

PRODUCT INFORMATION  
Lyxumia

## PRODUCT INFORMATION

### LYXUMIA INJECTION, SOLUTION

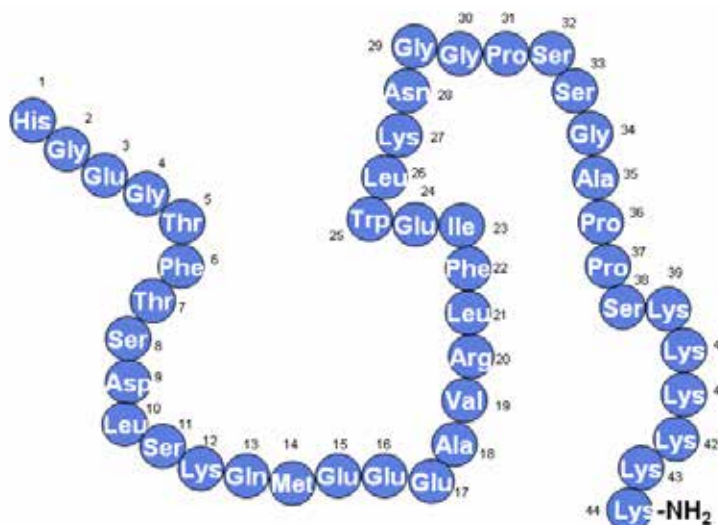
#### NAME OF MEDICINE

#### AUSTRALIAN APPROVED NAME

Lixisenatide

#### CHEMICAL STRUCTURE

The structure of lixisenatide is a peptide containing 44 amino acids, which is amidated at the C-terminal amino acid (position 44). The order of the amino acids is given in the figure below. Its molecular weight is 4858.5, and the empirical formula is  $C_{215}H_{347}N_{61}O_{65}S$  with the following chemical structure:



#### MOLECULAR WEIGHT

4858.5

#### CAS REGISTRY NUMBER

320367-13-3

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## DESCRIPTION

Lixisenatide is an amorphous, hygroscopic, white to off-white powder.

Lyxumia solution is a clear, colourless solution.

Lyxumia is supplied as a sterile solution for subcutaneous injection in a 3mL glass cartridge that has been permanently integrated into a pre-filled injector pen.

Lyxumia is available as 2 different pens which deliver either a 10µg or 20µg dose of lixisenatide. Each dose also contains glycerol (85%), sodium acetate, methionine, meta-cresol, hydrochloric acid/sodium hydroxide for pH adjustment, and water for injections.

## PHARMACOLOGY

### PHARMACODYNAMICS

#### Mechanism of Action

Lixisenatide is a potent and selective GLP-1 receptor agonist ( $K_i = 1.33\text{nM}$  in radioligand binding experiments). The GLP-1 receptor is the target for native GLP-1, an endogenous incretin hormone that potentiates glucose-dependent insulin secretion from the pancreatic beta cells.

Lixisenatide action is mediated via a specific interaction with GLP-1 receptors, leading to an increase in intracellular cyclic adenosine monophosphate (cAMP). Lixisenatide stimulates insulin secretion when blood glucose is increased but not at normoglycaemia. In parallel, glucagon secretion is suppressed. In case of hypoglycaemia, the rescue mechanism of glucagon secretion is preserved. Lixisenatide further showed a trend towards insulinotropic activity, including enhancement of insulin biosynthesis and stimulation of beta-cell proliferation in animals.

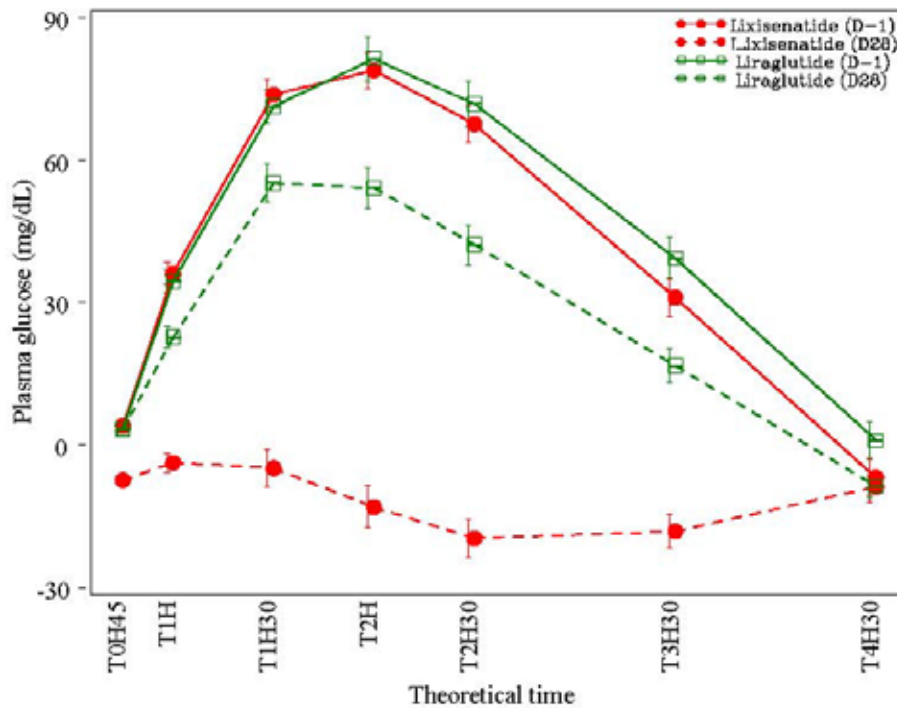
Lixisenatide slows gastric emptying thereby reducing the rate at which meal-derived glucose appears in the circulation. The effect on gastric emptying might also contribute to body weight reduction.

#### Pharmacodynamic Properties

When administered once daily, lixisenatide improves glycaemic control through the immediate and sustained effects of lowering both postprandial and fasting glucose concentrations in patients with type 2 diabetes. This effect on post-prandial glucose was confirmed in a 4-week study versus liraglutide 1.8 mg once a day. Lixisenatide 20 µg once a day demonstrated superior reduction compared to liraglutide in area under the curve of post-prandial plasma glucose after a test-meal. (see Figure 1)

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Figure 1 - Mean ( $\pm$  SEM) concentration of post-prandial plasma glucose change from pre-meal values profile on Day -1 and Day 28



## PHARMACOKINETICS

### Absorption

Following subcutaneous administration to patients with type 2 diabetes, the rate of lixisenatide absorption is rapid and not influenced by the dose administered. Irrespective of the dose and whether lixisenatide was administered as single or multiple doses, the median  $t_{max}$  is 1 to 3.5 hours in patients with type 2 diabetes. There are no clinically relevant differences in the extent of absorption when lixisenatide is administered subcutaneously in the abdomen, thigh, or arm, while the rate of absorption when injecting in the thigh was slightly lower ( $t_{max}$  of 2.5 hours instead of 2.0 hours) compared to injecting in the arm or abdomen in a study conducted in healthy volunteers. Following subcutaneous administration of a single 10 $\mu$ g dose of lixisenatide in the abdomen, thigh and arm, mean  $C_{max}$  was 56.7 pg/mL, 48.6 pg/mL (ratio thigh versus abdomen: 0.86; CI: 0.79-0.94) and 56.9 pg/mL [ratio arm versus abdomen: 1.00; CI: 0.92-1.09], respectively.

### Distribution

Lixisenatide has a moderate level of binding (55%) to human proteins.

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The apparent volume of distribution after subcutaneous administration of lixisenatide in patients with type 2 diabetes ranged between 90 and 140 L after single administration and between 90 and 120 L at steady state irrespective of the dose administered.

### **Metabolism**

Lixisenatide was found to be extensively metabolized by human kidney and liver S9 fractions in vitro. As a peptide, lixisenatide is presumed to be eliminated through glomerular filtration, followed by tubular reabsorption and subsequent metabolic degradation, resulting in smaller peptides and amino acids, which are reintroduced in the protein metabolism.

### **Excretion**

After multiple dose administration in patients with type 2 diabetes, mean apparent half-life generally ranged from 1.5 to 4.5 hours and the mean apparent clearance ranged from 20 to 67 L/h at steady state

### **Special populations**

#### ***Gender***

No dosage adjustment is required based on gender. Gender had no clinically meaningful effect on the pharmacokinetics of lixisenatide based on the results of population pharmacokinetic data analysis of male and female subjects and pharmacokinetic study in healthy subjects

#### ***Paediatric use***

The safety and effectiveness of Lyxumia in paediatric patients below the age of 18 years have not yet been established.

#### ***Elderly patients***

In a pharmacokinetic study in elderly non diabetic subjects, administration of lixisenatide 20 µg resulted in a mean increase of lixisenatide AUC by 29 % in the elderly population (11 subjects between 65 and 74 years and 7 subjects aged  $\geq 75$  years) compared to 18 subjects aged 18 to 45 years, likely related to reduced renal function in the older age group.

Age had no clinically relevant effect on the pharmacokinetics of lixisenatide based on a population pharmacokinetic data analysis in patients with type 2 diabetes.

#### ***Race***

Ethnic origin had no clinically relevant effect on the pharmacokinetics of lixisenatide based on the results of pharmacokinetic studies in Caucasian, Japanese and Chinese subjects.

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***Hepatic Impairment***

As lixisenatide is cleared primarily by the kidney, no pharmacokinetic study has been performed in patients with acute or chronic hepatic impairment. Hepatic dysfunction is not expected to affect the pharmacokinetics of lixisenatide.

***Renal Impairment***

A Phase I study was conducted in renally impaired, but otherwise healthy patients, to assess the influence of renal impairment (Creatinine Clearance calculated by the Cockcroft-Gault formula) on pharmacokinetics of lixisenatide.

There were no relevant differences in mean C<sub>max</sub> and AUC of lixisenatide (98% and 105% respectively) between subjects with normal renal function and subjects with mild renal impairment (Creatinine Clearance 50-80 mL/min).

In subjects with moderate renal impairment (creatinine clearance 30-<50 ml/min) AUC was increased by 24%.

In subjects with severe renal impairment (creatinine clearance 15-<30 ml/min) AUC was increased by 46%. (See PRECAUTIONS AND DOSAGE AND ADMINISTRATION).

## **CLINICAL TRIALS**

The effects of Lyxumia on glycaemic control were mainly evaluated in six randomised double-blind, placebo-controlled clinical studies and one randomised, open-label, active-controlled study versus exenatide.

These studies included 3825 patients with type 2 diabetes (2445 patients randomised to lixisenatide), 48.2 % men and 51.8% women. 768 subjects (447 randomised to lixisenatide) were ≥65 years of age and 103 subjects (57 randomised to lixisenatide) were ≥75 years of age.

In the completed Phase III studies, it was observed that more than 90% of the patient population was able to remain on the once daily maintenance dose of 20 µg Lyxumia at the end of the 24-week treatment period.

## **GLYCAEMIC CONTROL**

Lyxumia demonstrated superior effect compared to placebo in reducing glycosylated haemoglobin (HbA<sub>1c</sub>) regardless of the background treatment and Lyxumia once daily showed a non inferior HbA<sub>1c</sub> reduction compared to exenatide twice daily. This effect on HbA<sub>1c</sub> was sustained in long term studies for at least 76 weeks.

The HbA<sub>1c</sub> reduction was significant with either a once daily morning or evening administration.

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**Add-on combination therapy with oral antidiabetics**

Lyxumia in combination with metformin, a sulphonylurea or a combination of these agents showed clinically and statistically significant reductions in HbA1c, in fasting plasma glucose and in 2-hour post-prandial glucose after a test-meal compared to placebo at the end of the main 24-week treatment period. (Table 1 and Table 3).

**Add-on treatment to Metformin alone**

In two separate placebo-controlled studies when lixisenatide was used in combination with metformin, significant improvements in glucose control were observed compared to placebo (see Table 2).

**Table 1 - Placebo-controlled studies in combination with metformin (24-week results).**

	Metformin as background therapy					
	Two step versus one step dose regimen		Morning versus evening dose regimen			
	Lixisenatide 20 µg		Placebo (N= 159)		Lixisenatide 20 µg	
	Two-step dose initiation * (N= 160)	One-step dose initiation * (N= 160)		Morning (N= 255)	Evening (N= 255)	Placebo (N= 170)
Mean HbA1c (%)						
Baseline	8.12	7.99	8.03	8.07	8.07	8.02
LS mean change from baseline	-0.83	-0.92	-0.42	-0.87	-0.75	-0.38
Patients (%) achieving HbA1c < 7.0%	42.1	47.4	24.1	43.0	40.6	22.0
Mean body weight (kg) Baseline	88.08	90.30	87.86	90.14	89.01	90.40
LS mean change from baseline	-2.68	-2.63	-1.63	-2.01	-2.02	-1.64

\*Two dose initiation regimens of 2-week duration were evaluated in this study; they both were followed by a maintenance period with lixisenatide 20 µg once daily. The one-step initiation (10 µg for two weeks) followed by 20 µg for maintenance is the regimen recommended for use.

In an active-controlled study in combination with metformin, lixisenatide once daily showed a non inferior HbA1c reduction compared to exenatide twice daily at the end of the main 24-week treatment period (respectively - 0.79 % and -0.96%, with a mean treatment difference of 0.17% [95% CI: 0.033, 0.297]).

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**Table 2 - Active –controlled study in combination with metformin (24-week results)**

	Metformin as background therapy	
	Lixisenatide 20mcg once daily (N= 315)	Exenatide 10 mcg twice daily (N= 315)
Mean HbA1c (%) Baseline	7.97	7.96
LS mean change from baseline	-0.79	-0.96
Patients ( %) achieving HbA1c < 7.0%	48.5	49.8%
Mean body weight (kg) Baseline	94.51	96.69
LS mean change from baseline	-2.96	-3.98

**Add-on treatment with metformin and a sulphonylurea**

**Table 3 - Placebo –controlled study in combination with a sulphonylurea (24-week results)**

	Sulphonylurea ± metformin	
	Lixisenatide 20 µg (N= 570)	Placebo (N= 286)
Mean HbA1c (%) Baseline	8.28	8.22
LS mean change from baseline	-0.85	-0.10
Patients (%) achieving HbA1c < 7.0 %	36.4	13.5
Mean body weight (kg) Baseline	82.58	84.52
LS mean change from baseline	-1.76	-0.93

**Add-on combination therapy with a basal insulin**

Lixisenatide given in one study with a basal insulin alone or in combination with metformin, or given in another study with a basal insulin alone or in combination with a sulphonylurea ( see



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INDICATION) resulted in statistically significant reductions in HbA1c and in 2-hour post-prandial glucose after a test-meal compared to placebo. At the end of the main 24-week treatment period, the insulin daily dose was significantly reduced in the lixisenatide group as compared to the placebo group in the two separate studies conducted and reported in Table 4

**Table 4 - Placebo –controlled studies in combination with basal insulin (24-week results)**

	Basal insulin as background therapy Alone or in combination with metformin		Basal insulin as background therapy Alone or in combination with a sulphonylurea *	
	Lixisenatide 20 µg (N= 327)	Placebo (N= 166)	Lixisenatide 20 µg (N= 154)	Placebo (N= 157)
Mean HbA1c (%)				
Baseline	8.39	8.38	8.53	8.53
LS mean change from baseline	-0.74	-0.38	-0.77	0.11
Patients (%) achieving HbA1c < 7.0%	28.3	12.0	35.6	5.2
Mean change in basal insulin dose (U) Baseline	53.62	57.65	24.87	24.11
LS mean change from baseline	-5.62	-1.93	-1.39	-0.11
Mean body weight (kg)				
Baseline	87.39	89.11	65.99	65.60
LS mean change from baseline	-1.80	-0.52	-0.38	0.06

\*Performed in Asian population

### FASTING PLASMA GLUCOSE

The mean decrease in fasting plasma glucose obtained with lixisenatide treatment ranged from 0.42 mmol/L to 1.19 mmol/L at the end of the main 24-week treatment period in placebo-controlled studies.

### POST-PRANDIAL GLUCOSE

Treatment with lixisenatide resulted in reductions in 2-hour post-prandial glucose after a test-meal statistically superior to placebo, in placebo controlled studies. These reductions ranged from 4.51 to 7.96 mmol/L from baseline at the end of the main 24-week treatment period across all studies in which post-prandial glucose was measured; 26.2% to 46.8% of patients had a 2-hour post-prandial glucose value below 7.8 mmol/L.



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**BODY WEIGHT**

Treatment with Lyxumia in combination with metformin and/or a sulphonylurea resulted in a sustained body weight change from baseline in all controlled studies in a range from -1.76 kg to -2.96 kg at the end of the main 24-week treatment period. Body weight reduction was sustained in long term studies up to 76 weeks.

Body weight change from baseline in a range from -0.38 kg to -1.80 kg was also observed in lixisenatide patients receiving stable basal insulin dose, alone or in combination with metformin or a sulphonylurea.

**BETA CELL FUNCTION**

In clinical studies, lixisenatide improved the beta-cell function as measured by the homeostasis model assessment for beta-cell function (HOMA- $\beta$ ).

Restoration of first phase insulin secretion and improved second phase insulin secretion in response to an intravenous bolus of glucose was demonstrated in patients with type 2 diabetes (n=20) after a single dose of lixisenatide.

**HEART RATE**

No increase in heart rate was seen in all controlled phase III studies.

In a 4-week study versus liraglutide, mean heart rate decreased by 3.6 bpm in the lixisenatide group (20  $\mu$ g once a day) while it increased by 5.3 bpm in the liraglutide (1.8 mg once a day) group.

**BLOOD PRESSURE**

Systolic and diastolic blood pressure reductions up to 2.1mmHg and up to 1.5 mmHg respectively were observed in phase III placebo-controlled studies.

**INDICATIONS**

Lyxumia is indicated for the treatment of adults with type 2 diabetes mellitus to achieve glycaemic control in combination with metformin, metformin and sulphonylurea, basal insulin and metformin, basal insulin and sulphonylurea when these, together with diet and exercise, do not provide adequate glycaemic control (see sections CLINICAL TRIALS and PRECAUTIONS (Risk of Hypoglycemia)) for available data on the different combinations.

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## **CONTRAINDICATIONS**

Lyxumia is contraindicated in patients with known hypersensitivity to lixisenatide or to any of the inactive ingredients in the formulation.

## **PRECAUTIONS**

### **USE IN TYPE 1 DIABETES**

There is no therapeutic experience with Lyxumia in patients with type 1 diabetes mellitus and it is not recommended for these patients.

Lyxumia should not be used for treatment of diabetic ketoacidosis

### **POPULATIONS NOT STUDIED**

Lixisenatide has not been studied in combination with dipeptidyl peptidase 4 (DPP-4) inhibitors. There is limited experience in patients with congestive heart failure.

### **RISK OF PANCREATITIS**

Use of glucagon-like peptide-1 (GLP-1) receptor agonists has been associated with a risk of developing acute pancreatitis. Patients should be informed of the characteristic symptoms of acute pancreatitis: persistent, severe abdominal pain. If pancreatitis is suspected, Lyxumia should be discontinued ; if acute pancreatitis is confirmed, Lyxumia should not be restarted. Use with caution in patients with a history of pancreatitis.

### **USE IN PATIENTS WITH SEVERE GASTROINTESTINAL DISEASE**

Use of GLP-1 receptor agonists may be associated with gastrointestinal adverse reactions. Lyxumia has not been studied in patients with severe gastrointestinal disease, including severe gastroparesis, and therefore, the use of Lyxumia is not recommended in these patients.

### **USE IN PATIENTS WITH RENAL IMPAIRMENT**

Moderate renal impairment

There is limited therapeutic experience in patients with moderate renal impairment (creatinine clearance: 30-<50 ml/min) and Lyxumia should be used with caution in this population.

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Severe renal impairment

There is no therapeutic experience in patients with severe renal impairment (creatinine clearance < 30 mL/min) or end stage renal disease, and therefore it is not recommended to use Lyxumia in these populations.

**RISK OF HYPOGLYCAEMIA**

Patients receiving Lyxumia with a sulphonylurea or with a combination of a basal insulin and a sulphonylurea may have an increased risk of hypoglycaemia. Reduction of the dose of the sulphonylurea or the basal insulin may be considered to reduce the risk of hypoglycaemia. When used in combination with a sulphonylurea or a basal insulin, blood glucose monitoring may become necessary to adjust the doses of the sulphonylurea or the basal insulin. (see ADVERSE EVENTS)

**EFFECTS ON FERTILITY**

Hypospermatogenesis and focal sperm stasis were observed in dogs treated subcutaneously with lixisenatide. However, this occurred only at high doses (yielding  $\geq 64$  times the plasma AUC in patients at the maximum recommended human dose) and dogs were seen to be more sensitive to such toxicity by lixisenatide compared with other species. No related effect on spermatogenesis was seen in healthy men.

**USE IN PREGNANCY (CATEGORY B3)**

There are no adequate data from the use of Lyxumia in pregnant women. Studies in animals have shown reproductive toxicity. The potential risk for humans is unknown. Lyxumia should not be used during pregnancy and the use of insulin is recommended instead.

If a patient wishes to become pregnant, or pregnancy occurs, treatment with Lyxumia should be discontinued.

Foetal growth retardation, skeletal abnormalities and delayed ossification occurred in rats treated during gestation to maternally toxic doses resulting in exposures  $\geq 0.5$ -fold the mean exposure at the maximum recommended human dose (MRHD). In rabbits, impaired ossification and increased incidences of sternebrae abnormalities and rib variations were observed at maternally toxic doses ( $\geq 50\mu\text{g}/\text{kg}/\text{day}$  subcutaneously) yielding exposures  $\geq 40$ -fold the mean exposure at the MRHD.

In the pre-/postnatal toxicity study in rats subcutaneous treatment with lixisenatide during gestation and lactation caused slightly increased pup mortality at  $200\mu\text{g}/\text{kg}$  BID and decreased growth in male pups, and slightly decreased suckling and minor developmental delay in fur growth at 20 and  $200\mu\text{g}/\text{kg}$  BID (occurring in conjunction with maternal toxicity). No functional or behavioural toxicity was observed in the offspring of rats administered lixisenatide at doses up to  $200\mu\text{g}/\text{kg}$  BID.

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**USE IN LACTATION**

It is unknown if lixisenatide is excreted in human milk. A study in lactating rats showed very low transfer of lixisenatide and its metabolites into milk. Due to lack of experience, Lyxumia should not be used during breastfeeding.

**PAEDIATRIC USE**

The safety and effectiveness of Lyxumia in paediatric patients below the age of 18 years have not yet been established.

**USE IN THE ELDERLY**

No dose adjustment is required based on age. The clinical experience in patients  $\geq 75$  years is limited.

A total of 447 subjects aged 65 years or older received lixisenatide in these studies. There were no age-related differences in the change in HbA1c values from baseline to endpoint for subjects treated with lixisenatide.

**GENOTOXICITY**

Lixisenatide had no genotoxic effects, based on one in vivo micronucleus test in mice (involving IV administration up to 5000  $\mu\text{g}/\text{kg}$ ) and in vitro tests: the modified Ames test with or without metabolic activation, and in vitro mammalian chromosome aberration test in cultured human lymphocytes.

**CARCINOGENICITY**

Lixisenatide caused thyroid C-cell tumours in 2-year subcutaneous carcinogenicity studies in rodents. In mice, thyroid C-cell adenoma (together with focal C-cell hyperplasia) was increased at  $\geq 400 \mu\text{g}/\text{kg}/\text{day}$ , yielding systemic exposure levels  $\geq 29$ -fold greater than in humans at the maximum recommended human dose. No treatment-related increase in tumour incidence was seen in mice at 80  $\mu\text{g}/\text{kg}/\text{day}$  (relative exposure, 7). In rats, focal C-cell hyperplasia and C-cell adenoma were increased at all dose levels tested ( $\geq 80 \mu\text{g}/\text{kg}/\text{day}$ : yielding exposure ratios  $\geq 9$ ), and C-cell carcinoma was observed at  $\geq 400 \mu\text{g}/\text{kg}/\text{day}$  (yielding  $\geq 35$ -times the human exposure). These findings are considered to be caused by a GLP-1 receptor-mediated mechanism to which rodents are particularly sensitive. Human relevance cannot presently be completely excluded.

**EFFECT ON LABORATORY TESTS**

No studies on the effects of Lyxumia on laboratory tests have been performed.

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**EFFECTS ON ABILITY TO DRIVE AND USE MACHINES**

No studies on the effects on the ability to drive and use machines have been performed. When used in combination with a sulphonylurea or a basal insulin, patients should be advised to take precautions to avoid hypoglycaemia while driving and using machines.

**INTERACTIONS WITH OTHER MEDICINES**

Lixisenatide is a peptide and is not metabolised by cytochrome P450. In in vitro studies, lixisenatide did not affect the activity of cytochrome P450 isozymes or human transporters tested at therapeutically relevant concentrations.

The delay of gastric emptying with lixisenatide may influence absorption of orally administered medicines. For oral medicinal products that are particularly dependent on threshold concentrations for efficacy, patients should be advised to take those medicinal products at least 1 hour before or 11 hours after lixisenatide injection.

**PARACETAMOL**

Following administration of a single dose of paracetamol 1000 mg, paracetamol AUC and  $t_{1/2}$  were unchanged whatever the timing of its administration (before or after the lixisenatide injection). When administered 1 or 4 hours after the lixisenatide injection,  $C_{max}$  of paracetamol was decreased by 29 % and 31 % respectively, and median  $t_{max}$  was delayed by 2 and 1.75 hours respectively.

Based on these results, no dose adjustment for paracetamol is required.

**ORAL CONTRACEPTIVES**

Following administration of a single dose of an oral contraceptive medicinal product (ethinylestradiol 0.03 mg /levonorgestrel 0.15 mg) 1 hour before or 11 hours after subcutaneous injection of lixisenatide,  $C_{max}$ , AUC,  $t_{1/2}$  and  $t_{max}$  of ethinylestradiol and levonorgestrel were unchanged.

The administration of ethinylestradiol and levonorgestrel 1 hour or 4 hours after the subcutaneous lixisenatide injection did not affect AUC and  $t_{1/2}$  whereas  $C_{max}$  of ethinylestradiol was decreased by 52 % and 39% respectively and  $C_{max}$  of levonorgestrel was decreased by 46% and 20% respectively and median  $t_{max}$  was delayed by 1 to 3 hours.

The reduction in  $C_{max}$  is of limited clinical relevance and no dose adjustment for oral contraceptives is required.

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### **ATORVASTATIN**

When lixisenatide and atorvastatin 40 mg were co administered in the morning, the exposure of atorvastatin was not affected, while C<sub>max</sub> was decreased by 31% and t<sub>max</sub> was delayed by 3.25 hours.

No such increase for t<sub>max</sub> was observed when atorvastatin is administered in the evening and lixisenatide in the morning, but the AUC and C<sub>max</sub> were increased by 27 % and 66 % respectively.

These changes are not clinically relevant and therefore, no dose adjustment for atorvastatin is required when coadministered with lixisenatide.

### **WARFARIN AND OTHER COUMARIN DERIVATIVES**

After concomitant administration of warfarin 25 mg with repeated dosing of lixisenatide 20µg, there were no effects on AUC or INR (International Normalised Ratio) while C<sub>max</sub> was reduced by 19% and t<sub>max</sub> was delayed by 7 hours.

Based on these results, no dose adjustment for warfarin is required when coadministered with lixisenatide; however frequent monitoring of INR in patients on warfarin and/or coumarin derivatives is recommended at the time of initiation or ending of lixisenatide treatment

### **DIGOXIN**

After concomitant administration of lixisenatide and digoxin 0.25 mg, the AUC of digoxin was not affected. t<sub>max</sub> was delayed by 1.5 hour and C<sub>max</sub> was reduced by 26%.

Based on these results, no dose adjustment for digoxin is required when coadministered with lixisenatide.

### **RAMIPRIL**

After concomitant administration of lixisenatide and ramipril 5 mg during 7 days, the AUC of ramipril was increased by 21 % while the C<sub>max</sub> was decreased by 63 %. The AUC and C<sub>max</sub> of the active metabolite (ramiprilat) were not affected. t<sub>max</sub> of ramipril and ramiprilat was delayed by approximately 2.5 hours.

Based on these results, no dose adjustment for ramipril is required when coadministered with lixisenatide.

## **ADVERSE EFFECTS**

Over 2600 patients have received Lyxumia either alone or in combination with metformin, a sulphonylurea (with or without metformin) or a basal insulin (with or without metformin, or with

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or without a sulphonylurea) in 8 large placebo- or active-controlled phase III studies. The most frequently reported adverse reactions during clinical trials were nausea and vomiting. These reactions were mostly mild and transient.

In addition, hypoglycemia (when Lyxumia was used in combination with sulphonylurea and/or a basal insulin) and headache occurred.

In an active-controlled study in combination with metformin, the incidence of nausea in the lixisenatide group was 24.5% compared to 35.1% in the exenatide twice daily group and the incidence of symptomatic hypoglycaemia with lixisenatide was 2.5% during the 24-week main treatment period compared to 7.9% in the exenatide group.

Allergic reactions have been reported in 0.4% of Lyxumia patients.

Table 5 lists adverse reactions reported from placebo- and active-controlled phase III studies over the entire treatment period. The table presents adverse reactions by preferred term that occurred with an incidence > 5% if the frequency was higher among lixisenatide treated patients than patients treated with all comparators. The table also includes adverse reactions with a frequency ≥1% in the lixisenatide group if the frequency was >2 times the frequency for the comparator group.

*The following CIOMS frequency rating is used, when applicable:*

*Very common ≥ 10 %; Common ≥ 1 and <10 %; Uncommon ≥ 0.1 and < 1 %; Rare ≥ 0.01 and < 0.1 %; Very rare < 0.01 %; Unknown (cannot be estimated from available data).*

Within each system organ class, adverse reactions are presented in order of decreasing frequency.

**Table 5 - Adverse reactions reported during placebo- and active-controlled phase III studies during the entire treatment period (including the period beyond the main 24-week treatment period in studies of ≥76 weeks of total treatment).**

System Organ Class	Frequency of occurrence		
	Very common	Common	Uncommon
Infections and infestations		Influenza Upper respiratory tract infection Cystitis Viral infection	
Immune system disorders			Anaphylactic reaction
Metabolism and nutrition disorders	Hypoglycaemia (in combination with a sulphonylurea and / or a basal insulin)	Hypoglycaemia (in combination with metformin alone)	
Nervous system disorders	Headache	Dizziness	



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System Organ Class	Frequency of occurrence
	Somnolence
Gastrointestinal disorders	Nausea Dyspepsia Vomiting Diarrhoea
Skin and subcutaneous tissue disorders	Urticaria
Musculoskeletal and connective tissue disorders	Back pain
General disorders and administration site conditions	Injection site pruritus

## HYPOGLYCAEMIA

In patients taking Lyxumia in monotherapy, symptomatic hypoglycaemia occurred in 1.7% of lixisenatide treated patients and in 1.6% of placebo treated patients. When Lyxumia is used in combination with metformin alone, symptomatic hypoglycaemia occurred in 7.0% of lixisenatide patients and in 4.8% of placebo patients during the entire treatment period.

In patients taking Lyxumia in combination with a sulphonylurea and metformin, symptomatic hypoglycaemia occurred in 22.0% of lixisenatide treated patients and in 18.4% of placebo treated patients during the entire treatment period (3.6% absolute difference). When Lyxumia is used in combination with a basal insulin with or without metformin, symptomatic hypoglycaemia occurred in 42.1% of lixisenatide patients and in 38.9% of placebo patients during the entire treatment period (3.2% absolute difference).

During the entire treatment period, when Lyxumia was given with a sulphonylurea alone, symptomatic hypoglycaemia occurred in 22.7% of Lyxumia treated patients versus 15.2% with placebo (7.5% absolute difference). When Lyxumia was given with a sulphonylurea and a basal insulin, symptomatic hypoglycaemia occurred in 47.2% of Lyxumia treated patients compared to 21.6% with placebo (25.6% absolute difference).

Overall, the incidence of severe symptomatic hypoglycaemia was uncommon (0.4% in Lyxumia patients and 0.2% in placebo patients) during the entire treatment period of the Phase III placebo-controlled studies.

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**GASTROINTESTINAL DISORDERS**

Nausea and vomiting are the most frequently reported adverse reactions during the main 24-week treatment period. The incidence of nausea was higher in the Lyxumia group (26.1 %) compared to the placebo group (6.2 %) and the incidence of vomiting was higher in the Lyxumia (10.5 %) than in the placebo group (1.8 %). They were mostly mild and transient and occurred during the first 3 weeks after starting treatment. Thereafter, they progressively decreased during the following weeks.

**INJECTION SITE REACTIONS**

Injections site reactions have been reported in 3.9 % of the patients receiving Lyxumia while they were reported in 1.4 % of patients receiving placebo during the main 24-week treatment period. The majority of reactions were mild in intensity and usually did not result in discontinuation of the treatment. Less than 1% of patients discontinued lixisenatide treatment due to an injection site reaction.

**IMMUNOGENICITY**

Consistent with the potentially immunogenic properties of medicinal products containing proteins or peptides, patients may develop anti-lixisenatide antibodies following treatment with Lyxumia and, at the end of the main (24-week) treatment period in placebo-controlled studies, 69.8 % of lixisenatide patients had a positive antibody status.

The percentage of patients who were antibody positive was similar at the end of the entire 76-week treatment period. At the end of the main 24-week treatment period, 32.2% of the patients having a positive antibody status had an antibody concentration above the lower limit of quantification, and at the end of the entire 76-week treatment period, 44.7% of the patients had an antibody concentration above the lower limit of quantification. After stopping the treatment, few antibody positive patients were followed-up for antibody status; the percentage decreased to approximately 90% within 3 months and 30% at 6 months or beyond.

The change in HbA1c from baseline was similar regardless of the antibody status (positive or negative).

When the levels of antibodies in the lixisenatide-treated patients were quantified, 79.3 % had either a negative antibody status or an antibody concentration below the lower limit of quantification. The other 20.7 % of patients had a quantified antibody concentration and some of these patients had diminished efficacy associated with high anti-lixisenatide antibody concentration. In the subset of patients (5.2%) with the highest antibody concentrations, the mean improvement in HbA1c at Week 24 and at Week 76 was in a clinically relevant range; however there was variability in the glycaemic response and 1.9% had no decrease in HbA1c.

The antibody status ( positive or negative) is not predictive for a diminished HbA1c change in individual patients.

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There was no difference in the overall safety profile in patients regardless of the antibody status with the exception of an increase of the incidence of injection site reactions (4.7% in antibody positive patients compared to 2.5% in antibody-negative patients during the entire treatment period) for antibody positive patients. The majority of injection site reactions were mild, regardless of antibody status.

There was no cross-reactivity versus either native glucagon or endogenous GLP-1.

## ALLERGIC REACTIONS

Allergic reactions (such as anaphylactic reaction, angioedema and urticaria) have been reported in 0.4 % of Lyxumia patients compared to less than 0.1% in placebo patients during the main 24-week treatment period.

Anaphylactic reactions were reported in 0.2% of the lixisenatide treated patients vs. none in the placebo group. Most of these reported allergic reactions were mild in severity. One case of anaphylactoid reaction was reported during clinical trials with lixisenatide.

## HEART RATE

Cardiac arrhythmias particularly tachycardia (0.8% vs <0.1%) and palpitations (1.5% vs 0.8%) have been reported in lixisenatide patients compared to placebo treated patients .

## WITHDRAWAL

The incidence of treatment discontinuation due to adverse events was 7.4% for Lyxumia compared to 3.2% in the placebo group during the main 24-week treatment period. The most common adverse events which led to treatment discontinuation in the Lyxumia group were nausea (3.1%) and vomiting (1.2%).

## DOSAGE AND ADMINISTRATION

Lyxumia is to be injected subcutaneously in the thigh, abdomen or upper arm. Lyxumia should not be administered intravenously or intramuscularly.

Lyxumia is administered once daily within the hour prior to the first meal of the day or the evening meal.

The starting dose is 10 mcg ( $\mu\text{g}$ ) Lyxumia once daily for 14 days.

Then, the Lyxumia dose should be increased to 20 mcg ( $\mu\text{g}$ ) once daily, which is the maintenance dose.

If a dose of Lyxumia is missed, it should be injected within the hour prior to the next meal.

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When Lyxumia is added to existing metformin therapy, the current metformin dose can be continued unchanged.

When Lyxumia is added to a combination of a basal insulin and a sulphonylurea, a reduction in the dose of the basal insulin or the sulphonylurea may be considered according to individual response to reduce the risk of hypoglycaemia (see PRECAUTIONS).

When used in combination with basal insulin and a sulphonylurea, blood glucose monitoring may become necessary to adjust the doses of the basal insulin or the sulphonylurea.

In the absence of compatibility studies, Lyxumia must not be mixed with other medicinal products.

Inspect Lyxumia before each use. Lyxumia must only be used if the solution is clear, colourless, with no particles visible.

Lyxumia should not be used if it has been frozen.

Lyxumia can be used with 29 to 32 gauge disposable pen needles. Pen needles are not included. The patient should be instructed to discard the needle after each use in accordance with local requirements and to store the pen without the needle attached. This helps prevent contamination and potential needle blockage.

Each Lyxumia pen is to be used for one patient only.

### **USE IN THE ELDERLY (≥ 65 years)**

No dosage adjustment is required based on age. The clinical experience in patients ≥ 75 years is limited.

### **CHILDREN**

The safety and effectiveness of Lyxumia in paediatric patients below the ages of 18 years have not been established.

### **HEPATIC IMPAIRMENT**

No dose adjustment is needed in patients with hepatic impairment.

### **RENAL IMPAIRMENT**

No dose adjustment is required for patients with mild renal impairment (creatinine clearance: 50-80 mL/min).

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Moderate renal impairment

There is limited therapeutic experience in patients with moderate renal impairment (creatinine clearance: 30-<50 ml/min) and Lyxumia should be used with caution in this population.

Severe renal impairment

There is no therapeutic experience in patients with severe renal impairment (creatinine clearance < 30 mL/min) or end stage renal disease, and therefore it is not recommended to use Lyxumia in these populations.

## OVERDOSAGE

During clinical studies, doses up to 30 µg of lixisenatide twice a day were administered to type 2 diabetic patients in a 13-week study. They were well tolerated and only an increased incidence of gastrointestinal disorders was observed.

In case of overdose, appropriate supportive treatment should be initiated according to the patient's clinical signs and symptoms and the Lyxumia dose should be reduced to the prescribed dose.

For information on the management of overdose, contact the Poison Information Centre on 131126.

## PRESENTATION AND STORAGE CONDITIONS

Before first use, Lyxumia must be stored refrigerated between 2°C and 8°C in the outer packaging in order to protect it from light. Do not freeze.

After first use, Lyxumia must be kept at a temperature not exceeding 30°C. Do not refrigerate. The pen cap should be replaced on the pen after each use to protect it from light. The pen should not be stored with a needle attached.

The pen must be discarded 14 days after opening.

### LYXUMIA 10µg solution for injection (green injection pen)

Solution for injection in a green pre-filled injector pen containing 3 mL solution delivering 14 doses of 10 µg. Each dose (0.2 mL) contains 10 µg of lixisenatide (0.05 mg/ ml). Supplied as a single (14 days supply) injector pen.

**Attachment 1: Product information for AusPAR Lyxumia / Lyxumia Treatment initiation pack / Lixisenatide Sanofi / Lixisenatide Sanofi Treatment initiation pack / Lixisenatide Winthrop / Lixisenatide Winthrop Treatment initiation pack; Lixisenatide; Sanofi-Aventis Australia Pty Ltd; PM-2011-03163-3-5. Date of Finalisation 20 August 2013. This Product Information was approved at the time this AusPAR was published.**

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**LYXUMIA 20µg solution for injection (purple injection pen)**

Solution for injection in purple pre-filled injector pen containing 3 mL solution delivering 14 doses of 20 µg. Each dose (0.2 mL) contains 20 µg of lixisenatide (0.1 mg/mL). Supplied in packs of 1 (14 days supply), 2 (28 days supply) and 6 (84 days supply) injector pens.

**LYXUMIA TREATMENT INITIATION PACK (1 green + 1 purple injection pen)**

Solution for injection composite pack containing 1 green pre-filled 10 µg pen (14 days supply), and 1 purple pre-filled 20 µg pen (14 days supply; 28 days total supply). Each dose (0.2 mL) from the 10 µg pen contains 10 µg of lixisenatide (0.05 mg/mL). Each dose (0.2 mL) from the 20 µg pen contains 20 µg of lixisenatide (0.1 mg/mL).

**NAME AND ADDRESS OF THE SPONSOR**

sanofi-aventis australia pty ltd  
12-24 Talavera Road  
Macquarie Park NSW 2113

**POISON SCHEDULE OF THE MEDICINE**

Schedule 4 (Prescription Only Medicine)

**DATE OF FIRST INCLUSION IN THE ARTG**

10 April 2013