PRODUCT MONOGRAPH
INCLUDING PATIENT MEDICATION INFORMATION

PrTIAZAC® XC

Diltiazem Hydrochloride
Extended-Release Tablets 120 mg, 180 mg, 240 mg, 300 mg, and 360 mg oral

Antihypertensive Agent
Antianginal Agent

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RECENT MAJOR LABEL CHANGES

2. CONTRAINDICATIONS	12/2022

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Sections or subsections that are not applicable at the time of authorization are not listed.

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PART I: HEALTH PROFESSIONAL INFORMATION

1 INDICATIONS

- **Essential Hypertension**
  TIAZAC XC (diltiazem hydrochloride) is indicated for the treatment of mild to moderate essential hypertension.

  The safety of concurrent use of TIAZAC XC with other antihypertensive agents has not been established.

- **Chronic Stable Angina**
  For the management of chronic stable angina (effort-associated angina) without evidence of vasospasm in patients who remain symptomatic despite adequate doses of beta-blockers and/or organic nitrates or who cannot tolerate those agents (See 7 WARNINGS AND PRECAUTIONS, Use with Beta-Blockers).

  TIAZAC XC may be tried in combination with beta-blockers in chronic stable angina in patients with normal ventricular function. When such concomitant therapy is introduced, these patients must be monitored closely (see 7 WARNINGS AND PRECAUTIONS, Use with Beta-Blockers).

  Since the safety and efficacy of TIAZAC XC in the management of unstable or vasospastic angina has not been substantiated, its use for these conditions is not recommended.

1.1 Pediatrics

Pediatrics (< 18 years): No data are available to Health Canada; therefore, Health Canada has not authorized an indication for pediatric use.

1.2 Geriatrics

Geriatrics (> 65 years old): Administration of diltiazem to elderly patients (over or equal to 65 years of age) requires caution (see 7.1.4 WARNINGS AND PRECAUTIONS, Geriatrics).

2 CONTRAINDICATIONS

TIAZAC XC is contraindicated:

- In patients with sick sinus syndrome, except in the presence of a functioning ventricular pacemaker;
- In patients with second or third-degree AV block;
- In patients with known hypersensitivity to diltiazem or to any of the excipients;
- In patients with severe hypotension (less than 90 mm Hg systolic);
- In patients with severe bradycardia (below 40 beats per minute);
- In myocardial infarction patients, who have left ventricular failure manifested by

pulmonary congestion;

- In pregnancy and in women of child-bearing potential (see 7.1.1 Pregnant women).
- During breast-feeding;
- With concomitant use of dantrolene (see 9.4 Drug-drug Interactions);
- With concomitant use of ivabradine (see 9.4 Drug-drug Interactions);
- With concomitant use of lomitapide mesylate as it may result in increased concentrations of lomitapide mesylate due to CYP3A4 inhibition (see 9.4 Drug-drug Interactions)

4 DOSAGE AND ADMINISTRATION

4.1 Dosing Considerations

TIAZAC XC has an extended-release delivery system designed to deliver maximum effect in the morning when administered at night-time. Accordingly, TIAZAC XC should be administered once daily at bedtime. TIAZAC XC may be taken with or without food but should be so taken consistently.

4.2 Recommended Dose and Dosage Adjustment

Hypertension

When used as monotherapy, usual starting doses for hypertension are 180 to 240 mg once daily. Maximum antihypertensive effect is usually observed after approximately 2 to 4 weeks of therapy; therefore, dosage adjustments should be scheduled accordingly.

A maximum daily dose of 360 mg should not be exceeded. The dosage of TIAZAC XC or concomitant antihypertensive agents may need to be adjusted when adding one to the other (see 7 WARNINGS AND PRECAUTIONS, Use with beta-blockers).

Angina

Dosage should be based on individual patient response. Treatment should start with 180 mg once daily; this may be increased at intervals of 7 to 14 days if adequate response is not obtained. Higher doses may not result in greater anti-anginal effect. The maximum dose is 360 mg once daily.

TIAZAC XC may be safely co-administered with short- and long-acting nitrates.

Sublingual nitroglycerin may be taken as required to support acute anginal attacks during TIAZAC XC therapy.

Dosage in Pediatrics (<18 years of age):

No data are available to Health Canada; therefore, Health Canada has not authorized an indication for pediatric use

Dosage in Geriatrics (over or equal to 65 years of age):

Evidence from clinical studies and experience suggests that use in the geriatric population is

associated with differences in safety or effectiveness.

Pharmacokinetics of diltiazem in elderly patients has not been fully elucidated. Preliminary results in elderly patients (over 65 years old) suggest that a lower dosage might be required in this age group (see 7 WARNINGS AND PRECAUTIONS, 7.1.2 Geriatrics).
There are few available data concerning dosage requirements in patients with impaired renal or hepatic function. If diltiazem must be used in these patients, the dosage should be carefully and gradually adjusted depending on patient tolerance and response (see 7 WARNINGS AND PRECAUTIONS, 7.1.2 Geriatrics).

4.4 Administration

TIAZAC XC should not be chewed or crushed.

4.5 Missed Dose

If you miss a dose, take it as soon as possible. However, if it is almost time for the next dose, skip the missed dose and take your next dose as scheduled. Do not take two doses at the same time.

5 OVERDOSAGE

Significant diltiazem overdose causes cardiovascular and systemic toxicity and may be fatal. The onset of toxicity may be delayed in patients who have ingested a sustained release preparation such as TIAZAC XC. The clinical effects of acute overdose can involve pronounced hypotension possibly leading to collapse and acute kidney injury, sinus bradycardia with or without isorhythmic dissociation, sinus arrest, atrioventricular conduction disturbances and cardiac arrest. Mental status will often be preserved although patients with hypotension may be drowsy or comatose. Hypoxia may be due to non-cardiogenic lung injury caused by precapillary vasodilation. Impaired gut motility may result in ileus. Patients are often hyperglycemic due to impaired insulin release. Fatalities may occur with large overdoses and in patients with co-existing cardiac disease or with cardiotoxic co-ingestants.

Severely symptomatic patients poisoned with diltiazem should receive supplemental oxygen and be stabilized in the usual fashion with attention to maintaining the airway and restoring circulation. An electrocardiogram and routine blood analysis including electrolytes, glucose, and the usual search for co-ingestants should be performed.

Induced emesis is contraindicated. Patients who present within an hour of a significant overdose of diltiazem should have gastric lavage followed by activated charcoal. Lavage is not indicated for patients with delayed presentations. Whole bowel irrigation may be considered in patients with significant ingestions of sustained-release diltiazem.

In the event of overdose or exaggerated response, appropriate supportive measures should be employed in addition to gastric lavage.

The following measures may be considered:

Bradycardia

Atropine and intravenous fluids may suffice in patients with mild poisoning.

High Degree AV Block

Treat as for bradycardia above. Fixed high degree AV block should be treated with cardiac pacing.

Cardiac Failure

Administer inotropic agents (isoproterenol, dopamine, or dobutamine) and diuretics.

Hypotension

Calcium salts given intravenously (should be avoided in patients who may have co-ingested digoxin). Catecholamine pressors may be used to improve cardiac contractility (epinephrine, dopamine, dobutamine, isoproterenol) or vascular tone (norepinephrine, epinephrine, dopamine). High dose insulin together with glucose or glucagon may be effective in patients not responding to catecholamines.

Sustained release calcium channel blockers may cause delayed onset of toxicity and once established; toxicity may last for several days. Patients who have symptoms following a TIAZAC XC ingestion should be treated and monitored until all signs and symptoms of toxicity have resolved. Patients who remain asymptomatic with normal vital signs during a 24-hour period of observation in a monitored setting may be discharged.

For management of a suspected drug overdose, contact your regional poison control centre.

For the most recent information in the management of a suspected drug overdose, contact your regional poison control centre or Health Canada's toll-free number, 1-844 POISON-X (1-844-764-7669).

6 DOSAGE FORMS, STRENGTHS, COMPOSITION AND PACKAGING

Table 1 – Dosage Forms, Strengths, Composition and Packaging

Route of Administration	Dosage Form / Strength/Composition	Non-medicinal Ingredients
Oral	Tablets 120 mg, 180 mg, 240 mg, 300 mg, 360 mg	Carnauba Wax, Colloidal Silicone Dioxide, Croscarmellose Sodium, Eudragit, Hydrogenated Vegetable Oil, Hydroxypropylmethylcellulose, Magnesium Stearate, Microcrystalline Cellulose, Paraffin Wax, Polydextrose, Polyethylene Glycol, Polysorbate, Povidone, Pregelatinized Starch, Simethicone, Sodium

		Starch Glycolate, Sucrose Stearate, Talc, and Titanium Dioxide.

TIAZAC XC (diltiazem hydrochloride) Extended-Release Tablets are available in the following strengths. Each white, film coated tablet is debossed with “B” on one side, and the strength on the other.

- TIAZAC XC 120 mg tablets are supplied in bottles of 90 tablets.
- TIAZAC XC 180 mg tablets are supplied in bottles of 90 tablets.
- TIAZAC XC 240 mg tablets are supplied in bottles of 90 tablets.
- TIAZAC XC 300 mg tablets are supplied in bottles of 90 tablets.
- TIAZAC XC 360 mg tablets are supplied in bottles of 90 tablets.

7 WARNINGS AND PRECAUTIONS

Cardiovascular

Cardiac Conduction

TIAZAC XC (diltiazem hydrochloride) prolongs AV node refractory periods without significantly prolonging sinus node recovery time, except in patients with sick sinus syndrome. This effect may rarely result in abnormally slow heart rates (particularly in patients with sick sinus syndrome) or second- or third-degree AV block (13 of 3007 patients or 0.43%). Concomitant use of diltiazem with beta-blockers or digitalis may result in additive effects on cardiac conduction.

Congestive Heart Failure

Because diltiazem has a negative inotropic effect in vitro and it affects cardiac conduction, the drug should only be used with caution and under careful medical supervision in patients with cardiac failure (see also 2 CONTRAINDICATIONS).

Cases of acute renal failure have been reported in patients using diltiazem at therapeutic dosages. Patients at greater risk appear to have reduced left ventricular function, severe bradycardia or severe hypotension.

Prior to general anesthesia, the anesthetist must be informed of ongoing diltiazem treatment. Depression of cardiac contractility, conductivity and automaticity, as well as the vascular dilatation associated with anesthetics may be potentiated by calcium channel blockers.

Postinfarction patients with reduced ejection fraction are at particular risk for subsequent heart failure when treated with diltiazem. Accordingly, diltiazem should be avoided in patients with substantially reduced ejection fraction.

Hypotension

Decreases in blood pressure associated with diltiazem hydrochloride therapy may occasionally result in symptomatic hypotension.

Patients with Myocardial Infarction

Use of immediate release diltiazem at 240 mg per day started 3 to 15 days after a myocardial infarction was associated with an increase in cardiac events in patients with pulmonary congestion with no overall effect on mortality. Although there has not been a study of a sustained-release formulation of diltiazem in acute myocardial infarction, their use may have effects similar to those of immediate-release diltiazem in acute myocardial infarction.

Use with Beta-Blockers

Generally, diltiazem should not be given to patients with impaired left ventricular function if they are already receiving beta-blockers. In exceptional cases, when in the opinion of the physician, concomitant use is considered essential, such use should be instituted gradually in a hospital setting under close medical supervision.

The combination of diltiazem and beta-blockers warrants caution since in some patients additive effects on heart rate, cardiac conduction, blood pressure or left ventricular function have been observed.

Diltiazem gives no protection against the dangers of abrupt beta-blocker withdrawal and such withdrawal should be done by the gradual reduction of the dose of beta-blocker.

Endocrine and Metabolism

Patients with Diabetes

Careful monitoring is necessary to detect new onset of diabetes or in patients with diabetes mellitus (type 1 or type 2) due to an increase in blood glucose.

Gastrointestinal

Diltiazem has an inhibitory effect on intestinal motility. Therefore, it should be used with caution in patients at risk of developing an intestinal obstruction.

Hepatic/Biliary/Pancreatic

Acute Hepatic Injury

In rare instances, significant elevations in alkaline phosphatase, CPK, LDH, AST, ALT and symptoms consistent with hepatic injury have been observed. These reactions have been reversible upon discontinuation of drug therapy. Although a causal relationship to diltiazem has not been established in all cases, a drug induced hypersensitivity reaction is suspected (see 8 ADVERSE REACTIONS). As with any drug given over prolonged periods, laboratory parameters should be monitored at regular intervals.

Because TIAZAC XC is extensively metabolized by the liver and excreted by the kidney and in bile, monitoring of laboratory parameters and cautious dosage titration are recommended in patients with severe hepatic or renal function (see 8 ADVERSE REACTIONS).

Impaired Hepatic Function

Diltiazem should be used with caution in patients with hepatic impairment. Because diltiazem is extensively metabolized by the liver and excreted in bile, the monitoring of laboratory parameters of hepatic function is recommended and cautious dosage titration are recommended in patients with impaired hepatic function. (See 8 ADVERSE REACTIONS).

Neurologic
Calcium channel blocking agents, such as diltiazem, may be associated with mood changes, including depression (see 9 DRUG INTERACTIONS and 8 ADVERSE REACTIONS)

Renal
Acute Kidney Injury
Cases of acute renal failure have been reported in patients using diltiazem at therapeutic dosages. Patients at greater risk appear to have reduced left ventricular function, severe bradycardia or severe hypotension.

Impaired Renal Function
Diltiazem should be used with caution in patients with renal impairment. Because diltiazem is excreted by the kidney, the monitoring of laboratory parameters of renal function is recommended and cautious dosage titration are recommended in patients with impaired renal function. (See 8 ADVERSE REACTIONS).

Respiratory
The use of diltiazem may induce bronchospasm, including asthma aggravation, especially in patients with pre-existing bronchial hyper-activity. Cases have been reported after dose increase. Patients should be monitored for signs and symptoms of respiratory impairment during diltiazem therapy.

Skin
Dermatological events (see 8 ADVERSE REACTIONS) may be transient and may disappear despite continued use of diltiazem. However, skin eruptions progressing to erythema multiforme and/or exfoliative dermatitis have also been infrequently reported. Should a dermatologic reaction persist, the drug should be discontinued.

7.1 Special Populations

7.1.1 Pregnant Women

Fetal malformations and adverse effects on pregnancy have been reported in animals (see 2 CONTRAINDICATIONS).

7.1.2 Breast-feeding

Diltiazem is excreted in human milk. One report suggests that concentrations in breast milk may approximate serum levels. If use of TIAZAC XC is deemed essential, an alternative method of infant feeding should be instituted.

7.1.3 Pediatrics

No data are available to Health Canada; therefore, Health Canada has not authorized an

indication for pediatric use.

7.1.4 Geriatrics

Administration of diltiazem to elderly patients (over or equal to 65 years of age) requires caution. The incidence of adverse reactions is approximately 13% higher in this group. Those adverse reactions which occur more frequently include peripheral edema, bradycardia, palpitation, dizziness, rash and polyuria. Therefore, particular care in titration is advisable.

8 ADVERSE REACTIONS

8.1 Adverse Reaction Overview

The most common adverse reactions were headache (4.6%), edema (4.6%), dizziness (3.5%), asthenia (2.7%), first degree AV block (2.4%), bradycardia (1.7%), flushing (1.5%), nausea (1.4%), rash (1.2%), and dyspepsia (1.0%).

8.2 Clinical Trial Adverse Reactions

Clinical trials are conducted under very specific conditions. The adverse reaction rates observed in the clinical trials; therefore, may not reflect the rates observed in practice and should not be compared to the rates in the clinical trials of another drug. Adverse reaction information from clinical trials may be useful in identifying and approximating rates of adverse drug reactions in real-world use.

Hypertension

Table 2 presents the most common adverse reactions reported in the placebo-controlled hypertension trials in patients receiving a diltiazem hydrochloride extended-release formulation (once-a-day dosing) up to 360 mg.

Table 2: Adverse Events >1%: Diltiazem Hydrochloride Extended-Release Formulation Once-a-day PM Administration Placebo-Controlled Hypertension Trials

	Diltiazem Hydrochloride Extended-Release 120-360 mg (n = 238) # pts (%)	**Placebo (n = 69) # pts (%)**
Headache	10 (15)	29 (12)
Oedema lower limb	4 (6)	9 (4)
Upper respiratory tract infection	2 (3)	12 (5)
Nasopharyngitis	1 (1)	7 (3)
Sinusitis	2 (3)	7 (3)

Angina

In the angina clinical study, the adverse event profile of TIAZAC XC was consistent with that previously described for TIAZAC XC and other formulations of diltiazem HCl. The most frequent adverse effects experienced by TIAZAC XC patients are presented in Table 3.

Table 3: Adverse Events >1%: Diltiazem Hydrochloride Extended-Release Formulation Once-a-day Administration Placebo-Controlled Angina Trial

	Diltiazem Hydrochloride Extended-Release 120-360 mg (n = 238) # pts (%)	Placebo (n = 69) # pts (%)
Edema Lower Limb	2 (3.3)	17 (6.8)
Dizziness	0 (0)	16 (6.4)
Fatigue	3 (4.9)	12 (4.8)
Bradycardia Atrioventricular Block	0 (0)	9 (3.6)
First Degree	0 (0)	8 (3.2)
Cough	0 (0)	5 (2.0)

8.3 Less Common Clinical Trial Adverse Drug Reactions

The following treatment related adverse drug reactions were reported with <1% incidence in the TIAZAC XC clinical trial:

- ***Cardiac disorders:*** Atrioventricular block (first, degree), palpitations.
- ***Eye disorders:*** Vitreous floaters, diplopia.
- ***Gastrointestinal disorders:*** Dyspepsia, nausea.
- ***General disorders and administration site conditions:*** Feeling jittery, joint swelling, lethargy, neck swelling, oedema NOS, peripheral swelling, swelling NOS.
- ***Investigations:*** Aspartate aminotransferase increased.
- ***Nervous system and psychiatric disorders:*** Dizziness (vertigo), sinus headache.
- ***Renal and urinary disorders:*** Urinary frequency.
- ***Respiratory, thoracic and mediastinal disorders:*** Dyspnoea NOS.
- ***Skin and subcutaneous disorders:*** Dermatitis NOS, erythema NEC, face oedema, pruritus NOS, rash generalized.
- ***Vascular disorders:*** Flushing.

The following adverse events were reported with a frequency <1% in other diltiazem products:

- ***Cardiovascular:*** Angina, arrhythmia, AV block (second- or third-degree), bundle branch block, congestive heart failure (left ventricular dysfunction), ECG abnormalities, hypotension, palpitations, syncope, tachycardia, ventricular extrasystoles.
- ***Dermatological:*** Petechiae, photosensitivity, pruritus, urticaria.
- ***Eye disorders:*** Amblyopia, eye irritation.
- ***Gastrointestinal disorders:*** Anorexia, constipation, diarrhea, dry mouth, dysgeusia, thirst, vomiting, weight increase.
- ***General disorders and administration site conditions:*** Malaise (reported as common adverse reaction), osteoarticular pain.
- ***Investigations:*** Mild elevations of AST, ALT, LDH, and alkaline phosphatase (see 7 WARNINGS AND PRECAUTIONS, Hepatic), CPK increase.
- ***Metabolism and nutrition disorders:*** Hyperglycemia, hyperuricemia.
- ***Nervous System and psychiatric disorders:*** Abnormal dreams, amnesia, depression, gait abnormality, hallucinations, insomnia, nervousness, paresthesia, personality change, somnolence, tinnitus, tremor.
- ***Renal and urinary disorders:*** Nocturia, polyuria.
- ***Respiratory, thoracic and mediastinal disorders:*** Dyspnea, epistaxis, nasal congestion.
- ***Sexual dysfunction disturbances and gender identity disorders:*** Impotence, sexual difficulties.
- ***Vascular disorders:*** Orthostatic hypotension

8.5 Post-Market Adverse Reactions

Adverse reactions reported during post marketing experience are derived from spontaneous reports and therefore, the frequency of these adverse reactions is not known.

- ***Blood and lymphatic system disorders:*** Thrombocytopenia, hemolytic anemia, increased bleeding time, leukopenia
- ***Nervous system and psychiatric disorders:*** Mood changes including depression, extrapyramidal symptoms
- ***Cardiac disorders:*** Sinoatrial block, congestive heart failure, sinus arrest, cardiac arrest (asystole)

- ***Respiratory, thoracic and mediastinal disorders:*** Bronchospasm (including asthma aggravation)

- ***Gastrointestinal disorders:*** Gingival hyperplasia

- ***Metabolism and nutrition disorders:*** Hyperglycaemia, diabetes (new onset), worsening of existing diabetes (type 1 or type 2)
- ***Skin and subcutaneous tissue disorders:*** Photosensitivity (including lichenoid keratosis at sun exposed skin areas), angioneurotic oedema, erythema multiforme (including Stevens-Johnson syndrome, toxic epidermal necrolysis), sweating, exfoliative dermatitis (see 7 WARNINGS AND PRECAUTIONS), acute generalized exanthematous pustulosis, occasionally desquamative erythema with or without fever, allergic reactions, alopecia, purpura

- ***Vascular disorders:*** A number of well-documented cases of generalized rash, some characterized as leukocytoclastic vasculitis

- ***Hepatobiliary disorders:*** Hepatitis

- ***Renal disorders:*** Acute kidney injury/failure

- ***Reproductive system and breast disorders:*** Gynecomastia

- ***Eye disorders:*** Detached retina, retinopathy

- ***Musculoskeletal and connective tissue disorders:*** Myopathy

Isolated cases of angioedema have been reported. Angioedema may be accompanied by breathing difficulty. In addition, events such as myocardial infarction have been observed which are not readily distinguishable from the natural history of the disease in these patients. However, a definitive cause and effect relationship between these events and TIAZAC therapy is yet to be established

9 DRUG INTERACTIONS

9.1 Serious Drug Interactions

Serious Drug Interactions
• Concomitant use of dantrolene infusion • Concomitant use of ivabradine • Concomitant use of lomitapide mesylate • Concomitant use of Direct Oral Anticoagulants (DOACs; e.g. apixaban, rivaroxaban, dabigatran, see 9.4 Drug-Drug Interactions)

9.2 Drug Interactions Overview

Cytochrome P450 System

As with all drugs, care should be exercised when treating patients with multiple medications. Diltiazem undergoes biotransformation mainly by the CYP3A4 isoenzyme of the cytochrome P450 system and is a substrate of the P-glycoprotein (P-gp). Diltiazem has also been shown to be an inhibitor of CYP3A4 (moderate) and P-gp.
Co-administration of diltiazem with other drugs which follow the same route of biotransformation or are inhibitors or inducers of these enzymes may result in altered bioavailability of diltiazem or these drugs. Dosages of similarly metabolized drugs, particularly those of low therapeutic index, and especially in patients with renal and/or hepatic impairment, may require adjustment, or discontinuation, when starting or stopping concomitantly administered diltiazem to maintain optimum therapeutic blood levels.

9.3 Drug-Behavioural Interactions

Alcohol

Alcohol can exhibit hypotensive effects. Coadministration with antihypertensive agents including diltiazem may result in additive effects on blood pressure and orthostasis. Patients should be advised that alcohol may potentiate the hypotensive effects of diltiazem, especially during the initiation of therapy and following a dosage increase. Caution should be exercised when rising from a sitting or recumbent position, and patients should notify their physician if they experience dizziness, light-headedness, syncope, orthostasis, or tachycardia.

Sexual dysfunction disturbances and gender identity disorders

Impotence, sexual difficulties.

9.4 Drug-Drug Interactions

The drugs listed in this table are based on either drug interaction case reports or studies, or potential interactions due to the expected magnitude and seriousness of the interaction (i.e., those identified as contraindicated).

Table 4: Established or Potential Drug-Drug Interactions

Agent	Ref	Effect	Clinical comment
Acetylsalicylic acid or other antiplatelet drugs (e.g., cilostazole, ticagrelor)	T	↑ bleeding	Because of the increased risk of bleeding due to potential additive effect on platelet aggregation, the concomitant administration of acetylsalicylates or antiplatelet drugs with diltiazem should be undertaken with caution.

Agent	Ref	Effect	Clinical comment
Alpha-antagonists	T	↑ antihypertensive	Concomitant treatment with α-antagonists may produce or aggravate hypotension. The combination of diltiazem with an α-antagonist should be considered only with the strict monitoring of blood pressure.
Amiodarone, digoxin	T	↑ bradycardia	Caution is required when these are combined with diltiazem, particularly in elderly subjects and when high doses are used.
Anaesthetics	T	↑ depression of cardiac contractility, conductivity, and automaticity	The depression of cardiac contractility, conductivity, and automaticity as well as the vascular dilation associated with anesthetics may be potentiated by calcium channel blockers. When used concomitantly, anesthetics and calcium blockers should be titrated carefully.
Benzodiazepines (midazolam, triazolam)	CT	↑ benzodiazepines plasma concentration	Diltiazem significantly increases peak plasma levels and the elimination half-life of triazolam and midazolam. Special care (close medical supervision and/or dose adjustment) should be taken when prescribing short-acting benzodiazepines metabolized by CYP3A4 in patients using diltiazem.

Agent	Ref	Effect	Clinical comment
Beta-Blockers	T, CT	Arrhythmic effect ↑ propranolol exposure	The concomitant administration of diltiazem with beta-adrenergic blocking drugs warrants caution because of rhythm disturbances occurrence, and requires close medical supervision and ECG monitoring, particularly at the beginning of treatment. Such an association may have a synergetic effect on heart rate, on sino-atrial and AV conduction or on blood pressure (e.g. pronounced bradycardia, sinus arrest, and heart failure) (see 7 WARNINGS and PRECAUTIONS). Appropriate dosage adjustments may be necessary. A study in five normal subjects showed that diltiazem increased propranolol bioavailability by 50%.
Carbamazepine	CT	↑ carbamazepine serum level	Concomitant administration of diltiazem with carbamazepine has been reported to result in elevated serum levels of carbamazepine (40% to 72% increase), resulting in toxicity in some cases. Patients receiving these drugs concurrently should be monitored for a potential drug interaction and dose adjustment of carbamazepine and/or diltiazem may be necessary.

Agent	Ref	Effect	Clinical comment
Anti-H2 agents (Cimetidine, ranitidine)	CT	↑ cimetidine, ranitidine exposure	A study in six healthy volunteers has shown a significant increase in peak diltiazem plasma C_{max} levels (58%) and area-under-the-curve AUC (53%) after a 1-week course of cimetidine 1200 mg per day and a single dose of diltiazem 60 mg. Ranitidine produced smaller, nonsignificant increases. The effect may be mediated by cimetidine's known inhibition of hepatic cytochrome P450, the enzyme system responsible for the first-pass metabolism of diltiazem. Patients currently receiving diltiazem therapy should be carefully monitored for a change in pharmacological effect when initiating and discontinuing therapy with cimetidine. An adjustment in the diltiazem dose may be warranted.
Corticosteroids (methylprednisolone)	T	↑ P-gp plasma concentration	Inhibition of methylprednisolone metabolism (CYP3A4) and inhibition of P-glycoprotein by diltiazem. Therefore, patients should be monitored when initiating methylprednisolone treatment and a dose adjustment may be necessary.

Agent	Ref	Effect	Clinical comment
Cyclosporine	CT	↓ cyclosporine concentration in specific population	A pharmacokinetic interaction between diltiazem and cyclosporine has been observed during studies involving renal and cardiac transplant patients. In renal and cardiac transplant recipients, a reduction of cyclosporine dose ranging from 15% to 48% was necessary to maintain cyclosporine trough concentrations similar to those seen prior to the addition of diltiazem. If these agents are to be administered concurrently, cyclosporine concentrations should be monitored, especially when diltiazem therapy is initiated, adjusted, or discontinued. The effect of cyclosporine on diltiazem plasma concentrations has not been evaluated.
Dantrolene (infusion)	CT	Ventricular fibrillation effect in animals observed	Lethal ventricular fibrillation is regularly observed in animals when intravenous verapamil and dantrolene are administered concomitantly. The combination of calcium-channel antagonist and dantrolene is therefore potentially dangerous (see 2 CONTRAINDICATIONS).
Digitalis	CT	↑ digoxin serum level	Diltiazem and digitalis glycosides may have an additive effect in prolonging AV conduction. In clinical trials, concurrent administration of diltiazem and digoxin has resulted in increases in serum digoxin levels with prolongation of AV conduction. This increase may result from a decrease in renal clearance of digoxin. Patients on concomitant therapy, especially those with renal impairment, should be carefully monitored. The dose of digoxin may need downward adjustment.

Agent	Ref	Effect	Clinical comment
Direct Oral Anticoagulants (DOACs; e.g. apixaban, rivaroxaban, dabigatran)	C, CT	↑ DOAC plasma concentration	In a pharmacokinetic study, coadministration of apixaban with diltiazem led to a 1.4 and 1.3-fold increase in mean apixaban AUC and Cmax, respectively Coadministration of diltiazem and DOACs increases the risk of bleeding due to pharmacokinetic interaction via P-gp and CYP3A4. Literature evidence has shown increased risk of bleeding leading to hospitalization and even death in atrial fibrillation patients receiving diltiazem and apixaban, rivaroxaban or dabigatran. Concomitant treatment with diltiazem and DOACs in patients should be used with caution. Close clinical surveillance (looking for signs of bleeding or anemia) is recommended throughout the treatment period, especially in patients with renal impairment.
Erythromycin	CT	↑ erythromycin exposure	The use of erythromycin should be avoided in patients treated with CYP3A inhibitors, including diltiazem. An analysis reported in the literature indicates that the risk of sudden death is increased in current users of erythromycin (incidence-rate ratio = 2.01; 95% CI= 1.08 to 3.75), and this risk is further elevated in concurrent users of CYP3A inhibitors (5.35; 95% CI= 1.72 to 16.64), including diltiazem. Cohort analysis revealed one death in 106 person - years in diltiazem-treated patients.
Inducers of CYP3A4 (e.g. avasimibe, carbamazepine, phenytoin, rifampin)	T	↓ diltiazem plasma concentration	Diltiazem should be used with caution together with CYP3A4 inducers and dose adjustment may be necessary to maintain efficacy. Hence, monitoring of therapy is required

Agent	Ref	Effect	Clinical comment
Ivabradine	CT	Concomitant use with ivabradine is contraindicated due to the additional heart rate lowering effect of diltiazem to ivabradine	Additive effects are caused by PK and PD interactions between diltiazem and ivabradine. Both diltiazem and ivabradine are heart rate lowering substances. Moreover, diltiazem increases ivabradine exposure (2 to 3-fold increase in AUC) through CYP 3A4 inhibition. This could lead to an exacerbated reduction in patient's heart rate (see 2 CONTRAINDICATIONS).
Lithium	T	↑ Lithium neurotoxicity	Risk of increased in lithium-induced neurotoxicity.
Lomitapide mesylate	T	↑ AUC lomitapide mesylate (4-10- fold)	Co-administration of lomitapide mesylate with diltiazem is contraindicated (see 2 CONTRAINDICATIONS)
Other antiarrhythmic agents	T	↑ antiarrhythmic effect	Since diltiazem has antiarrhythmic properties, its concomitant prescription with other antiarrhythmic agents is not recommended (additive risk of increased cardiac adverse effects). This combination should only be used under close clinical and ECG monitoring.
Phenytoin	C	↑ phenytoin plasma concentration	When co-administered with phenytoin, diltiazem may increase phenytoin plasma concentration. It is recommended that the phenytoin plasma concentration be monitored.
Rifampicin	CT	↓ diltiazem plasma concentration	Administration of diltiazem with rifampin markedly reduced plasma diltiazem concentrations and the therapeutic effect of diltiazem. Patients should be carefully monitored when initiating or discontinuing rifampicin therapy.

Agent	Ref	Effect	Clinical comment
Short and Long Acting Nitrates	T	↑ vasodilating effect	Increased hypotensive effects and faintness (additive vasodilating effects) are observed when nitrates are coadministered with Calcium Channels Inhibitors. In patients treated with calcium antagonists, the prescription of nitrate derivatives should only be carried out gradually at increasing doses due to increased hypotensive effects.
Statins	CT	↑ simvastatin exposure	The concomitant administration of diltiazem with statin drugs warrants caution and requires close medical supervision. Rhabdomyolysis and hepatitis have been reported in patients treated with atorvastatin or simvastatin in combination with diltiazem, and in the case of simvastatin-treated patients, deaths have occurred. If diltiazem is prescribed to a patient already taking a statin, consideration should be given to decreasing the dose of the statin. In a published study of 10 healthy volunteers treated with simvastatin 20 mg, after 2 weeks of treatment with diltiazem 240 mg, the mean C_{max} (3.6 -fold) and AUC (5-fold) of simvastatin were increased significantly.
Strong inhibitors of CYP3A4 (e.g., ketoconazole, itraconazole, ritonavir, clarithromycin)	T	↑ diltiazem plasma concentration	Strong CYP3A4 inhibitors may significantly increase the plasma concentrations of diltiazem. Diltiazem should therefore be used with caution together with these agents and monitoring of therapy is required. Appropriate dosage adjustment of diltiazem may be necessary.
Theophylline	T	↑ antihypertensive	Increased antihypertensive effects.

Agent	Ref	Effect	Clinical comment
X-ray contrast media	T	↑ Hypotension	Cardiovascular effects of an intravenous bolus of an ionic X-ray contrast media, such as hypotension, may be increased in patients treated with diltiazem. Special caution is required in patients who concomitantly receive diltiazem and X-ray contrast media.

Legend: C = Case Study; CT = Clinical Trial; T = Theoretical

9.5 Drug-Food Interactions

Grapefruit Juice

Grapefruit Juice may increase the plasma concentrations of orally administered diltiazem in some patients. The proposed mechanism is inhibition of CYP450 3A4-mediated first-pass metabolism in the gut wall by certain compounds present in grapefruit.

Patients who regularly consume grapefruit or grapefruit juice should be monitored for increased adverse effects of diltiazem such as headache, irregular heartbeat, edema, unexplained weight gain, and chest pain. Grapefruit and grapefruit juice should be avoided if an interaction is suspected.

Multivitamins with minerals

Calcium-containing products may decrease the effectiveness of calcium channel blockers by saturating calcium channels with calcium. Calcium chloride has been used to manage acute severe verapamil toxicity. Monitoring of the effectiveness of calcium channel blocker therapy is advised during coadministration with calcium products.

9.6 Drug-Herb Interactions

Interactions with herbal products have not been established.

9.7 Drug-Laboratory Test Interactions

Interactions with laboratory tests have not been established.

10 CLINICAL PHARMACOLOGY

10.1 Mechanism of Action

TIAZAC XC (diltiazem hydrochloride) is a calcium ion cellular influx inhibitor (calcium channel blocker or calcium channel antagonist) of the benzothiazepine (non-dihydropyridine) class.

The therapeutic effect of this group of drugs is believed to be related to their specific cellular action of selectively inhibiting transmembrane influx of calcium ions into cardiac muscle and vascular smooth muscle. The contractile processes of these tissues are dependent upon the

movement of extracellular calcium into the cells through specific ion channels. Diltiazem blocks transmembrane influx of calcium through the slow channel without affecting, to any significant degree the transmembrane influx of sodium through the fast channel. This results in a reduction of free calcium ions available within cells of the above tissues. Diltiazem does not alter total serum calcium.

Hypertension

The antihypertensive effect of diltiazem is believed to be brought about largely by its vasodilatory action on peripheral blood vessels with resultant decrease in peripheral vascular resistance.

Angina

The precise mechanism by which diltiazem relieves angina has not been fully determined but it is believed to be brought about largely by its vasodilator action.

In angina due to coronary spasm, diltiazem increases myocardial oxygen delivery by dilating both large and small coronary arteries and by inhibiting coronary spasm at drug levels which cause little negative inotropic effect. The resultant increases in coronary blood flow are accompanied by dose-dependent decreases in systemic blood pressure and decreases in peripheral resistance.

In angina of effort it appears that the action of diltiazem is related to the reduction of myocardial oxygen demand. This is probably caused by a decrease in blood pressure brought about by the reduction of peripheral resistance and of heart rate.

10.2 Pharmacodynamics

Hypertension

In a double-blind clinical study, a diltiazem hydrochloride extended-release clinical trial formulation with the same bead coating as TIAZAC XC, administered daily at night for 7 weeks at doses of 120 mg, 240 mg, 360 mg and 540 mg was compared to administration of 360 mg in the morning. The 540 mg dose is not approved for use in Canada.

Group mean reductions in diastolic blood pressure between 6AM and 12 NOON, as measured by ambulatory blood pressure monitoring (ABPM) for 120 mg, 240 mg, 360 mg and 540 mg taken at night were 4.7, 8.9, 10.2- and 14.8-mm Hg, respectively, placebo-corrected. These reductions in diastolic blood pressure for all doses were significantly different from placebo and dose related. Within this time period of 6 AM to 12 NOON, the 360 mg PM dose produced a statistically significant 3.3 mm Hg greater reduction in diastolic blood pressure than the 360 mg AM dose.

When changes in mean seated office diastolic blood pressure from baseline were evaluated at 8 AM, the following decreases were noted: placebo 6.6 mmHg; 120 mg PM 10.5 mmHg; 240 mg PM 13.1 mmHg; 360 mg PM 15.5 mmHg; 540 mg PM 20.3 mmHg, with $p<0.0001$ for all comparisons with corresponding baseline measurements. For 360 mg AM, a mean decrease from baseline of 10.8 mmHg was seen, $p<0.0001$. When measured at 6 PM, the following decreases were noted: placebo 5.5 mmHg; 120 mg PM 5.2 mmHg; 240 mg PM 8.7 mmHg; 360 mg PM 10.3 mmHg; 540 mg PM 14.1 mmHg, with $p<0.0001$ for all comparisons with corresponding baseline measurements. For 360 mg AM, a mean decrease from baseline of

13.1 mmHg was seen, p<0.0001.

Angina

In a double-blind study involving 311 patients with chronic stable angina, evening doses of 180, 360 and 420 mg clinical trial formulation of TIAZAC XC were compared to placebo and to 360 mg administered in the morning. The 420 mg dose is not approved for use in Canada. All doses administered at night increased exercise tolerance when compared with placebo after 21 hours, during the diltiazem trough period. The median effect, placebo-subtracted, was 20 to 28 seconds for all three doses; no dose-response was demonstrated, i.e., use of the higher doses tested did not consistently result in increased exercise tolerance. The 360 mg dose given in the morning also improved exercise tolerance when measured 25 hours later. As expected, the effect was smaller than the effects measured only 21 hours following nighttime administration. TIAZAC XC had a larger effect in increasing exercise tolerance at peak serum concentrations than at trough.

Hemodynamic and Electrophysiologic Effects

Diltiazem produces antihypertensive effects both in the supine and standing positions. Resting heart rate is usually slightly reduced. During dynamic exercise, increases in diastolic pressure are inhibited while maximum achievable systolic pressure is usually unaffected. Heart rate at maximum exercise is reduced. Studies to date, primarily in patients with normal ventricular function, have shown that cardiac output, ejection fraction and left ventricular end-diastolic pressure have not been affected.

Chronic therapy with diltiazem produces no change, or a decrease, in circulating plasma catecholamines. However, no increased activity of the renin-angiotensin-aldosterone axis has been observed.

Diltiazem inhibits the renal and peripheral effects of angiotensin II.

In man, intravenous diltiazem in doses of 20 mg prolongs atrio-His conduction time and atrioventricular node functional and effective refractory periods by approximately 20%. Chronic oral administration of diltiazem in doses up to 540 mg per day has resulted in small increases in PR interval. Second degree and third-degree AV block have been observed (see 7 WARNINGS AND PRECAUTIONS). In patients with sick sinus syndrome, diltiazem significantly prolongs sinus cycle length (up to 50% in some cases).

In Vitro Observations

Initial experimental work revealed that diltiazem was a coronary and peripheral vasodilator. Subsequent work substantiated that diltiazem's smooth muscle relaxant effect, as well as negative inotropic effect, resulted from the drug's ability to block excitation-contraction coupling by inhibiting slow calcium channel conduction. In a muscle bath study with isolated human coronary artery segments obtained at the time of cardiac transplantation, diltiazem produced nearly complete relaxation of potassium-contracted segments.

Studies in various experimental models have confirmed the negative inotropic effect of diltiazem. At low doses (1.1 x 10-7 M), diltiazem caused a reduction in contractile force of guinea pig papillary muscle with no demonstrable effect on the action potential. However, at

higher concentrations (1.1 x 10-5 M), both a decrease in contractile tension and a lowering of maximum dp/dt were seen. Studies done in isolated perfused rat hearts showed that diltiazem (10-6 M) decreases contractility without affecting action potential duration or resting membrane potential. In several experimental models, it has been shown that the concentration of diltiazem required to produce smooth muscle relaxation and vasodilation is significantly less than the concentration required to produce a negative inotropic effect.

In Vivo Observations

Experiments in both open and closed chest dog models indicate that diltiazem increases coronary blood flow and reduces coronary vascular resistance. Intravenous diltiazem (100 mcg/kg) increased coronary blood flow by 90%, with a predominant effect on large coronary arteries and collaterals. Increase in coronary blood flow has also been shown following diltiazem administration in both the epicardial and subendocardial regions in ischemic and non-ischemic models. There was also a dose-related decrease in mean aortic pressure and systemic vascular resistance with an increase in stroke volume and cardiac output. No significant change was noted in determinants of LV function such as LVEDP or LV dp/dt.

The reduction in blood pressure that is seen with diltiazem is due to a direct vasodilatory effect on the blood vessels and is not mediated by sympathetic alpha receptor blockade, beta receptor stimulation, or ganglionic blockade. Diltiazem has been shown to inhibit the pressor responses induced by norepinephrine and angiotensin II.

In animal studies, the negative inotropic effect of diltiazem appears to be offset by its ability to decrease afterload and induce a mild reflex adrenergic response.

10.3 Pharmacokinetics

Absorption

Diltiazem is well absorbed from the gastrointestinal tract and is subject to an extensive first-pass effect giving absolute bioavailability (compared to intravenous dosing) of about 40%.

Distribution

Therapeutic blood levels appear to be in the range of 50-200 ng/mL. In-vitro human serum binding studies revealed that 70 to 80% of diltiazem is bound to plasma proteins. The pharmacokinetics of diltiazem are non-linear.

Metabolism

The metabolic pathways of diltiazem include N- and O-demethylation (via cytochrome P450), deacetylation (via plasma and tissue esterases), in addition to conjugation (via sulfation and glucuridonation). In vitro studies have demonstrated that CYP 3A4 is the principal CYP isoenzyme involved in N-demethylation (see 9 DRUG INTERACTIONS). The active metabolite, desacetyl diltiazem, is present in the plasma at levels 10-20% of the parent drug and is 25-50% as potent as diltiazem in terms of coronary vasodilation.

Excretion

Following extensive hepatic metabolism, only 2-4% of the drug appears unchanged in the urine and 6-7% appears as metabolites.

TIAZAC XC Tablets

TIAZAC XC has an extended-release delivery system designed for night-time administration, resulting in maximum diltiazem plasma levels in the morning.

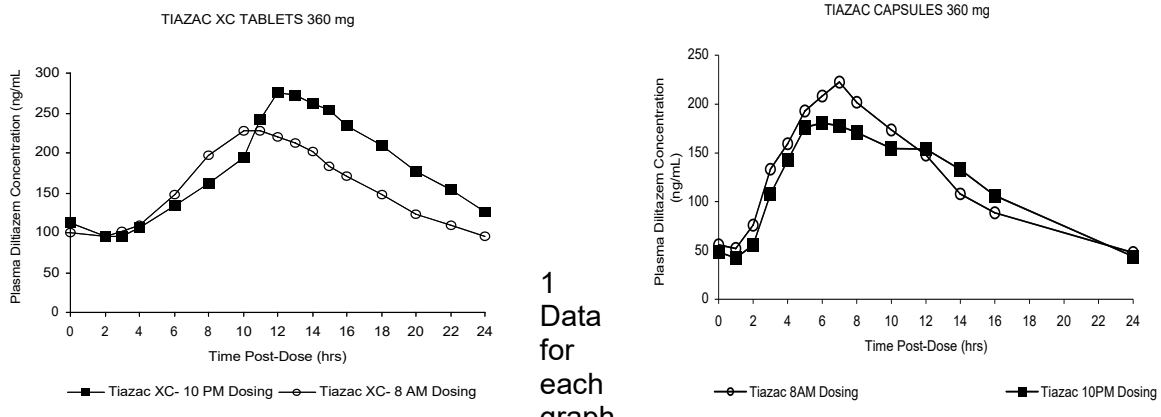
Administration of TIAZAC XC tablets in the fasted state at bedtime, in a single study, resulted in detectable diltiazem plasma levels after 3 to 4 hours, and peak plasma levels between 11 and 18 hours post dose. After single dosing, diltiazem bioavailability ranged from 2.5% to 16% over the first six hours. The apparent elimination half-life for TIAZAC XC after single or multiple dosing is 6 to 9 hours.

When a single dose of 360 mg TIAZAC XC tablets, administered at night, was compared to the same dose given in the morning, an 18% greater systemic exposure and 11% higher peak exposure were observed at night relative to morning. Under steady-state conditions, night-time administration resulted in 22% and 16% greater systemic and peak exposure, respectively, relative to morning administration.

When single doses of 360 mg TIAZAC XC tablets were given in the morning to assess potential food interaction, the observed ratios of means were AUC$_{TAO}$ 112.4% (90% C.I. 101.2 - 124.9) and Cmax 104.0% (90% C.I. 92.9 - 116.5) for the fed/fasted comparison (see 4 DOSAGE AND ADMINISTRATION).

While both TIAZAC XC tablets and TIAZAC capsules possess the same immediate release diltiazem-containing bead cores, the release-controlling polymer bead coatings are different, resulting in different bioavailability profiles. Further, the TIAZAC beads are encapsulated in gelatin capsules to produce the TIAZAC formulation, while TIAZAC XC tablet beads are blended with inert wax beads and excipients, then compressed into tablets.

Diltiazem time course kinetics, as noted across studies in healthy volunteers that evaluated TIAZAC XC tablets and TIAZAC capsules respectively, are presented below in Figure 1.



1 Data for each graph were obtained from separate studies.

Figure 1: 24- hour diltiazem plasma concentration time course at steady-state1

No studies are available that compare the relative bioavailability of TIAZAC XC tablets to TIAZAC capsules directly.

Special Populations and Conditions

- ***Pediatrics:*** Pharmacokinetic studies with TIAZAC XC in children have not been conducted.

- ***Geriatrics:*** Pharmacokinetic studies with TIAZAC XC in geriatrics have not been conducted. However, it is known that administration of diltiazem to elderly patients (over or equal to 65 years of age) requires caution. The incidence of adverse reactions is approximately 13% higher in this group.

- ***Sex:*** In pharmacokinetic studies in healthy volunteers, there were no statistically significant differences between male and female subjects with respect to the AUC (p=0.099) and Cmax (p=0.295).

- ***Race:*** The effect of race in pharmacokinetic studies has not been evaluated.

- ***Hepatic Insufficiency:*** No pharmacokinetic studies have been conducted with TIAZAC XC in patients with hepatic insufficiency.

- ***Renal Insufficiency:*** No pharmacokinetic studies have been conducted with TIAZAC XC in patients with renal insufficiency.

11 STORAGE, STABILITY AND DISPOSAL

Store at room temperature (15 - 30ºC).

Avoid excessive humidity, and temperatures above 30ºC. Keep out of sight and reach of children.

PART II: SCIENTIFIC INFORMATION

13 PHARMACEUTICAL INFORMATION

Drug Substance

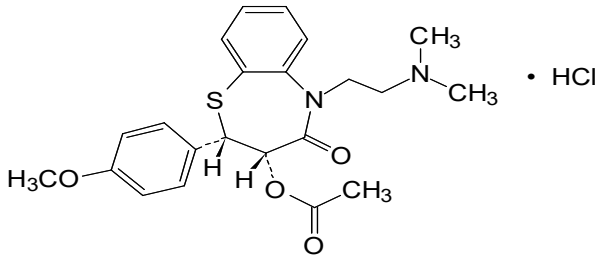
Proper name: Diltiazem Hydrochloride

Chemical name: Diltiazem hydrochloride is 1,5-Benzothiazepin-4(5H)-one,3-(acetyloxy)-5[2-(dimethylamino)ethyl]-2,-3-dihydro-2(4-methoxyphenyl)-, monohydrochloride, (+)-cis.

Molecular formula: $C_{22}H_{26}N_2O_4S.HCl$

Molecular mass: 450.98 g/mol

Structural formula:



Physicochemical properties

Description: Diltiazem hydrochloride is a white crystalline powder

Melting Point: 210 ºC to 215 ºC.

Solubility: Diltiazem hydrochloride is freely soluble in water, chloroform, formic acid and methanol. It is sparingly soluble in dehydrated alcohol, and insoluble in ether.

pH: The pH is of diltiazem is 4.3 to 5.3 (1% solution).

pKa: The pKa value is 7.7.

14 CLINICAL TRIALS

14.1 Clinical Trials by Indication

One clinical study was conducted in subjects with mild to moderate hypertension, and another clinical study was conducted in subjects with chronic stable angina.

Table 5-Clinical study

Study #	Dosage, Route of Administration and Duration	Study Subjects (n= number)	Mean age (range)	Gender (M/F)
Hypertension Double-blind, placebo-controlled, randomized, parallel group, dose-response.	Tablet, oral, 13 weeks	478 randomized, 429 completers	52.2 years (26 to 75 years)	63.4% male
Angina Double-blind, placebo-controlled, randomized, parallel-group, multicenter, dose-response	Tablet, oral, 3 weeks	311 randomized, 296 completers	63.2-65.4 per treatment group (33-84 years)	73.8-88.7% males treatment group

Hypertension

In a double-blind clinical study, a diltiazem hydrochloride extended-release clinical trial formulation with the same bead coating as TIAZAC XC, administered daily at night for 7 weeks at doses of 120 mg, 240 mg, 360 mg and 540 mg was compared to administration of 360 mg in the morning. The 540 mg dose is not approved for use in Canada.

Group mean reductions in diastolic blood pressure between 6 AM and 12 NOON, as measured by ambulatory blood pressure monitoring (ABPM) for 120 mg, 240 mg, 360 mg and 540 mg taken at night were 4.7, 8.9, 10.2- and 14.8-mm Hg, respectively, placebo-corrected. These reductions in diastolic blood pressure for all doses were significantly different from placebo and dose related. Within this time period of 6 AM to 12 NOON, the 360 mg PM dose produced a statistically significant 3.3 mm Hg greater reduction in diastolic blood pressure than the 360 mg AM dose.

When changes in mean seated office diastolic blood pressure from baseline were evaluated at 8 AM, the following decreases were noted: placebo 6.6 mmHg; 120 mg PM 10.5 mmHg; 240 mg PM 13.1 mmHg; 360 mg PM 15.5 mmHg; 540 mg PM 20.3 mmHg, with $p<0.0001$ for all comparisons with corresponding baseline measurements. For 360 mg AM, a mean decrease from baseline of 10.8 mmHg was seen, $p<0.0001$. When measured at 6 PM, the following decreases were noted: placebo 5.5 mmHg; 120 mg PM 5.2 mmHg; 240 mg PM 8.7 mmHg; 360 mg PM 10.3 mmHg; 540 mg PM 14.1 mmHg, with $p<0.0001$ for all comparisons with corresponding baseline measurements. For 360 mg AM, a mean decrease from baseline of 13.1 mmHg was seen, $p<0.0001$.

Angina

In a double-blind study involving 311 patients with chronic stable angina, evening doses of 180, 360 and 420 mg clinical trial formulation of TIAZAC XC were compared to placebo and to 360 mg administered in the morning. The 420 mg dose is not approved for use in Canada. All doses administered at night increased exercise tolerance when compared with placebo after 21 hours, during the diltiazem trough period. The median effect, placebo-subtracted, was 20 to 28 seconds for all three doses; no dose-response was demonstrated, i.e., use of the higher doses tested did not consistently result in increased exercise tolerance. The 360 mg dose given in the morning also improved exercise tolerance when measured 25 hours later. As expected, the effect was smaller than the effects measured only 21 hours following nighttime administration. TIAZAC XC had a larger effect in increasing exercise tolerance at peak serum concentrations than at trough.

14.2 Comparative Bioavailability Studies

TIAZAC XC has an extended-release delivery system designed for night-time administration, resulting in maximum diltiazem plasma levels in the morning.

Administration of TIAZAC XC tablets in the fasted state at bedtime, in a single study, resulted in detectable diltiazem plasma levels after 3 to 4 hours, and peak plasma levels between 11 and 18 hours post dose. After single dosing, diltiazem bioavailability ranged from 2.5% to 16% over the first six hours. The apparent elimination half-life for TIAZAC XC after single or multiple dosing is 6 to 9 hours.

When a single dose of 360 mg TIAZAC XC tablets, administered at night, was compared to the same dose given in the morning, an 18% greater systemic exposure and 11% higher peak exposure were observed at night relative to morning. Under steady-state conditions, night-time administration resulted in 22% and 16% greater systemic and peak exposure, respectively, relative to morning administration.

When single doses of 360 mg TIAZAC XC tablets were given in the morning to assess potential food interaction, the observed ratios of means were AUC_{Tao} 112.4% (90% C.I. 101.2 - 124.9) and Cmax 104.0% (90% C.I. 92.9 - 116.5) for the fed/fasted comparison (see 4 DOSAGE AND ADMINISTRATION).

16 NON-CLINICAL TOXICOLOGY

General Toxicology

Acute Toxicity

Table 6-Acute Toxicity

Route	Animal	Sex	LD_{50} (mg/kg)	LD_{50} 95% Confidence Limits (mg/kg)
Oral	Mice	M&F	415-700	(343-736)
	Rats	M&F	560-810	(505-1004)
s.c.	Mice	M&F	260-550	(220-672)
i.p.	Mice	M&F	187211	(165-211)
	Rats	M&F		(155-287)
i.v.	Mice	M&F	58-61	(52-69)
	Rats	M&F	38-39	(34-44)

Toxic effects appeared rapidly, and toxicity included reduction of spontaneous activity, ptosis, piloerection, ataxia, loss of muscle tone and loss of righting reflex. Gross autopsy of animals who died, as well as, the survivors revealed no abnormalities.

Tolerance was evaluated in rabbits and dogs. Dogs received oral doses of 12.5, 25, 50 or 100 mg/kg. Ataxia, disorientation, decreased activity, diuresis and mydriasis were noted at 25 mg/kg. In addition, heavy sedation and emesis were seen at 50 mg/kg. At 100 mg/kg, convulsions occurred, and one of the two animals died. Rabbits received 100, 200, 300, 400 mg/kg. The major symptoms were decreased activity, increased respiration, salivation and opisthotonos. One of the two rabbits died at 300 mg/kg and the two rabbits in the 400 mg/kg group died.

Subacute Toxicity

In rats, oral doses of 10, 20, 50, 100, 250 or 500 mg/kg/day of diltiazem were administered for 28 or 30 days. The relative liver weights of animals receiving 250 mg/kg/day and 500 mg/kg/day were increased. Microscopic examination revealed drug related degeneration of hepatic and renal cells in the highest dose group.

When the drug was given to rats intraperitoneally at 25 mg/kg/day for 30 days, hepatic and renal cell degeneration was seen. Macular hyaloid degeneration of the heart also was seen in 50% of the rats in this study.

Thirty-day subacute studies in dogs revealed hepatic and renal cell degeneration when diltiazem was given at doses of 25 mg/kg/day orally and 5 mg/kg/day intravenously. Two dogs out of 5 receiving 50 mg/kg/day orally, died.

Chronic Toxicity / Carcinogenicity

In mice, diltiazem was administered at doses of 5, 15 or 30 mg/kg/day for a period of 21 months in females. Because of a lower survival, males were terminated at 20 months. Gross and histopathological examination failed to reveal any treatment-related increase in the incidence of either neoplastic or other toxic lesions.

Rats received 6.25, 25 or 100 mg/kg/day of diltiazem for 24 months. An additional group received 200 mg/kg for 12 months. Treatment was terminated at 23 months in females receiving 100 mg/kg because of the low survival. Females had increased weight gain at 100 and 200 mg/kg, food consumption was increased among both sexes at these dose levels. Organ weight data revealed a significant increase in liver weight for rats of both sexes given 200 mg/kg. Microscopic evaluation revealed some evidence of dose dependent hepatic cytoplasmic vacuolization in rats treated with doses of 100 and 200 mg/kg/day and killed at 12 months. At 24 months, there were similar findings in control and treated animals. There was no increase in the incidence of neoplastic or other toxic lesions in rats treated with diltiazem.

Diltiazem was administered orally to dogs for 12 months at doses of 5, 10, 20 mg/kg/day. A dose related suppression of body weight gain became noticeable after 6 months.

Mutagenicity

No mutagenic changes were observed in the recombination test and two Ames reverse mutagenicity assays.

Reproductive and Developmental Toxicology

Table-7 Results in mice

Route	Doses mg/kg	Time of administration during gestation	Findings in the offspring
Oral	10, 25, 50, 100, 200, 400	Day 7 to 12	High incidence of vertebral column malformations when more than 50 mg/kg was administered.
Oral	Single doses of 12.5, 25, 50, 100, 200	One of days 7 to 14	Cleft palate and malformation of extremities or trunk were significantly higher when 50 or 100 mg/kg was administered on day 12. Vertebral malformations were most prevalent when 50 or 100 mg/kg was administered on day 9.

Intra-peritoneal	0.2, 3.1, 6.3, 12.5, 25	Day 7 to 12	Fetal mortality greatly increased when 12.5 mg/kg or more was administered. No teratogenic effect was demonstrated.
Intra-peritoneal	Single dose of 3.1, 6.3, 12.5, 25, 50	One of days 5 to 16	Brachydactyly and hematoma in the extremities when 50 mg/kg was administered on day 13. Vertebral column malformations from the thoracic to coccygeal level and malformations of the ribs were observed when a dose of 25 mg/kg or greater was administered on day 9.

Table-8 Results in Rats

Route	Doses mg/kg	Time of administration during gestation	Findings in the offspring
Oral	10, 30, 100	Day 6 to 15	No teratogenic effect.
Oral	Single doses of 300, 400, 600	On one of days 9 to 14	Significant incidence of skeletal malformations involving vertebrae & sternebrae when 400 mg/kg was administered on day 11. General edema, short or absent tail was observed when 600 mg/kg was administered on day 12.
Intra-peritoneal	0.2, 2.0, 20, 40, 80	Day 9 to 14	Brachydactyly & hematoma in the front paw and tail and a high fetal mortality rate were observed when 80 mg/kg was administered.
Intra-peritoneal	80	Day 9 to 11	Vertebral anomalies.
Intra-peritoneal	80	Day 12 to 14	Brachydactyly, hematoma of the front paw and tail deformities and high fetal mortality rate.
Intra-peritoneal	Single doses of 80	One of days 9 to 14	Fetal mortality increased on day 11, reached 100% on day 12, and decreased thereafter. Limb and tail deformities were induced when 80 mg/kg was administered on day 13 & 14. Vertebral column

	Single doses of 40	One of days 11 to 14	deformities were induced when 80 mg/kg was administered on day 11. No teratogenic effect.

Table-9 Results in Rabbits

Route	Doses mg/kg	Time of administration during gestation	Findings in the offspring
Oral	17.5, 35, 70	Day 6 to 18	Significant increase in skeletal malformations occurred when 35 mg/kg was administered. All pregnant dams aborted between days 21 and 25 of gestation when 70 mg/kg was administered.
Intra-peritoneal	6.3, 12.5, 25	Day 7 to 16	Fetal mortality greatly increased at 12.5 mg/kg and reached 100% at 25 mg/kg. Skeletal defects and external malformations were induced when 12.5 mg/kg was administered. Their incidence was not statistically significant due to the low number of surviving fetuses.

In the offspring of mice receiving a single oral dose of 50 or 100 mg/kg on day 12 of gestation, the incidence of cleft palate and malformed extremities was significantly higher. Vertebral malformations were most prevalent when they received the drug on day 9. In rats, a significantly higher fetal death rate was present when 200 and 400 mg/kg were given orally on days 9 to 14 of gestation. Single oral dose studies in rats resulted in a significant incidence of skeletal malformations in the offspring of the group receiving 400 mg/kg on day 11. In rabbits, all pregnant dams receiving 70 mg/kg orally from day 6 to 18 of gestation aborted; at 35 mg/kg, a significant increase in skeletal malformations was recorded in the offspring.

In fertility studies, female rats received doses of 12.5, 25, 50 and 100 mg/kg p.o. In the 100 mg/kg group, there was a reduction in the number showing a positive mating. However, the overall pregnancy rates and the average pre-coital time were comparable.

In peri- and post-natal studies, rats received diltiazem in doses of 10, 30 or 100 mg/kg/day from day 14 of gestation through day 21 post-partum. Diltiazem was associated with a reduction in early individual weights and survival rates of the pups. At 100 mg/kg/day, dystocia was evident. Retinal and tongue malformations were more frequent in the offspring of the 30 and 100 mg/kg/day group.

PATIENT MEDICATION INFORMATION
READ THIS FOR SAFE AND EFFECTIVE USE OF YOUR MEDICINE

PrTIAZAC® XC
Diltiazem Hydrochloride Extended-Release Tablets

This patient medication information is written for the person who will be taking **TIAZAC XC**. This may be you or a person you are caring for. Read this information carefully. Keep it as you may need to read it again.

This patient medication information is a summary. It will not tell you everything about this medication. If you have more questions about this medication or want more information about **TIAZAC XC**, talk to a healthcare professional.

What TIAZAC XC is used for

TIAZAC XC is used in adults to:

- treat mild to moderate high blood pressure. TIAZAC XC is normally used in patients who have tried other treatments for their blood pressure, but did not receive benefits, or had bad side effects.
- manage chest pain that most often occurs with physical activity or emotional stress (chronic stable angina). It can be used with other chest pain medicines when those medicines do not provide enough benefit on their own. TIAZAC XC is normally used in patients who have tried other treatments for their chest pain, but did not receive benefits, or had bad side effects.

How TIAZAC XC works:

TIAZAC XC belongs to a group of drugs called “calcium channel blockers” or “calcium antagonists”.

- TIAZAC XC relaxes the arteries, which allows blood to flow freely through them. This helps to lower blood pressure.
- TIAZAC XC increases the supply of oxygen to the heart muscle. This helps to control chest pain.

The ingredients in TIAZAC XC are:

Medicinal ingredients: Diltiazem Hydrochloride

Non-medicinal ingredients: Carnauba Wax, Colloidal Silicone Dioxide, Croscarmellose Sodium, Eudragit, Hydrogenated Vegetable Oil, Hydroxypropylmethylcellulose, Magnesium Stearate, Microcrystalline Cellulose, Paraffin Wax, Polydextrose, Polyethylene Glycol, Polysorbate, Povidone, Pregelatinized Starch, Simethicone, Sodium Starch Glycolate, Sucrose Stearate, Talc, and Titanium Dioxide.

TIAZAC XC comes in the following dosage forms:

Extended-release tablets; 120 mg, 180 mg, 240 mg, 300 mg, and 360 mg

Do not use TIAZAC XC if:

- you are allergic to diltiazem or any other ingredients in TIAZAC XC or its container.
- you have any heart rhythm disorders and do not have a pacemaker.
- you have very low blood pressure (less than 90 mmHg systolic).
- you have a very slow heartbeat (less than 40 beats/minute).
- you have had a heart attack and have fluid in your lungs as a result of heart failure.
- you are pregnant or plan to become pregnant.
- you are a woman of child-bearing potential, unless you and your healthcare professional have decided you should take TIAZAC XC.
- you are breastfeeding or planning to breastfeed.
- you are taking the following medicines:
  - dantrolene, used to treat severe muscle spasms or severe fever;
  - ivabradine, used to treat heart failure;
  - lomitapide mesylate, used to treat high blood cholesterol.

To help avoid side effects and ensure proper use, talk to your healthcare professional before you take TIAZAC XC. Talk about any health conditions or problems you may have, including if you:

- have had a recent heart attack.
- have heart, liver or kidney disease.
- have high blood sugar or diabetes.
- are 65 years of age or older.
- have a history of heart failure, new shortness of breath, slow heartbeat or low blood pressure. Cases of kidney injury in patients with such conditions have been reported.
- are at risk of developing an intestinal obstruction (blockage).
- have asthma or other breathing problems. TIAZAC XC may cause your symptoms to get worse after a dose increase.

Other warnings you should know about:

TIAZAC XC can cause serious side effects, including:

- **Kidney problems:** TIAZAC XC can cause kidney problems, even at prescribed doses. You are at higher risk if you have heart failure, a very slow heartbeat or very low blood pressure.
- **Hyperglycemia** (high blood sugar): TIAZAC XC may affect your blood sugar. If you have diabetes, closely monitor your blood sugar while taking TIAZAC XC and report any unusual results to your healthcare professional.

See the **Serious side effects and what to do about them** table for more information on these and other serious side effects.

Surgery: Tell any doctor, dentist, pharmacist or healthcare professional that you see, that you are taking this medicine. This is especially important if you are planning to have surgery (including dental procedures).

Pregnancy:

- Avoid becoming pregnant while you are taking TIAZAC XC. If you are able to get pregnant, you should use effective birth control (contraception) during your treatment. Talk to your healthcare professional about the best kind of birth control to use while you are taking TIAZAC XC.
- If you take TIAZAC XC during pregnancy, it may harm your unborn baby. Your healthcare professional will discuss the risks with you.
- If you discover that you are pregnant, stop taking TIAZAC XC and tell your healthcare professional **right away**.

Breastfeeding: TIAZAC XC passes into breast milk and may harm your baby. Do not breastfeed during treatment with TIAZAC XC. Talk to your healthcare professional about ways to feed your baby during this time.

Adults (65 years of age or older): Side effects like swelling of the arms or legs, irregular heartbeat, dizziness, skin rash and frequent urination may happen more often. Your healthcare professional might adjust your dose of TIAZAC XC. They will monitor your health during and after treatment.

Checks-up and testing:

- You will have regular visits with your healthcare professional while you are taking TIAZAC XC to monitor your health. They will:
  - do blood and urine tests to check your liver and kidney health, and the level of sugar in your blood;
  - check your lungs and verify if you have any breathing problems.
- TIAZAC XC can cause abnormal blood test results. Your healthcare professional will decide when to perform blood tests and will interpret the results.

Tell your healthcare professional about all the medicines you take, including any drugs, vitamins, minerals, natural supplements or alternative medicines.

Serious Drug Interactions

Do not take TIAZAC XC with:

- dantrolene, used to treat severe muscle spasms or severe fever;
- ivabradine, used to treat heart failure;
- lomitapide mesylate, used to treat high blood cholesterol.

Serious drug interactions with TIAZAC XC include:

- medicines used to prevent and treat blood clots (Direct Oral Anticoagulants (DOACs)) such as dabigatran, rivaroxaban, apixaban.

Taking TIAZAC XC with any of these medicines may cause serious drug interactions. Ask your healthcare professional if you are unsure you are taking these medicines.

The following may also interact with TIAZAC XC:

- medicines used to treat fungal infections with a name ending in “azole”;
- medicines used to treat bacterial infections, such as rifampin, erythromycin, clarithromycin;
- medicines used to treat high blood pressure, such as alpha antagonists, beta blockers;
- heart medications, such as amiodarone, digoxin, digitalis, flecainide, nifedipine, propafenone, quinidine, verapamil;
- medicines used to treat chest pain (angina), such as short or long acting nitrates;
- medicines used to control seizures, such as carbamazepine, phenytoin, phenobarbital;
- medicines used to lower blood cholesterol, such as “statins”;
- medicines used to reduce stomach acid and treat ulcers in the stomach or intestines, such as cimetidine, ranitidine;
- medicines used to treat inflammation, such as corticosteroids (including methylprednisolone);
- acetylsalicylic acid (ASA, or ASPIRIN) or medicines used to prevent blood clots, such as ticagrelor, cilostazol, clopidogrel, dipyridamole, ticlopidine, warfarin;
- sleeping pills, such as benzodiazepines (midazolam, triazolam);
- anesthetics;
- cyclosporine, used to control the immune system;
- lithium, used to treat bipolar disorder;
- imipramine, used to treat depression;
- theophylline, used to treat asthma or other lung diseases;
- terfenadine, used to treat allergies;
- ritonavir, used to treat HIV/AIDS;
- products that contain calcium such as multivitamins with minerals;
- X-ray contrast agents.

Alcohol
Drinking alcohol while taking TIAZAC XC may cause low blood pressure when you go from lying or sitting to standing up. This is more likely to occur after the first dose or when the dose is increased. Tell your healthcare professional if you experience dizziness, light-headedness, fainting decreased blood pressure or increased heart rate.

Grapefruit juice
Drinking grapefruit juice while taking TIAZAC XC may cause headache, irregular heartbeat, edema (swelling), unexplained weight gain and chest pain. Tell your healthcare professional if this happens to you. Your healthcare professional may recommend that you avoid grapefruit juice while taking TIAZAC XC.

How to take TIAZAC XC:

- Take TIAZAC XC once daily at bedtime.
- TIAZAC XC can be taken with or without food.
- It is important to take TIAZAC XC at night, at approximately the same time.
- DO NOT chew or crush TIAZAC XC tablets.

Usual dose:

High Blood Pressure: the usual starting dose is 180 mg to 240 mg once a day. Maximum daily dose: 360 mg once a day.

Chest Pain (angina): your healthcare professional will decide the best dose for you. The usual starting dose is 180 mg once a day. Your dose may be slowly increased (over 7 to 14 days). Maximum daily dose: 360 mg once a day.

Overdose:

Signs of an overdose with TIAZAC XC include:

- very slow or irregular heartbeat.
- very low blood pressure.
- kidney problems.
- heart does not pump blood as well as it should or suddenly stops beating.

If you think you, or a person you are caring for, have taken too much TIAZAC XC, contact a healthcare professional, hospital emergency department, or regional poison control centre immediately, even if there are no symptoms.

Missed Dose:

If you miss a dose, take it as soon as possible. However, if it is almost time for the next dose, skip the missed dose and take your next dose as scheduled. Do not take two doses at the same time.

Possible side effects from using TIAZAC XC:

These are not all the possible side effects you may feel when taking TIAZAC XC. If you experience any side effects not listed here, tell your healthcare professional.

- Headache, dizziness, malaise;
- Nausea (feeling like vomiting);
- Flushing (facial redness) or feeling unusually warm;
- Rash;
- Temporary swelling;
- Unusual tiredness and weakness;
- Upset stomach or indigestion.

Serious side effects and what to do about them			
Symptom / effect	**Talk to your healthcare professional**		**Stop taking drug and get immediate medical help**
	Only if severe	**In all cases**	
COMMON			
Allergic reaction: rash, hives, swelling of the face, lips, tongue or throat, difficulty swallowing or breathing			√
Fast, slow or irregular heartbeat		√	
Hypotension (low blood pressure): dizziness, fainting, light-headedness, blurred vision, nausea, vomiting, fatigue (may occur when you go from lying or sitting to standing up).	√		
Peripheral edema: (swelling of the legs or hands): swollen or puffy legs, ankles or hands, feeling heavy, achy or stiff	√		
Respiratory tract infection: (a cold): runny or stuffy nose, sore throat, cough, sinus congestion, body aches, headache, sneezing, fever, generally feeling unwell		√	
UNCOMMON			
Angina (chest pain): discomfort in the shoulder, arm, back, throat, jaw or teeth; pain or pressure in the chest		√	
Depression: (sad mood that won't go away): difficulty sleeping or sleeping too much, changes in appetite or weight, feelings of worthlessness, guilt, regret, helplessness or hopelessness, withdrawal from social situations, family, gatherings and activities with friends, reduced libido (sex drive) and thoughts of death or suicide. If you have a history of depression, your depression may become worse	√		
Eye problems: blurred vision, loss of vision in the eye, increased sensitivity of the eyes	√		

to light, eye pain or redness, swelling and itching of the eyelids			
Heart block (a disease in the electrical system of the heart): light-headedness, fainting, irregular heartbeat			√
Heart failure: shortness of breath, fatigue and weakness, leg swelling in legs, ankles and feet, cough, lack of appetite, nausea, rapid or irregular heartbeat, reduced ability to exercise		√	
Hyperglycemia: (high blood sugar): increased thirst and hunger, frequent urination, thirst, and hunger headache, blurred vision, fatigue	√		
RARE			
Kidney problems: nausea, vomiting, fever, swelling of extremities, fatigue, thirst, dry skin, irritability, dark urine, increased or decreased urine output, blood in the urine, rash, weight gain (from retaining fluid), loss of appetite, abnormal blood test results, mental status changes (drowsiness, confusion, coma)		√	
Liver problems: yellowing of the skin or eyes, dark urine, stomach pain or swelling, nausea, vomiting, unusual tiredness		√	
Severe skin reactions: fever, severe rash, swollen lymph glands, flu-like feeling, blisters and peeling skin that may start in and around the mouth, nose, eyes and genitals and spread to other areas of the body, yellow skin or eyes, shortness of breath, dry cough, chest pain or discomfort, feeling thirsty, urinating less often, less urine			√

If you have a troublesome symptom or side effect that is not listed here or becomes bad enough to interfere with your daily activities, tell your healthcare professional.

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 (https://www.canada.ca/en/health-canada/services/drugs-health-products/medeffect-canada/adverse-reaction-reporting.html) 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.

Storage:

- Store TIAZAC XC tablets at room temperature (15-30°C).
- Avoid excessive humidity and temperatures above 30ºC.
- Keep out of reach and sight of children.

If you want more information about TIAZAC XC:

- Talk to your healthcare professional
- Find the full product monograph that is prepared for healthcare professionals and includes this Patient Medication Information by visiting the Health Canada website: (https://www.canada.ca/en/health-canada/services/drugs-health-products/drug-products/drug-product-database.html); the manufacturer's website www.bauschhealth.ca, or by calling 1-800-361-4261.

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