

PRODUCT MONOGRAPH
INCLUDING PATIENT MEDICATION INFORMATION

Pr KAZANO[®]

alogliptin (as alogliptin benzoate) and metformin hydrochloride
12.5 mg/500 mg, 12.5 mg/850 mg, 12.5mg/1000 mg tablets

ATC Code: A10BD13

Combinations of oral blood glucose lowering drugs

Takeda Canada Inc. Oakville, Ontario L6M 4X8 www.takedacanada.com	Date of Preparation: October 18, 2018
---	--

Submission Control No: 217455

Table of Contents

PART I: HEALTH PROFESSIONAL INFORMATION.....3
SUMMARY PRODUCT INFORMATION3
INDICATIONS AND CLINICAL USE.....3
CONTRAINDICATIONS4
WARNINGS AND PRECAUTIONS.....5
ADVERSE REACTIONS.....11
DRUG INTERACTIONS20
DOSAGE AND ADMINISTRATION23
OVERDOSAGE24
ACTION AND CLINICAL PHARMACOLOGY25
STORAGE AND STABILITY.....32
SPECIAL HANDLING INSTRUCTIONS32
DOSAGE FORMS, COMPOSITION AND PACKAGING32

PART II: SCIENTIFIC INFORMATION33
PHARMACEUTICAL INFORMATION.....33
CLINICAL TRIALS.....34
DETAILED PHARMACOLOGY44
TOXICOLOGY46
REFERENCES50

PART III: CONSUMER INFORMATION.....53

^{Pr}**KAZANO**[®]
alogliptin (as alogliptin benzoate) and metformin hydrochloride

PART I: HEALTH PROFESSIONAL INFORMATION

SUMMARY PRODUCT INFORMATION

Route of Administration	Dosage Form / Strength	Clinically Relevant Nonmedicinal Ingredients
Oral	Tablets 12.5 mg/500 mg, 12.5 mg/850 mg, 12.5mg/1000 mg	For a complete listing see DOSAGE FORMS, COMPOSITION AND PACKAGING section.

INDICATIONS AND CLINICAL USE

KAZANO[®] is indicated to improve glycemic control in adult patients (≥ 18 years old) with type 2 diabetes mellitus:

- as an adjunct to diet and exercise in patients inadequately controlled on metformin or in patients already being treated with the combination of alogliptin and metformin.
- in combination with pioglitazone when diet and exercise plus dual therapy with metformin and pioglitazone do not provide adequate glycemic control.
- in combination with insulin, when insulin and metformin do not provide adequate glycemic control.

Geriatrics (≥65 years of age):

No dose adjustment is necessary based on age. However, dosing of KAZANO[®] should be carefully titrated in patients with advanced age due to the potential for decreased renal and cardiac function in this population. KAZANO[®] should not be used in patients with renal impairment (see CONTRAINDICATIONS). Monitoring of renal function is necessary to aid in prevention of metformin-associated lactic acidosis, particularly in the elderly (see WARNINGS AND PRECAUTIONS and ACTION AND CLINICAL PHARMACOLOGY).

Pediatrics (<18 years of age):

The safety and efficacy of KAZANO[®] in pediatric patients have not been established. No data are available. Therefore, KAZANO[®] should not be used in this population.

CONTRAINDICATIONS

KAZANO[®] is contraindicated in patients with:

- Unstable and/or insulin-dependent (type 1) diabetes mellitus.
- Acute or chronic metabolic acidosis, including diabetic ketoacidosis, with or without coma, history of ketoacidosis with or without coma. Diabetic ketoacidosis should be treated with insulin.
- In patients with a history of lactic acidosis, irrespective of precipitating factors.
- In the presence of renal disease or impairment, when renal function is not known, and in patients with serum creatinine levels above the upper limit of normal range or abnormal creatinine clearance (<60 mL/min), which may also result from conditions such as cardiovascular collapse (shock), acute myocardial infarction, and septicemia (see also WARNINGS and PRECAUTIONS).
- In excessive alcohol intake, acute or chronic (see WARNINGS AND PRECAUTIONS and DRUG INTERACTIONS).
- In patients suffering from severe hepatic dysfunction, since severe hepatic dysfunction has been associated with some cases of lactic acidosis, KAZANO[®] should generally be avoided in patients with clinical or laboratory evidence of hepatic disease.
- In cases of cardiovascular collapse and in disease states associated with hypoxemia such as cardiorespiratory insufficiency, which are often associated with hyperlactacidemia.
- During stress conditions, such as severe infections, trauma or surgery and the recovery phase thereafter.
- In patients suffering from severe dehydration.
- Known hypersensitivity to alogliptin, metformin or to any of the ingredients listed in the formulation (see ADVERSE REACTIONS). For a complete listing see the DOSAGE FORMS and COMPOSITION AND PACKAGING sections of the product monograph
- KAZANO[®] should be temporarily discontinued in patients undergoing radiologic studies involving intravascular administration of iodinated contrast materials, because use of such products may result in acute alteration of renal function (see WARNINGS AND PRECAUTIONS).
- During pregnancy and breastfeeding (see WARNINGS AND PRECAUTIONS).

WARNINGS AND PRECAUTIONS

Serious Warnings and Precautions

- Lactic acidosis is a rare, but serious, metabolic complication that can occur due to metformin accumulation during treatment with KAZANO[®] (see WARNINGS AND PRECAUTIONS, **Lactic Acidosis**).
- Patients should be cautioned against excessive alcohol intake, either acute or chronic, when taking KAZANO[®], since alcohol intake potentiates the effect of metformin on lactate (see WARNINGS AND PRECAUTIONS, **Lactic Acidosis**)

Cardiovascular

Alogliptin

Congestive Heart Failure: There is limited experience with alogliptin therapy in patients with congestive heart failure of New York Heart Association (NYHA) functional classes III and IV. KAZANO[®] should therefore, be used with caution in these patients.

Metformin

Hypoxic States: Cardiovascular collapse (shock) from whatever cause, acute congestive heart failure, acute myocardial infarction and other conditions characterized by hypoxemia have been associated with lactic acidosis and may also cause prerenal azotemia. When such events occur in patients on KAZANO[®] therapy, the drug should be promptly discontinued.

Hepatic/Biliary/Pancreatic

Hepatic

Metformin

Since impaired hepatic function has been associated with some cases of lactic acidosis, KAZANO[®] should generally be avoided in patients with clinical or laboratory evidence of hepatic disease (see CONTRAINDICATIONS).

Alogliptin

There have been postmarketing reports of fatal and non-fatal hepatic failure in patients taking Alogliptin, although some of the reports contain insufficient information necessary to establish the probable cause.

Patients with type 2 diabetes may have fatty liver disease which may cause liver test abnormalities, and they may also have other forms of liver disease, many of which can be treated or managed. Therefore, obtaining a liver test panel and assessing the patient before initiating Alogliptin therapy is recommended. In patients with abnormal liver tests, KAZANO[®] should be initiated with caution.

Measure liver tests promptly in patients who report symptoms that may indicate liver injury,

including fatigue, anorexia, right upper abdominal discomfort, dark urine or jaundice. In this clinical context, if the patient is found to have clinically significant liver enzyme elevations and if abnormal liver tests persist or worsen, Alogliptin should be interrupted and investigation done to establish the probable cause.

Alogliptin has not been studied in patients with severe hepatic impairment (Child-Pugh score >9) and is, therefore, not recommended for use in such patients (see DOSAGE AND ADMINISTRATION and ACTION AND CLINICAL PHARMACOLOGY).

Alogliptin

Pancreatitis

Events of acute pancreatitis have been reported with alogliptin in clinical trials and in postmarketing reports. Reports of acute pancreatitis, including fatal and non-fatal hemorrhagic or necrotizing pancreatitis, were noted in patients taking KAZANO[®] and other members of this class. After initiation of KAZANO[®], patients should be observed carefully for signs and symptoms of pancreatitis. If pancreatitis is suspected, KAZANO[®] should be promptly discontinued and appropriate management should be initiated. (see ADVERSE REACTIONS)

Hypersensitivity Reactions

Postmarketing events of serious hypersensitivity reactions in patients treated with KAZANO[®] such as anaphylaxis, angioedema, and severe cutaneous adverse reactions including Stevens-Johnson syndrome have been reported and have been associated with other DPP-4 inhibitors. A single event of serum sickness was observed with KAZANO[®] treatment in a clinical trial. If a hypersensitivity reaction is suspected, discontinuation of KAZANO[®] should be considered. Use caution in a patient with a history of angioedema with another DPP-4 inhibitor, since it is unknown whether such patients will be predisposed to angioedema with KAZANO[®].

Endocrine and Metabolism

Metformin

Lactic Acidosis: Lactic acidosis is a rare, but serious and potentially fatal metabolic complication that can occur due to metformin accumulation during treatment with KAZANO[®]; when it occurs, it is fatal in approximately 50% of cases. Lactic acidosis may also occur in association with a number of pathophysiologic conditions, including diabetes mellitus, and whenever there is significant tissue hypoperfusion and hypoxemia. Lactic acidosis is characterized by elevated blood lactate levels (>5 mmol/L), decreased blood pH, electrolyte disturbances with an increased anion gap, and an increased lactate/pyruvate ratio. When metformin is implicated as the cause of lactic acidosis, metformin plasma levels >5 mcg/mL are generally found.

The reported incidence of lactic acidosis in patients receiving metformin hydrochloride is very low (approximately 0.03 cases/1000 patient-years, with approximately 0.015 fatal cases/1000 patient-years). Reported cases have occurred primarily in diabetic patients with significant renal insufficiency, including both intrinsic renal disease and renal hypoperfusion, often in the setting of multiple concomitant medical/surgical problems and multiple concomitant medications.

Patients with congestive heart failure requiring pharmacologic management, in particular those with unstable or acute congestive heart failure who are at risk of hypoperfusion and hypoxemia, are at increased risk of lactic acidosis. In particular, treatment of the elderly should be accompanied by careful monitoring of renal function. Metformin treatment should not be initiated in patients ≥ 80 years of age unless measurement of creatinine clearance demonstrates that renal function is not reduced, as these patients are more susceptible to developing lactic acidosis. The risk of lactic acidosis increases with the degree of renal dysfunction and the patient's age. The risk of lactic acidosis may, therefore, be significantly decreased by regular monitoring of renal function in patients taking metformin and by use of the minimum effective dose of metformin.

In addition, metformin should be promptly withheld in the presence of any condition associated with hypoxemia, dehydration, or sepsis. Because impaired hepatic function may significantly limit the ability to clear lactate, metformin should generally be avoided in patients with clinical or laboratory evidence of hepatic disease.

Patients should be cautioned against excessive alcohol intake, either acute or chronic, when taking metformin, since alcohol potentiates the effects of metformin hydrochloride on lactate metabolism. In addition, metformin should be temporarily discontinued prior to any intravascular radiocontrast study and for any surgical procedure.

The onset of lactic acidosis often is subtle, and accompanied only by nonspecific symptoms such as malaise, myalgias, respiratory distress, increasing somnolence, and nonspecific abdominal distress. There may be associated hypothermia, hypotension, and resistant bradyarrhythmias with more marked acidosis. The patient and the patient's physician must be aware of the possible importance of such symptoms and the patient should be instructed to notify the physician immediately if they occur. Metformin should be withdrawn until the situation is clarified. Serum electrolytes, ketones, blood glucose, and if indicated, blood pH, lactate levels, and even blood metformin levels may be useful. Once a patient is stabilized on any dose level of metformin, gastrointestinal symptoms, which are common during initiation of therapy, are unlikely to be drug related. Later occurrence of gastrointestinal symptoms could be due to lactic acidosis or other serious disease.

Levels of fasting venous plasma lactate above the upper limit of normal but less than 5 mmol/L in patients taking metformin do not necessarily indicate impending lactic acidosis and may be explainable by other mechanisms, such as poorly controlled diabetes or obesity, vigorous physical activity, or technical problems in sample handling.

Lactic acidosis should be suspected in any diabetic patient with metabolic acidosis lacking evidence of ketoacidosis (ketonuria and ketonemia).

Lactic acidosis is a medical emergency that must be treated in a hospital setting. In a patient with lactic acidosis who is taking metformin, the drug should be discontinued immediately and general supportive measures promptly instituted. Because metformin hydrochloride is dialyzable (with a clearance of up to 170 mL/min under good hemodynamic conditions), prompt

hemodialysis is recommended to correct the acidosis and remove the accumulated metformin. Such management often results in prompt reversal of symptoms and recovery (see **CONTRAINDICATIONS** and **WARNINGS AND PRECAUTIONS, Cardiovascular, Hepatic and Renal**).

Physicians should instruct their patients to recognize the symptoms which could be a signal of the onset of lactic acidosis. If acidosis of any kind develops, KAZANO[®] should be discontinued immediately.

Change in Clinical Status of Patients with Previously Controlled Type 2 Diabetes Mellitus: As KAZANO[®] contains metformin, any patient with type 2 diabetes mellitus previously well controlled on KAZANO[®] who develops laboratory abnormalities or clinical illness (especially vague and poorly defined illness) should be evaluated promptly for evidence of ketoacidosis or lactic acidosis. Evaluation should include serum electrolytes and ketones, blood glucose and, if indicated, blood pH, lactate, pyruvate and metformin levels. If acidosis of either form occurs, KAZANO[®] must be stopped immediately and other appropriate corrective measures initiated.

Hypoglycemia

The incidence of hypoglycemia was greater in studies of alogliptin as add-on therapy to metformin with pioglitazone and as add-on therapy to metformin with insulin compared to active-control or placebo, respectively.

Insulin is known to cause hypoglycemia. Therefore, a lower dose of insulin may be considered to reduce the risk of hypoglycemia when this drug is used in combination with alogliptin.

Hypoglycemia could occur when caloric intake is deficient, when strenuous exercise is not compensated by caloric supplementation, or during concomitant use with other glucoselowering 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 β -adrenergic blocking drugs.

The patients should be warned about driving a vehicle or operating machinery under these conditions where risk of hypoglycemia is present.

Loss of Control of Blood Glucose: When a patient stabilized on any diabetic regimen is exposed to stress such as fever, trauma, infection, or surgery, a temporary loss of glycemic control may occur. At such times, it may be necessary to withhold KAZANO[®] and temporarily administer insulin. KAZANO[®] may be reinstated after the acute episode is resolved. The effectiveness of oral antidiabetic drugs in lowering blood glucose to a targeted level decreases in many patients over a period of time. This phenomenon, which may be due to progression of the underlying disease or to diminished responsiveness to the drug, is known as secondary failure, to distinguish it from primary failure in which the drug is ineffective during initial therapy.

Should secondary failure occur with KAZANO[®], therapeutic alternatives should be considered.

Vitamin B₁₂ Levels: Impairment of vitamin B₁₂ absorption has been reported in some patients. Therefore, measurements of serum vitamin B₁₂ are advisable at least every one to two years in patients on long-term treatment with KAZANO[®].

A decrease to subnormal levels of previously normal serum Vitamin B₁₂ levels, without clinical manifestations, is observed in approximately 7% of patients receiving metformin in controlled clinical trials of 29 weeks duration. Such decrease, possibly due to interference with B₁₂ absorption from the B₁₂-intrinsic factor complex, is, however, very rarely associated with anemia and appears to be rapidly reversible with discontinuation of metformin or Vitamin B₁₂ supplementation. Measurement of hematologic parameters on an annual basis is advised in patients on KAZANO[®] and any apparent abnormalities should be appropriately investigated and managed (see WARNINGS AND PRECAUTIONS, **Monitoring and Laboratory Tests**).

Skin

Bullous pemphigoid

Postmarketing cases of bullous pemphigoid requiring hospitalization have been reported with the use of alogliptin and other DPP-4 inhibitors. In reported cases, patients typically recovered with topical or systemic immunosuppressive treatment and discontinuation of the DPP-4 inhibitor.

Tell patients to immediately report development of blisters or erosions while receiving KAZANO[®]. If bullous pemphigoid is suspected, KAZANO[®] should be discontinued and referral to a dermatologist should be considered for diagnosis and appropriate treatment.

Renal

KAZANO[®] should not be used in patients with renal impairment (See CONTRAINDICATIONS, WARNINGS AND PRECAUTIONS, Endocrine and Metabolism – Lactic Acidosis, Geriatrics (≥ 65 years of age) and Monitoring and Laboratory Tests and DOSAGE AND ADMINISTRATION).

Metformin

Metformin is known to be substantially excreted by the kidney, and the risk of metformin accumulation and lactic acidosis increases with the degree of impairment of renal function. Thus, patients with serum creatinine levels above the upper limit of the normal range for their age should not receive KAZANO[®]. In patients with advanced age, KAZANO[®] should be carefully titrated to establish the minimum dose for adequate glycemic effect, because aging is associated with reduced renal function. In elderly patients, renal function should be monitored regularly.

Special caution should be exercised in situations where renal function may become impaired, for example when initiating antihypertensive therapy or diuretic therapy and when starting therapy with an NSAID.

Use of Concomitant Medications that May Affect Renal Function or Metformin

Disposition: Concomitant medication(s) that may affect renal function or result in significant hemodynamic change or may interfere with the disposition of metformin, such as cationic drugs that are eliminated by renal tubular secretion (see DRUG INTERACTIONS), should be used with caution.

Administration of Iodinated Contrast Agents: The intravascular administration of iodinated contrast agents in radiological studies can lead to renal failure which has been associated with lactic acidosis in patients receiving metformin. Therefore, KAZANO[®] should be discontinued prior to, or at the time of, the test and not reinstated until 48 hours afterwards, and only after renal function has been re-evaluated and found to be normal (see DRUG INTERACTIONS).

Peri-operative Consideration

KAZANO[®] therapy should be temporarily suspended for any surgical procedure (except minor procedures not associated with restricted intake of food and fluids). KAZANO[®] should be discontinued 2 days before surgical intervention and should not be restarted until the patient's oral intake has resumed and renal function has been evaluated as normal.

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 KAZANO[®].

Special Populations

Pregnant Women

There are no adequate or well-controlled studies in pregnant women with KAZANO[®] or its individual components. Animal studies do not indicate direct or indirect harmful effects with respect to developmental toxicity (see TOXICOLOGY). As a precautionary measure, KAZANO[®] should not be used during pregnancy.

Because recent information suggests that abnormal blood glucose levels during pregnancy are associated with a higher incidence of congenital abnormalities, there is a consensus among experts that insulin be used during pregnancy to maintain blood glucose levels as close to normal as possible.

Nursing Women

It is unknown whether alogliptin is excreted in human milk. Alogliptin is secreted in the milk of lactating rats. A risk to the breast-fed child cannot be excluded.

Metformin is excreted in human milk in small amounts. A risk to the breastfed child cannot be excluded. KAZANO[®] must, therefore, not be used in women who are breastfeeding (see CONTRAINDICATIONS).

Pediatrics (< 18 years of age):

Safety and effectiveness of KAZANO[®] in pediatric patients under 18 years of age have not been established. Therefore, KAZANO[®] should not be used in this population.

Geriatrics (>65 years of age)

No dose adjustment is necessary based on age. However, dosing of KAZANO[®] should be carefully titrated in patients with advanced age due to the potential for decreased renal and cardiac function in this population. KAZANO should not be used in patients with renal impairment (see CONTRAINDICATION, WARNINGS AND PRECAUTIONS, DOSAGE AND ADMINISTRATION and ACTION AND CLINICAL PHARMACOLOGY). Monitoring of renal function is necessary to aid in prevention of metformin-associated lactic acidosis, particularly in the elderly.

Monitoring and Laboratory Tests

Monitoring of Glycemic Parameters: Periodic measurements of blood glucose and HbA1c levels should be performed, with a goal of decreasing these levels towards the normal range. HbA1c is especially useful for evaluating long-term glycemic control.

Monitoring of Hematologic Parameters: Initial and periodic monitoring of hematologic parameters (e.g., hemoglobin/hematocrit and red blood cell indices) should be performed, at least on an annual basis.

Monitoring of Renal Function: Renal function should be monitored prior to initiating treatment with KAZANO[®], and regularly thereafter:

- at least once a year in patients with normal renal function
- at least two to four times a year in patients with serum creatinine levels at or above the upper limit of normal and in elderly patients

Monitoring of hepatic function: Obtaining a liver test panel and assessing the patient before initiating KAZANO[®] therapy is recommended.

ADVERSE REACTIONS

Adverse Drug Reaction Overview

Clinical studies conducted to support the efficacy and safety of KAZANO[®] involved the co-administration of alogliptin and metformin as separate tablets. However, the results of bioequivalence studies have demonstrated that KAZANO[®] film-coated tablets are bioequivalent to the corresponding doses of alogliptin and metformin co-administered as separate tablets.

The information provided is based on a total of 7151 patients with type 2 diabetes mellitus, including 2414 patients treated with alogliptin 25 mg/day and metformin (500 mg/day – 3400 mg/day), who participated in 7 Phase 3 double-blind, placebo- or active-controlled clinical studies. These studies evaluated the effects of co-administered alogliptin and metformin on

glycemic control and their safety as initial combination therapy, as dual therapy in patients initially treated with metformin alone, and as add-on therapy to pioglitazone or insulin.

The safety profile of co-administered alogliptin and metformin was consistent with that of the individual components as demonstrated in clinical trials for alogliptin and from the comprehensive data available for metformin. As such, the following section outlines the undesirable effects of the individual components of KAZANO[®] (alogliptin/metformin) as reported in their respective product monographs.

Alogliptin

Alogliptin was generally well-tolerated in controlled clinical studies with an overall incidence of adverse events in patients treated with alogliptin 25 mg comparable to placebo. In a phase 2 and phase 3 controlled study pool the most common adverse events observed in 3750 patients treated alogliptin 25 mg (with or without other oral antidiabetic agents, including metformin) were headache (5.7%), upper respiratory tract infection (5.7%) and nasopharyngitis (5.6%).

The incidence of serious adverse events was low in both treatment groups (alogliptin 25 mg 5.7% vs 3.2% placebo). The most frequently reported treatment-related serious adverse event in patients treated with alogliptin 25 mg was hypoglycemia (0.12%). The main causes for discontinuation in patients treated with alogliptin 25 mg/day occurring more frequently than in placebo were decreased creatinine renal clearance (0.6%), increased blood creatinine (0.2%), renal impairment (0.2%); vomiting (0.1%); peripheral oedema (0.1%); anxiety (<0.1%); and cardiac failure congestive (<0.1%)

Pancreatitis:

In a pooled analysis of 14 Phase 2 and 3 studies, including a cardiovascular outcomes trial, pancreatitis was reported in 11 of 5902 (0.2%) patients receiving alogliptin 25 mg daily, compared to 5 of 5183 (<0.1%) patients receiving all comparators (see WARNINGS AND PRECAUTIONS, Hepatic/Biliary/Pancreatic). In the completed cardiovascular outcomes study, pancreatitis was reported for 10 (0.4%) subjects in the alogliptin group and 7 (0.3%) subjects in the placebo group, which equates to reporting rates of 3 and 2 events per 1000 years with alogliptin and placebo, respectively.

Serious Hypersensitivity Reactions:

Serious cutaneous events and a single event of serum sickness were reported with patients administering therapeutic doses of alogliptin in clinical trials. Post-market events of anaphylaxis, angioedema, and severe cutaneous adverse reactions including Stevens-Johnson syndrome have been reported with alogliptin (see WARNINGS AND PRECAUTIONS, Hypersensitivity Reactions).

Metformin

The adverse events most commonly associated with metformin (alogliptin/metformin) are diarrhea, nausea, and upset stomach.

Lactic Acidosis:

The reported incidence of lactic acidosis in patients receiving metformin hydrochloride is very low (approximately 0.03 cases / 1000 patient-years, with approximately 0.015 fatal cases / 1000 patient-years) (see WARNINGS AND PRECAUTIONS, and OVERDOSAGE).

Gastrointestinal Reactions: Very common ($>1/10$) Gastrointestinal symptoms (diarrhea, nausea, vomiting, abdominal bloating, flatulence, and anorexia) are the most common reactions to metformin and are approximately 30% more frequent in patients on metformin monotherapy than in placebo-treated patients, particularly during initiation of metformin therapy. These symptoms are generally transient and resolve spontaneously during continued treatment. Occasionally, temporary dose reduction may be useful. Because gastrointestinal symptoms during therapy initiation appear to be dose-related, they may be decreased by gradual dose escalation and by having patients take metformin (metformin HCl) with meals (see DOSAGE and ADMINISTRATION).

Because significant diarrhea and/or vomiting can cause dehydration and prerenal azotemia, metformin should be temporarily discontinued, under such circumstances.

For patients who have been stabilized on metformin, non-specific gastrointestinal symptoms should not be attributed to therapy unless intercurrent illness or lactic acidosis have been excluded.

Special Senses: Common ($\geq 1/100$): During initiation of metformin therapy complaints of taste disturbance are common, i.e. metallic taste.

Dermatologic Reactions: Very rare ($<1/10,000$ and isolated reports): The incidence of rash/dermatitis in controlled clinical trials was comparable to placebo for metformin monotherapy and to sulfonylurea for metformin /sulfonylurea therapy. Reports of skin reactions such as erythema, pruritus, and urticaria are very rare.

Hematologic: During controlled clinical trials of 29 weeks duration, approximately 9% of patients on metformin monotherapy and 6% of patients on metformin /sulfonylurea therapy developed asymptomatic subnormal serum vitamin B₁₂ levels; serum folic acid levels did not decrease significantly. However, only five cases of megaloblastic anemia have been reported with metformin administration (none during U.S. clinical studies) and no increased incidence of neuropathy has been observed. (see WARNINGS AND PRECAUTIONS, Endocrine and Metabolism).

Decrease of vitamin B₁₂ absorption with decrease of serum levels during long-term use of metformin is rare ($\geq 1/10,000$ and $<1/1,000$). Consideration of such etiology is recommended if a patient presents with megaloblastic anemia.

Hepatic: Very rare ($<1/10,000$ and isolated reports): Liver function tests abnormalities or hepatitis resolving upon metformin discontinuation has been documented in isolated reports.

Clinical Trial Adverse Drug Reactions

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

In Phase 3 controlled studies, adverse events reported, regardless of causality assessment, in $\geq 1\%$ of patients treated with alogliptin and metformin are shown in Table 1 and Table 2.

Table 1. Treatment-Emergent Adverse Events by Preferred Term with Incidence in Metformin + Alogliptin 25 mg \geq 1% and in Excess of Metformin + Placebo (Study SYR-322-MET-008)

System Organ Class/ Preferred Term	Metformin + Alogliptin 25 mg (N = 207)	Metformin + Placebo (N = 104)
Gastrointestinal disorders		
Abdominal pain	2 (1.0%)	0
Constipation	5 (2.4%)	1 (1.0%)
Dyspepsia	5 (2.4%)	0
Vomiting	3 (1.4%)	0
General disorders and administration site conditions		
Fatigue	4 (1.9%)	1 (1.0%)
Non-cardiac chest pain	3 (1.4%)	0
Oedema peripheral	3 (1.4%)	1 (1.0%)
Infections and infestations		
Bronchitis	6 (2.9%)	2 (1.9%)
Gastroenteritis	3 (1.4%)	0
Herpes simplex	2 (1.0%)	0
Influenza	4 (1.9%)	0
Paronychia	2 (1.0%)	0
Viral infection	3 (1.4%)	0
Vulvovaginal mycotic infection	2 (1.0%)	0
Injury, poisoning and procedural complications		
Contusion	2 (1.0%)	0
Injury	2 (1.0%)	0
Limb injury	3 (1.4%)	0
Procedural pain	2 (1.0%)	0
Metabolism and nutrition disorders		
Decreased appetite	4 (1.9%)	0

System Organ Class/ Preferred Term	Metformin + Alogliptin 25 mg (N = 207)	Metformin + Placebo (N = 104)
Hyperlipidaemia	3 (1.4%)	1 (1.0%)
Hyperuricaemia	3 (1.4%)	1 (1.0%)
Hyponatraemia	2 (1.0%)	0
Musculoskeletal and connective tissue disorders		
Back pain	4 (1.9%)	1 (1.0%)
Musculoskeletal pain	4 (1.9%)	0
Myalgia	2 (1.0%)	0
Osteoarthritis	3 (1.4%)	1 (1.0%)
Nervous system disorders		
Dizziness	3 (1.4%)	0
Respiratory, thoracic and mediastinal disorders		
Cough	5 (2.4%)	1 (1.0%)
Nasal congestion	2 (1.0%)	0
Skin and subcutaneous tissue disorders		
Dermatitis contact	3 (1.4%)	1 (1.0%)
Dry skin	2 (1.0%)	0
Eczema	2 (1.0%)	0
Pruritus	3 (1.4%)	0
Rash	5 (2.4%)	0

Table 2. Treatment-Emergent Adverse Events by Preferred Term with Incidence in Metformin + Alogliptin 25 mg \geq 1% and in Excess of Metformin + Glipizide (Study SYR-322_305)

System Organ Class/ Preferred Term	Metformin + Alogliptin 25 mg (N = 878)	Metformin + Glipizide (N = 869)
Blood and lymphatic system disorders		
Anaemia	37 (4.2%)	32 (3.7%)
Neutropenia	10 (1.1%)	7 (0.8%)
Eye disorders		
Conjunctivitis	9 (1.0%)	8 (0.9%)
Gastrointestinal disorders		
Abdominal pain	22 (2.5%)	17 (2.0%)
Constipation	22 (2.5%)	20 (2.3%)
Gastroesophageal reflux disease	17 (1.9%)	8 (0.9%)
Haemorrhoids	9 (1.0%)	4 (0.5%)
Nausea	32 (3.6%)	21 (2.4%)
Toothache	18 (2.1%)	10 (1.2%)
Vomiting	22 (2.5%)	17 (2.0%)
Hepatobiliary disorders		
Cholelithiasis	9 (1.0%)	4 (0.5%)
Infections and infestations		
Gastroenteritis	25 (2.8%)	17 (2.0%)
Nasopharyngitis	67 (7.6%)	61 (7.0%)
Pharyngitis	20 (2.3%)	12 (1.4%)
Pneumonia	14 (1.6%)	7 (0.8%)
Sinusitis	29 (3.3%)	29 (3.3%)
Upper respiratory tract infection	90 (10.3%)	76 (8.7%)
Injury, poisoning and procedural complications		
Contusion	12 (1.4%)	7 (0.8%)
Investigations		

System Organ Class/ Preferred Term	Metformin + Alogliptin 25 mg (N = 878)	Metformin + Glipizide (N = 869)
Blood pressure increased	9 (1.0%)	5 (0.6%)
C-reactive protein increased	22 (2.5%)	13 (1.5%)
Creatinine renal clearance decreased	34 (3.9%)	32 (3.7%)
Lipase increased	9 (1.0%)	4 (0.5%)
Metabolism and nutrition disorders		
Decreased appetite	9 (1.0%)	6 (0.7%)
Hypercholesterolaemia	13 (1.5%)	7 (0.8%)
Hyperuricaemia	14 (1.6%)	9 (1.0%)
Musculoskeletal and connective tissue disorders		
Arthralgia	42 (4.8%)	40 (4.6%)
Muscle spasms	11 (1.3%)	10 (1.2%)
Musculoskeletal chest pain	11 (1.3%)	3 (0.3%)
Osteoarthritis	21 (2.4%)	18 (2.1%)
Spinal osteoarthritis	9 (1.0%)	6 (0.7%)
Nervous system disorders		
Headache	61 (6.9%)	46 (5.3%)
Neuropathy peripheral	14 (1.6%)	7 (0.8%)
Paraesthesia	13 (1.5%)	10 (1.2%)
Sciatica	9 (1.0%)	3 (0.3%)
Renal and urinary disorders		
Nephrolithiasis	13 (1.5%)	6 (0.7%)
Respiratory, thoracic and mediastinal disorders		
Dyspnoea	9 (1.0%)	6 (0.7%)
Oropharyngeal pain	17 (1.9%)	8 (0.9%)
Vascular disorders		
Hypertension	68 (7.7%)	65 (7.5%)

Less Common Clinical Trial Adverse Drug Reactions (<1%)

The following additional adverse events (i.e. not reported in Tables 1 or 2 above) were drug-related reported at an incidence of <1% in alogliptin + metformin clinical trials (reported in more than one patient, with higher frequency than comparator):

Blood and lymphatic system disorders: Iron deficiency anaemia, Lymphocytosis, Lymphopenia, Thrombocytopenia

Cardiac disorders: Ventricular extrasystoles

Ear and labyrinth disorders: Vertigo

Gastrointestinal disorders: Flatulence, Hyperchlorhydria, upper abdominal pain

General disorders and administration site conditions: Chest pain

Hepatobiliary disorders: Hyperbilirubinaemia

Investigations: Amylase increased, Creatinine renal clearance increased, Gamma-glutamyltransferase increased, Hepatic enzyme increased, Platelet count decreased, Weight decreased, Weight increased

Metabolism and nutrition disorders: Dyslipidaemia, Hyperglycaemia, Hyperkalaemia, Hyperphosphataemia

Nervous system disorders: Dysgeusia

Renal and urinary disorders: Renal impairment

Respiratory, thoracic and mediastinal disorders: Epistaxis

Skin and subcutaneous tissue disorders: Dermatitis allergic, Rash maculo-papular

Vascular disorders: Hypertensive crisis

Abnormal Hematologic and Clinical Chemistry Findings

Alogliptin

Overall, no clinically significant trend in abnormal laboratory findings were seen in patients treated with alogliptin in clinical trials compared with patients treated with placebo or active comparators.

Post-Market Adverse Drug Reactions

Alogliptin

Additional adverse reactions have been identified during post-marketing use of alogliptin, one of the components of KAZANO[®]. These reactions have been reported when alogliptin has been used alone and/or in combination with other antihyperglycemic agents. Because these reactions are reported voluntarily from a population of uncertain size, it is generally not possible to reliably estimate their frequency or establish a causal relationship to drug exposure.

Immune system disorders: Hypersensitivity reactions including anaphylaxis

Gastrointestinal disorders: acute pancreatitis

Hepatobiliary disorders: hepatic dysfunction including hepatic failure

Skin and subcutaneous tissue disorders: exfoliative skin conditions including Stevens-Johnson

syndrome, angioedema, urticaria, bullous pemphigoid
Musculoskeletal and connective tissue disorders: arthralgia

DRUG INTERACTIONS

Alogliptin and Metformin

Co-administration of 100 mg alogliptin once daily and 1000 mg metformin hydrochloride twice daily for 6 days in healthy subjects had no clinically relevant effects on the pharmacokinetics of alogliptin or metformin.

Specific pharmacokinetic drug interaction studies have not been performed with KAZANO[®]. The following section outlines the interactions observed with the individual components of KAZANO[®] (alogliptin/metformin) as reported in their respective Product Monographs.

Alogliptin

Alogliptin is primarily excreted unchanged in the urine and metabolism by the cytochrome P450 (CYP) enzyme system is negligible (see ACTION AND CLINICAL PHARMACOLOGY). In addition, alogliptin does not induce and does not inhibit the major human CYP isoforms at concentrations achieved with the recommended total daily dose of 25 mg alogliptin. As a result, alogliptin is not expected to interact with substances which induce, inhibit or are known substrates of cytochrome P450 enzymes. Furthermore, clinical data suggest that interactions with p-glycoprotein inhibitors are not expected, and no drug-drug interactions were observed with alogliptin and other renally excreted drugs in clinical studies.

Metformin

Certain drugs may potentiate the effect of metformin, particularly sulfonylurea type of drugs in the treatment of diabetes. The simultaneous administration of these two types of drugs could produce a hypoglycemic reaction, especially if they are given in patients already receiving other drugs which, themselves, can potentiate the effect of sulfonylureas. These drugs can be: long-acting sulfonamides, tuberculostatics, phenylbutazone, clofibrate, monoamine oxidase inhibitors, salicylates, probenecid and propranolol.

In healthy volunteers, the pharmacokinetics of propranolol and ibuprofen were not affected by metformin 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 sulfonylureas, which are extensively bound to serum proteins.

Drug-Drug Interactions

Effects of Other Drugs on Alogliptin

Clinical data suggest that alogliptin is not susceptible to interactions when administered concomitantly with gemfibrozil (a CYP2C8/9 inhibitor), fluconazole (a CYP2C9 inhibitor),

ketoconazole (a CYP3A4 inhibitor), cyclosporine (a p-glycoprotein inhibitor) or voglibose (an alpha-glucosidase inhibitor).

Results from clinical studies also demonstrate that there are no clinically relevant effects of digoxin, metformin, cimetidine, pioglitazone or atorvastatin on the pharmacokinetics of alogliptin.

Effects of Alogliptin on Other Drugs

In vitro studies suggest that alogliptin does not inhibit nor induce CYP 450 isoforms at concentrations achieved with the recommended dose of 25 mg alogliptin (see ACTION AND CLINICAL PHARMACOLOGY). In studies *in vitro*, alogliptin was found to be neither a substrate nor an inhibitor of key transporters associated with drug disposition in the kidney: organic anion transporter-1, organic anion transporter-3 or organic cationic transporter-2 (OCT2). Furthermore, clinical data do not suggest interaction with p-glycoprotein inhibitors or substrates.

In clinical studies, alogliptin had no clinically relevant effect on the pharmacokinetics of caffeine, (*R*)-warfarin, pioglitazone, glyburide, tolbutamide, (*S*)-warfarin, dextromethorphan, atorvastatin, midazolam, an oral contraceptive (norethindrone and ethinyl estradiol), digoxin, fexofenadine, metformin, or cimetidine, thus providing *in vivo* evidence of a low propensity to cause interaction with substrates of CYP1A2, CYP3A4, CYP2D6, CYP2C9, p-glycoprotein, and OCT2.

In healthy subjects, alogliptin had no effect on prothrombin time (PT) or International Normalized Ratio (INR) when administered concomitantly with warfarin.

Combination with Other Anti-diabetic Drugs

Results from studies with metformin, pioglitazone (thiazolidinedione), voglibose (alpha-glucosidase inhibitor) and glyburide (sulphonylurea) have shown no clinically relevant pharmacokinetic interactions (see ACTION AND CLINICAL PHARMACOLOGY)

Interactions with Metformin

Carbonic Anhydrase Inhibitors: Topiramate or other carbonic anhydrase inhibitors (e.g., zonisamide, acetazolamide or dichlorphenamide) frequently decrease serum bicarbonate and induce non-anion gap, hyperchloremic metabolic acidosis. Concomitant use of these drugs may induce metabolic acidosis. Use these drugs with caution in patients treated with metformin, as the risk of lactic acidosis may increase.

Glyburide: In a single-dose interaction study in NIDDM subjects, co-administration of metformin and glyburide did not result in any changes in either metformin pharmacokinetics or pharmacodynamics. Decreases in glyburide AUC and C_{max} were observed, but were highly variable. The single-dose nature of this study and the lack of correlation between glyburide blood levels and pharmacodynamics effects, makes the clinical significance of this interaction uncertain.

Furosemide: A single-dose study, metformin-furosemide drug interaction study in healthy subjects demonstrated that pharmacokinetic parameters of both compounds were affected by coadministration. Furosemide increased the metformin plasma and blood C_{max} by 22% and blood AUC by 15%, without any significant change in metformin renal clearance. When administered with metformin, the C_{max} 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 coadministered chronically.

Nifedipine: A single-dose, metformin-nifedipine drug interaction study in healthy volunteers demonstrated that co-administration of nifedipine increased plasma metformin C_{max} and AUC by 20% and 9%, respectively, and increased the amount excreted in the urine. T_{max} and half-life were unaffected. Nifedipine appears to enhance the absorption of metformin. Metformin had minimal effects on nifedipine.

Cationic Drugs: Cationic drugs (e.g., amiloride, digoxin, morphine, procainamide, quinidine, quinine, ranitidine, triamterene, trimethoprim, and vancomycin) that are eliminated by renal tubular secretion, theoretically have the potential for interaction with metformin by competing for common renal tubular transport systems. Such an interaction has been observed between metformin and oral cimetidine 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 was observed. There was no change in elimination half-life in the single dose study. Metformin had no effect on cimetidine pharmacokinetics. Therefore, careful patient monitoring and dose adjustment of metformin HCl or the interfering drug is recommended in patients who are taking cationic medications that are excreted via renal tubular secretion.

Other: Certain drugs tend to produce hyperglycemia and may lead to a loss of glycemic control when administered with KAZANOTM. These include thiazide and other diuretics, corticosteroids, phenothiazines, thyroid products, estrogens, estrogen plus progestogen, oral contraceptives, phenytoin, nicotinic acid, sympathomimetics, calcium channel blocking drugs, isoniazid, and beta-2 agonists.

ACE inhibitors may decrease the blood glucose levels. When such drugs are administered to patients receiving metformin HCl, the patient should be closely observed to maintain adequate glycemic control.

Elimination rate of the anticoagulant phenprocoumon has been reported to be increased by 20% when used concurrently with metformin HCl. Therefore, patients receiving phenprocoumon or other antivitamin K anticoagulants should be monitored carefully when both types of drugs are used simultaneously. In such cases, an important increase of prothrombin time may occur upon cessation of metformin HCl therapy, with an increased risk of hemorrhage.

Drug-Food Interactions

There are no known interactions with food.

Drug-Herb Interactions

Interactions with herbal products have not been established.

Drug-Laboratory Interactions

The intravascular administration of iodinated contrast agents may lead to renal failure resulting in metformin accumulation and a risk of lactic acidosis.

Drug-Lifestyle Interactions

No specific studies on the effects of KAZANO[®] on the ability to drive and use machines have been performed. Patients should be warned about driving a vehicle or operating machinery under conditions where a risk of hypoglycemia is present, such as when KAZANO[®] is used in combination with a sulfonylurea or in combination with insulin (see WARNINGS AND PRECAUTIONS, Endocrine and Metabolism, Metformin).

Patients should be cautioned against excessive alcohol intake, either acute or chronic, when taking KAZANO[®], since alcohol intake potentiates the effect of metformin on lactate metabolism (see CONTRAINDICATIONS).

DOSAGE AND ADMINISTRATION

Dosing Considerations

The dose of KAZANO[®] should be individualised on the basis of the patient's current treatment regimen whilst not exceeding the maximum recommended total daily dose of 25 mg alogliptin.

For patients switching from separate tablets of alogliptin and metformin, both alogliptin and metformin should be dosed at the total daily dose already being taken; the individual dose of alogliptin should be halved as it will be taken twice daily whilst the dosing of metformin should remain unchanged.

For patients switching from separate tablets of alogliptin and metformin as part of triple therapy in combination with insulin, the dose of insulin should be maintained, and both alogliptin and metformin should be dosed at the total daily dose already being taken; the individual dose of alogliptin should be halved as it will be taken twice daily whilst the dosing of metformin should remain unchanged (see WARNINGS AND PRECAUTIONS).

Recommended Dose and Dosage Adjustment

For patients inadequately controlled on metformin alone, the recommended dose of KAZANO[®] should provide alogliptin dosed at 12.5 mg twice daily (25 mg total daily dose) and metformin hydrochloride at a similar dose (500 mg, 850 mg or 1000 mg twice daily) to that already being taken.

For patients inadequately controlled on dual therapy with metformin and pioglitazone, the dose of the thiazolidinedione should be maintained, and KAZANO[®] administered concomitantly; alogliptin should be dosed at 12.5 mg twice daily (25 mg total daily dose) and metformin hydrochloride at a similar dose (500 mg, 850 mg or 1000 mg twice daily) to that already being taken.

Special Populations

Renal Impairment

KAZANO[®] is contraindicated in patients with renal impairment (see CONTRAINDICATIONS).

Assessment of renal function is recommended prior to initiation of KAZANO[®] therapy and regularly thereafter (see WARNINGS AND PRECAUTIONS, Renal).

Hepatic Impairment

Due to its metformin component, KAZANO[®] should not be used in patients with severe hepatic impairment (see CONTRAINDICATIONS and ACTION AND CLINICAL PHARMACOLOGY).

Pediatrics (<18 years of age)

The safety and efficacy of KAZANO[®] in patients < 18 years old have not been established. No data are available.

Geriatrics

No dose adjustment is necessary based on age. However, dosing of KAZANO[®] should be carefully titrated in patients with advanced age due to the potential for decreased renal and cardiac function in this population. KAZANO should not be used in patients with renal impairment (see CONTRAINDICATIONS, WARNINGS AND PRECAUTIONS and ACTION AND CLINICAL PHARMACOLOGY). Monitoring of renal function is necessary to aid in prevention of metformin-associated lactic acidosis, particularly in the elderly.

Missed Dose

If a dose is missed, it should be taken as soon as the patient remembers. A double dose should not be taken at the same time.

Administration

KAZANO[®] should be taken twice daily because of the pharmacokinetics of its metformin component. It should also be taken with meals to reduce the gastrointestinal undesirable effects associated with metformin. The tablets should be swallowed whole with water.

OVERDOSAGE

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

No data are available with regard to overdose of KAZANO[®].

The highest doses of alogliptin administered in clinical trials were single doses of 800 mg to healthy subjects and doses of 400 mg once daily for 14 days to patients with type 2 diabetes mellitus (equivalent to 32 times and 16 times the recommended total daily dose of 25 mg alogliptin, respectively). No serious adverse events were observed at these doses.

Lactic acidosis should be excluded. The drug should be discontinued and proper supportive therapy instituted. Overdose of metformin hydrochloride has occurred, including ingestion of amounts greater than 50 grams. Hypoglycemia was reported in approximately 10% of cases. Lactic acidosis has been reported in approximately 32% of metformin overdose cases (see WARNINGS AND PRECAUTIONS, Endocrine and Metabolism – Lactic Acidosis). 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 overdosage is suspected.

Management

In the event of an overdose, clinical monitoring and supportive measures should be employed as dictated by the patient's clinical status.

Minimal quantities of alogliptin are removed by hemodialysis (approximately 7% of the drug was removed during a 3-hour hemodialysis session). Therefore, hemodialysis is of little benefit in removing alogliptin in an overdose situation. It is not known if alogliptin is removed by peritoneal dialysis.

The most effective method of removing lactate and metformin is hemodialysis.

ACTION AND CLINICAL PHARMACOLOGY

Mechanism of Action

KAZANO[®] combines two antihyperglycemic medications with complementary and distinct mechanisms of action to improve glycemic control in patients with type 2 diabetes mellitus: alogliptin, a dipeptidyl-peptidase-4 (DPP-4) inhibitor, and metformin, a member of the biguanide class.

Alogliptin

Increased concentrations of the incretin hormones such as glucagon-like peptide-1 (GLP-1) and glucose-dependent insulinotropic peptide (GIP) are released into the bloodstream from the small intestine in response to meals. These hormones cause insulin release from the pancreatic beta cells in a glucose-dependent manner but are inactivated by the DPP-4 enzyme within minutes. GLP-1 also lowers glucagon secretion from pancreatic alpha cells, reducing hepatic glucose production. In patients with type 2 diabetes, concentrations of GLP-1 are reduced but the insulin response to GLP-1 is preserved. Alogliptin is a potent, reversible and selective inhibitor of dipeptidyl peptidase-4 (DPP-4) that slows the inactivation of the incretin hormones, thereby increasing their concentrations and reducing fasting and postprandial glucose concentrations in a

glucose-dependent manner in patients with type 2 diabetes mellitus. In summary, alogliptin is expected to improve glycemic control by inhibiting DPP-4 activity.

Alogliptin does not inhibit the activity of other closely related enzymes *in vitro* at concentrations 15-fold greater than the mean human plasma exposure at the recommended clinical dose. Alogliptin (mean IC₅₀ = 6.9) is greater than 10,000 fold more selective for DPP-4 than other related enzymes including DPP-8 and DPP-9.

Metformin

Metformin is an antihyperglycemic agent, which improves glucose tolerance in patients with type 2 diabetes, lowering both basal and postprandial plasma glucose. Metformin is a biguanide derivative producing an antihyperglycemic effect which is observed in diabetic patients or in diabetic animals. Its pharmacologic mechanisms of action are different from other classes of oral antihyperglycemic agents. Metformin may decrease hepatic glucose production, decrease intestinal absorption of glucose, and improve 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 WARNINGS AND PRECAUTIONS, Hypoglycemia) and does not cause hyperinsulinemia. With metformin therapy, insulin secretion remains unchanged while fasting insulin levels and day-long plasma insulin response may actually decrease.

Pharmacodynamics

Alogliptin

Administration of 25 mg alogliptin to patients with type 2 diabetes mellitus produced peak inhibition of DPP-4 within 1 to 2 hours and exceeded 93% both after a single 25 mg dose and after 14 days of once-daily dosing. Inhibition of DPP-4 remained above 81% at 24 hours after 14 days of dosing. The 4-hour postprandial glucose concentrations were consistently reduced from baseline following breakfast, lunch and dinner. When these glucose concentrations were averaged across all 3 meals and corrected from baseline, 14 days of treatment with 25 mg alogliptin resulted in a mean reduction in 4-hour post prandial glucose compared to placebo (-1.30 mmol/L versus 0.65 mmol/L, respectively).

Cardiac Electrophysiology: In a single-blind, randomised, placebo- and positive-controlled, parallel group ECG assessment study, healthy subjects received alogliptin 50 mg once daily (N=62), alogliptin 400 mg once daily (N=62), or placebo (N=63) for 7 days. ECG data were collected at baseline and on Days 1 and 7 of treatment at 0 hour and at 0.5, 1, 2, 3, 4, 5, 6, 8, 10, 12, 14, 16, 18, and 23.5 hour post-dose. In the alogliptin 50 mg group, the maximum mean difference from placebo in the QTcF interval was 4.5 ms (90% CI 0.4, 8.5) at 2 hour post-dosing on Day 7 of treatment. In the alogliptin 400 mg treatment group, the maximum mean difference from placebo was 5.8 ms (90% CI 1.8, 9.7) at 1 hour post-dosing on Day 7 of treatment. The therapeutic 25 mg dose of alogliptin was not tested in this study; however, based on pharmacokinetic-pharmacodynamic modelling, no QTcF prolongation is predicted at the 25 mg dose, assuming a mean steady-state C_{max} of 152.78 ng/mL. No effects on heart rate or the QRS duration were observed at the 50 mg and 400 mg doses tested in this study.

Metformin

In humans, independently of its action on glycemia, metformin has favorable effects on lipid metabolism. This has been shown at therapeutic doses in controlled, medium-term or long-term clinical studies; metformin reduces total cholesterol, LDL cholesterol and triglyceride levels.

Pharmacokinetics

Alogliptin

The pharmacokinetics of alogliptin have been studied in healthy subjects and in patients with type 2 diabetes mellitus (Table 3), and were comparable between the two populations.

Table 3. Summary of Alogliptin Steady State Pharmacokinetic Parameters (Arithmetic Mean ± SD) in Patients with T2DM

	T _{max} [*] (hr)	C _{max} (ng/mL)	t _{1/2} (hr)	AUC ₍₀₋₂₄₎ (ng·hr/mL)	Clearance (L/hr)	Volume of Distribution (L)
Alogliptin 25 mg at Steady State in Patients with T2DM	1.1 (0.8, 4.5)	153 ± 39	21.1 ± 8.8	1474 ± 214	10.4 ± 2.3	299 ± 77

*T_{max} is presented as Median (Min, Max).

After multiple-dose administration up to 400 mg for 14 days in patients with type 2 diabetes, accumulation of alogliptin was minimal with an increase in total (i.e., AUC) and peak (i.e., C_{max}) alogliptin exposures of 34% and 9%, respectively. Total and peak exposure to alogliptin increased proportionally across single doses and multiple doses of alogliptin ranging from 25 mg to 400 mg. The inter-subject coefficient of variation for alogliptin AUC was 17%.

The results of bioequivalence studies in healthy subjects demonstrated that KAZANO[®] film-coated tablets are bioequivalent to the corresponding doses of alogliptin and metformin co-administered as separate tablets.

Co-administration of 100 mg alogliptin once daily and 1000 mg metformin hydrochloride twice daily for 6 days in healthy subjects had no clinically relevant effects on the pharmacokinetics of alogliptin or metformin.

Administration of KAZANO[®] with food resulted in no change in total exposure (AUC) to alogliptin or metformin. However, mean peak plasma concentrations of alogliptin and metformin were decreased by 13% and 28% when KAZANO[®] was administered with food, respectively. There was no change in the time to peak plasma concentration (T_{max}) for alogliptin, but there was a delayed T_{max} for metformin of 1.5 hours. These changes are not likely to be clinically significant.

KAZANO[®] should be taken twice daily because of the pharmacokinetics of its metformin component. It should also be taken with meals to reduce the gastrointestinal undesirable effects associated with metformin (see DOSAGE AND ADMINISTRATION).

The pharmacokinetics of KAZANO[®] in patients < 18 years old have not been established. No data are available (see DOSAGE AND ADMINISTRATION).

The following sections outline the pharmacokinetic properties of the individual components of KAZANO[®] (alogliptin/metformin) as reported in their respective product monographs.

Absorption

Alogliptin

The pharmacokinetics of alogliptin have been studied in healthy subjects and in patients with type 2 diabetes mellitus, and have been shown to be generally similar.

The absolute bioavailability of alogliptin is approximately 100%.

Administration with a high-fat meal resulted in no change in total and peak exposure to alogliptin. Alogliptin may, therefore, be administered with or without food.

After administration of single oral doses of up to 800 mg in healthy subjects, alogliptin was rapidly absorbed with peak plasma concentrations occurring 1 to 2 hours (median T_{max}) after dosing.

No clinically relevant accumulation after multiple dosing was observed in either healthy subjects or in patients with type 2 diabetes mellitus.

Total and peak exposure to alogliptin increased proportionately across single doses of 6.25 mg up to 100 mg alogliptin (covering the therapeutic dose range). The inter-subject coefficient of variation for alogliptin AUC was small (17%).

Metformin

The absolute bioavailability of a metformin hydrochloride 500 mg tablet given under fasting conditions is approximately 50 to 60%. Studies using single oral doses of metformin hydrochloride tablets 500 mg to 1500 mg, and 850 mg to 2550 mg, indicate that there is a lack of dose proportionality with increasing doses, which is due to decreased absorption rather than an alteration in elimination. Food decreases the extent of and slightly delays the absorption of metformin, as shown by approximately a 40% lower mean peak plasma concentration (C_{max}), a 25% lower area under the plasma concentration versus time curve (AUC), and a 35 minute prolongation of time to peak plasma concentration (T_{max}) following administration of a single 850 mg tablet of metformin with food, compared to the same tablet strength administered fasting. The clinical relevance of these decreases is unknown.

Distribution

Alogliptin

Following a single intravenous dose of 12.5 mg alogliptin to healthy subjects, the volume of distribution during the terminal phase was 417 liters indicating that the drug is well distributed into tissues.

Alogliptin is 20% bound to plasma proteins.

Metformin

The apparent volume of distribution (V/F) of metformin following single oral doses of metformin hydrochloride tablets 850 mg averaged 654 ± 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 metformin hydrochloride tablets, steady state plasma concentrations of metformin are reached within 24 to 48 hours and are generally <1 mcg/mL. During controlled clinical trials of metformin, maximum metformin plasma levels did not exceed 5 mcg/mL, even at maximum doses.

Biotransformation

Alogliptin

Alogliptin does not undergo extensive metabolism and 60 to 71% of the dose is excreted as unchanged drug in the urine.

Two minor metabolites were detected following administration of an oral dose of [^{14}C] alogliptin, N-demethylated alogliptin, M-I ($< 1\%$ of the parent compound), and N-acetylated alogliptin, M-II ($< 6\%$ of the parent compound). M-I is an active metabolite and is a highly selective inhibitor of DPP-4 similar to alogliptin; M-II does not display any inhibitory activity towards DPP-4 or other DPP-related enzymes. *In vitro* data indicate that CYP2D6 and CYP3A4 contribute to the limited metabolism of alogliptin.

In vitro studies indicate that alogliptin does not induce CYP1A2, CYP2B6, CYP2C9, CYP2C19 or CYP3A4 and does not inhibit CYP1A2, CYP2B6, CYP2C8, CYP2C9, CYP2C19, CYP2D6 or CYP3A4 at concentrations achieved with the recommended total daily dose of 25 mg alogliptin.

Alogliptin exists predominantly as the (*R*)-enantiomer ($> 99\%$) and undergoes little or no chiral conversion *in vivo* to the (*S*)-enantiomer. The (*S*)-enantiomer is not detectable at therapeutic doses.

Metformin

Metformin is excreted unchanged in the urine and does not undergo hepatic metabolism (No metabolites have been identified in humans) nor biliary excretion.

Elimination

Alogliptin

The recommended total daily dose of 25 mg alogliptin was eliminated with a mean terminal half life ($T_{1/2}$) of approximately 21 hours.

Following administration of an oral dose of [^{14}C] alogliptin, 76% of total radioactivity was eliminated in the urine and involved some active renal tubular secretion, and 13% was recovered in the feces.

Metformin

Renal clearance 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.

Linearity

Alogliptin

Total exposure ($\text{AUC}_{(0-\text{inf})}$) to alogliptin following administration of a single dose was similar to exposure during one dose interval ($\text{AUC}_{(0-24)}$) after 6 days of once daily dosing. This indicates linear kinetics of alogliptin after multiple dosing.

Special Populations and Conditions

Renal Impairment

KAZANO[®] should not be used in patients with renal impairment (see CONTRAINDICATIONS).

Alogliptin

A single-dose of 50 mg alogliptin was administered to 4 groups of patients with varying degrees of renal impairment (creatinine clearance (CrCl) using the Cockcroft-Gault formula): mild (CrCl = ≥ 50 to ≤ 80 ml/min), moderate (CrCl = ≥ 30 to ≤ 50 ml/min), severe (CrCl = < 30 ml/min) and End-Stage Renal Disease (ESRD) on haemodialysis.

An approximate 1.7-fold increase in AUC for alogliptin was observed in patients with mild renal impairment. However, as the distribution of AUC values for alogliptin in these patients was within the same range as control subjects, no dose adjustment for patients with mild renal impairment is necessary (see WARNINGS AND PRECAUTIONS).

In patients with moderate or severe renal impairment, or ESRD on haemodialysis, an increase in systemic exposure to alogliptin of approximately 2- and 4-fold was observed, respectively. (Patients with ESRD underwent haemodialysis immediately after alogliptin dosing. Based on mean dialysate concentrations, approximately 7% of the drug was removed during a 3-hour haemodialysis session.) Therefore, in order to maintain systemic exposures to alogliptin that are similar to those observed in patients with normal renal function, lower doses of alogliptin should

be used in patients with moderate or severe renal impairment, or ESRD requiring dialysis (see WARNINGS AND PRECAUTIONS).

There was no significant difference in exposure to the active metabolite, M-I (< 1% of the parent compound), in patients with mild renal impairment compared to control subjects. Total exposure to M-I was approximately 2- and 3-fold higher in patients with moderate or severe renal impairment, respectively. However, the ratios of AUC for M-I/a logliptin in control subjects and patients with severe renal impairment or ESRD were similar.

Metformin

In patients with decreased renal function (based on measured creatinine clearance (<60 mL/min), the plasma and blood half-lives of metformin are prolonged and the renal clearance is decreased in proportion to the decrease in creatinine clearance.

Hepatic Impairment

Due to its metformin component, KAZANO[®] should not be used in patients with severe hepatic impairment (see DOSAGE AND ADMINISTRATION).

Alogliptin

Total exposure to alogliptin was approximately 10% lower and peak exposure was approximately 8% lower in patients with moderate hepatic impairment compared to healthy control subjects. The magnitude of these reductions was not considered to be clinically relevant. Therefore, no dose adjustment is necessary for patients with mild to moderate hepatic impairment (Child-Pugh scores of 5 to 9). Alogliptin has not been studied in patients with severe hepatic impairment (Child-Pugh score >9, see WARNINGS AND PRECAUTIONS).

Metformin

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

Age, Gender, Race

Alogliptin

Age (≥ 65 years old), gender and race (White, Black and Asian) did not have any clinically relevant effect on the pharmacokinetics of alogliptin. No dose adjustment is necessary.

Metformin

Limited data from controlled pharmacokinetic studies of 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. (WARNINGS AND PRECAUTIONS, Geriatrics).

KAZANO[®] treatment should not be initiated in patients ≥ 80 years of age unless measurement of creatinine clearance demonstrates that renal function is not reduced (see WARNINGS AND PRECAUTIONS, Lactic Acidosis).

Pediatric Population

No studies with KAZANO[®] have been performed in pediatric patients.

STORAGE AND STABILITY

Store at 15°-30°C.

SPECIAL HANDLING INSTRUCTIONS

There are no special requirements for KAZANO[®].

DOSAGE FORMS, COMPOSITION AND PACKAGING

KAZANO[®] is supplied as film-coated tablets as follows:

Strength	Description
12.5mg+500mg	Pale yellow, oblong, biconvex, film-coated tablet with “12.5/500” debossed on one side and “322M” debossed on the other side
12.5mg+850mg	Light yellow, oblong, biconvex, film-coated tablet with “12.5/850” debossed on one side and “322M” debossed on the other side
12.5mg+1000mg	Pale yellow, oblong, film-coated tablets with “12.5/1000” debossed on one side and “322M” debossed on the other side

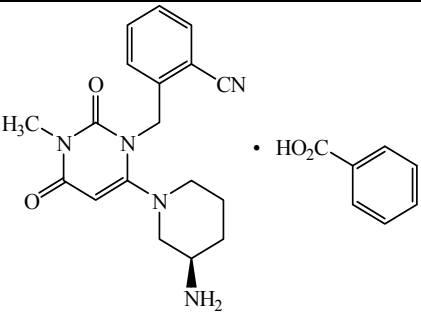
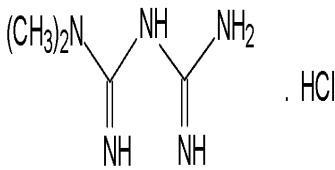
Each KAZANO[®] tablet contains 17 mg alogliptin benzoate which is equivalent to 12.5 mg of alogliptin and 1000 mg, 850 mg, or 500 mg metformin hydrochloride. The following inactive ingredients are also included in each tablet: mannitol, microcrystalline cellulose (PH 101 and KG-1000), povidone, crospovidone, and magnesium stearate. In addition, the film-coating contains the following inactive ingredients: hypromellose (2910), talc, titanium dioxide, and ferric oxide (yellow).

KAZANO[®] tablets are supplied in aluminum/aluminum blister strips of 56 tablets in a carton box (8 blister strips of 7 tablets) or high-density polyethylene (HDPE) bottles of 60 tablets.

PART II: SCIENTIFIC INFORMATION

PHARMACEUTICAL INFORMATION

Drug Substance: Alogliptin benzoate plus metformin hydrochloride

Proper name:	alogliptin benzoate	metformin hydrochloride
Chemical name:	2-({6-[(3 <i>R</i>)-3-aminopiperidin-1-yl]-3-methyl-2,4-dioxo-3,4-dihydropyrimidin-1(2 <i>H</i>)-yl}methyl) benzonitrile monobenzoate	1,1-Dimethylbiguanide hydrochloride
Molecular formula:	C ₁₈ H ₂₁ N ₅ O ₂ •C ₇ H ₆ O ₂	C ₄ H ₁₁ N ₅ .HCl
Molecular mass:	461.51 (benzoate salt) 339.39 (free base)	165.63
Structural formula:		
Physicochemical properties:	White to off-white, crystalline powder containing one asymmetric carbon in the aminopiperidine moiety. It is soluble in dimethylsulfoxide, sparingly soluble in methanol, water and aqueous solutions across the physiologic pH range; slightly soluble in ethanol, and very slightly soluble in octanol and isopropyl acetate. Melting point: 182.5°C.	White, crystalline powder; odourless or almost odourless; hygroscopic, with a bitter taste. Freely soluble in water and aqueous solutions across the physiologic pH range, slightly soluble in alcohol and practically insoluble in acetone and in methylene chloride. Melting point: between 222°C and 226°C.

CLINICAL TRIALS

Study demographics and trial design

Table 4. Summary of patient demographics for clinical trials in specific indication					
Add on Combination Therapy with Metformin					
Study #	Trial design	Dosage (patients enrolled/completing the trial), route of administration and duration	Study subjects (n=number)	Mean age (Range)	Gender (M- Male F- Female)
SYR-322-MET-008	Phase 3, randomized, double-blinded, placebo-controlled, 3-treatment arm design Efficacy (HbA1c)	MET with: ALO 12.5 mg (213/176) ALO 25 mg (207/165) PBO (104/72) Total (524/413) Oral administration Treatment duration: 26 weeks Subjects with T2DM being treated with MET alone	527	54.7 (22-80) years	265 (50.3%) Men, 262 (49.7%) Women
SYR-322-TZD-009	Phase 3, randomized, double-blinded, placebo-controlled, 3-treatment arm Efficacy (HbA1c)	PIO+SU or MET with: ALO 12.5 mg (197/153) ALO 25 mg (199/160) PBO (97/71) Total (493/384) Oral administration Treatment duration: 26 weeks Subjects with T2DM being treated with a TZD (PIO) alone or in combination with MET or an SU	493	55.4 (24-80) years	287 (58.2%) Men, 206 (41.8%) Women
SYR-322-INS-011	Phase 3, randomized, double-blinded, placebo-controlled, 3-treatment arm Efficacy (HbA1c)	Insulin with/without MET with: ALO 12.5 mg (131/83) ALO 25 mg (129/77) PBO (129/55) Total (389/215) Oral administration Treatment duration: 26 weeks Subjects with T2DM being treated with insulin alone or in combination with MET	390	55.4 (23-80) years	229 (58.7%) Women, 161 (41.3%) Men

Table 4. Summary of patient demographics for clinical trials in specific indication					
Add on Combination Therapy with Metformin					
Study #	Trial design	Dosage (patients enrolled/completing the trial), route of administration and duration	Study subjects (n=number)	Mean age (Range)	Gender (M- Male F- Female)
01-06-TL-322OPI-004	Phase 3, randomized, double-blinded, 2-treatment arm Efficacy (HbA1c)	MET+ALO 25+PIO 30 mg (404/283) MET+PIO 45 mg (399/243) Total (803/526) Oral administration Treatment duration: 52 weeks Subjects with T2DM and inadequate glycemic control on MET (\geq 1500 mg or MTD) and PIO 30 mg	803	55.1 (25-80) years	389 (48.4%) Women, 414 (51.6%) Men
SYR-322_305 (ENDURE)	Phase 3, randomized, double-blinded, active comparator Efficacy (HbA1c)	MET+ALO 12.5 mg (880/472) MET+ALO 25 mg (885/493) MET+Glipizide (874-/427) Total (2639/1392) Oral administration Treatment duration: 52 weeks and 104 weeks Subjects with T2DM and inadequate glycemic control on MET \geq 1500 mg (or MTD) alone	2639	55.4 (21-80) years	1312 (49.7%) Men, 1327 (50.3%) Women
SYR-322_402 (EXAMINE)	Phase 3b, randomized, double-blinded, placebo-controlled, 2-treatment arm Safety (time from randomization to the first occurrence of any event in the primary MACE composite [CV death, nonfatal MI, and nonfatal stroke])	ALO (25 mg, 12.5 mg, and 6.25 mg QD based on renal function) versus matching placebo Oral administration Treatment duration: mean 17 months; Study participation: mean 19 months Subjects with T2DM and recent ACS	5380	60.9 (26-91) years	3651 (67.9%) Men, 1729 (32.1%) Women

Study Results

Clinical studies conducted to support the efficacy of KAZANO[®] involved the co-administration of alogliptin and metformin as separate tablets. However, the results of bioequivalence studies have demonstrated that KAZANO[®] film-coated tablets are bioequivalent to the corresponding doses of alogliptin and metformin co-administered as separate tablets.

A total of 7151 patients with type 2 diabetes mellitus, including 2414 patients treated with alogliptin 25 mg/day and metformin, participated in 7 Phase 3 double-blind, placebo- or active-controlled clinical studies conducted to evaluate the effects of co-administered alogliptin and metformin on glycemic control and their safety. In these studies, 418(17.3%) alogliptin 25mg day plus metformin-treated patients were ≥ 65 years old.

Overall, treatment with the recommended daily dose of 25 mg alogliptin improved glycemic control when given as add-on combination therapy to metformin. This was determined by clinically relevant and statistically significant reductions in glycosylated hemoglobin (HbA1c) compared to control from baseline to study endpoint. Reductions in HbA1c were similar across different subgroups including age, gender, race and body mass index (BMI). Clinically meaningful reductions in HbA1c compared to control were also observed with 25 mg alogliptin regardless of baseline background medication dose, for subjects with a baseline HbA1c >7.5 . Higher baseline HbA1c was associated with a greater reduction in HbA1c.

Alogliptin as add-on therapy to Metformin (SYR-322-MET-008)

The addition of 25 mg alogliptin once daily to metformin hydrochloride therapy (mean dose = 1847 mg) resulted in statistically significant improvements from baseline in HbA1c and FPG at Week 26 when compared to the addition of placebo (Figure 1 and Table 5). Significant improvements in HbA1c vs the addition of placebo were noted as early as 4 weeks ($p < 0.001$) after the start of alogliptin, and these remained significant at every time point until Week 26. Significant improvements in FPG vs. placebo ($p < 0.001$) were noted as early as 1 week after the start of alogliptin, and these improvements in FPG remained significant at every time point until Week 26. Body weight did not differ significantly between the groups.

Significantly more patients receiving 25 mg alogliptin (44.4%) achieved target HbA1c levels of $\leq 7.0\%$ compared to those receiving placebo (18.3%) at Week 26 ($p < 0.001$). Also, significantly fewer patients receiving 25 mg alogliptin (8.2%) required hyperglycemic rescue compared to those receiving placebo (24.0%) during the study ($p = 0.003$).

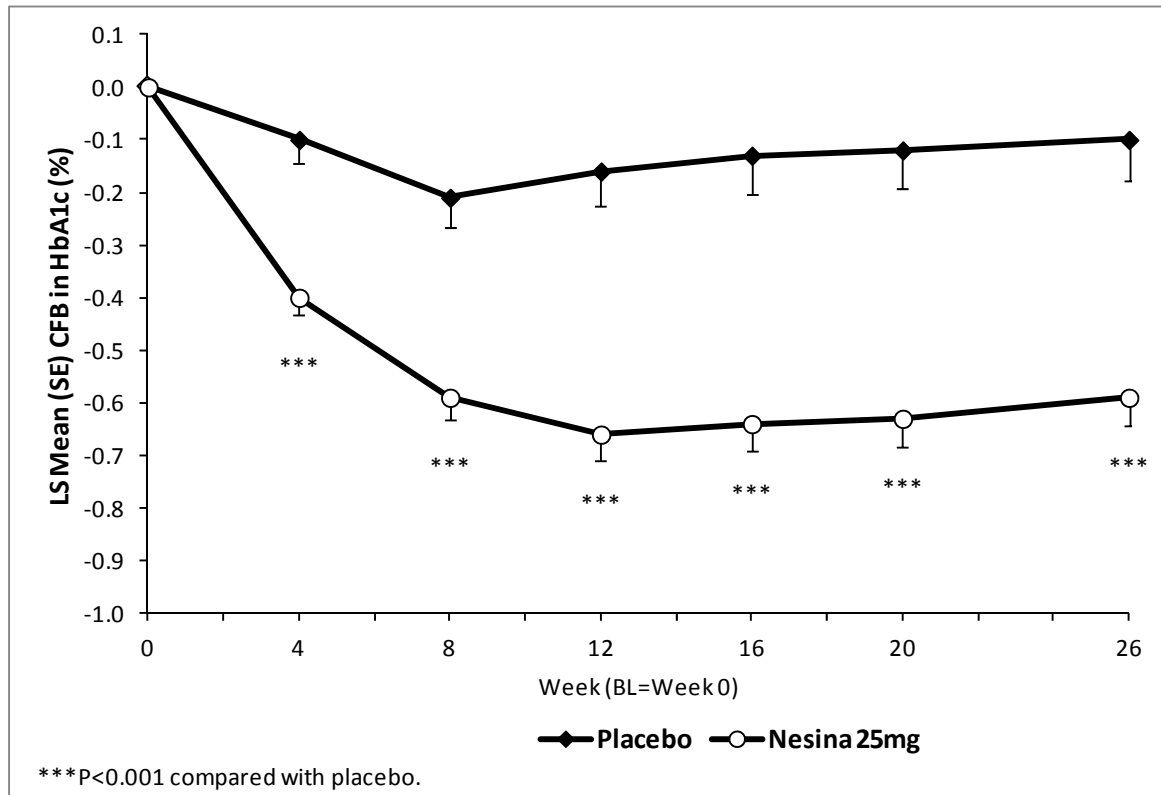
Table 5. Glycemic Parameters at Week 26 (Study SYR-322-008)

	Alogliptin 25 mg	Placebo
HbA1c (%)	N=207	N=104
Baseline (mean)	7.93	8.01
Change from Baseline at Week 26 [†]	-0.59 \pm 0.054 (n=203)	-0.10 \pm 0.076 (n=103)
Difference vs. Placebo [†]	-0.48%* [-0.67, -0.30]	
Patients (%) achieving HbA1c $\leq 7\%$ at Week 26	44.4%	18.3%
FPG (mmol/L)	N=204	N=104
Baseline (mean)	9.54	9.96
Change from Baseline at Week 26 [†]	-0.97 \pm 0.14 (n=204)	0.0 \pm 0.20 (n=104)
Difference vs. Placebo [†]	-0.97 mmol/L* [-1.44, -0.49]	

†Least squares mean ± SE

*p<0.001, [] shows two-sided 95% confidence interval

Figure 1. Change from Baseline at Week 26 in HbA1c When Alogliptin 25 mg is added to Metformin



Alogliptin as Add-on Therapy to Metformin vs Glipizide Add-on to Metformin (SYR-322-305) ENDURE

In a 104 week study to evaluate durability of glycemic control, patients were randomized to the addition of either alogliptin 25 mg daily (n = 885), alogliptin 12.5 mg daily (n = 880) or glipizide (n = 874) to a background of metformin. Patients receiving glipizide were given an initial dosage of 5 mg/day. After at least 2 weeks, patients receiving glipizide who demonstrated persistent hyperglycemia (FPG \geq 13.9 mmol/L) could be up-titrated by the investigator in 5 mg increments in 4-week intervals, up to a maximum of 20 mg per day, over the following 18 weeks. Thereafter, the glipizide dose was to have been maintained for the remainder of the trial. The mean daily dose of glipizide following the titration period was 5.2 mg/day.

The addition of alogliptin 25 mg once daily to metformin therapy (mean dose = 1835 mg) resulted in improvements from baseline in HbA1c at Week 52 and Week 104 that were statistically non-inferior to those produced by glipizide plus metformin therapy (mean dose = 1824 mg). Based on 537 per-protocol patients in the alogliptin 25mg plus metformin group and 509 per-protocol patients in the glipizide plus metformin group at Week 52, using the

last observation carried forward (LOCF), the mean decrease from baseline HbA1c was -0.61% with alogliptin 25 mg and -0.52% with glipizide. These results were maintained at Week 104. Results of secondary endpoints, based on the Full Analysis Set assessed at Week 104 (LOCF) showed that the mean change from baseline in FPG was -0.18 mmol/L with alogliptin 25 mg and 0.30 mmol/L with glipizide. Alogliptin did not have any meaningful change on body weight up to Week 104.

Alogliptin as Add-on Therapy to Pioglitazone (PIO) (SYR-322-TZD-009)

The addition of 25 mg alogliptin once daily to pioglitazone therapy (mean dose = 35.0 mg, with or without metformin or a sulphonylurea) resulted in statistically significant improvements from baseline in HbA1c (see Figure 2) and FPG at Week 26 when compared to the addition of placebo (Table 6). Approximately 56% and 21% of subjects were receiving metformin or sulfonylurea at baseline. Clinically meaningful reductions in HbA1c compared to placebo were also observed with 25 mg alogliptin regardless of whether patients were receiving concomitant metformin or sulphonylurea therapy. Significantly more patients receiving 25 mg alogliptin (49.2%) achieved target HbA1c levels of $\leq 7.0\%$ compared to those receiving placebo (34.0%) at Week 26 ($p=0.004$). Also, fewer patients receiving 25 mg alogliptin (9.0%) required hyperglycaemic rescue compared to those receiving placebo (12.4%) during the study. Body weight did not differ significantly between the groups.

Table 6. Glycemic Parameters at Week 26 for Alogliptin When Added to Pioglitazone (Study SYR-322-009)

	Alogliptin 25 mg	Placebo
HbA1c (%)	N=199	N=97
Baseline (mean)	8.01	7.97
Change from Baseline at Week 26 [†]	0.80 ± 0.056 (n=195)	-0.19 ± 0.081 (n=95)
Difference vs. Placebo [†]	-0.61%* [-0.80, -0.41]	
Patients (%) achieving HbA1c $\leq 7\%$ at Week 26	49.2	34.0
FPG (mmol/L)	N=199	N=97
Baseline (mean)	9.41	9.53
Change from Baseline at Week 26 [†]	-1.10 ± 0.15 (n=197)	-0.32 ± 0.21 (n=97)
Difference vs Placebo [†]	-0.78 mmol/L* [-1.29, -0.28]	

[†]Least squares mean ± SE

* $p < 0.01$, [] shows two-sided 95% confidence interval

Alogliptin as Add-on Therapy to Pioglitazone with Metformin (01-06-TL-322OPI-004)

The addition of 25 mg alogliptin once daily to 30 mg pioglitazone in combination with metformin hydrochloride therapy (mean dose = 1867.9 mg) resulted in clinically meaningful improvements from baseline in HbA1c at Week 52 that were statistically superior to those produced by 45 mg pioglitazone in combination with metformin hydrochloride therapy (mean dose = 1847.6 mg, Table 7 and Figure 2). The significant reductions in HbA1c observed with

25 mg alogliptin plus 30 mg pioglitazone and metformin were consistent over the entire 52-week treatment period compared to 45 mg pioglitazone and metformin ($p < 0.001$ at all time points). In addition, mean change from baseline in FPG at Week 52 for 25 mg alogliptin plus 30 mg pioglitazone and metformin was significantly greater than that for 45 mg pioglitazone and metformin ($p < 0.001$). Significantly more patients receiving 25 mg alogliptin plus 30 mg pioglitazone and metformin (33.2%) achieved target HbA1c levels of $\leq 7.0\%$ compared to those receiving 45 mg pioglitazone and metformin (21.3%) at Week 52 ($p < 0.001$). Also, fewer patients receiving 25 mg alogliptin plus 30 mg pioglitazone and metformin (10.9%) required hyperglycemic rescue compared to those receiving 45 mg pioglitazone and metformin (21.7%) during the study ($p < 0.001$). Body weight did not differ significantly between the groups.

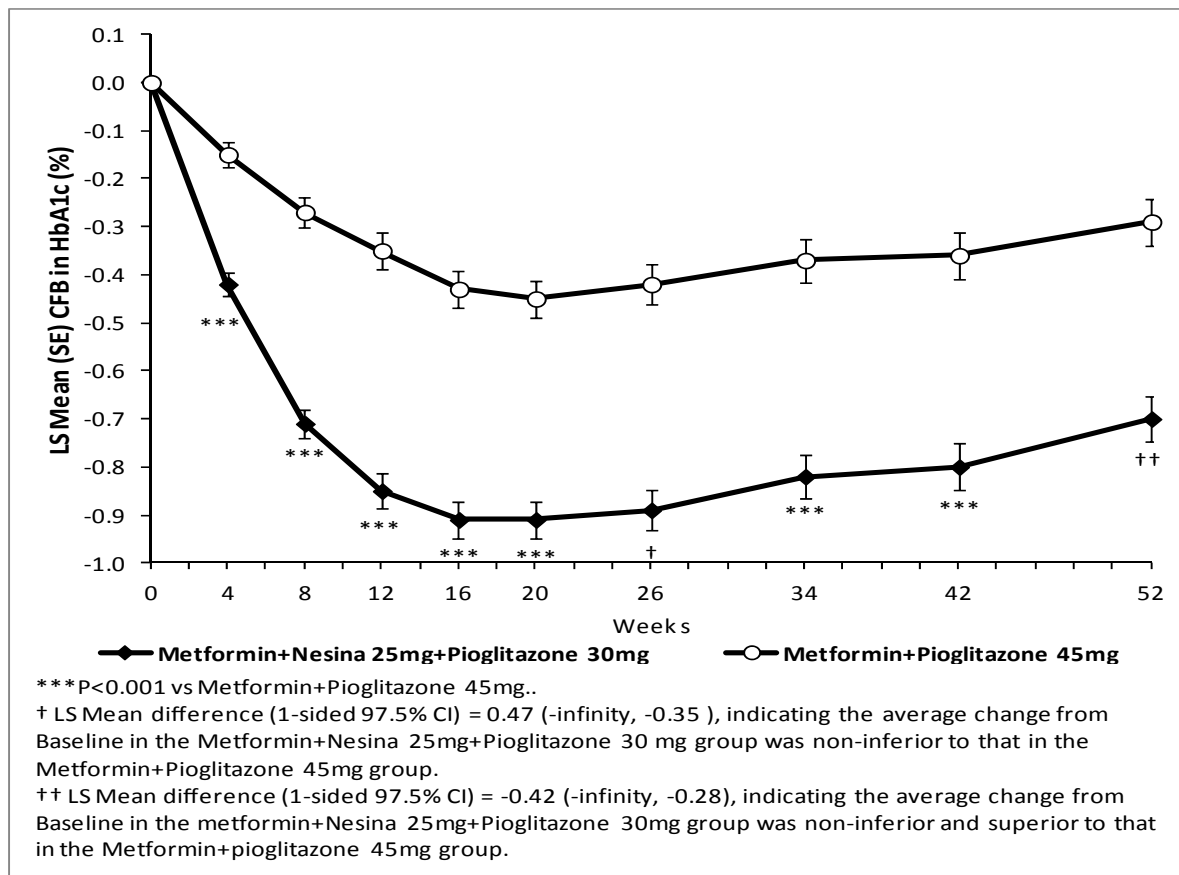
Table 7. Glycemic Parameters at Week 52 for Alogliptin as Add-on Combination Therapy with Pioglitazone and Metformin (Study 322OPI-004)

	Alogliptin 25 mg + Metformin hydrochloride (≥ 1500) + Pioglitazone 30 mg	Metformin hydrochloride (≥ 1500) + Pioglitazone 45 mg
HbA1c (%)	N=404	N=399
Baseline (mean)	8.24	8.14
Change from Baseline at Week 52 (Per protocol set) [†]	-0.70 ± 0.048 (n=303)	-0.29 ± 0.048 (n=306)
Difference vs Metformin + Pioglitazone [†]	-0.42% [-infinity, -0.28]	
Patients (%) achieving HbA1c $\leq 7\%$ at Week 52	33.2	21.3
FPG (mmol/L)	N=404	N=399
Baseline (mean)	8.98	9.00
Change from Baseline at Week 52 (Full Analysis Set) [†]	-0.81 ± 0.10 (n=399)	-0.21 ± 0.10 (n=396)
Difference vs. Metformin + Pioglitazone [†]	-0.60 mmol/L* <-0.90, -0.32>	

[†]Least squares mean \pm SE

* $p < 0.001$, [] shows one-sided 97.5% confidence interval, <> shows two-sided 95% confidence interval

Figure 2. Change from Baseline at Week 26 in HbA1c When Alogliptin 25 mg is Added on to Pioglitazone with Metformin



Alogliptin as Add-on Therapy to Insulin (with or without Metformin) (SYR-322-INS-011)

Alogliptin was investigated in patients with a baseline HbA1c ≥ 8.0 and taking insulin at doses ranging from 15 to 100 IU/day either as monotherapy (42% of the total sample) or in combination with insulin (58% of the total sample). The majority of insulins used in this study were mixed and basal classes. The addition of 25 mg alogliptin once daily to insulin therapy (mean dose = 56.5 IU, with or without metformin) resulted in statistically significant improvements from baseline in HbA1c (see Figure 3) and FPG at Week 26 when compared to the addition of placebo (Table 8). The completion rates in the study were low (42% completed in the placebo group and 60% completed in the alogliptin 25 mg group). Fewer patients receiving 25 mg alogliptin (19.4%) required hyperglycemic rescue compared to those receiving placebo (40%) during the study. Clinically meaningful reductions in HbA1c compared to placebo were also observed with 25 mg alogliptin regardless of whether patients were receiving concomitant metformin therapy. Significant improvements in HbA1c vs. placebo were noted as early as 4 weeks after the start of alogliptin, which remained significant at every time point until study end. More patients receiving 25 mg alogliptin (7.8%) achieved target HbA1c levels of $\leq 7.0\%$ compared to those receiving placebo (0.8%) at Week 26. Also, significantly fewer patients receiving 25 mg alogliptin (19.4%) required hyperglycemic rescue compared to those receiving

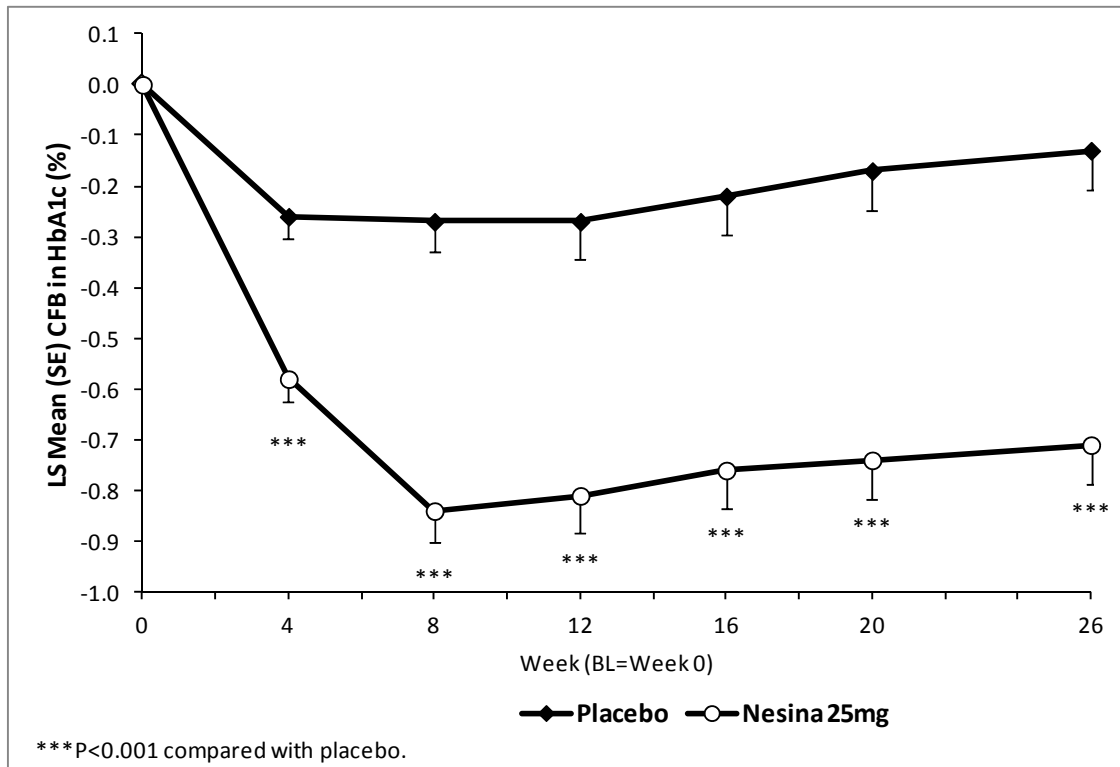
placebo (40.0%) during the study (p<0.001). Body weight did not differ significantly between the groups.

Table 8. Glycemic Parameters at Week 26 for Alogliptin as Add-on Combination Therapy with Insulin (with or without Metformin) (Study 322-INS-011)

	Alogliptin 25 mg	Placebo
HbA1c (%)	N=129	N=129
Baseline (mean)	9.27	9.28
Change from Baseline at Week 26 [†]	-0.71 ± 0.078 (n=126)	-0.13 ± 0.077 (n=126)
Difference vs Placebo [†]	-0.59%* [-0.80, -0.37]	
Patients (%) achieving HbA1c ≤7% at Week 26	7.8	0.8
FPG (mmol/L)	N=129	N=129
Baseline (mean)	10.34	10.88
Change from Baseline at Week 26 [†]	-0.65 ± 0.32 (n=128)	0.32± 0.32 (n=127)
Difference vs. Placebo [†]	-0.98 mmol/L* [-1.85, -0.09]	

[†]Least squares mean ± SE. *p<0.05, [] shows two-sided 95% confidence interval

Figure 3. Change from Baseline at Week 26 in HbA1c When Alogliptin 25 mg is Added to Insulin



Other Studies

Cardiovascular Safety

In a prospective, multicenter, randomized, double-blind, placebo-controlled cardiovascular outcomes safety study, treatment with alogliptin resulted in rates of major adverse cardiovascular events (MACE) that were comparable to those observed with placebo in addition to standard of care among patients with type 2 diabetes and a history of acute coronary syndrome within 15 to 90 days prior to randomization. Subjects were randomized in a 1:1 ratio to alogliptin or placebo. Randomization was stratified based on country and screening renal function (normal renal function/mild renal impairment vs moderate/severe renal impairment including ESRD). The assigned dose of alogliptin was based on renal function at screening:

- Subjects with normal renal function or mild renal impairment (eGFR \geq 60 mL/min using the MDRD formula at Screening) received alogliptin 25 mg QD or matching placebo.
- Subjects with moderate renal impairment (eGFR \geq 30 and $<$ 60 mL/min using the MDRD formula at Screening) received alogliptin 12.5 mg QD or matching placebo.
- Subjects with severe renal impairment/ESRD (eGFR $<$ 30 mL/min using the MDRD formula at Screening) received alogliptin 6.25 mg QD or matching placebo.

The cardiovascular outcomes safety study was conducted with 5,380 patients (67.9% male, 32.1% female) to examine the effect of alogliptin compared with placebo (when added to standard of care) on major adverse cardiovascular events (MACE) including time to the first occurrence of any event in the composite of cardiovascular death, nonfatal myocardial infarction and nonfatal stroke. At baseline, patients had a mean age of 61 years, mean duration of diabetes of 9.2 years, and mean HbA1c of 8.0%. Cardiovascular history reported for patients in this study included: MI (88%), congestive heart failure (27.9%), unstable angina (31.1%), cerebrovascular accident (CVA) (7.2%), hypertension (83.1%), dyslipidemias (27.0%). Renal function category at baseline was categorized as normal in 15.6% of subjects, mild impairment in 55.3% of subjects, moderate impairment in 26.2% of subjects, and severe impairment/ESRD in 2.9% of subjects. Geographical distribution was 28.0% from Eastern Europe and Africa, 25.9% from Mexico and Central/South America, 18.8% from Asia/Pacific, 15.9% from United States and Canada, and 11.4% from Western Europe, Australia, New Zealand, and the Middle East.

The study demonstrated that alogliptin did not increase the risk of having a MACE compared to placebo [Hazard Ratio: 0.96; 1-sided 99% Confidence Interval: 0-1.16]. In the alogliptin group, 11.3% of patients experienced a MACE compared to 11.8% of patients in the placebo group (Table 9). For the analysis of each component of the primary MACE composite endpoint, time to first event was defined as the time from the date of randomization to the date of first occurrence of the component, only if it was counted in the primary MACE composite endpoint; otherwise, the subject was censored at the day of last contact.

Table 9. MACE Reported in Cardiovascular Outcomes Study

	Number of Patients (%)		Hazard Ratio (1-sided 99% CI)
	Alogliptin	Placebo	
	N=2,701	N=2,679	
Primary Composite Endpoint [First Event of CV Death, Nonfatal MI or Nonfatal Stroke]	305 (11.3)	316 (11.8)	0.96 (0 - 1.16)
Cardiovascular Death	89 (3.3)	111 (4.1)	
Nonfatal Myocardial Infarction	187 (6.9)	173 (6.5)	
Nonfatal Stroke	29 (1.1)	32 (1.2)	

There were 703 patients who experienced an event within the secondary MACE composite endpoint (first event of cardiovascular death, nonfatal myocardial infarction, nonfatal stroke and urgent revascularization due to unstable angina). In the alogliptin group, 12.7% (344 subjects) experienced an event within the secondary MACE composite endpoint, compared with 13.4% (359 subjects) in the placebo group [Hazard Ratio = 0.95; 1-sided 99% Confidence Interval: 0-1.14].

Adjudicated events of total mortality, cardiovascular death, fatal/nonfatal myocardial infarction, fatal/nonfatal stroke, and heart failure resulting in death or hospitalization in all subjects (i.e., not excluding those events occurring after a non-fatal event included in a composite endpoint) had hazard ratios with 2-sided 95% confidence intervals including unity.

Table 10. Other Adjudicated Events Reported in All Subjects in Cardiovascular Outcomes Study

	Number of Patients (%)		Hazard Ratio (2-sided 95% CI)
	Alogliptin	Placebo	
	N=2701	N=2679	
All Cause Mortality	153 (5.7%)	173 (6.5%)	0.875 (0.705, 1.088)
Cardiovascular Death	112 (4.1%)	130 (4.9%)	0.851 (0.662, 1.096)
Myocardial Infarction: Fatal and Nonfatal	204 (7.6%)	190 (7.1%)	1.071 (0.878, 1.305)
Stroke: Fatal and Nonfatal	36 (1.3%)	44 (1.6%)	0.814 (0.524, 1.264)

Heart Failure: Hospitalization for Heart Failure and Death due to Heart Failure or Cardiogenic Shock	121 (4.5%)	99 (3.7%)	1.226 (0.940, 1.599)
--	------------	-----------	-------------------------

Geriatrics (≥65 years old)

Alogliptin

Treatment with 25 mg alogliptin once daily resulted in improvements from baseline in HbA1c at Week 52 that were non-inferior (HbA1c change from baseline to Week 52 = -0.14%) to those produced by glipizide (HbA1c change from baseline to Week 52 = -0.09%; mean dose of glipizide = 5.4 mg).

DETAILED PHARMACOLOGY

Alogliptin

Alogliptin exists predominantly as the (*R*)-enantiomer (>99%) and undergoes little or no enantiomeric conversion to the (*S*)-enantiomer *in vivo*. Alogliptin is metabolized to 2 minor metabolites, an *N*-demethylated metabolite (M-I) and an *N*-acetylated metabolite (M-II). *In vitro*, alogliptin is a potent and highly selective inhibitor of DPP-4 activity. M-I has similar DPP-4 inhibitory activity as alogliptin, the (*S*)-enantiomer has minimal DPP-4 inhibitory activity, and M-II showed no inhibition at the highest concentration evaluated.

In vivo, oral administration of alogliptin to mice, rats, dogs, and monkeys inhibited the activity of plasma DPP-4. When administered to animal models of T2DM, alogliptin improved various disease indices including glucose tolerance, glycosylated hemoglobin, and plasma and pancreatic insulin content. Immunohistochemical analyses of pancreatic beta cells and alpha cells from diabetic *ob/ob* mice given alogliptin for 4 weeks revealed an increase in the intensity of the staining in the pancreatic beta cells with no obvious changes in the staining of the pancreatic alpha cells.

The following data are findings from studies performed with alogliptin or metformin individually.

Metformin

Metformin absorption is relatively slow and may extend over about 6 hours.

Animal studies with metformin, labelled with ¹⁴C have shown that the drug is neither concentrated by liver cells nor is it excreted in the bile; it is concentrated in the intestinal mucosa and salivary glands.

It has been shown that, following a 2 gram dose of metformin, the blood level remains under 10 mcg/mL even at the peak, occurring 2 hours after absorption. During the experiments, metformin was shown to be devoid of any notable action in the body, apart from its specific metabolic activity.

In the healthy animal, metformin lowers blood sugar only at a nearly lethal dose. Different animal species are of unequal sensitivity. On the other hand, the animal with experimental diabetes, is sensitive to a much lower dosage, providing some insulin is still secreted.

The antihyperglycemic action of metformin is probably mediated through insulin:

- Metformin improves the K co-efficient of glucose assimilation.
- Metformin improves the co-efficient of insulin efficiency.

In the obese diabetic with hyperinsulinemia, metformin is reported to normalize insulin output. This normalizing effect is concurrent to that of glycemia.

Metformin has little effect on liver glycogen of the healthy animal. In low and average doses, no change occurs. In high doses nearing lethal levels, liver glycogen decreases. This lowering precedes the fall in blood sugar. This reaction represents a defense mechanism tending to mobilize body reserves in order to combat hypoglycemia.

In the diabetic animal with a low liver glycogen reserve, the opposite occurs and metformin builds up glycogen stores of the liver. *In vitro*, on muscular tissue isolated in Warburg's apparatus, metformin increases glucose uptake by the muscle. This action follows an aerobic pathway. Even in high concentration, contrary to phenethyl-biguanide, metformin apparently does not block respiration or change carbohydrate metabolism via the anaerobic pathway.

Metformin is eliminated in feces and urine. It is rapidly excreted by the kidneys in an unchanged form.

Renal clearance is 450 mL/minute; this appears to explain the absence of accumulation.

Metabolites of metformin have not been identified, neither by radioactive nor by chemical methods.

A single Rf spot is always present following radiochromatographic study of urine and always corresponds to that of pure metformin. Administration during 10 consecutive days has not shown any sign of accumulation.

Inhibition of glyconeogenesis has been observed in animals following its stimulation by fasting, cortisol, alcohol or other substrates such as alanine lactate or pyruvate. However, such an effect varies according to the type and dosage of the biguanide used, nutritional state of the animal species and design of experimental model.

This inhibition of glyconeogenesis is observed only in the presence of insulin and it does not appear to play an important role in man.

Inhibition of intestinal absorption of sugars, which is not related to a malabsorption phenomenon has been observed with biguanides under certain experimental conditions in animal and in man.

In one study, a 20% retardation of galactose absorption was observed in man receiving metformin. However, such an effect of metformin could not be confirmed in another study in man.

Recent findings appear to indicate that most of the metabolic effects of the biguanides are exerted through a single mechanism, namely inhibition of fatty acid oxidation and of acetyl-CoA generation.

However, inhibition of insulin-stimulated lipogenesis which has also been observed appears to be due to the inhibition of acetyl-CoA carboxylase by the biguanides. Such an effect may explain, at least partly, the weight-reducing effect exerted by these drugs in obese diabetic patients.

TOXICOLOGY

Alogliptin and Metformin in Combination

Repeat-dose toxicity studies of up to 13 weeks duration and an embryo-fetal developmental toxicity study have been conducted in rats with the combined substances in alogliptin and metformin .

Concomitant treatment with alogliptin and metformin did not produce new toxicities and no effects on the toxicokinetics of either compound were observed.

No treatment-related fetal abnormalities occurred following concomitant administration of 100 mg/kg/day alogliptin with 150 mg/kg/day metformin to pregnant rats. These doses produced estimated exposure margins of 28- to 29-fold for alogliptin and 2- to 2.5-fold for metformin at the maximum recommended human dose (MRHD) of 25 mg/day and 2000 mg/day, respectively. At notably higher doses of metformin (500 mg/kg/day) administered concomitantly with the same 100 mg/kg/day alogliptin dose, 5 abnormal fetuses were noted in 2 litters (4 fetuses from the same litter). This dose combination produced estimated exposure margins of 20-fold and 5- to 6-fold the MRHD for alogliptin and metformin, respectively.

Alogliptin

Nonclinical data reveal no special hazard for humans based on conventional studies of safety pharmacology, repeated dose toxicity, genotoxicity, carcinogenic potential, and reproduction and development toxicity.

The no-observed-adverse-effect level (NOAEL) in the repeated dose toxicity studies in rats and dogs up to 26- and 39-weeks in duration, respectively, produced exposure margins that were approximately 147- and 227-fold, respectively, the exposure in humans at the recommended total daily dose of 25 mg alogliptin.

Acute Toxicity

Alogliptin

Alogliptin was well tolerated by study animals. The single lethal oral dose of alogliptin in rats and dogs exceeded 1471 mg/kg and 368 mg/kg, respectively.

Chronic Toxicity

Alogliptin

The toxicity potential of alogliptin was evaluated in a series of repeated dose toxicity studies in rats and dogs of up to 26 and 39 weeks in duration, respectively. In rats, the main target organs of toxicity of alogliptin were the liver, kidney and urinary bladder. Moderate liver toxicity was noted at doses of ≥ 900 mg/kg/day as reflected by elevated serum AST, ALT and/or ALP activities, increased liver weights, as well as minimal to mild centrilobular hepatocellular hypertrophy. At doses of ≥ 1333 mg/kg/day, in addition to the liver, toxicities on kidney and urinary bladder were evident. In the kidneys, renal tubular degeneration and/or regeneration and renal tubular dilatation and/or necrosis were observed. In the urinary bladder, transitional cell hyperplasia (simple or papillary/nodular), hemorrhage, and inflammation, erosion/ulceration, and dilatation were noted. The urinary bladder and/or kidney complications contributed in part to an increase in mortality in rats from 1333 to 2000 mg/kg/day. The no-observed-adverse-effect-level in rats was 400 mg/kg, approximately 147 times the exposure in humans at the maximum recommended human adult dose (MRHD) of 25 mg alogliptin. In dogs, reddened ears and facial swelling, without associated histopathological changes, were noted at doses of ≥ 30 mg/kg/day. The no-observed-adverse-effect-level in dogs derived from the 39-week study was 100 mg/kg/day, approximately 112 times the exposure in humans at the MRHD.

Genotoxicity

Alogliptin was not genotoxic in a standard battery of *in vitro* and *in vivo* genotoxicity studies.

Carcinogenicity

Alogliptin

A two-year carcinogenicity study was conducted in rats at oral doses of 75, 400 and 800 mg/kg/day alogliptin. No treatment-related tumors were observed in either male or female rats given 75 mg/kg/day alogliptin (approximately 27 times human exposure at the MRHD). Increases in the combined incidence of C-cell adenoma and/or carcinoma were only observed in male rats at doses of ≥ 400 mg/kg/day (≥ 245 times human exposure at the MRHD). Increases in non-neoplastic histopathological changes in the liver, lung, urinary bladder, testes, epididymis, and prostate were noted in rats at doses that were at least 240 times the exposure in humans at the MRHD.

A two-year carcinogenicity study was conducted in mice at oral doses of 50, 150 and 300 mg/kg/day alogliptin. No treatment-related tumors were observed in either male or female mice at doses up to 300 mg/kg/day, approximately 51 times the exposure in humans at the MRHD.

Metformin

Long-term carcinogenicity studies 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 4 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.

Mutagenesis

Alogliptin

Alogliptin was negative in a battery of genetic toxicology studies, including the Ames bacterial assay (microbial mutagenesis test), an *in vitro* cytogenetic assay in mouse lymphoma cells, and an *in vivo* mouse micronucleus study.

Metformin

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.

Reproduction Toxicity

Alogliptin

No adverse effects of alogliptin were observed upon fertility, reproductive performance, or early embryonic development in rats given alogliptin orally at doses up to 500 mg/kg/day (up to approximately 191 times human exposure at the MRHD) prior to and throughout mating. Although fertility was not affected, a slight increase in the percent of abnormal sperm was noted at 1000 mg/kg/day (approximately 392 times human exposure at the MRHD).

Development

Alogliptin

Placental transfer of alogliptin occurs in rats following oral dosing. Alogliptin was not teratogenic in rabbits and rats at oral doses up to 200 and 500 mg/kg/day (up to approximately 149 and 180 times human exposure at the MRHD) given during organogenesis, respectively. Higher doses of alogliptin resulted in maternal toxicity, and were associated with delayed and/or lack of ossification of bones and decreased fetal body weights. The non-observed-adverse-effect-level for embryo-fetal development in rabbits and rats was 200 mg/kg/day and 500 mg/kg/day (approximately 149 and 180 times human exposure at the MRHD), respectively.

Alogliptin at oral doses up to 250 mg/kg/day (up to approximately 95 times human exposure at the MRHD) given to pregnant rats from gestation Day 6 to lactation Day 20 did not harm the developing embryo or affect offspring growth and development. Higher doses of alogliptin, providing exposures exceeding 200 times the exposure in humans at the MRHD, decreased F1 offspring body weights and induced some developmental effects.

No alogliptin-related effects were observed in juvenile rats following repeated oral dosing for 4 and 8 weeks at doses up to 300 mg/kg/day (up to approximately 63 and 75 times human exposure at the MRHD, respectively).

Metformin

Metformin was not teratogenic in rats and rabbits at doses up to 600 mg/kg/day. This represents an exposure of about 2 and 6 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.

REFERENCES

1. Moritoh Y, Takeuchi K, Hazama M. Combination treatment with alogliptin and voglibose prevents the development of diabetes and preserves islet function in prediabetic db/db mice. *Diabetes Obes Metab* 2010;12:(3):224-233.
2. Asakawa T, Moritoh Y, Kataoka O, Suzuki N, Takeuchi K, Odaka H. A novel dipeptidyl peptidase-4 inhibitor, alogliptin (SYR-322), is effective in diabetic rats with sulfonylurea-induced secondary failure. *Life Sci* 2009;85:(3 Pt 4):122-126.
3. GLUCOPHAGE Product Monograph, Sanofi-Aventis Canada Inc.
4. Moritoh Y, Takeuchi K, Asakawa T, Kataoka O, Odaka H. Combining a dipeptidyl peptidase-4 inhibitor, alogliptin, with pioglitazone improves glycaemic control, lipid profiles and beta-cell function in db/db mice. *Br J Pharmacol* 2009;157:(3):415-426.
5. Moritoh Y, Takeuchi K, Asakawa T, Kataoka O, Odaka H. The dipeptidyl peptidase-4 inhibitor alogliptin in combination with pioglitazone improves glycemic control, lipid profiles, and increases pancreatic insulin content in ob/ob mice. *Eur J Pharmacol* 2009;602:(2):448-454.
6. Lee B, Shi L, Kassel DB, Asakawa T, Takeuchi K, Christopher RC. Pharmacokinetic, pharmacodynamic and efficacy profiles of alogliptin, a novel inhibitor of dipeptidyl peptidase-4, in rats, dogs, and monkeys. *Eur J Pharmacol* 2008;589:306-314.
7. Moritoh Y, Takeuchi K, Asakawa T, Kataoka O, Odaka H. Chronic administration of alogliptin, a novel, potent, and highly selective dipeptidyl peptidase-4 inhibitor, improves glycemic control and beta-cell function in obese diabetic ob/ob mice. *Eur J Pharmacol* 2008;588:(2):325-332.
8. Gwaltney II S L. Medicinal chemistry approaches to the inhibition of dipeptidyl peptidase IV. *Current Topics in Medicinal Chemistry* 2008; 8:1545-1552.
9. Feng J, Zhang Z, Wallace MB, Stafford JA, Kaldor SW, Kassel DB, et al. Discovery of alogliptin: a potent, selective, bioavailable, and efficacious inhibitor of dipeptidyl peptidase IV. *J Med Chem* 2007;(10):2297-2300.
10. Karim A, Covington P, Christopher RC, Davenport M, Fleck P, Li X, et al. Pharmacokinetics of alogliptin in healthy volunteers when administered with food, metformin or cimetidine: a two-phase, crossover study in healthy subjects. *Int J Clin Pharmacol Ther.* 2010;48:(1):46-58.
11. Rosenstock J, Rendell M, Gross J, Fleck PR, Wilson CA, Mekki Q. Alogliptin added to insulin therapy in patients with type 2 diabetes reduces HbA(1C) without causing weight gain or increased hypoglycaemia. *Diabetes Obes Metab.* 2009;11(12):1145-1152.

12. Pratley RE, McCall T, Fleck PR, Wilson CA, Mekki Q. Alogliptin use in elderly people: a pooled analysis from phase 2 and 3 studies. *J Am Geriatr Soc.* 2009;57:(11):2011-2019.
13. Karim A, Laurent A, Munsaka M, Wann E, Fleck P, Mekki Q. Coadministration of pioglitazone or glyburide and alogliptin: pharmacokinetic drug interaction assessment in healthy participants. *J Clin Pharmacol.* 2009;49(10):1210-1219.
14. Pratley RE, Reusch JE, Fleck PR, Wilson CA, Mekki Q; Alogliptin Study 009 Group. Efficacy and safety of the dipeptidyl peptidase-4 inhibitor alogliptin added to pioglitazone in patients with type 2 diabetes: a randomized, double-blind, placebo-controlled study. *Curr Med Res Opin.* 2009;25:(10):2361-2371.
15. Pratley RE, Kipnes MS, Fleck PR, Wilson C, Mekki Q; Alogliptin Study 007 Group. Efficacy and safety of the dipeptidyl peptidase-4 inhibitor alogliptin in patients with type 2 diabetes inadequately controlled by glyburide monotherapy. *Diabetes Obes Metab.* 2009;11:(2):167-176.
16. Nauck MA, Ellis GC, Fleck PR, Wilson CA, Mekki Q; Alogliptin Study 008 Group. Efficacy and safety of adding the dipeptidyl peptidase-4 inhibitor alogliptin to metformin therapy in patients with type 2 diabetes inadequately controlled with metformin monotherapy: a multicentre, randomised, double-blind, placebo-controlled study. *Int J Clin Pract.* 2009;63:(1):46-55.
17. DeFronzo RA, Fleck PR, Wilson CA, Mekki Q; Alogliptin Study 010 Group. Efficacy and safety of the dipeptidyl peptidase-4 inhibitor alogliptin in patients with type 2 diabetes and inadequate glycemic control: a randomized, double-blind, placebo-controlled study. *Diabetes Care.* 2008;31:(12):2315-2317.
18. Christopher R, Covington P, Davenport M, Fleck P, Mekki QA, Wann E, et al. Pharmacokinetics, pharmacodynamics, and tolerability of single increasing doses of the dipeptidyl peptidase-4 inhibitor alogliptin in healthy male subjects. *Clin Ther* 2008;30:(3):513-517.
19. Covington P, Christopher R, Davenport M, Fleck P, Mekki Q, Wann ER, Karim A. Pharmacokinetic, pharmacodynamic, and tolerability profiles of the dipeptidyl peptidase-4 inhibitor alogliptin: a randomized, double-blind, placebo-controlled, multiple-dose study in adult patients with type 2 diabetes. *Clin Ther* 2008;30:(3):499-512.
20. Eliasson B, Möller-Goede D, Eeg-Olofsson K, Wilson C, Cederholm J, Fleck P, et al. Lowering of postprandial lipids in individuals with type 2 diabetes treated with alogliptin and/or pioglitazone: a randomised double-blind placebo-controlled study. *Diabetologia.* 2012;55(4):915-925.

21. White WB, Bakris GL, Bergenstal RM, Cannon CP, Cushman WC, Fleck P, et al. EXamination of cArDiovascular outcoMes with alogliptIN versus standard of carE in patients with type 2 diabetes mellitus and acute coronary syndrome (EXAMINE): a cardiovascular safety study of the dipeptidyl peptidase 4 inhibitor alogliptin in patients with type 2 diabetes with acute coronary syndrome . *Am Heart J.* 2011;162(4):620-626.
22. Rosenstock J, Inzucchi SE, Seufert J, Fleck PR, Wilson CA, Mekki Q. Initial combination therapy with alogliptin and pioglitazone in drug-naïve patients with type 2 diabetes. *Diabetes Care.* 2010;33(11): 2406-2408.
23. DeFronzo RA, Burant CF, Fleck P, Wilson C, Mekki Q, Pratley RE. Efficacy and tolerability of the DPP-4 inhibitor alogliptin combined with pioglitazone, in metformin-treated patients with type 2 diabetes. *J Clin Endocrinol Metab.* 2012;97(5):1615-22.
24. Bosi E, Ellis G, Wilson CA, Fleck PR. Alogliptin as a third oral antidiabetic drug in patients with type 2 diabetes and inadequate glycemic control on metformin and pioglitazone: a 52-week, randomized, double-blind, active-controlled, parallel-group study. *Diabetes Obes Metab.* 2011;13(12):1088-96.

PART III: CONSUMER INFORMATION**PrKAZANO®**

alogliptin (as alogliptin benzoate) and metformin hydrochloride

This leaflet is part III of a three-part "Product Monograph" published when KAZANO® was approved for sale in Canada and is designed specifically for Consumers. This leaflet is a summary and will not tell you everything about KAZANO®.

Contact your doctor or pharmacist if you have any questions about the drug.

ABOUT THIS MEDICATION**What the medication is used for:**

KAZANO® is used along with diet and exercise to improve control of blood sugar in adults with type 2 diabetes:

- in patients who are not controlled on metformin alone; OR
- in patients currently on alogliptin (NESINA®) and metformin; OR
- in combination with pioglitazone, in patients who are not controlled on metformin and pioglitazone
- in combination with insulin, when insulin and metformin do not provide adequate glycemic control.

What it does:

KAZANO® is used when your blood sugar cannot be adequately controlled by diet, exercise and other anti-diabetic medicines such as metformin alone; insulin alone; or metformin and medicines known as thiazolidinediones (e.g. pioglitazone) taken together.

If you are already taking both alogliptin and metformin as single tablets, KAZANO® can replace them in one tablet.

It is important that you continue to follow the advice on diet and exercise that your nurse or doctor has given you.

When it should not be used:

You should not take KAZANO® if you:

- have unstable and/or insulin-dependent (Type 1) diabetes mellitus.
- are allergic to alogliptin, metformin or any of the other ingredients of this medicine.
- recently had a heart attack or have severe circulatory problems including shock.
- have severe breathing difficulties.
- have kidney disease.
- have liver disease.
- drink alcohol excessively (either every day or only from time to time).
- have diabetic ketoacidosis (a serious complication of poorly controlled diabetes which can lead to a diabetic pre-coma). Symptoms include excessive thirst, frequent urination, loss of appetite, nausea or vomiting and rapid weight loss.
- have a severe infection or are seriously dehydrated (have lost a lot of water from your body).
- if you are going to have a certain type of X-ray with an injectable dye. You will need to stop taking this medicine at the time of and for a couple of days after the procedure.

- are pregnant or planning to become pregnant
- are breast-feeding

What the medicinal ingredient is:

alogliptin benzoate and metformin hydrochloride

What the nonmedicinal ingredients are:

mannitol, microcrystalline cellulose (PH 101 and KG-1000), povidone, crospovidone, magnesium stearate, hypromellose (2910), talc, titanium dioxide, yellow iron oxide.

What dosage forms it comes in:

12.5 mg/500mg, 12.5 mg/850 mg, 12.5mg/1000 mg tablets

WARNINGS AND PRECAUTIONS **Serious Warnings and Precautions**

KAZANO® contains metformin which can rarely cause lactic acidosis. Lactic acidosis can cause death and must be treated in the hospital (see section Lactic Acidosis below). Since alcohol may increase the risk of lactic acidosis caused by metformin you should not drink a lot of alcohol if you take KAZANO® (see **Lactic Acidosis** section below).

KAZANO® with alcohol

Do not take this medicine with alcohol as you could be at greater risk of developing lactic acidosis, a serious complication which must be treated in a hospital (see "SIDE EFFECTS AND WHAT TO DO ABOUT THEM").

Lactic Acidosis**Stop taking KAZANO® if you get the following symptoms of lactic acidosis:**

You feel very weak and tired.

- You have unusual (not normal) muscle pain.
- You have trouble breathing.
- You have stomach pain with nausea and vomiting, or diarrhea.
- You feel cold, especially in your arms and legs.
- You feel dizzy or lightheaded.
- You have a slow or irregular heart beat.
- Your medical condition suddenly changes.

You have a higher chance of getting lactic acidosis if you:

- Have kidney problems.
- Have congestive heart failure that requires treatment with medicines.
- Drink a lot of alcohol (very often or 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 don't drink enough fluids.
- Have certain x-ray tests with injectable dyes or contrast agents used.
- Have surgery.
- Have a heart attack, severe infection, or stroke.

- are 80 years of age or older and have not had your kidney function tested.

Before you take KAZANO[®], tell your doctor if you:

- have any allergies, especially to the ingredients in KAZANO[®]
- have type 1 diabetes (your body does not produce insulin).
- are taking KAZANO[®] with insulin. Your doctor may want to reduce your dose of insulin when you take it together with KAZANO[®] in order to avoid too low blood sugar.
- are going to have an operation under general, spinal or epidural anesthetic. You may need to stop taking this medicine for a couple of days before and after the procedure.
- During treatment with KAZANO[®], your doctor will check your kidney function at least once a year and more frequently if you are elderly or if your kidney function is borderline or at risk of worsening.

Pregnancy and breast-feeding

If you are pregnant, think you may be pregnant or are planning to have a baby, ask your doctor or pharmacist for advice before taking this medicine. You should not use KAZANO[®] in pregnancy.

Do not breast-feed while taking KAZANO[®] since metformin passes into breast milk.

Driving and using machines

KAZANO[®] has no known influence on the ability to drive and use machines.

INTERACTIONS WITH THIS MEDICATION

Tell your doctor about all the medicines you take, have recently taken or might take including prescription and nonprescription medicines, vitamins, and herbal supplements.

In particular tell your doctor or pharmacist if you are taking any of the following:

- hydrocortisone and prednisolone (corticosteroids) used to treat diseases that involve inflammation like asthma and arthritis
- other diabetes drugs such as glyburide
- furosemide
- nifedipine
- cationic drugs (e.g., amiloride, digoxin, morphine, procainamide, quinidine, quinine, ranitidine, triamterene, trimethoprim, and vancomycin)
- other drugs tend to produce hyperglycemia (high blood sugar) and may lead to a loss of blood sugar control. Some example of drugs that can increase the blood sugar include:
 - Thiazide and other diuretics (water pills)
 - Corticosteroids
 - Phenothiazines
 - Thyroid products
 - Estrogens or estrogens plus progestogen
 - Oral contraceptives
 - Phenytoin
 - Nicotinic Acid

- Sympathomimetics
- Calcium channel blocking drugs
- Isoniazid

- cimetidine, used to treat stomach problems
- bronchodilators (beta-2 agonists) which are used to treat asthma
- ramipril, lisinopril and enalapril (ACE inhibitors) used to treat high blood pressure
- iodinated contrast agents or medicines containing alcohol

PROPER USE OF THIS MEDICATION

Usual dose:

The usual dose is one tablet twice a day.

Swallow your tablet(s) whole with water. You should take this medicine with food to reduce your chance of an upset stomach.

Always take this medicine exactly as your doctor or pharmacist has told you. Check with your doctor or pharmacist if you are not sure.

Your doctor will tell you exactly how much KAZANO[®] you need to take. The amount of KAZANO[®] will vary depending on your condition and the doses you currently take of metformin alone, metformin in combination with pioglitazone, insulin and/or individual tablets of alogliptin and metformin.

Overdose:

In case of drug overdose, contact a health care practitioner, hospital emergency department or regional Poison Control Centre immediately, even if there are no symptoms.

Missed Dose:

If you forget to take a dose, take it as soon as you remember it. However, if it is almost time for your next dose, skip the missed dose. Do not take a double dose (two doses at the same time) to make up for a forgotten dose.

SIDE EFFECTS AND WHAT TO DO ABOUT THEM

Like all medicines, this medicine can cause side effects, although not everybody gets them.

Tell your doctor if you have any of the following side effects:

Stomach and intestinal side effects, such as nausea, diarrhea, stomach upset, abdominal bloating, gas and appetite loss, are very common with metformin – one of the active ingredients in KAZANO[®].

- cold or flu-like symptoms such as sore throat, stuffy or blocked nose, feeling tired, fever, chills, body aches, dry cough
- shortness of breath
- pink eye: itchy and red eye(s), with or without discharge
- dry, itchy skin, with or without hives, rash
- headache
- indigestion, heartburn,
- abdominal pain
- swollen or irritated blood vessels in the anus and rectum (hemorrhoids)
- gallstones
- kidney stones
- bruise
- back pain
- muscle and/or bone pain (including of the chest)
- cramp
- difficulty sleeping
- a metallic taste in your mouth
- stomach pain
- constipation
- nausea
- toothache
- vomiting
- tiredness (fatigue)
- swelling of extremities
- sensation of “pins and needles” or numbness (paresthesia)
- pain, weakness, numbness, or tingling in the leg (sciatica)
- coughing, wheezing shortness of breath, difficulty breathing, with or without fever
- high blood pressure (hypertension)

KAZANO® can cause abnormal blood test results. Your doctor will decide when to perform tests and will interpret the results.

SERIOUS SIDE EFFECTS, HOW OFTEN THEY HAPPEN AND WHAT TO DO ABOUT THEM				
Symptom / effect		Talk with your doctor or pharmacist		Stop taking drug and call your doctor or pharmacist Immediately
		Only if severe	In all cases	
Common	Decreased vitamin B12 levels or anemia: tiredness, lethargy, feeling faint, becoming breathless.		√	

SERIOUS SIDE EFFECTS, HOW OFTEN THEY HAPPEN AND WHAT TO DO ABOUT THEM				
Symptom / effect		Talk with your doctor or pharmacist		Stop taking drug and call your doctor or pharmacist Immediately
		Only if severe	In all cases	
Common	Low blood sugar (hypoglycemia): trembling, sweating, anxiety, blurred vision, tingling lips, paleness, mood change or feeling confused. Hypoglycemia may occur when KAZANO® is taken in combination with insulin or sulphonylureas (e.g. glipizide, tolbutamide, glibenclamide). Your blood sugar could fall below the normal level and can be increased by taking sugar. It is recommended that you carry some sugar lumps, sweets, biscuits or sugary fruit juice.		√	√
Uncommon	Allergic reaction: severe rash, hives, swallowing or breathing problems, swelling of your lips, face, throat or tongue and feeling faint.		√	√
Uncommon	Pancreatitis (inflamed pancreas): Severe and persistent pain around the top of stomach which may reach to your back, with or without vomiting		√	√

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

Symptom / effect		Talk with your doctor or pharmacist		Stop taking drug and call your doctor or pharmacist Immediately
		Only if severe	In all cases	
Very Rare	Liver disorders: yellowing of the skin or eyes, dark urine, abdominal pain, nausea, vomiting, loss of appetite, fatigue		√	√
Very Rare	Lactic Acidosis: Metformin, one of the substances in KAZANO [®] , can cause a very rare (may affect less than 1 in 10,000 people) but serious side effect called lactic acidosis (a build-up of lactic acid in the blood). This build-up can cause serious damage. Lactic acidosis is a medical emergency and must be treated in a hospital. It can particularly affect patients whose kidneys are not working properly. Symptoms include: feeling cold or uncomfortable, severe nausea with or without vomiting, stomach pain, unexplained weight loss, or rapid breathing.		√	√
Very Rare	Stevens-Johnson syndrome (a severe allergic reaction): serious rash, skin reddening, pain, swelling of lips, eyes or mouth, skin peeling and flu-like symptoms			√

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

Symptom / effect		Talk with your doctor or pharmacist		Stop taking drug and call your doctor or pharmacist Immediately
		Only if severe	In all cases	
Very Rare	Bullous pemphigoid (serious skin reaction): blistering of the skin, redness or peeling skin		√	
Frequency Unknown	Arthralgia: Severe and disabling joint pain		√	

This is not a complete list of side effects. For any unexpected effects while taking KAZANO[®], contact your doctor or pharmacist.

HOW TO STORE IT

Store KAZANO[®] at 15-30°C.

Keep this medicine out of the sight and reach of children.

Do not use this medicine after the expiry date which is stated on the carton and bottle or blister after EXP. The expiry date refers to the last day of that month.

This medicinal product does not require any special storage conditions.

Do not throw away any medicines via wastewater or household waste. Ask your pharmacist how to throw away medicines you no longer use. These measures will help protect the environment.

REPORTING SUSPECTED SIDE EFFECTS

You can report any suspected adverse reactions associated with the use of health products to the Canada Vigilance Program by one of the following 3 ways:

- Report online at www.canada.ca/en/health-canada/services/drugs-health-products/medeffect-canada/adverse-reaction-reporting.html
- Call toll-free at 1-866-234-2345
- Complete a Canada Vigilance Reporting Form and:
 - Fax toll-free to 1-866-678-6789, or
 - Mail to: Canada Vigilance Program
Health Canada
Postal Locator 1908C
Ottawa, Ontario
K1A 0K9

Postage paid labels, Canada Vigilance Reporting Form and the adverse reaction reporting guidelines are available on the MedEffect™ Canada Web site at www.healthcanada.gc.ca/medeffect.

NOTE: Should you require information related to the management of side effects, contact your health professional. The Canada Vigilance Program does not provide medical advice.

MORE INFORMATION

This document plus the full product monograph, prepared for health professionals can be found at:

<http://www.takedacanada.com/>

or by contacting the sponsor, Takeda Canada Inc. at:

1-866-295-4636.

This leaflet was prepared by Takeda Canada Inc., Oakville, Ontario L6H 0J8

KAZANO® is a registered trademark of Takeda Pharmaceutical Company Limited and used under licence by Takeda Canada Inc.

Last revised: October 18, 2018