

## PRODUCT MONOGRAPH

### **SYNFLORIX**

Pneumococcal conjugate vaccine (Non-Typeable *Haemophilus influenzae* (NTHi)  
protein D, diphtheria or tetanus toxoid conjugates) adsorbed

Suspension for injection

Active immunizing agent

GlaxoSmithKline Inc.  
7333 Mississauga Road  
Mississauga, Ontario  
L5N 6L4

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# SYNFLORIX

Pneumococcal conjugate vaccine (Non-Typeable *Haemophilus influenzae* (NTHi) protein D, diphtheria or tetanus toxoid conjugates) adsorbed

## PART I: HEALTH PROFESSIONAL INFORMATION

### SUMMARY PRODUCT INFORMATION

| Route of Administration | Dosage Form / Strength  | Clinically Relevant Nonmedicinal Ingredients   |
|-------------------------|---|--|
| Intramuscular           | Suspension for injection<br>1 dose (0.5 mL) contains:<br>Pneumococcal polysaccharide serotype 1 <sup>1</sup> 1 µg<br>Pneumococcal polysaccharide serotype 4 <sup>1</sup> 3 µg<br>Pneumococcal polysaccharide serotype 5 <sup>1</sup> 1 µg<br>Pneumococcal polysaccharide serotype 6B <sup>1</sup> 1 µg<br>Pneumococcal polysaccharide serotype 7F <sup>1</sup> 1 µg<br>Pneumococcal polysaccharide serotype 9V <sup>1</sup> 1 µg<br>Pneumococcal polysaccharide serotype 14 <sup>1</sup> 1 µg<br>Pneumococcal polysaccharide serotype 18C <sup>2</sup> 3 µg<br>Pneumococcal polysaccharide serotype 19F <sup>3</sup> 3 µg<br>Pneumococcal polysaccharide serotype 23F <sup>1</sup> 1 µg | aluminum phosphate, sodium chloride, water for injections.<br><br><i>For a complete listing see DOSAGE FORMS, COMPOSITION AND PACKAGING section.</i> |

<sup>1</sup> conjugated to protein D (derived from Non-Typeable *Haemophilus influenzae*) carrier protein

<sup>2</sup> conjugated to tetanus toxoid carrier protein

<sup>3</sup> conjugated to diphtheria toxoid carrier protein

### DESCRIPTION

SYNFLORIX [(pneumococcal conjugate vaccine (Non-Typeable *Haemophilus influenzae* (NTHi) protein D, diphtheria or tetanus toxoid conjugates) adsorbed] is a 10-valent pneumococcal polysaccharide conjugate vaccine using protein D derived from Non-Typeable *Haemophilus influenzae* as a carrier protein for 8 out of the 10 serotypes (1, 4,

5, 6B, 7F, 9V, 14 and 23F). Serotypes 18C and 19F are conjugated to tetanus toxoid and to diphtheria toxoid, respectively. All conjugates are adsorbed onto aluminum phosphate. Immunological similarities are expected amongst serotypes from the same serogroup.

## **INDICATIONS AND CLINICAL USE**

SYNFLORIX is indicated for active immunization of infants and children from 6 weeks up to 5 years of age against diseases caused by *Streptococcus pneumoniae* serotypes 1, 4, 5, 6B, 7F, 9V, 14, 18C, 19F, 23F and cross-reactive 19A:

- invasive disease (including sepsis, meningitis, bacteraemic pneumonia, pleural empyema and bacteraemia) (see Part II, CLINICAL TRIALS)
- pneumonia
- acute otitis media (AOM)

### **Geriatrics (> 65 years of age):**

Studies have not been conducted in adults 65 years and older.

### **Pediatrics:**

See Part II, CLINICAL TRIALS.

## **CONTRAINDICATIONS**

SYNFLORIX should not be administered to subjects with known hypersensitivity to any component of the vaccine. For a complete listing, see the DOSAGE FORMS, COMPOSITION AND PACKAGING section of the product monograph.

## **WARNINGS AND PRECAUTIONS**

SYNFLORIX is indicated and intended for use in children up to 5 years of age (see INDICATIONS AND CLINICAL USE). For appropriate usage of SYNFLORIX across age groups, children below 5 years of age should receive the appropriate-for-age SYNFLORIX vaccination series (see DOSAGE AND ADMINISTRATION).

### **General**

It is good clinical practice to precede vaccination by a review of the medical history (especially with regard to previous vaccination and possible occurrence of undesirable events) and a clinical examination.

As with other vaccines, the administration of SYNFLORIX should be postponed in subjects suffering from acute severe febrile illness. However, the presence of a minor infection, such as a cold, should not result in the deferral of vaccination.

SYNFLORIX should under no circumstances be administered intravascularly or intradermally. No data are available on subcutaneous administration of SYNFLORIX.

SYNFLORIX will not protect against pneumococcal serogroups or serotypes that are not included in the vaccine, except the cross-reactive serotype 19A (see Part II, Pharmaceutical Information, Product Characteristics). The observed immune responses to the vaccine varied with each of the vaccine serotypes (see Part II, CLINICAL TRIALS). Although antibody response to diphtheria toxoid, tetanus toxoid and protein D (protein D is highly conserved in all *H. influenzae* strains including NTHi) occurs, immunization with SYNFLORIX does not substitute routine immunization with diphtheria, tetanus or *Haemophilus influenzae* type b vaccines. Official recommendations for the immunizations against diphtheria, tetanus and *Haemophilus influenzae* type b should also be followed.

Prophylactic administration of antipyretics before or immediately after vaccine administration can reduce the incidence and intensity of post-vaccination febrile reactions. Post-market clinical data generated with acetaminophen and ibuprofen suggest that the use of prophylactic acetaminophen might reduce the immune response to SYNFLORIX. The clinical relevance of this observation as well as the impact of antipyretics other than acetaminophen and ibuprofen remains unknown.

The potential risk of apnoea and the need for respiratory monitoring for 48-72 hours should be considered when administering the primary immunization series to very premature infants (born  $\leq 28$  weeks of gestation) and particularly for those with a previous history of respiratory immaturity. As the benefit of vaccination is high in this group of infants, vaccination should not be withheld or delayed. Also see DOSAGE AND ADMINISTRATION and Part II, CLINICAL TRIALS.

Syncope (fainting) can occur following, or even before, any vaccination as a psychogenic response to the needle injection. It is important that procedures are in place to avoid injury from faints.

### **Hematologic**

As for other vaccines administered intramuscularly, SYNFLORIX should be given with caution to individuals with thrombocytopenia or any coagulation disorder since bleeding may occur following an intramuscular administration to these subjects.

### **Immune**

As with all injectable vaccines, appropriate medical treatment and supervision should always be readily available in case of a rare anaphylactic event following the administration of the vaccine.

As with any vaccine, a protective immune response may not be elicited in all vaccinees.

Children with impaired immune responsiveness, whether due to the use of immunosuppressive therapy, a genetic defect, HIV infection, or other causes, may have reduced antibody response to vaccination.

Safety and immunogenicity data are available for HIV infected infants and children with sickle cell disease (high risk populations predisposed to invasive pneumococcal disease), (see ADVERSE REACTIONS and Part II, CLINICAL TRIALS). Safety and immunogenicity data for SYNFLORIX are not available for individuals in other specific immunocompromised groups and vaccination should be considered on an individual basis.

### **Special Populations**

**Pregnant Women:** As SYNFLORIX is not intended for use in adults, adequate human data on use during pregnancy and adequate animal reproduction studies are not available.

**Nursing Women:** As SYNFLORIX is not intended for use in adults, adequate human data on use during lactation and adequate animal reproduction studies are not available.

**Geriatrics (> 65 years of age):** Studies have not been conducted in adults 65 years and older.

## **ADVERSE REACTIONS**

### **Clinical Trial Adverse Drug Reactions**

*Because clinical trials are conducted under very specific conditions the adverse reaction rates observed in the clinical trials may not reflect the rates observed in practice and should not be compared to the rates in the clinical trials of another drug. Adverse drug reaction information from clinical trials is useful for identifying drug-related adverse events and for approximating rates.*

Safety assessment of SYNFLORIX was based on clinical trials involving the administration of approximately 64,000 doses of SYNFLORIX to approximately 22,500 healthy children and 137 healthy premature infants as primary vaccination. Furthermore, approximately 19,500 healthy children and 116 premature infants received a booster dose of SYNFLORIX in the second year of life. Safety was also assessed in 400 children from 2 to 5 years of age. In all trials, SYNFLORIX was administered concurrently with the recommended childhood vaccines.

No increase in the incidence or severity of the adverse reactions was seen with subsequent doses of the primary vaccination series.

The most common adverse reactions observed after primary vaccination were redness at the injection site and irritability which occurred after approximately 41% and 55% of all doses respectively. Following booster vaccination, the most common adverse reactions were pain at the injection site and irritability, which occurred at approximately 51% and 53% respectively. The majority of these reactions were of mild to moderate severity and were not long lasting.

Adverse reactions reported (for all age groups) are listed according to the following frequency (see Table 1).

**Table 1      Adverse reactions considered as being at least possibly related to vaccination**

| Frequency                          | Adverse Reactions   | System/Organ Class                                   |
|------------------------------------|---|--|
| Very common<br>(≥ 1/10)            | Appetite loss   | Metabolism and nutrition disorders                   |
|                                    | Drowsiness  | Nervous system disorders                             |
|                                    | Pain, redness, swelling at the injection site, fever ≥ 38°C rectally (age < 2 years)  | General disorders and administration site conditions |
|                                    | Irritability  | Psychiatric disorders                                |
| Common (≥ 1/100 to < 1/10)         | Injection site reactions like site injection induration, fever > 39°C rectally (age < 2 years), fever ≥ 38°C rectally (age 2 to 5 years)*   | General disorders and administration site conditions |
| Uncommon<br>(≥ 1/1,000 to < 1/100) | Diarrhoea, vomiting, nausea (age 2 to 5 years)*   | Gastrointestinal disorders                           |
|                                    | Injection site reactions like injection site haematoma, haemorrhage and nodule  | General disorders and administration site conditions |
|                                    | Headache (age 2 to 5 years)*  | Nervous system disorders                             |
|                                    | injection site reactions like pruritus*, fever > 40°C rectally (age < 2 years)*, fever >39°C rectally (age 2 to 5 years)*, diffuse swelling of the injected limb, sometimes involving the adjacent joint* | General disorders and administration site conditions |
|                                    | crying abnormal   | Psychiatric disorders                                |
|                                    | Rash  | Skin and subcutaneous tissue disorders               |
|                                    | Apnoea (see section “Warnings and Precautions” in very premature infants [≤ 28 weeks of gestation])   | Respiratory, thoracic and mediastinal disorders      |
| Rare (≥ 1/10,000 to < 1/1,000)     | Febrile and non-febrile convulsions   | Nervous system disorders                             |
|                                    | Allergic reactions (such as allergic dermatitis, atopic dermatitis, eczema)   | Immune system disorders                              |
|                                    | Urticaria   | Skin and subcutaneous tissue disorders               |
| Very rare (<1/10000)               | Angioedema  | Immune system disorders                              |
|                                    | Kawasaki disease  | Vascular disorders                                   |

\* reported following booster vaccination of primary series and/or catch-up vaccination



Following booster vaccination, children > 12 months of age are more likely to experience injection site reactions compared to the rates observed in infants during the primary series with SYNFLORIX.

Following catch-up vaccination in children 12 to 23 months of age, urticaria was reported more frequently (uncommon) compare to the rates observed in infants during primary and booster vaccination.

The incidence of solicited local and general adverse events reported within 4 days after each vaccination dose of SYNFLORIX was within the same range as after vaccination with the 7-valent Pneumococcal Conjugate Vaccine (PCV) vaccine (see Table 2).

**Table 2 Percentage of subjects reporting local and general adverse events within 4 days (day 0-3) following each dose in primary vaccination course and after a booster dose of SYNFLORIX or the 7-valent PCV vaccine in primary study 10PN-PD-DIT-001 and subsequent booster study 10PN-PD-DIT-007**

|                                 | Dose 1    |                      | Dose 2    |                      | Dose 3    |                      | Dose 4    |                      |
|---------------------------------|-----------|----------------------|-----------|----------------------|-----------|----------------------|-----------|----------------------|
|                                 | SYNFLORIX | 7-valent PCV vaccine | SYNFLORIX | 7-valent PCV vaccine | SYNFLORIX | 7-valent PCV vaccine | SYNFLORIX | 7-valent PCV vaccine |
| <b>Local symptom</b>            | N = 1230  | N = 415              | N = 1217  | N = 414              | N = 1216  | N = 411              | N = 735   | N = 91               |
| Pain                            | 35.5      | 27.2                 | 27.8      | 26.8                 | 22.8      | 23.4                 | 56.6      | 49.5                 |
| Redness                         | 37.3      | 38.3                 | 37.6      | 39.1                 | 37.8      | 36.3                 | 51.7      | 57.1                 |
| Swelling                        | 28.9      | 26.0                 | 30.1      | 27.8                 | 28.3      | 24.6                 | 36.9      | 38.5                 |
| <b>General symptom</b>          |           |                      |           |                      |           |                      |           |                      |
| Fever $\geq 38^{\circ}\text{C}$ | 36.7      | 30.1                 | 35.3      | 39.6                 | 25.6      | 31.4                 | 33.3      | 36.3                 |
| Fever $> 39^{\circ}\text{C}$    | 2.0       | 1.4                  | 2.2       | 2.4                  | 1.8       | 2.4                  | 3.3       | 7.7                  |
| Irritability                    | 66.1      | 64.6                 | 61.5      | 61.8                 | 51.2      | 55.5                 | 59.6      | 60.4                 |
| Drowsiness                      | 58.0      | 54.7                 | 47.5      | 45.2                 | 33.1      | 35.3                 | 41.2      | 52.7                 |
| Loss of appetite                | 29.8      | 28.4                 | 23.7      | 23.4                 | 16.9      | 21.9                 | 31.3      | 34.1                 |

Study 10PN-PD-DIT-001 = 3 doses of SYNFLORIX or the 7-valent PCV vaccine+ DTPa-HBV-IPV/Hib at 2, 3 and 4 months of age

Study 10PN-PD-DIT-007 = 1 dose of SYNFLORIX or the 7-valent PCV vaccine+ DTPa-HBV-IPV/Hib at 12 to 18 months of age

The most common adverse reactions after primary vaccination of premature and healthy full-term children were irritability (36.1%), redness (28.3%) and pain (27.3%) in premature children and irritability (40.0%), redness (48.2%) and swelling (43.5%) in the healthy full-term children. Following booster vaccination of premature and healthy full-term children, the most common adverse reactions observed were pain (42.0% and 54.9%, respectively) and irritability (32.1% and 40.2%, respectively) in both premature and healthy children.

**Table 3**      **The overall per dose incidence of local adverse events within 4 days (day 0-3) following the primary vaccination course of SYNFLORIX co-administered with DTPa-HBV-IPV/Hib vaccine in preterm infants (Study10PN-PD-DIT-015) and after a booster dose of SYNFLORIX co-administered with DTPa-IPV/Hib at 16-18 months of age (Study10PN-PD-DIT-016)**

| Study 10PN-PD-DIT-015 |                             |           |                  |                             |           |                  |
|-----------------------|-----------------------------|-----------|------------------|-----------------------------|-----------|------------------|
|                       | Premature (N = 399)<br>(%†) |           |                  | Full-Term (N = 425)<br>(%†) |           |                  |
| Local Symptom         | Total‡                      | SYNFLORIX | DTPa-HBV-IPV/Hib | Total                       | SYNFLORIX | DTPa-HBV-IPV/Hib |
| Pain                  | 27.3                        | 24.1      | 21.8             | 32.7                        | 28.7      | 28.8             |
| Redness               | 28.3                        | 24.1      | 21.1             | 48.2                        | 41.9      | 39.9             |
| Swelling              | 21.1                        | 16.0      | 14.8             | 43.5                        | 36.5      | 36.3             |
| Study 10PN-PD-DIT-016 |                             |           |                  |                             |           |                  |
|                       | Premature (N = 112)<br>(%†) |           |                  | Full-Term (N = 122)<br>(%†) |           |                  |
| Local Symptom         | Total                       | SYNFLORIX | DTPa-IPV/Hib     | Total                       | SYNFLORIX | DTPa-IPV/Hib     |
| Pain                  | 42.0                        | 37.5      | 33.9             | 54.9                        | 48.4      | 46.7             |
| Redness               | 31.3                        | 27.7      | 23.2             | 53.3                        | 50.8      | 45.1             |
| Swelling              | 24.1                        | 21.4      | 17.0             | 45.1                        | 40.2      | 36.9             |

Premature – infants born after a gestation period of 27-36 weeks

Full-Term – infants born after a gestation period of more than 36 weeks

N – number of documented doses

†Percentage of doses followed by at least one type of symptom

‡Total represents percentage of doses with at least one local symptom whatever the number of injections

During the primary vaccination course, the overall per dose incidence of fever with rectal temperature > 39.0°C was 1.0% in the pooled Premature group and 2.1% in the Full-term group. Following booster vaccination, fever > 39°C was reported in 7.1% of subjects in the pooled Premature group and in 4.9% in the Full-term group.

Swelling reactions following vaccination in healthy populations:

In the clinical program, the occurrence of large swelling reactions (i.e. swelling with a diameter > 50 mm, noticeable diffuse swelling or noticeable increase of limb circumference) was solicited following booster or catch-up vaccination. In booster and catch-up vaccination study groups, 61 and 39 cases of large swelling reactions were reported respectively at the SYNFLORIX injection site. For all subjects the onset of swelling occurred within three days after vaccination and all resolved within eight days after vaccination, except for 2 cases which lasted 32 days and 33 days. Most of these swellings were local and limited to the injection site. There were 13 cases of diffuse swelling not involving adjacent joints.

Serious Adverse Events (SAE) following vaccination in healthy populations:  
Fifteen out of 22,429 subjects (0.07%) receiving primary vaccination with SYNFLORIX and three out of 1461 7-valent PCV vaccinees (0.2%) experienced an SAE that was assessed by the investigator as causally related to vaccination. In booster studies seven out of 19,466 subjects (0.04%) receiving a booster dose of SYNFLORIX and none of the 1011 7-valent PCV vaccinees reported an SAE that was assessed by the investigator as causally related to vaccination. In the catch-up vaccination, none of the SAEs were considered to be causally related to vaccination.

Deaths following vaccination in healthy populations:  
In primary vaccination studies, 21 (out of 22,429) SYNFLORIX vaccinees (receiving 63,905 doses) experienced serious adverse events with a fatal outcome. One of the fatalities among the SYNFLORIX vaccinees was considered to be causally related to vaccination by the investigator (1 day after dose 1 co-administered with *Tritanrix HepB/Hib* and 1 day after concomitant administration of oral polio vaccine). One out of 1,461 7-valent PCV vaccinees died due to muscle atrophy. In booster studies 8 (out of 19,466 subjects) receiving a booster dose of SYNFLORIX and one (out of the 1011) 7-valent PCV vaccinees reported an SAE with a fatal outcome. None of the fatalities reported in the booster studies was considered by the investigator to be causally related to vaccination. No fatal serious adverse events were reported in the completed catch-up immunization studies.

**High risk populations (with underlying immunocompromising conditions, predisposed to invasive pneumococcal disease)**

Safety of SYNFLORIX was assessed in 83 HIV positive (HIV+/+) infants (asymptomatic or mild disease (WHO, 2007), with a mean CD4 cell counts of 1,936 cell/mm<sup>3</sup>), 101 HIV negative infants born from an HIV positive mother (HIV+/-) and 50 infants with sickle cell disease (SCD), receiving primary vaccination. Of these, 76, 96 and 49 infants, respectively, received a booster dose. Safety of SYNFLORIX was also assessed in 50 children with SCD starting vaccination at 7-11 months of age, all of them receiving the booster vaccination, and in 50 children with SCD starting vaccination at 12-23 months of age. Results suggest that reactogenicity and safety profile of SYNFLORIX for these high risk groups were consistent with healthy children.

Swelling reactions following vaccination in high risk populations:

No large swelling reactions were reported after vaccination with *Synflorix* in HIV+/+ or HIV+/- infants and in children with SCD.

SAE following vaccination in high risk populations:

One HIV+/+ infant experienced a non-fatal SAEs assessed by the investigator to be causally related to vaccination (gastroenteritis), this event resolved without sequelae. No non-fatal SAEs were assessed by the investigator to be causally related to vaccination in HIV+/- infant, or following vaccination of children with SCD.

Deaths following vaccination in high risk populations:

Fatal SAEs were reported for 5 HIV+/+ infants and 3 HIV+/- infants during the post-primary phase and for 1 HIV+/- infant during the post-booster phase. Among these fatal SAEs, 1 HIV+/- infant was assessed by the investigator to be causally related to vaccination (sudden infant death syndrome) given the time interval between vaccination and the onset of the event (3 days).

Fatal SAEs were reported for 1 infant with SCD (salmonella meningitis) during the period between the primary and booster phases and for one child with SCD in the group starting vaccination at 7-11 months of age (pyrexia) during the post-booster phase. None of the fatal events was assessed by the investigator as causally related to vaccination.

### **Post-Marketing Adverse Drug Reactions**

The following events have been spontaneously reported during post-approval use of SYNFLORIX. Because these events were reported voluntarily from a population of uncertain size, it is not possible to reliably estimate their frequency or to establish a causal relationship to vaccine exposure.

#### **Nervous system disorders:**

Rare: hypotonic-hyporesponsive episode

#### **Immune system disorders**

Very rare: anaphylaxis

## **DRUG INTERACTIONS**

### **Drug-Drug Interactions**

#### **Use with other vaccines**

SYNFLORIX can be given concomitantly with any of the following monovalent or combination vaccines [including DTPa-HBV-IPV/Hib]: diphtheria-tetanus-acellular pertussis vaccine (DTPa), hepatitis B vaccine (HBV), inactivated polio vaccine (IPV), *Haemophilus influenzae* type b vaccine (Hib), measles-mumps-rubella vaccine (MMR), varicella vaccine, meningococcal serogroup C conjugate vaccine (CRM<sub>197</sub> and TT conjugates), meningococcal serogroups A, C, W-135 and Y conjugate vaccine (TT conjugate) and rotavirus vaccine. Different injectable vaccines should always be given at different injections sites.

Clinical studies demonstrated that the immune responses of the co-administered

vaccines were unaffected, with the exception of the inactivated poliovirus type 2 response, for which inconsistent results were observed across studies (seroprotection ranging from 78% to 100%). In addition, one month after co-administration with a meningococcal polysaccharide groups A, C, W-135 and Y conjugate vaccine, lower Geometric Mean antibody Concentrations (GMCs) and opsonophagocytic assay (OPA) antibody GMTs were observed for one pneumococcal serotype (18C conjugated to tetanus toxoid carrier protein). There was no impact of co-administration on the other nine pneumococcal serotypes. Enhancement of antibody response to Hib-TT conjugate, diphtheria and tetanus antigens was observed. The clinical relevance of the above observations is unknown.

The safety profiles of the co-administered vaccines appeared unaffected.

#### **Use with systemic immunosuppressive medications**

As with other vaccines it may be expected that in patients receiving immunosuppressive treatment an adequate response may not be elicited.

#### **Use with prophylactic administration of antipyretics**

See section WARNINGS AND PRECAUTIONS – General.

#### **Drug-Food Interactions**

Interactions with food have not been established.

#### **Drug-Herb Interactions**

Interactions with herbal products have not been established.

#### **Drug-Laboratory Interactions**

Interactions with laboratory tests have not been established.

### **DOSAGE AND ADMINISTRATION**

#### **Dosing Considerations**

Official recommendations in accordance with the Canadian Immunization Guide should be taken into account when immunizing with SYNFLORIX.

It is recommended that subjects who receive a first dose of SYNFLORIX complete the full vaccination course with SYNFLORIX.

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

##### **Infants from 6 weeks to 6 months of age:**

##### ***Three-dose primary series***

The recommended immunization series to ensure optimal protection consists of four

doses, each of 0.5 mL.

**Table 4 Vaccine Schedule for Infants from 6 weeks to 6 months of age**

| Dose        | Dose 1*  | Dose 2** | Dose 3** | Dose 4^        |
|-------------|----------|----------|----------|----------------|
| Age at Dose | 2 months | 4 months | 6 months | 12 - 15 months |

\* First dose may be given as early as 6 weeks of age.

\*\*An interval of at least 1 month between doses is recommended. Results available to date suggest a 2-4-6 month schedule provides a better immune response as compared with 2-3-4 or 3-4-5 month schedules.

^ A booster dose is recommended at least 6 months after the last primary dose and may be given from the age of 9 months onwards.

See Part II, CLINICAL TRIALS.

### ***Two-dose primary series***

Alternatively, when SYNFLORIX is given as part of a routine infant immunization program, a series consisting of three doses, each of 0.5 mL may be given.

**Table 5 Vaccine Schedule for Infants from 2 to 6 months of age**

| Dose        | Dose 1*  | Dose 2** | Dose 3^      |
|-------------|----------|----------|--------------|
| Age at Dose | 2 months | 4 months | 11-12 months |

\* First dose may be given as early as 6 weeks of age.

\*\*An interval of 2 months between doses is recommended.

^ A booster dose is recommended at least 6 months after the last primary dose and may be given from the age of 9 months onwards.

Note: it is possible that the 2-dose primary schedule, outside of a routine infant schedule, may not provide optimal protection, especially in infants with high risk of pneumococcal disease.

See Part II, CLINICAL TRIALS.

### **Premature infants born between 27 to 36 weeks of gestation:**

The primary vaccination schedule consists of three doses of 0.5 mL with the first dose usually given at 2 months of age and with an interval of at least 1 month between doses (see Part II, CLINICAL TRIALS).

A booster dose is recommended at least 6 months after the last priming dose (see Part II, CLINICAL TRIALS).

### **Previously unvaccinated older infants and children:**

For children who are beyond the age of routine infant vaccination schedule, the following catch-up schedule applies:

**Table 6            SYNFLORIX Schedule for Previously Unvaccinated Children  
≥ 7 Months through 5 Years of Age**

| Age at First Dose           | Total Number of 0.5 mL Doses |
|-----------------------------|------------------------------|
| 7-11 months of age          | 3 <sup>a</sup>               |
| 12 months to 5 years of age | 2 <sup>b*</sup>              |

<sup>a</sup>2 doses at least 1 month apart; third dose is recommended after the 1 year birthday, separated from the second dose by at least 2 months.

<sup>b</sup>2 doses at least 2 months apart.

\*The immune response elicited after two doses of SYNFLORIX in children 12-23 months of age is comparable to the response elicited after three doses in infants (see Part II, CLINICAL TRIALS). A 2-dose schedule in 12-23 month children with high risk of pneumococcal disease (such as children with sickle-cell disease, asplenia, HIV infection, chronic illness or who are immunocompromised) may not be sufficient to provide optimal protection.

**High risk populations (with underlying immunocompromising conditions, predisposed to invasive pneumococcal disease):**

In children with underlying immunocompromising conditions predisposed to invasive pneumococcal disease (such as SCD or HIV infection), SYNFLORIX may be given as follows (also see WARNINGS AND PRECAUTIONS and Part II, CLINICAL TRIALS):

- in infants as described under “Three-dose primary series” above.
- in unvaccinated children ≥ 7 months of age and under 2 years of age as described under “Previously unvaccinated older infants and children” above.

**Administration**

Use of pre-filled syringes: see SPECIAL HANDLING INSTRUCTIONS.

SYNFLORIX should be given by intramuscular injection. The preferred sites are anterolateral aspect of the thigh in infants or the deltoid muscle of the upper arm in children.

A fine white deposit with a clear colourless supernatant may be observed upon storage of the syringe/vial. This does not constitute a sign of deterioration.

The content of the syringe/vial should be inspected visually both before and after shaking for any foreign particulate matter and/or abnormal physical appearance prior to administration. In the event of either being observed, discard the vaccine.

Shake well before use.

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

## OVERDOSAGE

No cases of overdosage have been reported.

For management of a suspected drug overdose, contact your regional Poison Control Centre.

## ACTION AND CLINICAL PHARMACOLOGY

### Mechanism of Action

SYNFLORIX is a conjugate vaccine, adsorbed, composed of 10 active ingredients: the *S. pneumoniae* polysaccharide serotypes 1, 4, 5, 6B, 7F, 9V, 14, 18C, 19F and 23F, each conjugated to a carrier protein (protein D (PD), tetanus toxoid (TT) or diphtheria toxoid (DT)).

The carrier proteins (PD, TT and DT) provide T-cell help to B-cells to produce a boostable antibody response of high affinity to the polysaccharide antigens, thereby providing protection against bacterial tract infections caused by *S. pneumoniae*.

The amount of pneumococcal capsular polysaccharide antibodies elicited by the vaccine is measured by enzyme-linked immunosorbent assay (ELISA). These antibodies help to protect the host by facilitating opsonization of pneumococci and thus facilitating phagocytosis. The ability of a serum sample to facilitate opsonization of bacteria can be measured by *in vitro* opsonophagocytosis assays. It is generally agreed that opsonophagocytic activity (OPA) is the best functional correlate of protection against IPD (see Part II, CLINICAL TRIALS).



## **Epidemiological data**

### **Invasive Pneumococcal Disease (IPD)**

IPD is a severe illness that occurs when bacteria invade normally sterile sites. *S. pneumoniae* is the primary cause of IPD, which manifests as bacteraemia, bacteraemic pneumonia and meningitis. IPD can result in serious morbidity and mortality, particularly in children, even in developed countries with high standards of healthcare. The incidence of IPD decreased substantially in the period between 2000-2007, following routine use of PCV7. A surveillance study across Canada during this period revealed that the proportion of PCV7-serotypes decreased 92% in children 0 to 4 years of age after PCV7 vaccination, but concurrently non-PCV7 serotypes such as 19A, 7F, 3 and 22F increased in children under 5 years of age. SYNFLORIX was introduced in Ontario and Quebec in 2009, PCV13 was introduced in these provinces and across Canada starting in 2010. In Quebec, the introduction of SYNFLORIX in 2009 and then 13-valent PCV in 2011, resulted in a decrease of 19A IPD in children < 5 years of age in that province. In Canada, overall incidence of IPD in combined age groups has remained steady at 9.7 cases per 100 000 from 2008-2012.

### **Acute Otitis Media (AOM)**

Acute otitis media is a common childhood disease with different etiologies. Bacteria are believed to be responsible for at least 60-70% of clinical episodes of AOM. *Streptococcus pneumoniae* and NTHi are the most common causes of AOM worldwide.

The baseline AOM incidence in Canada pre-PCV7 introduction is about 600 cases per 1000 children ( $\leq 6$  years old) per year. The most common cause of AOM in North America is *Streptococcus pneumoniae*, accounting for 42% of all cases.

### **Pneumonia**

Pneumonia of different etiologies is a leading cause of childhood morbidity and mortality globally. In prospective studies, *Streptococcus pneumoniae* was estimated to be responsible for 30-50% of bacterial pneumonia cases.

In Canada, although immunization has decreased the incidence of bacterial pneumonia in vaccinated children, pneumonia remains common in healthy children. *Streptococcus pneumoniae* continues to be the most common cause of bacterial pneumonia in children.

## **STORAGE AND STABILITY**

Store in a refrigerator (2°C - 8°C). Do not freeze. Discard the vaccine if frozen.

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

Do not use after the expiry date shown on the label.

SYNFLORIX should be administered as soon as possible after being removed from the refrigerator. However, stability data generated indicate that SYNFLORIX remains stable and can be administered when the vaccine has been stored outside the refrigerator for up to 72 hours at temperatures between 8°C and 25°C. These data are not recommendations for storage.

### **Multidose vials**

After first opening of the multidose vial, immediate use is recommended. If not used immediately, the vaccine should be stored in a refrigerator (2°C - 8°C). If not used within 6 hours it should be discarded.

## **SPECIAL HANDLING INSTRUCTIONS**

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

A fine white deposit with a clear colourless supernatant may be observed upon storage of the syringe/vial. This does not constitute a sign of deterioration.

The content of the syringe/vial should be inspected visually both before and after shaking for any foreign particulate matter and/or abnormal physical appearance prior to administration. In the event of either being observed, discard the vaccine.

The vaccine should be well shaken before use.

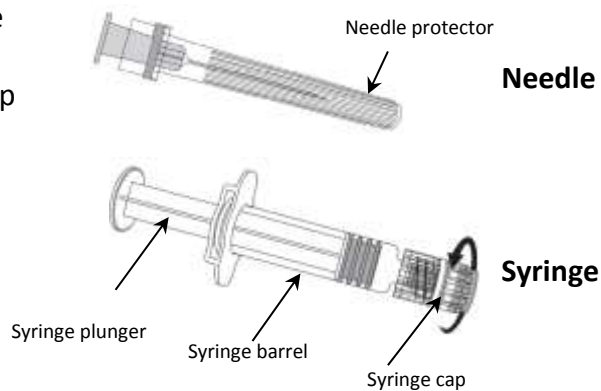
Any unused product or waste material should be disposed of in accordance with local requirements.

## Use of Pre-Filled Syringes

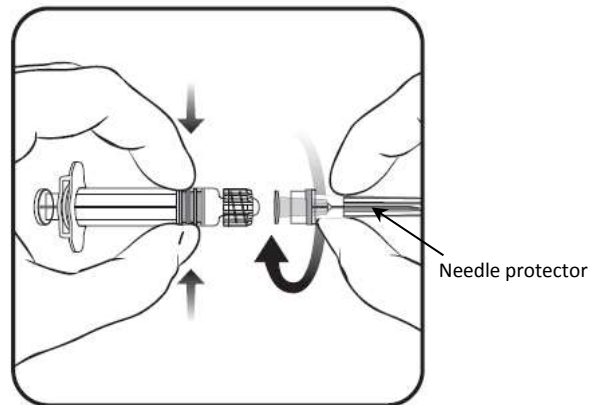
To attach the needle to the syringe, refer to the drawing below.

Note: However the syringe provided with SYNFLORIX might be slightly different (without screw thread) than the syringe described in the drawing. In that case the needle should be attached without screwing.

1. Holding the syringe **barrel** in one hand (avoid holding the syringe plunger), unscrew the syringe cap by twisting it anticlockwise.



2. To attach the needle to the syringe, twist the needle clockwise into the syringe until you feel it lock (see drawing).



3. Remove the needle protector, which on occasion can be a little stiff.
4. Administer the vaccine.

## DOSAGE FORMS, COMPOSITION AND PACKAGING

### Dosage Form

SYNFLORIX is available as a suspension for injection.

### Composition

One dose (0.5 mL) contains:

|  |                                |
|--|--------------------------------|
| Pneumococcal polysaccharide serotype 1 <sup>1,2</sup>  | 1 microgram                    |
| Pneumococcal polysaccharide serotype 4 <sup>1,2</sup>  | 3 micrograms                   |
| Pneumococcal polysaccharide serotype 5 <sup>1,2</sup>  | 1 microgram                    |
| Pneumococcal polysaccharide serotype 6B <sup>1,2</sup>   | 1 microgram                    |
| Pneumococcal polysaccharide serotype 7F <sup>1,2</sup>   | 1 microgram                    |
|  |                                |
| Pneumococcal polysaccharide serotype 9V <sup>1,2</sup>   | 1 microgram                    |
| Pneumococcal polysaccharide serotype 14 <sup>1,2</sup>   | 1 microgram                    |
|  |                                |
| Pneumococcal polysaccharide serotype 18C <sup>1,3</sup>  | 3 micrograms                   |
| Pneumococcal polysaccharide serotype 19F <sup>1,4</sup>  | 3 micrograms                   |
| Pneumococcal polysaccharide serotype 23F <sup>1,2</sup>  | 1 microgram                    |
| <sup>1</sup> adsorbed on aluminum phosphate  | 0.5 milligram Al <sup>3+</sup> |
| <sup>2</sup> conjugated to protein D (derived from Non-Typeable <i>H. influenzae</i> ) carrier protein | 9-16 micrograms                |
| <sup>3</sup> conjugated to tetanus toxoid carrier protein  | 5-10 micrograms                |
| <sup>4</sup> conjugated to diphtheria toxoid carrier protein   | 3-6 micrograms                 |

Additional Excipients: sodium chloride, water for injections

### Packaging

#### **Pre-filled Syringes**

SYNFLORIX is available as:

- 0.5 mL of suspension in a pre-filled syringe (type I glass) for 1 dose with a plunger stopper (rubber butyl) with or without needles in pack sizes of 1 or 10.

## Vials

SYNFLORIX is available as:

- 0.5 mL of suspension in a vial (type I glass) for 1 dose with a stopper (rubber butyl) in pack sizes of 1 or 100.
- 1 mL of suspension in a vial (type I glass) for 2 doses with a stopper (rubber butyl) in pack size of 100.

## PART II: SCIENTIFIC INFORMATION

### PHARMACEUTICAL INFORMATION

#### Drug Substances

- Pneumococcal polysaccharide serotypes 1, 4, 5, 6B, 7F, 9V, 14 and 23F conjugated to Non-Typeable *Haemophilus influenzae* (NTHi) protein D
- Pneumococcal polysaccharide serotype 18C conjugated to tetanus toxoid carrier protein
- Pneumococcal polysaccharide serotype 19F conjugated to diphtheria toxoid carrier protein

All drug substances are individually adsorbed onto aluminum phosphate.

#### Product Characteristics

Individual polysaccharides, tetanus toxoid and diphtheria toxoid are prepared from fermentation, inactivation and purification of isolates.

Protein D is a 40kD cell-surface protein originally derived from Non-Typeable *H. influenzae* and now produced recombinantly.

Each polysaccharide serotype is conjugated and adsorbed onto aluminum phosphate as a monovalent preparation prior to mixing into the final vaccine formulation.

Serotype 19A and 19F polysaccharides belong to the same serogroup and are closely related biochemically. They are composed of similar trisaccharide units polymerized through phosphate diester groups and differ only in position of the linkage to the  $\alpha$ -L-rhamnose residue. SYNFLORIX elicits cross-reactive antibodies against serotype 19A due to the inclusion of serotype 19F (see PART II, CLINICAL TRIALS).

## CLINICAL TRIALS

Table 7 outlines the study design of primary vaccination and booster studies in the healthy and high-risk populations (subjects with HIV, SCD).

**Table 7 Study design**

| Study No.                          | Trial design  | Vaccine schedule                            | No. of subjects <sup>†</sup>   |
|------------------------------------|---|---|--|
| <b>Primary vaccination studies</b> |   |   |  |
| 10PN-PD-DIT-001                    | Multi-centre, single-blind, randomized, controlled    | 2, 3 and 4 months of age                    | SYNFLORIX = 1235<br>7-valent PCV vaccine = 415   |
| 10PN-PD-DIT-002*                   | Multi-centre, open, randomized                        | 2 and 4 months or 2, 3 and 4 months of age  | SYNFLORIX = 351  |
| 10PN-PD-DIT-003                    | Single centre, single-blind, randomized, controlled   | 2, 3 and 4 months of age                    | SYNFLORIX = 70<br>7-valent PCV vaccine = 64  |
| 10PN-PD-DIT-005                    | Single centre, observer-blind, randomized, controlled | 2, 4 and 6 months of age                    | SYNFLORIX = 119<br>Hepatitis A vaccine = 121   |
| 10PN-PD-DIT-010                    | Single centre, open, randomized, controlled           | 3, 4 and 5 months of age                    | SYNFLORIX = 459  |
| 10PN-PD-DIT-013 <sup>§</sup>       | Single-centre, open, controlled                       | 3, 4 and 5 months of age                    | SYNFLORIX = 150  |
|                                    |   | 24 months-5 years of age                    | SYNFLORIX = 150  |
| 10-PN-PD-DIT-015 <sup>°</sup>      | Multi-centre, open, randomized, controlled            | 2, 4 and 6 months of age                    | SYNFLORIX = 286 <sup>°</sup><br>Preterm I group = 50<br>Preterm II group = 87<br>Full term group = 149 |
| 10PN-PD-DIT-028 <sup>Σ</sup>       | Multi-centre, double-blind, randomized, controlled    | 2, 4, 6 and 15-18 months of age             | SYNFLORIX = 11798  |
| 10PN-PD-DIT-043 <sup>γ</sup>       | Multi-centre, cluster-randomized, controlled          | 6 weeks-6 months of age                     | SYNFLORIX = 20327  |
|                                    |   | 7-11 months of age                          | SYNFLORIX = 3880   |
|                                    |   | 12-18 months of age                         | SYNFLORIX = 6535   |
| 10PN-PD-DIT-046**                  | Multi-centre, open, controlled, long-term study       | 36-46 months of age and 38-48 months of age | SYNFLORIX = 62   |
| 10PN-PD-DIT-053 <sup>β</sup>       | Multi-centre, cluster-randomized, controlled          | 6 weeks-6 months of age <sup>κ</sup>        | SYNFLORIX = 3165   |
|                                    |   | 7-11 months of age                          | SYNFLORIX = 241  |
|                                    |   | 12-18 months of age                         | SYNFLORIX = 368  |

| Study No.  | Trial design   | Vaccine schedule                     | No. of subjects <sup>†</sup>   |
|--|--|--------------------------------------|--|
| <b>Booster studies</b>   |  |                                      |  |
| 10PN-PD-DIT-002 <sup>¶</sup>   | Multi-centre, open, randomized   | 11 months of age                     | SYNFLORIX = 345  |
| 10PN-PD-DIT-007  | Multi-centre, single-blind, partially randomized, controlled                                 | 12-18 months of age                  | SYNFLORIX = 1020<br>7-valent PCV vaccine = 92  |
| 10PN-PD-DIT-022  | Single centre, open, randomized, controlled  | 12-16 months of age                  | SYNFLORIX = 324  |
| 10-PN-PD-DIT-016 <sup>□</sup>  | Multi-centre, open, controlled   | 16-18 months of age                  | SYNFLORIX = 245 <sup>□</sup><br>Preterm I group = 44<br>Preterm II group = 72<br>Full term group = 129 |
| <b>Post-Booster studies</b>  |  |                                      |  |
| 10PN-PD-DIT-046 <sup>Δ</sup><br>(Follow-up of Study 10PN-PD-DIT-002) | Multi-centre, open, controlled, long-term, follow-up study                                   | 36-46 months of age                  | SYNFLORIX = 110  |
| <b>HIV and SCD studies</b>   |  |                                      |  |
| 10PN-PD-DIT-034 <sup>¥</sup>   | Single-centre, open, partially randomized, controlled study                                  | Subjects with HIV:                   |  |
|  |  | 6, 10, 14 wks and 9-10 months of age | HIV+/(3+1) SYNFLORIX = 83<br>HIV+/- (3+1) SYNFLORIX = 101  |
|  |  | Healthy subjects:                    |  |
|  |  | 6, 10, 14 wks and 9-10 months of age | HIV-(3+1) SYNFLORIX = 100  |
|  |  | 6, 14 wks and 9-10 months of age     | HIV-(2+1) SYNFLORIX = 100  |
|  |  | 6, 10, 14 wks of age                 | HIV-(3+0) SYNFLORIX = 100  |
| 10-PN-PD-DIT-064 <sup>θ</sup>  | Single-centre, open, study with 6 parallel groups stratified according to age and SCD status | Subjects with SCD:                   |  |
|  |  | 8 wks to 2 years of age              | < 6 mo. SYNFLORIX = 50<br>7-11 mo. SYNFLORIX = 50<br>12-23 mo. SYNFLORIX = 50                          |
|  |  | Healthy subjects :                   |  |
|  |  | 8 wks to 2 years of age              | < 6 mo. SYNFLORIX = 50<br>7-11 mo. SYNFLORIX = 50<br>12-23 mo. SYNFLORIX = 50                          |

<sup>†</sup> Number of subjects represent total vaccinated cohort for safety.

\* Study 10PN-PD-DIT-002 evaluated both primary and booster vaccination: numbers of subjects are the numbers evaluated for the primary vaccination phase.

<sup>§</sup> Study 10PN-PD-DIT-013 evaluated primary, booster and catch-up vaccination: numbers of subjects is the number evaluated in the primary vaccination phase below 6 months of age and 24 months-5 years of age.

<sup>¶</sup> Study 10PN-PD-DIT-002 evaluated both primary and booster vaccination: numbers of subjects are the numbers evaluated for the booster vaccination phase.

\*\*Study 10PN-PD-DIT-046 evaluated the long-term immunogenicity and safety in children from study 10PN-PD-DIT-002. It also evaluated the immunogenicity and safety of a 2-dose catch-up vaccination in the 4<sup>th</sup> year of age in children who had not received any pneumococcal vaccine.

<sup>Δ</sup> Study 10PN-PD-DIT-046 evaluated the immunological memory after an additional dose of SYNFLORIX at 36-46

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- months of age in children previously vaccinated in Study 10PN-PD-DIT-002 by a 2-dose or 3-dose primary course within the first 6 months and booster vaccination at 11-12 months of age.
- <sup>°</sup> Study 10PN-PD-DIT-015 evaluated primary vaccination in premature infants versus full term born infants less than 6 months of age. The study included three parallel groups as follows: Preterm group I (very premature infants born after a gestation period of 27-30 weeks, Preterm group II (mild premature infants born after a gestation period of 31-36 weeks) and Full term group (infants born after a gestation period of more than 36 weeks).
  - <sup>Ω</sup> Study 10PN-PD-DIT-016 is the booster study of 10-PN-DIT-015 and included the same three parallel groups as study 10PN-PD-DIT-015.
  - <sup>Σ</sup> Study 10PN-PD-DIT-028 evaluated both primary and booster vaccination: three dose primary at 6-16 weeks of age and booster dose at 15-18 months.
  - <sup>γ</sup> Study 10PN-PD-DIT-043 evaluated both primary and booster vaccination: two dose or three dose primary at 6 weeks to 6 months of age followed by a booster dose preferably within 6 months for infants < 7 months of age, or two dose primary at 7-11 months of age followed by a booster dose preferably within 6 months for children between 7 and 11 months of age, or 2 doses for children aged 12-18 months at least six months apart.
  - <sup>β</sup> Study 10PN-PD-DIT-053 was a nested study within study 10PN-PD-DIT-043 which evaluated both primary and booster vaccination: two dose or three dose primary at 6 weeks to 6 months of age followed by a booster dose preferably within 6 months for infants < 7 months of age, or two dose primary at 7-11 months of age followed by a booster dose preferably within 6 months for children between 7 and 11 months of age, or 2 doses for children aged 12-18 months at least six months apart.
  - <sup>κ</sup> Number of subjects represent SYNFLORIX total vaccinated cohort for safety combined 3+1 and 2+1 dose schedules.
  - <sup>¥</sup> Study 10PN-PD-DIT-034 evaluated both primary and booster vaccination in 5 parallel groups: three dose primary (3+1) at 6, 10, and 14 weeks in HIV infected (HIV+/+) infants and HIV exposed uninfected (HIV+/-) infants followed by a booster dose at 9-10 months of age. HIV unexposed uninfected (HIV-) infants were randomized into 3 sub-groups: Group HIV- (3+1) received 3 doses at 6, 10, 14 weeks of age and a booster dose at 9-10 months of age. Group HIV- (3+0) received 3-doses at 6, 10,14 weeks without a booster; and Group HIV- (2+1) received 2 doses at 6 and14 weeks with a booster at 9-10 months of age.
  - <sup>Θ</sup> Study 10-PN-PD-DIT-064 evaluated primary, booster, and catch-up vaccination in children with SCD compared to healthy children: 3-dose primary vaccination at 8, 12 and 16 weeks of age, with an early booster dose administered at 9-10 months and three dose or two dose catch-up vaccination in children between 7 and 11 or between 12 and 23 months of age at the time of first vaccination.

### **Efficacy and Effectiveness Data**

In a large-scale phase III/IV, double-blind, cluster-randomized, controlled, clinical trial in Finland (FinIP) (Study 10PN-PD-DIT-043), children were randomized into 4 groups according to the two infant vaccination schedules [2-dose (3, 5 months of age) or 3-dose (3, 4, 5 months of age) primary schedule followed by a booster dose as of 11 months of age] to receive either SYNFLORIX (2/3 of clusters) or hepatitis vaccines as control (1/3 of clusters). In the catch-up cohorts, children between 7-11 months of age at first dose received 2 doses of either SYNFLORIX or hepatitis B control vaccine followed by a booster and children between 12-18 months of age at first dose received 2 doses of either SYNFLORIX or hepatitis A control vaccine. Average follow-up, from first vaccination, was 24 to 28 months for invasive disease, hospital-diagnosed pneumonia and outpatient antimicrobial prescriptions. In a nested study also conducted in Finland (Study FinIP 10PN-PD-DIT-053), infants were followed up until approximately 21 months of age to assess impact of nasopharyngeal carriage.

In a large-scale phase III, randomized, double-blind clinical trial (Clinical Otitis Media and Pneumonia Study - COMPAS 10PN-PD-DIT-028) conducted in Argentina, Panama, and Colombia, healthy infants aged 6 to 16 weeks received either SYNFLORIX or hepatitis B control vaccine at 2, 4 and 6 months of age followed respectively by either SYNFLORIX or hepatitis A control vaccine at 15 to 18 months of age.

### **Invasive Pneumococcal Disease (IPD)**

#### *Effectiveness/efficacy against IPD in clinical trials*

Vaccine effectiveness or efficacy (VE) was demonstrated in preventing culture-confirmed IPD due to vaccine pneumococcal serotypes when SYNFLORIX was given to infants in either 2+1 or 3+1 schedules in FinIP or 3+1 schedule in COMPAS (see Table 8).

**Table 8      Number of vaccine serotype IPD cases and vaccine effectiveness (FinIP) in infants below 7 months of age at enrolment receiving at least one vaccine dose (Infant total vaccinated cohort)**

| Type of IPD                         | FinIP                             |                                   |                                   |                                    |                                      |
|-------------------------------------|-----------------------------------|-----------------------------------|-----------------------------------|------------------------------------|--------------------------------------|
|                                     | No. of IPD cases                  |                                   |                                   | VE (95% CI)                        |                                      |
|                                     | SYNFLORIX 3+1 schedule (N=10,273) | SYNFLORIX 2+1 schedule (N=10,054) | Control <sup>(2)</sup> (N=10,200) | 3+1 schedule                       | 2+1 schedule                         |
| Vaccine serotype IPD <sup>(1)</sup> | 0                                 | 1                                 | 12                                | 100% <sup>(3)</sup><br>(82.8; 100) | 91.8% <sup>(4)</sup><br>(58.3; 99.6) |
| Serotype 6B IPD                     | 0                                 | 0                                 | 5                                 | 100%<br>(54.9; 100)                | 100%<br>(54.5; 100)                  |
| Serotype 14 IPD                     | 0                                 | 0                                 | 4                                 | 100%<br>(39.6; 100)                | 100%<br>(43.3; 100)                  |

IPD    Invasive Pneumococcal Disease

VE    Vaccine effectiveness

N    number of subjects per group

(1)    In FinIP apart from serotypes 6B and 14, culture-confirmed vaccine serotype IPD cases included 7F (1 case in the SYNFLORIX 2+1 clusters), 18C, 19F and 23F (1 case of each in the control clusters).

(2)    the 2 groups of control clusters of infants were pooled

(3)    p-value<0.0001

(4)    p-value=0.0009

In FinIP, the observed VE against culture-confirmed IPD due to any serotype reported in the Total Vaccinated Cohort (TVC cohort) was 100% (95% CI, 85.6; 100; 0 versus 14 cases) for the 3+1 schedule, 85.8% (95% CI, 49.1; 97.8; 2 versus 14 cases) for the 2+1 schedule and 93.0% (95% CI, 74.9; 98.9; 2 versus 14 cases) regardless of the primary vaccination schedule.

In the COMPAS study, the observed vaccine efficacy (VE) against IPD due to vaccine serotypes reported in the According To Protocol Cohort (ATP) cohort was 100%. The observed VE against IPD due to any serotype reported in the ATP cohort was 65.0%.

#### *Effectiveness following catch-up immunization*

Among the 15,447 children in the catch-up vaccinated cohorts, there were no culture-confirmed IPD cases in the SYNFLORIX groups while 7 IPD cases were observed in the control groups (serotypes 7F and 14 in the 7-11 month cohort and serotypes 3, 4, 6B, 15C and 19F in the 12-18 month cohort).

### Effectiveness in post-marketing surveillance

In line with WHO recommendations, post-marketing studies have been and continue to be conducted to confirm the efficacy of SYNFLORIX. The post-marketing effectiveness of SYNFLORIX has been assessed in three post-marketing observational studies conducted in Brazil, Finland and Quebec and the effectiveness of SYNFLORIX has been observed against vaccine serotype and cross-reactive serotype 19A IPD.

As with all post-marketing observational studies, the results from the following three observational studies should be interpreted with caution. For detailed information, including the inherent limitations of each study, please refer to the relevant publication.

In Quebec, Canada, SYNFLORIX was introduced into the infant immunization program (2 primary doses to infants less than 6 months of age and a booster dose at 12 months) following 4.5 years of use of 7-valent Pneumococcal Conjugate Vaccine PCV vaccine. Based on 1.5-years of surveillance following SYNFLORIX introduction, with over 90% coverage in the vaccine-eligible age group, a decrease in vaccine serotype IPD incidence (largely due to changes in serotype 7F disease) was observed with no concomitant increase in non-vaccine serotype IPD incidence, leading to an overall decrease in IPD incidence in the target age group compared to the incidence reported during the preceding period.

In Quebec, an established post-marketing study has been in place since 2005 to estimate vaccine effectiveness against IPD in children aged 2 to 59 months of age. To date, results of this study have included an 8-year study period when PCV7 (PREVNAR), PCV10 (SYNFLORIX) and PCV13 (PREVNAR 13) were used sequentially in that province. SYNFLORIX vaccine effectiveness (VE) ( $\geq 1$  dose) was 97% against vaccine-type and 6A IPD and 71% against 19A IPD. SYNFLORIX VE ( $\geq 2$  doses) against any IPD serotype was 75% and against 19A IPD was 71% (Deceuninck et al, 2015).

In Brazil, SYNFLORIX was introduced into the national immunization program (NIP) in March 2010, using a 3+1 schedule in infants (2, 4, 6 months of age and a booster dose at 12 months) with a catch-up campaign in children up to 2 years of age. Based on almost 3 years of surveillance following SYNFLORIX introduction, a matched case-control study reported VE was 84% against VT IPD. Against 6B and 14, VE IPD was 83% and 88%, respectively. Against 19A IPD, VE was 82% (Domingues et al, 2014).

In Finland, SYNFLORIX was introduced into NIP in September 2010, with a 2+1 schedule in infants (3, 5 months of age and a booster dose at 12 months) without a catch-up campaign. Before and after NIP comparison suggests a decrease of 80% in the incidence of any culture confirmed IPD, a decrease of 92% in any VT IPD and a reduction of 62% IPD due to serotype 19A (Jokinen et al, 2015).

### **Pneumonia**

Efficacy against pneumonia was assessed in COMPAS. For the interim analysis (IA, which contained the final analysis of the event-driven primary objective), the median follow-up duration was 24.3 months (1st quartile 19.9 months, 3rd quartile 28.4 months) from 2 weeks post-dose 3 in the ATP cohort; for the end-of-study analysis, the median follow-up duration was 32.3 months (1st quartile 27.6 months, 3rd quartile 36.2 months) in the ATP cohort.

Efficacy of SYNFLORIX against first episodes of likely bacterial Community Acquired Pneumonia (CAP) was demonstrated in the according-to-protocol (ATP) cohort (immunized with at least the three-dose primary series) ( $P$  value  $\leq 0.002$ ) as the primary objective in the IA (Table 9). Likely bacterial CAP is defined as radiologically confirmed CAP cases with either alveolar consolidation/pleural effusion on the chest X-ray, or with non alveolar infiltrates but with C reactive protein (CRP)  $\geq 40$  mg/L.

The vaccine efficacy against likely bacterial CAP observed in this study, is presented below (Table 9).

**Table 9**      **Numbers and percentages of subjects with first episodes of likely bacterial CAP after 3 doses of SYNFLORIX or a control vaccine and vaccine efficacy (IA, ATP cohort for efficacy)**

| SYNFLORIX<br>N=10,295 |         | Control vaccine<br>N=10,201 |         | Vaccine efficacy<br>95% CI                                       |
|-----------------------|---------|-----------------------------|---------|--|
| n                     | % (n/N) | n                           | % (n/N) |  |
| 240                   | 2.3%    | 304                         | 3.0%    | 22.0%<br>(7.7; 34.2)*<br>( $P$ value $\leq 0.002$ ) <sup>α</sup> |

N      number of subjects per group

n      number of subjects reporting a first episode of likely bacterial CAP anytime from 2 weeks after the administration of the 3rd dose

%      percentage of subjects reporting a first episode of likely bacterial CAP anytime from 2 weeks after the administration of the 3rd dose

CI      Confidence Interval

\*      Type I error not adjusted for the interim analysis

α      Adjusted one-sided alpha level of 1.75%

In the IA in the ATP cohort, the vaccine efficacy against CAP with alveolar consolidation or pleural effusion was 25.7% and against clinically suspected CAP referred for X-ray was 6.7%.

In the end of study analysis, the vaccine efficacy against likely bacterial CAP was 18.2% against CAP with alveolar consolidation or pleural effusion 22.4% and against clinically suspected CAP referred for X-ray 7.3%. The reduction in likely bacterial CAP was greatest in children < 36 months of age (vaccine efficacy of 20.6%). The persistence of protection against bacterial CAP beyond the age of 36 months is currently not established.

In the FinIP study, vaccine effectiveness in reducing hospital-diagnosed pneumonia cases reported in the TVC cohort (identified based on the ICD 10 codes for pneumonia) was 26.7% in the 3+1 infant schedule and 29.3% in the 2+1 infant schedule. For catch-up vaccination, vaccine effectiveness was 33.2% in the 7-11 month cohort and 22.4% in the 12-18 month cohort.

## AOM

Two efficacy studies, COMPAS and POET (Pneumococcal Otitis Media Efficacy Trial), were conducted with pneumococcal conjugate vaccines containing protein D: SYNFLORIX and an investigational 11-valent conjugate vaccine (11PN-PD) containing the 10 serotypes of SYNFLORIX along with serotype 3, respectively. In COMPAS, 7,214 subjects [Total Vaccinated cohort (TVC)] were included in the AOM efficacy analysis, of which 5,989 subjects were in the ATP cohort (Table 10).

**Table 10 Vaccine efficacy against first episodes of AOM<sup>(1)</sup> in COMPAS (ATP cohort)**

| Type or cause of AOM                 | Vaccine efficacy (95% CI)            |
|--------------------------------------|--------------------------------------|
|                                      | COMPAS (SYNFLORIX)                   |
| Clinical AOM regardless of aetiology | 16.1%<br>(-1.1; 30.4) <sup>(2)</sup> |
| Any pneumococcal serotype            | 56.1%                                |
| 10 pneumococcal vaccine serotypes    | 67.1%                                |
| NTHi only                            | 15.0%                                |

CI Confidence Interval.

(1) ATP=5989 subjects (3010 subjects in the 10Pn group and 2979 subjects in the control group)

(2) Not statistically significant by pre-defined criteria (One sided p=0.032).

In the TVC cohort, vaccine efficacy against clinical AOM episodes was 19%.

In a prior large randomized double-blind Pneumococcal Otitis Media Efficacy Trial (POET) conducted in the Czech Republic and in Slovakia, 2,489 infants received 11Pn-PD, containing the 10 serotypes of SYNFLORIX along with serotype 3 for which efficacy was not demonstrated, or the control vaccine, according to a 3, 4, 5 and 12-15 months vaccination schedule. Serotype 3 was removed from the SYNFLORIX formulation based on the absence of protection against AOM caused by this serotype and because the ELISA post-booster response was lower than the post-primary response. This was contrary to what was observed for other serotypes.

In the POET ATP cohort, a total of 333 clinical AOM episodes were confirmed by ENT specialists in the 11Pn-PD group and 499 in the control group. There was a statistically significant reduction of AOM irrespective of etiology in the 11Pn-PD group by 33.6% (95%CI, 20.8; 44.3). The overall efficacy against AOM episodes due to any of the 11 pneumococcal serotypes contained in the 11Pn-PD vaccine was 57.6% (95% CI, 41.4; 69.3).

No increase in the incidence of AOM due to non-vaccine/non-cross reactive serotypes, or due to other bacterial pathogens, was observed in either COMPAS (based on the few cases reported) or POET trial.

### **Impact on nasopharyngeal carriage (NPC)**

The effect of SYNFLORIX on nasopharyngeal carriage was studied in 2 double-blind randomized studies using an inactive control: in the nested study of FinIP in Finland and in COMPAS, including 5,023 subjects and 1,700 subjects with swabs cultured after at least one visit, respectively.

In both studies, there was a trend that SYNFLORIX reduced vaccine type carriage and increased non-vaccine (excluding cross reactive) type carriage after booster vaccination in the TVC cohort. In COMPAS, overall, the VE against NPC of any serotype and VTs were 3.0% and 25.6%, respectively. In the nested study of FinIP, Study 053, overall, the VE against NPC of any serotype and VTs were 11.5% and 37.6%, respectively in the infants group with the 3+1 schedule and 7.9% and 28.4%, respectively in the infants group with the 2+1 schedule. A trend for reduced serotype 19A NPC was observed in SYNFLORIX vaccinated children compared to those receiving control vaccine for 3+1 and 2+1 schedules in Study 053. The reduction in serotype 19A NPC in exploratory, pooled analyses across all study visits for the 3+1 and 2+1 schedules in Study 053 was 47.4% and 12.6%, respectively. The VE across all visits for 19A in the 2+1 group in Study 028 was -6.5%.

In a clinical study assessing NPC in HIV positive (asymptomatic or mild disease (WHO, 2007) with a mean CD4 cell counts of 1,936 cell/mm<sup>3</sup>) infants (HIV +/+, N = 83) and HIV negative infants born from an HIV positive mother (HIV +/-, N = 101), the percentages of nasopharyngeal (NP) swab positive for vaccine-type *S. pneumoniae* and non-typeable *H. influenzae* in HIV +/+ infants and HIV +/- infants were in line with that in HIV negative infants born from an HIV negative mother (HIV -/-, N = 100).

### **Immunogenicity Data**

#### ***Invasive Pneumococcal Disease (IPD)***

At the time of initial licensure, the indication against IPD, which includes sepsis, meningitis, bacteraemic pneumonia and bacteraemia, was based on World Health Organization (WHO) recommendations (see WHO Criteria). These recommendations

state that approval of any new pneumococcal conjugate vaccines against IPD can be based on the demonstration of immunological non-inferiority to the licensed 7-valent CRM<sub>197</sub> conjugate vaccine (7-valent PCV vaccine). These immunological data for serotypes contained in the vaccine are presented below (see WHO Criteria). Additionally, immunological data for cross-reactive serotype 19A is also presented (see PART II, CLINICAL TRIALS, Additional Immunogenicity Data, Table 15). A large-scale phase III/IV clinical trial, titled Finnish Invasive Pneumococcal disease vaccine effectiveness trial (FinIP), was conducted to evaluate the clinical efficacy of SYNFLORIX against vaccine-type IPD in children vaccinated with at 2+1 or 3+1 schedule (see Part II, CLINICAL TRIALS, IPD). Another study conducted with a different formulation demonstrated that the vaccine was able to confer protection against pneumococcal acute otitis media (see Part II, CLINICAL TRIALS, AOM).

### **WHO Criteria**

The WHO recommendations state that approval of any new pneumococcal conjugate vaccines against IPD can be based on the demonstration of immunological non-inferiority to 7-valent PCV vaccine by measuring the total amount of anticapsular IgG with an enzyme-linked immunosorbent assay (ELISA).

According to these recommendations, the primary endpoint for demonstration of immunological non-inferiority is the percentage of subjects reaching a predetermined antibody threshold one month after three primary doses of pneumococcal conjugate vaccine. As serotype specific thresholds were not identified, the WHO recommended the use of a single antibody threshold for all serotypes. This threshold was derived from a pooled analysis of three efficacy trials conducted with pneumococcal conjugated vaccines and was found to be 0.35 µg/mL with the second generation ELISA available at that time. The chosen threshold does not represent an individual antibody protection level.

To increase specificity, third generation ELISAs including a 22F adsorption step have been developed. WHO recommendations state that third generation ELISAs must be bridged to the second generation ELISA. An antibody concentration of 0.2 µg/mL in the GSK third generation ELISA was shown in bridging experiments to be equivalent to the 0.35 µg/mL WHO reference threshold. The 0.2 µg/mL threshold was therefore used for the demonstration of immunological non-inferiority compared to 7-valent PCV vaccine in a head-to-head comparative study.

The WHO also requires demonstration of functionality of the elicited antibodies. Opsonophagocytosis (antibody mediated killing of the bacteria) is recognized as the main mechanism of protection against pneumococcal disease. Measurement of the ability of the vaccine-elicited antibodies to opsonise and promote killing of the pneumococcus can be performed in vitro through an opsonophagocytosis activity assay (OPA). The percentage of subjects with an OPA titre  $\geq 8$  is used for comparison between



vaccines, although the data to support the OPA titre  $\geq 8$  as a marker of protection are currently insufficient.

Finally, demonstration that vaccines induce immune memory is also required for registration.

## Results

Immunological non-inferiority compared to 7-valent PCV vaccine was evaluated in the pivotal 10PN-PD-DIT-001 study in which infants were vaccinated according to a 2-3-4 months vaccination schedule. The study was randomized, controlled, multi-centric, conducted in Poland, France and Finland. Immunological non-inferiority was met when the upper limit of the 96.5% CI around the difference between groups (7-valent PCV vaccine minus SYNFLORIX) in terms of subjects with antibody concentration  $\geq 0.2\mu\text{g/ml}$  was lower than 10%.

As shown in Table 11, SYNFLORIX non inferiority was demonstrated by ELISA for all serotypes, except for 6B and 23F (upper limit of the 96.5% CI around the difference between groups  $> 10\%$ ). For serotypes 6B and 23F, respectively, 65.9% and 81.4% of vaccinees reached the threshold one month after the third primary dose (versus 79.0% and 94.1% for 7-valent PCV vaccine). The clinical relevance of these differences is not known. For the other serotypes contained in each vaccine, 95.4% to 99.5% of vaccinees reached the threshold. The percentage of vaccinees reaching the threshold for the three additional serotypes (1, 5 and 7F) was respectively 97.3%, 99.0% and 99.5% and was at least as good as the aggregate 7-valent PCV vaccine response against the 7 common serotypes (95.8%).

**Table 11 Study 10PN-PD-DIT-001: Non-inferiority analysis using ELISA**

| Antibody | SYNFLORIX |      | 7-valent PCV vaccine |      | Difference in $\% \geq 0.2\mu\text{g/ml}$ (7-valent PCV vaccine minus SYNFLORIX) |         |       |
|----------|-----------|------|----------------------|------|--|---------|-------|
|          | N         | %    | N                    | %    | %  | 96.5%CI |       |
| Anti-4   | 1106      | 97.1 | 373                  | 100  | <b>2.89</b>  | 1.71    | 4.16  |
| Anti-6B  | 1100      | 65.9 | 372                  | 79.0 | <b>13.12</b>   | 7.53    | 18.28 |
| Anti-9V  | 1103      | 98.1 | 374                  | 99.5 | <b>1.37</b>  | -0.28   | 2.56  |
| Anti-14  | 1100      | 99.5 | 374                  | 99.5 | <b>-0.08</b>   | -1.66   | 0.71  |
| Anti-18C | 1102      | 96.0 | 374                  | 98.9 | <b>2.92</b>  | 0.88    | 4.57  |
| Anti-19F | 1104      | 95.4 | 375                  | 99.2 | <b>3.83</b>  | 1.87    | 5.50  |
| Anti-23F | 1102      | 81.4 | 374                  | 94.1 | <b>12.72</b>   | 8.89    | 16.13 |

Table 12 presents the percentages of subjects reaching the non-inferiority threshold and the geometric mean concentrations (GMCs) of pneumococcal antibodies following the third primary dose (2-3-4 months schedule), prior to and after the booster dose (12-18 months) of SYNFLORIX or 7-valent PCV vaccine in the pivotal non-inferiority study (10PN-PD-DIT-001) and its booster phase (10PN-PD-DIT-007).

Post-primary GMCs elicited by SYNFLORIX against the seven serotypes in common were lower than those elicited by 7-valent PCV vaccine. However, antibody persistence 8 to 12 months after the last primary dose was similar or higher in SYNFLORIX vaccinees compared to 7-valent PCV vaccine vaccinees for all serotypes, except serotype 14. After the booster dose, the GMCs elicited by SYNFLORIX remained lower for most serotypes in common with 7-valent PCV vaccine (see Table 12), however the percentages of subjects reaching the 0.2 µg/mL threshold were similar for both vaccines.

In the same study, SYNFLORIX was shown to elicit functional antibodies to all vaccine serotypes. For each of the serotypes in common, 87.7% to 100% of SYNFLORIX vaccinees and 92.1% to 100% of 7-valent PCV vaccine vaccinees reached an OPA titre  $\geq 8$  one month after the third dose. The difference between both vaccines in terms of percentage of subjects with OPA titres  $\geq 8$  was below 5% for all serotypes in common, including 6B and 23F.

For serotypes 1, 5 and 7F, the percentages of SYNFLORIX vaccinees reaching an OPA titre  $\geq 8$  were respectively 65.7%, 90.9% and 99.6% after the primary vaccination course and 91.0%, 96.3% and 100% after the booster dose. OPA responses for serotypes 1 and 5 were lower in magnitude than the responses against the other serotypes, especially after the primary course. This may result in a lower efficacy for these serotypes prior to the booster dose which induces an anamnestic response. The clinical relevance of this observation is unknown as in studied populations, the vast majority of serotype 1 and 5 IPD cases occur after one year of age. The response observed for serotype 7F was in the same range as for the seven serotypes in common.

**Table 12 Percentages of subjects reaching the non-inferiority threshold and antibody GMCs, one month post-primary vaccination, prior and one month after booster vaccination – 10PN-PD-DIT-001 and -007**

| Serotype | Timing       | SYNFLORIX                  |                     | 7-valent PCV vaccine       |                     |
|----------|--------------|----------------------------|---------------------|----------------------------|---------------------|
|          |              | % $\geq 0.2\mu\text{g/ml}$ | GMC                 | % $\geq 0.2\mu\text{g/ml}$ | GMC                 |
| 1        | Post-primary | 97.3<br>(96.1;98.2)        | 1.05<br>(1.00;1.10) | 4.0<br>(2.3;6.6)           | 0.03<br>(0.03;0.03) |
|          | Pre-booster  | 36.4<br>(31.3;41.8)        | 0.14<br>(0.13;0.16) | 3.7<br>(0.8;10.3)          | 0.03<br>(0.03;0.04) |
|          | Post-booster | 99.4<br>(97.9;99.9)        | 1.53<br>(1.40;1.68) | 4.9<br>(1.4;12.2)          | 0.04<br>(0.03;0.05) |
| 4        | Post-primary | 97.1<br>(95.9;98.0)        | 1.45<br>(1.38;1.53) | 100.0<br>(99.0;100.0)      | 2.78<br>(2.58;3.00) |
|          | Pre-booster  | 57.3<br>(51.9;62.6)        | 0.23<br>(0.21;0.26) | 67.9<br>(56.4;78.1)        | 0.30<br>(0.25;0.37) |
|          | Post-booster | 99.7<br>(98.4;100.0)       | 3.35<br>(3.06;3.67) | 100.0<br>(95.9;100.0)      | 4.40<br>(3.75;5.15) |
| 5        | Post-primary | 99.0<br>(98.2; 99.5)       | 1.70<br>(1.62;1.78) | 1.9<br>(0.8;3.8)           | 0.03<br>(0.03;0.03) |
|          | Pre-booster  | 67.2<br>(61.9;72.1)        | 0.27<br>(0.25;0.30) | 6.0<br>(2.0;13.3)          | 0.04<br>(0.04;0.05) |
|          | Post-booster | 99.4                       | 2.20                | 6.1                        | 0.05                |

| Serotype | Timing       | SYNFLORIX                   |                     | 7-valent PCV vaccine        |                      |
|----------|--------------|-----------------------------|---------------------|-----------------------------|----------------------|
|          |              | % $\geq 0.2 \mu\text{g/ml}$ | GMC                 | % $\geq 0.2 \mu\text{g/ml}$ | GMC                  |
|          |              | (97.9;99.9)                 | (2.00;2.42)         | (2.0;13.7)                  | (0.04;0.07)          |
| 6B       | Post-primary | 65.9<br>(63.0;68.7)         | 0.33<br>(0.30;0.36) | 79.0<br>(74.5;83.1)         | 0.59<br>(0.51;0.67)  |
|          | Pre-booster  | 67.0<br>(61.6;72.0)         | 0.31<br>(0.27;0.35) | 30.7<br>(20.5;42.4)         | 0.14<br>(0.11;0.19)  |
|          | Post-booster | 96.5<br>(93.9;98.2)         | 1.94<br>(1.74;2.17) | 97.7<br>(91.9;99.7)         | 3.53<br>(2.83;4.41)  |
| 7F       | Post-primary | 99.5<br>(98.8;99.8)         | 1.72<br>(1.64;1.80) | 4.5<br>(2.7;7.2)            | 0.04<br>(0.04;0.04)  |
|          | Pre-booster  | 90.6<br>(87.0;93.5)         | 0.57<br>(0.52;0.62) | 4.7<br>(1.3;11.6)           | 0.03<br>(0.03;0.04)  |
|          | Post-booster | 100.0<br>(98.9;100.0)       | 3.50<br>(3.25;3.76) | 7.1<br>(2.6;14.7)           | 0.04<br>(0.03;0.05)  |
| 9V       | Post-primary | 98.1<br>(97.1;98.8)         | 1.32<br>(1.25;1.38) | 99.5<br>(98.1;99.9)         | 2.68<br>(2.47;2.91)  |
|          | Pre-booster  | 84.6<br>(80.3;88.2)         | 0.54<br>(0.48;0.60) | 90.9<br>(82.2;96.3)         | 0.62<br>(0.51;0.76)  |
|          | Post-booster | 100.0<br>(98.9;100.0)       | 3.25<br>(2.99;3.53) | 100.0<br>(95.9;100.0)       | 6.09<br>(5.19;7.15)  |
| 14       | Post-primary | 99.5<br>(98.9;99.9)         | 2.90<br>(2.75;3.05) | 99.5<br>(98.1;99.9)         | 4.49<br>(4.07;4.96)  |
|          | Pre-booster  | 79.8<br>(75.1;83.9)         | 0.66<br>(0.56;0.76) | 93.3<br>(85.1;97.8)         | 1.06<br>(0.82;1.38)  |
|          | Post-booster | 99.1<br>(97.4;99.8)         | 5.56<br>(5.01;6.18) | 100.0<br>(95.8;100.0)       | 9.29<br>(7.85;10.99) |
| 18C      | Post-primary | 96.0<br>(94.7;97.1)         | 1.66<br>(1.56;1.77) | 98.9<br>(97.3;99.7)         | 2.46<br>(2.25;2.69)  |
|          | Pre-booster  | 70.4<br>(65.2;75.2)         | 0.30<br>(0.28;0.34) | 72.3<br>(61.4;81.6)         | 0.32<br>(0.26;0.39)  |
|          | Post-booster | 100.0<br>(98.9;100.0)       | 5.01<br>(4.60;5.46) | 100.0<br>(95.8;100.0)       | 5.21<br>(4.44;6.11)  |
| 19F      | Post-primary | 95.4<br>(94.0;96.5)         | 1.84<br>(1.71;1.98) | 99.2<br>(97.7;99.8)         | 3.42<br>(3.16;3.70)  |
|          | Pre-booster  | 78.4<br>(73.7;82.6)         | 0.53<br>(0.46;0.61) | 44.7<br>(33.9;55.9)         | 0.23<br>(0.17;0.31)  |
|          | Post-booster | 99.4<br>(97.9;99.9)         | 6.05<br>(5.46;6.71) | 100.0<br>(95.8;100.0)       | 3.35<br>(2.83;3.97)  |
| 23F      | Post-primary | 81.4<br>(79.0;83.7)         | 0.53<br>(0.50;0.57) | 94.1<br>(91.2;96.3)         | 1.34<br>(1.18;1.52)  |
|          | Pre-booster  | 60.9<br>(55.5;66.2)         | 0.27<br>(0.23;0.31) | 55.8<br>(44.1;67.2)         | 0.24<br>(0.19;0.31)  |
|          | Post-booster | 97.4<br>(95.0;98.8)         | 2.38<br>(2.13;2.66) | 98.9<br>(93.8;100.0)        | 6.67<br>(5.38;8.26)  |

## Additional immunogenicity data

### *Infants less than 6 months of age:*

#### **3-dose primary schedule**

In clinical trials, the immunogenicity of SYNFLORIX was evaluated after a 3-dose primary vaccination course according to different schedules (including 2-3-4, 3-4-5 or 2-4-6 months of age) and after a fourth (booster) dose given at least 6 months after the last

primary dose and from the age of 9 month onwards.

In a clinical study, it has been demonstrated that SYNFLORIX can be safely administered as a booster dose in the second year of life to children who had received 3 primary doses of 7-valent PCV vaccine. This study has shown that the immune response against the 7 common serotypes was comparable after the booster dose. However, as these children were not primed by 7-valent PCV vaccine against the additional serotypes contained in SYNFLORIX (1, 5, 7F), a lower level of protection is anticipated against diseases caused by these three serotypes compared to other serotypes.

### ***2-dose primary schedule***

In clinical trials, the immunogenicity of SYNFLORIX was evaluated after a 2-dose primary vaccination course according to different schedules (including 6-14 weeks, 2-4 or 3-5 months of age) and after a third (booster) dose given at least 6 months after the last primary dose and from the age of 9 months onwards.

In study 10PN-PD-DIT-002, the immunogenicity was compared in an exploratory analysis between the 2+1 schedule and 3+1 schedule. Please refer to Table 13.

**Table 13 Seropositivity rates and GMCs for ANTI-1, ANTI-4, ANTI-5, ANTI-6B, ANTI-7F, ANTI-9V, ANTI-14, ANTI-18C, ANTI-19F and ANTI-23F antibodies (ATP cohort for immunogenicity)**

| Antibody | Group   | Timing    | N   | ≥ 0.2 µg/mL |      |            | GMC   |            |
|----------|---------|-----------|-----|-------------|------|------------|-------|------------|
|          |         |           |     | n           | %    | 95% CI     | value | 95% CI     |
| ANTI-1   | 10Pn_2d | PII(M3)   | 153 | 149         | 97.4 | 93.4; 99.3 | 1.03  | 0.90; 1.18 |
|          |         | PIII(M10) | 156 | 155         | 99.4 | 96.5; 100  | 1.85  | 1.59; 2.15 |
|          | 10Pn_3d | PIII(M3)  | 151 | 149         | 98.7 | 95.3; 99.8 | 1.23  | 1.07; 1.42 |
|          |         | PIV(M10)  | 147 | 147         | 100  | 97.5; 100  | 1.88  | 1.62; 2.17 |
| ANTI-4   | 10Pn_2d | PII(M3)   | 153 | 150         | 98.0 | 94.4; 99.6 | 1.37  | 1.21; 1.55 |
|          |         | PIII(M10) | 155 | 155         | 100  | 97.6; 100  | 3.06  | 2.68; 3.49 |
|          | 10Pn_3d | PIII(M3)  | 153 | 152         | 99.3 | 96.4; 100  | 1.71  | 1.47; 1.99 |
|          |         | PIV(M10)  | 147 | 147         | 100  | 97.5; 100  | 3.47  | 3.03; 3.98 |
| ANTI-5   | 10Pn_2d | PII(M3)   | 152 | 146         | 96.1 | 91.6; 98.5 | 1.32  | 1.14; 1.52 |
|          |         | PIII(M10) | 155 | 155         | 100  | 97.6; 100  | 2.65  | 2.31; 3.03 |
|          | 10Pn_3d | PIII(M3)  | 149 | 149         | 100  | 97.6; 100  | 1.85  | 1.63; 2.10 |
|          |         | PIV(M10)  | 147 | 147         | 100  | 97.5; 100  | 3.21  | 2.81; 3.67 |
| ANTI-6B  | 10Pn_2d | PII(M3)   | 149 | 83          | 55.7 | 47.3; 63.8 | 0.19  | 0.15; 0.24 |
|          |         | PIII(M10) | 156 | 138         | 88.5 | 82.4; 93.0 | 1.12  | 0.88; 1.41 |
|          | 10Pn_3d | PIII(M3)  | 149 | 94          | 63.1 | 54.8; 70.8 | 0.31  | 0.25; 0.38 |
|          |         | PIV(M10)  | 147 | 142         | 96.6 | 92.2; 98.9 | 1.85  | 1.54; 2.22 |
| ANTI-7F  | 10Pn_2d | PII(M3)   | 153 | 148         | 96.7 | 92.5; 98.9 | 1.28  | 1.13; 1.46 |
|          |         | PIII(M10) | 156 | 156         | 100  | 97.7; 100  | 2.81  | 2.51; 3.15 |
|          | 10Pn_3d | PIII(M3)  | 152 | 151         | 99.3 | 96.4; 100  | 2.14  | 1.90; 2.40 |
|          |         | PIV(M10)  | 147 | 147         | 100  | 97.5; 100  | 3.88  | 3.45; 4.37 |
| ANTI-9V  | 10Pn_2d | PII(M3)   | 152 | 142         | 93.4 | 88.2; 96.8 | 0.92  | 0.81; 1.05 |
|          |         | PIII(M10) | 156 | 155         | 99.4 | 96.5; 100  | 2.95  | 2.59; 3.37 |
|          | 10Pn_3d | PIII(M3)  | 153 | 152         | 99.3 | 96.4; 100  | 1.47  | 1.29; 1.68 |
|          |         | PIV(M10)  | 147 | 147         | 100  | 97.5; 100  | 3.97  | 3.49; 4.50 |
| ANTI-14  | 10Pn_2d | PII(M3)   | 152 | 146         | 96.1 | 91.6; 98.5 | 1.72  | 1.45; 2.05 |
|          |         | PIII(M10) | 156 | 155         | 99.4 | 96.5; 100  | 4.19  | 3.62; 4.85 |
|          | 10Pn_3d | PIII(M3)  | 152 | 152         | 100  | 97.6; 100  | 2.57  | 2.22; 2.97 |
|          |         | PIV(M10)  | 147 | 145         | 98.6 | 95.2; 99.8 | 5.47  | 4.68; 6.40 |
| ANTI-18C | 10Pn_2d | PII(M3)   | 152 | 146         | 96.1 | 91.6; 98.5 | 1.26  | 1.06; 1.51 |
|          |         | PIII(M10) | 156 | 156         | 100  | 97.7; 100  | 6.24  | 5.43; 7.18 |
|          | 10Pn_3d | PIII(M3)  | 153 | 152         | 99.3 | 96.4; 100  | 3.42  | 2.87; 4.07 |
|          |         | PIV(M10)  | 147 | 146         | 99.3 | 96.3; 100  | 7.20  | 6.08; 8.52 |
| ANTI-19F | 10Pn_2d | PII(M3)   | 152 | 141         | 92.8 | 87.4; 96.3 | 2.43  | 1.97; 2.98 |
|          |         | PIII(M10) | 156 | 150         | 96.2 | 91.8; 98.6 | 5.58  | 4.65; 6.69 |
|          | 10Pn_3d | PIII(M3)  | 152 | 146         | 96.1 | 91.6; 98.5 | 4.43  | 3.60; 5.45 |
|          |         | PIV(M10)  | 147 | 144         | 98.0 | 94.2; 99.6 | 6.95  | 5.92; 8.17 |
| ANTI-23F | 10Pn_2d | PII(M3)   | 153 | 106         | 69.3 | 61.3; 76.5 | 0.38  | 0.30; 0.47 |
|          |         | PIII(M10) | 154 | 148         | 96.1 | 91.7; 98.6 | 2.41  | 1.98; 2.94 |
|          | 10Pn_3d | PIII(M3)  | 152 | 118         | 77.6 | 70.2; 84.0 | 0.52  | 0.42; 0.63 |
|          |         | PIV(M10)  | 147 | 141         | 95.9 | 91.3; 98.5 | 2.78  | 2.31; 3.35 |

10Pn\_2d = 10Pn-PD-DiT (2-4-11 months)+DTPa-(HBV)-IPV/Hib(2-4-11 months)

10Pn\_3d = 10Pn-PD-DiT (2-3-4-11 months)+DTPa-(HBV)-IPV/Hib(2-4-11 months)

GMC = geometric mean antibody concentration; N = number of subjects with available results; n/% = number/percentage of subjects with concentration within the specified range.

PII(M3) = One month after dose 2 (for the 2 primary doses group); PIII(M10) = One month after booster dose (for the 2 primary doses group); PIII(M3) = One month after dose 3 (for the 3 primary doses group); PIV(M10) = One month after booster dose (for the 3 primary doses group)

Note: The Confidence Intervals are presented for descriptive purposes and are not intended to be used to draw conclusions.

The clinical consequences of the lower post-primary and post-booster immune responses observed after the two-dose primary schedule are not known.

In Study 10PN-PD-DIT-002, one month after primary vaccination, there was no significant difference between the 2 dose schedule and the 3 dose schedule in the percentages of subjects with antibody concentration  $\geq 0.2 \mu\text{g/ml}$  (ELISA) and antibody GMCs against cross-reactive serotype 19A. However, the percentage of subjects with OPA titres  $\geq 8$  and GMTs were lower in the 2 dose schedule than those in the 3 dose schedule following priming series and the booster. In both schedules, a booster response indicative of immunological priming was observed for cross-reactive serotype 19A (Table 14).

**Table 14 Study 10 PN-PD-DIT-002: Percentage of subjects with antibody concentrations greater or equal to  $0.2 \mu\text{g/mL}$ , OPA titres greater or equal to 8 and GMCs/GMTs against pneumococcal cross-reactive serotype 19A (ATP cohort for immunogenicity)**

|                           |                              |     | ELISA    |      |        |      |       |      |      |        |    | OPA  |      |      |        |      |      |  |  |
|---------------------------|------------------------------|-----|----------|------|--------|------|-------|------|------|--------|----|------|------|------|--------|------|------|--|--|
|                           |                              |     | 0.2ug/mL |      |        |      |       | GMC  |      |        |    | N    | ≥ 8  |      |        |      | GMT  |  |  |
|                           |                              |     |          |      | 95% CI |      |       |      |      | 95% CI |    |      |      |      | 95% CI |      |      |  |  |
| Group<br>(Schedule)       | Timing                       | N   | n        | %    | LL     | UL   | value | LL   | UL   |        | n  | %    | LL   | UL   | Value  | LL   | UL   |  |  |
| 10Pn_3d<br>(2,3,4 months) | One month after dose 3       | 150 | 80       | 53.3 | 45.0   | 61.5 | 0.19  | 0.16 | 0.24 | 130    | 46 | 35.4 | 27.2 | 44.2 | 15.8   | 11.2 | 22.3 |  |  |
|                           | Before booster dose          | 147 | 76       | 51.7 | 43.3   | 60.0 | 0.20  | 0.16 | 0.24 | 133    | 5  | 3.8  | 1.2  | 8.6  | 4.6    | 4.0  | 5.2  |  |  |
|                           | One month after booster dose | 147 | 122      | 83.0 | 75.9   | 88.7 | 0.87  | 0.69 | 1.11 | 116    | 54 | 46   | 37.2 | 56.0 | 27.2   | 18.0 | 41.2 |  |  |
| 10Pn_2d<br>(2-4 months)   | One month after dose 2       | 150 | 64       | 42.7 | 34.6   | 51.0 | 0.14  | 0.12 | 0.17 | 133    | 17 | 12.8 | 7.6  | 19.7 | 5.5    | 4.8  | 6.5  |  |  |
|                           | Before booster dose          | 149 | 63       | 42.3 | 34.2   | 50.6 | 0.14  | 0.12 | 0.17 | 134    | 2  | 1.5  | 0.2  | 5.3  | 4.2    | 3.9  | 4.6  |  |  |
|                           | One month after booster dose | 156 | 127      | 81.4 | 74.4   | 87.2 | 0.73  | 0.58 | 0.92 | 119    | 29 | 24.4 | 17.0 | 33.1 | 8.7    | 6.6  | 11.6 |  |  |

10Pn\_2d = SYNFLORIX (2-4-11 months)+ *Infanrix hexa*/ *Infanrix-IPV/Hib* (2-4-11 months)

10Pn\_3d = SYNFLORIX (2-3-4-11 months)+ *Infanrix hexa*/ *Infanrix-IPV/Hib* (2-4-11 months)

GMC/T = geometric mean concentration/titre;

N = number of subjects with available results;

n/% = number/percentage of subjects with concentration/titre within the specified range;  
95% CI = 95% confidence interval; LL = Lower Limit, UL = Upper Limit

A study conducted in South Africa assessed the immunogenicity of SYNFLORIX given as a booster dose at 9 to 10 months of age after a 3-dose (at 6, 10 and 14 weeks of age) or 2-dose (at 6 and 14 weeks of age) priming. The booster dose induced marked increases in antibody GMCs and OPA GMTs for each vaccine serotype and serotype 19A in both 2-dose and 3-dose priming groups indicative of immunological priming.

### ***Immune memory***

The administration of a booster dose in the second year of life elicited an anamnestic antibody response as measured by ELISA and OPA for the 10 serotypes included in the vaccine demonstrating the induction of immune memory after the three-dose primary course. In study 10PN-PD-DIT-008, administration of unconjugated pneumococcal polysaccharides at 13 months of age, after the primary series with SYNFLORIX was also followed by a sharp increase in antibody response for the 10 serotypes further confirming that SYNFLORIX induces immune memory.

In study 10PN-PD-DIT-046, based on a subset of the subjects originally randomized to Study 10PN-PD-DIT-002, (110/351 = 31%) 24-36 months after completion of the 2+1 schedule or the 3+1 schedule, at least 83.7% or 96.6% subjects, respectively, remained seropositive (i.e., detectable antibody > 0.05 µg/mL) to each of the vaccine pneumococcal serotypes. In this subset of subjects, a single dose of SYNFLORIX administered during the 4<sup>th</sup> year of life, as a challenge dose, elicited higher ELISA antibody GMCs 7-10 days following vaccination in 2-dose primed subjects (ranging from 4.00 to 20.28 µg/mL) and 3-dose primed subjects (ranging from 4.72 to 30.55 µg/mL).

### ***Premature infants***

In studies 10PN-PD-DIT-015 and 10PN-PD-DIT-016, immunogenicity of SYNFLORIX in very premature (born after a gestation period of 27-30 weeks) (N=42), premature (born after a gestation period of 31-36 weeks) (N=82) and full term (born after a gestation period of more than 36 weeks) (N=132) infants was evaluated descriptively following a three dose primary vaccination course at 2, 4, and 6 months of age. Immunogenicity was also evaluated in 44 very premature, 69 premature and 127 full term infants following a booster dose at 16 to 18 months of age. See immunogenicity data by ELISA in Table 15 below.

**Table 15 ELISA responders and ELISA GMCs to the 10 common serotypes one month post-primary vaccination (study 10PN-PD-DIT-015), prior to and one month after booster vaccination (study 10PN-PD-DIT-016)**

|          |       |              | ELISA       |            |       |            |
|----------|-------|--------------|-------------|------------|-------|------------|
| Serotype | Group | Timing       | ≥ 0.2 µg/mL |            | GMC   |            |
|          |       |              | %           | 95% CI     | Value | 95% CI     |
| 1        | PT1   | Post-primary | 97.6        | 87.4; 99.9 | 0.97  | 0.75; 1.26 |
|          |       | Pre-booster  | 37.2        | 23.0; 53.3 | 0.15  | 0.11; 0.20 |
|          |       | Post-booster | 100         | 91.8; 100  | 1.57  | 1.20; 2.05 |
|          | PT2   | Post-primary | 100         | 95.6; 100  | 1.10  | 0.93; 1.30 |
|          |       | Pre-booster  | 42.4        | 30.3; 55.2 | 0.14  | 0.11; 0.18 |
|          |       | Post-booster | 100         | 94.6; 100  | 1.74  | 1.41; 2.15 |
|          | FT    | Post-primary | 99.2        | 95.8; 100  | 1.35  | 1.18; 1.55 |
|          |       | Pre-booster  | 43.8        | 34.8; 53.1 | 0.17  | 0.15; 0.21 |
|          |       | Post-booster | 99.2        | 95.4; 100  | 1.98  | 1.66; 2.37 |
| 4        | PT1   | Post-primary | 97.6        | 87.1; 99.9 | 1.53  | 1.19; 1.98 |
|          |       | Pre-booster  | 53.5        | 37.7; 68.8 | 0.25  | 0.18; 0.35 |
|          |       | Post-booster | 100         | 91.8; 100  | 2.98  | 2.31; 3.85 |
|          | PT2   | Post-primary | 98.8        | 93.4; 100  | 1.88  | 1.61; 2.20 |
|          |       | Pre-booster  | 58.0        | 45.5; 69.8 | 0.24  | 0.20; 0.30 |
|          |       | Post-booster | 100         | 94.6; 100  | 3.67  | 3.07; 4.39 |
|          | FT    | Post-primary | 100         | 97.2; 100  | 2.42  | 2.13; 2.74 |
|          |       | Pre-booster  | 66.7        | 57.6; 74.9 | 0.30  | 0.25; 0.35 |
|          |       | Post-booster | 100         | 96.9; 100  | 4.23  | 3.67; 4.88 |
| 5        | PT1   | Post-primary | 100         | 91.6; 100  | 1.45  | 1.13; 1.86 |
|          |       | Pre-booster  | 62.8        | 46.7; 77.0 | 0.24  | 0.18; 0.33 |
|          |       | Post-booster | 100         | 91.8; 100  | 1.84  | 1.43; 2.38 |
|          | PT2   | Post-primary | 100         | 95.6; 100  | 1.93  | 1.65; 2.25 |
|          |       | Pre-booster  | 63.2        | 50.7; 74.6 | 0.27  | 0.21; 0.34 |
|          |       | Post-booster | 100         | 94.6; 100  | 2.38  | 1.93; 2.94 |
|          | FT    | Post-primary | 100         | 97.2; 100  | 2.31  | 2.00; 2.66 |
|          |       | Pre-booster  | 84.7        | 77.1; 90.5 | 0.40  | 0.34; 0.48 |
|          |       | Post-booster | 100         | 96.9; 100  | 2.58  | 2.20; 3.02 |
| 6B       | PT1   | Post-primary | 92.7        | 80.1; 98.5 | 0.85  | 0.61; 1.19 |
|          |       | Pre-booster  | 65.1        | 49.1; 79.0 | 0.28  | 0.21; 0.38 |
|          |       | Post-booster | 100         | 91.6; 100  | 2.44  | 1.87; 3.17 |
|          | PT2   | Post-primary | 95.1        | 88.0; 98.7 | 1.11  | 0.89; 1.37 |
|          |       | Pre-booster  | 61.2        | 48.5; 72.9 | 0.30  | 0.23; 0.37 |
|          |       | Post-booster | 98.5        | 91.8; 100  | 2.46  | 1.97; 3.06 |
|          | FT    | Post-primary | 93.9        | 88.3; 97.3 | 1.18  | 1.00; 1.39 |
|          |       | Pre-booster  | 79.8        | 71.7; 86.5 | 0.37  | 0.31; 0.45 |
|          |       | Post-booster | 100         | 96.9; 100  | 2.67  | 2.27; 3.13 |
| 7F       | PT1   | Post-primary | 100         | 91.4; 100  | 1.87  | 1.47; 2.39 |
|          |       | Pre-booster  | 79.1        | 64.0; 90.0 | 0.42  | 0.31; 0.56 |
|          |       | Post-booster | 100         | 91.8; 100  | 3.11  | 2.48; 3.90 |
|          | PT2   | Post-primary | 100         | 95.6; 100  | 2.37  | 2.07; 2.73 |
|          |       | Pre-booster  | 86.2        | 75.3; 93.5 | 0.46  | 0.37; 0.58 |
|          |       | Post-booster | 100         | 94.6; 100  | 4.16  | 3.52; 4.90 |
|          | FT    | Post-primary | 100         | 97.2; 100  | 2.69  | 2.39; 3.03 |
|          |       | Pre-booster  | 93.5        | 87.6; 97.2 | 0.66  | 0.57; 0.77 |
|          |       | Post-booster | 100         | 96.9; 100  | 3.93  | 3.45; 4.47 |



|          |       |              | ELISA       |            |       |              |
|----------|-------|--------------|-------------|------------|-------|--------------|
|          |       |              | ≥ 0.2 µg/mL |            | GMC   |              |
| Serotype | Group | Timing       | %           | 95% CI     | Value | 95% CI       |
| 9V       | PT1   | Post-primary | 97.6        | 87.1; 99.9 | 1.43  | 1.17; 1.74   |
|          |       | Pre-booster  | 90.7        | 77.9; 97.4 | 0.51  | 0.39; 0.67   |
|          |       | Post-booster | 100         | 91.8; 100  | 2.87  | 2.23; 3.70   |
|          | PT2   | Post-primary | 100         | 95.6; 100  | 1.69  | 1.44; 1.99   |
|          |       | Pre-booster  | 85.5        | 75.0; 92.8 | 0.42  | 0.35; 0.52   |
|          |       | Post-booster | 100         | 94.6; 100  | 3.47  | 2.86; 4.20   |
|          | FT    | Post-primary | 100         | 97.2; 100  | 2.41  | 2.13; 2.73   |
|          |       | Pre-booster  | 93.5        | 87.6; 97.2 | 0.59  | 0.51; 0.69   |
|          |       | Post-booster | 100         | 96.9; 100  | 4.17  | 3.60; 4.83   |
| 14       | PT1   | Post-primary | 100         | 91.4; 100  | 3.52  | 2.81; 4.42   |
|          |       | Pre-booster  | 95.3        | 84.2; 99.4 | 0.78  | 0.54; 1.11   |
|          |       | Post-booster | 100         | 91.8; 100  | 4.88  | 3.42; 6.98   |
|          | PT2   | Post-primary | 100         | 95.6; 100  | 3.28  | 2.77; 3.89   |
|          |       | Pre-booster  | 80.9        | 69.5; 89.4 | 0.48  | 0.37; 0.61   |
|          |       | Post-booster | 100         | 94.6; 100  | 5.14  | 4.22; 6.25   |
|          | FT    | Post-primary | 100         | 97.2; 100  | 3.71  | 3.21; 4.30   |
|          |       | Pre-booster  | 84.7        | 77.1; 90.5 | 0.68  | 0.55; 0.84   |
|          |       | Post-booster | 100         | 96.9; 100  | 5.98  | 5.10; 7.02   |
| 18C      | PT1   | Post-primary | 100         | 91.4; 100  | 3.28  | 2.51; 4.29   |
|          |       | Pre-booster  | 83.7        | 69.3; 93.2 | 0.58  | 0.42; 0.80   |
|          |       | Post-booster | 100         | 91.8; 100  | 9.51  | 7.36; 12.29  |
|          | PT2   | Post-primary | 100         | 95.5; 100  | 4.86  | 3.92; 6.02   |
|          |       | Pre-booster  | 88.2        | 78.1; 94.8 | 0.56  | 0.45; 0.70   |
|          |       | Post-booster | 100         | 94.6; 100  | 13.20 | 10.97; 15.89 |
|          | FT    | Post-primary | 98.5        | 94.6; 99.8 | 5.22  | 4.27; 6.38   |
|          |       | Pre-booster  | 84.8        | 77.3; 90.6 | 0.60  | 0.49; 0.73   |
|          |       | Post-booster | 99.2        | 95.4; 100  | 12.38 | 10.21; 15.00 |
| 19F      | PT1   | Post-primary | 100         | 91.6; 100  | 3.60  | 2.83; 4.57   |
|          |       | Pre-booster  | 88.4        | 74.9; 96.1 | 0.86  | 0.58; 1.30   |
|          |       | Post-booster | 100         | 91.8; 100  | 6.83  | 5.24; 8.89   |
|          | PT2   | Post-primary | 100         | 95.6; 100  | 4.80  | 4.15; 5.55   |
|          |       | Pre-booster  | 97.1        | 89.8; 99.6 | 1.07  | 0.78; 1.46   |
|          |       | Post-booster | 100         | 94.6; 100  | 9.78  | 8.19; 11.68  |
|          | FT    | Post-primary | 100         | 97.2; 100  | 4.56  | 3.95; 5.26   |
|          |       | Pre-booster  | 96.0        | 90.9; 98.7 | 1.27  | 1.02; 1.59   |
|          |       | Post-booster | 100         | 96.9; 100  | 9.72  | 8.38; 11.29  |
| 23F      | PT1   | Post-primary | 95.1        | 83.5; 99.4 | 1.05  | 0.74; 1.49   |
|          |       | Pre-booster  | 69.8        | 53.9; 82.8 | 0.27  | 0.20; 0.36   |
|          |       | Post-booster | 97.6        | 87.4; 99.9 | 2.70  | 1.91; 3.81   |
|          | PT2   | Post-primary | 96.3        | 89.7; 99.2 | 1.33  | 1.07; 1.65   |
|          |       | Pre-booster  | 65.2        | 52.8; 76.3 | 0.30  | 0.24; 0.38   |
|          |       | Post-booster | 100         | 94.6; 100  | 3.45  | 2.93; 4.06   |
|          | FT    | Post-primary | 95.4        | 90.3; 98.3 | 1.54  | 1.28; 1.85   |
|          |       | Pre-booster  | 80.5        | 72.4; 87.1 | 0.42  | 0.35; 0.51   |
|          |       | Post-booster | 99.2        | 95.4; 100  | 3.30  | 2.74; 3.99   |

PT1 = Preterm I group (children born as preterm after a gestation period of 27-30 weeks); PT2 = Preterm II group (children born as preterm after a gestation period of 31-36 weeks); FT = Full term group (children born after a gestation period of more than 36 weeks); GMC = geometric mean antibody concentration; % = percentage of subjects with concentration within the specified range

In premature infant studies 10PN-PD-DIT-015 and 10PN-PD-DIT-016 one month after primary vaccination, similar antibody GMCs and OPA GMTs for the cross-reactive serotype 19A were observed for all infants except lower antibody GMCs in preterm I infants (born after a gestation period of 27-30 weeks). The clinical relevance of these differences is unknown.

One month after the booster dose, increases of antibody GMCs and OPA GMTs were observed from the pre- to the post-booster time points for serotype 19A (4.6- to 6.9-fold and 5.8- to 7.8-fold increase for antibody GMCs and OPA GMTs, respectively), indicative of immunological memory. Regardless of maturity, similar antibody GMCs and OPA GMTs were observed for all infants groups for cross-reactive serotype 19A.

The profiles of ELISA GMTs and OPA GMTs observed for serotype 19A were in line with those observed for the serotypes contained in the vaccine.

***Previously Unvaccinated Older Infants and Children:***

One clinical study (study 013) evaluated catch-up vaccination in children older than 7 months of age (three age groups with different schedules). In the 7-11 months group, children received 2 primary doses followed by a booster dose in the second year of life, the 12 to 23 month group received 2 doses with at least a 2 month interval and the children in the group  $\geq 24$  months to 5 years of age received 1 dose .

**Table 16      Antibody GMCs Against the Vaccine Pneumococcal Serotypes (One month after the final dose)**

| Serotype | <6 months of age<br>(4 <sup>th</sup> dose)<br>N=137<br>(95% CI) | 7 to 11 months<br>of age<br>(3 <sup>rd</sup> dose)<br>N=114<br>(95% CI) | 12 to 23 months<br>of age<br>(2 <sup>nd</sup> dose)<br>N=133<br>(95% CI) | $\geq 24$ months to 5<br>years of age<br>(1 dose)<br>N=138-140<br>(95% CI) |
|----------|---|---|--|--|
| 1        | 1.84<br>(1.59; 2.12)  | 1.77<br>(1.55; 2.02)  | 1.22<br>(1.06; 1.40)   | 0.77<br>(0.66; 0.89)   |
| 4        | 2.98<br>(2.60; 3.42)  | 3.79<br>(3.27; 4.40)  | 4.21<br>(3.77; 4.69)   | 5.72<br>(5.00; 6.54)   |
| 5        | 2.21<br>(1.94; 2.53)  | 2.88<br>(2.48; 3.34)  | 1.80<br>(1.57; 2.06)   | 1.16<br>(0.99; 1.36)   |
| 6B       | 1.62<br>(1.35; 1.94)  | 1.39<br>(1.14; 1.69)  | 0.53<br>(0.43; 0.65)   | 0.38<br>(0.30; 0.47)   |
| 7F       | 3.31<br>(2.92; 3.74)  | 3.73<br>(3.24; 4.28)  | 3.62<br>(3.22; 4.06)   | 2.60<br>(2.25; 3.01)   |
| 9V       | 3.41<br>(2.96; 3.92)  | 2.13<br>(1.82; 2.50)  | 1.50<br>(1.30; 1.73)   | 1.01<br>(0.84; 1.22)   |
| 14       | 3.96<br>(3.39; 4.62)  | 5.41<br>(4.71; 6.22)  | 4.24<br>(3.64; 4.95)   | 1.36<br>(1.06; 1.74)   |
| 18C      | 5.28<br>(4.55; 6.12)  | 9.40<br>(8.04; 10.98)   | 9.20<br>(8.22; 10.29)  | 4.65<br>(4.06; 5.31)   |
| 19F      | 3.38<br>(2.81; 4.06)  | 5.71<br>(4.68; 6.97)  | 5.45<br>(4.63; 6.41)   | 5.26<br>(4.34; 6.39)   |
| 23F      | 2.76<br>(2.37; 3.21)  | 1.65<br>(1.33; 2.03)  | 0.88<br>(0.73; 1.05)   | 0.37<br>(0.30; 0.47)   |

N=number of subjects with available results

Note: The Confidence Intervals are presented for descriptive purposes and are not intended to be used to draw conclusions.

In another clinical study, a single dose of SYNFLORIX administered during the second year of life after two catch-up doses at 12-20 months of age elicited a marked increase

of ELISA GMCs and OPA GMTs (when comparing the responses pre and post the last dose), indicating that two catch-up doses provide adequate priming. In study 002, children were vaccinated according to either a 3-dose (shown below in Table 17) or 2-dose primary vaccination within the first 6 months of age and a booster vaccination at 11 months of age. In study 046, a 2 dose catch-up vaccination was given to children in their 4<sup>th</sup> year of life who had not previously received any pneumococcal vaccine.

**Table 17      Antibody GMCs Against the Vaccine Pneumococcal Serotypes**

| Serotype | 002*<br>3 <sup>rd</sup> dose<br>N=149-153 | 046^<br>Unprimed<br>N=60 |
|----------|---|--------------------------|
| 1        | 1.23                                      | 2.81                     |
| 4        | 1.71                                      | 8.44                     |
| 5        | 1.85                                      | 3.54                     |
| 6B       | 0.31                                      | 1.11                     |
| 7F       | 2.14                                      | 6.10                     |
| 9V       | 1.47                                      | 2.22                     |
| 14       | 2.57                                      | 6.48                     |
| 18C      | 3.42                                      | 22.28                    |
| 19F      | 4.43                                      | 17.03                    |
| 23F      | 0.52                                      | 1.09                     |

N=number of subjects with available results

\*One month after dose 3 (3 dose primary vaccination)

^2 doses; children unprimed in their fourth year of life

### *Hyporesponsiveness*

No evidence of hyporesponsiveness has been seen following a booster dose of SYNFLORIX or pneumococcal polysaccharide vaccine.

There are no data available to indicate whether the administration of pneumococcal polysaccharide vaccine to SYNFLORIX primed children may result in hyporesponsiveness to further doses of pneumococcal polysaccharide or to pneumococcal conjugate vaccine.

### ***Immunogenicity in Immunocompromised populations:***

#### ***HIV positive (HIV+/+) infants and HIV negative infants born from an HIV positive mother (HIV+/-)***

In a clinical study conducted in South Africa the immunogenicity of SYNFLORIX administered as a 3-dose primary vaccination course (at 6, 10 and 14 weeks of age) followed by a booster dose (at 9 to 10 months of age) was assessed in 70 HIV positive (HIV+/+) infants (asymptomatic or mild disease (WHO, 2007), with a mean CD4 cell count of 1,936 cell/mm<sup>3</sup>), 91 HIV negative infants born from an HIV positive mother (HIV+/-) and 93 HIV negative infants born from an HIV negative mother (HIV-/-).<sup>22</sup>

For most vaccine serotypes, group comparisons did not suggest any differences in post-primary immune responses between the HIV+/+ and HIV-/- groups, or the HIV+/- and HIV-/- groups, except for a trend towards a lower percentage of subjects reaching OPA titres  $\geq 8$  and lower OPA GMTs in the HIV+/+ group. The clinical relevance of this lower post-primary OPA response is not known. For the cross-reactive serotype 19A, the results did not suggest any differences in ELISA antibody GMCs and OPA GMTs between groups.

The booster dose of SYNFLORIX in HIV+/+ and HIV+/- infants induced robust increases in ELISA antibody GMCs and OPA GMTs for each vaccine serotype and serotype 19A indicative of immunological priming. For most vaccine serotypes and serotype 19A, group comparisons did not suggest any differences post-booster dose in ELISA antibody GMCs and OPA GMTs between the HIV+/+ and HIV-/- groups, or the HIV+/- and HIV-/- groups.

The results for protein D suggested comparable post-primary and post-booster immune responses between groups.

#### ***Children with sickle cell disease***

A clinical study conducted in Burkina Faso assessed the immunogenicity of SYNFLORIX administered to 146 children with SCD (48 children <6 months of age received primary vaccination at 8, 12 and 16 weeks of age, followed by a booster dose at 9-10 months of age, 50 children aged 7-11 months and 48 aged 12-23 months started catch-up vaccination according to their age) compared to 143 age-matched children without SCD. The immune response to SYNFLORIX for each of the vaccine serotype and serotype 19A, as well as for protein D, did not appear to be influenced by SCD.

## TOXICOLOGY

### Animal Pharmacology

In primary pharmacodynamic studies, the proposed 10-valent vaccine or related 11-valent vaccines were shown to be immunogenic in mice, guinea pigs and rabbits. Several 11-valent related phase II formulations were developed. These formulations contained the same serotypes as the current 10Pn-PD-DiT vaccine and in addition serotype 3, and the vaccine formulations differed in carrier protein (protein D- PD, tetanus toxoid – TT and diphtheria toxoid- DT). All vaccine formulations induced polysaccharide-specific IgG to all serotypes in the animal models tested. The predictivity of the animal models for human immunogenicity is not clear, and the assessment of comparability for immune response between vaccine formulations was further supported by clinical data. The clinical route of i.m. injection was used for immunogenicity analysis, and ELISA was used in all studies to determine serum antibody levels to each of the serotype. The sera of immunised mice and guinea pigs had functional (opsonophagocytic) activity *in vitro* against several test serotypes.

Two immunogenicity studies in mice showed the enhancing effect of the adjuvant on the antibody response for most of the serotypes. Further justification for the inclusion of aluminum phosphate as adjuvant in the vaccine was given by clinical data.

With respect to the non-clinical data for protein D, the carrier protein from *H influenzae*, a juvenile chinchilla otitis media model was used to demonstrate that passive inoculation with the sera of children administered the 10- or 11-valent vaccine conferred protection against otitis media caused by non-typeable *H influenzae*. The passively transferred sera provided ~34% protection against otitis media, and there were no significant differences between the 2 vaccines.

### Animal Toxicology

Although no toxicology studies have been performed with the final 10Pn-PD-DiT SYNFLORIX vaccine, toxicology studies were performed with similar 11-valent formulated vaccines containing higher amounts of antigen, carrier proteins or residues. The vaccine formulations used in these studies were immunogenic, well tolerated and without evidence of toxicity, other than injection site reactions which were reversible over time. The toxicity studies with similar 11-valent formulated vaccines are considered to be representative of the final 10-valent 10Pn-PD-DiT vaccine proposed for registration.

The potential side-effects of intramuscular administration of 11Pn-PD-DiT vaccine on cardiovascular and respiratory parameters in the anaesthetised male Wistar rat was studied and did not produce any treatment-related effects on any of the cardiovascular or respiratory parameters measured in the study.

Acute and repeat-dose toxicity studies in which rabbits were administered the full human dose of several 11-valent vaccines showed no systemic toxicity or target organ toxicity, providing overall evidence that the vaccine was safe and well tolerated in the studied animal species. A local inflammatory response was observed which tended to diminish over time with no long-term muscle damage or impairment being observed, consistent with other Aluminum-adjuvanted vaccines.

4-dimethylaminopyridine (DMAP) is an impurity resulting from the conjugation of the polysaccharide serotypes to their respective carrier proteins. The toxicity, mutagenicity and sensitisation potential of DMAP have been investigated. Since DMAP is not mutagenic and only a moderate skin sensitizer in guinea pigs at very high doses as compared to the human vaccine dose, it does not present any hazard to vaccinated subjects.

#### **Carcinogenesis and Mutagenesis**

SYNFLORIX has not been evaluated for the potential to cause carcinogenicity or genotoxicity.

#### **Reproductive Toxicology**

No studies on reproductive and developmental toxicity have been performed. This vaccine is not intended for women of child-bearing potential.

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### PART III: CONSUMER INFORMATION

#### SYNFLORIX

Pneumococcal conjugate vaccine (Non-Typeable *Haemophilus influenzae* (NTHi) protein D, diphtheria or tetanus toxoid conjugates) adsorbed

This leaflet is Part III of a three-part "Product Monograph" published when SYNFLORIX was approved for sale in Canada and is designed specifically for Consumers. This leaflet is a summary and will not tell you everything about SYNFLORIX. Contact your doctor or pharmacist if you have any questions about the vaccine.

#### ABOUT THIS VACCINE

##### **What the medication is used for and what it does:**

SYNFLORIX is a vaccine that will help protect your child against diseases caused by some types of a bacteria called *Streptococcus pneumoniae*. This bacteria can cause serious illnesses including meningitis, pneumonia, ear infection and blood infection.

SYNFLORIX works by helping the body to make its own antibodies, which protect your child against these diseases.

As with all vaccines, SYNFLORIX may not fully protect all children who are vaccinated.

SYNFLORIX will not protect against pneumococcal serogroups or serotypes that are not included in the vaccine except the cross-reactive serotype 19A.

Children with a weakened immune system, for example due to HIV infection, may not get the full benefit from SYNFLORIX.

##### **When it should not be used:**

Please see Warnings and Precautions section.

##### **What the medicinal ingredients are:**

- Pneumococcal polysaccharide serotypes 1, 4, 5, 6B, 7F, 9V, 14 and 23F conjugated to Non-Typeable *Haemophilus influenzae* (NTHi) protein D
- Pneumococcal polysaccharide serotype 18C conjugated to tetanus toxoid carrier protein
- Pneumococcal polysaccharide serotype 19F conjugated to diphtheria toxoid carrier protein

##### **What the important nonmedicinal ingredients are:**

SYNFLORIX contains the following nonmedicinal ingredients: aluminum phosphate, sodium chloride, water for injections.

##### **What dosage forms it comes in:**

SYNFLORIX is presented as a suspension for injection.

#### WARNINGS AND PRECAUTIONS

SYNFLORIX should not be given if your child has previously had any allergic reaction to SYNFLORIX, or any ingredient contained in SYNFLORIX. Signs of an allergic reaction may include itchy skin rash, shortness of breath and swelling of the face or tongue.

##### **Take special care with SYNFLORIX**

Before your child is vaccinated, make sure your doctor knows if any of the following apply to your child:

- has a severe infection with a high temperature. It might be necessary to postpone the vaccination until recovery. A minor infection such as a cold should not be a problem, but talk to your doctor first.
- has a bleeding problem or bruise easily.
- has breathing difficulties, please contact your doctor. This may be more common in the first three days following vaccination if your child is born prematurely (before or at 28 weeks of pregnancy).

Fainting can occur following, or even before, any needle injection; therefore, tell the doctor or nurse if you or your child fainted with a previous injection.

#### INTERACTIONS WITH THIS VACCINE

Please tell your doctor if your child is taking or has recently taken any other medicines, including medicines obtained without a prescription or has recently received any other vaccine.

SYNFLORIX may not work as well if your child is taking medicines that reduce the effectiveness of their immune system to fight infection.

SYNFLORIX can be given at the same time as other childhood vaccines. A different injection site will be used for each type of vaccine.

#### PROPER USE OF THIS VACCINE

##### **Usual dose:**

SYNFLORIX is always injected into a muscle, usually in the thigh or upper arm.

*Infants from 6 weeks to 6 months of age*

Usually, your child will receive three injections with an interval of at least one month between each one. The first injection can be given from the age of 6 weeks onwards. At least six months after the third injection and from the age of 9 months onwards, your child will receive an additional injection (booster).

Alternatively, your child may receive two injections with an interval of two months between injections. The first injection can be given from the age of 6 weeks onwards. At least six months after the second injection and from the age of 9 months onwards, your child will receive an additional injection (booster).

*Previously unvaccinated older infants and children*

*Infants aged 7-11 months:*

Your child will receive two injections with an interval of at least one month between injections. At least two months after the last injection and during his/her second year of life, your child will receive a third injection (booster).

*Children aged 12 months-5 years:*

Your child will receive a total of two injections with an interval of at least two months between injections.

You will be informed when your child should come back for their next injection.

*Infants from 6 weeks to 6 months of age born prematurely (born between 27 and 36 weeks of gestation)*

Your child will receive a total of three injections with an interval of at least one month between each one. At least six months after the last (third) injection, your child will receive an additional injection (booster).

*Immunocompromised populations:*

Children under 2 years of age and considered to be at a higher risk of pneumococcal infection (such as those with human immunodeficiency virus (HIV) infection or sickle cell disease) may receive SYNFLORIX. The number and timing of injections your child will receive will be as prescribed by your doctor. Please speak to your doctor for additional information.

**Overdosage:**

In case of drug overdose, contact a health care practitioner, hospital emergency department or regional Poison Control Centre immediately, even if there are no symptoms.

**Missed dose:**

If your child misses a scheduled injection, it is important that you make another appointment.

Make sure your child finishes the complete vaccination course.

**SIDE EFFECTS AND WHAT TO DO ABOUT THEM**

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

Side effects that occurred during clinical trials with SYNFLORIX were as follows:

Very common (these may occur in 1 in 10 doses or more of the vaccine):

- Pain, redness and swelling at the injection site
- Fever (38°C or higher)
- Drowsiness
- Irritability
- Loss of appetite

Common (these may occur in up to 1 in 10 doses of the vaccine):

- Hardness at the injection site

Uncommon (these may occur in up to 1 in 100 doses of the vaccine):

- Itching, blood clot, bleeding and small lump at the injection site
- Nausea, diarrhoea, vomiting
- Unusual crying
- Temporarily stopping breathing (apnoea)
- Headache
- Skin rash
- Swelling larger than 5 cm where the injection was given
- Hives

Rare (these may occur in up to 1 in 1,000 doses of the vaccine):

- Allergic reactions such as skin allergies
- Fits without temperature or due to high temperature (fever)
- Collapse (sudden onset of muscle floppiness), periods of unconsciousness or lack of awareness, and paleness or bluish skin discoloration.

Very rare (these may occur in up to 1 in 10,000 doses of the vaccine):

- Severe allergic reactions which can be recognised by:
  - raised and itchy rash (hives)
  - swelling, sometimes of the face or mouth (angioedema) causing difficulty in breathing – collapse

These reactions will usually occur before leaving the doctor's clinic. However, if your child gets any of these symptoms you should contact a doctor urgently.

- Kawasaki disease (major signs of the illness are for instance: fever which lasts for more than five days, associated with a rash on the trunk sometimes followed by a peeling of the skin on the hands and fingers, swollen glands in the neck, red eyes, lips, throat and tongue)

Following booster vaccination, children > 12 months of age are more likely to experience injection site reactions such as rash (uncommon) and crying abnormal (uncommon) compared to the rates observed in infants during the primary series with SYNFLORIX.

Other side effects have been seen with SYNFLORIX since being introduced onto the market:

- An extreme, often life-threatening, allergic reaction (on very rare instances)

If any of the side effects gets serious, or if you notice any side effects not listed in this leaflet, please tell your doctor or pharmacist.

If your child is more than 12 months of age when he/she receives his/her booster injection, he/she is more likely to experience reactions at the site of injection.

#### **HOW TO STORE IT**

- Keep out of the reach and sight of children.
- Do not use SYNFLORIX after the expiry date which is stated on the carton. The expiry date refers to the last day of that month.
- Store in a refrigerator (2°C – 8°C).
- Do not freeze.
- Store in the original package in order to protect from light.
- Medicines should not be disposed of via wastewater or household waste. These measures will help to protect the environment.

#### **REPORTING SUSPECTED SIDE EFFECTS**

To monitor vaccine safety, the Public Health Agency of Canada collects case reports on adverse events following immunization.

##### **For health care professionals:**

If a patient experiences an adverse event following immunization, please complete the appropriate Adverse Events following Immunization (AEFI) Form and send it to your local Health Unit in [your province/territory](#).

##### **For the General Public:**

Should you experience an adverse event following immunization, please ask your doctor, nurse, or pharmacist to complete the Adverse Events following Immunization (AEFI) Form.

If you have any questions or have difficulties contacting your local health unit, please contact Vaccine Safety Section at Public Health Agency of Canada:

By toll-free telephone: 1-866-844-0018

By toll-free fax: 1-866-844-5931

E-mail: [caefi@phac-aspc.gc.ca](mailto:caefi@phac-aspc.gc.ca)

At the following website:

<http://www.phac-aspc.gc.ca/im/vs-sv/index-eng.php>

##### **By regular mail:**

The Public Health Agency of Canada  
Vaccine Safety Section  
130 Colonnade Road  
Ottawa, Ontario  
K1A 0K9 Address Locator 6502A

**NOTE:** Should you require information related to the management of the side effect, please contact your health care provider before notifying the Public Health Agency of Canada. The Public Health Agency of Canada does not provide medical advice.

**MORE INFORMATION**

This document plus the full product monograph, prepared for health professionals can be found at:  
<http://www.gsk.ca> or can be obtained by contacting the sponsor,

GlaxoSmithKline Inc.  
7333 Mississauga Road  
Mississauga, Ontario  
L5N 6L4  
1-800-387-7374

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