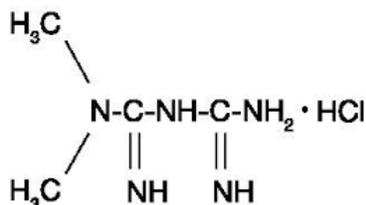


## Metformin Hydrochloride Extended-release Tablets

### Rx Only

#### DESCRIPTION

Metformin hydrochloride extended-release tablets USP contain an oral antihyperglycemic drug used in the management of type 2 diabetes. Metformin hydrochloride (N, N-dimethylimidodicarbonimidic diamide hydrochloride) is a member of the biguanide class of oral antihyperglycemics and is not chemically or pharmacologically related to any other class of oral antihyperglycemic agents. The empirical formula of metformin hydrochloride is  $C_4H_{11}N_5 \cdot HCl$  and its molecular weight is 165.63. Its structural formula is:



Metformin hydrochloride is a white to off-white crystalline powder that is freely soluble in water and is practically insoluble in acetone, ether, and chloroform. The pKa of metformin is 12.4. The pH of a 1% aqueous solution of metformin hydrochloride is 6.68.

Metformin hydrochloride extended-release tablets USP are designed for once-a-day oral administration and deliver 500 mg or 1000 mg of metformin hydrochloride. In addition to the active ingredient metformin hydrochloride, each tablet contains the following inactive ingredients: ammonio methacrylate copolymer type A, ammonio methacrylate copolymer type B, colloidal silicone dioxide, crospovidone, dibutyl sebacate, hypromellose, magnesium stearate, microcrystalline cellulose and povidone.

Metformin hydrochloride extended-release tablets USP meets USP Dissolution Test 12.

#### SYSTEM COMPONENTS AND PERFORMANCE

Metformin hydrochloride extended-release tablet USP is designed for once-a-day oral administration using the swellable matrix coated with a permeable membrane technology. The tablet is similar in appearance to other film-coated oral administered tablets but it consists of a swellable active core formulation that is coated by a permeable membrane. The core formulation is composed primarily of drug with swellable matrix excipients. Upon ingestion, water is taken up through the membrane, which in turn causes swelling of the polymer in an active core which control the drug release from the membrane. The rate of drug delivery is totally depending on the degree of swelling of the control release polymer and membrane thickness.

#### CLINICAL PHARMACOLOGY

##### Mechanism of Action

Metformin is an antihyperglycemic agent which improves glucose tolerance in patients with type 2 diabetes, lowering both basal and postprandial plasma glucose. Its pharmacologic mechanisms

of action are different from other classes of oral antihyperglycemic agents. Metformin decreases hepatic glucose production, decreases intestinal absorption of glucose, and improves insulin sensitivity by increasing peripheral glucose uptake and utilization. Unlike sulfonylureas, metformin does not produce hypoglycemia in either patients with type 2 diabetes or normal subjects (except in special circumstances, *see PRECAUTIONS*) and does not cause hyperinsulinemia. With metformin therapy, insulin secretion remains unchanged while fasting plasma insulin levels and day-long plasma insulin response may actually decrease.

## PHARMACOKINETICS AND DRUG METABOLISM

### Absorption and Bioavailability

The appearance of metformin in plasma from a metformin hydrochloride extended-release tablet is slower and more prolonged compared to immediate-release metformin.

In a multiple-dose crossover study, 23 patients with type 2 diabetes mellitus were administered either metformin hydrochloride extended-release tablets 2000 mg once a day (after dinner) or immediate-release (IR) metformin hydrochloride 1000 mg twice a day (after breakfast and after dinner). After 4 weeks of treatment, steady-state pharmacokinetic parameters, area under the concentration-time curve (AUC), time to peak plasma concentration ( $T_{max}$ ), and maximum concentration ( $C_{max}$ ) were evaluated. Results are presented in **Table 1**.

<b>Pharmacokinetic Parameters (mean ± SD)</b>	<b>Extended-Release Metformin 2000 mg (administered q. d. after dinner)</b>	<b>Immediate-Release Metformin 2000 mg (1000 mg b.i.d.)</b>
AUC <sub>0-24 hr</sub> (ng•hr/mL)	26,811 ± 7055	27,371 ± 5,781
$T_{max}$ (hr)	6 (3 to 10)	3 (1 to 8)
$C_{max}$ (ng/mL)	2849 ± 797	1820 ± 370

In four single-dose studies and one multiple-dose study, the bioavailability of metformin hydrochloride extended-release tablet 2000 mg given once daily, in the evening, under fed conditions [as measured by the area under the plasma concentration versus time curve (AUC)] was similar to the same total daily dose administered as immediate-release metformin 1000 mg given twice daily. The geometric mean ratios (metformin extended-release / immediate-release metformin) of AUC<sub>0-24hr</sub>, AUC<sub>0-72hr</sub>, and AUC<sub>0-inf</sub> for these five studies ranged from 0.96 to 1.08.

In a single-dose, four-period replicate crossover design study, comparing two 500 mg metformin hydrochloride extended-release tablets to one 1000 mg metformin hydrochloride extended-release tablet administered in the evening with food to 29 healthy male subjects, two 500 mg metformin hydrochloride extended-release tablets were found to be equivalent to one 1000 mg metformin hydrochloride extended-release tablet.

In a study carried out with metformin hydrochloride extended-release tablets, there was a dose-associated increase in metformin exposure over 24 hours following oral administration of 1000, 1500, 2000, and 2500 mg.

In three studies with metformin hydrochloride extended-release tablets using different treatment

regimens (2000 mg after dinner; 1000 mg after breakfast and after dinner; and 2500 mg after dinner), the pharmacokinetics of metformin as measured by AUC appeared linear following multiple-dose administration.

The extent of metformin absorption (as measured by AUC) from metformin hydrochloride extended-release tablets increased by approximately 60% when given with food. When metformin hydrochloride extended-release tablet was administered with food,  $C_{\max}$  was increased by approximately 30% and  $T_{\max}$  was more prolonged compared with the fasting state (6.1 versus 4.0 hours).

### **Distribution**

Distribution studies with metformin hydrochloride extended-release tablets have not been conducted. However, the apparent volume of distribution (V/F) of metformin following single oral doses of immediate-release metformin 850 mg averaged  $654 \pm 358$  L. Metformin is negligibly bound to plasma proteins, in contrast to sulfonylureas, which are more than 90% protein bound. Metformin partitions into erythrocytes, most likely as a function of time. At usual clinical doses and dosing schedules of immediate-release metformin, steady state plasma concentrations of metformin are reached within 24 to 48 hours and are generally  $<1$  mcg/mL. During controlled clinical trials of immediate-release metformin, maximum metformin plasma levels did not exceed 5 mcg/mL, even at maximum doses.

### **Metabolism and Excretion**

Metabolism studies with metformin hydrochloride extended-release tablets have not been conducted. Intravenous single-dose studies in normal subjects demonstrate that metformin is excreted unchanged in the urine and does not undergo hepatic metabolism (no metabolites have been identified in humans) nor biliary excretion.

In healthy nondiabetic adults (N=18) receiving 2500 mg q.d. metformin hydrochloride extended-release tablets, the percent of the metformin dose excreted in urine over 24 hours was 40.9% and the renal clearance was  $542 \pm 310$  mL/min. After repeated administration of metformin hydrochloride extended-release tablets, there is little or no accumulation of metformin in plasma, with most of the drug being eliminated via renal excretion over a 24-hour dosing interval. The  $t_{1/2}$  was 5.4 hours for metformin hydrochloride extended-release tablets.

Renal clearance of metformin (**Table 2**) is approximately 3.5 times greater than creatinine clearance, which indicates that tubular secretion is the major route of metformin elimination. Following oral administration, approximately 90% of the absorbed drug is eliminated via the renal route within the first 24 hours, with a plasma elimination half-life of approximately 6.2 hours. In blood, the elimination half-life is approximately 17.6 hours, suggesting that the erythrocyte mass may be a compartment of distribution.

### **Special Populations**

#### ***Geriatrics***

Limited data from controlled pharmacokinetic studies of immediate-release metformin in healthy elderly subjects suggest that total plasma clearance of metformin is decreased, the half-life is prolonged, and  $C_{\max}$  is increased, compared to healthy young subjects. From these data, it appears

that the change in metformin pharmacokinetics with aging is primarily accounted for by a change in renal function (**Table 2**; also see *WARNINGS, PRECAUTIONS and DOSAGE AND ADMINISTRATION*).

### **Pediatrics**

No pharmacokinetic data from studies of pediatric patients are currently available (*see PRECAUTIONS*).

### **Gender**

Five studies indicated that with metformin treatment, the pharmacokinetic results for males and females were comparable.

<b>Subject Groups: Immediate-Release Metformin dose<sup>a</sup> (number of subjects)</b>	<b>C<sub>max</sub><sup>b</sup> (mcg/mL)</b>	<b>T<sub>max</sub><sup>c</sup> (hrs)</b>	<b>Renal Clearance (mL/min)</b>
<b>Healthy, nondiabetic adults:</b>			
500 mg single dose (24)	1.03 ( $\pm$ 0.33)	2.75 ( $\pm$ 0.81)	600 ( $\pm$ 132)
850 mg single dose (74) <sup>d</sup>	1.60 ( $\pm$ 0.38)	2.64 ( $\pm$ 0.82)	552 ( $\pm$ 139)
850 mg three times daily for 19 doses <sup>e</sup> (9)	2.01 ( $\pm$ 0.42)	1.79 ( $\pm$ 0.94)	642 ( $\pm$ 173)
<b>Adults with type 2 diabetes:</b>			
850 mg single dose (23)	1.48 ( $\pm$ 0.5)	3.32 ( $\pm$ 1.08)	491 ( $\pm$ 138)
850 mg three times daily for 19 doses <sup>e</sup> (9)	1.90 ( $\pm$ 0.62)	2.01 ( $\pm$ 1.22)	550 ( $\pm$ 160)
<b>Elderly<sup>f</sup>, healthy nondiabetic adults:</b>			
850 mg single dose (12)	2.45 ( $\pm$ 0.70)	2.71 ( $\pm$ 1.05)	412 ( $\pm$ 98)
<b>Renal-impaired adults: 850 mg single dose</b>			
<b>Mild</b> (CL <sub>cr</sub> <sup>g</sup> 61 to 90 mL/min) (5)	1.86 ( $\pm$ 0.52)	3.20 ( $\pm$ 0.45)	384 ( $\pm$ 122)
<b>Moderate</b> (CL <sub>cr</sub> 31 to 60 mL/min) (4)	4.12 ( $\pm$ 1.83)	3.75 ( $\pm$ 0.50)	108 ( $\pm$ 57)
<b>Severe</b> (CL <sub>cr</sub> 10 to 30 mL/min) (6)	3.93 ( $\pm$ 0.92)	4.01 ( $\pm$ 1.10)	130 ( $\pm$ 90)

<sup>a</sup> All doses given fasting except the first 18 doses of the multiple dose studies

<sup>b</sup> Peak plasma concentration

<sup>c</sup> Time to peak plasma concentration

<sup>d</sup> Combined results (average means) of five studies: mean age 32 years (range 23 to 59 years)

<sup>e</sup> Kinetic study done following dose 19, given fasting

<sup>f</sup> Elderly subjects, mean age 71 years (range 65 to 81 years)

<sup>g</sup> CL<sub>cr</sub> = creatinine clearance normalized to body surface area of 1.73 m<sup>2</sup>

### **Renal Impairment**

In patients with decreased renal function, the plasma and blood half-life of metformin is prolonged and the renal clearance is decreased (**Table 2**; also see *CONTRAINDICATIONS, WARNINGS, PRECAUTIONS, and DOSAGE AND ADMINISTRATION*).

### **Hepatic Insufficiency**

No pharmacokinetic studies of metformin have been conducted in patients with hepatic insufficiency.

### **Race**

No studies of metformin pharmacokinetic parameters according to race have been performed. In controlled clinical studies of immediate-release metformin in patients with type 2 diabetes, the

antihyperglycemic effect was comparable in whites (n=249), blacks (n=51), and Hispanics (n=24).

**Clinical Studies**

In a double-blind, randomized, active-controlled, multicenter U.S. clinical study, which compared extended-release metformin q.d. to immediate-release metformin b.i.d., 680 patients with type 2 diabetes who had been taking metformin-containing medication at study entry were randomly assigned in equal numbers to double-blind treatment with either extended-release metformin or immediate-release metformin. Doses were adjusted during the first six weeks of treatment with study medication based on patients’ FPG levels and were then held constant over a period of 20 weeks. The primary efficacy endpoint was the change in HbA<sub>1c</sub> from baseline to endpoint. The primary objective was to demonstrate the clinical non-inferiority of extended-release metformin compared to immediate-release metformin on the primary endpoint.

Extended-release metformin and metformin patients had mean HbA<sub>1c</sub> changes from baseline to endpoint equal to +0.40 and +0.14, respectively (**Table 3**). The least-square (LS) mean treatment difference was 0.25 (95% CI = 0.14, 0.37) demonstrating that extended-release metformin was clinically similar to metformin according to the pre-defined criterion to establish efficacy.

<b>Table 3 Extended-Release Metformin vs. Immediate-Release Metformin Switch Study: Summary of Mean Changes in HbA<sub>1c</sub>, Fasting Plasma Glucose, Body Weight, Body Mass Index, and Plasma Insulin</b>			
	<b>Extended-Release Metformin</b>	<b>Immediate-Release Metformin</b>	<b>Treatment difference for change from baseline (Extended-Release Metformin minus Immediate-Release Metformin) LS mean (2 sided 95% CI<sup>a</sup>)</b>
<b>HbA<sub>1c</sub> (%)</b>			
<b>N</b>	327	332	0.25
<b>Baseline (mean ± SD)</b>	7.04 ± 0.88	7.07 ± 0.76	(0.14, 0.37) <sup>b</sup>
<b>Change from baseline (mean ± SD)</b>	0.40 ± 0.75	0.14 ± 0.75	
<b>Fasting Plasma Glucose (mg/dL)</b>			
<b>N</b>	329	333	6.43
<b>Baseline (mean ± SD)</b>	146.8 ± 32.1	145.6 ± 29.5	(0.57, 12.29)
<b>Change from baseline (mean ± SD)</b>	10.0 ± 40.8	4.2 ± 35.9	
<b>Plasma Insulin (µu/mL)</b>			
<b>N</b>	304	316	0.02
<b>Baseline (mean ± SD)</b>	17.9 ± 15.1	17.3 ± 10.5	(-1.47, 0.50)
<b>Change from baseline (mean ± SD)</b>	-3.6 ± 13.8	-3.2 ± 8.6	
<b>Body Weight (kg)</b>			
<b>N</b>	313	320	0.30
<b>Baseline (mean ± SD)</b>	94.1 ± 17.8	93.3 ± 17.4	(-0.22, 0.81)
<b>Change from baseline (mean ± SD)</b>	0.3 ± 2.9	0.0 ± 3.7	
<b>Body Mass Index (kg/m<sup>2</sup>)</b>			
<b>N</b>	313	320	0.08
<b>Baseline (mean ± SD)</b>	31.1 ± 4.7	31.4 ± 4.5	(-0.11, 0.26)
<b>Change from baseline (mean ± SD)</b>	0.1 ± 1.1	0.0 ± 1.3	

<sup>a</sup> CI= Confidence Interval

<sup>b</sup> Extended-release metformin was clinically similar to immediate-release metformin based on the pre-defined criterion to establish efficacy. While demonstrating clinical similarity, the response to extended-release metformin

compared to immediate-release metformin was also shown to be statistically smaller as seen by the 95% CI for the treatment difference which did not include zero.

Footnote: Patients were taking metformin-containing medications at baseline that were prescribed by their personal physician.

The mean changes for FPG (**Table 3**) and plasma insulin (**Table 3**) were small for both extended-release metformin and immediate-release metformin, and were not clinically meaningful. Seventy-six (22%) and 49 (14%) of the extended-release metformin and immediate-release patients, respectively, discontinued prematurely from the trial. Eighteen (5%) patients on extended-release metformin withdrew because of a stated lack of efficacy, as compared with 8 patients (2%) on immediate-release metformin (p=0.047).

Results from this study also indicated that neither extended-release metformin nor immediate-release metformin were associated with weight gain or increases in body mass index.

A 24-week, double blind, placebo-controlled study of immediate-release metformin plus insulin, versus insulin plus placebo, was conducted in patients with type 2 diabetes who failed to achieve adequate glycemic control on insulin alone (**Table 4**). Patients randomized to receive immediate-release metformin plus insulin achieved a reduction in HbA<sub>1c</sub> of 2.10%, compared to a 1.56% reduction in HbA<sub>1c</sub> achieved by insulin plus placebo. The improvement in glycemic control was achieved at the final study visit with 16% less insulin, 93.0 U/day versus 110.6 U/day, immediate-release metformin plus insulin versus insulin plus placebo, respectively, p=0.04.

	<b>Immediate-Release Metformin /Insulin (n = 26)</b>	<b>Placebo/Insulin (n = 28)</b>	<b>Treatment difference Mean ± SE</b>
<b>HbA<sub>1c</sub> (%)</b>			
Baseline	8.95	9.32	
Change at FINAL VISIT	-2.10	-1.56	-0.54 ± 0.43 <sup>a</sup>
<b>Insulin Dose (U/day)</b>			
Baseline	93.12	94.64	
Change at FINAL VISIT	-0.15	15.93	-16.08 ± 7.77 <sup>b</sup>

<sup>a</sup> Statistically significant using analysis of covariance with baseline as covariate (p=0.04).

Not significant using analysis of variance (values shown in table)

<sup>b</sup> Statistically significant for insulin (p=0.04)

A second double-blind, placebo-controlled study (n=51), with 16 weeks of randomized treatment, demonstrated that in patients with type 2 diabetes controlled on insulin for 8 weeks with an average HbA<sub>1c</sub> of 7.46 ± 0.97%, the addition of immediate-release metformin maintained similar glycemic control (HbA<sub>1c</sub> 7.15 ± 0.61 versus 6.97 ± 0.62 for immediate-release metformin plus insulin and placebo plus insulin, respectively) with 19% less insulin versus baseline (reduction of 23.68 ± 30.22 versus an increase of 0.43 ± 25.20 units for immediate-release metformin plus insulin and placebo plus insulin, p<0.01). In addition, this study demonstrated that the combination of immediate-release metformin plus insulin resulted in reduction in body weight of 3.11 ± 4.30 lbs, compared to an increase of 1.30 ± 6.08 lbs for placebo plus insulin, p=0.01.

### Pediatric Clinical Studies

No pediatric clinical studies have been conducted with extended-release metformin. In a double-blind, placebo-controlled study in pediatric patients aged 10 to 16 years with type 2 diabetes (mean FPG 182.2 mg/dL), treatment with immediate-release metformin (up to 2000 mg/day) for up to 16 weeks (mean duration of treatment 11 weeks) resulted in a significant mean net reduction in FPG of 64.3 mg/dL compared with placebo (**Table 5**).

	<b>Immediate-Release Metformin</b>	<b>Placebo</b>	<b>p-Value</b>
<b>FPG (mg/dL)</b>	<b>(n = 37)</b>	<b>(n = 36)</b>	
Baseline	162.4	192.3	
Change at FINAL VISIT	-42.9	21.4	<0.001
<b>Body Weight (lbs)</b>	<b>(n = 39)</b>	<b>(n = 38)</b>	
Baseline	205.3	189.0	
Change at FINAL VISIT	-3.3	-2.0	NS**

<sup>a</sup> Pediatric patients mean age 13.8 years (range 10 to 16 years)

\* All patients on diet therapy at Baseline

\*\* Not statistically significant

### INDICATIONS AND USAGE

Metformin hydrochloride extended-release tablets are indicated as an adjunct to diet and exercise to improve glycemic control in adults with type 2 diabetes mellitus.

### CONTRAINDICATIONS

Metformin is contraindicated in patients with:

1. Severe renal impairment (eGFR below 30 mL/min/1.73 m<sup>2</sup>) (*see WARNINGS and PRECAUTIONS*).
2. Known hypersensitivity to metformin.
3. Acute or chronic metabolic acidosis, including diabetic ketoacidosis, with or without coma. Diabetic ketoacidosis should be treated with insulin.

## WARNINGS: LACTIC ACIDOSIS

Post-marketing cases of metformin-associated lactic acidosis have resulted in death, hypothermia, hypotension, and resistant bradyarrhythmias. The onset of metformin-associated lactic acidosis is often subtle, accompanied only by nonspecific symptoms such as malaise, myalgias, respiratory distress, somnolence, and abdominal pain. Metformin-associated lactic acidosis was characterized by elevated blood lactate levels (> 5 mmol/Liter), anion gap acidosis (without evidence of ketonuria or ketonemia), an increased lactate/pyruvate ratio; and metformin plasma levels generally >5 mcg/mL [*see PRECAUTIONS*].

Risk factors for metformin-associated lactic acidosis include renal impairment, concomitant use of certain drugs (e.g., carbonic anhydrase inhibitors such as topiramate), age 65 years old or greater, having a radiological study with contrast, surgery and other procedures, hypoxic states (e.g., acute congestive heart failure), excessive alcohol intake, and hepatic impairment.

Steps to reduce the risk of and manage metformin-associated lactic acidosis in these high risk groups are provided [*see DOSAGE AND ADMINISTRATION, CONTRAINDICATIONS, and PRECAUTIONS*].

If metformin-associated lactic acidosis is suspected, immediately discontinue metformin hydrochloride extended-release tablets and institute general supportive measures in a hospital setting. Prompt hemodialysis is recommended [*see PRECAUTIONS*].

## PRECAUTIONS

### General

#### *Lactic Acidosis*

There have been post-marketing cases of metformin-associated lactic acidosis, including fatal cases. These cases had a subtle onset and were accompanied by nonspecific symptoms such as malaise, myalgias, abdominal pain, respiratory distress, or increased somnolence; however, hypotension and resistant bradyarrhythmias have occurred with severe acidosis. Metformin-associated lactic acidosis was characterized by elevated blood lactate concentrations (> 5 mmol/L), anion gap acidosis (without evidence of ketonuria or ketonemia), and an increased lactate:pyruvate ratio; metformin plasma levels were generally > 5 mcg/mL. Metformin decreases liver uptake of lactate increasing lactate blood levels which may increase the risk of lactic acidosis, especially in patients at risk.

If metformin-associated lactic acidosis is suspected, general supportive measures should be instituted promptly in a hospital setting, along with immediate discontinuation of metformin hydrochloride extended-release tablets. In metformin hydrochloride extended-release tablets treated patients with a diagnosis or strong suspicion of lactic acidosis, prompt hemodialysis is recommended to correct the acidosis and remove accumulated metformin (metformin hydrochloride is dialyzable with a clearance of up to 170 mL/min under good hemodynamic conditions). Hemodialysis has often resulted in reversal of symptoms and recovery.

Educate patients and their families about the symptoms of lactic acidosis and if these symptoms occur, instruct them to discontinue metformin hydrochloride extended-release tablets and report these symptoms to their healthcare provider.

For each of the known and possible risk factors for metformin-associated lactic acidosis, recommendations to reduce the risk of and manage metformin-associated lactic acidosis are provided below:

- **Renal Impairment:**

The postmarketing metformin-associated lactic acidosis cases primarily occurred in patients with significant renal impairment. The risk of metformin accumulation and metformin-associated lactic acidosis increases with the severity of renal impairment because metformin is substantially excreted by the kidney. Clinical recommendations based upon the patient's renal function include (*see DOSAGE AND ADMINISTRATION and CLINICAL PHARMACOLOGY*):

- Before initiating metformin hydrochloride extended-release tablets, obtain an estimated glomerular filtration rate (eGFR)
- Metformin hydrochloride extended-release tablets are contraindicated in patients with an eGFR less than 30 mL/min/1.73 m<sup>2</sup> (*see CONTRAINDICATIONS*).
- Initiation of metformin hydrochloride extended-release tablets are not recommended in patients with eGFR between 30 to 45 mL/min/1.73 m<sup>2</sup>.
- Obtain an eGFR at least annually in all patient taking metformin hydrochloride extended-release tablets. In patients at risk for the development of renal impairment (e.g., the elderly), renal function should be assessed more frequently.
- In patients taking metformin hydrochloride extended-release tablets whose eGFR falls below 45 mL/min/1.73 m<sup>2</sup>, assess the benefit and risk of continuing therapy.

- **Drug interactions:**

The concomitant use of metformin hydrochloride extended-release tablets with specific drugs may increase the risk of metformin-associated lactic acidosis: those that impair renal function, result in significant hemodynamic change, interfere with acid-base balance, or increase metformin accumulation. Consider more frequent monitoring of patients.

- **Age 65 or Greater:**

The risk of metformin-associated lactic acidosis increases with the patient's age because elderly patients have a greater likelihood of having hepatic, renal, or cardiac impairment than younger patients. Assess renal function more frequently in elderly patients.

- **Radiologic studies with contrast:**

Administration of intravascular iodinated contrast agents in metformin-treated patients has led to an acute decrease in renal function and the occurrence of lactic acidosis. Stop metformin hydrochloride extended-release tablets at the time of, or prior to, an iodinated contrast imaging procedure in patients with an eGFR between 30 and 60 mL/min/1.73 m<sup>2</sup>; in patients with a history of hepatic impairment, alcoholism or heart failure, or in patients who will be administered intra-arterial iodinated contrast. Re-evaluate eGFR 48

hours after the imaging procedure, and restart metformin hydrochloride extended-release tablets if renal function is stable.

- ***Surgery and other procedures:***

Withholding of food and fluids during surgical or other procedures may increase the risk for volume depletion, hypotension, and renal impairment. Metformin hydrochloride extended-release tablets should be temporarily discontinued while patients have restricted food and fluid intake.

- ***Hypoxic states:***

Several of the postmarketing cases of metformin-associated lactic acidosis occurred in the setting of acute congestive heart failure (particularly when accompanied by hypoperfusion and hypoxemia). Cardiovascular collapse (shock), acute myocardial infarction, sepsis, and other conditions associated with hypoxemia have been associated with lactic acidosis and may cause prerenal azotemia. When such an event occurs, discontinue metformin hydrochloride extended-release tablets.

- ***Excessive Alcohol intake:***

Alcohol is known to potentiate the effect of metformin on lactate metabolism. Patients, therefore, should be warned against excessive alcohol intake, acute or chronic, while receiving metformin hydrochloride extended-release tablets.

- ***Hepatic impairment:***

Patients with hepatic impairment have developed cases of metformin-associated lactic acidosis. This may be due to impaired lactate clearance resulting in higher lactate blood levels. Therefore, avoid use of metformin hydrochloride extended-release tablets in patients with clinical or laboratory evidence of hepatic disease.

### ***Vitamin B<sub>12</sub> levels***

In controlled clinical trials of immediate-release metformin of 29 weeks duration, a decrease to subnormal levels of previously normal serum Vitamin B<sub>12</sub> levels, without clinical manifestations, was observed in approximately 7% of patients. Such decrease, possibly due to interference with B<sub>12</sub> absorption from the B<sub>12</sub>-intrinsic factor complex, is, however, very rarely associated with anemia and appears to be rapidly reversible with discontinuation of immediate-release metformin or Vitamin B<sub>12</sub> supplementation. Measurement of hematologic parameters on an annual basis is advised in patients on metformin and any apparent abnormalities should be appropriately investigated and managed (*see PRECAUTIONS: Laboratory Tests*). Certain individuals (those with inadequate Vitamin B<sub>12</sub> or calcium intake or absorption) appear to be predisposed to developing subnormal Vitamin B<sub>12</sub> levels. In these patients, routine serum Vitamin B<sub>12</sub> measurements at two- to three-year intervals may be useful.

### ***Hypoglycemia***

Hypoglycemia does not occur in patients receiving metformin alone under usual circumstances of use, but could occur when caloric intake is deficient, when strenuous exercise is not compensated by caloric supplementation, or during concomitant use with other glucose-lowering agents (such as sulfonylureas and insulin) or ethanol. Elderly, debilitated, or malnourished patients, and those with adrenal or pituitary insufficiency or alcohol intoxication are particularly

susceptible to hypoglycemic effects. Hypoglycemia may be difficult to recognize in the elderly, and in people who are taking beta-adrenergic blocking drugs.

### ***Macrovascular Outcomes***

There have been no clinical studies establishing conclusive evidence of macrovascular risk reduction with metformin hydrochloride extended-release tablets or any other anti-diabetic drug.

### **Information for Patients**

Patients should be informed of the potential risks and benefits of metformin and of alternative modes of therapy. They should also be informed about the importance of adherence to dietary instructions, of a regular exercise program, and of regular testing of blood glucose, glycosylated hemoglobin, renal function, and hematologic parameters.

The risks of lactic acidosis, its symptoms, and conditions that predispose to its development, as noted in the **WARNINGS** and **PRECAUTIONS** sections, should be explained to patients. Patients should be advised to discontinue metformin immediately and to promptly notify their health practitioner if unexplained hyperventilation, myalgia, malaise, unusual somnolence, or other nonspecific symptoms occur. Once a patient is stabilized on any dose level of metformin, gastrointestinal symptoms, which are common during initiation of metformin therapy, are unlikely to be drug related. Later occurrence of gastrointestinal symptoms could be due to lactic acidosis or other serious disease.

Patients should be counseled against excessive alcohol intake, either acute or chronic, while receiving metformin.

Metformin alone does not usually cause hypoglycemia, although it may occur when metformin is used in conjunction with oral sulfonylureas and insulin. When initiating combination therapy, the risks of hypoglycemia, its symptoms and treatment, and conditions that predispose to its development should be explained to patients and responsible family members (*see PATIENT INFORMATION* Printed Below).

Patients should be informed that metformin must be swallowed whole and not chewed, cut, or crushed, and that the inactive ingredients may occasionally be eliminated in the feces as a soft mass that may resemble the original tablet (*see PATIENT INFORMATION*).

### **Laboratory Tests**

Response to all diabetic therapies should be monitored by periodic measurements of fasting blood glucose and glycosylated hemoglobin levels, with a goal of decreasing these levels toward the normal range. During initial dose titration, fasting glucose can be used to determine the therapeutic response. Thereafter, both glucose and glycosylated hemoglobin should be monitored. Measurements of glycosylated hemoglobin may be especially useful for evaluating long-term control (*see also DOSAGE AND ADMINISTRATION*).

Initial and periodic monitoring of hematologic parameters (e.g., hemoglobin/hematocrit and red blood cell indices) and renal function (serum creatinine) should be performed, at least on an annual basis. While megaloblastic anemia has rarely been seen with immediate-release metformin

therapy, if this is suspected, Vitamin B<sub>12</sub> deficiency should be excluded.

Instruct patients to inform their doctor that they are taking metformin hydrochloride extended-release tablets prior to any surgical or radiological procedure, as temporary discontinuation of metformin hydrochloride extended-release tablets may be required until renal function has been confirmed to be normal (*see PRECAUTIONS*).

### ***Drug Interactions (Clinical Evaluation of Drug Interactions Conducted with Immediate-Release Metformin)***

#### ***Glyburide:***

In a single-dose interaction study in type 2 diabetes patients, co-administration of metformin and glyburide did not result in any changes in either metformin pharmacokinetics or pharmacodynamics. Decreases in glyburide AUC and C<sub>max</sub> were observed, but were highly variable. The single-dose nature of this study and the lack of correlation between glyburide blood levels and pharmacodynamic effects, makes the clinical significance of this interaction uncertain (*see DOSAGE AND ADMINISTRATION: Concomitant Metformin and Oral Sulfonylurea Therapy in Adult Patients*).

#### ***Furosemide:***

A single-dose, metformin-furosemide drug interaction study in healthy subjects demonstrated that pharmacokinetic parameters of both compounds were affected by co-administration. Furosemide increased the metformin plasma and blood C<sub>max</sub> by 22% and blood AUC by 15%, without any significant change in metformin renal clearance.

When administered with metformin, the C<sub>max</sub> and AUC of furosemide were 31% and 12% smaller, respectively, than when administered alone, and the terminal half-life was decreased by 32%, without any significant change in furosemide renal clearance. No information is available about the interaction of metformin and furosemide when co-administered chronically.

#### ***Nifedipine:***

A single-dose, metformin-nifedipine drug interaction study in normal healthy volunteers demonstrated that co-administration of nifedipine increased plasma metformin C<sub>max</sub> and AUC by 20% and 9%, respectively, and increased the amount excreted in the urine. T<sub>max</sub> and half-life were unaffected. Nifedipine appears to enhance the absorption of metformin. Metformin had minimal effects on nifedipine.

### ***Drugs that reduce metformin clearance***

Concomitant use of drugs that interfere with common renal tubular transport systems involved in the renal elimination of metformin (e.g., organic cationic transporter-2 [OCT2] / multidrug and toxin extrusion [MATE] inhibitors such as ranolazine, vandetanib, dolutegravir, and cimetidine) could increase systemic exposure to metformin and may increase the risk for lactic acidosis. Consider the benefits and risks of concomitant use. Such interaction between metformin and oral cimetidine has been observed in normal healthy volunteers in both single- and multiple-dose, metformin-cimetidine drug interaction studies, with a 60% increase in peak metformin plasma and whole blood concentrations and a 40% increase in plasma and whole blood metformin AUC.

There was no change in elimination half-life in the single-dose study. Metformin had no effect on cimetidine pharmacokinetics.

In healthy volunteers, the pharmacokinetics of metformin and propranolol, and metformin and ibuprofen were not affected when coadministered in single-dose interaction studies.

Metformin is negligibly bound to plasma proteins and is, therefore, less likely to interact with highly protein-bound drugs such as salicylates, sulfonamides, chloramphenicol, and probenecid, as compared to the sulfonylureas, which are extensively bound to serum proteins.

***Other:***

Certain drugs tend to produce hyperglycemia and may lead to loss of glycemic control. These drugs include the thiazides and other diuretics, corticosteroids, phenothiazines, thyroid products, estrogens, oral contraceptives, phenytoin, nicotinic acid, sympathomimetics, calcium channel blocking drugs, and isoniazid. When such drugs are administered to a patient receiving metformin, the patient should be closely observed for loss of blood glucose control. When such drugs are withdrawn from a patient receiving metformin, the patient should be observed closely for hypoglycemia.

In healthy volunteers, the pharmacokinetics of metformin and propranolol, and metformin and ibuprofen were not affected when co-administered in single-dose interaction studies.

Metformin is negligibly bound to plasma proteins and is, therefore, less likely to interact with highly protein-bound drugs such as salicylates, sulfonamides, chloramphenicol, and probenecid, as compared to the sulfonylureas, which are extensively bound to serum proteins.

***Carbonic Anhydrase Inhibitors***

Topiramate or other carbonic anhydrase inhibitors (e.g., zonisamide, acetazolamide or dichlorphenamide) frequently causes a decrease in serum bicarbonate and induce non-anion gap, hyperchloremic metabolic acidosis. Concomitant use of these drugs with metformin hydrochloride extended-release tablets may increase the risk for lactic acidosis. Consider more frequent monitoring of these patients.

***Alcohol***

Alcohol is known to potentiate the effect of metformin on lactate metabolism. Warn patients against excessive alcohol intake while receiving metformin hydrochloride extended-release tablets.

***Carcinogenesis, Mutagenesis, Impairment of Fertility***

Long-term carcinogenicity studies with metformin have been performed in rats (dosing duration of 104 weeks) and mice (dosing duration of 91 weeks) at doses up to and including 900 mg/kg/day and 1500 mg/kg/day, respectively. These doses are both approximately four times the maximum recommended human daily dose of 2000 mg based on body surface area comparisons. No evidence of carcinogenicity with metformin was found in either male or female mice. Similarly, there was no tumorigenic potential observed with metformin in male rats. There was, however, an increased incidence of benign stromal uterine polyps in female rats treated with 900 mg/kg/day.

There was no evidence of mutagenic potential of metformin in the following *in vitro* tests: Ames test (*S. typhimurium*), gene mutation test (mouse lymphoma cells), or chromosomal aberrations test (human lymphocytes). Results in the *in vivo* mouse micronucleus test were also negative.

Fertility of male or female rats was unaffected by metformin when administered at doses as high as 600 mg/kg/day, which is approximately three times the maximum recommended human daily dose based on body surface area comparisons.

### **Pregnancy**

#### ***Teratogenic Effects: Pregnancy Category B***

Recent information strongly suggests that abnormal blood glucose levels during pregnancy are associated with a higher incidence of congenital abnormalities. Most experts recommend that insulin be used during pregnancy to maintain blood glucose levels as close to normal as possible. Because animal reproduction studies are not always predictive of human response, metformin should not be used during pregnancy unless clearly needed.

There are no adequate and well-controlled studies in pregnant women with immediate-release metformin or extended-release metformin. Metformin was not teratogenic in rats and rabbits at doses up to 600 mg/kg/day. This represents an exposure of about two and six times the maximum recommended human daily dose of 2000 mg based on body surface area comparisons for rats and rabbits, respectively. Determination of fetal concentrations demonstrated a partial placental barrier to metformin.

### **Nursing Mothers**

Studies in lactating rats show that metformin is excreted into milk and reaches levels comparable to those in plasma. Similar studies have not been conducted in nursing mothers. Because the potential for hypoglycemia in nursing infants may exist, a decision should be made whether to discontinue nursing or to discontinue the drug, taking into account the importance of the drug to the mother. If metformin is discontinued, and if diet alone is inadequate for controlling blood glucose, insulin therapy should be considered.

### **Pediatric Use**

No pediatric clinical studies have been conducted with metformin hydrochloride extended-release tablets. The safety and effectiveness of immediate-release metformin for the treatment of type 2 diabetes have been established in pediatric patients ages 10 to 16 years (studies have not been conducted in pediatric patients below the age of 10 years). Use of immediate-release metformin in this age group is supported by evidence from adequate and well-controlled studies of immediate-release metformin in adults with additional data from a controlled clinical study in pediatric patients ages 10 to 16 years with type 2 diabetes, which demonstrated a similar response in glycemic control to that seen in adults (*see CLINICAL PHARMACOLOGY: Pediatric Clinical Studies*). In this study, adverse effects were similar to those described in adults (*see ADVERSE REACTIONS: Pediatric Patients*). A maximum daily dose of 2000 mg of immediate-release metformin is recommended.

The safety and efficacy of metformin hydrochloride extended-release tablets have not been

evaluated in pediatric patients.

### Geriatric Use

Of the 389 patients who received metformin in controlled Phase III clinical studies, 26.5% [103/389] were 65 years and older. No overall differences in effectiveness or safety were observed between these patients and younger patients.

Controlled clinical studies of immediate-release metformin did not include sufficient numbers of elderly patients to determine whether they respond differently from younger patients, although other reported clinical experience has not identified differences in responses between the elderly and younger patients.

In general, dose selection for an elderly patient should be cautious, usually starting at the low end of the dosing range, reflecting the greater frequency of decreased hepatic, renal, or cardiac function, and of concomitant disease or other drug therapy and the higher risk of lactic acidosis. Assess renal function more frequently in elderly patients (see *WARNINGS, PRECAUTIONS, AND DOSAGE AND ADMINISTRATION*).

## ADVERSE REACTIONS

### Extended-Release Metformin Clinical Studies

In the controlled clinical studies of extended-release metformin in patients with type 2 diabetes, a total of 424 patients received extended-release metformin therapy (up to 2500 mg/day) and 430 patients received immediate-release metformin. Adverse reactions reported in  $\geq 5\%$  of the extended-release metformin or immediate-release metformin patients are listed in **Table 6**. These pooled results show that the most frequently reported adverse reactions in the extended-release metformin group were infection, diarrhea, and nausea. Similar incidences of these adverse reactions were seen in the immediate-release metformin group.

Body System Preferred Term	Extended-Release Metformin (N=424)		Immediate-Release Metformin (N=430)	
	n	(%)	n	(%)
<b>Body as a Whole</b>				
Accidental Injury	31	(7.3)	24	(5.6)
Headache	20	(4.7)	22	(5.1)
Infection	87	(20.5)	90	(20.9)
<b>Digestive System</b>				
Diarrhea	71	(16.7)	51	(11.9)
Dyspepsia	18	(4.2)	22	(5.1)
Nausea	36	(8.5)	32	(7.4)
<b>Respiratory System</b>				
Rhinitis	18	(4.2)	24	(5.6)

The most frequent adverse events thought to be related to extended-release metformin were diarrhea, nausea, dyspepsia, flatulence, and abdominal pain. The frequency of dyspepsia was 4.2% in the extended-release metformin group compared to 5.1% in the immediate-release

group, the frequency of flatulence was 3.5% in the extended-release metformin group compared to 3.7% in the immediate-release group, and the frequency of abdominal pain was 3.3% in the extended-release metformin group compared to 4.4% in the immediate-release group.

In the controlled studies, 4.7% of patients treated with extended-release metformin and 4.9% of patients treated with immediate-release metformin were discontinued due to adverse events.

### Immediate-Release Metformin

#### *Immediate-Release Metformin Phase III Clinical Studies*

In a U.S. double-blind clinical study of immediate-release metformin in patients with type 2 diabetes, a total of 141 patients received immediate-release metformin therapy (up to 2550 mg per day) and 145 patients received placebo. Adverse reactions reported in greater than 5% of the immediate-release metformin patients, and that were more common in immediate-release metformin than placebo-treated patients, are listed in **Table 7**.

	<b>Immediate-Release Metformin Monotherapy (n = 141)</b>	<b>Placebo (n = 145)</b>
<b>Adverse Reaction</b>	<b>% of Patients</b>	
Diarrhea	53.2	11.7
Nausea/Vomiting	25.5	8.3
Flatulence	12.1	5.5
Asthenia	9.2	5.5
Indigestion	7.1	4.1
Abdominal Discomfort	6.4	4.8
Headache	5.7	4.8

\* Reactions that were more common in immediate-release metformin than placebo-treated patients

Diarrhea led to discontinuation of study medication in 6% of patients treated with immediate-release metformin. Additionally, the following adverse reactions were reported in  $\geq 1.0$  to  $\leq 5.0\%$  of immediate-release metformin patients and were more commonly reported with immediate-release metformin than placebo: abnormal stools, hypoglycemia, myalgia, lightheaded, dyspnea, nail disorder, rash, sweating increased, taste disorder, chest discomfort, chills, flu syndrome, flushing, palpitation.

### Pediatric Patients

No pediatric clinical studies have been conducted with metformin hydrochloride extended-release tablets. In clinical trials with immediate-release metformin in pediatric patients with type 2 diabetes, the profile of adverse reactions was similar to that observed in adults.

Cholestatic, hepatocellular, and mixed hepatocellular liver injury have been reported with postmarketing use of metformin.

### OVERDOSAGE

Hypoglycemia has not been seen even with ingestion of up to 85 grams of immediate-release metformin, although lactic acidosis has occurred in such circumstances (*see WARNINGS*).

Metformin is dialyzable with a clearance of up to 170 mL/min under good hemodynamic conditions. Therefore, hemodialysis may be useful for removal of accumulated drug from patients in whom metformin over-dosage is suspected.

## **DOSAGE AND ADMINISTRATION**

There is no fixed dosage regimen for the management of hyperglycemia in patients with type 2 diabetes with metformin hydrochloride extended-release tablets or any other pharmacologic agent. Dosage of metformin hydrochloride extended-release tablets must be individualized on the basis of both effectiveness and tolerance, while not exceeding the maximum recommended daily dose. The maximum recommended daily dose of metformin hydrochloride extended-release tablets in adults is 2500 mg.

Metformin hydrochloride extended-release tablets should be taken with a full glass of water once daily with the evening meal. Metformin hydrochloride extended-release tablets should be started at a low dose, with gradual dose escalation, both to reduce gastrointestinal side effects and to permit identification of the minimum dose required for adequate glycemic control of the patient.

During treatment initiation and dose titration (*see Recommended Dosing Schedule*), fasting plasma glucose should be used to determine the therapeutic response to metformin hydrochloride extended-release tablets and identify the minimum effective dose for the patient. Thereafter, glycosylated hemoglobin should be measured at intervals of approximately three months. The therapeutic goal should be to decrease both fasting plasma glucose and glycosylated hemoglobin levels to normal or near normal by using the lowest effective dose of metformin hydrochloride extended-release tablets, either when used as monotherapy or in combination with sulfonylurea or insulin.

Monitoring of blood glucose and glycosylated hemoglobin will also permit detection of primary failure, i.e., inadequate lowering of blood glucose at the maximum recommended dose of medication, and secondary failure, i.e., loss of an adequate blood glucose lowering response after an initial period of effectiveness.

Short-term administration of metformin hydrochloride extended-release tablets may be sufficient during periods of transient loss of control in patients usually well-controlled on diet alone.

### **Recommended Dosing Schedule**

The usual starting dose of metformin hydrochloride extended-release tablets is 1000 mg taken with a full glass of water once daily with the evening meal, although 500 mg may be utilized when clinically appropriate. Dosage increases should be made in increments of 500 mg weekly, up to a maximum of 2500 mg once daily with the evening meal (*see CLINICAL PHARMACOLOGY, Clinical Studies*).

In randomized trials, patients currently treated with immediate-release metformin were switched to metformin hydrochloride extended-release tablets. Results of this trial suggest that patients receiving immediate-release metformin treatment may be safely switched to metformin hydrochloride extended-release tablets once daily at the same total daily dose, up to 2500 mg once daily. Following a switch from immediate-release metformin to metformin hydrochloride

extended-release tablets, glycemic control should be closely monitored and dosage adjustments made accordingly (*see CLINICAL PHARMACOLOGY, Clinical Studies*).

**Pediatrics** – There is no pediatric information available for metformin hydrochloride extended-release tablets.

### **Concomitant Metformin Hydrochloride Extended-Release Tablets and Oral Sulfonylurea Therapy in Adult Patients**

If patients have not responded to four weeks of the maximum dose of metformin hydrochloride extended-release tablets monotherapy, consideration should be given to gradual addition of an oral sulfonylurea while continuing metformin hydrochloride extended-release tablets at the maximum dose, even if prior primary or secondary failure to a sulfonylurea has occurred. Clinical and pharmacokinetic drug-drug interaction data are currently available only for metformin plus glyburide (also known as glibenclamide). With concomitant metformin hydrochloride extended-release tablets and sulfonylurea therapy, the desired control of blood glucose may be obtained by adjusting the dose of each drug. However, attempts should be made to identify the minimum effective dose of each drug to achieve this goal. With concomitant metformin hydrochloride extended-release tablets and sulfonylurea therapy, the risk of hypoglycemia associated with sulfonylurea therapy continues and may be increased. Appropriate precautions should be taken (*see Package Insert of the respective sulfonylurea*).

If patients have not satisfactorily responded to one to three months of concomitant therapy with the maximum dose of metformin and the maximum dose of an oral sulfonylurea, consider therapeutic alternatives including switching to insulin with or without metformin.

### **Concomitant Metformin Hydrochloride Extended-Release Tablets and Insulin Therapy in Adult Patients**

The current insulin dose should be continued upon initiation of metformin hydrochloride extended-release tablets therapy. Metformin therapy should be initiated at 500 mg once daily in patients on insulin therapy. For patients not responding adequately, the dose of metformin hydrochloride extended-release tablets should be increased by 500 mg after approximately 1 week and by 500 mg every week thereafter until adequate glycemic control is achieved. The maximum recommended daily dose for metformin hydrochloride extended-release tablets is 2500 mg. It is recommended that the insulin dose be decreased by 10% to 25% when fasting plasma glucose concentrations decrease to less than 120 mg/dL in patients receiving concomitant insulin and metformin hydrochloride extended-release tablets. Further adjustment should be individualized based on glucose-lowering response.

### **Recommendations for Use in Renal Impairment**

Assess renal function prior to initiation of metformin hydrochloride extended-release tablets and periodically thereafter.

Metformin hydrochloride extended-release tablets are contraindicated in patients with an estimated glomerular filtration rate (eGFR) below 30 mL/minute/1.73 m<sup>2</sup>.

Initiation of metformin hydrochloride extended-release tablets in patients with an eGFR between 30 to 45 mL/minute/1.73 m<sup>2</sup> is not recommended.

In patients taking metformin hydrochloride extended-release tablets whose eGFR later falls below 45 mL/min/1.73 m<sup>2</sup>, assess the benefit risk of continuing therapy.

Discontinue metformin hydrochloride extended-release tablets if the patient's eGFR later falls below 30 mL/minute/1.73 m<sup>2</sup>. (See *WARNINGS and PRECAUTIONS*).

### **Discontinuation for Iodinated Contrast Imaging Procedures**

Discontinue metformin hydrochloride extended-release tablets at the time of, or prior to, an iodinated contrast imaging procedure in patients with an eGFR between 30 and 60 mL/min/1.73 m<sup>2</sup>; in patients with a history of liver disease, alcoholism or heart failure; or in patients who will be administered intra-arterial iodinated contrast. Re-evaluate eGFR 48 hours after the imaging procedure; restart metformin hydrochloride extended-release tablets if renal function is stable.

### **Specific Patient Populations**

Metformin hydrochloride extended-release tablets are not recommended for use in pregnancy, and is not recommended in patients below the age of 17 years.

The initial and maintenance dosing of metformin hydrochloride extended-release tablets should be conservative in patients with advanced age, due to the potential for decreased renal function in this population. Any dosage adjustment should be based on a careful assessment of renal function.

Monitoring of renal function is necessary to aid in prevention of lactic acidosis, particularly in the elderly (*see WARNINGS*).

### **HOW SUPPLIED**

Metformin hydrochloride extended-release tablets USP are supplied as biconvex-shaped, film-coated extended-release tablets containing 500 mg or 1000 mg of metformin hydrochloride.

Metformin hydrochloride extended-release tablets USP 500 mg are extended-release, white to off-white, oval shaped, biconvex coated tablets debossed with "Q21" on one side and "LU" on the other side.

NDC 68180-336-07 bottles of 60  
NDC 68180-336-01 bottles of 100  
NDC 68180-336-02 bottles of 500

Metformin hydrochloride extended-release tablets USP 1000 mg are extended-release, white to off-white, oval shaped, biconvex coated tablets debossed with "Q22" on one side and "LU" on the other side.

NDC 68180-337-07 bottles of 60  
NDC 68180-337-01 bottles of 100  
NDC 68180-337-02 bottles of 500

### **STORAGE**

Store at 25°C (77°F); excursions permitted to 15° to 30°C (59° to 86°F) [see USP Controlled Room Temperature]. Keep tightly closed (protect from moisture). Protect from light. Avoid excessive heat and humidity.

Manufactured for:  
**Lupin Pharmaceuticals, Inc.**  
Baltimore, Maryland 21202  
United States

Manufactured by:  
**Lupin Limited**  
Goa 403 722  
INDIA.

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**PATIENT INFORMATION ABOUT  
Metformin Hydrochloride Extended-release Tablets  
(met-FOR-min HYE-droe-KLOR-ide)**

**Q1. Why do I need to take metformin hydrochloride extended-release tablets?**

Your doctor has prescribed metformin hydrochloride extended-release tablets to treat your type 2 diabetes, a condition in which blood sugar (blood glucose) is elevated. There are two types of diabetes. Metformin hydrochloride extended-release tablets are indicated for the most common type, known as type 2 diabetes.

**Q2. Why is it important to control type 2 diabetes?**

Type 2 diabetes has multiple possible complications, including blindness, kidney failure, and circulatory and heart problems. Lowering your blood sugar to a normal level may prevent or delay these complications.

**Q3. How is type 2 diabetes usually controlled?**

High blood sugar can be lowered by diet and exercise, by a number of oral medications and by insulin injections. Your doctor may recommend that you try lifestyle modifications such as improved diet and exercise before initiating drug treatment for type 2 diabetes. Each patient will be treated individually by his or her physician, and should follow all treatment recommendations.

**Q4. Does metformin hydrochloride extended-release tablets work differently from other glucose control medications?**

Yes. Metformin hydrochloride extended-release tablets, as well as other formulations of metformin, lowers the amount of sugar in your blood by controlling how much sugar is released by the liver. Metformin hydrochloride extended-release tablets does not cause your body to produce more insulin. Metformin hydrochloride extended-release tablets rarely causes hypoglycemia (low blood sugar) and it does not usually cause weight gain when taken alone. However, if you do not eat enough, if you take other medications to lower blood sugar, or if you drink alcohol, you can develop hypoglycemia. Specifically, when metformin hydrochloride extended-release tablets is taken together with a sulfonylurea or with insulin, hypoglycemia and weight gain are more likely to occur.

**Q5. What happens if my blood sugar is still too high?**

If your blood sugar is high, consult your physician. When blood sugar cannot be lowered enough by either metformin hydrochloride extended-release tablets or a sulfonylurea, the two medications can be effective when taken together. Other alternatives involve switching to other oral antidiabetic drugs (e.g., alpha glucoside inhibitors or glitazones). Metformin hydrochloride extended-release tablets may be stopped and replaced with other drugs and/or insulin. If you are unable to maintain your blood sugar with diet, exercise and glucose-control medications taken orally, then your doctor may prescribe injectable insulin to control your diabetes.

**Q6. Why should I take metformin hydrochloride extended-release tablets in addition to insulin if I am already on insulin alone?**

Adding metformin hydrochloride extended-release tablets to insulin can help you better control your blood sugar while reducing the insulin dose and possibly reducing your weight.

**Q7. Can metformin hydrochloride extended-release tablets cause side effects?**

Metformin hydrochloride extended-release tablets, like all blood sugar-lowering medications, can cause side effects in some patients. Most of these side effects are minor and will go away after you've taken metformin hydrochloride extended-release tablets for a while. However, there are also serious but rare side effects related to metformin hydrochloride extended-release tablets (see below).

**Q8. What kind of side effects can metformin hydrochloride extended-release tablets cause?**

If side effects occur, they usually occur during the first few weeks of therapy. They are normally minor ones such as diarrhea, nausea, abdominal pain and upset stomach. Metformin hydrochloride extended-release tablets are generally taken with meals, which reduce these side effects.

Although these side effects are likely to go away, call your doctor if you have severe discomfort or if these effects last for more than a few weeks. Some patients may need to have their doses lowered or stop taking metformin hydrochloride extended-release tablets, either temporarily or permanently. You should tell your doctor if the problems come back or start later on during the therapy.

**WARNING: A rare number of people who have taken metformin have developed a serious condition called lactic acidosis. Properly functioning kidneys are needed to help prevent lactic acidosis (see Q9-13).**

**Q9. Are there any serious side effects that metformin hydrochloride extended-release tablets can cause?**

Metformin hydrochloride extended-release tablets rarely causes serious side effects. The most serious side effect that metformin hydrochloride extended-release tablets can cause is called lactic acidosis.

**Q10. What is lactic acidosis and can it happen to me?**

**Metformin, the medicine in metformin hydrochloride extended-release tablets can cause a rare but serious condition called lactic acidosis (a buildup of an acid in the blood) that can cause death. Lactic acidosis is a medical emergency and must be treated in the hospital.**

**Q11. Are there other risk factors for lactic acidosis?**

Most people who have had lactic acidosis with metformin have other things that, combined with the metformin, led to the lactic acidosis. Tell your doctor if you have any of the following, because you have a higher chance for getting lactic acidosis with metformin hydrochloride extended-release tablets if you:

- have severe kidney problems or your kidneys are affected by certain x-ray tests that use injectable dye.

- have liver problems
- drink alcohol very often, or drink a lot of alcohol in short-term "binge" drinking
- get dehydrated (lose a large amount of body fluids). This can happen if you are sick with a fever, vomiting, or diarrhea. Dehydration can also happen when you sweat a lot with activity or exercise and do not drink enough fluids
- have surgery
- have a heart attack, severe infection, or stroke

The best way to keep from having a problem with lactic acidosis from metformin is to tell your doctor if you have any of the problems in the list above. Your doctor may decide to stop your metformin hydrochloride extended-release tablets for a while if you have any of these things.

**Q12. What are the symptoms of lactic acidosis?**

Call your doctor right away if you have any of the following symptoms, which could be signs of lactic acidosis:

- you feel cold in your hands or feet
- you feel dizzy or lightheaded
- you have a slow or irregular heartbeat
- you feel very weak or tired
- you have unusual (not normal) muscle pain
- you have trouble breathing
- you feel sleepy or drowsy
- you have stomach pains, nausea or vomiting

**Q13. What does my doctor need to know to decrease my risk of lactic acidosis?**

**Before you take metformin hydrochloride extended-release tablets, tell your doctor if you:**

- have severe kidney problems
- have liver problems
- have heart problems, including congestive heart failure
- drink alcohol very often, or drink a lot of alcohol in short term "binge" drinking
- are going to get an injection of dye or contrast agents for an x-ray procedure. Metformin hydrochloride extended-release tablets may need to be stopped for a short time. Talk to your doctor about when you should stop metformin hydrochloride extended-release tablets and when you should start metformin hydrochloride extended-release tablets again. See "**What is the most important information I should know about metformin hydrochloride extended-release tablets?**"
- have any other medical conditions

**Q14. Can I take metformin hydrochloride extended-release tablets with other medications?**

Remind your doctor and/or pharmacist that you are taking metformin hydrochloride extended-release tablets when any new drug is prescribed or a change is made in how you take a drug already prescribed. Metformin hydrochloride extended-release tablets may interfere with the way some drugs work and some drugs may interfere with the action of metformin hydrochloride extended-release tablets.

**Q15. What if I become pregnant while taking metformin hydrochloride extended-release tablets?**

Tell your doctor if you plan to become pregnant or have become pregnant. As with other oral glucose-control medications, you should not take metformin hydrochloride extended-release tablets during pregnancy. Usually your doctor will prescribe insulin while you are pregnant.

**Q16. How do I take metformin hydrochloride extended-release tablets?**

Metformin hydrochloride extended-release tablets should not be cut, crushed, or chewed and should be taken whole with a full glass of water once daily with the evening meal. Occasionally, the inactive ingredients of metformin hydrochloride extended-release tablets may be eliminated as a soft mass in your stool that may look like the original tablet; this is not harmful and will not effect the way metformin hydrochloride extended-release tablets works to control diabetes. Metformin hydrochloride extended-release tablets should be taken once a day with food. You will be started on a low dose of metformin hydrochloride extended-release tablets and your dosage will be increased gradually until your blood sugar is controlled.

**Q17. Where can I get more information about metformin hydrochloride extended-release tablets?**

This leaflet is a summary of the most important information about metformin hydrochloride extended-release tablets. If you have any questions or problems, you should talk to your doctor or other healthcare provider about type 2 diabetes as well as metformin hydrochloride extended-release tablets and its side effects.

Manufactured for:

**Lupin Pharmaceuticals, Inc.**  
Baltimore, Maryland 21202  
United States

Manufactured by:

**Lupin Limited**  
Goa 403 722  
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