

PRODUCT MONOGRAPH  
INCLUDING PATIENT MEDICATION INFORMATION

Pr**ULTOMIRIS**<sup>®</sup>

**Ravulizumab for injection**

10 mg/mL & 100 mg/mL  
concentrate for solution for intravenous infusion

Selective immunosuppressant

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## RECENT MAJOR LABEL CHANGES

[1 Indications]	[NOV/2022]
[4 Dosage and Administration], [4.2 Recommended Dose and Dosage Adjustment]	[NOV/2022 & DEC 2022]
[7 Warnings & Precautions]	[NOV/2022]

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## PART I: HEALTH PROFESSIONAL INFORMATION

### 1 INDICATIONS

#### Paroxysmal Nocturnal Hemoglobinuria (PNH)

ULTOMIRIS (ravulizumab for injection) is indicated for the treatment of adult and pediatric patients one month of age and older with paroxysmal nocturnal hemoglobinuria (PNH).

#### atypical Hemolytic Uremic Syndrome (aHUS)

ULTOMIRIS (ravulizumab for injection) is indicated for the treatment of adult and pediatric patients one month of age and older with atypical hemolytic uremic syndrome (aHUS) to inhibit complement-mediated thrombotic microangiopathy (TMA).

#### Limitations of Use:

ULTOMIRIS is not indicated for the treatment of patients with Shiga toxin *E. coli* related hemolytic uremic syndrome (STEC-HUS).

#### Generalized Myasthenia Gravis (gMG)

ULTOMIRIS (ravulizumab for injection) is indicated for the treatment of adult patients with anti-acetylcholine receptor (AChR) antibody-positive generalized Myasthenia Gravis (gMG).

ULTOMIRIS was studied in adult gMG patients with a Myasthenia Gravis Foundation of America (MGFA) clinical classification Class II to IV and a Myasthenia Gravis Activities of Daily Living (MG-ADL) total score  $\geq 6$ .

#### 1.1 Pediatrics

Pediatrics (1 month-18 years): Based on the data submitted and reviewed by Health Canada, the safety and efficacy of Ultomiris in pediatric patients with PNH and aHUS has been established. Therefore, Health Canada has authorized an indication for pediatric use only in patients with PNH and aHUS. (see **Section 7.1.3**)

#### 1.2 Geriatrics

Ultomiris may be administered to patients with PNH, aHUS or gMG aged 65 years and over. There is no evidence indicating any special precautions are required for treating a geriatric population.

### 2 CONTRAINDICATIONS

Ultomiris is contraindicated in patients who are hypersensitive to this drug or to any ingredient in the formulation, including any non-medicinal ingredient, or component of the container. For a complete listing, see Section 6, Dosage Forms, Strengths, Composition and Packaging.

Do not initiate Ultomiris therapy in patients with unresolved *Neisseria meningitidis* infection.

### 3 SERIOUS WARNINGS AND PRECAUTIONS BOX

#### WARNING: SERIOUS MENINGOCOCCAL INFECTIONS

Life-threatening meningococcal infections/sepsis have occurred in patients treated with

**Ultomiris. Meningococcal infection may become rapidly life-threatening or fatal if not recognized and treated early (See Section 7, Warnings and Precautions).**

- **Comply with the most current National Advisory Committee on Immunization (NACI) recommendations for meningococcal vaccination in patients with complement deficiencies.**
- **Patients must be vaccinated against meningococcal infections prior to, or at the time of, initiating Ultomiris, unless the risks of delaying Ultomiris therapy outweigh the risks of developing a meningococcal infection (see also *Serious Meningococcal infections in Section 7* for additional guidance on the management of the risk of meningococcal infections).**
- **Monitor patients for early signs of meningococcal infections and treat immediately if infection is suspected.**

**Ultomiris in Canada is available under a controlled distribution program. Patients are enrolled in a dedicated Patient Support Program (PSP).**

## **4 DOSAGE AND ADMINISTRATION**

### **4.1 Dosing Considerations**

Ultomiris should be administered by a qualified healthcare professional.

Vaccinate patients according to current NACI guidelines to reduce the risk of serious infection (see **Section 3, Serious Warnings and Precautions Box**).

Provide two weeks of antibacterial drug prophylaxis to patients if Ultomiris must be initiated immediately and vaccines are administered less than 2 weeks before starting Ultomiris therapy.

### **4.2 Recommended Dose and Dosage Adjustment**

The recommended Ultomiris intravenous (IV) dosing in adult and pediatric patients with PNH or aHUS with a body weight greater than or equal to 5 kg, or adult patients with gMG with a body weight greater than or equal to 40 kg, is based on the patient's body weight, as shown in Table 1 with maintenance doses administered every 4 or 8 weeks, starting 2 weeks after loading dose. Dosing schedule is allowed to occasionally vary by  $\pm 7$  days of the scheduled infusion day (except for the first maintenance dose of Ultomiris) but the subsequent dose should be administered according to the original schedule.

For patients switching from Soliris<sup>®</sup> to Ultomiris, the loading dose of Ultomiris should be administered at the time of the next scheduled Soliris infusion, and then Ultomiris maintenance doses are administered once every 4 to 8 weeks (depending on body weight), starting 2 weeks after loading dose administration as shown in Table 1.

**Table 1: Ultomiris Weight-Based Dosing Regimen**

<b>Body Weight Range (kg)</b>	<b>Loading Dose (mg)</b>	<b>Maintenance Dose (mg)</b>	<b>Dosing Interval</b>
$\geq 5$ to $< 10^*$	600	300	Every 4 weeks

≥ 10 to < 20*	600	600	Every 4 weeks
≥ 20 to < 30*	900	2,100	Every 8 weeks
≥ 30 to < 40*	1,200	2,700	Every 8 weeks
≥40 to < 60	2,400	3,000	Every 8 weeks
≥60 to < 100	2,700	3,300	Every 8 weeks
≥100	3,000	3,600	Every 8 weeks

\*For PNH and aHUS indications only.

Supplemental dosing following treatment with plasma exchange (PE), plasmapheresis (PP), or intravenous immunoglobulin (IVIg)

Plasma exchange (PE), plasmapheresis (PP) and intravenous immunoglobulin (IVIg) have been shown to reduce Ultomiris serum levels. A supplemental dose of Ultomiris is required in the setting of PE, PP or IVIg (Table 2).

**Table 2: Supplemental Dose of Ultomiris IV Dose after PE, PP, or IVIg**

Body Weight Group (kg)	Most Recent Ultomiris Dose (mg)	Supplemental Dose (mg) Following Each PP or PE Session	Supplemental Dose (mg) following Completion of IVIg Cycle
≥ 40 to < 60	2,400	1,200	600
	3,000	1,500	
≥ 60 to < 100	2,700	1,500	600
	3,300	1,800	
≥ 100	3,000	1,500	600
	3,600	1,800	
<b>Timing of Ultomiris Supplemental Dose</b>		Within 4 hours following each PE or PP intervention	Within 4 hours following completion of an IVIg cycle

Abbreviations: IVIg = intravenous immunoglobulin; PE = plasma exchange; PP = plasmapheresis

### 4.3 Reconstitution

**Parenteral Products:** Each vial of Ultomiris is intended for single use only.

Ultomiris 100 mg/mL must be diluted to a final concentration of 50 mg/mL.

Ultomiris 10 mg/mL must be diluted to a final concentration of 5 mg/mL.

Aseptic technique must be used.

Prepare Ultomiris as follows:

1. The number of vials to be diluted is determined based on the individual patient's weight and the prescribed dose; see **Section 4.2 Recommended Dose and Dosage Adjustment**.
2. Prior to dilution, the solution in the vials should be visually inspected; the solution should be

free of any particulate matter or precipitation. Do not use if there is evidence of particulate matter or precipitation.

3. The calculated volume of medicinal product is withdrawn from the appropriate number of vials and diluted in an infusion bag using sodium chloride 9 mg/mL (0.9%) solution for injection as diluent. Refer to the administration reference tables below. The product should be mixed gently. It should not be shaken.
4. After dilution, the final concentration of the solution to be infused is 50 mg/mL for Ultomiris 100 mg/mL and 5 mg/mL for Ultomiris 10 mg/mL.
5. The prepared solution should be administered immediately following preparation. Do not administer as an intravenous push or bolus injection. Refer to the administration reference tables below for minimum infusion duration. Infusion must be administered through a 0.2 µm filter.
6. If the medicinal product is not used immediately after reconstitution, storage times at 2°C - 8°C must not exceed 24 hours taking into account the expected infusion time.

The loading, maintenance and supplemental dose administration reference tables for Ultomiris 100 mg/mL and 10 mg/mL are provided in Table 3 to Table 8.

**Table 3: Loading Dose Administration Reference Table for Ultomiris 100 mg/mL**

Body Weight Range (kg) <sup>a</sup>	Loading Dose (mg)	Ultomiris Volume (mL)	Volume of NaCl Diluent <sup>b</sup> (mL)	Total Volume (mL)	Minimum Infusion Time (hr)	Maximum Infusion Rate (mL/hr)
≥ 5 to < 10*	600	6	6	12	1.4	9
≥ 10 to < 20*	600	6	6	12	0.8	15
≥ 20 to < 30*	900	9	9	18	0.6	39
≥ 30 to < 40*	1,200	12	12	24	0.5	48
≥ 40 to < 60	2,400	24	24	48	0.8	60
≥ 60 to < 100	2,700	27	27	54	0.6	90
≥ 100	3,000	30	30	60	0.4	150

<sup>a</sup>Body weight at time of treatment.

<sup>b</sup>Ultomiris should only be diluted using sodium chloride 9 mg/mL (0.9%) solution.

\*For PNH and aHUS indications only.

**Table 4: Loading Dose Administration Reference Table for Ultomiris 10 mg/mL**

Body Weight Range (kg) <sup>a</sup>	Loading Dose (mg)	Ultomiris Volume (mL)	Volume of NaCl Diluent <sup>b</sup> (mL)	Total Volume (mL)	Minimum Infusion Time (hr)	Maximum Infusion Rate (mL/hr)
≥ 5 to < 10*	600	60	60	120	3.8	32
≥ 10 to < 20*	600	60	60	120	1.9	63
≥ 20 to < 30*	900	90	90	180	1.5	120

≥30 to < 40*	1,200	120	120	240	1.3	184
≥ 40 to < 60	2,400	240	240	480	1.9	252
≥ 60 to < 100	2,700	270	270	540	1.7	317
≥ 100	3,000	300	300	600	1.8	333

<sup>a</sup>Body weight at time of treatment

<sup>b</sup>Ultomiris should only be diluted using sodium chloride 9 mg/mL (0.9%) solution

\*For PNH and aHUS indications only.

**Table 5: Maintenance Dose Administration Reference Table for Ultomiris 100 mg/mL**

Body Weight Range (kg) <sup>a</sup>	Maintenance Dose (mg)	Ultomiris Volume (mL)	Volume of NaCl Diluent <sup>b</sup> (mL)	Total Volume (mL)	Minimum Infusion Time (hr)	Maximum Infusion Rate (mL/hr)
≥ 5 to < 10*	300	3	3	6	0.8	8
≥ 10 to < 20*	600	6	6	12	0.8	15
≥ 20 to < 30*	2,100	21	21	42	1.3	32
≥30 to < 40*	2,700	27	27	54	1.1	49
≥ 40 to < 60	3,000	30	30	60	0.9	67
≥ 60 to < 100	3,300	33	33	66	0.7	94
≥ 100	3,600	36	36	72	0.5	144

<sup>a</sup>Body weight at time of treatment.

<sup>b</sup>Ultomiris should only be diluted using sodium chloride 9 mg/mL (0.9%) solution.

\*For PNH and aHUS indications only.

**Table 6: Maintenance Dose Administration Reference Table for Ultomiris 10 mg/mL**

Body Weight Range (kg) <sup>a</sup>	Maintenance Dose (mg)	Ultomiris Volume (mL)	Volume of NaCl Diluent <sup>b</sup> (mL)	Total Volume (mL)	Minimum Infusion Time (hr)	Maximum Infusion Rate (mL/hr)
≥ 5 to < 10*	300	30	30	60	1.9	31
≥ 10 to < 20*	600	60	60	120	1.9	63
≥ 20 to < 30*	2,100	210	210	420	3.3	127
≥30 to < 40*	2,700	270	270	540	2.8	192
≥ 40 to < 60	3,000	300	300	600	2.3	257
≥ 60 to < 100	3,300	330	330	660	2.0	330
≥ 100	3,600	360	360	720	2.2	327

<sup>a</sup>Body weight at time of treatment

<sup>b</sup>Ultomiris should only be diluted using sodium chloride 9 mg/mL (0.9%) solution

\*For PNH and aHUS indications only.



**Table 7: Supplemental Dose Reference Table for Ultomiris 100 mg/mL**

Body Weight Range (kg) <sup>a</sup>	Supplemental Dose (mg)	Ultomiris Volume (mL)	Volume of NaCl Diluent <sup>b</sup> (mL)	Total Volume (mL)	Minimum Infusion Time (hr)	Maximum Infusion Rate (mL/hr)
≥ 40 to < 60	600	6	6	12	0.25	48
	1,200	12	12	24	0.42	57
	1,500	15	15	30	0.5	60
≥ 60 to < 100	600	6	6	12	0.2	60
	1,500	15	15	30	0.36	83
	1,800	18	18	36	0.42	86
≥ 100	600	6	6	12	0.17	71
	1,500	15	15	30	0.25	120
	1,800	18	18	36	0.28	129

Note: Refer to Table 2 for selection of ravulizumab supplemental dose

<sup>a</sup>Body weight at time of treatment.

<sup>b</sup>Dilute Ultomiris only using 0.9% Sodium Chloride Injection, USP.

**Table 8: Supplemental Dose Reference Table for Ultomiris 10 mg/mL**

Body Weight Range (kg) <sup>a</sup>	Supplemental Dose (mg)	Ultomiris Volume (mL)	Volume of NaCl Diluent <sup>b</sup> (mL)	Total Volume (mL)	Minimum Infusion Time (hr)	Maximum Infusion Rate (mL/hr)
≥ 40 to < 60	600	60	60	120	0.5	240
	1,200	120	120	240	1.0	240
	1,500	150	150	300	1.2	250
≥ 60 to < 100	600	60	60	120	0.4	300
	1,500	150	150	300	1.0	300
	1,800	180	180	360	1.1	328
≥ 100	600	60	60	120	0.4	300
	1,500	150	150	300	1.0	300
	1,800	180	180	360	1.1	328

Note: Refer to Table 2 for selection of ravulizumabs supplemental dose

<sup>a</sup>Body weight at time of treatment.

<sup>b</sup>Dilute Ultomiris only using 0.9% Sodium Chloride Injection, USP.

**Ultomiris 10 mg/mL and 100 mg/mL should not be mixed together.**

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

In the absence of compatibility studies, this medicinal product must not be mixed with other medicinal products. Reconstitution and dilution should only use sodium chloride 9 mg/mL (0.9%) solution for injection as diluent.

**4.4 Administration**

**Only administer as an intravenous infusion.**

*Do not administer as an Intravenous Push or Bolus Injection.*

- Ultomiris 100 mg/mL must be diluted to a final concentration of 50 mg/mL.
- Ultomiris 10 mg/mL must be diluted to a final concentration of 5 mg/mL.
- For intravenous infusion only.
- Must be administered through a 0.2 µm filter.

Prior to administration, the admixture should be allowed to adjust to room temperature (18°-25° C, 64°-77° F). The admixture must not be heated in a microwave or with any heat source other than ambient air temperature.

Parenteral drug products should be inspected visually for particulate matter and discoloration prior to administration, whenever solution and container permit.

**4.5 Missed Dose**

In case of a missed dose, resume the regular schedule as soon as possible. Dosing schedule is allowed to occasionally vary by ± 7 days of the scheduled infusion day (except for the first maintenance dose of Ultomiris) but the subsequent dose should be administered according to the original schedule.

**5 OVERDOSAGE**

Ultomiris is to be administered by a healthcare professional, which minimizes the potential of a significant overdose. No cases of overdose have been reported during clinical studies.

For management of a suspected drug overdose, contact your regional poison control centre.

**6 DOSAGE FORMS, STRENGTHS, COMPOSITION AND PACKAGING**

**Table 9: Dosage Forms, Strengths, Composition and Packaging**

Route of Administration	Dosage Form / Strength / Composition	Non-medicinal Ingredients
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Intravenous infusion	300 mg/ 3 mL (100 mg/mL), single dose vial  1,100 mg/11 mL (100 mg/mL), single dose vial	Polysorbate 80 Sodium phosphate, dibasic Sodium phosphate, monobasic L-arginine Sucrose Water for injection
Intravenous infusion	300 mg/ 30 mL (10 mg/mL), single dose vial	Polysorbate 80 Sodium chloride Sodium phosphate, dibasic Sodium phosphate, monobasic Water for injection

**Description:**

Ultomiris is a formulation of ravulizumab which is a long-acting humanized monoclonal IgG2/4K antibody produced in Chinese hamster ovary (CHO) cell culture by recombinant DNA technology.

Ultomiris 100 mg/mL

Each vial of 3 mL contains 300 mg of ravulizumab (100 mg/mL).  
Each vial of 11 mL contains 1,100 mg of ravulizumab (100 mg/mL).  
Translucent, clear to yellowish color, pH 7.4 solution.

Ultomiris 10 mg/mL

Each vial of 30 mL contains 300 mg of ravulizumab (10 mg/mL).  
Clear to translucent, slight whitish color, pH 7.0 solution.

**7 WARNINGS AND PRECAUTIONS**

For serious meningococcal infections, please see *Section 3, Serious Warnings and Precautions Box*.

**Serious Meningococcal Infections**

Due to its mechanism of action, the use of Ultomiris increases the patient’s susceptibility to meningococcal infection/sepsis (*Neisseria meningitidis*). Meningococcal disease due to any serogroup may occur. To reduce this risk of infection, all patients must be vaccinated against meningococcal infections prior to, or at the time of, initiating Ultomiris. Patients who initiate Ultomiris treatment less than 2 weeks after receiving a meningococcal vaccine must receive treatment with appropriate prophylactic antibiotics until 2 weeks after vaccination. Vaccines against serogroups A, C, Y, W135, and B, are recommended in preventing the commonly pathogenic meningococcal serogroups. Patients must be vaccinated or revaccinated according to current national guidelines for vaccination use.

Vaccination may not be sufficient to prevent meningococcal infection. Consideration should be given to official guidance on the appropriate use of antibacterial agents. Cases of serious or fatal meningococcal infections/sepsis have been reported in patients treated with Ultomiris and with other terminal complement inhibitors. All patients should be monitored for early signs of meningococcal infection and sepsis, evaluated immediately if infection is suspected and treated with appropriate antibiotics. Patients should be informed of these signs and symptoms and steps should be taken to seek medical

care immediately. Patients should be provided with information from the patient information leaflet and a patient safety card.

### *Immunization*

Vaccination may further activate complement. As a result, patients with complement-mediated diseases, may experience increased signs and symptoms of their underlying disease, such as hemolysis (PNH), TMA complications (aHUS) or MG exacerbation (gMG). Therefore, patients should be closely monitored for disease symptoms after recommended vaccination.

## **General**

### *Excipients*

Ultomiris 10 mg/mL when diluted with 0.9% sodium chloride for IV administration contains 2.65 g sodium per 720 mL at the maximum dose, which is above Health Canada's maximum daily intake recommendation of 2.3 g sodium. This should be taken into consideration by patients on a controlled sodium diet.

Ultomiris 100 mg/mL when diluted with 0.9% sodium chloride for IV administration contains 0.18 g sodium per 72 mL at the maximum dose, which is below Health Canada's maximum daily intake recommendation of 2.3 g sodium.

### *Infusion Reactions*

Administration of Ultomiris may result in infusion reactions and allergic or hypersensitivity reactions (including anaphylaxis).

In clinical trials, infusion reactions (infusion-related reactions) were common (1%). They were mild to moderate in severity and transient (e.g., lower back pain, drop in blood pressure, elevation in blood pressure, limb discomfort, drug hypersensitivity [allergic reaction], dysgeusia [bad taste], and drowsiness).

In case of infusion reaction, if signs of cardiovascular instability or respiratory compromise occur, administration of Ultomiris should be interrupted and appropriate supportive measures should be instituted.

### *Other Systemic Infections*

Ultomiris therapy should be administered with caution to patients with active systemic infections. Ultomiris blocks terminal complement activation; therefore, patients may have increased susceptibility to infections, especially infections caused by *Neisseria* species. Serious infections with *Neisseria* species (other than *Neisseria meningitidis*), including disseminated gonococcal infections, have been reported in patients treated with Ultomiris and other terminal complement inhibitors.

Patients should be provided with information from the Patient Leaflet to increase their awareness of the signs and symptoms of potential serious infections. Physicians should advise patients about gonorrhoea prevention. Patients below the age of 18 years old must be vaccinated against *Haemophilus influenzae* and pneumococcal infections and need to adhere strictly to the National Advisory Committee on Immunization (NACI) vaccination recommendations for their age group.

### *Aplastic Anemia*

In phase 3 PNH clinical studies, Ultomiris was administered to 75/222 (33.8%) patients with aplastic anemia and PNH, some of which were treated with concomitant medications for aplastic anemia (including immunosuppressive therapies). There is no evidence indicating any special precautions are required for treating patients with aplastic anemia.

### *Renal and Hepatic Impairment*

Studies have not been conducted to examine the effects of hepatic impairment; however, pharmacokinetic data suggest that no dose adjustment is required in patients with hepatic impairment. No dose adjustment is required in patients with renal impairment. (See **Section 10.2**,

### ***Pharmacodynamics***)

The clinical trials of Ultomiris in patients with aHUS included patients with other complement-mediated TMA conditions (patients with renal impairment, some of whom were receiving dialysis). No dose adjustment is required in this population. (see **Section 10.3, Pharmacokinetics, Special Populations**)

### *Treatment Discontinuation*

#### PNH

PNH is a chronic disease and treatment with Ultomiris is recommended to continue for the patient's lifetime.

If patients with PNH must discontinue treatment with Ultomiris, they should be closely monitored for signs and symptoms of hemolysis, identified by elevated LDH along with sudden decrease in – Glycophosphatidylinositol (GPI)-deficient red blood cell (RBC) clone size or hemoglobin, or re-appearance of symptoms such as fatigue, hemoglobinuria, abdominal pain, shortness of breath (dyspnea), major adverse vascular event (including thrombosis), dysphagia, or erectile dysfunction. Monitor any patient who must discontinue Ultomiris for at least 16 weeks to detect hemolysis and other reactions. If signs and symptoms of hemolysis occur after discontinuation, including elevated LDH, consider restarting treatment with Ultomiris.

#### aHUS

Ultomiris treatment to resolve aHUS should be a minimum duration of 6 months, beyond which length of treatment needs to be considered for each patient individually.

There are no specific data on Ultomiris discontinuation.

If patients must discontinue treatment with Ultomiris, they should be monitored closely for signs and symptoms of TMA for at least 12 months. However, monitoring may be insufficient to predict or prevent severe TMA complications.

TMA complications post-discontinuation can be identified if any of the following is observed:

(i) At least two of the following laboratory results observed concurrently: a decrease in platelet count of 25% or more as compared to either baseline or to peak platelet count during Ultomiris treatment; an increase in serum creatinine of 25% or more as compared to baseline or to nadir during Ultomiris treatment; or, an increase in serum LDH of 25% or more as compared to baseline or to nadir during Ultomiris treatment; (results should be confirmed by a second measurement 28 days apart).

Or

(ii) any one of the following symptoms of TMA: changes in mental status, seizures, angina, dyspnea, thrombosis or increasing blood pressure.

If TMA complications occur after Ultomiris discontinuation, consider reinitiation of Ultomiris treatment beginning with the loading dose and maintenance dose described in **Section 4.2 Recommended Dose and Dosage Adjustment**.

### gMG

Considering that gMG is a chronic disease, patients who are required to discontinue Ultomiris treatment should be monitored for symptoms of the underlying disease. If symptoms of gMG reoccur after discontinuation, consider restarting treatment with Ultomiris.

## **Immune**

As with all therapeutic proteins, there is the potential for immunogenicity with Ultomiris. Immunogenicity tests are generally product-specific and are highly dependent on the sensitivity and specificity of the assay. Comparison of incidence of antibodies between products by different tests may be misleading.

In Ultomiris studies in PNH (N = 488), aHUS (N=89) and gMG (N=86), treatment-emergent anti-drug antibodies were reported in 2 patients (0.30%) (one adult with PNH and one adult with aHUS). These anti-drug antibodies were transient in nature with low titer and did not correlate with clinical response or adverse events.

## **Reproductive Health: Female and Male Potential**

- **Women of childbearing potential**

Women of childbearing potential should use effective contraception methods during treatment and for up to 8 months after treatment.

- **Fertility**

No specific non-clinical animal study on fertility has been conducted with ravulizumab (see **Section 16, Non-Clinical Toxicology, Reproductive and Developmental Toxicology**).

### **7.1 Special Populations**

#### **7.1.1 Pregnant Women**

No clinical data on exposed pregnancies are available.

Non-clinical animal reproductive and developmental toxicology studies were not conducted with ravulizumab due to lack of pharmacologic activity in non-human species. (see **Section 16, Non-Clinical Toxicology, Reproductive and Developmental Toxicology**)

It is unknown whether Ultomiris can cause fetal harm when administered to a pregnant woman. Human IgG are known to cross the human placental barrier, and thus ravulizumab may potentially cause terminal complement inhibition in the fetal circulation. Ultomiris should not be used during pregnancy unless the potential benefit justifies the potential risk to the mother and the fetus.

### 7.1.2 Breast-feeding

It is unknown whether Ultomiris is excreted into human milk. Since many medicinal products and immunoglobulins are secreted into human milk, and because of the potential for serious adverse reactions in nursing infants, breastfeeding should be discontinued during treatment and up to 8 months after treatment.

### 7.1.3 Pediatrics

**Pediatrics (1 month to <18 years of age):** Use of Ultomiris in pediatric patients for treatment of PNH is supported by evidence from a pediatric clinical study (12 patients aged 9 to 17 years). The safety of Ultomiris for the treatment of PNH appears similar in pediatric and adult patients.

Ultomiris has not been studied in patients with PNH below 9 years of age. The dosage to be used in pediatric patients with PNH is identical to the weight-based dosing recommendations provided for pediatric patients with aHUS. Based on the PK/PD data available in aHUS and PNH patients treated with Ultomiris, this dosing regimen is expected to result in an efficacy and safety profile similar to that in adults, for all pediatric patients starting at 5 kg.

Use of Ultomiris in pediatric patients for treatment of aHUS is supported by evidence from a pediatric clinical study (18 patients aged 10 months to 17 years). The safety of Ultomiris for the treatment of aHUS appears to be similar in pediatric and adult patients.

The safety and effectiveness of Ultomiris for the treatment of PNH or gMG in pediatric patients below the age of 18 years have not been established.

### 7.1.4 Geriatrics

**Geriatrics (>65 years of age):** Ultomiris may be administered to patients with PNH, aHUS or gMG aged 65 years and over. There is no evidence indicating any special precautions are required for treating a geriatric population.

## 8 ADVERSE REACTIONS

### 8.1 Adverse Reaction Overview

The most common adverse drug reactions reported in patients receiving ravulizumab were diarrhea, nausea, vomiting, nasopharyngitis and headache. Clinically significant serious adverse reactions reported in patients in clinical trials included meningococcal infection and meningococcal sepsis.

Meningococcal infections were reported in the ravulizumab clinical development program. These patients were treated with antibiotics and recovered while remaining on ravulizumab without treatment interruption.

Patients should be informed of the signs and symptoms of meningococcal septicaemia and advised to seek medical care immediately.

### 8.2 Clinical Trial Adverse Reactions

Clinical trials are conducted under very specific conditions. The adverse reaction rates observed in the

clinical trials; therefore, may not reflect the rates observed in practice and should not be compared to the rates in the clinical trials of another drug. Adverse reaction information from clinical trials may be useful in identifying and approximating rates of adverse drug reactions in real-world use.

## **PNH**

### **Adult patients with PNH**

The data described below reflect exposure of 441 adult patients with PNH in Phase 3 studies who received Ultomiris (n = 222) or eculizumab (n = 219) at the recommended dosing regimens with median treatment duration of 6 months for Ultomiris and 6 months for eculizumab. The most frequent adverse drug reactions (>10%) with Ultomiris were upper respiratory tract infection and headache. Table 10 describes adverse reactions that occurred at a rate of 5% or more among patients treated with Ultomiris.

Serious adverse reactions were reported in 15 (6.8%) patients receiving Ultomiris. The serious adverse reactions in patients treated with Ultomiris included hyperthermia and pyrexia. No serious adverse reaction was reported in more than 1 patient treated with Ultomiris.

**Table 10: Treatment-Emergent Adverse Events Reported by ≥5% of Patients by Pooled Treatment Groups (Phase 3 Adult PNH Population)**

System Organ Class Preferred Term	All ravulizumab (N = 222)		All Eculizumab (N = 219)	
	n (%)	E	n (%)	E
<b>Gastrointestinal disorders</b>				
Diarrhea	19 (8.6)	22	12 (5.5)	14
Nausea	19 (8.6)	23	19 (8.7)	23
Abdominal pain	13 (5.9)	16	16 (7.3)	16
<b>General disorders and administration site conditions</b>				
Pyrexia	15 (6.8)	18	18 (8.2)	23
Chest pain	5 (2.3)	9	14 (6.4)	19
<b>Infections and infestations</b>				
Nasopharyngitis	32 (14.4)	40	38 (17.4)	41
Upper respiratory tract infection	31 (14.0)	37	17 (7.8)	20
<b>Musculoskeletal and connective tissue disorders</b>				
Pain in extremity	14 (6.3)	15	11 (5.0)	14
Arthralgia	11 (5.0)	15	12 (5.5)	13
Myalgia	9 (4.1)	10	13 (5.9)	16
<b>Nervous system disorders</b>				
Headache	71 (32.0)	101	57 (26.0)	98
Dizziness	12 (5.4)	12	14 (6.4)	18
<b>Respiratory, thoracic and mediastinal disorders</b>				
Oropharyngeal pain	12 (5.4)	14	15 (6.8)	15
Cough	9 (4.1)	9	18 (8.2)	22

Notes: Phase 3 PNH Population = ALXN1210-PNH-301 and ALXN1210-PNH-302.

The data cut-off dates were the end of randomized treatment period for ALXN1210-PNH-301 and ALXN1210-PNH-302.

AEs are coded using MedDRA 20.1.

Abbreviations: AE = adverse event; E = number of events; SOC = System Organ Class; TEAE = treatment-



emergent adverse event.

#### Pediatric patients with PNH

In pediatric patients with PNH (aged 9 to 17 years) included in the pediatric PNH Phase 3 study, the safety profile appeared similar to that observed in adult PNH patients and in pediatric and adult aHUS patients. The most common adverse events (>10%) were abdominal pain and nasopharyngitis.

#### aHUS

The data described below reflect exposure of 58 adult and 31 pediatric patients with aHUS in single-arm trials who received Ultomiris at the recommended dose and schedule. Table 11, Table 12 and Table 13 describe the adverse events that occurred at a rate of 10% or more among patients treated with Ultomiris in the aHUS studies. The most frequent adverse reactions reported in ≥20% of adult and pediatric patients with aHUS treated with Ultomiris were upper respiratory tract infection, diarrhea, nausea, vomiting, headache, hypertension and pyrexia.

#### Adult patients with aHUS

Serious adverse events were reported in 48 (54%) patients with aHUS receiving Ultomiris. The most frequent serious adverse events reported in more than 2 patients (2.2%) treated with Ultomiris were hypertension, pneumonia and abdominal pain. Four patients died during the ALXN1210-aHUS-311 study. The cause of death was sepsis in 2 patients and intracranial hemorrhage in 1 patient. The fourth patient, who was excluded from the trial after a diagnosis of STEC-HUS, died due to pre-treatment cerebral arterial thrombosis.

**Table 11: Adverse Events Reported in 10% or More of Ultomiris-Treated Adult Patients with aHUS in Study ALXN1210-aHUS-311**

System Organ Class Preferred Term	N=58	
	All Grades*** (n=53) n (%)	≥ Grade 3 (n=14) n (%)
<b>Blood and lymphatic system disorders</b>		
Anemia	8 (14)	0 (0)
<b>Gastrointestinal disorders</b>		
Diarrhea	19 (33)	2 (3)
Vomiting	18 (31)	2 (3)
Nausea	15 (26)	1 (2)
Constipation	9 (16)	1 (2)
Abdominal pain	8 (14)	1 (2)
<b>General disorders and administration site conditions</b>		
Pyrexia	12 (21)	1 (2)
edema peripheral	10 (17)	0 (0)
Fatigue	9 (16)	0 (0)
<b>Infections and infestations</b>		
Upper respiratory tract infection*	16 (28)	0 (0)
Urinary tract infection	11 (19)	5 (9)
Gastrointestinal infection**	8 (14)	2 (3)
<b>Metabolism and nutrition disorders</b>		
Hypokalemia	6 (10)	1 (2)

<b>Musculoskeletal and connective tissue disorders</b>		
Arthralgia	15 (26)	0 (0)
Back pain	7 (12)	1 (2)
Muscle spasms	6 (10)	0 (0)
Pain in extremity	6 (10)	0 (0)
<b>Nervous system disorders</b>		
Headache	22 (38)	1 (2)
Dizziness	6 (10)	0 (0)
<b>Psychiatric disorders</b>		
Anxiety	8 (14)	1 (2)
<b>Respiratory, thoracic and mediastinal disorders</b>		
Cough	10 (17)	0 (0)
Dyspnea	11 (19)	1 (2)
<b>Skin and subcutaneous tissue disorders</b>		
Alopecia	6 (10)	0 (0)
Dry skin	6 (10)	0 (0)
<b>Vascular disorders</b>		
Hypertension	14 (24)	7 (12)

\*: Grouped term includes Nasopharyngitis, Pharyngitis, Upper respiratory tract infection, Rhinitis, Viral upper respiratory tract infection, Rhinovirus infection, Viral pharyngitis, Rhinorrhea, and Oropharyngeal pain.

\*\*: Grouped term includes Gastroenteritis, Gastrointestinal infection, Enterocolitis infectious, Infectious colitis, and Enterocolitis. \*\*\*: Graded per CTCAE v5.0.

Clinically relevant adverse reactions in <10% of patients include viral tonsillitis.

#### Pediatric patients with aHUS

**Table 12: Adverse Events Reported in 10% or More of Ultomiris-Treated Pediatric Patients with aHUS in Study ALXN1210-aHUS-312**

System Organ Class Preferred Term	N=31	
	All Grades** (n=28) n (%)	≥ Grade 3 (n=6) n (%)
<b>Gastrointestinal disorders</b>		
Vomiting	8 (26)	1 (3)
Diarrhea	8 (26)	0 (0)
Abdominal pain	7 (23)	0 (0)
Constipation	4 (13)	0 (0)
Nausea	4 (13)	0 (0)
<b>General disorders and administration site conditions</b>		
Pyrexia	10 (32)	0 (0)
<b>Infections and infestations</b>		
Upper respiratory tract infection*	17 (55)	2 (6)
Pneumonia	4 (13)	2 (6)
<b>Injury, poisoning and procedural complications</b>		
Contusion	4 (13)	0 (0)

<b>Musculoskeletal and connective tissue disorders</b>		
Myalgia	4 (13)	0 (0)
<b>Nervous system disorders</b>		
Headache	8 (26)	1 (3)
<b>Respiratory, thoracic and mediastinal disorders</b>		
Cough	6 (19)	0 (0)
<b>Skin and subcutaneous tissue disorders</b>		
Rash	4 (13)	0 (0)
<b>Vascular disorders</b>		
Hypertension	7 (23)	2 (6)

\*: Grouped term includes Nasopharyngitis, Pharyngitis, Upper respiratory tract infection, Rhinitis, Viral upper respiratory tract infection, Rhinovirus infection, Viral pharyngitis, Rhinorrhea, and Oropharyngeal pain.

\*\* : Graded per CTCAE v5.0.

Clinically relevant adverse reactions in <10% of patients include viral infection.

**Table 13: Adverse Events Reported in 10% or More of Ultomiris-Treated Patients with aHUS in Study ALXN1210-aHUS-312 by Baseline Age Group**

System Organ Class Preferred Term	Age 0 to <2 (N=4)	Age 2 to <12 (N=17)	Age 12 to <16 (N=9)	Total (n=30)
	n=4 n (%)	n=17 n (%)	n=8 n (%)	n=29 n (%)
<b>Blood and lymphatic system disorders</b>				
Lymphadenopathy	0 (0)	2 (12)	1 (11)	3 (10)
<b>Gastrointestinal disorders</b>				
Diarrhea	1 (25)	4 (24)	2 (22)	7 (23)
Constipation	0 (0)	4 (24)	0 (0)	4 (13)
Vomiting	1 (25)	6 (35)	0 (0)	7 (23)
Abdominal pain	0 (0)	5 (29)	1 (11)	6 (20)
Nausea	0 (0)	3 (18)	0 (0)	3 (10)
<b>General disorders and administration site conditions</b>				
Pyrexia	1 (25)	7 (41)	1 (11)	9 (30)
Fatigue	1 (25)	1 (6)	1 (11)	3 (10)
<b>Infections and infestations</b>				
Upper respiratory tract infection*	2 (50)	11 (65)	4 (44)	17 (57)
Otitis media	1 (25)	2 (12)	0 (0)	3 (10)
Pneumonia	1 (25)	2 (12)	0 (0)	3 (10)
Gastroenteritis viral	0 (0)	2 (12)	0 (0)	2 (7)
Tonsillitis	1 (25)	2 (12)	0 (0)	3 (10)
<b>Injury, poisoning and procedural complications</b>				
Contusion	0 (0)	3 (18)	0 (0)	3 (10)
<b>Investigations</b>				
Vitamin D decreased	0 (0)	2 (12)	1 (11)	3 (10)

<b>Metabolism and nutrition disorders</b>				
Iron deficiency	0 (0)	3 (18)	0 (0)	3 (10)
<b>Musculoskeletal and connective tissue disorders</b>				
Back pain	0 (0)	2 (12)	1 (11)	3 (10)
Myalgia	1 (25)	2 (12)	0 (0)	3 (10)
Pain in extremity	0 (0)	2 (12)	1 (11)	3 (10)
<b>Nervous system disorders</b>				
Headache	0 (0)	5 (29)	2 (22)	7 (23)
<b>Respiratory, thoracic and mediastinal disorders</b>				
Cough	0 (0)	5 (29)	1 (11)	6 (20)
Nasal congestion	1 (25)	2 (12)	0 (0)	3 (10)
<b>Skin and subcutaneous tissue disorders</b>				
Rash	1 (25)	3 (18)	0 (0)	4 (13)
<b>Vascular disorders</b>				
Hypertension	2 (50)	3 (18)	2 (22)	7 (23)

\*: Grouped term includes Nasopharyngitis, Pharyngitis, Upper respiratory tract infection, Rhinitis, Viral upper respiratory tract infection, Rhinovirus infection, Viral pharyngitis, Rhinorrhea, and Oropharyngeal pain

Clinically relevant adverse reactions in <10% of patients include viral infection.

## **gMG**

### **Adult Patients with gMG**

The data described below reflect exposure of 175 adult patients with gMG who received Ultomiris (n = 86) or placebo (n = 89) during the 26-week Randomized Controlled Period of Study ALXN1210-MG-306. The most frequent adverse reactions with Ultomiris were diarrhea (15%) and upper respiratory tract infection (12%). Table 14 describes adverse reactions that occurred at a frequency of 5% or more and at greater frequency than placebo among adult patients with gMG treated with Ultomiris. Serious adverse reactions were reported in 20 (23.3%) patients with gMG receiving Ultomiris. The most frequent serious adverse reaction reported in at least 2 (2.3%) patients treated with Ultomiris was transient ischemic attack.

**Table 14: Adverse Reactions Reported in ≥ 5% and at Greater Frequency than Placebo in Ultomiris-Treated Adult Patients with gMG in Study ALXN1210-MG-306**

<b>Body System Adverse Reaction</b>	<b>Number of Patients</b>	
	<b>Placebo (N=89) n (%)</b>	<b>Ultomiris (N=86) n (%)</b>
<b>Gastrointestinal Disorders</b>		
Diarrhea	11 (12)	13 (15)
Abdominal pain	0	5 (6)
<b>Infections and Infestations</b>		
Upper respiratory tract infection*	7 (8)	10 (12)
Urinary tract infection	4 (4)	5 (6)
<b>Musculoskeletal and Connective Tissue Disorders</b>		
Back Pain	5 (6)	7 (8)

Body System Adverse Reaction	Number of Patients	
	Placebo (N=89) n (%)	Ultomiris (N=86) n (%)
<b>Nervous System Disorders</b>		
Dizziness	3 (3)	8 (9)

\*: Grouped term includes Nasopharyngitis, Oropharyngeal pain, Pharyngitis, and Upper respiratory tract infection.

## 8.5 Post-Market Adverse Reactions

### Infusion reactions

Administration of Ultomiris may result in infusion reactions and allergic or hypersensitivity reactions (including anaphylaxis). In case of infusion reaction, infusion of Ultomiris should be interrupted and appropriate supportive measures should be instituted if signs of cardiovascular instability or respiratory compromise occur.

## 9 DRUG INTERACTIONS

### 9.3 Drug-Behavioural Interactions

There are no drug-behavioural interactions known at this time.

### 9.4 Drug-Drug Interactions

Interactions with other drugs have not been established.

See **Section 4.2** for guidance in case of concomitant PE, PP, or IVIg treatment.

Ultomiris was administered to 75/222 (33.8%) patients with a history of Aplastic Anemia and PNH some of which were treated with concomitant medications for Aplastic Anemia, including immunosuppressive therapies. No evidence of drug interactions was observed in these patients.

### 9.5 Drug-Food Interactions

Interactions with food have not been established.

### 9.6 Drug-Herb Interactions

Interactions with herbal products have not been established.

### 9.7 Drug-Laboratory Test interactions

Interactions with laboratory tests have not been established.

## 10 CLINICAL PHARMACOLOGY

### 10.1 Mechanism of Action

Ravulizumab is a terminal complement inhibitor that specifically binds to the complement protein C5

with high affinity, thereby inhibiting its cleavage to C5a (the proinflammatory anaphylatoxin) and C5b (the initiating subunit of the membrane attack complex [MAC or C5b-9]) and thus preventing the generation of MAC.

In patients with PNH complement-mediated intravascular hemolysis is blocked with ravulizumab treatment. Ravulizumab resolves complement-mediated TMA in patients with aHUS.

The precise mechanism by which ravulizumab exerts its therapeutic effect in gMG patients is unknown, but is presumed to involve reduction of terminal complement complex C5b-9 deposition at the neuromuscular junction.

## 10.2 Pharmacodynamics

Following ravulizumab treatment in both adult and pediatric complement-inhibitor naïve patients and eculizumab-experienced adult and pediatric patients with PNH, complete inhibition of serum free C5 (concentration of < 0.5 µg/mL) was observed by the end of the first infusion and sustained throughout the entire 26-week treatment period.

Complete inhibition of serum free C5 was also observed in nearly all adult (95%) and pediatric (100%) patients with aHUS by the end of the first infusion and sustained throughout the 26-week treatment period. Complete inhibition of serum free C5 was also observed in adult patients with gMG by the end of the first infusion and throughout the 26-week treatment period.

The extent and duration of the pharmacodynamic response in patients with PNH and aHUS were exposure dependent for ravulizumab. Free C5 levels of <0.5 µg/mL were correlated with maximal intravascular hemolysis control and complete terminal complement inhibition in patients with PNH. This complete terminal complement inhibition following ravulizumab treatment led to normalization (or near normalization) of serum lactate dehydrogenase (LDH) in complement inhibitor-naïve adult PNH patients and maintenance of LDH normalization in adult PNH patients previously treated with eculizumab.

## 10.3 Pharmacokinetics

Ravulizumab exposure following intravenous (IV) administration increases proportionally over a dose range of 200 to 5400 mg.

Table 15 and Table 16 present observed ravulizumab serum maximum concentration (C<sub>max</sub>) and the concentration at the end of the dosing interval (C<sub>trough</sub>) in PNH and aHUS patients, respectively.

**Table 15: Observed PK Parameters of ravulizumab after the loading dose and the last maintenance dose in complement inhibitor-naïve patients or prior eculizumab-treated patients with PNH**

		Pediatric Patients				Adult Patients			
		ALXN1210-PNH-304				ALXN1210-PNH-301		ALXN1210-PNH-302	
PK Parameter	Dosing Period	Complement Inhibitor-Naïve		Prior eculizumab-treated		Complement Inhibitor-Naïve		Prior eculizumab-treated	
		n	Mean ± SD (%CV)	n	Mean ± SD (%CV)	n	Mean ± SD (%CV)	n	Mean ± SD (%CV)

C <sub>max</sub> (µg/mL)	LD	4	733 ± 106.3 (14.5)	8	885 ± 170.8 (19.3)	125	771.4 ± 165.9 (21.5)	95	842.9 ± 203.5 (24.1)
	Last MD	4	1490 ± 397.8 (26.7)	8	1705 ± 165.4 (9.7)	124	1378.5 ± 275.9 (20.0)	95	1386.3 ± 268.4 (19.4)
C <sub>trough</sub> (µg/mL)	LD	4	368 ± 54.1 (14.7)	8	452 ± 68.3 (15.1)	125	391.2 ± 136.8 (35.0)	96	405.4 ± 121.2 (29.9)
	Last MD	4	495 ± 105.4 (21.3)	8	566 ± 69.1 (12.2)	124	472.7 ± 157.9 (33.4)	95	500.8 ± 143.2 (28.6)

LD = loading dose; MD = maintenance dose

**Table 16: Observed PK Parameters of ravulizumab after the loading dose and the last maintenance dose in patients with aHUS**

		Pediatric Patients (ALXN1210-aHUS-312)				Adult Patients (ALXN1210-aHUS-311)	
		< 20 kg MD Q4W		> 20 to < 40 kg MD Q8W		> 40 kg MD Q8W	
		n	Mean ± SD (%CV)	n	Mean ± SD (%CV)	n	Mean ± SD (%CV)
C <sub>max</sub> (µg/mL)	LD	8	656 ± 249.9 (38.1)	4	600 ± 103.8 (17.3)	52	754.3 ± 265.3 (35.2)
	MD	7	1,467 ± 554.5 (37.8)	6	1,863 ± 285.0 (15.3)	46	1,458.4 ± 256.2 (17.6)
C <sub>trough</sub> (µg/mL)	LD	9	241 ± 125.6 (52.1)	5	186 ± 30.7 (16.5)	55	313.2 ± 106.2 (33.9)
	MD	7	683 ± 314.9 (46.1)	6	549 ± 187.2 (34.1)	46	506.9 ± 215.5 (42.5)

LD = Loading Dose; MD = Maintenance Dose; Q4W = Every 4 Weeks; Q8W = Every 8 Weeks

Table 17 presents observed mean pharmacokinetic parameters of ravulizumab in adult patients with gMG.

**Table 17: Mean (%CV) Pharmacokinetic Parameters of ravulizumab in Adult Patients with gMG**

		N	Adult Patients (ALXN1210-MG-306)
C <sub>max</sub> (µg/mL)	LD	86	874 (184.2)
	MD	76	1548 (359.4)
C <sub>trough</sub> (µg/mL)	LD	85	418 (115.5)
	MD	70	587 (173.9)

LD = Loading Dose; MD=Maintenance Dose

Based on population PK modeling, the mean (%CV) AUC at steady state (AUC<sub>ss</sub>) during maintenance dosing was 1,010,000 (27.2%) µg\*h/mL and 1,040,000 (24.7%) µg\*h/mL in pediatric and adult PNH patients, respectively. The mean (%CV) AUC<sub>ss</sub> during maintenance dosing was 617,000 (47.4%) µg\*h/mL for pediatric aHUS patients < 20 kg dosed q4w, 1,260,000 (26.8%) µg\*h/mL for pediatric aHUS patients ≥ 20 to < 40 kg dosed q8w, and 995000 (31.7%) µg\*h/mL for adult aHUS patients, based on population PK modeling. The mean (%CV) AUC<sub>ss</sub> during maintenance dosing was 1,180,000 (28.5%) µg\*h/mL in adult patients with gMG.

**Distribution:** The mean (standard deviation [SD]) volume of distribution at steady state in patients with PNH, aHUS, or gMG are shown in Table 18.

**Metabolism:** As an immunoglobulin gamma (IgG) monoclonal antibody, ravulizumab is expected to be metabolized in the same manner as any endogenous IgG (degraded into small peptides and amino acids via catabolic pathways), and is subject to similar elimination. Ravulizumab contains only natural occurring amino acids and has no known active metabolites.

**Elimination:** The mean (standard deviation [SD]) terminal elimination half-life and clearance of ravulizumab are shown in Table 18.

**Table 18: Distribution, Biotransformation, and Elimination Parameters Following Intravenous Ravulizumab Treatment based on population-PK modeling**

	Adult and Pediatric Patients with PNH	Adult and Pediatric Patients with aHUS	Adult Patients with gMG
<b>Distribution</b>			
<b>Volume of distribution at steady state (liters) Mean (SD)</b>	5.30 (0.95)	5.22 (1.85)	5.74 (1.2)
<b>Biotransformation and Elimination</b>			
<b>Terminal elimination half-life (days) Mean (SD)</b>	49.6 (9.1)	51.8 (16.2)	56.6 (8.4)
<b>Clearance (liters/day) Mean (SD)</b>	0.08 (0.02)	0.08 (0.04)	0.08 (0.02)

### Special Populations and Conditions

No formal clinical studies of the effect of sex, race, age, hepatic or renal impairment on the pharmacokinetics of ravulizumab were conducted. Based on population PK assessment, body weight was identified as a significant covariate on the pharmacokinetics of ravulizumab. No clinically meaningful differences in pharmacokinetics of ravulizumab were observed in PNH, aHUS or gMG patients based on gender, age (10 months to 83 years), race, hepatic impairment or mild to moderate renal impairment including aHUS patients with proteinuria or receiving dialysis.

No patients with severe renal impairment were enrolled in ravulizumab PNH, aHUS or gMG studies.



## 11 STORAGE, STABILITY AND DISPOSAL

Ultomiris vials must be stored under refrigerated conditions at 2°C – 8°C.

Keep the vial in the outer carton to protect from light.

Do not use beyond the expiration date stamped on the carton.

## 12 SPECIAL HANDLING INSTRUCTIONS

Vials must not be frozen or shaken.

### Ultomiris 100 mg/mL

After dilution, the medicinal product should be used immediately. However, chemical and physical stability of the diluted product have been demonstrated for up to 24 hours at 2°C-8°C and up to 4 hours at room temperature.

### Ultomiris 10 mg/mL

After dilution, the medicinal product should be used immediately. However, chemical and physical stability of the diluted product have been demonstrated for up to 24 hours at 2°C-8°C and up to 6 hours at room temperature.

Refer to **Section 4.3, Reconstitution** for information on the stability and storage of diluted solutions of Ultomiris.

## PART II: SCIENTIFIC INFORMATION

### 13 PHARMACEUTICAL INFORMATION

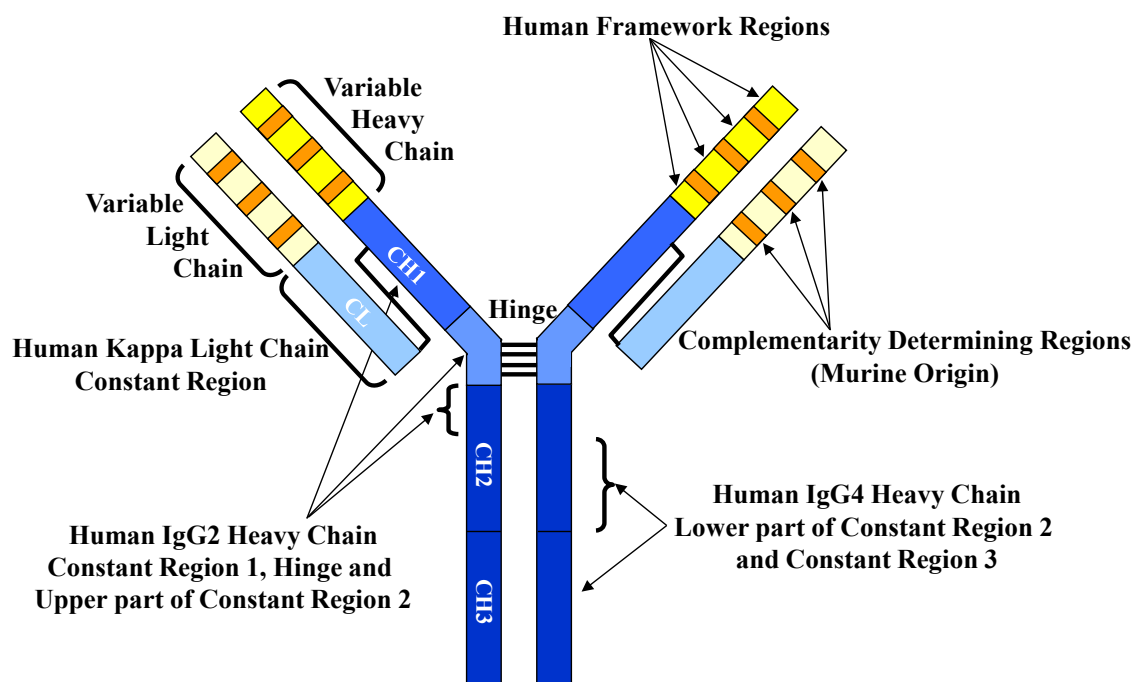
#### Drug Substance

Proper name: ravulizumab

Chemical name: Immunoglobulin G2/G4, anti-(human complement C5) (human-Mus musculus ALXN1210 heavy chain), disulfide with human-Mus musculus ALXN1210 kappa-chain, dimer

Molecular formula:  $C_{6542}H_{10,072}N_{1704}O_{2106}S_{48}$

Structural formula:



Physicochemical properties:

Ravulizumab drug substance is a humanized IgG2/4 kappa antibody. Table 19 lists the general physicochemical properties of ravulizumab drug substance.

**Table 19: Ravulizumab Physicochemical Properties**

Property	Result
Number of Amino Acids Heavy Chain <sup>a</sup>	448
Number of Amino Acids Light Chain <sup>a</sup>	226
Theoretical Molecular Weight <sup>b</sup>	147,827.62 Da
Isoelectric (pI) range	Multiple bands between pI 5.5 and 6.8
Extinction Coefficient at 290 nm <sup>c</sup>	$1.479 \text{ AU}(\text{mg/mL})^{-1}(\text{cm})^{-1}$

<sup>a</sup>Antibody is comprised of duplicate identical heavy and light chains

<sup>b</sup>Assumes antibody contains eighteen disulfide bonds, two heavy chain N-terminal pyroglutamations, the clipping of two heavy chain C terminal lysines, and the addition of two G0F glycan residues

<sup>c</sup>Extinction coefficient was theoretically-determined and experimentally-confirmed

### **Product Characteristics:**

Ravulizumab is a humanized monoclonal antibody (mAb) consisting of 2 identical 448 amino acid heavy chains and 2 identical 214 amino acid light chains and has a molecular weight of approximately 148kDa. The constant regions of ravulizumab include the human kappa light chain constant region, and the protein engineered "IgG2/4" heavy chain constant region.

The heavy chain CH1 domain, hinge region, and the first 5 amino acids of the CH2 domain match the human IgG2 amino acid sequence, residues 6 to 36 in the CH2 region (common to both human IgG2 and IgG4 amino acid sequences), while the remainder of the CH2 domain and the CH3 domain match the human IgG4 amino acid sequence. The heavy and light chain variable regions that form the human C5 binding site consist of human framework regions grafted to murine complementarity-determining regions.

### **Description:**

Ultomiris is a formulation of ravulizumab which is a long-acting humanized monoclonal IgG2/4K antibody produced in Chinese hamster ovary (CHO) cell culture by recombinant DNA technology.

One vial of 30 mL contains 300 mg of ravulizumab (10 mg/mL). Clear to translucent, slight whitish color, pH 7.0 solution.

## **14 CLINICAL TRIALS**

### **Paroxysmal Nocturnal Hemoglobinuria (PNH)**

#### **Trial Design and Study Demographics**

The safety and efficacy of Ultomiris in patients with PNH was assessed in two open-label, randomized, active-controlled, non-inferiority Phase 3 studies: Study ALXN1210-PNH-301 and Study ALXN1210-PNH-302. Study ALXN1210-PNH-301 enrolled patients with PNH who were complement inhibitor naïve and had active hemolysis. Study PNH-302 enrolled patients with PNH who were clinically stable after having been treated with eculizumab for at least the past 6 months.

Ultomiris was dosed in accordance with the recommended dosing described in *Section 4.2, Recommended Dose and Dosage Adjustment* (4 infusions of Ultomiris over 26 weeks) while Soliris was administered according to the approved dosing regimen of Soliris (15 infusions over 26 weeks) which was the standard-of-care for PNH at the time of studies.

To reduce the risk of meningococcal infection (*Neisseria meningitidis*), all patients were required to have been vaccinated against meningococcal infections within 3 years prior to, or at the time of, initiating study drug. Patients who initiated study drug treatment less than 2 weeks after receiving a meningococcal vaccine were required to have received treatment with appropriate prophylactic antibiotics until 2 weeks after vaccination.

A summary of key study design features and patient demographics for each study is given in Table 20 below.

**Table 20: Summary of patient demographics for clinical trials in adult and pediatric patients with PNH**

Study	Trial design	Dosage, route of administration and duration	Study subjects (n)	Mean age <sup>b</sup> (Range)	Sex n (%)
ALXN1210 -PNH-301	Phase 3, multicentre, open-label, randomized, active controlled in patients naïve to complement inhibitor treatment	<u>Ultomiris</u> Weight based <sup>a</sup> ; Loading dose on day 1 followed by maintenance dose on Day 15 and every 8 weeks after;	<u>Ultomiris</u> n=125	<u>Ultomiris</u> 44.8 (18 – 83)	<u>Ultomiris</u> Male 65 (52) Female 60 (48)
		<u>Soliris</u> Induction Dose of 600 mg on Days 1, 8, 15, and 22, followed by maintenance dose of 900 mg on Day 29, and every 2 weeks after; Intravenous Infusion; 26 Weeks	<u>Soliris</u> n=121	<u>Soliris</u> 45 (18-86)	<u>Soliris</u> Male 69 (57) Female 52 (43)
			Total n=246		

ALXN1210 -PNH-302	Phase 3, multicentre, open-label, randomized, active controlled in clinically stable patients treated with Soliris for at least 6 months	<u>Ultomiris</u> Weight based <sup>a</sup> ; Loading dose on day 1 followed by maintenance dose on Day 15 and every 8 weeks after;	<u>Ultomiris</u> n=97	<u>Ultomiris</u> 46.6 (18-79)	<u>Ultomiris</u> Male 50 (51.5) Female 47 (48.5)
		<u>Soliris</u> 900 mg every 2 weeks Intravenous Infusion; Duration: 26 Weeks followed by an extension period in which all patients receive Ultomiris maintenance dose q8w (patients switching from eculizumab received a weight-based loading dose followed 2 weeks later by a weight-based maintenance dose q8w)	<u>Soliris</u> n=98	<u>Soliris</u> 48.8 (23-77)	<u>Soliris</u> Male 48 (49) Female 50 (51)
			Total n=195		
ALXN1210 -PNH-304	Phase 3, open-label, uncontrolled, multicentre, single treatment arm study in pediatric patients with PNH who are complement inhibitor treatment-naïve or eculizumab-experienced	<u>Ultomiris</u> IV infusion Weight-based loading <sup>a</sup> dose on Day 1 and maintenance <sup>a</sup> dose on Day 15 and q8w (q4w for patients < 20 kg  <u>Duration</u> 26 weeks Primary Evaluation Period Extension period up to 4 years	n=12  <u>complement inhibitor treatment-naïve</u> n=4  <u>Soliris (eculizumab)-experienced</u> n=8	14.4 (9-17)	Male 4 (33.3) Female 8 (66.7)

<sup>a</sup>See **Section 4.2 Recommended Dose and Dosage Adjustment**

<sup>b</sup>Age (years) at first infusion in study

q4w = once every 4 weeks; q8w = once every 8 weeks

ALXN1210-PNH-301 Study in complement-inhibitor naïve patients with PNH

Study ALXN1210-PNH-301 was a 26-week, multicenter, open-label, randomized, active-controlled, non-inferiority Phase 3 study conducted in 246 patients who were naïve to complement inhibitor treatment prior to study entry. Eligible patients to enter this trial had to have a documented diagnosis of PNH with granulocyte or monocyte clone size of  $\geq 5\%$ . Ninety-eight percent of patients had a documented PNH-associated condition diagnosed prior to enrollment on the trial: anemia (85%), hemoglobinuria (63%), history of aplastic anemia (32%), history of renal failure (12%), myelodysplastic syndrome (5%), pregnancy complication (3%), and other (16%).

In addition, eligible patients had to demonstrate high disease activity, defined as LDH level  $\geq 1.5 \times$  ULN at screening along with the presence of 1 or more of the following PNH-related signs or symptoms within 3 months of screening: fatigue, hemoglobinuria, abdominal pain, shortness of breath (dyspnea), anemia (hemoglobin  $<10$  g/dL), history of a major adverse vascular event (including thrombosis), dysphagia, or erectile dysfunction; or history of pRBC transfusion due to PNH.

Patients were stratified into 6 groups based on their transfusion history in the 1 year prior to the first dose of study drug, and screening LDH levels. The patients within each of the 6 groups were then randomly assigned in a 1:1 ratio to receive either Ultomiris or Soliris. Enrollment of patients without a history of transfusion in the previous year was capped at 20%.

Table 21 presents the baseline characteristics of the PNH patients enrolled in the Complement-Inhibitor Naïve Study.

**Table 21: Baseline characteristics in the Complement-Inhibitor Naïve Study**

Parameter	Statistics	Ultomiris (N = 125)	Soliris (N = 121)
Race	n (%)		
Asian		72 (57.6)	57 (47.1)
White		43 (34.4)	51 (42.1)
Black or African American		2 (1.6)	4 (3.3)
American Indian or Alaska Native		1 (0.8)	1 (0.8)
Other		4 (3.2)	4 (3.3)
Not reported		3 (2.4)	4 (3.3)
Pre-treatment LDH levels (U/L)	Median Min, max	1513.5 (378.0, 3759.5)	1445.0 (423.5, 3139.5)
Units of pRBC/whole blood transfused within 12 months prior to first dose	Median Min, max	6.0 (1, 44)	6.0 (1, 32)
Antithrombotic agents used within 28 days prior to first dose	n (%)	22 (17.6)	22 (18.2)
Patients with a history of MAVE <sup>b</sup>	n (%)	17 (13.6)	25 (20.7)
Patients with a history of thrombosis	n (%)	17 (13.6)	20 (16.5)
Patients with concomitant anticoagulant treatment	n (%)	23 (18.4)	28 (23.1)

<sup>a</sup> "Other" as specified on case report form included thrombocytopenia, chronic kidney disease, and pancytopenia, as well as a number of other conditions.

<sup>b</sup> MAVE = major adverse vascular event

ALXN1210-PNH-302 Study in PNH patients previously treated with Soliris

Study PNH-302 was a 26-week, multicenter, open-label, randomized, active-controlled, non-inferiority Phase 3 study conducted in 195 patients with PNH who were clinically stable after having been treated with Soliris for at least the past 6 months.

Patients with PNH who were clinically stable (LDH level  $\leq 1.5 \times$  ULN at screening) after having been treated with Soliris for at least 6 months were eligible for enrollment in the study. Ninety five percent of patients had a documented PNH-associated condition diagnosed prior to enrollment on the trial: anemia (67%), hematuria or hemoglobinuria (49%), history of aplastic anemia (37%), history of renal failure (9%), myelodysplastic syndrome (5%), pregnancy complication (7%), and other (14%).

Patients were stratified into 1 of 2 groups based on their transfusion history within the previous 12 months. Patients within each of the 2 groups were then randomly assigned in a 1:1 ratio to either continue treatment with Soliris or switch to Ultomiris.

Table 22 presents the baseline characteristics of the adult PNH patients enrolled in the Soliris-Experienced Study.

**Table 22: Baseline characteristics in the Soliris-Experienced Study**

Parameter	Statistics	Ultomiris (N = 97)	Soliris (N = 98)
Race	n (%)		
White		50 (51.5)	61 (62.2)
Asian		23 (23.7)	19 (19.4)
Black or African American		5 (5.2)	3 (3.1)
Other		2 (2.1)	1 (1.0)
Not reported		13 (13.4)	13 (13.3)
Unknown		3 (3.1)	1 (1.0)
Multiple		1 (1.0)	0
Pre-treatment LDH levels (U/L)	Median Min, max	224.0 135.0, 383.5	234.0 100.0, 365.5
Units of pRBC/whole blood transfused within 12 months prior to first dose	Median Min, max	4.0 (1, 32)	2.5 (2, 15)
Antithrombotic agents used within 28 days prior to first dose	n (%)	20 (20.6)	13 (13.3)
Patients with a history of MAVE <sup>a</sup>	n (%)	28 (28.9)	22 (22.4)
Patients with a history of thrombosis	n (%)	27 (27.8)	21 (21.4)
Patients with concomitant anticoagulant treatment	n (%)	22 (22.7)	16 (16.3)

<sup>a</sup> MAVE = major adverse vascular event

ALXN1210-PNH-304 Study in Pediatric patients with PNH

The pediatric study (ALXN1210-PNH-304) study was conducted in eculizumab-experienced and complement inhibitor treatment naïve pediatric patients with PNH. Patients who completed the 26-week primary evaluation period are to be followed for up to 4 years in the long-term Extension Period.

In an interim analysis a total of 12 PNH pediatric patients completed Ultomiris treatment during the Primary Evaluation Period (26 weeks). Most of the patients were between 12 and 17 years of age at first infusion, with 2 patients under 12 years old (11 and 9 years old). Based on body weight, patients received a loading dose of Ultomiris on Day 1, followed by maintenance treatment on Day 15 and once every 8 weeks (q8w) thereafter for patients weighing  $\geq 20$  kg, or once every 4 weeks (q4w) for patients weighing  $< 20$  kg. For patients who entered the study on Soliris therapy, Day 1 of study treatment was planned to occur 2 weeks from the patient’s last dose of Soliris.

Table 23 presents the baseline characteristics of the pediatric patients with PNH enrolled in the clinical study.

**Table 23: Baseline Characteristics of Pediatric Patients with PNH**

Parameter	Complement Inhibitor Treatment-naïve Patients (N= 4)	Eculizumab-Experienced Patients(N=8)	All Patients N=12
Sex, n (%)			
Male	3 (75.0)	1 (12.5)	4 (33.3)
Female	1 (25.0)	7 (87.5)	8 (66.7)
Age at first infusion (years) category, n(%)			
Mean (SD)	14.5 (2.52)	14.4 (3.07)	14.4 (2.78)
Median (min, max)	15.0 (11, 17)	15.0 (9, 17)	15.0 (9, 17)
Age at first infusion (years) category, n(%)			
< 12 years	1 (25.0)	1 (25.0)	2 (16.7)
$\geq 12$ years	3 (75.0)	7 (87.5)	10 (83.3)
Baseline weight (kg) category, n(%)			
$\geq 30$ to $< 40$ kg	1 (25.0)	1 (12.5)	2 (16.7)
$\geq 40$ to $< 60$ kg	2 (50.0)	4 (50.0)	6 (50.0)
$\geq 60$ to $< 100$ kg	1 (25.0)	3 (37.5)	4 (33.3)
LDH (U/L)			
Mean (SD)	961.38 (874.302)	262.75 (106.016)	NA
Median (min, max)	565.90 (444, 2269.7)	251.50 (140.5, 487)	
Number of patients with pRBC/whole blood transfusions within 12 months prior to first dose, n (%)	2 (50.0)	2 (25.0)	4 (25.0)

Note: Percentages were based on the total number of patients in each cohort, or overall.

LDH = lactate dehydrogenase; max = maximum; min = minimum; NA = not available; PNH = paroxysmal nocturnal hemoglobinuria; SD = standard deviation



## **Study Results**

### **ALXN1210-PNH-301 Study in complement-inhibitor naïve patients with PNH**

The coprimary endpoints were transfusion avoidance, and reduction of hemolysis as directly measured by normalization of LDH levels. Transfusion avoidance was considered as achieved only by the patients who did not receive a transfusion and did not meet the protocol specified guidelines for transfusion from baseline to Day 183. Key secondary endpoints included the percent change from baseline in LDH levels; change in quality of life (FACIT-Fatigue); the proportion of patients with breakthrough hemolysis, defined as at least one new or worsening symptom or sign of intravascular hemolysis in the presence of elevated LDH  $\geq 2 \times$  ULN, after prior LDH reduction to  $< 1.5 \times$  ULN on therapy; and proportion of patients with stabilized hemoglobin.

Non-inferiority of Ultomiris to eculizumab was demonstrated across endpoints in the complement inhibitor naïve treatment population described in the table below.

**Table 24: Efficacy Results in the Complement-Inhibitor Naïve Study**

	<b>Ultomiris (N=125)</b>	<b>Eculizumab (N=121)</b>	<b>Statistic for Comparison</b>	<b>Treatment Effect (95% CI)</b>
Transfusion avoidance rate	73.6%	66.1%	Difference in rate	6.8 (-4.66, 18.14)
LDH normalization	53.6%	49.4%	Odds ratio	1.19 (0.80, 1.77)
LDH percent change	-76.84%	-76.02%	Difference in % change from baseline	-0.83 (-5.21, 3.56)
Breakthrough hemolysis	4.0%	10.7%	Difference in rate	-6.7 (-14.21, 0.18)
Hemoglobin stabilization	68.0%	64.5%	Difference in rate	2.9 (-8.80, 14.64)

Note: LDH = lactate dehydrogenase; CI = confidence interval

For the transfusion avoidance endpoint, treatment differences (95% CIs) are based on estimated differences in percent with 95% CI. For the lactate dehydrogenase normalization endpoint, the adjusted prevalence within each treatment is displayed.

A type I error of 1-sided 2.5% was used for the coprimary endpoints. Once noninferiority was declared for the coprimary endpoints, the key secondary endpoints were tested in a prespecified hierarchical testing procedure to control the Type-I error rate.

There was no observable difference in fatigue between Ultomiris and eculizumab after 26 weeks of treatment compared to baseline as measured by the FACIT-fatigue instrument. Patient-reported fatigue may be an under- or over-estimation, because patients were not blinded to treatment assignment.

### **ALXN1210-PNH-302 Study in PNH patients previously treated with Soliris**

The primary endpoint was hemolysis as measured by LDH percent change from baseline. Secondary endpoints included the proportion of patients that experienced breakthrough hemolysis, quality-of-life

(FACIT-Fatigue), transfusion avoidance (TA), and proportion of patients with stabilized hemoglobin.

Non-inferiority of Ultomiris to eculizumab was demonstrated across endpoints in the patients with PNH previously treated with eculizumab described in the table below.

**Table 25: Efficacy Results in the Eculizumab-Experienced Patients with PNH Eculizumab- Experienced Study**

	Ultomiris n = 97	Eculizumab n = 98	Statistic for Comparison	Treatment Effect (95% CI)
LDH Percent change	-0.82%	8.4%	Difference in % change from baseline	9.2 (-0.42, 18.8)
Breakthrough hemolysis	0%	5.1%	Difference in rate	5.1 (-8.9, 19.0)
Transfusion avoidance	87.6%	82.7%	Difference in rate	5.5 (-4.3, 15.7)
Hemoglobin Stabilization	76.3%	75.5%	Difference in rate	1.4 (-10.4, 13.3)

Note: CI = confidence interval

A type I error of 1-sided 2.5% was used for the primary endpoint. Once noninferiority was declared for the primary endpoint, the key secondary endpoints were tested in a prespecified sequential testing procedure to control the Type-I error rate.

There was no observable difference in fatigue between Ultomiris and eculizumab after 26 weeks of treatment compared to baseline as measured by the FACIT-fatigue instrument. Patient-reported fatigue may be an under- or over-estimation, because patients were not blinded to treatment assignment.

#### ALXN1210-PNH-304 Study in Pediatric patients with PNH

The weight-based dose regimen of Ultomiris provided immediate, complete, and sustained inhibition of terminal complement throughout the entire 26-week treatment period regardless of prior experience with Soliris. Following initiation of Ultomiris treatment, steady-state therapeutic serum concentrations of Ultomiris were achieved after the first dose and maintained throughout the Primary Evaluation Period in both cohorts.

Two of the 4 complement inhibitor treatment-naïve patients and 6 of the 8 Soliris-experienced patients achieved hemoglobin stabilization by Week 26, respectively. Transfusion-avoidance was reached for 10 of 12 patients during the 26-week Primary Evaluation Period. There were no breakthrough hemolysis events during the 26-week Primary Evaluation Period and no patients had post-baseline free C5 levels above 0.5 µg/mL.

A clinically relevant improvement from baseline in fatigue as assessed by Pediatric FACIT-Fatigue (i.e., mean improvement of > 3 units for Pediatric FACIT-Fatigue scores) was sustained throughout the Primary Evaluation Period in the 4 complement inhibitor treatment-naïve patients. A slight improvement was also observed in Soliris-experienced patients; however, patients were not blinded to treatment assignment. Table 26 presents efficacy outcomes for the Primary Evaluation Period.

**Table 26: Efficacy Outcomes from the interim analysis of Pediatric Study in PNH (ALXN1210-PNH-304)**

Endpoint	Treatment Naïve (N = 4)	Eculizumab Experienced (N = 8)
LDH- Change from Baseline (%)	-42.09 (58.992)	4.65 (44.702)
Transfusion Avoidance (%)	50.0 (6.76, 93.24)	100.0 (63.06, 100.00)
Change in FACIT-Fatigue	3.00 (6.976)	1.28 (5.235)
Hemoglobin Stabilization (%)	50.0 (6.76, 93.24)	75 (34.91, 96.81)
Breakthrough Hemolysis (%)	0	0

Abbreviations: FACIT = Functional Assessment of Chronic Illness Therapy; LDH = lactate dehydrogenase

Based on data from the interim analysis, pediatric patients with PNH can be initiated on Ultomiris or switched from Soliris to Ultomiris. The efficacy of Ultomiris in pediatric PNH patients appears to be similar to that observed in adult PNH patients enrolled in pivotal studies.

### **Atypical Hemolytic Uremic Syndrome (aHUS)**

#### **Trial Design and Study Demographics**

The safety and efficacy of Ultomiris in patients with aHUS was assessed in 2 open label, single arm, Phase 3 studies. Study ALXN1210-aHUS-311 enrolled adult patients and Study ALXN1210-aHUS-312 enrolled pediatric patients. In order to qualify for enrollment, patients were required to have a platelet count  $\leq 150 \times 10^9/L$ , evidence of hemolysis such as an elevation in serum LDH, and serum creatinine above the upper limits of normal or required dialysis.

A summary of key study design features and patient demographics for each study is given in Table 27 below.

**Table 27: Summary of Patient Demographics for Clinical Trials in Adult and Pediatric Patients with aHUS**

Study	Trial design	Dosage, route of administration and duration	Study subjects (n)	Mean age <sup>b</sup> (Range)	Sex n (%)
ALXN1210-aHUS-311	Phase 3, open-label, uncontrolled, multicentre, single treatment arm study in adult patients with evidence of TMA who are naïve to complement inhibitor treatment	Ravulizumab IV Weight-based loading dose on Day 1 and maintenance dose on Day 15 and q8w  Duration:	58	42.2 (19.5-76.6)	Male 19 (33.9)

		26 -week initial evaluation period, up to 2-year extension period			
ALXN1210-aHUS-312	Phase 3, open-label, uncontrolled, multicentre, single treatment arm study in pediatric patients with evidence of TMA who are naïve to complement inhibitor treatment (Cohort 1) or were clinically stable after having been treated with eculizumab according to the labeled dosing recommendation for aHUS for at least 90 days (Cohort 2)	Ravulizumab IV Weight -based loading dose on Day 1 and maintenance dose on Day 15 and q8w (q4w for patients < 20 kg) Duration: 26 -week initial evaluation period up to 2-year extension period	31 <sup>a</sup> Cohort 1: 21 <sup>a</sup> Cohort 2: 10	<u>Ravulizumab Naïve</u> (N=18) Birth to < 2 years =2, 2 to < 6 years =9, 6 to < 12 years =5, 12 to < 18 years =2  <u>Ravulizumab switch</u> (N=10) Birth to < 2 years = 1, 2 to < 6 years =1, 6 to < 12 years =1, 12 to < 18 years =7	<u>Ravulizumab-Naïve</u> Male 8 (44.4)  <u>Ravulizumab switch</u> Male 9 (90.0)

Loading and maintenance doses were per **DOSAGE AND ADMINISTRATION, Table 1**.

<sup>a</sup> The final study population that has received at least 1 dose of ravulizumab in Study ALXN1210-aHUS-312 is 34 patients (24 in Cohort1 and 10 in Cohort 2). The interim CSR for this study includes results through at least Week 52 (or early withdrawal) from the first 21 patients in Cohort 1 and all 10 patients in Cohort 2.  
q4w = once every 4 weeks; q8w = once every 8 weeks

#### ALXN1210-aHUS-311 Study in Adult Patients with aHUS

The adult study was conducted in patients who were naïve to complement inhibitor treatment prior to study entry. The study consisted of a 26-week Initial Evaluation Period and patients were allowed to enter an extension period for up to 4.5 years.

A total of 58 patients with documented TMA were enrolled. Enrolment criteria excluded patient presenting with TMA due to a disintegrin and metalloproteinase with a thrombospondin type 1 motif, member 13 (ADAMTS13) deficiency, Shiga toxin *Escherichia coli* related hemolytic uremic syndrome (STEC-HUS) and genetic defect in cobalamin C metabolism. Two patients were excluded from the Full Analysis Set due to a confirmed diagnosis of Shiga toxin *Escherichia coli*-related hemolytic uremic

syndrome (STEC-HUS).

The majority of patients had extra renal signs or symptoms of aHUS at baseline. At baseline, 71.4% (n = 41) of patients had Stage 5 chronic kidney disease (CKD).

Table 28 presents the demographics and baseline characteristics of the 56 adult patients enrolled in Study ALXN1210-aHUS-311 that constituted the Full Analysis Set.

**Table 28: Baseline Characteristics in Adult Patients with aHUS**

Parameter	Statistics	Ravulizumab (N = 56)
Age at time of first infusion (years)	Mean (SD) Min, max	42.2 (14.98) 19.5, 76.6
Sex		
Male	n (%)	19 (33.9)
Race <sup>a</sup>	n (%)	
Asian		15 (26.8)
White		29 (51.8)
Unknown		8 (14.3)
Other		14 (7.2)
Any pretreatment extra-renal signs or symptoms of aHUS	n (%)	
Cardiovascular		52 (92.9)
Pulmonary		39 (69.6)
Central nervous system		25 (44.6)
Gastrointestinal		29 (51.8)
Skin		35 (62.5)
Skeletal muscle		17 (30.4)
Skeletal muscle		13 (23.2)
History of transplant	n (%)	8 (14.3)
Patients postpartum	N (%)	8 (14.3)
Platelets (10 <sup>9</sup> /L) blood [normal range 130 to 400 × 10 <sup>9</sup> /L]	n Mean (SD) Median (min, max)	56 118.52 (86.440) 95.25 (18, 473)
Hemoglobin (g/L) blood [normal range 115 to 160 g/L (female), 130 to 175 g/L (male)]	n Mean (SD) Median (min, max)	56 86.26 (14.866) 85.00 (60.5, 140)
LDH (U/L) serum [normal range 120 to 246 U/L]	n Mean (SD) Median (min, max)	56 702.38 (557.959) 508.00 (229.5, 3249)
eGFR (mL/min/1.73 m <sup>2</sup> ) [normal range ≥ 60 mL/min/1.73 m <sup>2</sup> ]	n (%) Mean (SD) Median (min, max)	55 15.86 (14.815) 10.00 (4, 80)
Patients on dialysis	N (%)	29 (51.8)

Note: Percentages are based on the total number of patients. eGFR = estimated glomerular filtration rate; LDH = lactate dehydrogenase; max = maximum; min = minimum; TMA = thrombotic microangiopathy

ALXN1210-aHUS-312 Study in Pediatric Patients with aHUS

This is a 26-week, ongoing pediatric study. A total of 18 Soliris-naïve patients with documented diagnosis of complement-mediated TMA were enrolled and included in the full analysis set. Enrollment criteria excluded patient presenting with TMA due to ADAMTS13 deficiency, STEC-HUS and genetic defect in cobalamin C metabolism. The mean age at the time of first infusion was 6.4 years. The overall mean weight at Baseline was 22.2 kg; majority of the patients were in the baseline weight category  $\geq 10$  to  $< 20$  kg. The majority of patients (72.2%) had pretreatment extra renal signs (cardiovascular, pulmonary, central nervous system, gastrointestinal, skin, skeletal muscle) or symptoms of aHUS at baseline. At baseline, 33.3% (n = 6) of patients had CKD Stage 5. A total of 10 patients who switched from Soliris to Ultomiris with documented diagnosis of complement-mediated TMA were enrolled. Patients had to have clinical response to Soliris prior to enrollment.

Table 29 presents the baseline characteristics of the pediatric patients enrolled in Study ALXN1210-aHUS-312.

**Table 29: Demographics and Baseline Characteristics in Pediatric Patients with aHUS**

Parameter	Statistics	Ravulizumab (Naïve, N = 18)	Ravulizumab (Switch, N = 10)
Age at time of first infusion (years) category	n (%)		
Birth to < 2 years		2 (11.1)	1 (10.0)
2 to < 6 years		9 (50.0)	1 (10.0)
6 to < 12 years		5 (27.8)	1 (10.0)
12 to < 18 years		2 (11.1)	7 (70.0)
Sex			
Male	n (%)	8 (44.4)	9 (90.0)
Race <sup>a</sup>	n (%)		
American Indian or Alaskan Native		1 (5.6)	0 (0.0)
Asian		5 (27.8)	4 (40.0)
Black or African American		3 (16.7)	1 (10.0)
White		9 (50.0)	5 (50.0)
Unknown		1 (5.6)	0 (0.0)
Any pretreatment extra- renal signs or symptoms of aHUS	n (%)	13 (72.2)	1 (10.0)
Cardiovascular		9 (50.0)	1 (10.0)
Pulmonary		1 (5.6)	0 (0)
Central Nervous System		7 (38.9)	0 (0)
Gastrointestinal		11 (61.1)	0 (0)
Skin		9 (50.0)	0 (0)
Skeletal muscle		1 (5.6)	0 (0)
History of transplant	n (%)	1 (5.6)	1 (10.0)
Platelets ( $10^9$ /L) blood [normal range 229 to $533 \times 10^9$ /L]	Mean (SD) Median (min, max)	60.39 (32.613) 51.25 (14, 125)	287.90 (74.596) 281.75 (207, 415.5)

Hemoglobin (g/L) blood [normal range 107 to 131 g/L]	Mean (SD) Median (min, max)	74.42 (17.387) 74.25 (32, 106)	131.50 (11.311) 132.0 (114.5, 148)
LDH (U/L) serum [normal range 165 to 395 U/L]	Mean (SD) Median (min, max)	2223.47 (1321.118) 1963.00 (772, 4985)	219.40 (56.850) 206.5 (138.5, 356)
eGFR (mL/min/1.73 m <sup>2</sup> ) [normal range ≥ 60 mL/min/1.73 m <sup>2</sup> ]	Mean (SD) Median (min, max)	26.4 (21.17) 22.0 (10, 84)	104.90 (29.545) 99.75 (54, 136.5)
Required dialysis at baseline	n (%)	6 (33.3)	0 (0.0)

Note: Percentages are based on the total number of patients.

<sup>a</sup> Patients can have multiple races selected.

aHUS = atypical hemolytic uremic syndrome; eGFR = estimated glomerular filtration rate; LDH = lactate dehydrogenase; max = maximum; min = minimum

## **Study Results**

### **ALXN1210-aHUS-311 Study in Adult Patients with aHUS**

The primary endpoint was Complete TMA Response during the 26-week Initial Evaluation Period, as evidenced by normalization of hematological parameters (platelet count and LDH) and ≥ 25% improvement in serum creatinine from baseline. Patients had to meet each Complete TMA Response criteria at 2 separate assessments obtained at least 4 weeks (28 days) apart, and any measurement in between.

Other endpoints included time to Complete TMA Response, Complete TMA Response status over time, platelet count change from baseline, dialysis requirement, and renal function,

Complete TMA Response was observed in 30 of the 56 patients (53.6%) during the 26-week Initial Evaluation Period as shown in Table 30.

**Table 30: Complete TMA Response and Complete TMA Response Components Analysis during the 26-Week Initial Evaluation Period (ALXN1210- aHUS-311)**

	Total	Responder	
		n	Proportion (95% CI) <sup>a</sup>
Complete TMA response	56	30	0.536 (0.396, 0.675)
Components of Complete TMA Response			
Platelet count normalization	56	47	0.839 (0.734, 0.944)
LDH normalization	56	43	0.768 (0.648, 0.887)
≥25% improvement in serum creatinine from baseline	56	33	0.589 (0.452, 0.727)
Hematologic normalization	56	41	0.732 (0.607, 0.857)

<sup>a</sup> 95% CIs for the proportion were based on the asymptotic Gaussian approximation method with a continuity correction.

CI = confidence interval; LDH = lactate dehydrogenase; TMA = thrombotic microangiopathy.

Four additional patients had a Complete TMA Response that was confirmed after the 26-week Initial Evaluation Period.

Complete TMA Response was achieved at a median time of 86 days (7 to 169 days). The median

duration of Complete TMA Response was 7.97 months (range: 2.52 to 16.69 months). An increase in mean platelet count was observed after commencement of ravulizumab, increasing from  $118.52 \times 10^9/L$  at baseline to  $240.34 \times 10^9/L$  at Day 8 and remaining above  $227 \times 10^9/L$  at all subsequent visits in the Initial Evaluation Period (26 weeks).

Renal function, as estimated glomerular filtration rate (eGFR), was improved or maintained during ravulizumab treatment. The mean eGFR (SD) increased from 15.86 (14.82) at baseline to 51.83 (39.16) by 26 weeks. In patients with Complete TMA Response, renal function continued to improve after the Complete TMA Response was achieved. Two thirds of the patient population (32/47), who were mostly CKD Stage 4 or 5 at baseline, improved by 1 or more CKD stages. Chronic kidney disease stage continued to improve for many patients (19/30) after achieving Complete TMA Response during the 26-week Initial Evaluation Period. Seventeen of the 29 patients who required dialysis at study entry were able to discontinue dialysis by the end of the available follow-up and 6 of 27 patients who were off dialysis at baseline were on dialysis at last available follow-up.

#### ALXN1210-aHUS-312 Study in Pediatric Patients with aHUS

The primary endpoint was Complete TMA Response during the 26-week Initial Evaluation Period, as evidenced by normalization of hematological parameters (platelet count and LDH) and  $\geq 25\%$  improvement in serum creatinine from baseline. Patients had to meet all Complete TMA Response criteria at 2 separate assessments obtained at least 4 weeks (28 days) apart, and any measurement in between.

Secondary endpoints included time to Complete TMA Response, TMA response status over time, dialysis requirement, and platelet count change from baseline, dialysis requirement, and renal function. Complete TMA Response was observed in 14 of the 18 naïve patients (77.8%) during the 26-week Initial Evaluation Period as shown in Table 31.

**Table 31: Complete TMA Response and Complete TMA Response Components Analysis during the 26-Week Initial Evaluation Period (ALXN1210-aHUS-312)**

	Total	Responder	
		n	Proportion (95% CI) <sup>a</sup>
Complete TMA Response	18	14	0.778 (0.524, 0.936)
Components of Complete TMA Response			
Platelet count normalization	18	17	0.944 (0.727, 0.999)
LDH normalization	18	16	0.889 (0.653, 0.986)
$\geq 25\%$ improvement in serum creatinine from baseline	18	15	0.833 (0.586, 0.964)
Hematologic normalization	18	16	0.889 (0.653, 0.986)

Note: 1 patient withdrew from study after receiving 2 doses of ravulizumab.

<sup>a</sup> 95% CIs for the proportion were based on the asymptotic Gaussian approximation method with a continuity correction.

CI = confidence interval; LDH = lactate dehydrogenase; TMA = thrombotic microangiopathy

Three additional patients had a Complete TMA Response that was confirmed after the 26-week Initial Evaluation Period.

Complete TMA Response during the Initial Evaluation Period was achieved at a median time of 30 days (15 to 97 days). The median duration of Complete TMA Response was 5.08 months (range: 3.08 to 5.54 months). An increase in mean platelet count was observed after commencement of ravulizumab,



increasing from  $60.50 \times 10^9/L$  at baseline to  $296.67 \times 10^9/L$  at Day 8 and remained above  $296 \times 10^9/L$  at all subsequent visits in the Initial Evaluation Period (26 weeks).

All 6 patients who required dialysis at study entry were able to discontinue dialysis; 5 of which had already done so by Day 43. The mean eGFR (+/- SD) increased from 28.4 (23.11) at baseline to 108.0 (63.21) by 26 weeks.

### **Generalized Myasthenia Gravis (gMG)**

#### **Trial Design and Study Demographics**

**Table 32: Summary of Patient Demographics for Clinical Trial in patients with gMG**

<b>Study</b>	<b>Trial design</b>	<b>Dosage, route of administration and duration</b>	<b>Study subjects (n)</b>	<b>Mean age<sup>c</sup> (Range)</b>	<b>Sex n (%)</b>
ALXN1210-MG-306	Phase 3, randomized, double-blind, parallel-group, placebo-controlled, multicentre study with an ongoing open-label extension Period in adult patients with gMG who were naïve to complement inhibitor treatment	<u>Primary Evaluation Period (Day 1):</u> <u>Ultomiris</u> Ravulizumab IV weight-based loading <sup>a</sup> dose on Day 1 and weight-based maintenance <sup>b</sup> dose starting on Day 15 and q8w thereafter	<u>Ultomiris</u> n=86	<u>Ultomiris</u> 58.0 (19 to 79)	<u>Ultomiris</u> Male 42 (49)  Female 44 (51)
		<u>Placebo</u> Matched dosing to ravulizumab IV Blinded loading dose (900 mg) for all patients at Week 26 Extension Period (Week 28): Ravulizumab IV weight-based maintenance dose <sup>b</sup> q8w	<u>Placebo</u> n=89	<u>Placebo</u> 53.3 (20 to 82)	<u>Placebo</u> Male 44 (49)  Female 45 (51)
			Total n=175		

<sup>a</sup> Ravulizumab loading dose: 2400 mg for patients weighing  $\geq 40$  to  $< 60$  kg, 2700 mg for patients weighing  $\geq 60$  to  $< 100$  kg, 3000 mg for patients weighing  $\geq 100$  kg.

<sup>b</sup> Ravulizumab maintenance dose: 3000 mg for patients weighing  $\geq 40$  to  $< 60$  kg, 3300 mg for patients weighing  $\geq 60$  to  $< 100$  kg, 3600 mg for patients weighing  $\geq 100$  kg.

<sup>c</sup> Age at first dose of study drug (years)

The efficacy and safety of Ultomiris in adult patients with gMG was assessed in a Phase 3, randomized, double-blind, placebo-controlled, multicentre study (ALXN1210-MG-306). Patients participating in this study were randomized 1:1 to either receive Ultomiris (N=86) or placebo (N=89) for the 26-week Randomized-Controlled Period (RCP), and were subsequently allowed to enter an Open-Label Extension (OLE) Period during which all patients received Ultomiris.

Patients with gMG (diagnosed for at least 6 months) with a positive serologic test for antiacetylcholine receptor (AChR) antibodies, MGFA (Myasthenia Gravis Foundation of America) clinical classification Class II to IV and remaining symptomatology as evidenced by a Myasthenia Gravis Activities of Daily Living (MG-ADL) total score  $\geq 6$  were enrolled. Patients were not on chronic IVIg or PE/PP treatment within 4 weeks prior to study entry. Prior treatment with immunosuppressant therapies (ISTs) (corticosteroids, azathioprine, cyclophosphamide, cyclosporine, methotrexate, mycophenolate mofetil, or tacrolimus) was not required for enrollment. However, patients on ISTs were permitted to continue on therapy throughout the course of the study. In addition, rescue therapy (including high-dose corticosteroid, PE/PP, or IVIg) was allowed if a patient experienced clinical deterioration, as defined by the study protocol.

A total of 162 (92.6%) patients completed the 26-week RCP. The baseline characteristics of patients were balanced across the two treatment groups (Table 33).

**Table 33: Baseline Disease Characteristics in Study ALXN1210-MG-306**

Parameter	Statistics	Placebo (N = 89)	Ultomiris (N = 86)
<b>Sex</b>	n (%)		
Male		44 (49.4)	42 (48.8)
Female		45 (50.6)	44 (51.2)
<b>Age at first dose of study drug (years)</b>	Mean (SD) (min, max)	53.3 (16.05) (20, 82)	58.0 (13.82) (19, 79)
<b>Duration of MG since diagnosis (years)</b>	Mean (SD) (min, max) Median	10.0 (8.90) (0.5, 36.1) 7.6	9.8 (9.68) (0.5, 39.5) 5.7
<b>Baseline MG-ADL Score</b>	Mean (SD) (min, max) Median	8.9 (2.30) (6.0, 15.0) 9.0	9.1 (2.62) (6.0, 24.0) 9.0
<b>Baseline QMG Score</b>	Mean (SD) (min, max) Median	14.5 (5.26) (2.0, 27.0) 14.0	14.8 (5.21) (6.0, 39.0) 15.0
<b>Baseline MGFA classification</b>	n (%)		
Class II (mild weakness)		39 (44)	39 (45)
Class III (moderate weakness)		45 (51)	41 (48)
Class IV (severe weakness)		5 (6)	6 (7)
<b>Any prior intubation since diagnosis (MGFA Class V)</b>	n (%)	9 (10.1)	8 (9.3)
<b>Number of patients receiving stable</b>	n (%)	65 (73.0)	56 (65.1)

<b>corticosteroids at study entry</b>			
<b>Number of patients receiving other stable immunosuppressant agents* at study entry</b>	n (%)	63 (70.8)	56 (65.1)

\* Other immunosuppressant agents include azathioprine, cyclophosphamide, cyclosporine, methotrexate, mycophenolate mofetil, or tacrolimus.

Abbreviations: Max = maximum; min = minimum; MG = myasthenia gravis; MG-ADL = Myasthenia Gravis Activities of Daily Living; MGFA = Myasthenia Gravis Foundation of America; QMG = Quantitative Myasthenia Gravis; SD = standard deviation

The primary endpoint was the change from baseline in the MG-ADL total score at Week 26. The MG-ADL is a patient reported 8-item categorical scale that assesses the impact on daily function of 8 signs or symptoms that are typically affected in gMG. The MG-ADL score is composed of the following items: Assessment of the ability to speak, chew, swallow, breathe, perform self-care activities, perform physical activities, and vision-related parameters (2 items). Each item is assessed on a 4-point scale where a score of 0 represents normal function and a score of 3 represents loss of ability to perform that function. The total score ranges from 0 to 24, with a higher score indicating more impairment.

The key secondary endpoint was the change from baseline in the Quantitative Myasthenia Gravis (QMG) total score at Week 26. The QMG is a physician-reported 13-item categorical scale that assesses the impact of muscle weakness on disease severity, based on impairments of body functions and structures. The QMG score is composed of the following items: ocular (2 items), facial (1 item), bulbar (2 items), gross motor (6 items), axial (1 item), and respiratory (1 item). Each item is assessed on a 4-point scale where a score of 0 represents 'no weakness' and a score of 3 represents 'severe weakness' (total score 0-39).

Additionally secondary endpoints assessed at Week 26 included the proportion of patients with improvements of at least 5-points in QMG, and at least 3-points in the MG-ADL total scores, respectively, as well as changes in quality of life assessments.

### **Study Results**

Ultomiris demonstrated a statistically significant change from baseline in MG-ADL total score at Week 26, as compared to placebo. The results are presented in Table 34.

**Table 34: Results of Primary and Key Secondary Efficacy Endpoint**

<b>Change from baseline to Week 26</b>	<b>Placebo (N = 89) LS Mean (SEM)</b>	<b>Ultomiris (N = 86) LS Mean (SEM)</b>	<b>Treatment Effect (95% CI)<sup>a</sup></b>
MG-ADL	-1.4 (0.37)	-3.1 (0.38)	-1.6 (-2.6, -0.7) <sup>b</sup>
QMG	-0.8 (0.45)	-2.8 (0.46)	-2.0 (-3.2, -0.8) <sup>b</sup>

<sup>a</sup> Based on a mixed effect repeated measures analysis

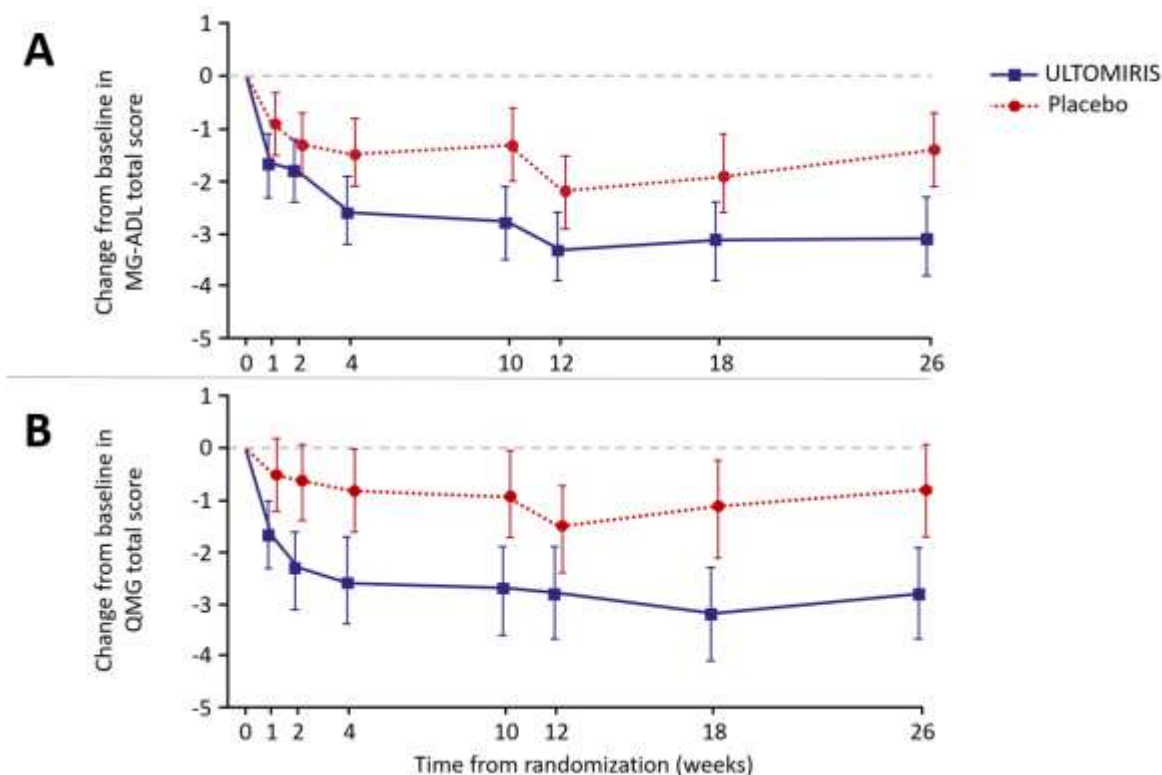
<sup>b</sup> Statistically significant under multiplicity control for Ultomiris vs placebo comparison (p < 0.05).

Abbreviations: CI = confidence interval; LS = least squares; MG-ADL = Myasthenia Gravis Activities of Daily Living; QMG = Quantitative Myasthenia Gravis; SEM = standard error of mean

The proportion of clinical responders was consistently greater for Ultomiris compared to placebo for QMG  $\geq 5$ -point improvement [30.0% vs. 11.3%; risk ratio (95% confidence interval [CI]): 2.7 (1.4, 5.3)] and MG-ADL  $\geq 3$ -point improvement [56.7% vs. 34.1%; risk ratio (95% CI): 1.6 (1.2, 2.3)] endpoints.

In patients treated with Ultomiris, favourable changes were observed in all domain scores of the MG-ADL and in the ocular, bulbar, and limb domain scores of the QMG.

**Figure 1:** Change from Baseline in MG-ADL Total Score (A) and QMG Total Score (B) Through Week 26 of the Randomized Controlled Period of ALXN1210-MG-306 (Mean and 95% CI)<sup>a</sup>



Note: Loading dose at Week 0 followed by maintenance doses at Week 2 and then Q8W thereafter.

<sup>a</sup>Based on a mixed effect repeated measures analysis

In the ongoing uncontrolled Open-Label Extension of ALXN1210-MG-306, among the subset of subjects randomized to ravulizumab, the mean changes in MG-ADL and QMG observed at Week 52 were -4.2 (n=35) and -4.7 (n=34).

## 15 NON-CLINICAL TOXICOLOGY

Animal toxicology studies have not been conducted with ravulizumab due to a lack of pharmacologic activity in non-human species, but were conducted in mice with a surrogate murine anti-mouse C5 antibody, BB5.1.

### **General Toxicology:**

A 26-week repeat-dose toxicity study in mice was performed with the surrogate antibody BB5.1. Animals were intravenously administered vehicle control or BB5.1 at a dose of 30 mg/kg body weight once or twice weekly. C5-induced hemolytic activity in an ex vivo assay was effectively blocked throughout the course of the study in both female and male mice. Administration with BB5.1 did not affect any of the toxicity parameters examined. The no-observed-adverse-effect level (NOAEL) in this study was 30 mg/kg body weight administered twice weekly.

### **Carcinogenicity:**

No studies have been performed to evaluate the carcinogenic potential of ravulizumab.

### **Genotoxicity:**

No studies have been performed to evaluate the genotoxic potential of ravulizumab.

### **Reproductive and Developmental Toxicology:**

Three reproductive and developmental studies were conducted with the murine surrogate molecule, BB5.1.

In a fertility and early embryonic development study, BB5.1 was administered by intravenous injection to male and female mice from prior to mating, throughout mating, and post-mating until termination (males) or through early gestation until gestation day (GD) 7 (females) at a dose of 30 mg/kg body weight once or twice weekly. This study included assessment of potential effects on general toxicity, estrous cycling, sperm parameters, mating behavior, implantation, general fertility, and litter parameters. There were no test article-related adverse findings in this study. Thus, the NOAEL for effects on fertility and early embryonic development was 30 mg/kg body weight administered twice weekly.

In an embryo-fetal development study, the maternal and embryo/fetal toxicity and teratogenic potential of BB5.1 were evaluated following administration to pregnant mice during the period of organogenesis (GD 6 to 15). BB5.1 was administered by intravenous injection at a dose of 30 mg/kg body weight once or twice weekly. Fetal malformations consisted of two cases of retinal dysplasia and one case of umbilical hernia observed among 230 fetuses from dams administered BB5.1 twice weekly. Similar findings were not observed following administration of BB5.1 once weekly. No other adverse findings were observed following administration of BB5.1, including no increase in fetal loss or neonatal death. Based on the fetal soft tissue malformations observed following twice weekly dosing, the NOAEL for developmental toxicity was 30 mg/kg body weight administered once weekly.

A pre- and postnatal development study was conducted to evaluate the effects of BB5.1 on pregnant and lactating female mice and the development of the offspring. BB5.1 was administered to female mice by intravenous injection at a dose of 30 mg/kg body weight once or twice weekly from implantation through weaning (GD 6 to lactation day 18). No adverse effects on pregnancy or delivery were observed following administration of BB5.1. However, a higher number of male offspring from

dams administered BB5.1 became moribund or died (1/25 in the control group, 2/25 in the 30 mg/kg body weight once weekly group, and 5/25 in the 30 mg/kg body weight twice weekly group). There was also an increased incidence of dilated renal pelves in male offspring of both BB5.1 dose groups. No other adverse developmental findings were observed in surviving offspring, including in reproductive performance.

## PATIENT MEDICATION INFORMATION

### READ THIS FOR SAFE AND EFFECTIVE USE OF YOUR MEDICINE

#### ULTOMIRIS® Ravulizumab for injection

Read this carefully before you start taking **Ultomiris** and each time you get a refill. This leaflet is a summary and will not tell you everything about this drug. Talk to your healthcare professional about your medical condition and treatment and ask if there is any new information about **Ultomiris**.

#### Serious Warnings and Precautions

- **Ultomiris increases your chance of getting serious and life-threatening meningococcal infections. Meningococcal infections may quickly become life-threatening and cause death if not recognized and treated early.**
- **You must be vaccinated against meningococcal infections prior to, or at the time of, initiating Ultomiris.**
- **You must be monitored for early signs of meningococcal infections, evaluated immediately if infection is suspected, and treated with antibiotics.**

Consult your doctor before you take Ultomiris to be sure that you receive vaccination against *Neisseria meningitidis* prior to, or at the time of, beginning therapy. If you start therapy less than 2 weeks after being vaccinated, you must take antibiotics to reduce the risk of infection for 2 weeks. Ensure that your current meningococcal vaccinations are up to date. You should also be aware that vaccination may not prevent this type of infection. In accordance with national recommendations, your doctor might consider that you need supplementary measures to prevent infection.

#### Meningococcal infection symptoms

Because of the importance of rapidly identifying and treating meningococcal infection in patients who receive Ultomiris, you will be provided a card to carry with you at all times, listing relevant signs and symptoms of meningococcal infection/sepsis. This card is named: "Patient Safety Card".

If you experience any of the following symptoms, you should immediately inform your doctor:

- headache with nausea or vomiting
- headache and a fever
- headache with a stiff neck or stiff back
- fever
- fever and rash
- confusion
- muscle aches with flu-like symptoms
- eyes sensitive to light

#### **What is Ultomiris used for?**

#### Paroxysmal Nocturnal Hemoglobinuria

Ultomiris is used for the treatment of adult and pediatric patients one month of age and older with a certain type of disease affecting the blood system called Paroxysmal Nocturnal Hemoglobinuria (PNH).

In patients with PNH, their red blood cells can be destroyed which can lead to low blood counts (anemia), tiredness, difficulty in functioning, pain, dark urine, shortness of breath, and blood clots.

#### atypical Hemolytic Uremic Syndrome

Ultomiris is used for the treatment of adult and pediatric patients one month of age and older with atypical Hemolytic Uremic Syndrome (aHUS).

In patients with aHUS, their kidneys and blood vessels, including platelets, can be inflamed which can lead to low blood counts (thrombocytopenia and anemia), reduced or lost kidney function, blood clots, tiredness and difficulty in functioning.

#### Generalized Myasthenia Gravis

Ultomiris is used to treat adult patients with a certain type of disease affecting the muscles called generalized Myasthenia Gravis (gMG).

In patients with gMG, their muscles can be damaged by their immune system, which can cause severe muscle weakness, impaired vision and mobility, shortness of breath, extreme fatigue, risk for aspiration (i.e. choking caused by inhaling food or liquid), and decreased ability to perform activities of daily living.

#### **How does Ultomiris work?**

Ultomiris contains the active substance ravulizumab that belongs to a class of medicines called monoclonal antibodies. Ravulizumab attaches to and stops the action of a specific protein in the body preventing one very specific component of your immune system from attacking and destroying vulnerable and needed blood, tissue and muscle cells.

#### **What are the ingredients in Ultomiris?**

Medicinal ingredients: Ravulizumab

#### 100 mg/mL

Non-medicinal ingredients: L-arginine, polysorbate 80 (vegetable origin), sodium phosphate dibasic, sodium phosphate monobasic, sucrose, water for injection.

#### 10 mg/mL

Non-medicinal ingredients: Polysorbate 80 (vegetable origin), sodium chloride, sodium phosphate dibasic, sodium phosphate monobasic, water for injection.

#### **Ultomiris comes in the following dosage forms:**

#### 100 mg/mL

Single use vial of 300 mg concentrate for solution for infusion; 3 mL

Single use vial of 1,100 mg concentrate for solution for infusion; 11 mL

#### 10 mg/mL

Single use vial of 300 mg concentrate for solution for infusion; 30 mL

#### **Do not use Ultomiris if:**

- you are allergic to ravulizumab, or any of the other ingredients of this medicine



- you have not received a meningococcal vaccine before or at the time of starting therapy
- you have unresolved meningococcal infection before therapy initiation

**To help avoid side effects and ensure proper use, talk to your healthcare professional before you take Ultomiris. Talk about any health conditions or problems you may have, including if you:**

- have an infection (including if you have or are at risk for gonorrhea infection)

**Other warnings you should know about:**

Allergic Reactions

Ultomiris contains a protein that may cause allergic reactions in some people. Tell your doctor or nurse right away if you get any of these symptoms during your Ultomiris infusion:

- chest pain
- trouble breathing or shortness of breath
- swelling of your face, tongue, or throat
- feel faint or pass out

Infusion reactions

When Ultomiris is given, you may experience reactions to the infusion (drip) such as headache, lower back pain, and infusion-related pain. Some patients may experience infusion reactions and allergic or hypersensitivity reactions (including anaphylaxis, a serious allergic reaction which causes difficulty breathing or dizziness). Tell your doctor or nurse right away if you develop these symptoms, or any other symptoms during your Ultomiris infusion.

Pregnancy and Nursing

Ultomiris should not be used during pregnancy unless the potential benefit justifies the potential risk to the mother and the fetus.

The use of effective contraception during treatment and up to 8 months after treatment should be considered in women who are able to get pregnant.

If you are pregnant or breast-feeding, think you may be pregnant, or are planning to have a baby, ask your doctor or pharmacist for advice before using this medicine.

Ultomiris contains sodium

Ultomiris 10 mg/mL when diluted with 0.9% sodium chloride for IV administration contains 2.65 g sodium per 720 mL at the maximum dose, which is above Health Canada's maximum daily intake recommendation of 2.3 g sodium. This should be taken into consideration by patients on a controlled sodium diet.

Ultomiris 100 mg/mL when diluted with 0.9% sodium chloride for IV administration contains 0.18 g sodium per 72 mL at the maximum dose, which is below Health Canada's maximum daily intake recommendation of 2.3 g sodium.

**Tell your healthcare professional about all the medicines you take, including any drugs, vitamins, minerals, natural supplements or alternative medicines.**

**How to take Ultomiris:**

The treatment will be given by your doctor or other health care provider by infusing a dilution of the Ultomiris vial from a drip bag through a tube directly into one of your veins. It is recommended that the

beginning of your treatments, called the loading phase, will extend over 2 weeks, followed by a maintenance phase. The doses administered are based on your body weight, as shown in Table 1, your doctor will calculate this. Two weeks after receiving your loading dose, you will be administered Ultomiris once every 8 weeks.

If you were receiving Soliris prior to receiving Ultomiris, the loading dose should be administered 2 weeks after the last Soliris infusion. The infusion will take approximately 2 hours.

**Pediatric patients:**

Pediatric patients who weigh  $\geq 40$  kg are treated with the adult dosing recommendations. The weight-based dosing recommendation and dosing interval for pediatric patients  $< 40$  kg are shown in Table 1 with maintenance doses starting 2 weeks after loading dose administration.

**Table 1: Ultomiris Weight-Based Dosing Regimen**

Body Weight Range (kg)	Loading Dose (mg)	Maintenance Dose (mg)	Dosing Interval
$\geq 5$ to $< 10^*$	600	300	Every 4 weeks
$\geq 10$ to $< 20^*$	600	600	Every 4 weeks
$\geq 20$ to $< 30^*$	900	2,100	Every 8 weeks
$\geq 30$ to $< 40^*$	1,200	2,700	Every 8 weeks
$\geq 40$ to $< 60$	2,400	3,000	Every 8 weeks
$\geq 60$ to $< 100$	2,700	3,300	Every 8 weeks
$\geq 100$	3,000	3,600	Every 8 weeks

\*For PNH and aHUS indications only.

Administration of PE/PI (plasmapheresis or plasma exchange, or fresh frozen plasma infusion) or Intravenous immunoglobulin (IVIg) may reduce Ultomiris serum levels.

**Overdose:**

If you think you, or a person you are caring for, have taken too much Ultomiris, contact a healthcare professional, hospital emergency department, or regional poison control centre immediately, even if there are no symptoms.

**Missed Dose:**

If you forget an appointment, please contact your doctor immediately for advice, and see section below “If you stop using Ultomiris.”

**If you stop using Ultomiris for:**

**PNH**

Interrupting or ending treatment with Ultomiris may cause your PNH symptoms to return with greater severity. Your doctor will discuss the possible side effects with you and explain the risks. Your doctor will want to monitor you closely for at least 16 weeks.

The risks of stopping Ultomiris include an increase in the destruction of your red blood cells, which may cause:

- a significant fall in your red blood cell counts (anemia),

- confusion or change in how alert you are,
- chest pain, or angina,
- an increase in your serum creatinine level (problems with your kidneys), or
- thrombosis (blood clotting).

### **aHUS**

If you have aHUS, your doctor will need to monitor you closely for at least 12 months after stopping treatment for signs of worsening aHUS or problems related to a type of abnormal clotting and breakdown of your red blood cells called thrombotic microangiopathy (TMA). Symptoms or problems that can happen with TMA may include:

- confusion or loss of consciousness
- seizures
- chest pain (angina)
- difficulty breathing
- blood clots or stroke

### **gMG**

Interrupting or stopping treatment with Ultomiris may cause your gMG symptoms to reoccur or become worse. Talk to your doctor about the management of your gMG before stopping Ultomiris. They will discuss with you the possible side effects and risks of interrupting or stopping treatment with Ultomiris.

If you have any of these symptoms, contact your doctor.

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

### **What are possible side effects from using Ultomiris?**

These are not all the possible side effects you may have when taking Ultomiris. If you experience any side effects not listed here, tell your healthcare professional.

The most serious side effect is meningococcal infection/sepsis.

If you experience any of the meningococcal infection symptoms, you should immediately inform your doctor. Symptoms are listed under the ‘Serious Warnings & Precautions’ Box and in your Patient Safety Card.

The most common side effects in adult patients with PNH treated with Ultomiris are upper respiratory infection and headache.

The most common side effects of Ultomiris in pediatric patients with PNH are abdominal pain and common cold.

The most common side effects of Ultomiris in patients with aHUS are upper respiratory tract infection, common cold and headache.

The most common side effects of Ultomiris in people with gMG are diarrhea and upper respiratory tract infection.

<b>Serious side effects and what to do about them</b>			
Symptom / effect	Talk to your healthcare professional		Stop taking drug and get immediate medical help
	Only if severe	In all cases	
<b>VERY COMMON</b>			
Common cold (nasopharyngitis)	x		
Diarrhea	x		
Fatigue	x		
Headache	x		
Nausea	x		
Upper respiratory tract infection	x		
<b>COMMON</b>			
Abdominal pain	x		
Back Pain	x		
Dizziness	x		
Fatigue	x		
Fever		x	
Hives	x		
Influenza-like illness		x	
Itchiness	x		
Joint Pain	x		
Muscle Pain	x		
Muscle Spasm	x		
Nausea	x		
Pruritus	x		
Rash	x		
Upset stomach	x		
Vomiting	x		
Weakness	x		
<b>UNCOMMON</b>			
Anaphylactic reaction <sup>a</sup>		x	x
Chills		x	
Gonococcal infection <sup>b</sup>		x	
Hypersensitivity <sup>c</sup>		x	
Meningococcal infection		x	x
Meningococcal sepsis		x	x

a: Estimated from postmarketing experience

b: Gonococcal infection includes disseminated gonococcal infection

c: Hypersensitivity is a group term for Preferred Term drug hypersensitivity with related causality and Preferred Term hypersensitivity

If you have a troublesome symptom or side effect that is not listed here or becomes bad enough to interfere with your daily activities, tell your healthcare professional.

### Reporting Side Effects

You can report any suspected side effects associated with the use of health products to Health Canada by:

- Visiting the Web page on Adverse Reaction Reporting (<https://www.canada.ca/en/health-canada/services/drugs-health-products/medeffect-canada.html>) for information on how to report online, by mail or by fax; or
- Calling toll-free at 1-866-234-2345.

*NOTE: Contact your health professional if you need information about how to manage your side effects. The Canada Vigilance Program does not provide medical advice.*

### Storage:

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

Store in a refrigerator (2°C – 8°C).

Do not freeze. Do not shake.

Store in the original package in order to protect from light.

After dilution with 0.9% sodium chloride, the Ultomiris 100 mg/mL product should be used within 24 hours if refrigerated or within 4 hours at room temperature.

After dilution with 0.9% sodium chloride, the Ultomiris 10 mg/mL product should be used within 24 hours if refrigerated or within 6 hours at room temperature.

Keep out of reach and sight of children.

### If you want more information about Ultomiris:

- Talk to your healthcare professional
- Find the full product monograph that is prepared for healthcare professionals and includes this Patient Medication Information by visiting the Health Canada website: <https://www.canada.ca/en/health-canada/services/drugs-health-products/drug-products/drug-product-database.html>; the manufacturer’s website [www.alexion.com](http://www.alexion.com), or by calling 1-888-765-4747.

Alexion Pharmaceuticals, Inc. has established a PNH and aHUS registries in order to continue to monitor and evaluate the safety and effectiveness of Ultomiris. Please speak to your physician if you are interested in participating in the study. For further information on the registries, please contact [medinfo.ca@alexion.com](mailto:medinfo.ca@alexion.com).

This leaflet was prepared by Alexion Pharma GmbH.

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