DUKORAL®
*Vibrio cholerae* and enterotoxigenic *Escherichia coli* vaccine

**Name of the Medicine**
Vaccine containing heat inactivated *Vibrio cholerae* O1 Inaba classic strain, formalin inactivated *Vibrio cholerae* O1 Inaba El Tor strain, heat inactivated *Vibrio cholerae* O1 Ogawa classic strain, formalin inactivated *Vibrio cholerae* O1 Ogawa classic strain, and recombinant *Vibrio cholerae* toxin B subunit.

**Description**
DUKORAL® is provided as a whitish oral liquid suspension (vaccine) in a single dose glass vial with white to off-white effervescent granules (buffer), in an accompanying sachet.

Each dose contains:

**Active ingredients**
- A total of $1.25 \times 10^{11}$ bacteria of the following strains:
  - *Vibrio cholerae* O1 Inaba classic strain, heat inactivated  $\approx 31.25 \times 10^9$ bacteria*
  - *Vibrio cholerae* O1 Inaba El Tor strain, formalin inactivated  $\approx 31.25 \times 10^9$ bacteria*
  - *Vibrio cholerae* O1 Ogawa classic strain, formalin inactivated  $\approx 31.25 \times 10^9$ bacteria*
  - *Vibrio cholerae* O1 Ogawa classic strain, heat inactivated  $\approx 31.25 \times 10^9$ bacteria*

  *bacterial count before inactivation

- Recombinant cholera toxin B subunit  1mg

**Excipients**
Vaccine, 1 dose (3mL) contains:

- Sodium phosphate, monobasic dihydrate  1.95mg
- Sodium phosphate, dibasic dihydrate  9.39mg
- Sodium chloride  25.5mg
- Water for injections  to 3.0mL

Effervescent granules, one sachet (5.6g) contains:

- Sodium bicarbonate  3600mg
- Citric acid, anhydrous  1450mg
- Raspberry flavour  70.0mg
- Sodium carbonate anhydrous  400mg
- Sodium citrate  6.0mg
- Sodium saccharin  30.0mg

**Pharmacology**
The vaccine contains killed whole *Vibrio cholerae* O1 bacteria and the recombinant non-toxic B-subunit of the cholera toxin (CTB). Bacterial strains of both Inaba and Ogawa serotypes and of El Tor and Classical biotypes are included in the vaccine. DUKORAL® is taken orally with bicarbonate buffer, which protects the antigens from the gastric acid. The vaccine acts by inducing antibodies against both the bacterial components and CTB. The antibacterial intestinal antibodies prevent the bacteria from attaching to the intestinal wall thereby impeding colonisation of *V. cholerae* O1. The anti-toxin intestinal antibodies prevent the cholera toxin from binding to the intestinal mucosal surface thereby preventing the toxin-mediated diarrhoeal symptoms.

The heat-labile toxin (LT) of enterotoxigenic *Escherichia coli* (ETEC) is structurally, functionally and immunologically similar to CTB. The two toxins cross-react immunologically.
This means that DUKORAL® also will protect against ETEC diarrhoea.

Cholera and ETEC infections are limited to the intestinal tract. Oral administration will induce local immunity.

Since the B subunit is acid labile, the vaccine is mixed with a buffering sodium hydrogen carbonate solution.

**Clinical Trials Data**

**Efficacy against cholera:**
Clinical results have revealed a protective efficacy against cholera of 80-85% for the first six months in all age categories. In adults and children over the age of 6, protective efficacy over a 3-year follow-up period averaged about 63% (without a booster dose). Children under the age of 2 were not examined, but protective efficacy in the 2-6-year age range was satisfactory for the first six months.

In an efficacy study done in Bangladesh in 89,596 adults and children aged 2 years and older, the efficacy of DUKORAL® against cholera was 85% in the 6 months after the third dose and 57% in the second year after immunization. Protective efficacy declined over the 3-year study period, declining more rapidly in those under 6 years of age.

An exploratory analysis suggested that 2 vaccine doses seemed as effective as 3 doses in adults.

Protective efficacy of DUKORAL® against cholera has not been studied following repeated booster vaccination.

Protective effectiveness against cholera was evaluated during two mass-vaccination campaigns conducted in Mozambique (December 2003 – January 2004) and Zanzibar (February 2009 – May 2010).

In the case-control study conducted during the mass vaccination campaign in Mozambique, protective effectiveness of 2 doses of DUKORAL® was 84% (95% CI: 43, 95, per-protocol analysis; p=0.005) for the initial 5 months of follow-up.

In the longitudinal cohort-analysis conducted during the mass-vaccination campaign in Zanzibar, protective effectiveness after 2 doses of DUKORAL® was 79% (95% CI, 47, 92) for a follow-up period of 15 months. In addition to the direct protection, it was shown that DUKORAL® provides significant indirect (herd) protection in the studied setting.

**Efficacy against ETEC:**
Protective efficacy against ETEC diarrhoea is about 60%. Protective efficacy with reference to all kinds of tourist diarrhoea will vary depending on the prevalence of ETEC. There are considerable variations between different seasons and geographic areas. Protective efficacy against ETEC is of comparatively short duration, lasting about 3 months.

In a prospective double-blind clinical trial conducted in Finnish travellers, 615 healthy persons aged 15 years and older received two doses of either DUKORAL® (N = 307) or placebo (N = 308) before trip departure. The total incidence of diarrhoea, independent of cause, was 31% in the placebo treated group and 24% in the DUKORAL® treated group, i.e. 23% protective efficacy against all types of ‘travellers’ diarrhoea.

In a randomized, double-blind efficacy study done in Bangladesh in 89,596 adults and children aged 2 years and older, DUKORAL® conferred 67% protection against episodes of diarrhoea caused by enterotoxigenic E. coli synthesizing heat-labile toxin (LT-ETEC) during the initial 3 months of follow-up but demonstrated no protection thereafter. Protective efficacy against clinically severe episodes of LT-ETEC was 86%.

**Indications**

**Cholera:** Active immunisation of adults and children from two years of age, who will be visiting areas
with an ongoing or anticipated epidemic or who will be spending an extended period of time in areas
in which cholera infection is a risk.

The vaccine should be considered for foreign aid workers and others intending to visit or spend an
extended period of time in areas endemic or epidemic for cholera.

ETEC: Active immunisation of adults and children from two years of age who will be visiting areas
posing a great risk of diarrhoeal illness caused by enterotoxigenic Escherichia coli (ETEC), one of the
most common causes of ‘travellers’ diarrhoea’.

DUKORAL® should not replace standard protective measures. In the event of diarrhoea, measures of
rehydration should be instituted.

**Contraindications**
Hypersensitivity to the active substances, to any of the excipients or to formaldehyde.

Administration of DUKORAL® should be postponed for subjects suffering from acute gastrointestinal
illness or acute febrile illness.

**Precautions**
No clinical data on protective efficacy of DUKORAL® against cholera after administration of booster
doses are available.

DUKORAL® confers protection specific to Vibrio cholerae serogroup O1. Immunisation does not
protect against V. cholerae serogroup O139 or other species of Vibrio cholerae.

The vaccine does not provide complete protection and it is important to adhere additionally to
standard protective measures to avoid cholera.

In subjects infected with HIV, limited data are available on immunogenicity and safety of the vaccine.
Vaccine protective efficacy has not been studied in these subjects. Immunisation of HIV infected
subjects could result in transient increases of viral load. DUKORAL® may not induce protective
antibody levels in subjects with advanced HIV disease. However, an effectiveness study in a
population with high HIV prevalence showed similar protection as in other populations.

Antibody response in vaccinees with endogenous or iatrogenic immunosuppression may be
insufficient.

Formaldehyde is used during the manufacturing process and trace amounts may be present in the
final product. Caution should be taken in subjects with known hypersensitivity to formaldehyde.

DUKORAL® contains approximately 1.1 g sodium per dose, which should be taken into consideration
by patients on a controlled sodium diet.

**Use in Children**
DUKORAL® has been given to children between 1 and 2 years of age in safety and immunogenicity
studies, but the protective efficacy has not been studied in this age group. Therefore, DUKORAL® is
not recommended to be used in children less than 2 years of age.

**Use in the Elderly**
There are only very limited data on protective efficacy of the vaccine in subjects aged 65 years and
over.

**Carcinogenicity, mutagenicity, impairment of fertility**
DUKORAL has not been evaluated for carcinogenicity, mutagenicity, or impairment of fertility.

**Use in Pregnancy - Category B2**
No animal data on reproduction toxicity are available. Following careful benefit/risk assessment the
vaccine may be administered during pregnancy although no specific studies have been conducted to investigate the safety of DUKORAL® during pregnancy. However, DUKORAL® is an inactivated, non-replicating vaccine given orally and it is not taken up by the blood stream. It is therefore considered to be safe.

During a mass-vaccination campaign conducted in Zanzibar, 196 mothers had received at least one dose of DUKORAL® during pregnancy. There was no statistically significant evidence of a harmful effect of DUKORAL® exposure during pregnancy.

**Use in Lactation**
Following careful benefit/risk assessment the vaccine may be administered to lactating women. It has been given to lactating women in several studies, although no specific studies have been conducted to investigate the safety of DUKORAL® during lactation.

**Effect on Ability to Drive and Use Machines**
There is no evidence of an effect on the ability to drive and use machines.

**Effects on Laboratory Tests**
Not documented.

**Interactions with other Medicines**
The vaccine is acid labile. Food and/or drink will increase acid production in the stomach and the effect of the vaccine may be impaired. Consequently, food and drink should be avoided 1 hour before and 1 hour after vaccination.

Oral administration of other vaccines and medicinal products should be avoided 1 hour before and 1 hour after administration of DUKORAL®.

Preliminary results from a clinical study including a limited number of volunteers showed no interaction with the antibody response to DUKORAL® when a live oral vaccine (enterocapsules) against typhoid was given simultaneously with DUKORAL®. The immune response to live typhoid vaccine was not investigated in this study.

Similarly, a yellow fever vaccine was given concomitantly with DUKORAL®, and there was no interaction observed with the immune response to the yellow fever vaccine. The immune responses to DUKORAL® were not studied.

No other vaccines/medicinal products, including oral polio vaccine and antimalarials, have been given simultaneously with DUKORAL® in clinical studies.

**Adverse Effects**
Adverse reactions are adverse events that were considered to be reasonably associated with the use of DUKORAL® based on the comprehensive assessment of the available adverse event information. A causal relationship with DUKORAL® cannot be reliably established in individual cases. Further, because clinical trials are conducted under widely varying conditions, adverse reaction rates observed in the clinical trials of a vaccine cannot be directly compared to rates in the clinical trials of another vaccine and may not reflect the rates observed in clinical practice.

The safety of DUKORAL® was assessed in clinical trials, including both adults and children, conducted in endemic and non-endemic countries for cholera and enterotoxigenic *Escherichia coli* (ETEC) producing heat-labile enterotoxin (LT). Over 94,000 doses of DUKORAL® were administered during the clinical trials. Evaluation of safety varied between trials with respect to mode of surveillance, definition of symptoms and time of follow-up. In the majority of studies adverse events were assessed by passive surveillance. The most frequently reported adverse reactions, such as gastrointestinal symptoms including abdominal pain, diarrhoea, loose stools, nausea and vomiting, occurred at similar frequencies in vaccine and placebo groups.

Frequency classification: Very common (≥ 1/10); common (≥ 1/100 to <1/10); uncommon (≥ 1/1,000 to <1/100); rare (≥ 1/10,000 to <1/1,000); very rare (<1/10,000), not known (cannot be estimated from
Metabolism and nutrition disorder

Rare: Loss of/or poor appetite
Very rare: Dehydration

Nervous system disorders

Uncommon: Headache
Rare: Dizziness
Very rare: Drowsiness, insomnia, fainting, reduced sense of taste

Respiratory, thoracic and mediastinal disorders

Rare: Respiratory symptoms (including rhinitis and cough)

Gastrointestinal disorders

Uncommon: Diarrhoea, abdominal cramps, abdominal pain, stomach/abdominal gurgling (gas), abdominal discomfort
Rare: Vomiting, nausea
Very rare: Sore throat, dyspepsia

Skin and subcutaneous tissue disorders

Very rare: Sweating, rash

Musculoskeletal and connective tissue disorders

Very rare: Joint pain

General disorders and administration site conditions

Rare: Fever, malaise
Very rare: Fatigue, shivers

Postmarketing data

Additional adverse reactions reported during post-marketing surveillance, are listed below. The frequency cannot be estimated from the available data.

Infections and infestations: Gastroenteritis
Blood and lymphatic system disorders: Lymphadenitis
Nervous system disorders: Paraesthesia
Vascular disorders: Hypertension
Respiratory, thoracic and mediastinal disorders: Dyspnoea, increased sputum
Gastrointestinal disorders: Flatulence
Skin and subcutaneous tissue disorders: Urticaria, angioedema, pruritus
General disorders and administration site conditions: Pain, flu-like syndrome, asthenia, chills

Dosage and Administration

Dosage

Cholera:
Primary immunisation: Consists of 2 doses of vaccine for adults and children over the age of 6. Children from 2 to 6 years of age should receive 3 doses. Doses are to be administered at intervals of at least 1 week. If more than 6 weeks elapse between doses, the primary immunisation course should be re-started.

Immunisation should be completed at least 1 week prior to potential exposure.

Booster dose: For optimum long-term protection, a single booster dose is recommended for adults after 2 years. Children from 2 to 6 years of age should receive a booster dose after 6 months.

No clinical efficacy data has been generated on repeat booster dosing.
**ETEC:**

**Primary immunisation:** Consists of 2 doses of vaccine for adults and children from 2 years of age. Doses are to be administered at an interval of at least 1 week. **If more than 6 weeks elapse between doses, the primary immunisation course should be re-started.**

Satisfactory protection against cholera and ETEC diarrhoea can be expected about one week after primary immunisation is concluded.

**Administration**

The vaccine is intended for oral use. Before ingestion, the vaccine suspension should be mixed with a buffer (sodium hydrogen carbonate) solution prepared from the supplied effervescent granules.

Dissolve the effervescent granules in approximately 150 mL of cool water to make the buffer solution. Shake the vaccine vial gently and add the contents to the buffer solution. Mix well and drink the mixture.

*Children 2 to 6 years of age: half the amount of buffer solution is poured away and the remaining part (approx. 75mL) is mixed with the entire contents of the vaccine vial.*

Food and drink should be avoided for 1 hour before and 1 hour after vaccine administration.

For administration with other oral medicinal products, see ‘Interactions with other medicines’.

DUKORAL® should only be mixed with the supplied effervescent granules dissolved in water. In the absence of compatibility studies, this medicinal product must not be mixed with other medicinal products.

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

**Overdosage**

Data on overdose are limited. Adverse reactions reported following overdose have been consistent with those seen after the recommended dosing.

For information on the management of overdose, contact the New Zealand Poisons Centre on 0800 POISON or 0800 764 766

**Presentation**

DUKORAL® is provided as a whitish oral liquid suspension (vaccine) in a single dose glass vial with white to off-white effervescent granules (buffer), in an accompanying sachet.

The vaccine suspension is filled to a volume of 3 mL in vials (type I glass) with a rubber stopper (bromobutyl rubber) and a screw cap.

DUKORAL® is available in the following pack size:
- Single Dose Carton: 1 vaccine vial and 1 sachet of effervescent granules

**Storage**

Store at 2° to 8°C. REFRIGERATE. DO NOT FREEZE.

Do not use after expiry date.

**Medicine Classification**

Prescription Medicine

**Manufacturer**

Valneva Sweden AB
105 21 Stockholm, Sweden

**Sponsor Details**

bioCSL (NZ) Limited
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