate Hydrochloride Extended Release	Methylphenidate Hydrochloride Extended Release
	36 mg (n = 10)	54 mg (n = 8)	72 mg* (n = 6)
<b>C<sub>max</sub> (ng/mL)</b>	9.9 ± 5.5	12.8 ± 3.4	17.8 ± 4.5
<b>T<sub>max</sub> (h)</b>	7.0 ± 2.1	6.8 ± 1.7	7.0 ± 1.8
<b>AUC<sub>inf</sub> (ng·h/mL)</b>	112 ± 55.9	141 ± 34.3	186 ± 33.9
<b>t<sub>1/2</sub> (h)</b>	4.3 ± 2.0	3.6 ± 0.5	3.5 ± 0.5

\* Not recommended. In the clinical study, only 62 adolescents received methylphenidate hydrochloride extended release at this dose level.

Adults

The mean single dose pharmacokinetic parameters in 36 healthy adults following the administration of methylphenidate hydrochloride extended release 18 mg q.d. and methylphenidate hydrochloride 5 mg t.i.d. are summarized in Table 1.11.

**Table 1.11: Pharmacokinetic Parameters in Adult Subjects after Single Dosing (Mean ± SD)**

Parameters	Methylphenidate Hydrochloride Extended Release (18 mg q.d.) (n = 36)	Methylphenidate Hydrochloride (5 mg t.i.d.) (n = 35)
C <sub>max</sub> (ng/mL)	3.7 ± 1.0	4.2 ± 1.0
T <sub>max</sub> (h)	6.8 ± 1.8	6.5 ± 1.8
AUC <sub>inf</sub> (ng·h/mL)	41.8 ± 13.9	38.0 ± 11.0
T <sub>½</sub> (h)	3.5 ± 0.4	3.0 ± 0.5

The mean single dose and steady-state pharmacokinetic parameters in 25 healthy adults following the administration of methylphenidate hydrochloride extended release 54 and 72 mg q.d. are summarized in Table 1.12.

Table 1.12: Pharmacokinetic Parameters in Adult Subjects Following Single Dose and at Steady-State (Mean ± SD)		
Parameters	Methylphenidate Hydrochloride Extended Release	
	54 mg (n = 25)	72 mg (n = 25)
<b>Single Dose</b>		
C <sub>max</sub> (ng/mL)	12.03 ± 3.54	17.12 ± 5.80
T <sub>max</sub> <sup>a</sup> (h)	6 (1-10)	6 (5-10)
AUC <sub>inf</sub> (ng·h/mL)	130 ± 32.4	196 ± 65.7
T <sub>½</sub> (h)	3.58 ± 0.629	3.57 ± 0.617
<b>Steady State</b>		
C <sub>max</sub> (ng/mL)	12.45 ± 2.84	16.12 ± 4.60
T <sub>max</sub> <sup>a</sup> (h)	6 (1-10)	6 (5-8)
AUC <sub>tau</sub> (ng·h/mL)	139 ± 33.6 <sup>b</sup>	185 ± 49.0
T <sub>½</sub> (h)	3.60 ± 0.844	3.63 ± 0.49

<sup>a</sup> median and range are listed

<sup>b</sup> N = 24

**Distribution:** Plasma methylphenidate concentrations in adults decline bi-exponentially following oral administration. The half-life of methylphenidate in adults following oral administration of methylphenidate hydrochloride extended release was approximately 3.5 h. In humans, 15 ± 5% of methylphenidate in the blood is bound to plasma proteins.

**Metabolism and Excretion:** In humans, methylphenidate is metabolized primarily by de-esterification to PPAA, which has little pharmacologic activity. In adults the metabolism of methylphenidate hydrochloride extended release q.d., as evaluated by metabolism to PPAA, is similar to that of methylphenidate t.i.d. The metabolism of single and repeated q.d. doses of methylphenidate hydrochloride extended release is similar. After oral dosing of radio-labelled methylphenidate in humans, about 90% of the radioactivity was recovered in urine. The main urinary metabolite was PPAA, accounting for approximately 80% of the dose (see **ACTION AND CLINICAL PHARMACOLOGY; Special Populations and Conditions, Renal Insufficiency**).

### **Dose Proportionality**

Following administration of methylphenidate hydrochloride extended release in single doses of 18, 36, and 54 mg/day to healthy adults,  $C_{\max}$  and  $AUC_{(0-\text{inf})}$  of d-methylphenidate were proportional to dose, whereas l-methylphenidate  $C_{\max}$  and  $AUC_{(0-\text{inf})}$  increased disproportionately with respect to dose. Following administration of methylphenidate hydrochloride extended release, plasma concentrations of the l-isomer were approximately 1/40th the plasma concentrations of the d-isomer.

In a multiple-dose study in adolescent ADHD patients aged 13 to 16 administered their prescribed dose (18 to 72 mg/day) of methylphenidate hydrochloride extended release, mean  $C_{\max}$  and  $AUC_{\text{tau}}$  of *d*- and total methylphenidate increased proportionally with respect to dose.

### **Food Effects**

In patients, there were no differences in either the pharmacokinetics or the pharmacodynamic performance of methylphenidate hydrochloride extended release when administered after a high-fat breakfast. There is no evidence of dose dumping in the presence or absence of food.

### **Special Populations and Conditions**

**Gender:** In healthy adults, the mean dose-adjusted  $AUC_{(0-\text{inf})}$  values for methylphenidate hydrochloride extended release were 36.7 ng•h/mL in men and 37.1 ng•h/mL in women, with no differences noted between the two groups.

**Race:** In adults receiving methylphenidate hydrochloride extended release tablets, dose-adjusted  $AUC_{(0-\text{inf})}$  was consistent across ethnic groups; however, the sample size may have been insufficient to detect ethnic variations in pharmacokinetics.

**Age:** The pharmacokinetics of methylphenidate hydrochloride extended release have not been studied in children less than 6 years of age, and TEVA-METHYLPHENIDATE ER-C should not be used in this patient population. There are no data available for the use of methylphenidate hydrochloride extended release in patients over 65 years of age.

**Hepatic Insufficiency:** Methylphenidate hydrochloride extended release has not been studied in patients with hepatic insufficiency.

**Renal Insufficiency:** There is very limited experience with the use of methylphenidate in patients with renal insufficiency. Renal clearance is not significant for methylphenidate elimination, but the main methylphenidate metabolic product, PPAA, is predominantly (80%) cleared through the urine.

**Nursing Women:** Methylphenidate excretion into breast milk has been noted in two case reports, where the calculated relative infant dose was  $\leq 0.2\%$  of the weight adjusted maternal dose.

## STORAGE AND STABILITY

Store at controlled room temperature (15-30°C). Protect from moisture.

## DOSAGE FORMS, COMPOSITION AND PACKAGING

### Dosage Forms and Packaging

TEVA-METHYLPHENIDATE ER-C Extended-release Tablets contain methylphenidate hydrochloride as the medicinal ingredient and are available in 18 mg, 27 mg, 36 mg and 54 mg dosage strengths.

- 18 mg: Yellow, capsule-shaped, film-coated, extended release tablets, engraved with **N** on one side and **18** on the other side.
- 27 mg: Grey, capsule-shaped, film-coated, extended release tablets, engraved with **N** on one side and **27** on the other side.
- 36 mg: White to off-white, capsule-shaped, film-coated, extended release tablets, engraved with **N** on one side and **36** on the other side.
- 54 mg: Brownish-red, capsule-shaped, film-coated, extended release tablets, engraved with **N** on one side and **54** on the other side.

All dosage strengths are supplied in bottles containing 100 and 500 tablets. In clinical studies, a dose of 72 mg was achieved by taking two 36 mg tablets. There is no 72 mg tablet available.

### Composition

TEVA-METHYLPHENIDATE ER-C contains the following non-medicinal ingredients: hydroxypropyl methylcellulose, lactose monohydrate, microcrystalline cellulose, polyvinyl alcohol- polyethylene glycol copolymer and colloidal silica, simethicone and stearic acid.

Colourants present in the tablets are:

- 18 mg: D&C Yellow #10 aluminum lake, FD&C Red #40 aluminum lake, iron oxide yellow, polyethylene glycol, polyvinyl alcohol, talc and titanium dioxide.
- 27 mg: iron oxide black, polyethylene glycol, polyvinyl alcohol, talc and titanium dioxide.
- 36 mg: polyethylene glycol, polyvinyl alcohol, talc and titanium dioxide.
- 54 mg: hydroxypropyl methylcellulose, iron oxide yellow, iron oxide red, polyethylene glycol and titanium dioxide.

## PART II: SCIENTIFIC INFORMATION

### PHARMACEUTICAL INFORMATION

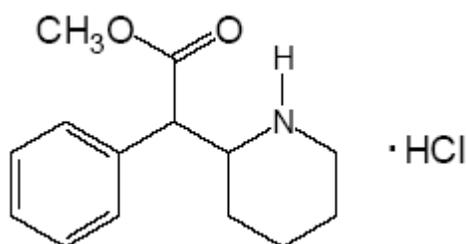
#### Drug Substance

Proper name: methylphenidate hydrochloride USP

Chemical name: Methyl- $\alpha$ -phenyl-2-piperidineacetate hydrochloride, (R\*, R\*)-(±)

Molecular formula and molecular mass: C<sub>14</sub>H<sub>19</sub>NO<sub>2</sub> • HCl 269.8 g/mol

Structural formula:



Physicochemical properties: methylphenidate hydrochloride USP is a white crystalline powder

pH: methylphenidate hydrochloride solutions are acidic to litmus

pKa: 8.8

Solubility: freely soluble in water and in methanol, soluble in alcohol, and slightly soluble in chloroform and in acetone

Melting Point: 224°C to 226°C

## CLINICAL TRIALS

### Comparative Bioavailability Study

A randomized, single-dose, three-period, three-treatment crossover comparative bioavailability study of Teva-Methylphenidate ER-C 54 mg tablets (Teva Canada Limited, Canada) and Concerta™ 54 mg ER tablets (Janssen-Ortho Inc., Canada) was conducted in 24 healthy adult male and female subjects. A summary of the comparative bioavailability data assessed under fed conditions is tabulated below:

Methylphenidate (1 x 54 mg ) From measured data <b>uncorrected for potency</b> Geometric Mean Arithmetic Mean (CV %)				
Parameter	Test*	Reference†	% Ratio of Geometric Means	Confidence Interval, 90%
AUC <sub>t</sub> (ng*h/mL)	170.440 179.811 (36)	161.974 171.358 (37)	105.23	100.80 – 109.85
AUC <sub>24</sub> (ng*h/mL)	169.103 178.084 (35)	160.552 169.435 (36)	105.33	100.95 – 109.90
AUC <sub>inf</sub> (ng*h/mL)	175.125 184.403 (35)	166.194 175.562 (36)	105.37	101.06 – 109.87
C <sub>max</sub> (ng/mL)	18.719 19.433 (29)	15.878 16.709 (36)	117.90	110.17 – 126.17
T <sub>max</sub> <sup>§</sup> (h)	4.61 (21)	7.58 (26)		
T <sub>½</sub> <sup>§</sup> (h)	4.02 (25)	3.70 (18)		

\* Teva-Methylphenidate ER-C 54mg tablets (Teva Canada Limited, Canada)

† Concerta™ 54mg ER tablets (Janssen-Ortho Inc., Canada, purchased in Canada)

§ Expressed as the arithmetic mean (CV%) only

A randomized, single-dose, two-period, two-treatment crossover comparative bioavailability study of Teva-Methylphenidate ER-C 54 mg tablets (Teva Canada Limited, Canada) and Concerta™ 54 mg ER tablets (Janssen-Ortho Inc., Canada) was conducted in 25 healthy adult male and female subjects. A summary of the comparative bioavailability data assessed under fasting conditions is tabulated below:

Methylphenidate (1 x 54 mg) From measured data <b>uncorrected for potency</b> Geometric Mean Arithmetic Mean (CV %)				
Parameter	Test*	Reference†	% Ratio of Geometric Means	Confidence Interval, 90%
AUC <sub>t</sub> (ng*h/mL)	131.848 139.785 (38)	132.231 139.495 (36)	99.71	94.87 – 104.80
AUC <sub>inf</sub> (ng*h/mL)	137.782 145.888 (37)	137.795 145.774 (35)	99.99	95.27 – 104.94
C <sub>max</sub> (ng/mL)	15.308 15.946 (31)	13.903 14.452 (29)	110.10	104.22 – 116.32
T <sub>max</sub> <sup>§</sup> (h)	3.81 (28)	7.20 (22)		
T <sub>1/2</sub> <sup>§</sup> (h)	5.13 (22)	3.98 (25)		

\* Teva-Methylphenidate ER-C 54mg tablets (Teva Canada Limited, Canada)

† Concerta™ 54mg ER tablets (Janssen-Ortho Inc., Canada, purchased in Canada)

§ Expressed as the arithmetic mean (CV%) only

Methylphenidate hydrochloride extended release was demonstrated to be effective in the treatment of ADHD in five randomized, double-blind, placebo-controlled studies in children, adolescents and adults who met the Diagnostic and Statistical Manual 4th edition (DSM-IV) criteria for ADHD.

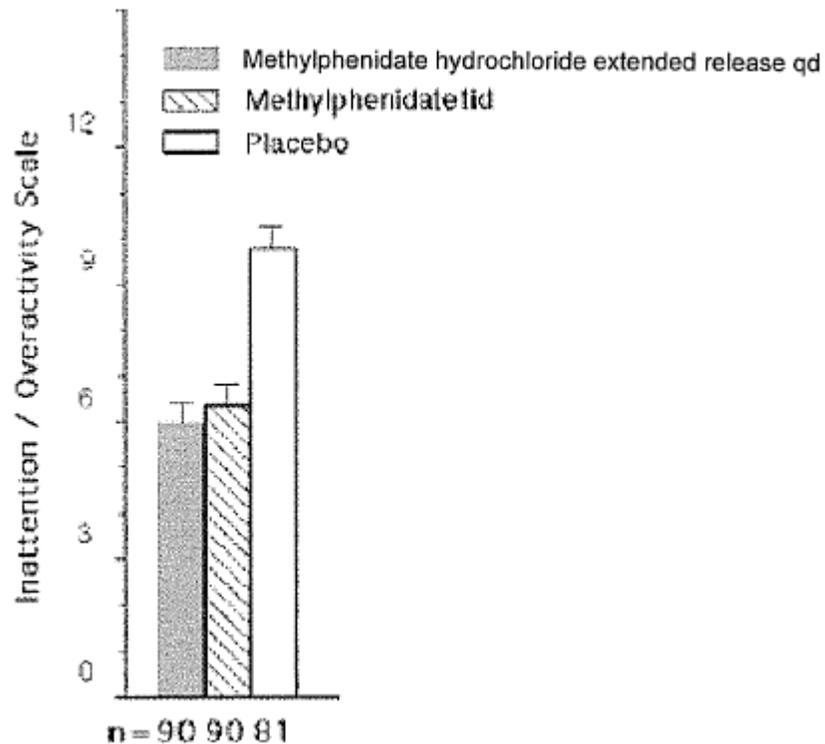
## Study Demographics and Designs

<b>Table 2.1: Demographics and Designs for Controlled Clinical Trials in Patients with ADHD</b>					
<b>Study</b>	<b>Design</b>	<b>Methylphenidate Hydrochloride Extended Release</b>  <b>Dose/Treatment Duration</b>	<b># of Patients</b>	<b>Mean Age</b>  <b>(years)</b> <b>[Range]</b>	<b>Primary Efficacy Variable</b>
<b>Controlled Studies in Children</b>					
Study 1	Double-blind, randomized, 3-period, 6-sequence crossover, placebo-controlled, comparative vs. IR methylphenidate	18, 36 or 54 mg once daily	64	9.2 [6-12]	IOWA Conners Rating scale for inattention/overactivity
Study 2	Double-blind, randomized, placebo-controlled, active-controlled, crossover, comparative vs. IR methylphenidate	18, 36 or 54 mg once daily	70	9.1 [6-12]	IOWA Conners Rating scale for inattention/overactivity
Study 3	Double-blind, randomized, placebo-controlled, active-controlled, parallel group vs. IR methylphenidate	18, 36 or 54 mg once daily	282	8.7 [6-12]	IOWA Conners Rating scale for inattention/overactivity
<b>Controlled Studies in Adolescents</b>					
Study 4	Double-blind, randomized, placebo-controlled	titration to 72 mg once daily	220	14.7 [13-18]	Investigator ADHD rating scale
<b>Controlled Studies in Adults</b>					
Study 5	Double-blind, randomized, placebo-controlled, parallel group, dose-response	fixed doses of 18, 36 and 72 mg once daily	401	34.0 [18-63]	Investigator-rated Connors Adult ADHD Rating Scale (CAARS) total score

### Children

Three double-blind, active- and placebo-controlled studies were conducted in 416 children aged six to twelve. The controlled studies compared methylphenidate hydrochloride extended release q.d. (18, 36 or 54 mg), methylphenidate hydrochloride t.i.d. over 12 hours (15, 30 or 45 mg total daily dose), and placebo in two single-centre, 3-week, crossover studies (Study 1 and Study 2) and in a multicentre, 4-week, parallel-group comparison (Study 3). The primary comparison of interest in all three trials was methylphenidate hydrochloride extended release versus placebo.

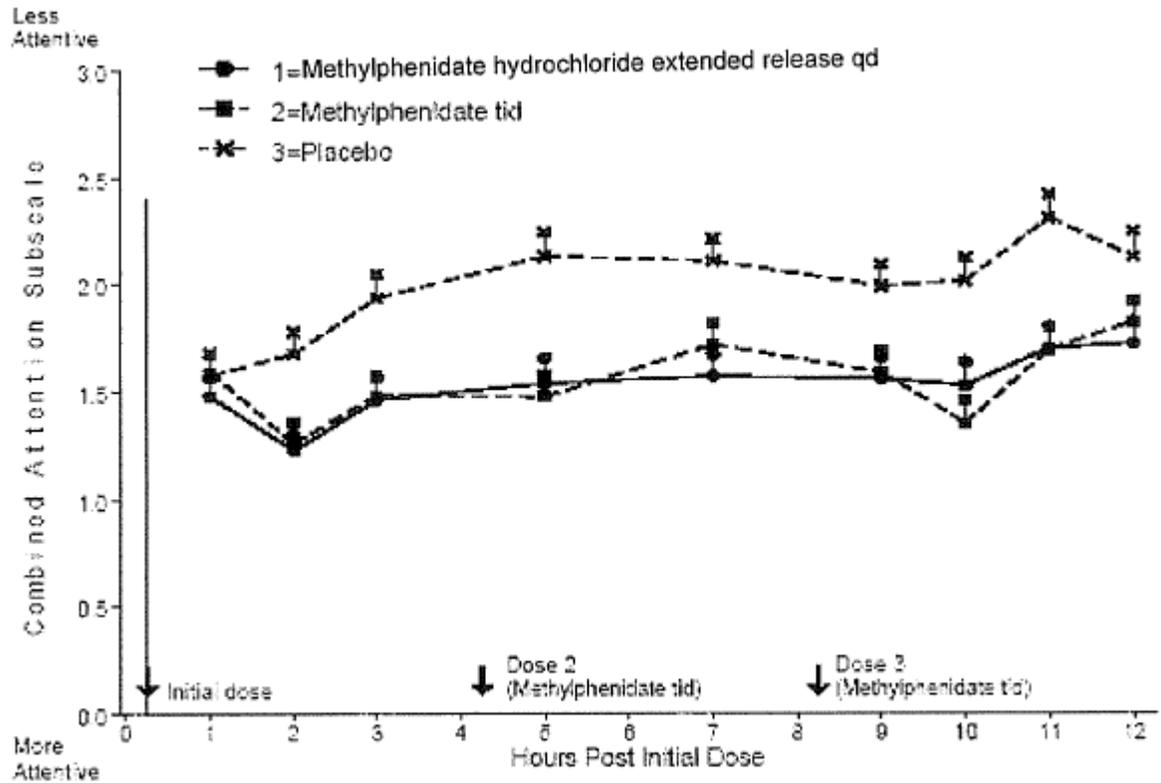
Symptoms of ADHD were evaluated by community school teachers using the Inattention/Overactivity with Aggression (IOWA) Conners scale. Significant reduction in the Inattention/Overactivity subscale in the treatment group versus the placebo was shown consistently across all three controlled studies for methylphenidate hydrochloride extended release q.d. and methylphenidate hydrochloride t.i.d. ( $p < 0.001$ ). The scores for the placebo-controlled parallel study for all three treatment groups are presented in Figure 2.1.



**Figure 2.1:** Mean community school teacher IOWA Conners Inattention/Overactivity scores with methylphenidate hydrochloride extended release q.d. (18, 36 or 54 mg), methylphenidate hydrochloride t.i.d. over 12 hours (15, 30 or 45 mg total daily dose), and placebo. The study involved 4 weeks of parallel-group treatments with a Last Observation Carried Forward analysis for weeks 2 to 4. Data at Week 4 is shown. Error bars represent mean plus standard error of the mean.

### *Studies 1 and 2*

In the two placebo-controlled crossover studies (Studies 1 and 2), symptoms of ADHD were evaluated by laboratory school teachers using the SKAMP (Swanson, Kotkin, Agler, M-Flynn and Pelham) laboratory school rating scale. Significant improvement in attention and behaviour versus placebo was shown consistently across the two studies ( $p < 0.005$ ). Efficacy was maintained through 12 hours after dosing, and the sustained beneficial effects of methylphenidate hydrochloride extended release q.d. therapy seen throughout the laboratory classroom day were comparable in duration to those with methylphenidate hydrochloride t.i.d. Figure 2.2 presents the laboratory school teacher SKAMP ratings for methylphenidate hydrochloride extended release q.d., methylphenidate hydrochloride t.i.d. and placebo in Study 1. Similar results were obtained in Study 2.



**Figure 2.2:** Mean laboratory school teacher SKAMP Ratings of Combined Attention (Study 1) with methylphenidate hydrochloride extended release q.d. (18, 36 or 54 mg), methylphenidate hydrochloride t.i.d. over 12 hours (15, 30 or 45 mg total daily dose) and placebo. Error bars represent mean plus standard error of the mean. The sample sizes for methylphenidate hydrochloride extended release, methylphenidate hydrochloride t.i.d., and placebo groups were 60, 62 and 60, respectively.

#### Adolescents (Study 4)

In a randomized, double-blind, multicentre, placebo-controlled trial (Study 4) involving 177 patients, methylphenidate hydrochloride extended release was demonstrated to be effective in the treatment of ADHD and was well tolerated in adolescents aged 13 to 18 at doses up to 72 mg/day (1.4 mg/kg/day). Of 220 patients who entered an open 4-week titration phase, 177 were titrated to an individualized dose (maximum 72 mg/day) based on meeting specific improvement criteria on the ADHD Rating Scale and the Global Assessment of Effectiveness with acceptable tolerability. Patients who met these criteria were then randomized to receive either their individualized dose of methylphenidate hydrochloride extended release (18 - 72 mg/day, n = 87) or placebo (n = 90) during a two-week double-blind phase. At the end of this phase, mean scores for the investigator rating on the ADHD Rating Scale for methylphenidate hydrochloride extended release were significantly improved relative to placebo (CON -14.93; PLA -9.58; p=0.001). Mean scores for methylphenidate hydrochloride extended release and placebo, respectively, at the end of the double-blind phase were 16.62 and 21.40, compared to 31.55 and 30.99 at baseline.

## **Adults (Study 5)**

This was a 5-week, randomized, double-blind, multicentre, placebo-controlled, dose-response trial (Study 5) was conducted in 401 adults with ADHD aged 18 to 65 years using once daily methylphenidate hydrochloride extended release fixed doses of 18 mg, 36 mg and 72 mg. Efficacy was evaluated by the mean change from baseline to double-blind endpoint in the investigator-rated Connors' Adult ADHD Rating Scale (CAARS) total score. All doses of methylphenidate hydrochloride extended release (18 mg, 36 mg and 72 mg/day) were statistically significantly superior to placebo in improving the CAARS total scores at double-blind endpoint compared to baseline (mean change of -7.6 for placebo, -10.6 (p=0.0146) for methylphenidate hydrochloride extended release 18 mg, -11.5 (p=0.0131) for methylphenidate hydrochloride extended release 36 mg and -13.7 (p<0.0001) for the methylphenidate hydrochloride extended release 72 mg). Statistically significant differences compared to placebo were first observed at Week 1. Secondary endpoints included the investigator-rated Clinical Global Impressions - Severity (CGI-S) and the CAARS-S:S (patient-rated CAARS scale). The results from the secondary endpoints were consistent with the primary endpoint.

## **DETAILED PHARMACOLOGY**

### **Animal Pharmacology**

#### **Pharmacodynamics**

Methylphenidate hydrochloride is a sympathomimetic agent classified as a central nervous system (CNS) stimulant. Its mechanism of action is not entirely understood; however, it blocks the reuptake and enhances the release of dopamine and norepinephrine in the mammalian brain, an effect that increases dopamine and norepinephrine levels in the synaptic cleft. In vitro radioligand binding studies demonstrate that binding of methylphenidate in the brain is localized to dopamine-rich areas. Methylphenidate releases dopamine from a reserpine-sensitive storage pool and inhibits the catecholamine metabolic enzyme, monoamine oxidase (MAO), in the brain of rats.

Methylphenidate is a racemic mixture comprised of the *d*- and *l*-threo stereoisomers. The *d*-isomer is pharmacologically active; the *l*-isomer has little pharmacologic activity. In a number of animal models, methylphenidate enhances locomotor activity and induces stereotypic behaviours. Recent clinical findings in ADHD children suggest an abnormality in the dopamine transporter gene (DAT<sub>1</sub>), the D<sub>4</sub> receptor gene (DRD-4) and/or the D<sub>2</sub> receptor gene that may be at least partly overcome by the dopaminergic effects of methylphenidate, suggesting a possible mode of action.

#### **Safety Pharmacology**

Methylphenidate hydrochloride had no effect in hERG-transfected cells or on the action potential of guinea pig papillary muscles. The no observed adverse effect level (NOAEL) for stimulatory effects on the cardiovascular system in conscious dogs (increased blood pressure and heart rate) was 10 mg/kg. The NOAEL for stimulatory effects on the respiratory system in free-moving rats was 3 mg/kg. The NOAEL for methylphenidate hydrochloride's convulsion evoking action in mice was 10 mg/kg.

### Pharmacokinetics

Studies primarily in humans and rats, as well as limited information available for mice, dogs, monkeys and other species, demonstrate that methylphenidate is readily absorbed, distributed, metabolized and eliminated regardless of the route of administration. While the kinetic rates for these processes are similar among different species, there are differences in metabolic profiles. Distribution of metabolites differs from that of the unchanged parent material, with most of the material that reaches the brain consisting of the unchanged parent compound. Biotransformation in the gut or first-pass metabolism, or both, is common among the species studied. The primary metabolite in humans and a major metabolite in other species is alpha-phenyl-alpha-(2-piperidyl) acetic acid (PPAA), also commonly called ritalinic acid. Pharmacokinetic data showed dose-dependent exposure to methylphenidate and PPAA in adult animals; in juvenile rats, exposure was more than dose-proportional. In the presence of alcohol, an intermediate metabolite, ethylphenidate, is produced. The amount of ethylphenidate production is proportional to the blood alcohol concentration. Excretion of radioactivity into breast milk was observed after single oral administration of 5 mg/kg <sup>14</sup>C-methylphenidate hydrochloride to lactating rats.

### **TOXICOLOGY**

The toxicology program for methylphenidate and the oral controlled-release OROS methylphenidate dosage form consists of acute toxicity, long-term toxicity, carcinogenicity and mutagenicity, reproductive and developmental toxicity, and other special toxicity studies.

#### Acute Toxicity

The acute toxicity of methylphenidate hydrochloride has been studied primarily in mice and rats, and additionally in rabbits and dogs. Published oral LD<sub>50</sub> values for rodents and rabbits range from approximately 190 to 900 mg/kg. The probable cause of death in LD<sub>50</sub> studies was excessive central adrenergic stimulation. Clinical signs noted with high doses of methylphenidate in animal acute toxicity studies include agitation and increased motor activity, tremors and convulsions, decreased food consumption and stereotypic behaviours such as licking or gnawing.

A dog study was conducted to study the abuse potential of methylphenidate hydrochloride extended release (N=8) and immediate release methylphenidate (N=8). The dogs were intravenously administered with pulverized methylphenidate hydrochloride extended release or methylphenidate tablets mixed with liquid. Death occurred after a single 0.5 mg or 1 mg/kg dose of methylphenidate hydrochloride extended release. Mortality was not observed in methylphenidate-treated dogs dosed at 1 mg/kg/day for 2 weeks. It is likely that the deaths were due the particles present in the pulverized methylphenidate hydrochloride extended release tablets.

#### Long-Term Toxicity

Treatment with methylphenidate hydrochloride at repeated high doses has demonstrated transient effects on body weight in rats and mice. The liver was the primary target organ for toxicity in mice and rats, with male mice being the most sensitive showing hepatocellular degeneration. Methylphenidate has shown some effects on maturation and estrous cyclicity in neonatal rats;

estrous cycles were reversibly affected in older rats. Reversible effects of methylphenidate were seen on skeletal growth in neonatal rats; such effects were not seen in older rats. Endocrine effects of MPH have generally been inconsistent or did not show a dose response. The potential gastrointestinal (GI) effects and systemic toxicity of the OROS methylphenidate dosage form were evaluated in a study conducted in dogs. Except for excessive salivation, no other treatment-related clinical signs were observed. No treatment-related findings were seen in body or organ weights, physical exams, ophthalmic exams, qualitative food consumption, hematology, clinical chemistry, urinalysis, macroscopic exams or histopathologic evaluation of tissues. No treatment-related GI irritation or systemic effects were seen for oral doses up to 72 mg/day for 30 days.

A second study in beagle dogs was conducted to determine the possible local gastrointestinal and systemic effects of methylphenidate hydrochloride extended release after daily administration (0, 72, 144 or 216 mg/day) for 4 weeks. Females in all methylphenidate hydrochloride extended release groups showed toxicologic effects such as hyperactivity, reduced food consumption, and decreased mean body weight gain; in males similar effects were seen only in the two higher methylphenidate hydrochloride extended release groups (144 and 216 mg/day). However, with the exception of mean body weight gain in 216 mg/day females, the methylphenidate hydrochloride extended release -related changes resolved during recovery.

### **Carcinogenicity and Mutagenicity**

In a lifetime carcinogenicity study carried out in B6C3F1 mice, methylphenidate hydrochloride caused an increase in hepatocellular adenomas and, in males only, an increase in hepatoblastomas at a daily dose of approximately 60 mg/kg/day. This dose is approximately 30 times and 4 times the maximum recommended human dose of methylphenidate hydrochloride extended release on a mg/kg and mg/m<sup>2</sup> basis, respectively. Hepatoblastoma is a relatively rare rodent malignant tumour type. There was no increase in total malignant hepatic tumours. The mouse strain used is sensitive to the development of hepatic tumours, and the significance of these results to humans is unknown.

Methylphenidate hydrochloride did not cause any increases in tumours in a lifetime carcinogenicity study carried out in F344 rats; the highest dose used was approximately 45 mg/kg/day, which is approximately 22 times and 5 times the maximum recommended human dose of methylphenidate hydrochloride extended release on a mg/kg and mg/m<sup>2</sup> basis, respectively.

In a 24-week carcinogenicity study in the transgenic mouse strain p53+/-, which is sensitive to genotoxic carcinogens, there was no evidence of carcinogenicity. Male and female mice were fed diets containing the same concentration of methylphenidate as in the lifetime carcinogenicity study; the high-dose groups were exposed to 60 to 74 mg/kg/day of methylphenidate hydrochloride.

Methylphenidate was not mutagenic in the in vitro Ames reverse mutation assay or the in vitro mouse lymphoma cell forward mutation assay. Sister chromatid exchanges and chromosome aberrations were increased, indicative of a weak clastogenic response, in an in vitro assay in

cultured Chinese Hamster Ovary cells. Methylphenidate was negative in vivo in males and females in the mouse bone marrow micronucleus assay.

### **Reproductive and Developmental Toxicity**

Studies have been conducted in mice, rats and rabbits to evaluate the potential reproductive and developmental toxicity of methylphenidate. Rats appear to be a better animal model than rabbits for developmental/reproductive studies of methylphenidate, based on plasma AUC ratios of drug:metabolite.

Reproductive toxicity was studied using a Reproductive Assessment by Continuous Breeding (RACB) protocol or Sperm Morphology Vaginal Cytology Evaluations (SMVCE) endpoints to assess male and female reproductive functions. Methylphenidate hydrochloride did not impair fertility in male or female mice that were fed diets containing the drug in an 18-week Continuous Breeding study. The study was conducted at doses up to 160 mg/kg/day, approximately 80-fold and 8-fold the highest recommended human dose of methylphenidate hydrochloride extended release on a mg/kg and mg/m<sup>2</sup> basis, respectively. A perinatal and postnatal development study with neurobehavioural assessments in rats indicated slight developmental delay and marginal alterations in neuromotor performance in offspring of the high-dose dams treated with 30 mg/kg/day methylphenidate hydrochloride (approximately 15 and 3 times the maximum recommended daily human dose for methylphenidate hydrochloride extended release tablets [54 mg methylphenidate hydrochloride] on a mg/kg and mg/m<sup>2</sup> basis, respectively). No effects on learning and memory were seen in offspring and no adverse effects were noted in offspring of dams treated with methylphenidate hydrochloride doses of 12.5 mg/kg/ day and lower. A teratology study conducted in rats supports the conclusion that methylphenidate is not a developmental toxicant at the dose levels tested, up to 30 mg/kg/ day. The maternal no-observed-adverse-effect level (NOAEL) of methylphenidate hydrochloride was 5 mg/kg/ day. No adverse effects on embryo/fetal viability, growth or malformations were seen. The developmental toxicity NOAEL of methylphenidate hydrochloride was at least 30 mg/kg/ day. In a study conducted in rabbits, methylphenidate hydrochloride was shown to have teratogenic effects when given in doses of 200 mg/kg/ day, which is approximately 100 times and 40 times the maximum recommended human dose on a mg/kg and mg/m<sup>2</sup> basis, respectively.

Weaning juvenile rats (F<sub>0</sub>) of both sexes were administered methylphenidate hydrochloride at total daily doses of 5, 12.5, and 30 mg/kg for approximately 4.5 months. The no observed adverse effect level (NOAEL) for F<sub>0</sub> juvenile toxicity was considered to be 12.5 mg/kg/day for males and 30 mg/kg/day for females. For F<sub>1</sub> developmental toxicity the NOAEL was considered to be 12.5 mg/kg/day.

### **Other Special Toxicity Studies**

Five system transit and drug release studies conducted with the OROS methylphenidate dosage form in dogs showed no unexpected clinical signs during transit through the gastrointestinal (GI) tract. Membrane shells remained intact during GI transit with cumulative release of active ingredient generally comparable in vitro and in vivo.

Cellular toxicity profile of methylphenidate and effects of methylphenidate on mitochondrial function were evaluated in vitro using an MTT(3-[4,5-dimethylthiazole-2-yl]-2,5-di-phenyl-

tetrazolium bromide) assay. Results demonstrated that MPH in cell culture medium, at approximate concentrations of 0.125 and 0.25 mg/mL, was noncytotoxic to L-929 mouse fibroblast cells.

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**PART III: CONSUMER INFORMATION**



**TEVA-METHYLPHENIDATE ER-C**  
methylphenidate hydrochloride  
Extended-release Tablets

**This leaflet is part III of a three-part “Product Monograph” published when TEVA-METHYLPHENIDATE ER-C was approved for sale in Canada and is designed specifically for Consumers. This leaflet is a summary and will not tell you everything about TEVA-METHYLPHENIDATE ER-C. Contact your doctor or pharmacist if you have any questions about the drug.**

**This information is for patients taking TEVA-METHYLPHENIDATE ER-C Extended-release Tablets for the treatment of Attention Deficit Hyperactivity Disorder, or their parents or caregivers.**

**Please read this before you / your child start taking TEVA-METHYLPHENIDATE ER-C tablets. Remember, this information does not take the place of your doctor’s instructions.**

**ABOUT THIS MEDICATION**

**What the medication is used for:**

TEVA-METHYLPHENIDATE ER-C is a once-a-day treatment for Attention Deficit Hyperactivity Disorder, or ADHD, in children 6 years of age or older, adolescents and adults. Methylphenidate hydrochloride is a central nervous system stimulant. TEVA-METHYLPHENIDATE ER-C contains a medicinal ingredient that has been used to treat ADHD for more than 30 years.

ADHD has three main types of symptoms: inattention, hyperactivity and impulsiveness. Symptoms of inattention include not paying attention, making careless mistakes, not listening, not finishing tasks, not following directions and being easily distracted. Symptoms of hyperactivity and impulsiveness include fidgeting, talking excessively, running around at inappropriate times and interrupting others. Some patients have more symptoms of hyperactivity and impulsiveness while others have more symptoms of inattentiveness. Some patients have all three types of symptoms. Many people have symptoms like these from time to time,

but patients with ADHD have these symptoms more than others their age. Symptoms must be present for at least 6 months to be certain of the diagnosis.

Symptoms of ADHD in adults may include a lack of organization, problems starting tasks, impulsive actions, daydreaming, slow processing of information, difficulty learning new things, irritability, lack of esteem and excessive effort to maintain some organization.

**What it does:**

Part of the TEVA-METHYLPHENIDATE ER-C tablet dissolves right after you / your child swallow it in the morning, giving you / your child an initial dose of medication. The rest of the medication is slowly released during the day to keep improving the symptoms of ADHD. TEVA-METHYLPHENIDATE ER-C helps increase attention and decrease impulsiveness and hyperactivity in patients with ADHD.

**When it should not be used:**

You / your child should NOT take TEVA-METHYLPHENIDATE ER-C if you / your child:

- have significant anxiety, tension or agitation because TEVA-METHYLPHENIDATE ER-C may make these conditions worse;
- are allergic to methylphenidate hydrochloride or any of the other ingredients in TEVA-METHYLPHENIDATE ER-C;
- have glaucoma, an eye disease;
- have symptomatic cardiovascular disease;
- have moderate to severe high blood pressure;
- have advanced arteriosclerosis (hardened arteries);
- have hyperthyroidism (an overactive thyroid gland); or
- are taking or have taken within the past 14 days monoamine oxidase inhibitors (a type of drug, see INTERACTIONS WITH THIS MEDICATION).

Talk to your doctor if you believe any of these conditions apply to you / your child.

**What the medicinal ingredient is:**

methylphenidate hydrochloride

**What the nonmedicinal ingredients are:**

TEVA-METHYLPHENIDATE ER-C contains the following non-medicinal ingredients: hydroxypropyl methylcellulose, lactose monohydrate, microcrystalline cellulose, polyvinyl alcohol-

polyethylene glycol copolymer and colloidal silica, simethicone and stearic acid.

Colourants present in the tablets are:

18 mg: D&C Yellow #10 aluminum lake, FD&C Red #40 aluminum lake, iron oxide yellow, polyethylene glycol, polyvinyl alcohol, talc and titanium dioxide.

27 mg: iron oxide black, polyethylene glycol, polyvinyl alcohol, talc and titanium dioxide.

36 mg: polyethylene glycol, polyvinyl alcohol, talc and titanium dioxide.

54 mg: hydroxypropyl methylcellulose, iron oxide yellow, iron oxide red, polyethylene glycol and titanium dioxide.

**What dosage forms it comes in:**

extended-release tablets: 18 mg, 27 mg, 36 mg and 54 mg

**WARNINGS AND PRECAUTIONS**

**Serious Warnings and Precautions**

**Drug Dependence**

Abuse of TEVA-METHYLPHENIDATE ER-C can lead to dependence. Tell your doctor if you have ever abused or been dependent on alcohol or drugs, or if you are now abusing or dependent on alcohol or drugs

**The following have been reported with use of methylphenidate hydrochloride extended-release and other medicines used to treat ADHD.**

**1. Heart-related problems:**

- **sudden death in patients who have heart problems or heart defects**
- **stroke and heart attack in adults**
- **increased blood pressure and heart rate**

Sudden death has been reported in association with stimulant drugs for ADHD treatment in children with structural heart abnormalities. TEVA-METHYLPHENIDATE ER-C generally should not be used in children, adolescents or adults with known structural heart abnormalities.

Tell your doctor if you or your child have any heart problems, heart defects, high blood pressure, or a family history of these problems.

Your doctor may wish to check you or your child carefully for heart problems before starting TEVA-METHYLPHENIDATE ER-C.

Your doctor may wish to check you or your child's blood pressure and heart rate regularly during treatment with TEVA-METHYLPHENIDATE ER-C.

**Call your doctor right away if you or your child has any signs of heart problems such as chest pain, shortness of breath, or fainting while taking TEVA-METHYLPHENIDATE ER-C.**

**2. Mental (Psychiatric) problems:**

- **New or worse thoughts or feelings related to suicide (thinking about or feeling like killing oneself) and suicide actions (including suicide attempt, suicidal ideation and completed suicide)**
- **new or worse symptoms of bipolar illness, characterized by extreme mood swings, with periods of mania (unusually excited, over-active or uninhibited) alternating with periods of depression (feelings of sadness, worthlessness or hopelessness)**
- **new or worse aggressive behaviour or hostility**
- **new psychotic symptoms (such as hearing voices, believing things that are not true, are suspicious) or new manic symptoms**

These new or worse mental symptoms may be more likely to occur if you/your child have mental disorders that you may or may not know about. Tell your doctor about any mental problems or about any personal or family history of suicide, bipolar illness, or depression you or your child have.

A small number of patients taking ADHD drugs may experience unusual feelings of agitation, hostility or anxiety, or have impulsive or disturbing thoughts such as thoughts of suicide, self-harm or harm to others. Those suicidal thoughts or behaviors may occur at any time during treatment, particularly at the start or during dose changes, and also after stopping TEVA-METHYLPHENIDATE ER-C. **Should this happen to you, or to those in your care if you are a caregiver or guardian, consult your doctor immediately. Close observation by a doctor is necessary in this situation.**

**Call your doctor right away if you or your child have any new or worsening mental symptoms or problems while taking TEVA-METHYLPHENIDATE ER-C, especially seeing**

**or hearing things that are not real, believing things that are not real, or are suspicious.**

**BEFORE** you or your child use TEVA-METHYLPHENIDATE ER-C, talk to your doctor or pharmacist if you / your child:

- have structural heart abnormalities;
- have tics (movements or sounds that you cannot control) or Tourette's syndrome, or if someone in your family has tics or Tourette's syndrome;
- have mental problems or family history of mental problems, including psychosis, mania, bipolar illness, depression or suicide;
- have had seizures (convulsions, epilepsy) or abnormal EEGs (electroencephalograms);
- have mild high blood pressure;
- take blood pressure medications;
- take cold and allergy remedies which contain medicines that can affect blood pressure;
- have a narrowing or blockage of your gastrointestinal tract (your esophagus, stomach, or small or large intestine);
- have a family history of sudden death or death related to heart problems;
- do strenuous exercise;
- take other drugs for ADHD;
- have or have had any disorder of the blood vessels in the brain (e.g. aneurysm, stroke, vasculitis), or
- have circulation problems in fingers and toes, including numbness; feeling cold or pain. (This is also known as Raynaud's).

Tell your doctor **immediately** if you / your child develop any of the above conditions or symptoms while taking TEVA-METHYLPHENIDATE ER-C. He/she will decide if you can start/continue taking TEVA-METHYLPHENIDATE ER-C.

**BEFORE** taking TEVA-METHYLPHENIDATE ER-C, tell your doctor if you are pregnant or plan to become pregnant.

Tell your doctor if you are nursing a baby. If you take TEVA-METHYLPHENIDATE ER-C, it can be in your breast milk. You should consult with your doctor to determine whether you should stop breast-feeding or discontinue TEVA-METHYLPHENIDATE ER-C.

Your doctor will monitor your progress with TEVA-METHYLPHENIDATE ER-C and may require you

to do occasional tests to ensure your health and safety.

### **INTERACTIONS WITH THIS MEDICATION**

Tell your doctor about **all** medicines that you / your child are taking. Your doctor should decide whether you / your child can take TEVA-METHYLPHENIDATE ER-C with other medicines. These include:

- type of medicine for depression or anxiety called a 'serotonin reuptake inhibitor' (SSRI) or a 'serotonin and norepinephrine reuptake inhibitor' (SNRI);
- clonidine;
- other medicines that a doctor has prescribed;
- medicines that you buy yourself without a prescription;
- any herbal remedies that you / your child may be taking.

You / your child should not take TEVA-METHYLPHENIDATE ER-C with monoamine oxidase (MAO) inhibitors.

While on TEVA-METHYLPHENIDATE ER-C, do not start taking a new medicine or herbal remedy before checking with your doctor.

You should avoid alcoholic drinks while taking TEVA-METHYLPHENIDATE ER-C.

TEVA-METHYLPHENIDATE ER-C may change the way your / your child's body reacts to certain medicines. These include medicines used to treat depression (e.g., amitriptyline, imipramine and fluoxetine), prevent seizures (e.g., phenobarbitone, phenytoin, carbamazepine and primidone) or prevent blood clots (commonly called "blood thinners", e.g., warfarin).

Your doctor may need to change your / your child's dose of these medicines if you / your child are taking them with TEVA-METHYLPHENIDATE ER-C.

### **PROPER USE OF THIS MEDICATION**

**Do not chew, crush or divide the tablets.** Swallow TEVA-METHYLPHENIDATE ER-C tablets whole with water or other liquids, such as milk or juice.

Take TEVA-METHYLPHENIDATE ER-C once each day in the morning with or without food.

## IMPORTANT: PLEASE READ

TEVA-METHYLPHENIDATE ER-C has not been studied and should not be used in children under six years of age. Methylphenidate hydrochloride extended release has not been studied in adults over 65 years of age.

TEVA-METHYLPHENIDATE ER-C may be a part of your / your child's overall treatment for ADHD. Your doctor may also recommend that you / your child have counselling or other therapy.

As with all medicines, never share TEVA-METHYLPHENIDATE ER-C with anyone else.

### Usual dose:

Take the dose prescribed by your doctor. Your doctor may adjust the amount of drug you / your child take until it is right for you / your child. From time to time, your doctor may interrupt your / your child's treatment to check your / your child's symptoms while you / your child are not taking the drug.

### Overdose:

**In case of a drug overdose, immediately go to the nearest emergency room even if you do not feel sick. Make sure you take your medicine bottle with you to show the doctor.**

## SIDE EFFECTS AND WHAT TO DO ABOUT THEM

Refer to the beginning of this leaflet for information on reported heart-related and mental (psychiatric) problems.

In the clinical studies with patients using methylphenidate extended release, the very common side effects (may affect more than 1 in 10 people) were headache, stomach pain, sleeplessness, dry mouth, nausea (feeling sick) and decreased appetite. Other side effects commonly seen with methylphenidate extended release (may affect up to 1 in 10 people) include vomiting, fast heart rate, weight loss, anxiety, irritability, increased sweating, dizziness, nervousness, tics, increased blood pressure.

Tell your doctor if you / your child have blurred vision when taking TEVA-METHYLPHENIDATE ER-C.

Slower growth (weight gain and/or height) has been reported with long-term use of methylphenidate hydrochloride in children. Your doctor will be carefully watching your child's height and weight. If

you / your child are not growing or gaining weight as your doctor expects, your doctor may stop your / your child's TEVA-METHYLPHENIDATE ER-C treatment.

Stimulants may impair your / your child's ability to operate potentially hazardous machinery or vehicles. You should exercise caution until you are reasonably certain that TEVA-METHYLPHENIDATE ER-C does not adversely affect your / your child's ability to engage in such activities.

SERIOUS SIDE EFFECTS, HOW OFTEN THEY HAPPEN AND WHAT TO DO ABOUT THEM			
Symptom/Effect	Call your doctor right away		Stop taking drug and seek emergency medical assistance
	Only if severe	In all cases	
<b>Rare</b> Symptoms of allergic reaction, such as itching, skin rash, swelling of the mouth, face, lips, or tongue, or shortness of breath.			√
<b>Very Rare</b> Signs of heart problems, such as chest pain, shortness of breath, or fainting		√	
<b>Very Rare</b> Convulsions (seizures)			√
<b>Very Rare</b> Persistent (greater than 4 hours in duration) and painful erections (priapism)			√
<b>Very Rare</b> New or worsening psychotic or manic symptoms: - Paranoia, delusions - Hallucinations: seeing, feeling or hearing things that are not real - Mania: feeling unusually excited, over-active, or uninhibited (see <b>Warnings and Precautions</b> )		√	
<b>Common</b> Aggressive behavior or hostility		√	
<b>Very Rare</b> Suicidal behavior: Thoughts or actions about hurting or killing yourself. (see <b>Warnings and Precautions</b> )			√
<b>Unknown</b>		√	

## IMPORTANT: PLEASE READ

### SERIOUS SIDE EFFECTS, HOW OFTEN THEY HAPPEN AND WHAT TO DO ABOUT THEM

Raynaud's Phenomenon: discoloration of the fingers and toes, pain, sensations of cold and/or numbness			
<b>Very Rare</b> Liver damage or sudden liver failure. Symptoms may include yellowing of the whites of the eyes, or of the skin, dark urine, bleeding, mental clouding (feeling like you're in a fog), confusion.		√	

*This is not a complete list of side effects. For any unexpected effects while taking TEVA-METHYLPHENIDATE ER-C, contact your doctor or pharmacist.*

### HOW TO STORE IT

TEVA-METHYLPHENIDATE ER-C should be stored in a safe place at room temperature (between 15-30°C). Do not store this medicine in hot, damp or humid places.

**Keep out of the reach of children.**

### Reporting Side Effects

You can report any suspected side effects associated with the use of health products to Health Canada by:

- Visiting the Web page on Adverse Reaction Reporting (<http://www.hc-sc.gc.ca/dhp-mps/medeff/report-declaration/index-eng.php>) for information on how to report online, by mail or by fax; or
- Calling toll-free at 1-866-234-2345.

*NOTE: Contact your health professional if you need information about how to manage your side effects. The Canada Vigilance Program does not provide medical advice.*

### MORE INFORMATION

This document plus the full product monograph, prepared for health professionals can be found by contacting Teva Canada Limited by:

Phone: 1-800-268-4127 ext. 3;  
Email: [druginfo@tevacanada.com](mailto:druginfo@tevacanada.com) ; or

Fax: 1-416-335-4472

Please consult your doctor or pharmacist with any questions or concerns you may have regarding your individual condition.

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