

ANNEX I
SUMMARY OF PRODUCT CHARACTERISTICS

▼ This medicinal product is subject to additional monitoring. This will allow quick identification of new safety information. Healthcare professionals are asked to report any suspected adverse reactions. See section 4.8 for how to report adverse reactions.

1. NAME OF THE MEDICINAL PRODUCT

Oxlumo 94.5 mg/0.5 mL solution for injection.

2. QUALITATIVE AND QUANTITATIVE COMPOSITION

Each mL of solution contains lumasiran sodium equivalent to 189 mg lumasiran.

Each vial contains 94.5 mg lumasiran in 0.5 mL.

For the full list of excipients, see section 6.1.

3. PHARMACEUTICAL FORM

Solution for injection.

Clear, colourless to yellow solution (pH of approximately 7; osmolality 240 to 360 mOsm/kg).

4. CLINICAL PARTICULARS

4.1 Therapeutic indications

Oxlumo is indicated for the treatment of primary hyperoxaluria type 1 (PH1) in all age groups.

4.2 Posology and method of administration

Therapy should be initiated and supervised by a physician experienced in the management of hyperoxaluria.

Posology

Oxlumo is administered by subcutaneous injection. The recommended dose of Oxlumo consists of loading doses given once a month for 3 doses, followed by maintenance doses beginning one month after the last loading dose, as shown in Table 1. Dosing is based on body weight.

The patient dose (in mg) and volume (in mL) should be calculated as follows:

Patient body weight (kg) × dose (mg/kg) = total amount (mg) of medicinal product to be administered.

Total amount (mg) divided by concentration (189 mg/mL) = total volume of medicinal product (mL) to be injected.

Table 1: Oxlumo weight-based dosing regimen

| Body weight | Loading dose | Maintenance dose (beginning one month after the last loading dose) |
|--------------------------|----------------------------------|--|
| less than 10 kg | 6 mg/kg once monthly for 3 doses | 3 mg/kg once monthly, beginning one month after the last loading dose |
| 10 kg to less than 20 kg | 6 mg/kg once monthly for 3 doses | 6 mg/kg once every 3 months (quarterly), beginning one month after the last loading dose |
| 20 kg and above | 3 mg/kg once monthly for 3 doses | 3 mg/kg once every 3 months (quarterly), beginning one month after the last loading dose |

Patients on haemodialysis

Administer Oxlumo following haemodialysis if administered on dialysis days.

Missed dose

If a dose is delayed or missed, treatment should be administered as soon as possible. Prescribed monthly or quarterly dosing should be resumed from the most recently administered dose.

*Special populations**Elderly*

No dose adjustment is necessary in patients ≥ 65 years of age (see section 5.2).

Hepatic impairment

Oxlumo has not been studied in patients with hepatic impairment. No dose adjustment is necessary in patients with transient elevation in total bilirubin (total bilirubin >1.0 to $1.5 \times \text{ULN}$). Caution is required when treating patients with moderate or severe hepatic impairment (see sections 4.4 and 5.2).

Renal impairment

No dose adjustment is necessary in patients with renal impairment (eGFR <90 mL/min/1.73m²) including end-stage renal disease (ESRD), or those on dialysis. Limited data are available in patients with ESRD and on dialysis, and these patients should be treated with caution (see sections 4.4 and 5.2).

Paediatric population

In patients under 1 year of age, limited data are available. Caution should be used when treating these patients (see section 5.2).

Method of administration

For subcutaneous use only.

This medicinal product is provided as a ready-to-use solution in a single use vial.

- The required volume of Oxlumo should be calculated based on the recommended weight-based dose as shown in Table 1.
- If the dose is more than 0.5 mL (94.5 mg), more than one vial will be needed.
- The maximum acceptable single injection volume is 1.5 mL. Doses requiring more than 1.5 mL should be administered as multiple injections (the total dose divided equally between syringes with each injection containing approximately the same volume) to minimise potential injection site discomfort due to injection volume.

- Having the medicinal product on the needle tip before the needle is in the subcutaneous space should be avoided.
- This medicinal product should be injected subcutaneously into the abdomen, upper arms, or thighs.
- For subsequent injections or doses, rotating the injection site is recommended.
- This medicinal product should not be administered into scar tissue or areas that are reddened, inflamed, or swollen.

Oxlumo should be administered by a healthcare professional. For instructions on the medicinal product before administration see section 6.6.

4.3 Contraindications

Severe hypersensitivity to the active substance or any of the excipients listed in section 6.1.

4.4 Special warnings and precautions for use

Severe or end-stage renal impairment

Treatment with lumasiran increases plasma glycolate levels, which may increase the risk of metabolic acidosis or worsening of pre-existing metabolic acidosis in patients with severe or end-stage renal disease. These patients should therefore be monitored for signs and symptoms of metabolic acidosis.

Moderate or severe hepatic impairment

In patients with moderate or severe hepatic impairment there is a potential for decreased efficacy. Therefore, efficacy should be monitored in these patients (see section 5.2).

Excipient (sodium content)

This medicinal product contains less than 1 mmol sodium (23 mg) per mL, that is to say essentially 'sodium-free'.

4.5 Interaction with other medicinal products and other forms of interaction

No clinical drug interaction studies have been performed (see section 5.2).

Concomitant use with pyridoxine

Concomitant use of pyridoxine did not meaningfully influence the pharmacodynamics or pharmacokinetics of lumasiran.

4.6 Fertility, pregnancy, and lactation

Pregnancy

There are no data from the use of lumasiran in pregnant women. Animal studies do not indicate direct or indirect harmful effects with respect to reproductive toxicity (see section 5.3). The use of this medicinal product could be considered during pregnancy taking into account the expected health benefit for the woman and potential risks to the foetus.

Breast-feeding

It is unknown whether lumasiran is excreted in human milk. A risk to the newborns/infants cannot be excluded. A decision must be made whether to discontinue breast-feeding or to discontinue/abstain from Oxlumo therapy, taking into account the benefit of breast-feeding for the child and the benefit of therapy for the woman.

Fertility

There are no data on the effects of lumasiran on human fertility. No impact on male or female fertility was detected in animal studies (see section 5.3).

4.7 Effects on ability to drive and use machines

Oxlumo has no or negligible influence on the ability to drive and use machines.

4.8 Undesirable effects

Summary of the safety profile

The most common adverse reaction reported was injection site reaction (35%).

Tabulated list of adverse reactions

Adverse reactions associated with lumasiran obtained from clinical studies are tabulated below. The adverse reactions are coded to preferred terms (PTs) under the MedDRA system organ class (SOC) and are presented by frequency. The frequency of the adverse reactions is expressed according to the following categories: Very common ($\geq 1/10$); common ($\geq 1/100$ to $< 1/10$); uncommon ($\geq 1/1\ 000$ to $< 1/100$); rare ($\geq 1/10\ 000$ to $< 1/1\ 000$); very rare ($< 1/10\ 000$).

Table 2: Adverse reactions

| System organ class | Adverse reaction | Frequency |
|--|--------------------------------------|------------------|
| Gastrointestinal disorders | Abdominal pain ^a | Very common |
| General disorders and administration site conditions | Injection site reaction ^b | Very common |

^a Includes abdominal pain, abdominal pain upper, abdominal pain lower, abdominal discomfort, and abdominal tenderness.

^b Includes injection site reaction, injection site erythema, injection site pain, injection site pruritus, injection site swelling, injection site discomfort, injection site discolouration, injection site mass, injection site induration, injection site rash, injection site bruising, injection site haematoma and injection site exfoliation.

Description of selected adverse reactions

Injection site reactions

In placebo-controlled and open-label clinical studies, injection site reactions were reported in 34 out of 98 patients (34.7%). The most commonly reported symptoms were erythema, swelling, pain, haematoma, pruritus, and discolouration. The majority of injection site reactions started on the day of administration, with $< 2\%$ of injection site reactions occurring 5 or more days after administration. Injection site reactions were generally mild, resolved within two days, and did not result in interruption or discontinuation of treatment.

Abdominal pain

In the placebo-controlled study, abdominal pain was reported in 1 of 13 (7.7%) placebo-treated patients and 4 of 26 (15.4%) lumasiran-treated patients. In the placebo-controlled and open-label clinical studies, 16 of 98 patients (16.3%) reported abdominal pain, including upper or lower abdominal pain, abdominal discomfort, or abdominal tenderness. Most of the events have been mild, transient, and resolved without treatment. None have resulted in discontinuation of treatment.

Immunogenicity

In patients with PH1 and healthy volunteers dosed with Oxlumo in clinical studies, 7 of 120 (5.8%) individuals tested positive for anti-drug-antibodies (ADA). ADA titres were low and generally

transient, with no impact on the efficacy, safety, pharmacokinetic, or pharmacodynamic profiles of the medicinal product.

Paediatric population

The safety profile of lumasiran was similar in paediatric (aged 4 months to 17 years) and adult patients with PH1.

Reporting of suspected adverse reactions

Reporting suspected adverse reactions after authorisation of the medicinal product is important. It allows continued monitoring of the benefit/risk balance of the medicinal product. Healthcare professionals are asked to report any suspected adverse reactions via the national reporting system listed in [Appendix V](#).

4.9 Overdose

In case of overdose, it is recommended that the patient be monitored as medically indicated for any signs or symptoms of adverse reactions and appropriate symptomatic treatment be instituted.

5. PHARMACOLOGICAL PROPERTIES

5.1 Pharmacodynamic properties

Pharmacotherapeutic group: Various alimentary tract and metabolism products, ATC code: A16AX18.

Mechanism of action

Lumasiran is a double-stranded small interfering ribonucleic acid (siRNA) that reduces levels of glycolate oxidase (GO) enzyme by targeting the hydroxyacid oxidase 1 (*HAOI*) gene messenger ribonucleic acid (mRNA) in hepatocytes through RNA interference. Decreased GO enzyme levels reduce the amount of available glyoxylate, a substrate for oxalate production. This results in reduction of urinary and plasma oxalate levels, the underlying cause of disease manifestations in patients with PH1. As the GO enzyme is upstream of the deficient alanine: glyoxylate aminotransferase (AGT) enzyme that causes PH1, the mechanism of action of lumasiran is independent of the underlying *AGXT* gene mutation.

Clinical efficacy

The efficacy of lumasiran was studied in a randomised, double-blind, placebo-controlled clinical study in patients 6 years and older with PH1 (ILLUMINATE-A), in a single-arm clinical study in patients less than 6 years of age with PH1 (ILLUMINATE-B), and in a single-arm clinical study in paediatric and adult patients with PH1 who have advanced renal disease, including patients on haemodialysis (ILLUMINATE-C).

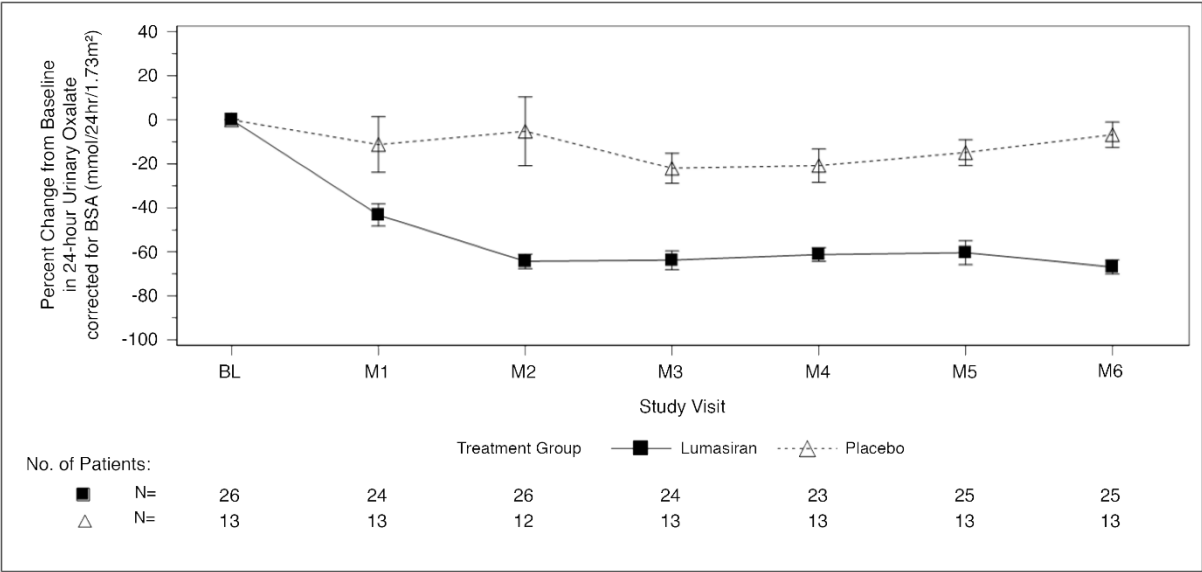
ILLUMINATE-A

A total of 39 patients with PH1 were randomised 2:1 to receive subcutaneous doses of lumasiran or placebo during the 6-month double-blind, placebo-controlled period. Patients 6 years and older with an estimated glomerular filtration rate (eGFR) ≥ 30 mL/min/1.73 m² were enrolled and received 3 loading doses of 3 mg/kg lumasiran or placebo administered once monthly, followed by quarterly maintenance doses of 3 mg/kg lumasiran or placebo (see section 4.2). After the 6-month double-blind treatment period, patients, including those originally assigned to placebo, entered an extension period with administration of lumasiran.

During the 6-month double-blind, placebo-controlled period, 26 patients received lumasiran, and 13 received placebo. The median age of patients at first dose was 14.9 years (range 6.1 to 61.0 years), 66.7% were male, and 76.9% were white. The median 24-hour urinary oxalate excretion corrected for body surface area (BSA) at baseline was 1.72 mmol/24 h/1.73 m², the median spot urinary oxalate: creatinine ratio at baseline was 0.21 mmol/mmol, and the median plasma oxalate level at baseline was 13.1 μmol/L. Overall, 33.3% of patients had normal renal function (eGFR ≥90 mL/min/1.73 m²), 48.7% had mild renal impairment (eGFR of 60 to <90 mL/min/1.73 m²), and 18% had moderate renal impairment (eGFR of 30 to <60 mL/min/1.73 m²). Of the patients enrolled in the study, 84.6% reported a history of symptomatic renal stone events and 53.8% reported a history of nephrocalcinosis at baseline. The treatment arms were balanced at baseline with respect to age, urinary oxalate level, and eGFR.

The primary endpoint was the percent reduction from baseline in 24-hour urinary oxalate excretion corrected for BSA averaged over months 3 through 6. Lumasiran was associated with a statistically significant reduction of 65.4% in 24-hour urinary oxalate corrected for BSA, as compared to 11.8% in the placebo group, representing a difference of 53.5% (95% CI: 44.8, 62.3; p<0.0001). Consistent with the primary endpoint, a reduction of 60.5% was observed at month 6 in spot urinary oxalate: creatinine ratio in the lumasiran arm compared to an 8.5% increase in the placebo arm. Furthermore, patients treated with lumasiran had a rapid and sustained decrease in 24-hour urinary oxalate corrected for BSA, as shown in Figure 1.

Figure 1: ILLUMINATE-A: Percent change from baseline in 24-hour urinary oxalate corrected for BSA by month



Abbreviations: BL = baseline; BSA = body surface area; M = month; SEM = standard error of mean. Results are plotted as mean (±SEM) of percent change from baseline.

At month 6, a higher proportion of lumasiran-treated patients achieved normal or near-normal levels of 24-hour urinary oxalate corrected for BSA (≤1.5×ULN) compared to placebo-treated patients, as shown in Table 3.

Table 3: ILLUMINATE-A: Secondary endpoint results over the 6-month double-blind, placebo-controlled period

| Endpoints | Lumasiran (N=26) | Placebo (N=13) | Treatment difference (95% CI) | p-value |
|---|--------------------------------|--------------------------|--------------------------------|----------------------|
| Proportion of patients with 24-hour urinary oxalate levels at or below ULN [‡] | 0.52 (0.31, 0.72) [§] | 0 (0, 0.25) [§] | 0.52 (0.23, 0.70) [¶] | 0.001 [#] |
| Proportion of patients with 24-hour urinary oxalate levels at or below 1.5×ULN [‡] | 0.84 (0.64, 0.95) [§] | 0 (0, 0.25) [§] | 0.84 (0.55, 0.94) [¶] | <0.0001 [#] |
| Percent reduction in plasma oxalate from baseline ^{*p} | 39.8 (2.9) [†] | 0.3 (4.3) [†] | 39.5 (28.9, 50.1) | <0.0001 |

Abbreviations: ULN = upper limit of normal; SEM = standard error of mean

Results are based on liquid chromatography tandem mass spectrometry (LC-MS/MS) assay.

* The estimate based on the average of the least square mean of percent reduction at Months 3, 4, 5, and 6 using a mixed model for repeated measures.

† LS Mean (SEM).

‡ ULN=0.514 mmol/24 hr/1.73 m² for 24-hour urinary oxalate corrected for BSA.

§ 95% CI based on Clopper Pearson Exact confidence interval.

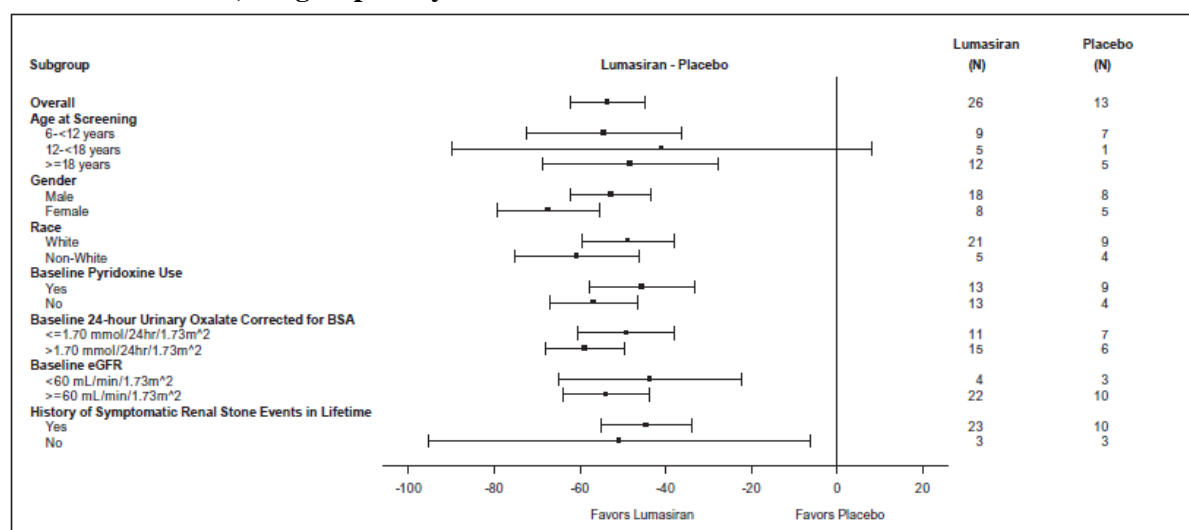
¶ Calculated using the Newcombe Method based on the Wilson Score.

p-value is based on Cochran–Mantel–Haenszel test stratified by baseline 24-hour urinary oxalate corrected for BSA (≤ 1.70 vs > 1.70 mmol/24 hr/1.73 m²).

^p Analysed in 23 lumasiran and 10 placebo patients who had baseline levels that allowed for reduction to occur.

Reduction in 24-hour urinary oxalate corrected for BSA from baseline in patients with PH1 receiving lumasiran compared to placebo was similar across all pre-specified subgroups, including age, sex, race, renal impairment, baseline pyridoxine (vitamin B6) use, and history of symptomatic renal stone events (Figure 2).

Figure 2: ILLUMINATE-A: Percent change from baseline in 24-hour urinary oxalate corrected for BSA, subgroup analysis



Reduced oxalate levels observed in the double-blind period were maintained with continued lumasiran treatment through 24 months during the extension period of study. eGFR and renal stone events (reported by events per person-year) were assessed through the 6-month double-blind and extension periods for a total of 24 months. eGFR remained stable in patients administered lumasiran.

The rate of renal stone events per person-year reported in patients treated with lumasiran in ILLUMINATE-A are presented in Table 4.

Table 4: Rate of Renal Stone Events per Person-Year Reported in the Lumasiran Group

| Treatment | Time Period | Rate (95% CI) |
|--------------|-----------------------------|-------------------|
| No treatment | 12 months prior to consent | 3.19 (2.57, 3.96) |
| Lumasiran | 6-month double-blind period | 1.09 (0.63, 1.88) |
| | Month 6 to month 12 | 0.87 (0.47, 1.62) |
| | Month 12 to month 18 | 0.56 (0.25, 1.24) |
| | Month 18 to month 24 | 0.63 (0.30, 1.33) |

The rate of renal stone events per person-year reported in patients treated with placebo in ILLUMINATE-A are presented in Table 5. The patients in the placebo group were initially randomised to placebo for the 6-month double-blind period and subsequently treated with lumasiran in the extension periods: month 6 to month 12, month 12 to month 18, and month 18 to month 24.

Table 5: Rate of Renal Stone Events per Person-Year Reported in the Placebo Group

| Treatment | Time Period | Rate (95% CI) |
|--------------|-----------------------------|-------------------|
| No treatment | 12 months prior to consent | 0.54 (0.26, 1.13) |
| Placebo | 6-month double-blind period | 0.66 (0.25, 1.76) |
| Lumasiran | Month 6 to month 12 | 0.16 (0.02, 1.17) |
| | Month 12 to month 18 | 0.67 (0.25, 1.78) |
| | Month 18 to month 24 | 0.00 (0.00, 0.62) |

Medullary nephrocalcinosis results, assessed by renal ultrasound, at month 6 and month 12 relative to baseline are presented in Table 6.

Table 6: ILLUMINATE-A: Patients with Medullary Nephrocalcinosis at Month 6 and Month 12 Relative to Baseline*

| Timepoint | Treatment (n) | Improvement | No Change | Worsening |
|-----------|----------------------------|-------------|-----------|-----------|
| Month 6 | Lumasiran (n=23) | 3 | 20 | 0 |
| | Placebo (n=12) | 0 | 11 | 1 |
| Month 12 | Lumasiran (n=18) | 11 | 4 | 3 |
| | Placebo/Lumasiran** (n=11) | 1 | 9 | 1 |

* Patients with renal ultrasounds at baseline and the relevant timepoint were assessed.

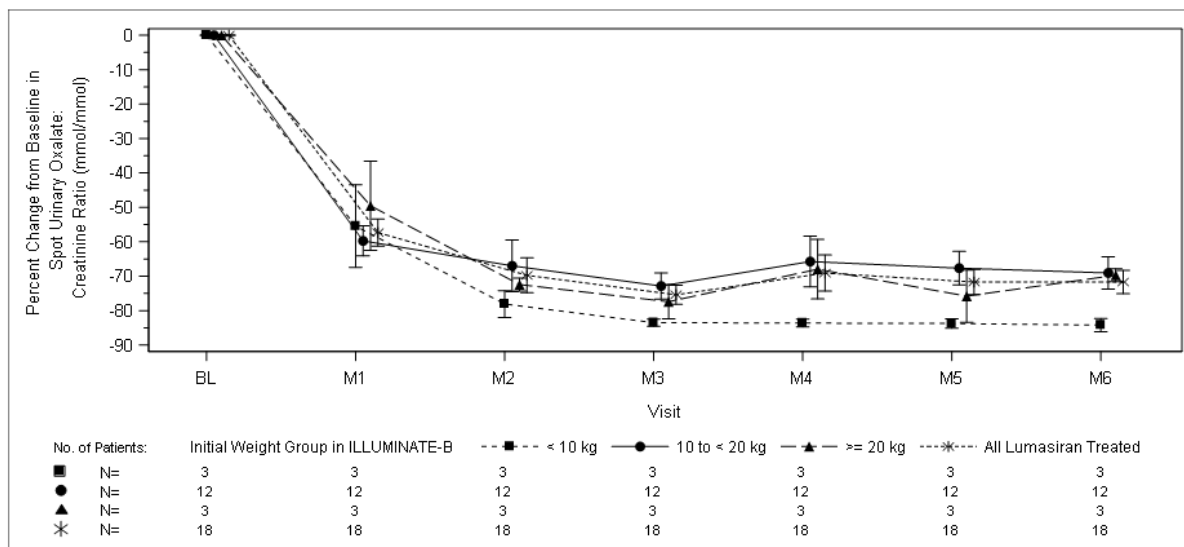
** Patients received placebo for 6 months followed by lumasiran treatment for 6 months.

ILLUMINATE-B

A total of 18 patients were enrolled and treated with lumasiran in an ongoing multi-centre, single-arm study in patients with PH1 (ILLUMINATE-B). The study enrolled patients less than 6 years of age with an eGFR >45 mL/min/1.73 m² in patients 12 months of age and older, and normal serum creatinine in patients less than 12 months of age. In the 6-month primary analysis, at first dose, 3 patients were less than 10 kg, 12 were 10 kg to less than 20 kg, and 3 were 20 kg and above. The median age of patients at first dose was 51.4 months (range 4.0 to 74.0 months), 55.6% were female, and 88.9% were white. The median spot urinary oxalate: creatinine ratio at baseline was 0.47 mmol/mmol.

At month 6, patients treated with lumasiran achieved a reduction of 72.0% (95% CI: 66.4, 77.5) in spot urinary oxalate: creatinine ratio from baseline (averaged over months 3 through month 6), the primary endpoint. Lumasiran was associated with rapid, and sustained reductions in spot urinary oxalate: creatinine ratio (Figure 3), which were similar across all weight strata. The percent reduction in urinary oxalate excretion was maintained with continued lumasiran treatment through month 12 and consistent with data from ILLUMINATE-A.

Figure 3: ILLUMINATE-B: Percent change in spot urinary oxalate: creatinine ratio from baseline by month



At month 6, nine of 18 patients achieved near normalisation ($\leq 1.5 \times \text{ULN}$), including 1 patient who achieved normalisation ($\leq \text{ULN}$), in spot urinary oxalate: creatinine ratio. At month 12, ten of 18 patients achieved near normalization ($\leq 1.5 \times \text{ULN}$), including 2 patients who achieved normalization ($\leq \text{ULN}$), in spot urinary oxalate: creatinine ratio.

Furthermore, from baseline to month 6 (average of month 3 to month 6), a mean plasma oxalate reduction of 31.7% (95% CI: 23.9, 39.5) was observed. Reduced plasma oxalate levels observed in the primary analysis period were maintained with continued lumasiran treatment. The eGFR remained stable in all patients with continued dosing.

The rate of renal stone events per person-year reported in the 12-month period prior to consent and during the 6-month primary analysis period was 0.24 (95% CI: 0.09, 0.63) and 0.24 (95% CI: 0.06, 0.96), respectively. The rate of events from month 6 to month 12 was 0.12 (95% CI: 0.02, 0.84).

Medullary nephrocalcinosis results, assessed by renal ultrasound, at month 6 and month 12 relative to baseline are presented in Table 7.

Table 7: ILLUMINATE-B: Patients with Medullary Nephrocalcinosis at Month 6 and Month 12 Relative to Baseline*

| Timepoint | Improvement (n) | No Change | Worsening |
|-----------------|-----------------|-----------|-----------|
| Month 6 (n=18) | 8 | 10 | 0 |
| Month 12 (n=17) | 11 | 6 | 0 |

*Patients with renal ultrasounds at baseline and the relevant timepoint were assessed.

ILLUMINATE-C

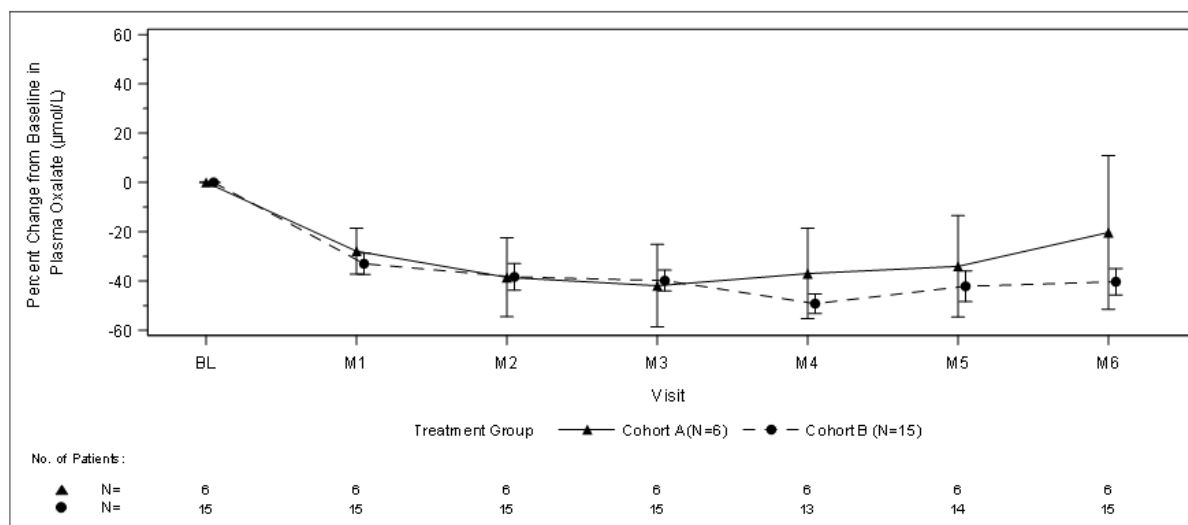
A total of 21 patients were enrolled and treated with lumasiran in an on-going multi-centre, single-arm study in patients with PH1 and advanced renal disease (eGFR ≤ 45 mL/min/1.73 m² in patients 12 months of age and older and elevated serum creatinine in patients less than 12 months of age), including patients on haemodialysis. ILLUMINATE-C includes 2 cohorts: Cohort A consists of 6 patients who did not require dialysis at the time of study enrolment and Cohort B consists of 15 patients who were on stable regimen of haemodialysis. Patients received the recommended dosing regimen of lumasiran based on body weight (see section 4.2).

The median age of patients at first dose was 8.9 years (range 0 to 59 years), 57.1% were male, and 76.2% were white. For Cohort A patients, the median plasma oxalate level was 57.94 $\mu\text{mol/L}$. For Cohort B patients, the median plasma oxalate level was 103.65 $\mu\text{mol/L}$.

The primary endpoint of the study was the percent change in plasma oxalate from baseline to month 6 (average from month 3 to month 6) for Cohort A (N=6) and the percent change in pre-dialysis plasma oxalate from baseline to month 6 (average from month 3 to month 6) for Cohort B (N=15).

During the 6-month primary analysis period, patients in both cohorts had a reduction in plasma oxalate as early as month 1. The percent change from baseline to month 6 (average from month 3 to month 6) in plasma oxalate levels for Cohort A was an LS mean difference of -33.3% (95% CI: -81.82, 15.16) and for Cohort B the LS mean difference was -42.4% (95% CI: -50.71, -34.15).

Figure 4: ILLUMINATE-C: Percent Change from Baseline in Plasma Oxalate ($\mu\text{mol/L}$) at Each Visit during the Primary Analysis Period



Results are plotted as mean (\pm SEM) of percent change from baseline.

Abbreviations: BL = baseline; M = month; SEM = standard error of mean.

For Cohort A, the baseline is defined as the mean of all plasma oxalate samples collected prior to the first dose of lumasiran; for Cohort B, the baseline is defined as the last four pre-dialysis plasma oxalate samples collected prior to the first dose of lumasiran. In Cohort B, only pre-dialysis samples are utilized.

In Cohort A the mean (SD) eGFR was 19.85 (9.6) mL/min/1.73 m^2 at baseline and 16.43 (9.8) mL/min/1.73 m^2 at month 6.

The rate of renal stone events per person-year reported 12 months prior to consent for Cohort A and during the 6-month primary analysis period was 3.20 (95% CI: 1.96, 5.22) and 1.48 (95% CI: 0.55, 3.92), respectively.

Paediatric population

The European Medicines Agency has deferred the obligation to submit the results of studies with Oxlumio in one or more subsets of the paediatric population in hyperoxaluria (see section 4.2 for information on paediatric use).

5.2 Pharmacokinetic properties

Absorption

Following subcutaneous administration, lumasiran is rapidly absorbed with a median (range) time to reach maximum plasma concentration (t_{max}) of 4.0 (0.5 to 12.0) hours. In children and adults with PH1 ≥ 20 kg, the peak plasma concentration of lumasiran (C_{max}) and area under the concentration curve from time zero to the last measurable concentration after dosing ($\text{AUC}_{0-\text{last}}$) following the

recommended lumasiran dose of 3 mg/kg were 529 (205 to 1130) ng/mL and 7400 (2890 to 10700) ng·h/mL, respectively. In children less than 20 kg, C_{max} and AUC_{0-last} of lumasiran following the recommended lumasiran dose of 6 mg/kg were 912 (523 to 1760) and 7960 (5920 to 13300). Lumasiran concentrations were measurable, up to 24 to 48 hours post-dose.

Distribution

In healthy adult plasma samples, the protein binding of lumasiran is moderate to high (77 to 85%) at clinically relevant concentrations. For an adult patient with PH1, the population estimate for the apparent central volume of distribution ($V_{d/F}$) for lumasiran is 4.9 L. Lumasiran primarily distributes to the liver after subcutaneous dosing.

Biotransformation

Lumasiran is metabolised by endo- and exonucleases to oligonucleotides of shorter lengths. *In vitro* studies indicate that lumasiran does not undergo metabolism by CYP450 enzymes.

Elimination

Lumasiran is primarily eliminated from plasma by hepatic uptake, with only 7 to 26% of the administered dose recovered in urine as lumasiran in the pooled data from healthy adult subjects and patients with PH1 >6 years of age. The mean (%CV) terminal plasma half-life of lumasiran is 5.2 (47.0%) hours. The population estimate for apparent plasma clearance was 26.5 L/h for a typical 70-kg adult. The mean renal clearance of lumasiran was minor and ranged from 2.0 to 3.4 L/h in paediatric and adult patients with PH1.

Linearity/non-linearity

Lumasiran exhibited linear to slightly nonlinear, time-independent pharmacokinetics in plasma following single subcutaneous doses ranging from 0.3 to 6 mg/kg and multiple doses of 1 and 3 mg/kg once monthly or 3 mg/kg quarterly. There was no accumulation of lumasiran in plasma after repeated once monthly or quarterly dosing.

Pharmacokinetic/pharmacodynamic relationship(s)

Plasma concentrations of lumasiran do not reflect the extent or duration of the pharmacodynamic activity of lumasiran. Rapid and targeted uptake of lumasiran by the liver results in rapid decline in plasma concentrations. In the liver, lumasiran exhibits a long half-life leading to maintenance of pharmacodynamic effect over the monthly or quarterly dosing interval.

Interactions

In vitro studies indicate that lumasiran is not a substrate or an inhibitor of cytochrome P450 (CYP) enzymes. Lumasiran is not expected to inhibit or induce CYP enzymes or modulate the activities of drug transporters.

Special populations

Elderly

No studies have been conducted in patients ≥ 65 years of age. Age was not a significant covariate in the pharmacokinetics of lumasiran.

Gender and race

In clinical studies, there was no difference in the plasma exposure or pharmacodynamics of lumasiran based on gender or race.

Hepatic impairment

No studies have been conducted in patients with hepatic impairment (see section 4.2). Limited pharmacokinetic data in patients with mild and transient elevations in total bilirubin (total bilirubin >1.0 to $1.5 \times \text{ULN}$) showed comparable plasma exposure of lumasiran and similar pharmacodynamics as patients with normal hepatic function. Published literature show lower expression of the asialoglycoprotein receptors in the liver, i.e. the receptors responsible for lumasiran uptake, in patients with hepatic impairment. Nonclinical data suggest that this may not influence liver uptake or pharmacodynamics at therapeutic doses. The clinical relevance of these data is unknown.

Renal impairment

Patients with mild renal impairment (eGFR 60 to <90 mL/min/1.73 m²) had comparable plasma exposure of lumasiran as patients with normal renal function (eGFR ≥ 90 mL/min/1.73 m²). In patients with moderate renal impairment (eGFR 30 to <60 mL/min/1.73 m²) C_{max} was similar to that in patients with normal renal function; AUC was 25% higher based on limited data. In patients with severe renal impairment (eGFR 15 to <30 mL/min/1.73 m²), ESRD (eGFR <15 mL/min/1.73 m²), or who are on dialysis (see section 4.2), within the same body weight category, a transient 1.8 to 3.6 fold higher C_{max} and 1.6 to 3.1 fold higher AUC_{0-last} was observed (see section 5.2). These increases were transient as plasma concentrations decline below the level of detection within 24 to 48 hours, similar to patients without renal impairment (see section 5.2 Pharmacokinetic/pharmacodynamic relationship(s)). The pharmacodynamics in patients with renal impairment (eGFR <90 mL/min/1.73 m²), including ESRD (eGFR <15 mL/min/1.73 m²) or those on dialysis were similar to patients with normal renal function (eGFR ≥ 90 mL/min/1.73 m²) (see section 4.2).

Paediatric population

Data in children younger than 1 year of age are limited. In children <20 kg, lumasiran C_{max} was 2-fold higher due to the nominally higher 6-mg/kg dose and faster absorption rate. The pharmacodynamics of lumasiran were comparable in paediatric patients (aged 4 months to 17 years) and in adults, despite the transiently higher plasma concentrations in children <20 kg, due to the rapid and predominant distribution of lumasiran to the liver.

Body weight

The recommended dosing regimens yielded up to 2-fold higher C_{max} in children <20 kg while AUC was similar across the body weights studied (6.2 to 110 kg).

5.3 Preclinical safety data

Non-clinical data reveal no special hazard for humans based on conventional studies of safety pharmacology, genotoxicity, and carcinogenicity.

In rats, but not in monkeys, microscopic changes in the liver (e.g. hepatocellular vacuolation, mitosis and karyomegaly) were observed, accompanied by decrease in plasma fibrinogen levels and other laboratory changes. The reason for the apparent rodent-specificity is not understood and the relevance for humans is unclear.

Lumasiran did not show any adverse effects on male and female fertility and pre- and post-natal development in rats. In embryo-foetal development studies in rats and rabbits, skeletal abnormalities were observed, but at high exposure multiples relative to human therapeutic exposures. The NOAELs were approximately 20- to 70-times higher (based on monthly exposures).

A dose-range finding toxicity study in neonate rats did not show increased sensitivity of the developing rat to either the toxicology or pharmacology of lumasiran at exposure multiples of 2 compared to human therapeutic exposures (based on monthly exposures).

6. PHARMACEUTICAL PARTICULARS

6.1 List of excipients

Sodium hydroxide (pH adjustment)
Phosphoric acid (pH adjustment)
Water for injections

6.2 Incompatibilities

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

6.3 Shelf life

3 years.

Once the vial is opened, the medicinal product should be used immediately.

6.4 Special precautions for storage

Do not store above 30°C.

Keep vial in the outer carton to protect from light.

6.5 Nature and contents of container

Glass vial with a fluoropolymer-coated rubber stopper and an aluminium overseal with a flip-off button. Each vial contains 0.5 mL solution for injection.

Pack size of one vial.

6.6 Special precautions for disposal and other handling

This medicinal product is ready-to-use and for single use only.

For subcutaneous use only

- Before administration, materials not included in the pack that are needed for administration should be collected, which will include a sterile syringe (0.3 mL, 1 mL, or 3 mL), an 18-gauge (G) needle, and a 25 G to 31 G needle.
- The required volume of Oxlumo should be calculated based on the recommended weight-based dose (see section 4.2).
- An 18-gauge needle should be used to withdraw Oxlumo from the vial. The vial should be held upright or tilted at a slight angle, and the flat edge of the needle should be pointed downwards.
- For volumes less than 0.3 mL, a sterile 0.3 mL syringe is recommended.
- The medicinal product should be administered with a sterile 25- to 31-G needle with a 13 mm or 16 mm needle length for subcutaneous injection.
- Note: This medicinal product should not be pushed into the 25 G to 31 G needle.
- Syringes, transfer needles, and injection needles should only be used once.

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

7. MARKETING AUTHORISATION HOLDER

Alnylam Netherlands B.V.
Antonio Vivaldistraat 150
1083 HP Amsterdam
Netherlands

8. MARKETING AUTHORISATION NUMBER(S)

EU/1/20/1496/001

9. DATE OF FIRST AUTHORISATION/RENEWAL OF THE AUTHORISATION

Date of first authorisation: 19 November 2020

10. DATE OF REVISION OF THE TEXT

Detailed information on this medicinal product is available on the website of the European Medicines Agency <http://www.ema.europa.eu>

ANNEX II

- A. MANUFACTURER RESPONSIBLE FOR BATCH RELEASE**
- B. CONDITIONS OR RESTRICTIONS REGARDING SUPPLY AND USE**
- C. OTHER CONDITIONS AND REQUIREMENTS OF THE MARKETING AUTHORISATION**
- D. CONDITIONS OR RESTRICTIONS WITH REGARD TO THE SAFE AND EFFECTIVE USE OF THE MEDICINAL PRODUCT**

A. MANUFACTURER RESPONSIBLE FOR BATCH RELEASE

Name and address of the manufacturer responsible for batch release

Alnylam Netherlands B.V.
Antonio Vivaldistraat 150
1083 HP Amsterdam
Netherlands

B. CONDITIONS OR RESTRICTIONS REGARDING SUPPLY AND USE

Medicinal product subject to restricted medical prescription (see Annex I: Summary of Product Characteristics, section 4.2).

C. OTHER CONDITIONS AND REQUIREMENTS OF THE MARKETING AUTHORISATION

- **Periodic safety update reports (PSURs)**

The requirements for submission of PSURs for this medicinal product are set out in the list of Union reference dates (EURD list) provided for under Article 107c(7) of Directive 2001/83/EC and any subsequent updates published on the European medicines web-portal.

The marketing authorisation holder (MAH) shall submit the first PSUR for this medicinal product within 6 months following authorisation.

D. CONDITIONS OR RESTRICTIONS WITH REGARD TO THE SAFE AND EFFECTIVE USE OF THE MEDICINAL PRODUCT

- **Risk management plan (RMP)**

The marketing authorisation holder (MAH) shall perform the required pharmacovigilance activities and interventions detailed in the agreed RMP presented in Module 1.8.2 of the marketing authorisation and any agreed subsequent updates of the RMP.

An updated RMP should be submitted:

- At the request of the European Medicines Agency;
- Whenever the risk management system is modified, especially as the result of new information being received that may lead to a significant change to the benefit/risk profile or as the result of an important (pharmacovigilance or risk minimisation) milestone being reached.

ANNEX III
LABELLING AND PACKAGE LEAFLET

A. LABELLING

PARTICULARS TO APPEAR ON THE OUTER PACKAGING

OUTER CARTON

1. NAME OF THE MEDICINAL PRODUCT

Oxlumo 94.5 mg/0.5 mL solution for injection
lumasiran

2. STATEMENT OF ACTIVE SUBSTANCE(S)

Each mL of solution contains lumasiran sodium equivalent to 189 mg lumasiran.

Each vial contains 94.5 mg lumasiran in 0.5 mL.

3. LIST OF EXCIPIENTS

Excipients:
Sodium hydroxide
Phosphoric acid
Water for injections
See leaflet for further information.

4. PHARMACEUTICAL FORM AND CONTENTS

solution for injection
94.5 mg/0.5 mL
1 vial

5. METHOD AND ROUTE(S) OF ADMINISTRATION

For single use only.
Read the package leaflet before use.
Subcutaneous use

6. SPECIAL WARNING THAT THE MEDICINAL PRODUCT MUST BE STORED OUT OF THE SIGHT AND REACH OF CHILDREN

Keep out of the sight and reach of children.

7. OTHER SPECIAL WARNING(S), IF NECESSARY

8. EXPIRY DATE

EXP

9. SPECIAL STORAGE CONDITIONS

Do not store above 30°C.
Keep vial in the outer carton to protect from light.

10. SPECIAL PRECAUTIONS FOR DISPOSAL OF UNUSED MEDICINAL PRODUCTS OR WASTE MATERIALS DERIVED FROM SUCH MEDICINAL PRODUCTS, IF APPROPRIATE**11. NAME AND ADDRESS OF THE MARKETING AUTHORISATION HOLDER**

Alnylam Netherlands B.V.
Antonio Vivaldistraat 150
1083 HP Amsterdam
Netherlands

12. MARKETING AUTHORISATION NUMBER(S)

EU/1/20/1496/001

13. BATCH NUMBER

Lot

14. GENERAL CLASSIFICATION FOR SUPPLY**15. INSTRUCTIONS ON USE****16. INFORMATION IN BRAILLE**

Oxlumo

17. UNIQUE IDENTIFIER – 2D BARCODE

2D barcode carrying the unique identifier included.

18. UNIQUE IDENTIFIER - HUMAN READABLE DATA

PC
SN
NN

MINIMUM PARTICULARS TO APPEAR ON SMALL IMMEDIATE PACKAGING UNITS

VIAL LABEL

1. NAME OF THE MEDICINAL PRODUCT AND ROUTE(S) OF ADMINISTRATION

Oxlumo 94.5 mg/0.5 mL solution for injection
lumasiran

2. METHOD OF ADMINISTRATION

Subcutaneous use

3. EXPIRY DATE

EXP

4. BATCH NUMBER

Lot

5. CONTENTS BY WEIGHT, BY VOLUME OR BY UNIT

94.5 mg/0.5 mL

6. OTHER

B. PACKAGE LEAFLET

Package leaflet: Information for the patient

Oxlumo 94.5 mg/0.5 mL solution for injection lumasiran

▼ This medicine is subject to additional monitoring. This will allow quick identification of new safety information. You can help by reporting any side effects you may get. See the end of section 4 for how to report side effects.

Read all of this leaflet carefully before you are given this medicine because it contains important information for you.

- Keep this leaflet. You may need to read it again.
- If you have any further questions, ask your doctor or nurse.
- If you get any side effects, talk to your doctor or nurse. This includes any possible side effects not listed in this leaflet. See section 4.

What is in this leaflet:

1. What Oxlumo is and what it is used for
2. What you need to know before you are given Oxlumo
3. How Oxlumo is given
4. Possible side effects
5. How to store Oxlumo
6. Contents of the pack and other information

1. What Oxlumo is and what it is used for

What Oxlumo is

Oxlumo contains the active substance lumasiran.

What Oxlumo is used for

Oxlumo is used to treat primary hyperoxaluria type 1 (PH1) in adults and children of all ages.

What PH1 is

PH1 is a rare illness in which the liver produces too much of a substance called oxalate. Your kidneys remove oxalate from the body and it is passed out in the urine. In people with PH1, the extra oxalate can build up in the kidneys and cause kidney stones, and can stop the kidney from working as well as they should. A build-up of oxalate can also damage other parts of the body such as eyes, heart, skin, and bone. This is called oxalosis.

How Oxlumo works

Lumasiran, the active substance in Oxlumo, reduces the amount of an enzyme called glycolate oxidase that the liver makes. Glycolate oxidase is one of the enzymes involved in producing oxalate. By lowering the amount of the enzyme, the liver produces less oxalate and the levels of oxalate in the urine and blood also fall. This can help to reduce the effects of the illness.

2. What you need to know before you are given Oxlumo

You must not be given Oxlumo:

- if you are severely allergic to lumasiran, or any of the other ingredients of this medicine (listed in section 6).

Warnings and precautions

Talk to your doctor before being given this medicine.

Your doctor may monitor you for signs of metabolic acidosis (the build-up of acid in the body) if you have severe renal impairment.

Other medicines and Oxlumo

Tell your doctor if you are using, have recently used, or might use any other medicines.

Pregnancy

If you are pregnant, think you may be pregnant, or are planning to have a baby, ask your doctor or nurse for advice before using this medicine. Your doctor will decide whether you should take Oxlumo after considering the expected health benefits for you as well as the risks to your unborn baby.

Breast-feeding

This medicine may pass into breast milk and it could have an effect on your baby. If you are breast-feeding, ask your doctor for advice before taking this medicine. Your doctor will help you decide whether to stop breast-feeding or to stop treatment.

Driving and using machines

This medicine is unlikely to have any effect on your ability to drive or use machines.

Oxlumo contains sodium

This medicine contains less than 1 mmol sodium (23 mg) per mL, that is to say essentially 'sodium-free'.

3. How Oxlumo is given

How much Oxlumo is given

Your doctor will work out how much medicine to give you. The dose will depend on how much you weigh. Your doctor will adjust your dose as your weight changes.

You will receive your first doses (loading doses) once a month for 3 doses. You will then start maintenance dosing beginning one month after the last loading dose.

Body weight less than 10 kg

- Loading doses: 6 mg for every kg of your weight, given once a month for 3 doses.
- Maintenance dosing: 3 mg for every kg of your weight, given once every month beginning one month after the last loading dose.

Body weight from 10 kg to less than 20 kg

- Loading doses: 6 mg for every kg of your weight, given once a month for 3 doses.

- Maintenance dosing: 6 mg for every kg of your weight, given once every 3 months beginning one month after the last loading dose.

Body weight 20 kg or more

- Loading doses: 3 mg for every kg of your weight, given once a month for 3 doses.
- Maintenance dosing: 3 mg for every kg of your weight, given once every 3 months beginning one month after the last loading dose.

How Oxlumo is given

This medicine will be given to you by a doctor or nurse.

- It is given as an injection under the skin (subcutaneously) into your stomach area (abdomen), or in some cases, your upper arm or thigh. You will be given the injection in a different spot from one injection to the next.
- Depending on your dose, more than one subcutaneous injection may need to be given.
- Your doctor or nurse will not inject into skin areas that are scarred, reddened, inflamed, or swollen.

If you are given too much Oxlumo

In the unlikely event that your doctor or nurse gives you too much (an overdose) they will check you for side effects.

If you miss your dose of Oxlumo

If you miss a dose of Oxlumo, talk to your doctor or nurse as soon as possible about when to get your next dose.

If you have any further questions on the use of this medicine, ask your doctor or nurse.

4. Possible side effects

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

The following side effects may occur when taking Oxlumo:

Very common: may affect more than 1 in 10 people

- Redness, pain, itching, swelling, discomfort, colour changes, mass, induration, rash, bruising or exfoliation at the site of the injection (injection site reaction).
- Stomach pain or discomfort (abdominal pain)

Reporting of side effects

If you get any side effects, talk to your doctor or nurse. This includes any possible side effects not listed in this leaflet. You can also report side effects directly via [the national reporting system listed in Appendix V](#). By reporting side effects you can help provide more information on the safety of this medicine.

5. How to store Oxlumo

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

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

This medicine is for single use only. Once the vial is opened, use immediately.

Do not store above 30°C.

Keep vial in the outer carton to protect from light.

Do not throw away any medicines via wastewater or household waste. Your doctor or nurse will throw away any medicines that are no longer being used. These measures will help protect the environment.

6. Contents of the pack and other information

What Oxlummo contains

- The active substance is lumasiran.
- Each vial contains lumasiran sodium equivalent to 94.5 mg lumasiran.
- The other ingredients are water for injections, sodium hydroxide, and phosphoric acid (see “Oxlummo contains sodium” in section 2).

What Oxlummo looks like and contents of the pack

This medicine is a clear, colourless-to-yellow solution for subcutaneous injection.

Each pack contains one single use vial containing 0.5 mL solution.

Marketing Authorisation Holder and Manufacturer

Alnylam Netherlands B.V.
Antonio Vivaldistraat 150
1083 HP Amsterdam
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For any information about this medicine, please contact the local representative of the Marketing Authorisation Holder:

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This leaflet was last revised in .

Other sources of information

Detailed information on this medicine is available on the European Medicines Agency web site:
<http://www.ema.europa.eu>.

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The following information is intended for healthcare professionals only:

Instructions for use

For subcutaneous use only.

- Collect materials not included in the pack that are needed for administration which will include a sterile syringe (0.3 mL, 1 mL, or 3 mL), an 18-gauge (G) needle, and a 25-G to 31-G needle.
- Calculate the required volume of Oxlumo based on the recommended weight-based dose. If the dose is more than 0.5 mL, you will need to use more than one vial. The maximum acceptable single injection volume to be administered is 1.5 mL. If more than 1.5 mL is needed, you may need to give more than one subcutaneous injection.
- To withdraw Oxlumo, hold the vial upright or tilt at a slight angle and ensure the flat edge of the needle is pointed downwards.
- Point the needle and syringe straight up and tap the syringe to move any bubbles to the top. Once the bubbles are at the top, gently push the plunger to force the bubbles out of the syringe. Check to ensure the correct amount of medicine is in the syringe.
- Administer the medicine with a sterile 25- to 31-G needle with a 13-mm or 16-mm needle length for subcutaneous injection. For volumes less than 0.3 mL, a sterile 0.3-mL syringe is recommended.
- Note: Do not push this medicine into the 25-G to 31-G needle. When using 0.3 mL (insulin) syringes, do not force the bubble from syringe.
- Injection can be into the abdomen, upper arms, or thighs. Consider rotating injection sites. Do not administer into scar tissue or areas that are reddened, inflamed, or swollen.
- Note: When administering subcutaneous injections into the abdomen, avoid a 2.0-cm diameter circle around the navel.
- Clean the area of planned injection with an alcohol swab and wait for the area to dry completely.
- Ensure proper injection technique. Do not inject into a vein or muscle.
- Insert the needle at a right angle (90 degrees) to deliver the injection just below the skin. In patients with little subcutaneous tissue, the needle should be inserted at a 45-degree angle.
- Do not press down on the plunger while piercing the skin. Once the needle is inserted through the skin, release the pinched skin and administer the dose in a slow and steady manner. Once the medicine has been administered count for at least 5 seconds before withdrawing the needle from the skin. Lightly press gauze or cotton ball on the injection site as needed. Do not put the needle cap back on.
- Note: Do not aspirate after inserting the needle to prevent tissue damage, haematoma, and bruising.
- If more than one injection is needed for a single dose of Oxlumo, the injection sites should be at least 2 cm apart.
- Only use the vial once. After administering the dose, dispose of any unused medicine in the vial according to local regulations.
- Use the syringes, transfer needles, and injection needles only once. Dispose of any used syringes and needles in accordance with local regulations.