NEW ZEALAND DATA SHEET

1. PRODUCT NAME

JARDIAMET 5 mg/500 mg film coated tablets

JARDIAMET 5 mg/850 mg film coated tablets

JARDIAMET 5 mg/1000 mg film coated tablets

JARDIAMET 12.5 mg/500 mg film coated tablets

JARDIAMET 12.5 mg/850 mg film coated tablets

JARDIAMET 12.5 mg/1000 mg film coated tablets

2. QUALITATIVE AND QUANTITATIVE COMPOSITION

JARDIAMET 5 mg/500 mg film coated tablets

Each film coated tablet contains 5 mg empagliflozin and 500 mg metformin hydrochloride.

JARDIAMET 5 mg/850 mg film coated tablets

Each film coated tablet contains 5 mg empagliflozin and 850 mg metformin hydrochloride.

JARDIAMET 5 mg/1000 mg film coated tablets

Each film coated tablet contains 5 mg empagliflozin and 1000 mg metformin hydrochloride.

JARDIAMET 12.5 mg/500 mg film coated tablets

Each film coated tablet contains 12.5 mg empagliflozin and 500 mg metformin hydrochloride.

JARDIAMET 12.5 mg/850 mg film coated tablets

Each film coated tablet contains 12.5 mg empagliflozin and 850 mg metformin hydrochloride.

JARDIAMET 12.5 mg/1000 mg film coated tablets

Each film coated tablet contains 12.5 mg empagliflozin and 1000 mg metformin hydrochloride.

For the full list of excipients, see section 6.1.

3. PHARMACEUTICAL FORM

Film coated tablet (tablet).

JARDIAMET 5 mg/500 mg film coated tablets

Orange yellow, oval, biconvex film-coated tablet. One side is debossed with the Boehringer Ingelheim company symbol and "S5" the other side is debossed with "500".

JARDIAMET 5 mg/850 mg film coated tablets

Yellowish white, oval, biconvex film-coated tablet. One side is debossed with Boehringer Ingelheim company symbol and “S5”, the other side is debossed with “850”.

JARDIAMET 5 mg/1000 mg film coated tablets

Brownish yellow, oval, biconvex film-coated tablet. One side is debossed with Boehringer Ingelheim company symbol and “S5”, the other side is debossed with “1000”.

JARDIAMET 12.5 mg/500 mg film coated tablets

Pale brownish purple, oval, biconvex film-coated tablet. One side is debossed with Boehringer Ingelheim company symbol and “S12”, the other side is debossed with “500”.

JARDIAMET 12.5 mg/850 mg film coated tablets

Pinkish white, oval, biconvex film-coated tablet. One side is debossed with Boehringer Ingelheim company symbol and “S12”, the other side is debossed with “850”.

JARDIAMET 12.5 mg/1000 mg film coated tablets

Dark brownish purple, oval, biconvex film-coated tablet. One side is debossed with Boehringer Ingelheim company symbol and “S12”, the other side is debossed with “1000”.

4. CLINICAL PARTICULARS

4.1. Therapeutic indications

Glycaemic control:

JARDIAMET is indicated as an adjunct to diet and exercise to improve glycaemic control in adult patients with type 2 diabetes mellitus:

- when treatment with both empagliflozin and metformin is appropriate
- inadequately controlled with metformin or empagliflozin alone
- inadequately controlled with empagliflozin or metformin in combination with other glucose-lowering products including insulin (see section 5.1)
- already treated with empagliflozin and metformin co-administered as separate tablets.

Prevention of cardiovascular events:

JARDIAMET is indicated in patients with type 2 diabetes mellitus and established cardiovascular disease when treatment with empagliflozin and metformin is appropriate and empagliflozin is needed to reduce the risk of cardiovascular death (see section 5.1).

To prevent cardiovascular deaths, JARDIAMET should be used in conjunction with other measures to reduce cardiovascular risk in line with the current standard of care.

4.2. Dose and method of administration

Dose

Adults with normal renal function (GFR ≥ 90mL/min)

The recommended dose is one tablet twice daily.

The dosage should be individualised on the basis of the patient's current regimen, effectiveness, and tolerability. The maximum recommended daily dose of JARDIAMET is 25 mg of empagliflozin and 2000 mg of metformin (see Table 1 for additional dosing information).

- In patients not adequately controlled on metformin alone or in combination with other products, including insulin, the recommended starting dose of JARDIAMET should provide empagliflozin 5 mg twice daily (10 mg total daily dose) and the dose of metformin similar to the dose already being taken. In patients tolerating a total daily dose of empagliflozin 10 mg, the dose can be increased to a total daily dose of empagliflozin 25 mg.
- Patients already treated with empagliflozin should continue to take the same daily dose of empagliflozin.
- Patients switching from separate tablets of empagliflozin (10 mg or 25 mg total daily dose) and metformin to JARDIAMET should receive the same total daily dose of empagliflozin and metformin already being taken or the nearest therapeutically appropriate dose of metformin.

When JARDIAMET is used in combination with a sulfonylurea and/or insulin, a lower dose of sulfonylurea and/or insulin may be required to reduce the risk of hypoglycaemia (see sections 4.5 and 4.8).

For the different doses of metformin, JARDIAMET is available in strengths of 5 mg empagliflozin plus 500 mg, 850 mg or 1000 mg metformin hydrochloride or 12.5 mg empagliflozin plus 500 mg, 850 mg or 1000 mg metformin hydrochloride.

Special populations

Renal impairment

In patients with type 2 diabetes mellitus, the glycaemic efficacy of empagliflozin is dependent on renal function. Glycaemic lowering efficacy of empagliflozin is reduced in patients with moderate renal impairment and likely absent in patients with severe renal impairment, if further glycaemic control is needed, the addition of other anti- hyperglycaemic agents should be considered. See section 4.4, 5.1 and 5.2.

No dose adjustment is recommended for patients with mild renal impairment.

Empagliflozin should not be used in patients with ESRD or in patients on dialysis. There are insufficient data to support use in these patients.

A GFR should be assessed before initiation of treatment with metformin containing products and at least annually thereafter. In patients at increased risk of further progression of renal impairment and in the elderly, renal function should be assessed more frequently, e.g. every 3-6 months.

Table 1 Posology for renally impaired patients*

eGFR (mL/min/1.73m^2)	**Metformin**	**Empagliflozin**
60 - 89	Maximum daily dose is 2000 mg.* Dose reduction may be considered in relation to declining renal function.	Maximum daily dose is 25 mg. No dose adjustment is required.
45 - 59	Maximum daily dose is 1000 mg. The starting dose is at most half of the maximum dose.	No dose adjustment is required.
30 - 44	Maximum daily dose is 1000 mg.* The starting dose is at most half of the maximum dose.	No dose adjustment is required.
<30	Metformin is contraindicated.	Empagliflozin is not recommended

* If no adequate strength of JARDIAMET is available, individual monocomponents should be used instead of the fixed dose combination.

Hepatic impairment

JARDIAMET is contraindicated in patients with hepatic impairment due to the metformin component (see section 4.3 Contraindications).

Elderly

Due to the potential for decreased renal function in elderly subjects, the metformin dosage should be adjusted based on renal function. Regular assessment of renal function is necessary (see section 4.4).

Paediatric population

JARDIAMET is not recommended for use in children below 18 years due to lack of data on safety and efficacy.

Method of administration

JARDIAMET should be given with meals to reduce the gastrointestinal undesirable effects associated with metformin.

If a dose is missed, it should be taken as soon as the patient remembers. However, a double dose should not be taken at the same time. In that case, the missed dose should be skipped.

4.3. Contraindications

- Hypersensitivity to active ingredients empagliflozin and/or metformin or to any of the excipients in JARDIAMET (see section 6.1)
- Any type of acute metabolic acidosis (such as lactic acidosis, diabetic ketoacidosis)
- Diabetic pre-coma
- Severe renal failure (CrCl < 30 mL/min or eGFR < 30 mL/min/1.73m^2), due to its metformin component
- Acute conditions with the potential to alter renal function such as: dehydration, severe infection, shock, intravascular administration of iodinated contrast agents (see section 4.4)

- Disease which may cause tissue hypoxia (especially acute disease, or worsening of chronic disease) such as: decompensated heart failure, respiratory failure, recent myocardial infarction, shock

- Hepatic insufficiency, acute alcohol intoxication, alcoholism (see section 4.5).

4.4. Special warnings and precautions for use

General

JARDIAMET should not be used in patients with type 1 diabetes.

Diabetic ketoacidosis

Cases of diabetic ketoacidosis (DKA), a serious life-threatening condition requiring urgent hospitalisation, have been reported in patients treated with empagliflozin, including fatal cases. In a number of reported cases, the presentation of the condition was atypical with only moderately increased blood glucose values, below 14 mmol/L.

The risk of diabetic ketoacidosis must be considered in the event of non-specific symptoms such as nausea, vomiting, anorexia, abdominal pain, excessive thirst, difficulty breathing, confusion, unusual fatigue or sleepiness.

Patients should be assessed for ketoacidosis immediately if these symptoms occur, regardless of blood glucose level. If ketoacidosis is suspected, JARDIAMET should be discontinued, patient should be evaluated, and prompt treatment should be instituted. Treatment of ketoacidosis generally requires insulin, fluid, potassium and carbohydrate replacement. Diabetic ketoacidosis and glucosuria may be prolonged after discontinuation of JARDIAMET in some patients, i.e. it may last longer than expected from 5 plasma half-lives of empagliflozin (see Section 5.2 Pharmacokinetic properties). Restarting SGLT2 inhibitor treatment in patients with previous ketoacidosis while on SGLT2 inhibitor treatment is not recommended, unless another clear precipitating factor is identified and resolved. Before initiating JARDIAMET, consider factors in the patient history that may predispose to ketoacidosis.

Patients who may be at higher risk of ketoacidosis while taking JARDIAMET include patients on a very low carbohydrate diet (as the combination may further increase ketone body production), patients with an acute illness, pancreatic disorders suggesting insulin deficiency (e.g., type 1 diabetes, history of pancreatitis or pancreatic surgery), insulin dose reduction (including insulin pump failure), alcohol abuse, severe dehydration, surgery, malnourished/reduced caloric intake , increased insulin requirements due to infections, and patients with a history of ketoacidosis. JARDIAMET should be used with caution in these patients. When reducing the insulin dose (see section 4.2), caution should be taken. In patients treated with JARDIAMET consider monitoring for ketoacidosis and temporarily discontinuing JARDIAMET in clinical situations known to predispose to ketoacidosis (e.g. prolonged fasting due to acute illness or surgery). In these situations, consider monitoring of ketones, even if JARDIAMET treatment has been interrupted. Measurement of blood ketone levels is preferred to urine. An increase in other glucose lowering agents may be required during this time. Patients scheduled for non-urgent surgery who have not ceased empagliflozin should be assessed and consideration should be given to postponing the procedure. Treatment with JARDIAMET may be restarted once the patient's condition has stabilised and oral intake is normal.

Lactic acidosis

Lactic acidosis, a very rare but serious metabolic complication, most often occurs at acute worsening of renal function or cardiorespiratory illness or sepsis. Metformin accumulation occurs at acute worsening of renal function and increases the risk of lactic acidosis.

In case of dehydration (severe diarrhoea or vomiting, fever or reduced fluid intake), JARDIAMET should be temporarily discontinued and contact with a health care professional is recommended.

Medicinal products that can acutely impair renal function (such as antihypertensives, diuretics and NSAIDs) should be initiated with caution in metformin-treated patients. Other risk factors for lactic acidosis are excessive alcohol intake, hepatic insufficiency, inadequately controlled diabetes, ketosis, prolonged fasting and any conditions associated with hypoxia, as well as concomitant use of medicinal products that may cause lactic acidosis (see sections 4.3 and 4.5).

Patients and/or care-givers should be informed of the risk of lactic acidosis. Lactic acidosis is characterised by acidotic dyspnoea, abdominal pain, muscle cramps, asthenia and hypothermia followed by coma. In case of suspected symptoms, the patient should stop taking JARDIAMET and seek immediate medical attention.

Diagnostic laboratory findings are decreased blood pH (< 7.35), increased plasma lactate levels (> 5 mmol/L), and an increased anion gap and lactate/pyruvate ratio.

Patients with known or suspected mitochondrial diseases

In patients with known mitochondrial diseases such as Mitochondrial Encephalopathy with Lactic Acidosis, and Stroke-like episodes (MELAS) syndrome and Maternal inherited diabetes and deafness (MIDD), metformin is not recommended due to the risk of lactic acidosis exacerbation and neurologic complications which may lead to worsening of the disease.

In case of signs and symptoms suggestive of MELAS syndrome or MIDD after the intake of metformin, treatment with JARDIAMET should be withdrawn immediately and prompt diagnostic evaluation should be performed.

Administration of iodinated contrast agent

Intravascular administration of iodinated contrast agents may lead to contrast induced nephropathy, resulting in metformin accumulation and an increased risk of lactic acidosis. JARDIAMET should be discontinued prior to or at the time of the imaging procedure and not restarted until at least 48 hours after, provided that renal function has been re-evaluated and found to be stable, see sections 4.2 and 4.5.

Necrotising fasciitis of the perineum (Fournier's gangrene)

Cases of necrotising fasciitis of the perineum (also known as Fournier's gangrene), a rare, but serious and life-threatening necrotising infection, have been reported in female and male patients treated with SGLT2 inhibitors, including empagliflozin. Serious outcomes have included hospitalisation, multiple surgeries, and death.

Patients treated with JARDIAMET who present with pain or tenderness, erythema, swelling in the genital or perineal area, fever, malaise should be evaluated for necrotising fasciitis. Be aware that uro-genital infection may precede necrotising fasciitis. If necrotising fasciitis is suspected, JARDIAMET should be discontinued and prompt treatment should be instituted (including broad-spectrum antibiotics and surgical debridement if necessary).

Renal function

Due to the mechanism of action, the efficacy of empagliflozin is dependent on renal function.

GFR should be assessed before treatment initiation and regularly thereafter, see section 4.2. JARDIAMET is contraindicated in patients with GFR < 30 mL/min and should be temporarily discontinued in the presence of conditions that alter renal function, see section 4.3.

Cardiac function

Patients with heart failure are more at risk of hypoxia and renal impairment. In patients with stable chronic heart failure, JARDIAMET may be used with a regular monitoring of cardiac and renal function.

For patients with acute and unstable heart failure, JARDIAMET is contraindicated due to the metformin component (see section 4.3).

Elderly

Patients age 75 years and older may be at an increased risk of volume depletion, therefore, JARDIAMET should be prescribed with caution in these patients (see section 4.8).

As metformin is excreted via the kidney, and elderly patients have a tendency to decreased renal function, elderly patients taking JARDIAMET should have their renal function monitored regularly.

Use in patients at risk for volume depletion

Based on the mode of action of SGLT2 inhibitors, osmotic diuresis accompanying glucosuria may lead to a modest decrease in blood pressure (see section 5.1).

Volume depletion is a known risk factor for renal impairment. Patients with hypovolaemia may be more susceptible to these changes. There have been postmarketing reports of acute kidney injury, some requiring hospitalization and dialysis, in patients with type 2 diabetes mellitus receiving SGLT2 inhibitors, including JARDIAMET.

Therefore, caution should be exercised in patients for whom an empagliflozin-induced drop in blood pressure could pose a risk, such as patients with known cardiovascular disease, patients on anti-hypertensive therapy with a history of hypotension or patients aged 75 years and older.

In case of conditions that may lead to fluid loss (e.g. gastrointestinal illness), careful monitoring of volume status (e.g. physical examination, blood pressure measurements, laboratory tests including haematocrit) and electrolytes is recommended for patients receiving empagliflozin. Temporary interruption of treatment with JARDIAMET should be considered until the fluid loss is corrected.

Urinary tract infections

In the pooled placebo-controlled double-blind trials of 18 to 24 weeks duration, the overall frequency of urinary tract infection reported as adverse event was higher in patients treated with empagliflozin 10 mg plus metformin as compared to patients treated with placebo plus metformin or empagliflozin 25 mg plus metformin (see section 4.8).

Post-marketing cases of complicated urinary tract infections including pyelonephritis and urosepsis have been reported in patients treated with empagliflozin. Temporary interruption of treatment should be considered in patients with complicated urinary tract infections.

Surgery

JARDIAMET must be discontinued at the time of surgery under general, spinal or epidural anaesthesia. Therapy may be restarted no earlier than 48 hours following surgery or resumption of oral nutrition and provided that renal function has been re-evaluated and found to be stable.

Vitamin B12

The risk of low vitamin B12 levels increases with increasing metformin dose, treatment duration, and/or in patients with risk factors known to cause vitamin B12 deficiency. In case of suspicion of vitamin B12 deficiency (such as anaemia or neuropathy), vitamin B12 serum levels should be monitored. Periodic vitamin B12 monitoring could be necessary in patients with risk factors for vitamin B12 deficiency. Metformin therapy should be continued for as long as it is tolerated and not contra-indicated and appropriate corrective treatment for vitamin B12 deficiency provided in line with current clinical guidelines.

4.5. Interaction with other medicines and other forms of interaction

Co-administration of multiple doses of empagliflozin and metformin does not meaningfully alter the pharmacokinetics of either empagliflozin or metformin in healthy subjects.

No interaction studies have been performed for JARDIAMET. The following statements reflect the information available on the individual active substances.

Empagliflozin

Pharmacodynamic Interactions

Diuretics

Empagliflozin may add to the diuretic effect of thiazide and loop diuretics and may increase the risk of dehydration and hypotension.

Insulin and insulin secretagogues

Insulin and insulin secretagogues, such as sulfonylureas, may increase the risk of hypoglycaemia. Therefore, a lower dose of insulin or an insulin secretagogue may be required to reduce the risk of hypoglycaemia when used in combination with empagliflozin (see sections 4.2 and 4.8).

Interference with 1,5-anhydroglucitol (1,5-AG) Assay

Monitoring glycaemic control with 1,5-AG assay is not recommended as measurements of 1,5-AG are unreliable in assessing glycaemic control in patients taking SGLT2 inhibitors. Use alternative methods to monitor glycaemic control.

Pharmacokinetic Interactions

Lithium

Concomitant use of SGLT2 inhibitors, including empagliflozin, with lithium may decrease blood lithium levels through increased renal lithium elimination. Therefore, serum lithium concentration should be monitored more frequently with empagliflozin initiation or following dose changes. Please refer the patient to the lithium prescribing doctor in order to monitor serum concentration of lithium.

In vitro assessment of drug interactions

Empagliflozin does not inhibit, inactivate, or induce CYP450 isoforms. *In vitro* data suggest that the primary route of metabolism of empagliflozin in humans is glucuronidation by the uridine 5'-diphospho-glucuronosyltransferases UGT1A3, UGT1A8, UGT1A9, and UGT2B7. Empagliflozin does not inhibit UGT1A1, UGT1A3, UGT1A8, UGT1A9, or UGT2B7. At therapeutic doses, the potential for empagliflozin to reversibly inhibit or inactivate the major CYP450 isoforms or UGT1A1 is remote. Drug-drug interactions involving the major CYP450

and UGT isoforms with empagliflozin and concomitantly administered substrates of these enzymes are therefore considered unlikely.

Empagliflozin is a substrate for P-glycoprotein (P-gp) and breast cancer resistance protein (BCRP), but it does not inhibit these efflux transporters at therapeutic doses. Based on *in vitro* studies, empagliflozin is considered unlikely to cause interactions with drugs that are P-gp substrates. Empagliflozin is a substrate of the human uptake transporters OAT3, OATP1B1, and OATP1B3, but not OAT1 and OCT2. Empagliflozin does not inhibit any of these human uptake transporters at clinically relevant plasma concentrations and, as such, drug-drug interactions with substrates of these uptake transporters are considered unlikely.

In vivo assessment of drug interactions

No clinically meaningful pharmacokinetic interactions were observed when empagliflozin was co-administered with other commonly used medicinal products. Based on results of pharmacokinetic studies no dose adjustment of empagliflozin is recommended when co-administered with commonly prescribed medicinal products.

Empagliflozin pharmacokinetics were similar with and without co-administration of glimepiride, pioglitazone, sitagliptin, linagliptin, warfarin, verapamil, ramipril, simvastatin, in healthy volunteers and with or without co-administration of torasemide and hydrochlorothiazide in patients with T2DM. Increases in overall exposure (AUC) of empagliflozin were seen following co-administration with gemfibrozil (59%), rifampicin (35%), or probenecid (53%). These changes were not considered to be clinically meaningful.

Empagliflozin had no clinically relevant effect on the pharmacokinetics of glimepiride, pioglitazone, sitagliptin, linagliptin, warfarin, digoxin, ramipril, simvastatin, hydrochlorothiazide, torasemide and oral contraceptives when co-administered in healthy volunteers.

Metformin

Concomitant use not recommended

Alcohol

Alcohol intoxication is associated with an increased risk of lactic acidosis, particularly in cases of fasting, malnutrition or hepatic insufficiency.

Iodinated contrast agents

JARDIAMET must be discontinued prior to or at the time of the imaging procedure and not be restarted until at least 48 hours after, provided that renal function has been re-evaluated and found to be stable (see sections 4.2 and 4.4).

Combination requiring precautions for use

Some medicinal products can adversely affect renal function which may increase the risk of lactic acidosis, e.g. NSAIDs, including selective cyclo-oxygenase (COX) II inhibitors, ACE inhibitors, angiotensin II receptor antagonists and diuretics, especially loop diuretics. When starting or using such products in combination with metformin, close monitoring of renal function is necessary.

Medicinal products with intrinsic hyperglycaemic activity (e.g. glucocorticoids and tetracosactides (systemic and local routes), beta-2-agonists, danazol, chlorpromazine at high dosages of 100 mg per day and diuretics:

More frequent blood glucose monitoring may be required, especially at the beginning of treatment. If necessary, adjust the metformin dosage during therapy with the respective medicinal product and upon discontinuation.

Thiazide diuretics

Thiazide therapy may impair glucose tolerance. Dosage adjustment of metformin may be required.

Organic cation transporters (OCT)

Metformin is a substrate of both transporters OCT1 and OCT2. Co-administration of metformin with:

- Inhibitors of OCT1 (such as verapamil) may reduce efficacy of metformin.
- Inducers of OCT1 (such as rifampicin) may increase gastrointestinal absorption and efficacy of metformin.
- Inhibitors of OCT2 (such as cimetidine, dolutegravir, ranolazine, trimethoprim, vandetanib, isavuconazole) may decrease the renal elimination of metformin and thus lead to an increase in metformin plasma concentration.
- Inhibitors of both OCT1 and OCT2 (such as crizotinib, olaparib) may alter efficacy and renal elimination of metformin.

Caution is therefore advised, especially in patients with renal impairment, when these drugs are co-administered with metformin, as metformin plasma concentration may increase. If needed, dose adjustment of metformin may be considered as OCT inhibitors/inducers may alter the efficacy of metformin.

Carbonic anhydrase inhibitors

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

Sulfonylureas and repaglinide

During concomitant therapy with sulfonylureas and repaglinide, blood glucose should be monitored because combined therapy may cause hypoglycaemia.

4.6. Fertility, pregnancy and lactation

Pregnancy (Category D)

There are limited data from the use of JARDIAMET or its individual components in pregnant women. Nonclinical studies with empagliflozin alone do not indicate direct or indirect harmful effects with respect to reproductive toxicity. Animal studies with the combination of empagliflozin and metformin or with metformin alone have shown reproductive toxicity at higher doses of metformin only (see section 5.3). As a precautionary measure, it is recommended to avoid the use of JARDIAMET during pregnancy unless clearly needed.

Empagliflozin administered to female rats from gestation day 6 to lactation day 20 resulted in reduced weight gain in offspring at >30 mg/kg/day (maternal exposures approximately 4- and 11- times those seen with a clinical dose of 25 mg and 10 mg, respectively). No adverse effects

on postnatal development were noted at 10 mg/kg/day (maternal exposures approximately equivalent to those seen with a clinical dose of 25 mg). Specialised studies in rats with other members of the pharmacological class have shown toxicity to the developing kidney in the time period corresponding to the second and third trimesters of human pregnancy (see section 5.3). Similar effects have been seen for empagliflozin at approximately 11 times the clinical AUC exposure associated with the 25 mg dose. These findings were absent after a 13-week drug-free recovery period.

Breast-feeding

Metformin is excreted into human breast milk. No adverse effects were observed in breastfed newborns/infants. It is unknown whether empagliflozin is excreted in human milk.

No data in humans are available on excretion of empagliflozin into milk. Available nonclinical data in animals have shown excretion of empagliflozin in milk. Reduced body weight was observed in rats exposed to empagliflozin in utero and through the consumption of maternal milk (see section 4.6). Adverse effects on renal development have been observed in juvenile rats treated with other members of this pharmacological class. A risk to human newborns/infants cannot be excluded. It is recommended to discontinue breast feeding during treatment with JARDIAMET.

Fertility

No studies on the effect on human fertility have been conducted with JARDIAMET or its individual components.

Non-clinical studies in animals with the individual components do not indicate direct or indirect harmful effects with respect to fertility.

4.7. Effects on ability to drive and use machines

JARDIAMET has minor influence on the ability to drive and use machines. Patients should be advised to take precautions to avoid hypoglycaemia while driving and using machines, in particular when JARDIAMET is used in combination with a sulfonylurea and/or insulin.

4.8. Undesirable effects

a. Summary of the safety profile

A total of 12245 patients with type 2 diabetes were treated in clinical studies to evaluate the safety of empagliflozin plus metformin, of which 8199 patients were treated with empagliflozin plus metformin, either alone, or in addition to a sulfonylurea, pioglitazone, DPP4 inhibitors, or insulin. In these trials 2910 patients received treatment with empagliflozin 10 mg plus metformin and 3699 patients treatment with empagliflozin 25 mg plus metformin for at least 24 weeks and 2151 or 2807 patients for at least 76 weeks.

The overall safety profile of empagliflozin plus metformin for patients enrolled in the EMPA-REG OUTCOME study was comparable to the previously known safety profile.

Placebo controlled double-blind trials of 18 to 24 weeks of exposure included 3456 patients, of which 1271 were treated with empagliflozin 10 mg plus metformin and 1259 with empagliflozin 25 mg plus metformin.

The most frequently reported adverse event in clinical trials was hypoglycaemia, which depended on the type of background therapy used in the respective studies (see Table 2 and section 4.8 c. Description of selected adverse reactions).

No additional adverse reactions were identified in clinical trials with empagliflozin plus metformin compared to the adverse reactions of the single components.

b. Tabulated list of adverse reactions

Frequency categories are defined as very common (≥ 1/10), common (≥ 1/100 to < 1/10), uncommon (≥ 1/1,000 to < 1/100), rare (≥ 1/10,000 to < 1/1,000), very rare (< 1/10,000) and not known (cannot be estimated from the available data).

Table 2 Adverse reactions reported in patients who received empagliflozin monotherapy or combination therapy of empagliflozin and metformin in placebo controlled double-blind studies and derived from postmarketing experience

System Organ Class	Very common	Common	Uncommon	Very rare	Not known
Infections and infestations		Vaginal moniliasis, vulvovaginitis, balanitis and other genital infections[1, 2] Urinary tract infection[1,2] (including pyelonephritis and urosepsis)[5]			Necrotising fasciitis of the perineum (Fournier´s gangrene)[2,5]
Metabolism and nutrition disorders	Hypoglycaemia (when used with sulfonylurea or insulin)[1]	Vitamin B12 decrease/deficiency[3]	Ketoacidosis[5]	Lactic acidosis[3]	
Nervous system disorders		Taste disturbance[3]			
Vascular disorders			Volume depletion[1, 2]		
Gastrointestinal disorders[4]	Nausea[3] Vomiting[3] Diarrhoea[3] Abdominal pain[3] Loss of appetite[3]	Constipation			
Hepatobiliary disorders				Liver function tests abnormalities[3] Hepatitis[3]	
Skin and subcutaneous tissue disorders		Allergic skin reactions (e.g. Rash[5], Urticaria[3,5], Erythema[3])	Pruritus[2, 3]		Angioedema[2,5]
Renal and urinary disorders		Increased urination[2]	Dysuria[2]		
General disorders and administration site conditions		Thirst[2]			

System Organ Class	Very common	Common	Uncommon	Very rare	Not known
Investigations		Serum lipids increased[2,6]	Glomerular filtration rate decreased[1] Blood creatinine increased[1] Haematocrit increased[2,6]		

[1] See subsections below for additional information
[2] Identified adverse reactions of empagliflozin monotherapy
[3] Identified adverse reactions of metformin monotherapy (see below - Metformin hydrochloride monotherapy)
[4] Gastrointestinal symptoms such as nausea, vomiting, diarrhoea, abdominal pain and loss of appetite occur most frequently during initiation of therapy and resolve spontaneously in most cases
[5] Identified adverse reactions from postmarketing experience
[6] See section clinical trials for additional information

c. Description of selected adverse reactions

The frequencies below are calculated for adverse reactions regardless of causality.

Hypoglycaemia

The frequency of hypoglycaemia depended on the background therapy in the respective studies and was similar to placebo for empagliflozin as add-on to metformin and as add-on to pioglitazone +/- metformin, and as add-on with linagliptin + metformin. The frequency of patients with hypoglycaemia was increased in patients treated with empagliflozin compared to placebo when given as add-on to metformin plus sulfonylurea, and as add-on to insulin +/- metformin and +/-sulfonylurea (see section 4.2; see Table 3).

Major hypoglycaemia (events requiring assistance)

The overall frequency of patients with major hypoglycaemic events was low (<1%) and similar for empagliflozin and placebo on a background of metformin. The frequency of major hypoglycaemia depended on the background therapy in the respective studies (see section 4.2; see Table 3).

Table 3 Frequency of patients with confirmed hypoglycaemic events per trial and indication (1245.19, 1245.23(met), 1245.23(met+SU), 1245.33, 1245.49, 1276.1, 1276.10, 1275.9 and 1245.25 – TS[1])

Treatment group	Placebo	Empagliflozin 10 mg	Empagliflozin 25 mg
In combination with metformin (1245.23 *(met)*) (24 weeks)			
N	**206**	**217**	**214**
Overall confirmed (%)	0.5%	1.8%	1.4%
Major (%)	0%	0%	0%
In Combination with Metformin + Sulfonylurea (1245.23 *(met + SU)*) (24 weeks)			
N	**225**	**224**	**217**
Overall confirmed (%)	8.4%	16.1%	11.5%
Major (%)	0%	0%	0%
In Combination with Pioglitazone +/- Metformin (1245.19) (24 weeks)			
N	**165**	**165**	**168**
Overall confirmed (%)	1.8%	1.2%	2.4%
Major (%)	0%	0%	0%
In Combination with Basal Insulin +/- Metformin +/ Sulfonylurea (1245.33) (18 weeks[2] / 78 weeks)			
N	**170**	**169**	**155**
Overall confirmed (%)	20.6% / 35.3%	19.5% / 36.1%	28.4% / 36.1%
Major (%)	0% / 0%	0% / 0%	1.3% / 1.3%

Treatment group	Placebo	Empagliflozin 10 mg	Empagliflozin 25 mg
In Combination with MDI Insulin +/-Metformin (1245.49) (18 weeks[2] / 52 weeks)			
N	**188**	**186**	**189**
Overall confirmed (%)	37.2% / 58.0%	39.8% / 51.1%	41.3% / 57.7%
Major (%)	0.5% / 1.6%	0.5% / 1.6%	0.5% / 0.5%
Empagliflozin BID versus QD as add on to metformin (1276.10) (16 weeks)			
N	**107**	**439**	**437**
Overall confirmed (%)	0.9%	0.5%	0.2%
Major (%)	0%	0%	0%
In Combination with metformin in drug-naïve patients (1276.1[3]) (24 weeks)			
	Met 500/1000 mg BID	**Empa 10/25 mg QD**	**Empa (5/12.5 mg) + Met (500/1000 mg) BID**
N	**341**	**339**	**680**
Overall confirmed (%)	0.6%	0.6%	1.0%
Major (%)	0%	0%	0%
In Combination with metformin and linagliptin (1275.9) (24 weeks)[4]			
N	**110**	**112**	**110**
Overall confirmed (%)	0.9%	0.0%	2.7%
Major (%)	0%	0%	0.9%
EMPA REG OUTCOME Study (1245.25)			
	Placebo	Empa 10mg	Empa 25mg
N	2333	2345	2342
Overall confirmed (%)	27.9%	28%	27.6%
Major (%)	1.5%	1.4%	1.3%

Confirmed: blood glucose ≤3.89 mmol/L or required assistance
Major: required assistance

1 i.e. patients who had received at least one dose of study drug
2 The dose of insulin as background medication was to be stable for the first 18 weeks
3 Eight treatment arms: 4 combination treatments of empagliflozin (5 mg or 12.5 mg BID) and metformin (500 or 1000 mg BID) and treatment with the individual components of empagliflozin (10 mg or 25 mg QD) or metformin (500 mg or 1000 mg BID).
4 This was a fixed-dose combination of empagliflozin with linagliptin 5 mg with a background treatment with metformin (see section 5.1).

Urinary tract infection

The overall frequency of urinary tract infection adverse events was higher in patients treated with empagliflozin 10 mg plus metformin (8.8%) as compared to empagliflozin 25 mg plus metformin (6.6%) or placebo plus metformin (7.8%). Similar to placebo, urinary tract infection was reported more frequently for empagliflozin plus metformin in patients with a history of chronic or recurrent urinary tract infections. The intensity of urinary tract infections was similar to placebo. Urinary tract infection events were reported more frequently for empagliflozin 10 mg plus metformin compared with placebo in female patients, but not for empagliflozin 25 mg plus metformin. The frequencies of urinary tract infections were low for male patients and were balanced across treatment groups.

Vaginal moniliasis, vulvovaginitis, balanitis and other genital infection

Vaginal moniliasis, vulvovaginitis, balanitis and other genital infections were reported more frequently for empagliflozin 10 mg plus metformin (4.0%) and empagliflozin 25 mg plus metformin (3.9%) compared to placebo plus metformin (1.3%), and were reported more frequently for empagliflozin plus metformin compared to placebo in female patients. The difference in frequency was less pronounced in male patients. Genital tract infections were mild and moderate in intensity, none was severe in intensity.
Cases of phimosis/ acquired phimosis have been reported concurrent with genital infections.

Increased urination

As expected via its mechanism of action, increased urination (as assessed by preferred term search including pollakiuria, polyuria, nocturia) was observed at higher frequencies in patients treated with empagliflozin 10 mg plus metformin (3.0%) and empagliflozin 25 mg plus metformin (2.9%) compared to placebo plus metformin (1.4%). Increased urination was mostly mild or moderate in intensity. The frequency of reported nocturia was comparable between placebo and empagliflozin, both on a background of metformin (<1%).

Volume depletion

The overall frequency of volume depletion (including the predefined terms blood pressure (ambulatory) decreased, blood pressure systolic decreased, dehydration, hypotension, hypovolaemia, orthostatic hypotension, and syncope) was low and comparable to placebo (empagliflozin 10 mg plus metformin (0.6%), empagliflozin 25 mg plus metformin (0.3%) and placebo plus metformin (0.1%)). The effect of empagliflozin on urinary glucose excretion is associated with osmotic diuresis, which could affect the hydration status of patients age 75 years and older. In patients ≥75 years of age volume depletion events have been reported in a single patient treated with empagliflozin 25 mg plus metformin.

Blood creatinine increased and glomerular filtration rate decreased

Use of empagliflozin was associated with initial transient increases in serum creatinine and initial transient decreases in eGFR. These changes were observed to reverse after treatment discontinuation, suggesting acute haemodynamic changes play a role in the renal function abnormalities observed with empagliflozin. Renal-related adverse reactions (e.g. acute kidney injury, renal impairment, acute prerenal failure) may occur in patients treated with empagliflozin.

The overall frequency of patients with increased blood creatinine and decreased glomerular filtration rate was similar between empagliflozin and placebo as add-on to metformin (blood creatinine increased: empagliflozin 10 mg 0.5%, empagliflozin 25 mg 0.1%, placebo 0.4%; glomerular filtration rate decreased: empagliflozin 10 mg 0.1%, empagliflozin 25 mg 0%, placebo 0.2%).

In placebo-controlled, double-blind studies up to 24 weeks, initial transient increases in creatinine (mean change from baseline after 12 weeks: empagliflozin 10 mg 0.001 mmol/L, empagliflozin 25 mg 0.001 mmol/L) and initial transient decreases in estimated glomerular filtration rates (mean change from baseline after 12 weeks: empagliflozin 10 mg -1.46 mL/min/1.73m^2, empagliflozin 25 mg -2.05 mL/min/1.73m^2) have been observed. These changes were generally reversible during continuous treatment or after drug discontinuation (see section 4.2; Figure 6 for the eGFR course in the EMPA-REG OUTCOME study).

Reporting of suspected adverse reactions

Reporting suspected adverse reactions after authorisation of the medicine is important. It allows continued monitoring of the benefit/risk balance of the medicine. Healthcare professionals are asked to report any suspected adverse reactions

https://pophealth.my.site.com/carmreportnz/s/

4.9. Overdose

For risk assessment and advice on the management of overdose please contact the National Poisons Centre on 0800 POISON (0800 764766).

Empagliflozin

During controlled clinical trials in healthy subjects, single doses of up to 800 mg empagliflozin, equivalent to 32 times the maximum recommended daily dose, were well tolerated.

Metformin

Hypoglycaemia has not been seen with metformin hydrochloride doses of up to 85 g, although lactic acidosis has occurred in such circumstances. High overdose of metformin hydrochloride or concomitant risks may lead to lactic acidosis. Lactic acidosis is a medical emergency and must be treated in hospital.

Therapy

In the event of an overdose, supportive treatment should be initiated as appropriate to the patient's clinical status. The most effective method to remove lactate and metformin hydrochloride is haemodialysis whereas removal of empagliflozin by haemodialysis has not been studied.

5. PHARMACOLOGICAL PROPERTIES

5.1. Pharmacodynamic properties

Pharmacotherapeutic group: Combinations of oral blood glucose lowering drugs, ATC code: A10BD20.

Mechanism of action

JARDIAMET contains two oral antihyperglycaemic drugs used in the management of type 2 diabetes mellitus: empagliflozin, an inhibitor of sodium-glucose co-transporter 2 (SGLT2) and metformin hydrochloride, a member of the biguanide class.

Empagliflozin

Empagliflozin is a reversible, highly potent and selective competitive inhibitor of SGLT2 with an IC_{50} of 1.3 nM. It has a 5000-fold selectivity over human SGLT1 (IC_{50} of 6278 nM), responsible for glucose absorption in the gut. Furthermore high selectivity could be shown toward other glucose transporters (GLUTs) responsible for glucose homeostasis in the different tissues.

SGLT2 is highly expressed in the kidney, whereas expression in other tissues is absent or very low. It is responsible as the predominant transporter for re-absorption of glucose from the glomerular filtrate back into the circulation. In patients with type 2 diabetes mellitus (T2DM) and hyperglycaemia a higher amount of glucose is filtered and reabsorbed.

Empagliflozin improves glycaemic control in patients with T2DM by reducing renal glucose re-absorption. The amount of glucose removed by the kidney through this glucuretic mechanism is dependent upon the blood glucose concentration and glomerular filtration rate (GFR). Through inhibition of SGLT2 in patients with T2DM and hyperglycaemia, excess glucose is excreted in the urine.

In patients with T2DM, urinary glucose excretion increased immediately following the first dose of empagliflozin and is continuous over the 24 hour dosing interval. Increased urinary glucose excretion was maintained at the end of 4-week treatment period, averaging approximately 78 g/day with 25 mg empagliflozin once daily. Increased urinary glucose excretion resulted in an immediate reduction in plasma glucose levels in patients with T2DM.

Empagliflozin improves both fasting and post-prandial plasma glucose levels.

The mechanism of action of empagliflozin is independent of beta cell function and insulin pathway and this contributes to a low risk of hypoglycaemia.

Improvement of surrogate markers of beta cell function including Homeostasis Model Assessment-β (HOMA-β) and proinsulin to insulin ratio were noted. In addition urinary glucose excretion triggers calorie loss, associated with body fat loss and body weight reduction.

The glucosuria observed with empagliflozin is accompanied by mild diuresis which may contribute to sustained and moderate reduction of blood pressure (BP).

Metformin

Metformin hydrochloride is a biguanide with antihyperglycaemic effects, on both basal and postprandial hyperglycaemia. It does not stimulate insulin secretion and therefore does not cause hypoglycaemia. Metformin reduces basal hyperinsulinemia, and in combination with insulin, reduces insulin requirement.

Metformin exerts its antihyperglycaemic effect via multiple mechanisms:

Metformin reduces hepatic glucose production.

Metformin facilitates peripheral glucose uptake and utilization, in part by increasing insulin action.

Metformin alters glucose turnover in the gut: Uptake from circulation is increased and absorption from food is decreased.

Additional mechanisms attributed to the gut include an increase in release of glucagon-like peptide 1 (GLP-1) and a decrease of bile acid resorption. Metformin alters the gut microbiome.Metformin can improve the lipid profile in hyperlipidaemic individuals.

In clinical studies, use of metformin was associated with either a stable body weight or modest weight loss. Metformin is an adenosine monophosphate-protein-kinase (AMPK) activator and increases the transport capacity of all types of membrane glucose transporters (GLUTs).

Clinical efficacy and safety

A total of 10224 patients with type 2 diabetes (T2DM) were treated in 9 double-blind, placebo or active-controlled clinical studies of at least 24 weeks duration, of which 2947 patients received empagliflozin 10 mg and 3703 received empagliflozin 25 mg as add-on to metformin therapy.

Treatment with empagliflozin in combination with metformin with or without other background (pioglitazone, sulfonylurea, DPP-4 inhibitors, and insulin) led to clinically relevant improvements in HbA_{1c}, fasting plasma glucose (FPG), body weight, systolic and diastolic blood pressure (BP). Administration of empagliflozin 25 mg resulted in a higher proportion of patients achieving HbA_{1c} goal of < 7% and fewer patients needing glycaemic rescue compared to empagliflozin 10 mg and placebo. There was a clinically meaningful improvement in HbA_{1c} in all subgroups of gender, race, geographic region, time since diagnosis of T2DM and body mass index (BMI). In patients aged 75 years and older, numerically lower reductions in HbA_{1c} were observed with empagliflozin treatment. Higher baseline HbA_{1c} was associated with a greater reduction in HbA_{1c}. Empagliflozin in combination with metformin in drug-naïve patients led to clinically meaningful reductions in HbA_{1c}, FPG, body weight and BP.

Empagliflozin as add on to metformin therapy

A double-blind, placebo-controlled study of 24 weeks duration was conducted to evaluate the efficacy and safety of empagliflozin in patients not sufficiently treated with metformin.

Treatment with empagliflozin resulted in statistically significant improvements in HbA_{1c} and body weight, and clinically meaningful reductions in FPG and BP compared to placebo (Table 4).

In the double-blind placebo-controlled extension of this study, reductions of HbA_{1c} (change from baseline of -0.62% for empagliflozin 10 mg, -0.74% for empagliflozin 25 mg and -0.01% for placebo), body weight (change from baseline of -2.39 kg for empagliflozin 10 mg, -2.65 kg for empagliflozin 25 mg and -0.46 kg for placebo) and BP (systolic BP: change from baseline of -5.2 mmHg for empagliflozin 10 mg, -4.5 mmHg for empagliflozin 25 mg and -0.8 mmHg for placebo, diastolic BP: change from baseline of -2.5 mmHg for empagliflozin 10 mg, -1.9 mmHg for empagliflozin 25 mg and -0.5 mmHg for placebo) were sustained up to Week 76.

Table 4 Results of a 24 week (LOCF)[3] placebo-controlled study of empagliflozin as add-on to metformin (Full Analysis Set)

Empagliflozin as add-on to metformin therapy	**Placebo**	**Empagliflozin 10 mg**	**Empagliflozin 25 mg**
N	207	217	213
HbA_{1c} (%)			
Baseline (mean)	7.90	7.94	7.86
Change from baseline[1]	-0.13	-0.70	-0.77
Difference from placebo[1] (97.5% CI)		-0.57* (-0.72, -0.42)	-0.64* (-0.79, -0.48)
N	184	199	191
Patients (%) achieving HbA_{1c} <7% with baseline HbA_{1c} ≥7%[2]	12.5	37.7	38.7
N	207	216	213
FPG (mmol/L)[2]			
Baseline (mean)	8.66	8.58	8.29
Change from baseline[1]	0.35	-1.11	-1.24
Difference from placebo[1] (95% CI)		-1.47* (-1.74, -1.20)	-1.59* (-1.86, -1.32)
N	207	217	213
Body Weight (kg)			
Baseline (mean)	79.73	81.59	82.21
Change from baseline[1]	-0.45	-2.08	-2.46
Difference from placebo[1](97.5% CI)		-1.63* (-2.17, -1.08)	-2.01* (-2.56, -1.46)
N	207	217	213
Patients (%) achieving weight loss of >5%[2]	4.8	21.2	23.0
N	207	217	213
SBP (mmHg)[2]			
Baseline (mean)	128.6	129.6	130.0
Change from baseline[1]	-0.4	-4.5	-5.2
Difference from placebo[1] (95% CI)		-4.1* (-6.2, -2.1)	-4.8* (-6.9, -2.7)

[1] mean adjusted for baseline value and stratification
[2] not evaluated for statistical significance; not part of sequential testing procedure for the secondary endpoints
[3] Last observation (prior to glycaemic rescue) carried forward (LOCF)
* p-value <0.0001

Empagliflozin and metformin combination therapy in drug-naïve patients

A factorial design study of 24 weeks duration was conducted to evaluate the efficacy and safety of empagliflozin in drug-naïve patients. Treatment with empagliflozin in combination with metformin (5 mg and 500 mg; 5 mg and 1000 mg; 12.5 mg and 500 mg, and 12.5 mg and 1000 mg given twice daily) provided statistically significant improvements in HbA_{1c} and led to significantly greater reductions in FPG and body weight compared to the individual components. A greater proportion of patients with a baseline HbA_{1c} ≥7.0% and treated with empagliflozin in combination with metformin achieved a target HbA_{1c} <7% compared to the individual components (Tables 5 and 6).

Table 5 Results of a 24 week (OC)[2] study comparing empagliflozin 10 mg in combination with metformin to the individual components

	Empagliflozin 10 mg +metformin 1000 mg[a]	**Empagliflozin 10 mg +metformin 2000 mg[a]**	**Empagliflozin 10 mg (qd)**	**Metformin 1000 mg[a]**	**Metformin 2000 mg[a]**
N	161	167	169	167	162
HbA_{1c} (%)					
Baseline (mean)	8.7	8.7	8.6	8.7	8.6
Change from baseline[1]	-2.0	-2.1	-1.4	-1.2	-1.8
Comparison vs. empagliflozin (95% CI)[1]	-0.6* (-0.9, -0.4)[b]	-0.7* (-1.0, -0.5)[b]			
Comparison vs. metformin (95% CI)[1]	-0.8* (-1.0, -0.6)[b]	-0.3* (-0.6, -0.1)[b]			
N	153	161	159	166	159
Patients (%) achieving HbA_{1c} <7% with baseline HbA_{1c} ≥7%	96 (63%)	112 (70%)	69 (43%)	63 (38%)	92 (58%)
N	161	166	168	165	164
FPG (mmol/L)					
Baseline (mean)	9.2	9.1	9.4	9.6	9.4
Change from baseline[1]	-2.5	-2.7	-1.8	-1.0	-1.8
Comparison vs. empagliflozin (95% CI)[1]	-0.7** (-1.1, -0.3)[b]	-0.8** (-1.2, -0.5)[b]			
Comparison vs. metformin (95% CI)[1]	-1.6** (-1.9, -1.2)[b]	-0.9** (-1.2, -0.5)[b]			
N	161	165	168	166	162
Body Weight (kg)					
Baseline (mean)	82.3	83.0	83.9	82.9	83.8
% Change from baseline[1]	-3.1	-4.1	-2.7	-0.4	-1.2
Comparison vs. metformin (95% CI)[1]	-2.7** (-3.6, -1.8)[b]	-2.8** (-3.8, -1.9)[b]			

[a] Given in two equally divided doses per day

[b] Full analysis population (observed case) using MMRM. MMRM model included treatment, renal function, region, visit, visit by treatment interaction, and baseline HbA_{1c}; FPG included baseline FPG in addition; weight included baseline weight in addition.

[1] mean adjusted for baseline value

[2] Analyses were performed on the full analysis set (FAS) using an observed cases (OC) approach

* $p \leq 0.0062$ for HbA_{1c};

** Analysis in an exploratory manner: $p \leq 0.0002$ for FPG and $p < 0.0001$ for body weight

Table 6 Results of a 24 week (OC)[2] study comparing empagliflozin 25 mg in combination with metformin to the individual monotherapy components

	Empagliflozin 25 mg +metformin 1000 mg[a]	**Empagliflozin 25 mg +metformin 2000 mg[a]**	**Empagliflozin 25 mg qd**	**Metformin 1000 mg[a]**	**Metformin 2000 mg[a]**
N	165	169	163	167	162
HbA_{1c} (%)					
Baseline (mean)	8.8	8.7	8.9	8.7	8.6
Change from baseline [1]	-1.9	-2.1	-1.4	-1.2	-1.8
Comparison vs. empagliflozin (95% CI)[1]	-0.6* (-0.8, -0.3)[b]	-0.7* (-1.0, -0.5)[b]			
Comparison vs. metformin (95% CI)[1]	-0.8* (-1.0, -0.5)[b]	-0.3* (-0.6, -0.1)[b]			
N	159	163	158	166	159
Patients (%) achieving HbA_{1c} <7% with baseline HbA_{1c} ≥7%	91 (57%)	111 (68%)	51 (32%)	63 (38%)	92 (58%)
N	163	167	163	165	164
FPG (mmol/L)					
Baseline (mean)	9.5	9.3	9.8	9.6	9.4
Change from baseline[1]	-2.4	-2.8	-1.6	-1.0	-1.8
Comparison vs. empagliflozin (95% CI)[1]	-0.9** (-1.3, -0.5) [b]	-1.3** (-1.6, -0.9) [b]			
Comparison vs. metformin (95% CI) [1]	-1.5** (-1.9, -1.1) [b]]	-1.0** (-1.4, -0.7) [b]			
N	165	167	162	166	162
Body Weight (kg)					
Baseline (mean)	82.9	83.7	83.4	82.9	83.8
% Change from baseline[1]	-3.6	-4.3	-2.8	-0.4	-1.2
Comparison vs. metformin (95% CI)[1]	-3.1** (-4.1, -2.2)[b]	-3.1** (-4.1, -2.2)[b]			

[a] Given in two equally divided doses per day
[b] Full analysis population (observed case) using MMRM. MMRM model included treatment, renal function, region, visit, visit by treatment interaction, and baseline HbA_{1c}; FPG included baseline FPG in addition; weight included baseline weight in addition.
[1] mean adjusted for baseline value
[2] Analyses were performed on the full analysis set (FAS) using an observed cases (OC) approach
* $p \leq 0.0056$ for HbA_{1c}
** Analysis in an exploratory manner: $p<0.0001$ for FPG and $p<0.0001$ for body weight

Empagliflozin as add on to a combination of metformin and sulfonylurea therapy

A double-blind, placebo-controlled study of 24 weeks duration was conducted to evaluate the efficacy and safety of empagliflozin in patients not sufficiently treated with a combination of metformin and a sulfonylurea. Treatment with empagliflozin resulted in statistically significant improvements in HbA_{1c} and body weight and clinically meaningful reductions in FPG and BP compared to placebo (Table 7).

In the double-blind placebo-controlled extension of this study, reductions of HbA_{1c} (change from baseline of -0.74% for empagliflozin 10 mg, -0.72% for empagliflozin 25 mg and -0.03% for placebo), body weight (change from baseline of -2.44 kg for empagliflozin 10 mg, -2.28 kg for empagliflozin 25 mg and -0.63 kg for placebo) and BP (systolic BP: change from baseline of -3.8 mmHg for empagliflozin 10 mg and -3.7 mmHg for empagliflozin 25 mg and -1.6 mmHg for placebo, diastolic BP: change from baseline of -2.6 mmHg for empagliflozin 10 mg, -2.3 mmHg for empagliflozin 25 mg and -1.4 mmHg for placebo) were sustained up to Week 76.

Table 7 Results of a 24 week (LOCF)[3] placebo-controlled study of empagliflozin as add-on to metformin and a sulfonylurea (Full Analysis Set)

Empagliflozin as add-on to metformin and a sulfonylurea therapy	**Placebo**	**Empagliflozin 10 mg**	**Empagliflozin 25 mg**
N	225	225	216
HbA_{1c} (%)			
Baseline (mean)	8.15	8.07	8.10
Change from baseline[1]	-0.17	-0.82	-0.77
Difference from placebo[1] (97.5% CI)		-0.64* (-0.79, -0.49)	-0.59* (-0.74, -0.44)
N	216	209	202
Patients (%) achieving HbA_{1c} <7% with baseline HbA_{1c} ≥7%[2]	9.3	26.3	32.2
N	224	225	215
FPG (mmol/L)[2]			
Baseline (mean)	8.42	8.38	8.68
Change from baseline[1]	0.31	-1.29	-1.29
Difference from placebo[1] (95% CI)		-1.60* (-1.90, -1.30)	-1.60* (-1.90, -1.29)
N	225	225	216
Body Weight (kg)			
Baseline (mean)	76.23	77.08	77.50
Change from baseline[1]	-0.39	-2.16	-2.39
Difference from placebo[1](97.5% CI)		-1.76* (-2.25, -1.28)	-1.99* (-2.48, -1.50)
N	225	225	216
Patients (%) achieving weight loss of >5%[2]	5.8	27.6	23.6
N	225	225	216
SBP (mmHg)[2]			
Baseline (mean)	128.8	128.7	129.3
Change from baseline[1]	-1.4	-4.1	-3.5
Difference from placebo[1] (95% CI)		-2.7 (-4.6, -0.8)	-2.1 (-4.0, -0.2)

[1] mean adjusted for baseline value and stratification
[2] not evaluated for statistical significance; not part of the sequential testing procedure for the secondary endpoints
[3] Last observation (prior to glycaemic rescue) carried forward (LOCF)
* p-value <0.0001

Empagliflozin as add on to a combination of pioglitazone therapy (+/- metformin)

The efficacy and safety of empagliflozin in combination with pioglitazone, with or without metformin (75.5% of all patients were on metformin background) was evaluated in a double-blind, placebo-controlled study of 24 weeks duration. Empagliflozin in combination with pioglitazone (dose ≥30 mg) with or without metformin resulted in statistically significant reductions in HbA_{1c}, fasting plasma glucose, and body weight and clinically meaningful reductions in BP compared to placebo (Table 8).

In the double-blind placebo-controlled extension of this study, reductions of HbA_{1c} (change from baseline of -0.61% for empagliflozin 10 mg, -0.70% for empagliflozin 25 mg and -0.01% for placebo), body weight (change from baseline of -1.47 kg for empagliflozin 10 mg, -1.21 kg for empagliflozin 25 mg and +0.50 kg for placebo) and BP (systolic BP: change from baseline of -1.7 mmHg for empagliflozin 10 mg, -3.4 mmHg for empagliflozin 25 mg and +0.3 mmHg for placebo, diastolic BP: change from baseline of -1.3 mmHg for empagliflozin 10 mg, -2.0 mmHg for empagliflozin 25 mg and +0.2 mmHg for placebo) were sustained up to Week 76.

Table 8 Results of a 24 week (LOCF)[3] placebo-controlled study of empagliflozin as add-on to pioglitazone with or without metformin (Full Analysis Set)

Pioglitazone +/- metformin add-on therapy	**Placebo**	**Empagliflozin 10 mg**	**Empagliflozin 25 mg**
N	165	165	168
HbA_{1c} (%)			
Baseline (mean)	8.16	8.07	8.06
Change from baseline[1]	-0.11	-0.59	-0.72
Difference from placebo[1] (97.5% CI)		-0.48* (-0.69, -0.27)	-0.61* (-0.82, -0.40)
N	155	151	160
Patients (%) achieving HbA_{1c} <7% with baseline HbA_{1c} ≥7%[3]	7.7	23.8	30.0
N	165	163	168
FPG (mmol/L)			
Baseline (mean)	8.43	8.44	8.43
Change from baseline[1]	0.37	-0.94	-1.23
Difference from placebo[1] (97.5% CI)		-1.32* (-1.72, -0.91)	-1.61* (-2.01, -1.21)
N	165	165	168
Body Weight (kg)			
Baseline (mean)	78.1	77.97	78.93
Change from baseline[1]	0.34	-1.62	-1.47
Difference from placebo[1] (97.5% CI)		-1.95* (-2.64, -1.27)	-1.81* (-2.49, -1.13)
N	165	165	168
Patients(%) achieving weight loss of >5%[3]	5.5	18.8	13.7
N	165	165	168
SBP (mmHg)[2, 3]			
Baseline (mean)	125.7	126.5	125.9
Change from baseline[1]	0.7	-3.1	-4.0
Difference from placebo[1] (95% CI)		-3.9 (-6.2, -1.5)	-4.7 (-7.1, -2.4)

[1] mean adjusted for baseline value and stratification
[2] not evaluated for statistical significance; not part of the sequential testing procedure for the secondary endpoints
[3] Last observation (prior to glycaemic rescue) carried forward (LOCF)
* p-value <0.0001

Empagliflozin and linagliptin as add on therapy to metformin

In a factorial design study, patients inadequately controlled on metformin, 24-weeks treatment with both doses of empagliflozin 10 mg and 25 mg administered together with linagliptin 5 mg provided statistically significant improvements in HbA_{1c} and FPG compared to linagliptin 5 mg and also compared to empagliflozin 10 or 25 mg. Compared to linagliptin 5 mg, both doses of empagliflozin plus linagliptin 5 mg provided statistically significant reductions in body weight and blood pressure. A greater proportion of patients with a baseline HbA_{1c} ≥7.0% and treated with empagliflozin plus linagliptin achieved a target HbA_{1c} of <7% compared to linagliptin 5 mg (Table 9).

After 24 weeks' treatment with empagliflozin+linagliptin, both systolic and diastolic blood pressures were reduced, -5.6/-3.6 mmHg ($p<0.001$ versus linagliptin 5 mg for SBP and DBP) for empagliflozin 25 mg+linagliptin 5 mg and -4.1/-2.6 mmHg ($p<0.05$ versus linagliptin 5 mg for SBP, n.s. for DBP) for empagliflozin 10 mg+linagliptin 5 mg. Clinically meaningful reductions in blood pressure were maintained for 52 weeks, -3.8/-1.6 mmHg ($p<0.05$ versus linagliptin 5 mg for SBP and DBP) for empagliflozin 25 mg/linagliptin 5 mg and -3.1/-1.6 mmHg ($p<0.05$ versus linagliptin 5 mg for SBP, n.s. for DBP) for empagliflozin 10 mg/linagliptin 5 mg.

After 24 weeks, rescue therapy was used in 1 (0.7%) patient treated with empagliflozin 25 mg/linagliptin 5 mg and in 3 (2.2%) patients treated with empagliflozin 10 mg/linagliptin 5 mg, compared to 4 (3.1%) patients treated with linagliptin 5 mg and 6 (4.3%) patients treated with empagliflozin 25 mg and 1 (0.7%) patient treated with empagliflozin 10 mg.

Table 9 Results of a 24 week (OC) placebo-controlled study of empagliflozin and linagliptin as fixed dose combination as add-on therapy to metformin (Full Analysis Set)

	Empagliflozin/ linagliptin (25 mg/5 mg)	**Empagliflozin/ linagliptin (10 mg/5 mg)**	**Empagliflozin 25 mg**	**Empagliflozin 10 mg**	**Linagliptin 5 mg**
N	134	135	140	137	128
HbA_{1c} (%) – 24 weeks					
Baseline (mean)	7.9	8.0	8.0	8.0	8.0
Change from baseline (adjusted mean)	-1.2	-1.1	-0.6	-0.7	-0.7
Comparison vs. linagliptin 5 mg (adjusted mean) (95% CI)[2]	-0.5 (-0.7, -0.3)*	-0.4 (-0.6, -0.2)*			
N	134	135	140	137	128
HbA_{1c} (%) – 52 weeks[1]					
Baseline (mean)	7.9	8.0	8.0	8.0	8.0
Change from baseline (adjusted mean)	-1.2	-1.0	-0.7	-0.7	-0.5
Comparison vs. linagliptin 5 mg (adjusted mean) (95% CI)[2]	-0.8 (-1.0, -0.6)*	-0.60 (-0.8, -0.4)*			
N	134	135	140	137	128
Body Weight - 24 weeks					
Baseline (mean) in kg	85	87	88	86	85
Change from baseline (adjusted mean)	-3.0	-2.6	-3.2	-2.5	-0.7
Comparison vs. linagliptin 5 mg (adjusted mean) (95% CI)[4]	-2.3 (-3.2, -1.4)*	-1.9 (-2.8, -1.1)*			
N	123	128	132	125	119
Patients (%) achieving HbA_{1c} <7% with baseline HbA_{1c} ≥7% - 24 weeks	62	58	33	28	36
Comparison vs. linagliptin 5 mg (odds ratio) (95% CI)[3]	3.5 (1.9, 6.4)*	2.8 (1.6, 5.0)**			

1 not evaluated for statistical significance as a result of the sequential confirmatory testing procedure
2 Full analysis population (observed case) using MMRM. MMRM model included treatment, renal function, region, visit, visit by treatment interaction, and baseline HbA_{1c}.
3 Full analysis population with non-completers considered failure. Logistic regression included treatment, baseline renal function, geographical region and baseline HbA_{1c}.
4 Full analysis population using last observation carried forward. ANCOVA model included treatment, renal function, region, baseline weight, and baseline HbA_{1c}.
* P<0.0001
** P<0.001

Empagliflozin in patients inadequately controlled on metformin and linagliptin

In patients inadequately controlled on metformin and linagliptin 5 mg, 24-weeks treatment with both empagliflozin/linagliptin 10 mg/5mg and empagliflozin/linagliptin 25 mg/5 mg provided statistically significant improvements in HbA_{1c}, FPG and body weight compared to placebo + linagliptin 5 mg. A statistically significantly greater number of patients with a baseline HbA_{1c} ≥7.0% and treated with both doses of empagliflozin achieved a target HbA_{1c} of <7% compared to placebo+linagliptin 5 mg (Table 10). After 24 weeks' treatment with empagliflozin, both systolic and diastolic blood pressures were reduced, -2.6/-1.1 mmHg (n.s. versus placebo for SBP and DBP) for empagliflozin 25 mg + linagliptin 5 mg and -1.3/-0.1 mmHg (n.s. versus placebo for SBP and DBP) for empagliflozin 10 mg+linagliptin 5 mg.

After 24 weeks, rescue therapy was used in 4 (3.6%) patients treated with empagliflozin 25 mg+linagliptin 5 mg and in 2 (1.8%) patients treated with empagliflozin 10 mg+linagliptin 5 mg, compared to 13 (12.0%) patients treated with placebo+linagliptin 5 mg.

Table 10 Efficacy Parameters Comparing Empagliflozin to Placebo as Add-on Therapy in Patients Inadequately Controlled on Metformin and Linagliptin 5 mg

	Metformin + Linagliptin 5 mg		
	Empagliflozin 10 mg[1]	**Empagliflozin 25 mg[1]**	**Placebo[2]**
HbA_{1c} (%) - 24 weeks[3]			
N	109	110	106
Baseline (mean)	7.97	7.97	7.96
Change from baseline (adjusted mean)	-0.65	-0.56	0.14
Comparison vs. placebo (adjusted mean) (95% CI)[2]	-0.79 (-1.02, -0.55) p<0.0001	-0.70 (-0.93, -0.46) p<0.0001	
FPG (mmol/L) – 24 weeks[3]			
N	109	109	106
Baseline (mean)	9.3	9.5	9.1
Change from baseline (adjusted mean)	-1.5	-1.8	0.3
Comparison vs. placebo (adjusted mean) (95% CI)	-1.8 (-2.3, -1.3) p<0.0001	-2.1 (-2.6,-1.6) p<0.0001	
Body Weight-24 weeks[3]			
N	109	110	106
Baseline (mean) in kg	88.4	84.4	82.3
Change from baseline (adjusted mean)	-3.1	-2.5	-0.3
Comparison vs. placebo (adjusted mean) (95% CI)[1]	-2.8 (-3.5, -2.1) p<0.0001	-2.2 (-2.9, -1.5) p<0.0001	
Patients (%) achieving HbA_{1c} <7% with baseline HbA_{1c} ≥7% - 24 weeks[4]			
N	100	107	100
Patients (%) achieving A_{1C} <7%	37.0	32.7	17.0
Comparison vs. placebo (odds ratio) (95% CI)[5]	4.0 (1.9, 8.7) p=0.0004	2.9 (1.4, 6.1) p=0.0061	

1 Patients randomised to the empagliflozin 10 mg or 25 mg groups were receiving empagliflozin/linagliptin 10 mg/5 mg or 25 mg/5 mg with background metformin

2 Patients randomised to the placebo group were receiving the placebo plus linagliptin 5 mg with background metformin

3 MMRM model on FAS (OC) includes baseline HbA_{1c}, baseline eGFR (MDRD), geographical region, visit, treatment, and visit by treatment interaction. For FPG, baseline FPG is also included. For weight, baseline weight is also included.

4 not evaluated for statistical significance; not part of sequential testing procedure for the secondary endpoints

5 Logistic regression on FAS (NCF) includes baseline HbA_{1c}, baseline eGFR (MDRD), geographical region, and treatment; based on patients with HbA_{1c} of 7% and above at baseline

In a prespecified subgroup of patients with baseline HbA_{1c} greater or equal than 8.5% the reduction from baseline in HbA_{1c} with empagliflozin 25 mg+linagliptin 5 mg was -1.3% at 24 weeks (p<0.0001 versus placebo+linagliptin 5 mg) and with empagliflozin 10 mg+linagliptin 5 mg -1.3% at 24 weeks (p<0.0001 versus placebo+linagliptin 5 mg).

Empagliflozin 2-year data, as add on to metformin in comparison to glimepiride

In a study comparing the efficacy and safety of empagliflozin 25 mg versus glimepiride (4 mg) in patients with inadequate glycaemic control on metformin alone, treatment with empagliflozin daily resulted in superior reduction in HbA_{1c}, and a clinically meaningful reduction in FPG, compared to glimepiride (Table 11). Empagliflozin daily resulted in a statistically significant reduction in body weight, systolic and diastolic BP (change from baseline in diastolic BP of -1.8 mmHg for empagliflozin and +0.9 mmHg for glimepiride, p<0.0001).

Treatment with empagliflozin resulted in statistically significantly lower proportion of patients with hypoglycaemic events compared to glimepiride (2.5% for empagliflozin, 24.2% for glimepiride, p<0.0001).

Table 11 Results at 104 week (LOCF)[4] in an active controlled study comparing empagliflozin to glimepiride as add on to metformin (Full Analysis Set)

Empagliflozin as add-on to metformin therapy in comparison to glimepiride	**Empagliflozin 25 mg**	**Glimepiride (up to 4 mg)**
N	765	780
HbA_{1c} (%)		
Baseline (mean)	7.92	7.92
Change from baseline[1]	-0.66	-0.55
Difference from glimepiride[1] (97.5%) CI)	-0.11* (-0.20, -0.01)	
N	690	715
Patients (%) achieving HbA_{1c} <7% with baseline HbA_{1c} ≥7%[2]	33.6	30.9
N	764	779
FPG (mmol/L)		
Baseline (mean)	8.33	8.32
Change from baseline[1]	-0.85	-0.17
Difference from glimepiride[1] (95% CI)	-0.69** (-0.86,-0.52)	
N	765	780
Body Weight (kg)		
Baseline (mean)	82.52	83.03
Change from baseline[1]	-3.12	1.34
Difference from glimepiride[1] (97.5% CI)	-4.46** (-4.87, -4.05)	
N	765	780
Patients(%) achieving weight loss of >5%[2]	27.5	3.8%
N	765	780
SBP (mmHg)[3]		
Baseline (mean)	133.4	133.5
Change from baseline[1]	-3.1	2.5
Difference from glimepiride[1] (97.5% CI)	-5.6** (-7.0,-4.2)	

[1] Mean adjusted for baseline value and stratification
[2] Not evaluated for statistical significance; not part of the sequential testing procedure for the secondary endpoints
[3] LOCF, values after antihypertensive rescue censored
[4] Last observation (prior to glycaemic rescue) carried forward (LOCF)
* p-value <0.0001 for non-inferiority, and p-value = 0.0153 for superiority
** p-value <0.0001

Empagliflozin as add on to basal insulin therapy

The efficacy and safety of empagliflozin as add on to basal insulin with or without concomitant metformin and/or sulfonylurea therapy (79.8% of all patients were on metformin background) was evaluated in a double-blind, placebo-controlled trial of 78 weeks duration. During the initial 18 weeks the insulin dose was to be kept stable, but was adjusted to achieve a FPG <6.10 mmol/L in the following 60 weeks.

At week 18, empagliflozin provided statistically significant improvement in HbA_{1c} compared to placebo. A greater proportion of patients with a baseline HbA_{1c} ≥7.0% achieved a target HbA_{1c} of <7% compared to placebo. At 78 weeks, empagliflozin resulted in a statistically significant decrease in HbA_{1c} and insulin sparing compared to placebo (Table 12).

At week 78, empagliflozin resulted in a reduction in FPG (-0.58 mmol/L for empagliflozin 10 mg, -0.97 mmol/L for empagliflozin 25 mg and -0.30 mmol/L for placebo), body weight (-2.47 kg for empagliflozin 10 mg, -1.96 kg for empagliflozin 25 mg and +1.16 kg for placebo, p<0.0001), BP (systolic BP: -4.1 mmHg for empagliflozin 10 mg, -2.4 mmHg for empagliflozin 25 mg and 0.1 mmHg for placebo, diastolic BP: -2.9 mmHg for empagliflozin 10 mg, -1.5 mmHg for empagliflozin 25 mg and -0.3 mmHg for placebo).

Table 12 Results at 18 and 78 weeks (LOCF)[2] in a placebo-controlled study of empagliflozin as add on to basal insulin with or without metformin and/or sulfonylurea (Full Analysis Set - Completers)

Basal insulin +/- metformin or sulfonylurea add-on therapy	**Placebo**	**Empagliflozin 10 mg**	**Empagliflozin 25 mg**
N	125	132	117
HbA_{1c} (%) at week 18			
Baseline (mean)	8.10	8.26	8.34
Change from baseline[1]	-0.01	-0.57	-0.71
Difference from placebo[1] (97.5% CI)		-0.56* (-0.78, -0.33)	-0.70* (-0.93, -0.47)
N	112	127	110
HbA_{1c} (%) at week 78			
Baseline (mean)	8.09	8.27	8.29
Change from baseline[1]	-0.02	-0.48	-0.64
Difference from placebo[1] (97.5% CI)		-0.46* (-0.73, -0.19)	-0.62* (-0.90, -0.34)
N	112	127	110
Basal insulin dose (IU/day) at week 78			
Baseline (mean)	47.84	45.13	48.43
Change from baseline[1]	5.45	-1.21	-0.47
Difference from placebo[1] (97.5% CI)		-6.66*** (-11.56, -1.77)	-5.92*** (-11.00, -0.85)

[1] mean adjusted for baseline value and stratification
[2] Last observation (prior to glycaemic rescue) carried forward (LOCF)
* p-value <0.0001
*** p-value <0.01

Empagliflozin as add on to multiple daily insulin therapy and metformin

The efficacy and safety of empagliflozin as add-on to multiple daily insulin with or without concomitant metformin therapy (71.0% of all patients were on metformin background) was evaluated in a double-blind, placebo-controlled trial of 52 weeks duration. During the initial 18 weeks and the last 12 weeks, the insulin dose was kept stable, but was adjusted to achieve pre-prandial glucose levels <5.5 mmol/L, and post-prandial glucose levels <7.8 mmol/L between Weeks 19 and 40.

At Week 18, empagliflozin provided statistically significant improvement in HbA_{1c} compared with placebo (Table 13). A greater proportion of patients with a baseline HbA_{1c} ≥7.0% (19.5% empagliflozin 10 mg, 31.0% empagliflozin 25 mg) achieved a target HbA_{1c} of <7% compared with placebo (15.1%).

At Week 52, treatment with empagliflozin resulted in a statistically significant decrease in HbA_{1c} and insulin sparing compared with placebo and a reduction in FPG (change from baseline of -0.02 mmol/L for placebo, -1.09 mmol/L for empagliflozin 10 mg, and -1.31 mmol/L for empagliflozin 25 mg), body weight, and BP (systolic BP: change from baseline of -2.6 mmHg for placebo, −3.9 mmHg for empagliflozin 10 mg and -4.0 mmHg for empagliflozin 25 mg, diastolic BP: change from baseline of -1.0 mmHg for placebo, -1.4 mmHg for empagliflozin 10 mg and -2.6 mmHg for empagliflozin 25 mg).

Table 13 Results at 18 and 52 (LOCF)[5] weeks in a placebo-controlled study of empagliflozin as add on to multiple daily doses of insulin with metformin[2]

Empagliflozin as add-on to insulin + metformin therapy	**Placebo**	**Empagliflozin 10 mg**	**Empagliflozin 25 mg**
N	188	186	189
HbA_{1c} (%) at week 18			
Baseline (mean)	8.33	8.39	8.29
Change from baseline[1]	-0.50	-0.94	-1.02
Difference from placebo[1] (97.5% CI)		-0.44* (-0.61, -0.27)	-0.52* (-0.69, -0.35)
N	115	119	118
HbA_{1c} (%) at week 52[3]			
Baseline (mean)	8.25	8.40	8.37
Change from baseline[1]	-0.81	-1.18	-1.27
Difference from placebo[1] (97.5% CI)		-0.38** (-0.62, -0.13)	-0.46* (-0.70, -0.22)
N	113	118	118
Patients (%) achieving HbA_{1c} <7% with baseline HbA_{1c} ≥7% at week 52[4]	26.5	39.8	45.8
N	188	186	189
FPG (mmol/L) at week 52[5]			
Baseline (mean)	8.41	8.83	8.34
Change from baseline[1]	-0.02	-1.09	-1.31
Difference from placebo[1] (95% CI)		-1.07 (-1.55, -0.6)	-1.30 (-1.77, -0.83)
N	115	118	117
Insulin dose (IU/day) at week 52[3]			
Baseline (mean)	89.94	88.57	90.38
Change from baseline[1]	10.16	1.33	-1.06
Difference from placebo[1] (97.5% CI)		-8.83** (-15.69, -1.97)	-11.22** (-18.09, -4.36)
N	115	119	118
Body Weight (kg) at week 52[3]			
Baseline (mean)	96.34	96.47	95.37
Change from baseline[1]	0.44	-1.95	-2.04
Difference from placebo[1] (97.5% CI)		-2.39* (-3.54, -1.24)	-2.48* (-3.63, -1.33)
N	188	186	189
SBP (mmHg)[6]			
Baseline (mean)	132.6	134.2	132.9
Change from baseline[1]	-2.6	-3.9	-4.0
Difference from placebo[1,4] (95% CI)		-1.4 (-3.6, 0.9)	-1.4 (-3.7, 0.8)

1 mean adjusted for baseline value and stratification
2 Week 18: FAS; week 52: PPS-Completers-52
3 Week 19-40: treat-to-target regimen for insulin dose adjustment to achieve pre-defined glucose target levels (pre-prandial <5.5 mmol/L, post-prandial <7.8 mmol/L
4 not evaluated for statistical significance; not part of the sequential testing procedure for the secondary endpoints
5 Last observation (prior to glycaemic rescue) carried forward (LOCF)
6 Week 52: FAS
* p-value <0.0001
** p-value <0.001

Empagliflozin twice daily versus once daily as add on to metformin therapy

The efficacy and safety of empagliflozin twice daily versus once daily (daily dose of 10 mg and 25 mg) as add-on therapy in patients with insufficient glycaemic control on metformin monotherapy was evaluated in a double blind placebo-controlled study of 16 weeks duration. All treatments with empagliflozin resulted in significant reductions in HbA_{1c} from baseline (total mean 7.8%) after 16 weeks of treatment compared with placebo. Empagliflozin twice daily dose regimens led to comparable reductions in HbA_{1c} versus once daily dose regimens with a treatment difference in HbA_{1c} reductions from baseline to week 16 of -0.02% (95% CI -0.16,

0.13) for empagliflozin 5 mg twice daily vs. 10 mg once daily, and -0.11% (95% CI -0.26, 0.03) for empagliflozin 12.5 mg twice daily vs. 25 mg once daily.

2 hour postprandial glucose

Treatment with empagliflozin as add-on to metformin or metformin plus sulfonylurea resulted in clinically meaningful improvement of 2-hour post-prandial glucose (meal tolerance test) at 24 weeks (add-on to metformin, placebo (n=57): +0.33 mmol/L, empagliflozin 10 mg (n=52): -2.56 mmol/L, empagliflozin 25 mg (n=58): -2.48 mmol/L; add-on to metformin plus sulfonylurea, placebo (n=35): -0.13 mmol/L, empagliflozin 10 mg (n=44): -1.98 mmol/L, empagliflozin 25 mg (n=46): -2.03 mmol/L).

Patients with baseline HbA_{1c} ≥9%

In a pre-specified analysis of subjects with baseline HbA_{1c} ≥9.0%, treatment with empagliflozin 10 mg or 25 mg as add-on to metformin resulted in statistically significant reductions in HbA_{1c} at Week 24 (adjusted mean change from baseline of -1.49% for empagliflozin 25 mg, -1.40% for empagliflozin 10 mg, and -0.44% for placebo).

Body weight

In a pre-specified pooled analysis of 4 placebo controlled studies, treatment with empagliflozin (68% of all patients were on metformin background) resulted in body weight reduction compared to placebo at week 24 (-2.04 kg for empagliflozin 10 mg, -2.26 kg for empagliflozin 25 mg and -0.24 kg for placebo) that was maintained up to week 52 (-1.96 kg for empagliflozin 10 mg, -2.25 kg for empagliflozin 25 mg and -0.16 kg for placebo).

Blood pressure

The efficacy and safety of empagliflozin was evaluated in a double-blind, placebo controlled study of 12 weeks duration in patients with type 2 diabetes and high blood pressure on different antidiabetic (67.8% treated with metformin with or without other antidiabetic drugs including insulin) and up to 2 antihypertensive therapies (Table 14). Treatment with empagliflozin once daily resulted in statistically significant improvement in HbA_{1c}, 24 hour mean systolic and diastolic blood pressure as determined by ambulatory BP monitoring. Treatment with empagliflozin provided reductions in seated systolic BP (change from baseline of -0.67 mmHg for placebo, -4.60 mmHg for empagliflozin 10 mg and -5.47 mmHg for empagliflozin 25 mg) and seated diastolic BP (change from baseline of -1.13 mmHg for placebo, -3.06 mmHg for empagliflozin 10 mg and -3.02 mmHg for empagliflozin 25 mg).

Table 14 Results at 12 week (LOCF)[3] in a placebo-controlled study of empagliflozin in patients with type 2 diabetes and uncontrolled blood pressure (Full Analysis Set)

	Placebo	**Empagliflozin 10 mg**	**Empagliflozin 25 mg**
N	271	276	276
HbA_{1c} (%) at week 12			
Baseline (mean)	7.90	7.87	7.92
Change from baseline[1]	0.03	-0.59	-0.62
Difference from placebo[1] (95% CI)		-0.62* (-0.72, -0.52)	-0.65* (-0.75, -0.55)
24 hour SBP at week 12[2]			
Baseline (mean)	131.72	131.34	131.18
Change from baseline[1]	0.48	-2.95	-3.68
Difference from placebo[1] (95% CI)		-3.44* (-4.78, -2.09)	-4.16* (-5.50, -2.83)
24 hour DBP at week 12[2]			
Baseline (mean)	75.16	75.13	74.64
Change from baseline[1]	0.32	-1.04	-1.40
Difference from placebo[1] (95% CI)		-1.36** (-2.15, -0.56)	-1.72* (-2.51, -0.93)

[1] Mean adjusted for baseline value and stratification

[2] Last observation (prior to antihypertensive rescue) carried forward (LOCF) LOCF, values after antihypertensive rescue censored value

[3] Last observation (prior to glycaemic rescue) carried forward (LOCF)
* p-value <0.0001
** p-value =0.0008

In a pre-specified pooled analysis of 4 placebo-controlled studies, treatment with empagliflozin (68% of all patients were on metformin background) resulted in a reduction in systolic blood pressure (empagliflozin 10 mg -3.9 mmHg, empagliflozin 25 mg -4.3 mmHg) compared with placebo (-0.5 mmHg), and in diastolic blood pressure (empagliflozin 10 mg -1.8 mmHg, empagliflozin 25 mg -2.0 mmHg) compared with placebo (-0.5 mmHg), at week 24, that were maintained up to week 76.

Laboratory parameters

Haematocrit increased

In a pooled safety analysis of all trials with metformin background treatment, mean changes from baseline in haematocrit were 3.6% and 4.0% for empagliflozin 10 mg and 25 mg, respectively, compared to 0% for placebo. In the EMPA-REG OUTCOME study, haematocrit values returned towards baseline values after a follow-up period of 30 days after treatment stop.

Serum lipids increased

In a pooled safety analysis of all trials with metformin background treatment, mean percent increases from baseline for empagliflozin 10 mg and 25 mg versus placebo, respectively, were total cholesterol 5.0% and 5.2% versus 3.7%; HDL-cholesterol 4.6% and 2.7% versus -0.5%; LDL-cholesterol 9.1% and 8.7% versus 7.8%; triglycerides 5.4% and 10.8% versus 12.1%.

Cardiovascular outcome

The EMPA-REG OUTCOME study is a multi-centre, multi-national, randomised, double-blind, placebo-controlled trial investigating the effect of JARDIANCE as adjunct to standard care therapy in reducing cardiovascular (CV) events in patients with type 2 diabetes and one or more CV risk factors, including coronary artery disease, peripheral artery disease, history of myocardial infarction (MI), or history of stroke. The primary endpoint was the time to first event in the composite of CV death, nonfatal MI, or non-fatal stroke (Major Adverse Cardiovascular Events (MACE-3)). Additional pre-specified endpoints addressing clinically relevant outcomes tested in an exploratory manner included CV death, the composite of heart failure requiring hospitalisation or CV death, all-cause mortality and the composite of new or worsening nephropathy.

A total of 7020 patients were treated with JARDIANCE (empagliflozin 10 mg: 2345, empagliflozin 25 mg: 2342, placebo: 2333) and followed for a median of 3.1 years.

The population was 72.4% Caucasian, 21.6% Asian, and 5.1% Black. The mean age was 63 years and 71.5% were male. At baseline, approximately 81% of patients were being treated with renin angiotensin system inhibitors, 65% with beta-blockers, 43% with diuretics, 89% with anticoagulants, and 81% with lipid lowering medication. Approximately 74% of patients were being treated with metformin at baseline, 48% with insulin and 43% with sulfonylurea.

About half of the patients (52.2%) had an eGFR of 60-90 mL/min/1.73 m^2, 17.8% of 45-60 mL/min/1.73 m^2 and 7.7% of 30-45 mL/min/1.73 m^2. Mean systolic BP was 136 mmHg, diastolic BP 76 mmHg, Low Density Lipoprotein 2.2 mmol/L, High Density Lipoprotein 1.1 mmol/L, and urinary albumin to creatinine ratio (UACR) 19.8 mg/mmol at baseline.

Reductions in risk of CV death and all-cause mortality

Empagliflozin was superior in reducing the primary composite endpoint of cardiovascular death, non-fatal MI, or non-fatal stroke compared to placebo. The treatment effect reflected a significant reduction in cardiovascular death with no significant change in non-fatal MI, or non-fatal stroke (Table 15 and Figure 1).

Empagliflozin also improved overall survival (Table 15 and Figure 2), which was driven by a reduction in cardiovascular death with JARDIANCE. There was no statistically significant difference between empagliflozin and placebo in non-cardiovascular mortality.

Table 15 Treatment effect for the primary composite endpoint, its components and mortality (Treated Set*)

	Placebo	**Empagliflozin (10 and 25 mg, pooled)**
N	2333	4687
Time to first occurrence of CV death, nonfatal MI, or non-fatal stroke N (%)	282 (12.1)	490 (10.5)
Hazard ratio vs. placebo (95.02% CI)**		0.86 (0.74, 0.99)
p−value for superiority		0.0382
CV Death N (%)	137 (5.9)	172 (3.7)
Hazard ratio vs. placebo (95% CI)		0.62 (0.49, 0.77)
p-value		<0.0001
Non-fatal MI N (%)	121 (5.2)	213 (4.5)
Hazard ratio vs. placebo (95% CI)		0.87 (0.70, 1.09)
p−value		0.2189
Non-fatal stroke N (%)	60 (2.6)	150 (3.2)
Hazard ratio vs. placebo (95% CI)		1.24 (0.92, 1.67)
p−value		0.1638
All-cause mortality N (%)	194 (8.3)	269 (5.7)
Hazard ratio vs. placebo (95% CI)		0.68 (0.57, 0.82)
p-value		<0.0001
Non-CV mortality N (%)	57 (2.4)	97 (2.1)
Hazard ratio vs. placebo (95% CI)		0.84 (0.60, 1.16)

* i.e. patients who had received at least one dose of study drug

** Since data from the trial were included in an interim analysis, a two-sided 95.02% confidence interval applied which corresponds to a p value of less than 0.0498 for significance.

Figure 1 Time to occurrence of CV death

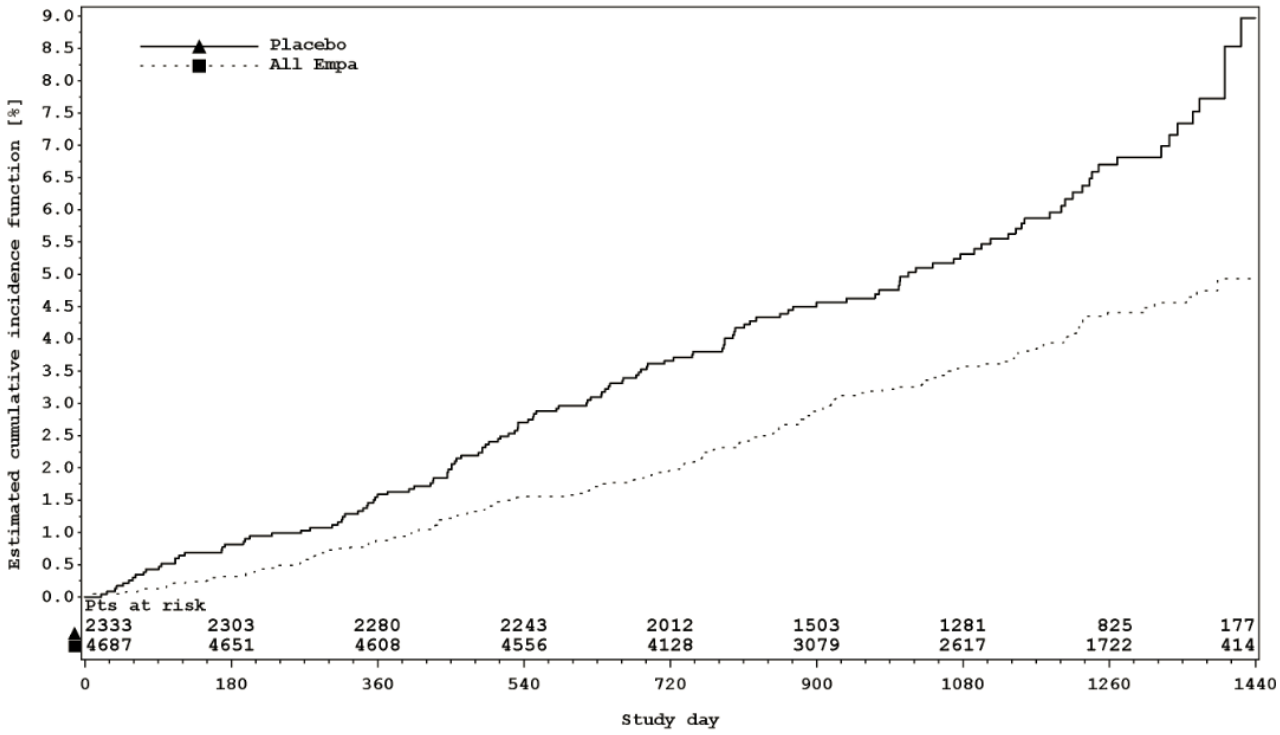
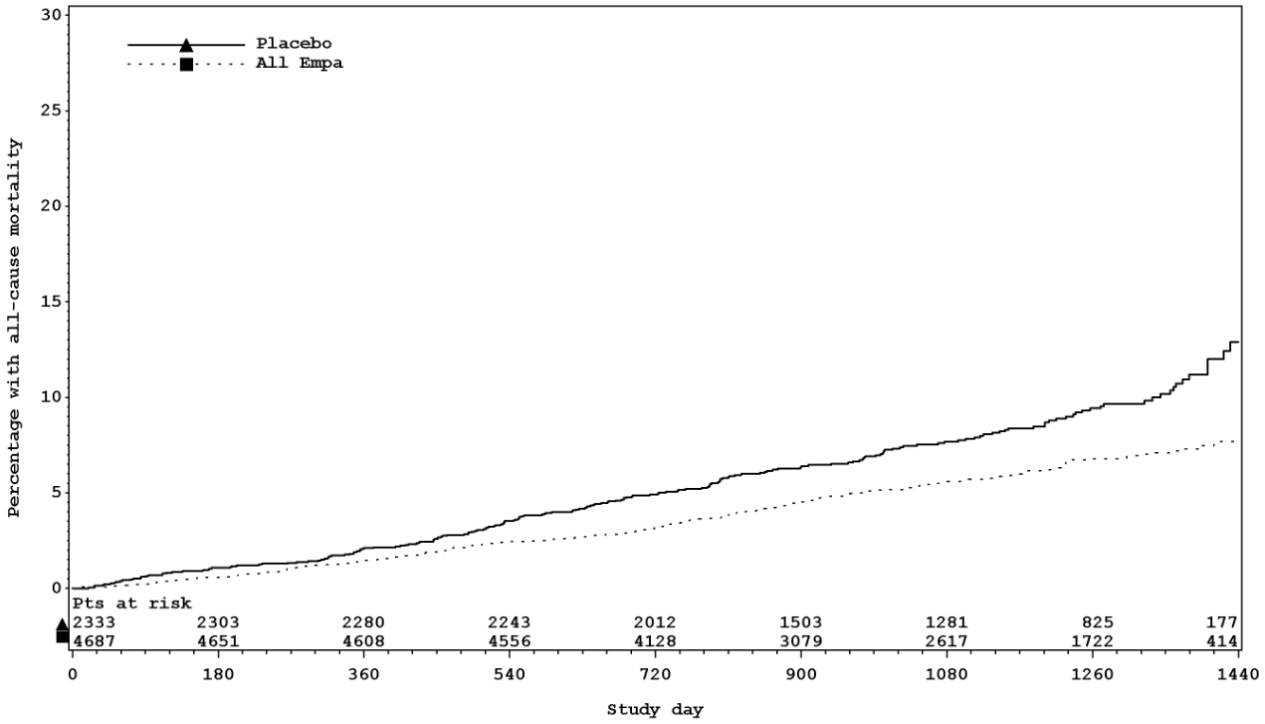


Figure 2 Time to occurrence of all-cause mortality*



*Kaplan-Meier estimate of time to all cause-mortality, pooled empagliflozin vs. placebo – treated set

Reductions in risk of heart failure requiring hospitalisation or CV death

Empagliflozin significantly reduced the risk of hospitalisation for heart failure and cardiovascular death or hospitalisation for heart failure compared with placebo (Table 16 and Figure 3).

Table 16 Treatment effect for hospitalisation for heart failure or cardiovascular death (excluding fatal stroke) (Treated Set*)

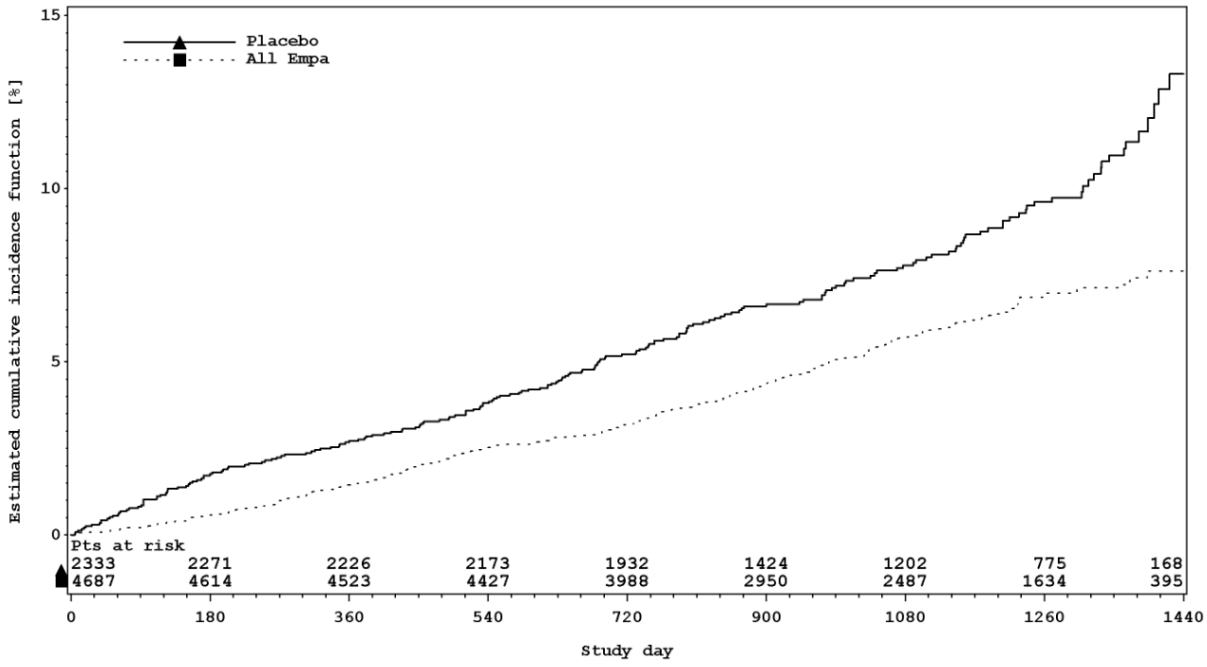
	Placebo	**Empagliflozin** (10 and 25 mg, pooled)**
N	2333	4687
Heart failure requiring hospitalisation or CV death (excluding fatal stroke) N (%)* **	198 (8.5)	265 (5.7)
HR (95% CI)		0.66 (0.55, 0.79)
p−value		<0.0001
Heart failure requiring hospitalisation N (%)	95 (4.1)	126 (2.7)
HR (95% CI)		0.65 (0.50, 0.85)
p−value		0.0017
CV death (excluding fatal stroke) N (%)	126 (5.4)	156 (3.3)
HR (95% CI)		0.61 (048, 0.77)
p−value		<0.0001

* i.e. patients who had received at least one dose of study drug

** empagliflozin 10 mg and 25 mg showed consistent results

*** time to first event

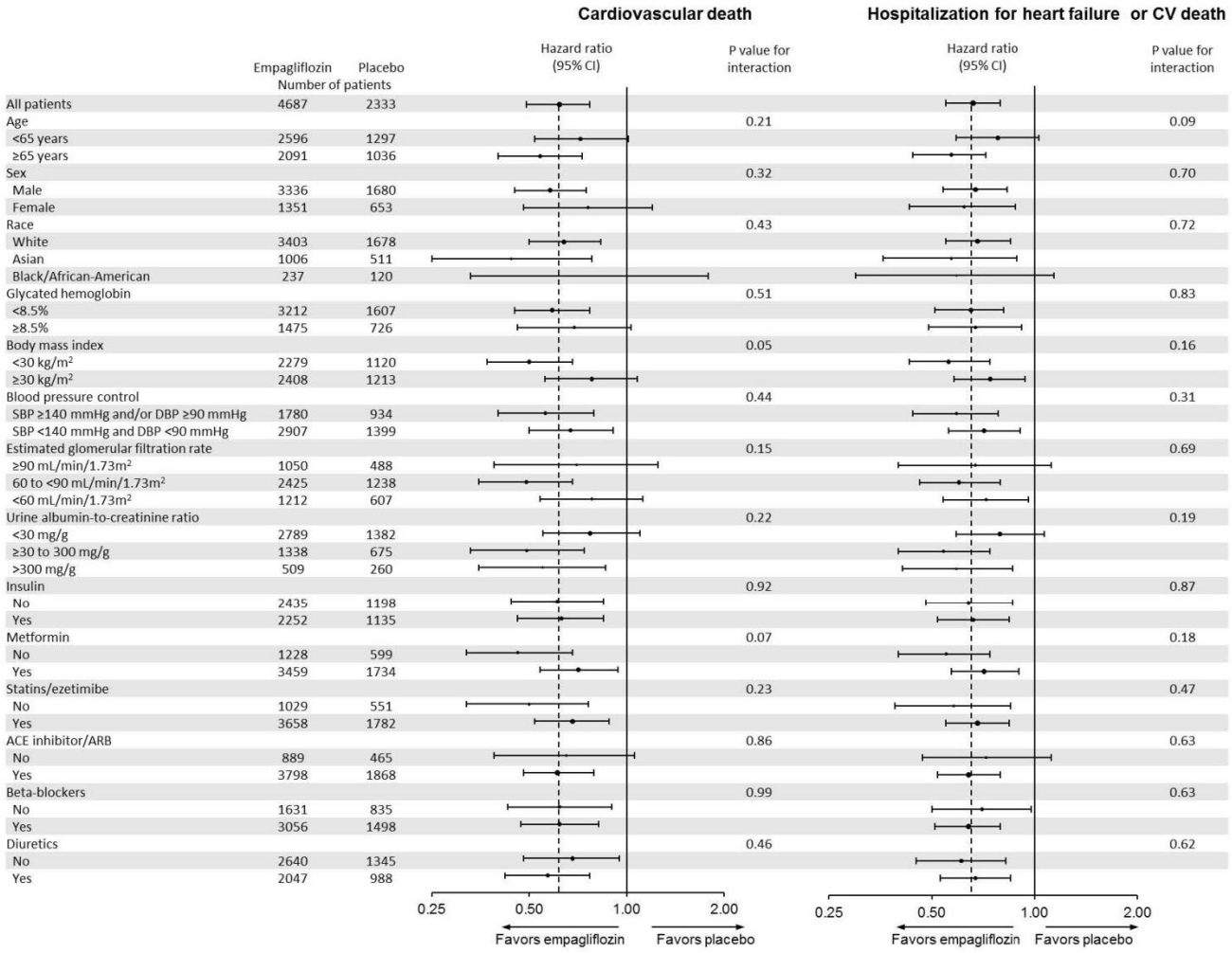
Figure 3 Time to first occurrence of first heart failure hospitalisation or CV death*



* Estimated cumulative incidence function for time to first occurrence of first heart failure hospitalisation or CV death, pooled empagliflozin vs placebo – treated set

The cardiovascular benefits of empagliflozin observed were consistent across the subgroups depicted in Figure 4.

Figure 4 Subgroup analyses for CV death and hospitalisation for heart failure or CV death*,**



* Hospitalisation for heart failure or CV death excludes fatal stroke

** p-value is for test of homogeneity of treatment group difference among subgroups (test for group by covariate interaction) with no adjustment for multiple tests and may not reflect the effect of a particular factor after adjustment for all other factors. Apparent homogeneity or heterogeneity among groups should not be over-interpreted.

In the subgroup of patients who were on metformin at baseline, the effects on CV outcomes were consistent with the results observed in the entire study population of EMPA-REG OUTCOME.

Diabetic kidney disease

In the EMPA-REG OUTCOME study population, the risk of new or worsening nephropathy (defined as onset of macroalbuminuria, doubling of serum creatinine, and initiation of renal replacement therapy (i.e. haemodialysis)) was significantly reduced in empagliflozin group compared to placebo (Table 17 and Figure 5).

Empagliflozin compared with placebo showed a significantly higher occurrence of sustained normo- or microalbuminuria in patients with baseline macroalbuminuria (HR 1.82, 95% CI 1.40, 2.37).

Table 17 Time to first new or worsening of nephropathy (Treated Set*)

	Placebo	**Empagliflozin (10 and 25 mg, pooled)**
N	2061	4124
New or worsening nephropathy N (%)	388 (18.8)	525 (12.7)
HR (95% CI)		0.61 (0.53, 0.70)
p−value <0.0001		<0.0001
N	2323	4645
Doubling of serum creatinine levelN (%)**	60 (2.6)	70 (1.5)
HR (95% CI)		0.56 (0.39, 0.79
p−value		0.0009
N	2033	4091
New onset of macroalbuminuria* N (%)**	330 (16.2)	459 (11.2)
HR (95% CI)		0.62 (0.54, 0.72)
p−value		<0.0001
N	2333	4687
Initiation of continuous renal replacement therapy N (%)	14 (0.6)	13 (0.3)
HR (95% CI)		0.45 (0.21, 0.97)
p−value		0.0409
N	2333	4687
Death due to renal disease N (%)**	0	3 (0.1)

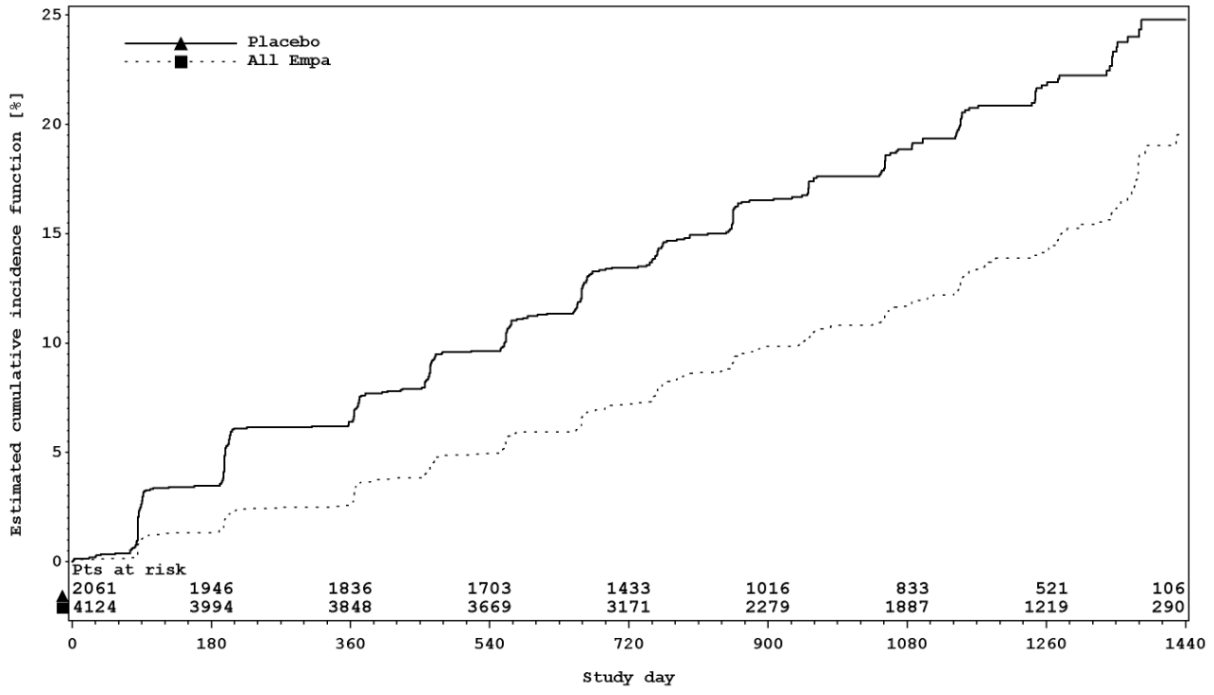
* i.e. patients who had received at least one dose of study drug

** Accompanied by an eGFR ≤45 mL/min/1.73m^2

*** Urine Albumin Creatinine Ratio >33.9 mg/mmol

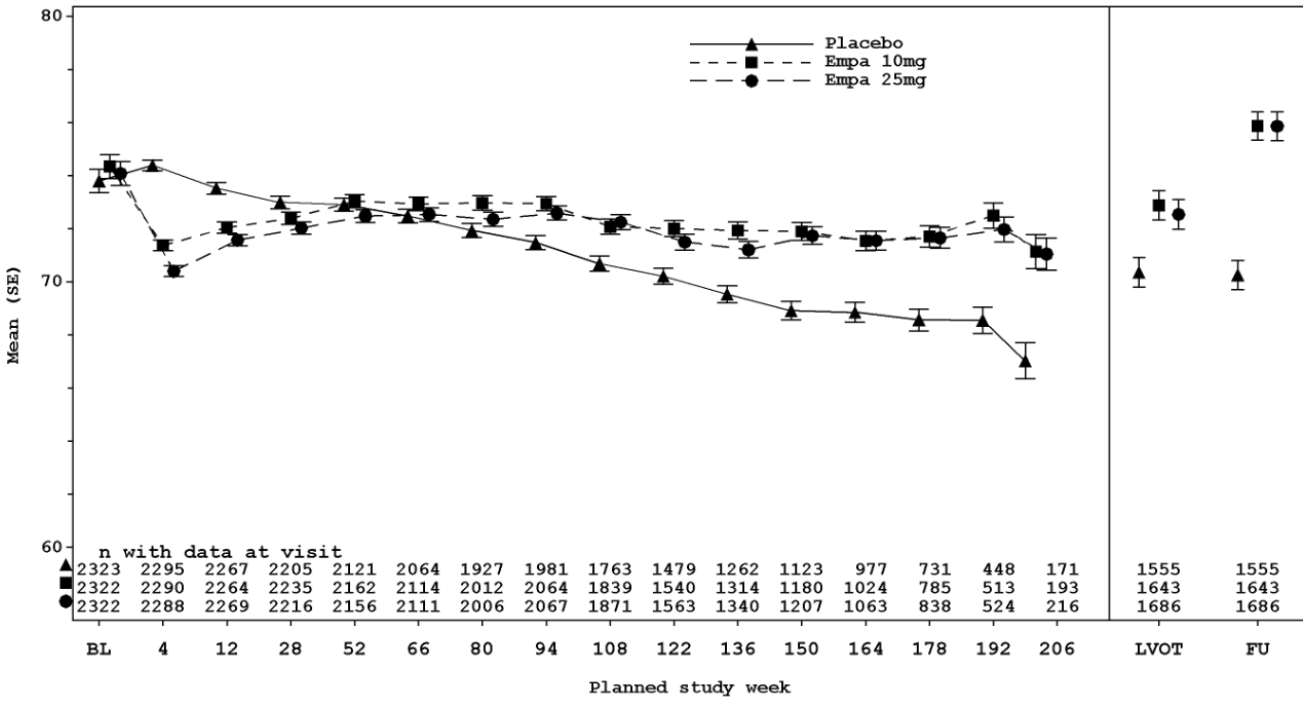
**** Due to low event rate, HR not calculated

Figure 5 Time to first new or worsening of nephropathy



Treatment with empagliflozin preserved eGFR and eGFR increased during the post treatment 4-week follow up. However, the placebo group showed a gradual decline in GFR during the course of the study with no further change during 4-week follow up (see Figure 6).

Figure 6 eGFR over time*



* eGFR (MDRD) (mL/min/1.73m^2) MMRM results over time, unadjusted last value on treatment and follow-up value - treated set – right side based on patients with available last value on treatment (LVOT) and follow-up (FU).

In the subgroup of patients who were on metformin at baseline, the effects on these renal outcomes were consistent with the results observed in the entire study population of EMPA REG OUTCOME.

Thorough QTc study

In a randomised, placebo-controlled, active-comparator, crossover study of 30 healthy subjects no increase in QTc was observed with either 25 mg or 200 mg empagliflozin.

5.2. Pharmacokinetic properties

JARDIAMET

The results of bioequivalence studies in healthy subjects demonstrated that JARDIAMET (empagliflozin/metformin hydrochloride) 5 mg/500 mg, 5 mg/850 mg, 5 mg/1000 mg, 12.5 mg/500 mg, 12.5 mg/850 mg, and 12.5 mg/1000 mg combination tablets are bioequivalent to co-administration of corresponding doses of empagliflozin and metformin as individual tablets.

Administration of 12.5 mg empagliflozin/1000 mg metformin under fed conditions resulted in a 9% decrease in AUC and a 28% decrease in C_{max} for empagliflozin, when compared to fasted conditions. For metformin, AUC decreased by 12% and C_{max} decreased by 26% compared to fasting conditions. The observed effect of food on empagliflozin and metformin is not considered to be clinically relevant. However, as metformin is recommended to be given with meals, JARDIAMET is also proposed to be given with food.

The following data are findings in studies performed with empagliflozin or metformin individually.

Empagliflozin

Absorption

The pharmacokinetics of empagliflozin have been extensively characterised in healthy volunteers and patients with T2DM. After oral administration, empagliflozin was rapidly absorbed with peak plasma concentrations occurring at a median t_{max} 1.5 h post-dose. Thereafter, plasma concentrations declined in a biphasic manner with a rapid distribution phase and a relatively slow terminal phase. The steady state mean plasma AUC and C_{max} were 1870 nmol·h/L and 259 nmol/L with empagliflozin 10 mg and 4740 nmol·h/L and 687 nmol/L with empagliflozin 25 mg once daily, respectively. Systemic exposure of empagliflozin increased in a dose-proportional manner. The single-dose and steady-state pharmacokinetics parameters of empagliflozin were similar suggesting linear pharmacokinetics with respect to time. There were no clinically relevant differences in empagliflozin pharmacokinetics between healthy volunteers and patients with T2DM.

The pharmacokinetics of 5 mg empagliflozin twice daily and 10 mg empagliflozin once daily were compared in healthy subjects. Overall exposure (AUC_{ss}) of empagliflozin over a 24-hour period with 5 mg administered twice daily was similar to 10 mg administered once daily. As expected, empagliflozin 5 mg administered twice daily compared with 10 mg empagliflozin once daily resulted in lower C_{max} and higher trough plasma empagliflozin concentrations (C_{min}).

Administration of 25 mg empagliflozin after intake of a high-fat and high calorie meal resulted in slightly lower exposure; AUC decreased by approximately 16% and C_{max} decreased by approximately 37%, compared to fasted condition. The observed effect of food on empagliflozin pharmacokinetics was not considered clinically relevant and empagliflozin may be administered with or without food.

Distribution

The apparent steady-state volume of distribution was estimated to be 73.8 L, based on a population pharmacokinetic analysis. Following administration of an oral [^{14}C]-empagliflozin solution to healthy subjects, the red blood cell partitioning was approximately 36.8% and plasma protein binding was 86.2%.

Biotransformation

No major metabolites of empagliflozin were detected in human plasma and the most abundant metabolites were three glucuronide conjugates (2-O-, 3-O-, and 6-O-glucuronide). Systemic exposure of each metabolite was less than 10% of total drug-related material. *In vitro* studies suggested that the primary route of metabolism of empagliflozin in humans is glucuronidation by the uridine 5'-diphospho-glucuronosyltransferases, UGT1A3, UGT1A8, UGT1A9, and UGT2B7.

Elimination

The apparent terminal elimination half-life of empagliflozin was estimated to be 12.4 h and apparent oral clearance was 10.6 L/h based on the population pharmacokinetic analysis. The inter-subject and residual variabilities for empagliflozin oral clearance were 39.1% and 35.8%, respectively. With once-daily dosing, steady-state plasma concentrations of empagliflozin were reached by the fifth dose. Consistent with the half-life, up to 22% accumulation, with respect to plasma AUC, was observed at steady-state. Following administration of an oral [^{14}C]-empagliflozin solution to healthy subjects, approximately 95.6% of the drug related radioactivity was eliminated in faeces (41.2%) or urine (54.4%). The majority of drug related radioactivity recovered in faeces was unchanged parent drug and approximately half of drug related radioactivity excreted in urine was unchanged parent drug.

Special Populations

Renal Impairment

In patients with mild (eGFR: 60 - <90 mL/min/1.73 m^2), moderate (eGFR: 30 - <60 mL/min/1.73 m^2), severe (eGFR: <30 mL/min/1.73 m^2) renal impairment and patients with kidney failure/ESRD patients, AUC of empagliflozin increased by approximately 18%, 20%, 66%, and 48%, respectively, compared to subjects with normal renal function. Peak plasma levels of empagliflozin were similar in subjects with moderate renal impairment and kidney failure/ESRD compared to patients with normal renal function. Peak plasma levels of empagliflozin were roughly 20% higher in subjects with mild and severe renal impairment as compared to subjects with normal renal function. In line with the Phase I study, the population pharmacokinetic analysis showed that the apparent oral clearance of empagliflozin decreased with a decrease in eGFR leading to an increase in drug exposure. Based on pharmacokinetics, no dosage adjustment is recommended in patients with renal insufficiency.

Hepatic Impairment

In subjects with mild, moderate, and severe hepatic impairment according to the Child-Pugh classification, AUC of empagliflozin increased approximately by 23%, 47%, and 75% and C_{max} by approximately 4%, 23%, and 48%, respectively, compared to subjects with normal hepatic function. Based on pharmacokinetics, no dosage adjustment is recommended in patients with hepatic impairment.

Body Mass Index (BMI)

No dosage adjustment is necessary based on BMI. Body mass index had no clinically relevant effect on the pharmacokinetics of empagliflozin based on the population pharmacokinetic analysis.

Gender

No dosage adjustment is necessary based on gender. Gender had no clinically relevant effect on the pharmacokinetics of empagliflozin based on the population pharmacokinetic analysis.

Race

No dosage adjustment is necessary based on race. Based on the population pharmacokinetic analysis, AUC was estimated to be 13.5% higher in Asian patients with a BMI of 25 kg/m^2 compared to non-Asian patients with a BMI of 25 kg/m^2.

Elderly

Age did not have a clinically meaningful impact on the pharmacokinetics of empagliflozin based on the population pharmacokinetic analysis.

Paediatric population

Studies characterising the pharmacokinetics of empagliflozin in paediatric patients have not been performed.

<u>Metformin hydrochloride</u>

Absorption

After an oral dose of metformin, t_{max} is reached in 2.5 hours. Absolute bioavailability of a 500 mg or 850 mg metformin hydrochloride tablet is approximately 50-60% in healthy subjects. After an oral dose, the non-absorbed fraction recovered in faeces was 20-30%.

After oral administration, metformin hydrochloride absorption is saturable and incomplete. It is assumed that the pharmacokinetics of metformin hydrochloride absorption are non-linear.

At the recommended metformin hydrochloride doses and dosing schedules, steady state plasma concentrations are reached within 24 to 48 hours and are generally less than 1 microgram/mL. In controlled clinical trials, maximum metformin hydrochloride plasma levels (C_{max}) did not exceed 5 microgram/mL, even at maximum doses.

Food decreases the extent and slightly delays the absorption of metformin hydrochloride. Following administration of a dose of 850 mg, a 40% lower plasma peak concentration, a 25% decrease in AUC (area under the curve) and a 35 minute prolongation of the time to peak plasma concentration were observed. The clinical relevance of these decreases is unknown.

Distribution

Plasma protein binding is negligible. Metformin hydrochloride partitions into erythrocytes. The blood peak is lower than the plasma peak and appears at approximately the same time. The red blood cells most likely represent a secondary compartment of distribution. The mean volume of distribution (Vd) ranged between 63-276 L.

Biotransformation

Metformin is excreted unchanged in the urine. No metabolites have been identified in humans.

Elimination

Renal clearance of metformin hydrochloride is > 400 mL/min, indicating that metformin hydrochloride is eliminated by glomerular filtration and tubular secretion. Following an oral dose, the apparent terminal elimination half-life is approximately 6.5 hours. When renal function is impaired, renal clearance is decreased in proportion to that of creatinine and thus the elimination half-life is prolonged, leading to increased levels of metformin hydrochloride in plasma.

Special Populations

Renal impairment

The available data in subjects with moderate renal insufficiency are scarce and no reliable estimation of the systemic exposure to metformin in this subgroup as compared to subjects with normal renal function could be made. Therefore, the dose adaptation should be made upon clinical efficacy/tolerability considerations (see section 4.2).

Paediatric population

Single dose study: After single doses of metformin 500 mg, paediatric patients, have shown a similar pharmacokinetic profile to that observed in healthy adults.

Multiple dose study: After repeated doses of 500 mg twice daily for 7 days in paediatric patients the peak plasma concentration (C_{max}) and systemic exposure (AUC_{0-t}) were approximately 33% and 40% lower, respectively, compared to diabetic adults who received repeated doses of 500 mg twice daily for 14 days. As the dose is individually titrated based on glycaemic control, this is of limited clinical relevance.

5.3. Preclinical safety data

Empagliflozin and metformin

General toxicity studies in rats up to 13 weeks were performed with the combination of empagliflozin and metformin. In a 13 week combination study with empagliflozin and metformin in rats the No-observed-adverse-effect-level (NOAEL) was based on hypochloremia seen at exposures of approximately 24- and 9-times the clinical AUC exposure of empagliflozin associated with the 10 and 25 mg doses, respectively.

An embryofetal development study in pregnant rats did not indicate a teratogenic effect attributed to the co-administration of empagliflozin and metformin at exposures of approximately 35- and 14-times the clinical AUC exposure of empagliflozin associated with the 10 and 25 mg doses, respectively, and 4-times the clinical AUC exposure of metformin associated with the 2000 mg dose. At dose levels of 600 mg/kg/day, associated with 8-times the maximum recommended human dose (MRHD) of metformin in humans, teratogenicity of metformin was observed.

The following data are findings in studies performed with empagliflozin or metformin individually.

Empagliflozin

In general toxicity studies in rodents and dogs, signs of toxicity were observed at exposures greater than or equal to 10-times the clinical dose of 25 mg. Most toxicity was consistent with secondary pharmacology related to urinary glucose loss and included decreased body weight and body fat, increased food consumption, diarrhoea, dehydration, decreased serum glucose and increases in other serum parameters reflective of increased protein metabolism, gluconeogenesis and electrolyte imbalances, urinary changes such as polyuria and glucosuria, and microscopic changes in kidney.

Carcinogenicity

Empagliflozin did not increase the incidence of tumours in female rats at doses up to the highest dose of 700 mg/kg/day, which corresponds to approximately 72- and 182- times the clinical AUC exposure associated with the 25 mg and 10 mg doses, respectively. In male rats, treatment-related benign vascular proliferative lesions (hemangiomas) of the mesenteric lymph node were observed at 700 mg/kg/day, which corresponds to approximately 42- and 105-times the clinical exposure associated with the 25 mg and 10 mg doses, respectively. These tumours are common in rats and are unlikely to be relevant to humans. Empagliflozin did not increase the incidence of tumours in female mice at doses up to 1000 mg/kg/day, which corresponds to approximately 62- and 158-times the clinical exposure associated with the 25 mg and 10 mg doses, respectively. Empagliflozin induced renal tumours in male mice at 1000 mg/kg/day, which corresponds to approximately 45- and 113-times the clinical exposure associated with the 25 mg and 10 mg doses, respectively. The mode of action for these tumours is dependent on the natural predisposition of the male mouse to renal pathology and a metabolic pathway not reflective of humans. The male mouse renal tumours are considered not relevant to humans.

Genotoxicity

Empagliflozin is not genotoxic.

Reproduction Toxicity

Nonclinical studies show that empagliflozin crosses the placenta during late gestation to a very limited extent but do not indicate direct or indirect harmful effects with respect to early

embryonic development. Empagliflozin administered during the period of organogenesis was not teratogenic at doses up to 300 mg/kg in the rat or rabbit, which corresponds to approximately 48- and 122- times or 128- and 325- times the clinical dose of empagliflozin based on AUC exposure associated with the 25 mg and 10 mg doses, respectively. Doses of empagliflozin causing maternal toxicity in the rat also caused the malformation of bent limb bones at exposures approximately 155- and 393- times the clinical dose associated with the 25 mg and 10 mg doses, respectively. Maternally toxic doses in the rabbit also caused increased embryofetal loss at doses approximately 139- and 353- times the clinical dose associated with the 25 mg and 10 mg doses, respectively.

In pre- and postnatal toxicity studies in rats, reduced weight gain in offspring was observed at maternal exposures approximately 4- and 11-times the clinical dose associated with the 25 mg and 10 mg doses, respectively.

In a juvenile toxicity study in the rat, when empagliflozin was administered from postnatal day 21 until postnatal day 90, non-adverse, minimal to mild renal tubular and pelvic dilation in juvenile rats was seen only at 100 mg/kg/day, which approximates 11-times the maximum clinical dose of 25 mg. These findings were absent after a 13-week drug-free recovery period. These outcomes occurred with drug exposure during periods of renal development in rats that correspond to the late second and third trimester of human renal development.

Metformin

Non-clinical data reveal no special hazard for humans based on conventional studies on safety pharmacology, genotoxicity, and carcinogenic potential. In a 2 week metformin only study and 2 and 13-week toxicity empagliflozin/metformin studies in rats, metformin related toxicity was seen in heart, liver, kidneys, salivary glands, ovaries, gastrointestinal tract and adrenal glands at dosages associated with a systemic exposure of 5 times the MRHD or higher.

Metformin was not teratogenic in rats at a dose of 200 mg/kg/day associated with a systemic exposure of 4 times the MRHD (2000 mg metformin). At higher doses (500 and 1000 mg/kg/day, associated with 11 and 23 times the MRHD), teratogenicity of metformin was observed in the rat which was mostly evident as an increase in the number of skeletal malformations.

6. PHARMACEUTICAL PARTICULARS

6.1. List of excipients

Tablet core
Maize starch
Copovidone
Colloidal silicon dioxide
Magnesium stearate

Film-coating
Hypromellose
Macrogol 400
Titanium dioxide (E171)
Talc
Iron oxide yellow (E172) [5 mg/500 mg, 5 mg/850 mg, and 5 mg/1000 mg film coated tablets only]
Iron oxide black (E172) [12.5 mg/500 mg, 12.5 mg/850 mg, and 12.5 mg/1000 mg film coated tablets only]
Iron oxide red (E172) [12.5 mg/500 mg, 12.5 mg/850 mg, and 12.5 mg/1000 mg film coated tablets only].

6.2 Incompatibilities

Not applicable.

6.3. Shelf life

36 months.

6.4. Special precautions for storage

Store at or below 30ºC.

6.5. Nature and contents of container

PVC/PCTFE (Aclar)/aluminium perforated unit dose blisters.

Pack sizes of 14 (sample) and 60 film coated tablets.

Not all pack sizes and strengths may be available in New Zealand.

6.6. Special precautions for disposal

Any unused medicine or waste material should be disposed of in accordance with local requirements.

7. MEDICINE SCHEDULE

Prescription Medicine.

8. SPONSOR

Boehringer Ingelheim (N.Z.) Limited
P O Box 76-216
Manukau City
Auckland
New Zealand
Telephone: 0800 802 461

9. DATE OF FIRST APPROVAL

22 October 2015

10. DATE OF REVISION OF THE TEXT

22 May 2026

SUMMARY TABLE OF CHANGES

Section changed	Summary of new information
4.4	Additional warning with information on metformin concerning patients with known or suspected mitochondrial diseases; editorial updates to replace with product name when discontinuation of metformin is recommended.
5.1	Updated information on mechanism of action of metformin.